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## Food price changes and consumer welfare in Tanzania 1991 - 2007

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# Food Price Changes and Consumer Welfare in Tanzania 1991-2007

by

**Vincent Leyaro, Oliver Morrissey and Trudy Owens**

## **Abstract**

This paper analyses the effect of food price changes on household consumption (welfare) in Tanzania during the 1990s and 2000s, and simulates the welfare effect attributable to tax (tariffs and VAT) reforms, distinguishing both static (first order) and dynamic (full price) effects of price changes. The three rounds of the Tanzania Household Budget Survey (1991/92, 2000/01 and 2007) are used to estimate consumers' responses using Deaton's method, based on median unit values (prices) and household budget shares. These are then utilized, first to evaluate the distributional impacts of the relative food price changes on consumer welfare in terms of compensating variation and secondly to organise the households into quintiles to simulate the effect of indirect (tariffs and VAT) tax changes on consumer welfare. The results indicate that, in real terms, price increases have worsened the welfare of most consumers during the 1990s and 2000s; the poor, in particular the rural poor, bore much of the brunt compared to the non-poor (in particular the urban non-poor). The welfare losses in the 2000s were greater than those in the 1990s. Although we cannot establish explicit links between tax reforms and domestic food price changes, the simulation shows that tax reforms tended to offset the welfare losses for all household groups. However, the non-poor and urban poor benefit more in relative terms from tax reforms; the rural poor benefit least (and to the extent that pass through is incomplete we overstate the benefit to rural households).

**JEL Classification:** H20, H31, O55

**Keywords:** Price Changes, Consumer Welfare, Tariff Reforms, Tanzania

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## 1 Introduction

Although there is a large cross-country literature looking at relationships between indicators of trade performance or policy with poverty, the results are inconclusive even regarding general empirical regularities, and are uninformative for individual countries. Whilst one cannot generalise from country studies, they can be informative on the ways in which trade reforms affect household welfare and poverty. Despite a growing number of country studies based on household data, there is limited evidence regarding the effect of trade policy reforms on poverty, especially for African countries. This can be explained by the complexity of linkages that need investigating and by the limited availability of data identifying direct links between trade policy and poverty.

The existing literature argues that trade affects poverty through two major channels (McCulloch *et al.* 2002; Nissanke and Thorbecke, 2006; Winters, 2002; Winters *et al.* 2004). Directly, trade is expected to affect poverty through: change in relative prices faced by households as consumers and producers; the market for labour (i.e. employment and wage adjustments) and public spending (as influenced by taxation and government revenue). Indirectly, trade is expected to affect poverty through effects on growth, inequality, productivity and technical change (which may be conditional on initial levels of development, international capital movements, labour migration, vulnerability, institutions and complementary policies). The analysis in this paper focuses on the first channel; although we cannot identify directly effects of trade on prices, we estimate the consumer welfare effects of food price changes and from this simulate the effects of tariff changes (through the price effect) for these food products. In the discussion we relate the estimates to other evidence on income changes and non-food prices. Although the analysis is limited to food products, food accounted for over half of household budgets and there were pronounced increases in food prices during the period covered.

Studies using micro level data can attempt to disentangle the effects of trade reforms from other contemporaneous factors and allow for household heterogeneity. However, few studies examine the effects of price changes on household welfare using survey data and econometric analysis, and most focus on the first order effects

(i.e. do not allow for substitution effects). Deaton (1989) provides an overview of the early literature.

Recent studies tend to focus on East Asian countries; one exception is Nicita (2004) who investigated consumption and income effects of trade reforms in Mexico using household level data and found diverse outcomes for different households. Minot and Goletti (2000) study the effects of rice market liberalisation in Vietnam on income and poverty taking into account both consumer demand and producer supply response to commodity price change. They found that market liberalization has had a positive effect on economic growth, agricultural production, and the rice sector. Niimi (2005) also analyzes the household response to prices in Vietnam, and found the welfare impact of price changes to be similar using unit values or market prices (as we find). Friedman and Levinsohn (2002) used household level information to analyse the distributional impacts of the economic crises in Indonesia following the 1997 Asian currency crises. They found that substitution in consumption dampens the welfare losses. In one of the few studies on Africa, Ackah and Appleton (2007) consider the effect of food price changes due to tariff changes on consumer welfare in Ghana. Their results indicate that the distributional burden of higher food prices fell mainly on the urban poor.<sup>1</sup>

This paper is in that tradition. Tanzanian household budget surveys are used to estimate substitution (in expenditure) elasticities for the major food consumption goods and the effects of changes in prices of these goods on household welfare. Trade policy, in the form of tariff reductions, is introduced as affecting prices, and thereby affecting household welfare (effects of changes in VAT are also addressed). This is done distinguishing the poor and non-poor, and the urban against the rural dwellers. The focus is on the consumption (price transmission) channel. Most international trade models assume that individuals have identical and homothetic preferences. In these models, trade-policy-induced changes in relative prices of goods change the consumption of individuals with different incomes in proportional terms; as a result, trade does not affect one's relative position in the welfare distribution through the consumption channel. A large literature in development economics has shown that

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<sup>1</sup> Related studies include Barraud and Calfat (2008), Edmonds and Pavcnik (2002), Porto (2006), Seshan (2005) and Topalova (2004).

poorer households devote a disproportionately large share of their household expenditures to basic items such as food. To the extent that household consumption depends on the relative position of households in the welfare distribution, trade-induced price changes therefore affect household welfare (and thus poverty) through consumption.<sup>2</sup>

With real per capita GDP of \$335 in 2006, Tanzania is one of the poorest countries in the world. Headcount poverty as measured from national household budget surveys has remained high (although comparisons over time may not be very reliable): 39 percent of households in 1991/92 (the pre-reform baseline), 36 percent in 2000/01 and 33 percent in 2007 (the post-reform observation); headcount poverty fell only six percentage points in some 16 years, and three percentage points in each sub-period (National Bureau of Statistics, 2002, 2008). During this period Tanzania has implemented substantial trade reforms and although precise figures vary depending on how the average is measured all data show a decline between 1992 and 2002 (Jones and Morrissey, 2008): the average tariff fell from 28 percent in the early 1990s to 16 percent in the early 2000s. Many reforms to tariffs and non-tariff barriers were implemented and had a significant impact on real domestic commodity prices. The availability of household survey data spanning a period of trade reforms makes Tanzania an interesting case for identifying the effects of trade reforms across households.

This paper uses survey data to econometrically estimate own and cross price elasticities and the effects of price changes on consumer welfare, and uses the resulting model to simulate the welfare effects of trade (tariff) reforms. While most previous studies only pursue impact analysis, the first order effects, we allow for behavioural responses and estimate full price effects. The indirect utility function (in terms of the expenditure function) is used to estimate the household compensating variation, the measure of consumer welfare effects of price changes. Deaton (1987, 1988, 1990 and 1997) provides the method for estimating consumer's responses, extracting information from unit values, to estimate full price effects. Correcting unit

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<sup>2</sup> Furthermore, the increased availability and lower prices of traded goods may shift demand away from non-tradable services (e.g., household services, such as housekeeping, cooking, etc.) towards tradable goods (washing machines, dryers, microwaves, etc.), further depressing the earning prospects of the poor.

values for quality effects and measurement errors addresses the problem of endogeneity of unit values, whilst endogenizing household income accounts for potential biases in the estimation of own- and cross-price elasticities in consumption.<sup>3</sup>

The final step is to relate trade reforms to changes in domestic prices. This would require allowing for the trade costs and market imperfections to estimate the pass-through effects to capture the extent to which the border effects are translated into changes in domestic prices. Due to data limitations, we assume full pass through: the observed changes (percentage reductions) in tariffs augmented with VAT (i.e. allowing for the fact that VAT is levied on the tariff-inclusive price) are used to calculate the percentage change in prices between each survey and over the whole period. The percentage changes in prices and estimated behavioural response elasticities are used to assess the impact of tax reforms on consumer welfare. The analysis of the welfare effects of tax reforms does not account for any indirect or related effects, such as would arise if tariff reductions reduced revenue and therefore public spending declined with potential adverse welfare effects. Such analysis would require a general equilibrium model, although as noted in Section 2 tax revenue appears to have been increasing during this period of reform so it may be reasonable to assess the welfare effect in a revenue-neutral context.

This paper is organised as follows. Section 2 provides a brief overview of tax and trade reforms and observable effects on prices in Tanzania since 1990. The framework used to estimate the effects of trade reforms on household welfare is given in Section 3. Data sources and descriptions are in Section 4 while Section 5 presents and discusses the results. Section 6 concludes, and details are provided in appendices.

## **2 Tax and Trade Reforms**

As in many other developing countries, tax reform has been an important component of Tanzania's structural reform programmes since the 1980s (Osoro, 2000; Levin, 2001). Following agreements with the IMF and World Bank, the economic reform

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<sup>3</sup> Given the availability of actual markets prices data in Tanzania, we check robustness by estimating the own and cross price elasticities and then computing the consumer welfare using the market prices (see Appendix Table A17).

programme from 1986 included measures to reduce import duties, sales taxes and marginal income tax rates. The two major objectives of the tax reform during the 1980s and the early 1990s were to simplify the tax system and to enhance revenue collection; little emphasis was placed on distribution as the tax system was seen as an inefficient means of redistribution (Morrissey, 1995). Although the first objective has been achieved the revenue objective has not been fulfilled (Osoro, 2000).

The Value Added Tax (VAT) was introduced in July 1998 to replace previous sales taxes (and part of stamp duty and entertainment taxes). The sales tax was the most important source of tax revenue in the 1980s but became less important in the 1990s. It was anticipated that more revenue would be generated with VAT, as the VAT base is significantly broader than the previous sales tax. Two VAT rates were imposed in Tanzania; a zero rate on exports and a standard rate of 20 percent on all other goods that are not exempted. VAT on imports is based on the value of the product including customs and excise duties and VAT on locally produced goods is based on price plus excise duty. Under the East Africa Community (EAC) Customs pact, VAT has been reduced to 18 percent rate in 2008/09. Before the introduction of VAT all food commodities faced sales taxes. After the introduction of VAT, all food commodities were subject to the 20% rate during 1998/99 to 2008/09, although this has now been reduced to 18%. The tariffs applied to food commodities are shown in Appendix Table A1.

Significant progress in reforming the trade regime was made in the late 1980s and early 1990s. Trade policy reforms were geared to rationalisation of import tariffs, dismantling of import restrictions, exchange rate liberalization and improving incentives to export performance (for instance through further devaluations, abolishing of all export taxes, and increases of agricultural prices). By 1994 the range of tariff rates was compressed to between 0% and 40%. By end of the 1990s, the tariff structure comprised five rates; 0, 5, 10, 20 and 30 per cent. Items that carried zero tariffs were mostly agricultural inputs such as fertilisers, chemicals and pesticides. Agricultural implements carried a rate of five per cent while raw materials and capital goods had a rate of 10 per cent. Intermediate and consumer goods faced rates of 20 and 30 per cent respectively. The highest rate is currently 25% with three tariff bands (0%, 10% and 25%). The principal indirect tax changes to be analysed are reductions



in tariffs, to some extent offset by increased domestic taxes when VAT was introduced.

We are not aware of any studies on the fiscal impact of these reforms, although trends in national accounting data suggest significant improvement in tax effort over the past decade: tax revenue (which is less than domestic revenue) was equivalent to 10% of GDP in 1999 and covered 53% of public expenditure, whereas by 2007 the tax/GDP ratio had risen to 16% and accounted for 64% of public expenditure (ESRF, 2003). Indirect taxes remain the principal source of tax revenue, so the implication is that changes in the composition have not been revenue-reducing and may even have been revenue-enhancing (see Bank of Tanzania, 2008: 110). In 2008/09 VAT accounted for 29% of tax revenue, down from 36% in 1998/99 when it was introduced, while Customs and Excise accounted for 29%, nearly the same share as in 1998/99. For the past 10 years VAT has accounted on average for 37% of tax revenue, compared to Sales Tax that accounted on average for 25%. However, although tariffs accounted for some 14% of tax revenue in 1999/2000, the same share as Excises, this fell to 9% in 2007/08, compared to 20% for Excises.

### **3 Empirical Model and Estimation Methods**

Treating the household as the basic unit over which poverty is defined, the question posed is how reforms impinge on poor households. Trade or tax reforms directly affect households as consumers and producers of the commodities whose prices have been affected by the reforms. It is therefore important to use a model that recognizes this dual role of the household, as both a consumer and producer. However, as we have no production data, our focus in this study is only to measure the benefits and losses that accrue to consumers as a result of a price change – the price transmission effect.<sup>4</sup> Though there are different ways to measure household welfare (see McCulloch et al. 2002; Nicita, 2004; Seshan, 2005; Porto, 2006), for our case we use

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<sup>4</sup> Labour and producer effects of trade reforms cannot be addressed with the household budget survey as there are no data on factor or producer prices. Our analysis therefore does not account for income effects and results must be interpreted given these caveats.

a method that focuses on price transmission (following Deaton, 1989, 1997; Minot and Goletti, 2000; Friedman and Levinsohn, 2002; Ackah and Appleton, 2007).

A consumer's own monetary valuation is the best measure of the welfare effect of price change. Since the measure is in terms of money, individual valuation measures are commensurable and could in principle be added to form a measure of the aggregate benefit to all consumers (a full exposition can be found in Deaton and Muellbauer, 1980). This monetary valuation of utility is the maximum amount a consumer would be prepared to pay for the opportunity of buying a good at the new price rather than at the old price. This is the *Compensating Variation (CV)* measure, formally defined as the amount of money which must be taken from the consumer in the new situation in order to be as well off as in the initial situation.<sup>5</sup>

The compensating variation is implicitly best expressed in terms of the indirect utility function. Initially a consumer faces prices  $p^0 = (p^0_1, \dots, p^0_n)$  with income  $M^0$  and maximized utility is  $u^*(p^0, M^0) = u^0$ . With the new prices  $p^1 = (p^1_1, \dots, p^1_n)$  and the same income, maximized utility becomes  $u^*(p^1, M^0) = u^1$ . *CV* is the change in money income necessary to make utility under  $p^1$  equal to the initial utility (with  $p^0$  and income of  $M^0$ ). Hence the *CV* is expressed as:

$$u^*(p^0, M^0) = u^*(p^1, M^0 - CV) = u^0 \quad (1)$$

For the purpose of estimation, we define *CV* using the expenditure function. The minimum level of expenditure necessary to achieve the consumer's initial utility level  $u^0$  with the initial price vector  $p^0$  is  $c(p^0, u^0) = M^0$ . The minimum level necessary to achieve this initial utility level when prices alter to  $p^1$  is  $c(p^1, u^0)$ , so that the difference between  $c(p^0, u^0)$  and  $c(p^1, u^0)$  is the change in income necessary to ensure the consumer is indifferent between facing prices  $p^0$  with income  $M^0$  and prices  $p^1$  with a different income. This change in income is the compensating variation, expressed as:

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<sup>5</sup> This definition applies equally well to price rises, in which case the compensating variation takes the opposite sign: the consumer becomes worse off and must be given money to be as well off with the new prices as with the old.

$$CV = M^0 - c(p^1, u^0) = c(p^0, u^0) - c(p^1, u^0) \quad (2)$$

If welfare after the price change is lower than the initial period, the compensating variation would be positive at the new price level.<sup>6</sup> The superscripts refer to before (0) and after (1) the price change. The partial derivative of the minimum expenditure function with respect to price yields quantities consumed, to derive the expression:

$$\Delta \ln C \approx q \Delta \ln p \quad (3)$$

where  $q$  is a  $1 \times n$  row vector of commodity groups,  $\Delta p$  is a  $1 \times n$  column vector of price changes, with  $n$  the number of commodity groups in the total demand system. This is the first order effect, where household behavioural responses (substitution between commodities) are ignored, approximated by first-order Taylor expansion of the minimum expenditure function. The first order effects approximation of compensating variation requires information only on pre-reform consumption quantities and on the price changes (pre-reform prices or post reform consumption quantities are not required). Reformulating (3) in terms of budget shares,  $w$ , and proportionate price changes,  $\Delta \ln p$ , yields:

$$\Delta \ln C^h \approx \sum_{i=1}^n w_i^h \Delta \ln p_i^h \quad (4)$$

where  $i$  subscripts refer to the commodity and  $h$  refers the household.  $w_i^h$  is the budget share devoted to good  $i$  in household  $h$ 's budget, which is obtained by dividing the pre-reform expenditure on the good by households total expenditure on all goods. For any differential distributional impact of the price changes to be meaningful, it must derive both from the presence of large relative price changes and large differences in the budget share across households.

The costs of attaining pre-reform utility levels will increase less rapidly than indicated by (3) or (4), as the household has ability to switch away from commodities whose relative prices have disproportionately increased. Thus this measure of

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<sup>6</sup> For ease of interpretation we will report negative signs (money needs to be taken away to get to initial utility) as positive to imply welfare improvement, and negative if welfare worsens.

compensating variation provides only a maximum bound of the impact of the structural reforms, ignoring the behavioural responses, the substitution effects towards goods whose prices are relatively lower (see, e.g., Deaton, 1997). Given the large (relative) price changes between early 1990s (pre-reform) and 2000s (post reform) as shown in Tables 1 and A4, the substitution effects could be significant in Tanzania and (3) or (4) may not be an accurate measure of household welfare. Hence, in calculating the household welfare effect, we use the second order Taylor series expansion approximation that utilizes own and cross price elasticities to capture household's behavioural responses. Going back to the minimum expenditure function, this will be expressed as:

$$\Delta \ln C \approx q \Delta \ln p + \frac{1}{2} q \Delta \ln p^T s \Delta \ln p \quad (5)$$

where  $q$  and  $\Delta \ln p$  are commodity groups and price change vectors as before and  $s$  is an  $n \times n$  matrix of compensated price elasticities. As for (4) we can reformulate this expression in terms of budget shares and proportional price changes as:

$$\Delta \ln C^h \approx \sum_{i=1}^n w_i^h \Delta \ln p_i^h + \frac{1}{2} \sum_{i=1}^n \sum_{j=1}^n c_{ij} \Delta \ln p_i^h \Delta \ln p_j^h \quad (6)$$

$c_{ij}$  contains the Slutsky derivatives  $s_{ij}$  and is defined by the expression:

$$c_{ij} = \frac{P_i s_{ij} P_j}{C^h} \quad (7)$$

Using some algebraic manipulation,  $c_{ij}$  can be shown to be equivalent to  $w_i \varepsilon_{ij}$ , where  $\varepsilon_{ij}$  is Hicks compensated price elasticity of commodity group  $i$  with respect to price change of group  $j$ , so (6) becomes (Friedman and Levinsohn, 2002; Deaton and Muellbauer, 1980):

$$\Delta \ln C^h \approx \sum_{i=1}^n w_i^h \Delta \ln p_i^h + \frac{1}{2} \sum_{i=1}^n \sum_{j=1}^n w_i^h \varepsilon_{ij} \Delta \ln p_i^h \Delta \ln p_j^h \quad (8)$$

Equation (8) indicates that the welfare effect depends on the size of price changes as well as the importance of a particular commodity in the household consumption basket. The two compensating variation specifications given in (4) and (8) are used to identify the consumption effects of price changes to households in

Tanzania between 1991 and 2001, 2001 and 2007, and 1991 and 2007. Two more important pieces of information in addition to the budget shares, unit values (prices) and household characteristics are required: the terms  $\Delta \ln p_i^h$  (proportionate price change) and  $\varepsilon_{ij}$  (compensated price elasticities). The following sub-sections present and summarize the methods used to measure these.

### **Proportionate Price Changes: Unit Values and Market Prices**

To obtain the percentage change in prices  $\Delta \ln p_i^h$  necessary to apply to the model in (4) and (8), proportionate change of observed prices over the periods from unit values (surveys) and market prices are calculated. The survey recorded everything that the interviewed households consumed for one month. This included food and other items that have been purchased and own-produced. Respondents were asked to provide information on how much they spent on each item and on the quantity consumed. The values were cleaned to correct for outliers (following Capeau and Dercon, 1998 and 2006; Kedir, 2005). For the own produced commodities, which were reported in local units like '*kibaba*', '*fungu*,' '*upawa*', basket, etc, quantities were converted to standard measurements (kilogram, grams, litre and millilitre) or their equivalents. Items that were not measured in the standard units are excluded from our analysis, with the exception of eggs that were given in number of units. These quantity and value figure were used to calculate price as the ratio of expenditure on the item to volume consumed (i.e. a measure of unit value).

One issue is that the expenditure in the surveys was collected in money terms which vary across the locations and over time. To compare welfare estimates between the periods and across different areas, expenditures must be deflated by a representative index of prices. Inaccuracy in the estimation of the index can result in inaccuracy in the estimate of welfare. It is therefore important to establish an accurate price index - one that not only measures inflation over time, but also compares price levels between urban and rural sectors and across regions. This is

done using the Fisher Ideal Index<sup>7</sup> which uses the price and quantity information from the surveys themselves. The Fisher Index calculated from the commodity groups is used to adjust for price variation both over time and across different geographical areas. The survey data is used to calculate the Fisher Index as:

$$P_F = \sum_{n=1}^N w_n \left( \frac{P_n^1}{P_n^0} \right) \quad (9)$$

where  $P^0$  is the price in the base year (1991) and  $n$  is the 20 food items. The Fisher Index has been calculated using the three Tanzanian Household Budget Surveys as a weighted sum of median unit prices for each food item. This includes 130 food items mostly consumed by households and which have been grouped into 20 commodity groups.<sup>8</sup> The same index is also used for the district market prices, the ones used for sensitivity analysis. The proportionate change in observed price change is then calculated as:

$$\Delta p = \frac{P_t - P_{t-1}}{P_{t-1}} \quad (10a)$$

where  $P_t$  represents observed unit value or the market price for the years 2001 and 2007 (post reform) and  $P_{t-1}$  refers to the same before the reforms. In logarithm this is the same as:

$$\Delta \ln p = \ln P_t - \ln P_{t-1} \quad (10b)$$

### **Estimating Consumer Responses**

To identify behavioural responses of consumers in Tanzania due to price changes of food commodities, we adopt the model developed by Deaton (1987, 1988, 1990 and

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<sup>7</sup> There are two possible sources of concern with respect to the national CPI when measuring changes in welfare in Tanzania. First, the official inflation is calculated from prices collected monthly in 20 urban towns using out of date weights. Second, the 20 urban towns from where the prices are gathered, may no longer be representative of urban towns, and are certainly not representative of prices faced in rural areas. For that reason we need to look beyond the CPI when using price indexes to estimate levels of welfare.

<sup>8</sup> As said before, unit prices are calculated by dividing expenditure by the quantity converted in standard units (kilograms or grams) after having deleted outliers. Then, median unit prices and quantities are obtained for each food item. The Fisher Index is a weighted average of these two measures.

1997). Traditional practice in the literature for modelling behavioural responses has been to identify price variation as coming from price changes over time (the historical data). In contrast, Deaton's approach exploits the structure of household surveys where the source of price variations is from price changes over space (spatial variation). Such surveys collect data from samples of households in various villages (clusters) that are geographically separated. 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). Households are asked to report not only their expenditure on each commodity but also the physical amounts consumed which are used to calculate unit values. It is these unit values and reported quantities which are the building blocks in Deaton's model.<sup>9</sup>

A concern, however, is that households choose not only how much of a commodity to purchase or use but in what quality or grade. Thus, there is quality on top of quantity and prices, and all that is consumed is not necessarily purchased (some could be own-produced). In the simplest version, Deaton starts by specifying the standard 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. The major drawback is that such a model can only be used to describe the behaviour of those households who purchase positive amounts.<sup>10</sup> For a full analysis we need to include all households, purchasing and non-purchasing. To address this, Deaton provides an alternative by modifying the logarithmic model 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:

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<sup>9</sup> This is unlike the standard demand model, such as the 'almost ideal demand system', where there is only quantity and prices plus the assumption that all that is consumed is purchased.

<sup>10</sup> Although the logarithmic model is analytically tractable, a major drawback is that it is confined to positive purchases only.

$$w_{hc} = \alpha^0 + \beta^0 \ln x_{hc} + \gamma^0 z_{hc} + \sum_{H=1}^i \theta_H \ln p_{Hc} + f_c + \mu_{hc}^0 \quad (11)$$

$$\ln v_{hc} = \alpha^1 + \beta^1 \ln x_{hc} + \gamma^1 z_{hc} + \sum_{H=1}^i \psi_H \ln p_{Hc} + \mu_{hc}^1 \quad (12)$$

where  $w_{hc}$  is the budget share devoted to good  $i$  in household  $h$ 's budget, obtained by dividing the expenditure on the good by households total expenditure on all goods.  $\ln v_{hc}$  is the logarithm of unit value of good  $i$ , obtained by dividing household expenditure on the good by the quantity purchased of that good.  $x_{hc}$  is household total expenditure per household member,  $z_{hc}$  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. Fixed effects can be interpreted as taste variation across clusters which are allowed to be correlated with total household expenditure per capita and the socio-demographic characteristics but must be uncorrelated with prices. Since both fixed effects and prices are unobserved, we will not be able to measure the effect of prices if both are allowed to be correlated. For a similar reason, the unit value equation has no fixed effect and is observed only for purchasing households. The exclusion of the fixed effects in the unit value equation is for identification reasons. Since the prices are not measured, for the model to hold it requires a direct link between prices and unit value that would have vanished with the inclusion of a fixed effect. If there were no quality effects, unit value would move one by one with price, but quality shading in response to price change makes it less than directly proportional to price.

The  $\mu_{hc}^0$  and  $\mu_{hc}^1$  are idiosyncratic error terms. The error term  $\mu_{ic}^0$  in the share equation is standard as it incorporates unobservables and any measurement error in the budget share. It is important that  $\mu_{ic}^0$  is allowed to be correlated with  $\mu_{ic}^1$  which captures measurement error in the unit value equation. If the number of households in each village is large enough, the means of  $\mu_{ic}^0$  and  $\mu_{ic}^1$  will average to zero. There is no reason however to expect measurement or behavioural errors to average to zero for each village where there are only a few households. 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 (11) from the logarithmic model, its coefficient  $\theta_H$  is not the price elasticity but the response of budget share to price change, and  $\psi_H$  is the response of unit value to the change in price. The income elasticity is estimated as  $\beta^0$  and  $\beta^1$  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. Appendix A 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  $\varepsilon_{ij}$  (own and cross price elasticities) as used in equations (4) and (8).

### **Estimation Methods**

There are two stages in estimating the parameters in the paired equations (11) and (12). 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 capita, market prices and socio-demographic characteristics. Without price data it is possible to estimate non-price parameters consistently provided that we are prepared to make the assumption that market prices do not vary within each village over the relevant reporting period. Equations (11) and (12) 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 run a regression using as left- and right-hand side variables the deviation from the village means. The removal of cluster means removes the prices and fixed effects and allows

for consistent estimation.<sup>11</sup> Within cluster estimators of unit value and share equations thus identify Engel and Quality effects without contamination by the (unobservable) variation in market prices.<sup>12</sup>

The estimates of  $\beta_s$  and  $\gamma_s$  from the within estimator 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 we take cluster averages of the corrected budget share and unit values. The cluster average of corrected budget share is obtained by dividing them by the number of all households in a given cluster. The cluster average of the corrected unit value is obtained by dividing them by the number of the purchasing households in a given cluster. Hence;

$$\tilde{y}_{0ic} = n_c^{-1} \sum_{h \in c} (w_{ihc} - \tilde{\beta}_{0i} \ln x_{hc} - \tilde{\gamma}_{0i} z_{hc}) \quad (13)$$

$$\tilde{y}_{1ic} = n_c^{+1} \sum_{h \in c} (\ln v_{ihc} - \tilde{\beta}_{1i} \ln x_{hc} - \tilde{\gamma}_{1i} z_{hc}) \quad (14)$$

where  $n_c$  the number of all households in the cluster,  $n_c^+$  is the number of purchasing households in the cluster (thus report unit value) and superimposed tildes indicates estimates from the first, within-cluster stage.  $\tilde{y}_{0hc}$  and  $\tilde{y}_{1hc}$  are not the same thing as residuals from the first stage regression (see below), rather these are corrected magnitudes and the inter-cluster variations of these corrected magnitudes are used to estimate price elasticities (the estimates may suffer from measurement errors and quality effects).

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

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<sup>11</sup> Following Frisch and Waugh (1933), the regression of deviation from village means gives identical parameter estimates to those that would have been obtained from the regression containing village dummies.

<sup>12</sup> All of the first stage estimators will be consistent as the sample size tends to infinity.

allow the model to capture the spurious relationship between quantity and price that do not come from genuine price responses. But with  $i$  groups of goods, we now have  $2i$  variances and  $i(2i-1)$  covariances. Suppose  $\Sigma$ , typical element  $\sigma_{iH}$ , is the variance-covariance matrix of  $\mu_{ic}^0$ 's,  $\Omega$ , typical element  $\omega_{iH}$  is the variance-covariance matrix of  $\mu_{ic}^1$ 's, and  $X$ , typical element  $\chi_{iH}$  is the covariance matrix of  $\mu_{ic}^1$  (on the rows) and  $\mu_{ic}^0$  (on the column). Then we can estimate the matrices of variances of  $\mu_{ic}^0$  and  $\mu_{ic}^1$ , and covariance of  $\mu_{ic}^0$  and  $\mu_{ic}^1$  using the estimators

$$\tilde{\sigma}_{iH} = (n - C - k)^{-1} \sum_c \sum_{h \in c} \ell_{ihc}^0 \ell_{Hhc}^0 \quad (15)$$

$$\tilde{\omega}_{iH} = (n - C - k)^{-1} \sum_c \sum_{h \in c} \ell_{ihc}^1 \ell_{Hhc}^1 \quad (16)$$

$$\tilde{\chi}_{iH} = (n - C - k)^{-1} \sum_c \sum_{h \in c} \ell_{ihc}^1 \ell_{Hhc}^0 \quad (17)$$

where  $\ell^0$  and  $\ell^1$  are residuals from the first stage within village share and unit value regressions, respectively, and  $n-k-C-1$  the degrees of freedom in these regressions; where  $n$  is total number of observations,  $C$  the number of clusters and  $k$  is the number of other right hand side (RHS) variables. But corresponding to  $\tilde{y}_{ic}^0$  and  $\tilde{y}_{ic}^1$  are the underlying true values  $y_{ic}^0$  and  $y_{ic}^1$  which we would have obtained had the first stage parameters been known rather than estimated. Hence the between village variance-covariance matrix of  $y_{ic}^0$  is defined as  $Q$ , that of  $y_{ic}^1$  is defined as  $S$  and their covariance is defined as  $R$ . When these are estimated from (13) and (14), we have

$$\tilde{q}_{iH} = \text{cov}(\hat{y}_{iH}^0, \hat{y}_{Hc}^0), \quad \tilde{s}_{iH} = \text{cov}(\hat{y}_{ic}^1, \hat{y}_{Hc}^1) \quad \text{and} \quad \tilde{r}_{iH} = \text{cov}(\hat{y}_{ic}^1, \hat{y}_{Hc}^0) \quad (18)$$

A very rough estimate of the price elasticities would be to use  $\hat{y}^0$  and  $\hat{y}^1$  to run a between village multivariate ordinary least square regression to obtain the matrices

$$B_{OLS} = \tilde{S}^{-1} \tilde{R} \quad (19)$$

However, as noted already, this estimator takes no account of the influence of  $\mu_{ic}^0$  and  $\mu_{ic}^1$  when the cluster size is finite. We need therefore to correct for the measurement errors which are calculated as

$$B = (\tilde{S} - \tilde{\Omega}\tilde{N}_+^{-1})^{-1}(\tilde{R} - \tilde{X}\tilde{N}^{-1})^{13} \quad (20)$$

where  $\tilde{N}_+^{-1}$  is a diagonal matrix formed from the elements of  $n_{ic}^+$  and matrix  $\tilde{N}^{-1}$  is the corresponding quantity formed from the  $n_{c,s}$ . But still we have not corrected for the quality effects in  $\psi_H^{-1}\theta_H$ . Without taking into account the quality effect, (20) would be the matrix of the price elasticities. To correct for the quality effects requires the application of the quality model (Appendix A1). In the presence of quality effects the probability limit is not  $\Theta$  but the matrix generalization of the ratio of  $\Theta$  to  $\Psi$  given as (Deaton, 1997)

$$p \lim \tilde{B} = B = (\Psi')^{-1}\Theta' \quad (21)$$

As shown above, the matrix  $\Theta$  is not identified without further information, which in our case is supplied by the separability theory of quality, which in matrix notation is

$$\Psi = 1 + D(\beta^1)D(e)^{-1}E \quad (22)$$

Where  $E$  is the matrix of price elasticities and  $D(\cdot)$  is the diagonalization operator which converts its vector argument into a diagonal matrix. The matrix of price elasticities and the vector of total household expenditure elasticities are linked to the model parameters by

$$E = -\Psi + D(\bar{w})^{-1}\Theta \quad (23)$$

$$e = \iota - \beta^1 + \beta^0 D(\bar{w})^{-1} \quad (24)$$

when (22) through (24) is combined with (21), we derive

$$\Theta = B'\Psi = B'[1 - D(\xi)B' + D(\xi)D(\bar{w})]^{-1} \quad (25)$$

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<sup>13</sup> This estimator is the generalization of  $\hat{\phi} = \frac{\text{cov}(\hat{y}^0 \hat{y}^1) - \hat{\sigma}^{01}/n_c}{\text{var}(\hat{y}_c^1) - \hat{\sigma}^{11}/n_c}$  from  $\psi_H^{-1}\theta_H$

This completes our estimation stage. The first stage parameters and the residuals are used to make covariance matrices in (15) through (18), the results are used to calculate the matrix  $\tilde{B}$  in (20), an estimate that is corrected using the first stage estimates to give the  $\Theta$  parameters or elasticity matrix using (25).

#### **4 Data Sources and Description**

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. They obtain data and information from private households on: household expenditure, consumption and income; economic activities; household members' education and health status; ownership of consumer goods and assets; housing structure and building materials; and household access to services and facilities. A total of 4823 households in 1991/92, 22178 households in 2000/01 and 10466 households in 2007 were covered. The surveys provide data at the level of Dar es Salaam (the capital), other urban areas and rural areas. The sampling design for interviewed households was done in two stages. In the first stage, primary sampling units (PSUs), which can be either urban enumeration areas or rural villages, were selected throughout the country. In the second stage, households were selected using systematic random sampling from a stratified list of households compiled from each of sampled PSU.

The surveys records everything that the interviewed households declare as consumed over one month. It includes food and other items that have been purchased, and food grown by the households and consumed during the month; a large share of consumption comes from own production, over a third in 1991/92 declining to over a quarter since 2000/01 (Appendix Table A3). It excludes household expenditure that was not for consumption, e.g., purchasing inputs for a farm worked by the household. Respondents were asked to provide information on how much they spent on each item and on the quantity consumed. For the 1991/92 and 2000/01 surveys a total of 135 items were coded. However this increased to over 2000 items in 2007. The increase was due to disaggregating categories – for example, chicken distinguished fresh and frozen chicken, traditional and other breads were distinguished. Therefore,

for consistency and to minimize quality effects, 2007 codes were aggregated to match those in 2000/01. These were then aggregated to form 20 commodity groups (listed in Table 1). These contain consumption expenditure values for each household in nominal Tanzanian shillings (Tshs) per month and have been aggregated per household, per item, and per ‘availability’ (purchased, home produced and items received as payments in kind or as gifts). Data on expenditures and quantities consumed form the core variables. The ratio of item expenditure to volume consumed provides the measure of price, more precisely a measure of unit value. The ratio of item expenditure to total household food expenditure provides the measure of budget share. Total household expenditure per adult equivalent (per capita) is the measure of outlay. Other variables, such as household characteristics, are also derived from the surveys (for details see Appendix Table A2). To simulate the effects of trade reforms on consumer welfare we use average tariff rates data from the Tanzania Revenue Authority, Customs Department, aggregated to four digits over the relevant HS codes to match the survey years. This includes both scheduled and implicit (actual) tariffs as shown in Table A1.

### **Descriptive Statistics**

With an average share of 64 per cent of household income spent on food consumption in 2007, 66.5 per cent in 2000/01 and 71.3 per cent 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.<sup>14</sup> The largest household food budget share, decreasing from 37% in 1991/92 to 34% in 2007, is for cereals (grains, flour, bread, confectionary and other cereals). This compares well with other studies in Tanzania that have looked at household demand for food (Sarris and Tinios, 1995; Weliwita *et al.* 2003; Awudu and 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 groups, except pulses at around seven per cent, account for less than five per cent of the

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<sup>14</sup> All estimation uses unit values but, for comparison across surveys and to address outliers, the mean of median unit values is used also.

budget. These aggregated commodities make up to almost 100 per cent of the food consumption basket for the households in Tanzania.

**Table 1 Summary Statistics for Budget Share and Median Unit Price\***

	<i>Budget share, 2007</i>	<i>Median unit price, 2007</i>	<i>Budget share 00/01</i>	<i>Median unit price, 00/01</i>	<i>Price ratio</i>
<i>Cereals, grain</i>	0.16	398	0.14	238	1.67
<i>Cereals, flour</i>	0.18	470	0.20	271	1.73
<i>Other cereals</i>	0.01	300	0.01	745	0.40
<i>Bread</i>	0.00	1,024	0.01	618	1.66
<i>Confectionery</i>	0.02	1,250	0.01	1,918	0.65
<i>Starch, roots and tubers</i>	0.12	193	0.11	134	1.43
<i>Sugar and sweets</i>	0.02	1,200	0.05	577	2.08
<i>Pulses, dry</i>	0.03	650	0.07	301	2.16
<i>Nuts and Seeds</i>	0.02	583	0.02	506	1.15
<i>Vegetables</i>	0.11	594	0.08	356	1.67
<i>Fruits</i>	0.03	442	0.02	288	1.53
<i>Meat and meat products</i>	0.09	1,760	0.10	829	2.12
<i>Eggs</i>	0.00	105,333	0.00	65,624	1.61
<i>Fish and shellfish</i>	0.08	1,306	0.08	826	1.58
<i>Milk and dairy products</i>	0.02	2,000	0.03	1,254	1.59
<i>Oils and Fats products</i>	0.05	2,000	0.03	1,028	1.95
<i>Spices and other foodstuffs</i>	0.01	2,500	0.02	1,335	1.87
<i>Raw materials for drink</i>	0.01	6,307	0.01	2,761	2.28
<i>Non-alcoholic drinks</i>	0.02	800	0.01	612	1.31
<i>Alcoholic drinks</i>	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. Comparative results between 2000/01 and 1991/92 are in Table A4.

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

*Source:* Authors own calculations from Tanzania Household Budget Surveys for 2000/01 and 2007.

Although (nominal) unit prices have risen considerably, budget shares have not changed noticeably over time; Table 1 reports the median unit price ratios for 2007 compared to 2001 (see Table A4 for 2001 compared to 1991). 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. Appendix Tables A7-A9 show 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. Non-food consumption which includes durables (assets) and other services such as water, education, medical care, and transport is the second component accounting for around 35% of household budget share in all survey years. The bottom deciles spent around 34% compared to 44% for the top deciles in 1991/92; and 30% compared to 45% in 2007. Poverty is concentrated in rural areas and rural compared to urban households spent more on food (which they perceived as necessities) and less on non-food (which they perceived as the luxuries).

**Table 2: Unit Values and Markets Prices, 2000/01**

Commodity	Unit Values (uv)		Market Prices (per gram)*	
	Mean	Std. Dev.	Mean	Std. Dev.
<i>Maize</i>	0.006	0.034	0.005	0.022
<i>Rice</i>	0.035	0.117	0.035	0.117
<i>Sorghum</i>	0.001	0.017	0.001	0.019
<i>Millet</i>	0.002	0.029	0.002	0.027
<i>Potatoes</i>	0.010	0.054	0.011	0.072
<i>Beans</i>	0.341	0.132	0.334	0.209
<i>Wheat flour</i>	0.012	0.065	0.011	0.062
<i>Maize flour</i>	0.016	0.058	0.019	0.074
<i>Tomatoes</i>	0.033	0.165	0.032	0.120
<i>Onions</i>	0.042	0.369	0.029	0.103
<i>Cassava</i>	0.008	0.054	0.004	0.032
<i>Groundnuts</i>	0.008	0.045	0.141	0.082
<i>Coconuts</i>	0.025	0.147	0.020	0.096
<i>Meat</i>	0.008	0.052	4.666	29.386
<i>Offal</i>	0.073	0.267	0.082	0.299
<i>Chicken</i>	0.005	0.070	0.007	0.157
<i>Eggs</i>	0.041	2.893	0.046	0.298
<i>Milk</i>	2.901	288.438	2.229	15.215

*Notes:* The reported figures are weighted using survey weights as for Table 1 (implying in effect that each is based on 120440 observations). \* The Unit Value and Market Price is in Tanzanian Shillings (Tshs) per gram or milliliter, except eggs which are Tshs per piece. Oranges are omitted as while is measured per gram in surveys it is measured per piece in the market pieces.

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



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. These markets are typically based in district capitals or urban centres and sell a wide variety of food products. In theory, these district market prices should reflect prices faced by households across different locations and so should correspond to the relevant unit values. In reality however (as elaborated above), due to quality shading and measurement errors, unit values are not always equal to market prices.

As shown in Table 2 which compares the sample mean of unit values against that of market prices for the 2000/01 survey, this is the case for three out of 19 items as their prices vary considerably. However, for the 16 out of 19 items prices derived from the household surveys are close to the prices from the district markets. We use these actual market prices for sensitivity and robustness checks.

## **5 Results and Discussion**

Firstly we discuss results obtained from estimating the system of demand equations that provides income, quality, own and cross price elasticities. This is done in stages using the survey data and applying Deaton's methodology as explained above. Although the main focus of the discussion is on the 2000/01 survey, corresponding estimates for the 1991/92 and 2007 surveys as presented in Appendix Tables A10, A12 and A13. These then are used to estimate the consumer welfare effects.

### **Income and Quality Elasticity**

Table 3 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 ( $\beta^1$ ) and quantity ( $\beta^0$ ). Although regressions for equations (11) and (12) 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 3: Within Village Estimates: Budget Shares, Unit Values and Expenditure Elasticities, 2000/01**

Commodity Group	Expenditure elasticities	Budget Shares		Unit Values	
		$Ln x (\beta^0)$	$l n n$	$Ln x (\beta^1)$	$L n n$
Cereals, grain	1.012	0.017	0.014	0.123	-0.022
Cereals, flour	<b>0.582</b>	<b>-0.047</b>	-0.003	0.136	0.040
Other cereals	<b>0.992</b>	<b>-0.001</b>	0.001	0.117	0.060
Bread	1.342	0.002	0.001	0.003 <sup>NS</sup>	-0.016
Confectionery	<b>0.959</b>	<b>-0.001*</b>	0.001	0.030	0.024
Starch, roots and tubers	<b>0.643</b>	<b>-0.029</b>	-0.005	0.073	0.034
Sugar	1.244	0.012	0.009	-0.014	-0.010
Pulses, dry	<b>0.793</b>	<b>-0.009</b>	-0.003	0.056	0.004
Nuts and Seeds	<b>0.958</b>	<b>-0.001<sup>NS</sup></b>	0.001*	0.037	0.021
Vegetables	<b>0.627</b>	<b>-0.026</b>	-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	<b>0.722</b>	<b>-0.014</b>	-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	<b>0.568</b>	<b>-0.004</b>	-0.004	0.141	0.122
Raw materials for drink	1.305	0.002	0.000	0.003 <sup>NS</sup>	-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. Dependent variables are budget share and logarithm of unit values,  $ln x$  is logarithm of total household expenditure per household member and  $l n n$  is the logarithm of household size. Included but not shown, are demographic ratios by age and sex, as well as dummies for the level of education attained and for household head. The data is weighted using survey weights. Unit Value is as defined in Table 2.

*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 2007 survey are in Table A10). Most commodities are responsive to additional total household expenditure per capita: 14 out of 20 commodity groups have expenditure elasticity greater than 0.90. Cereal flour; confectionary, other cereals; starch; pulses, nuts, seeds; vegetables; fish; and spices have negative  $\beta^0$  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 as shown in A7-A9). Goods such as cereal grains, bread, sugar, meat, eggs, milk, non-alcohol and alcoholic drinks consumed at home have positive  $\beta^0$  coefficients and income elasticities greater than unity, thus appear to be luxury goods (consumed mostly by middle to high income groups as in A7-A9).

When we disaggregate further the cereal grain group (the most important food commodity group in Tanzania), except largely for the influence of wheat and partly rice, most cereal grains (particularly maize) have negative  $\beta^0$  and less than unity expenditure elasticities confirming they are basic foodstuffs (see Table A14). The necessities highlighted in bold in Table 3 are the main sources of calories for the majority of people. Nearly half of wheat is imported and expensive (Morrissey and Leyaro, 2007); it is reasonable to consider wheat and wheat products such as wheat flour, bread, barley, macaroni, spaghetti, buns, cakes, small breads, cooking oats, corn flakes, baby foods, biscuits, and other cereal products as luxuries, mainly consumed in urban areas. Other goods that can be considered as luxuries include: sugar; meat; eggs; milk; oil and fats; raw materials for drinks; alcohol and alcohol drinks consumed at home. It is reasonable to consider such commodity groups as luxuries for a low income country like Tanzania.

What is more important and interesting to look at are 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 per cent. It is only alcoholic drinks that have relatively higher quality effects, at 63 per cent, which is due to a mix of more expensive brands such as spirits consumed by rich and cheap locally produced drinks like '*kibuku*' consumed by poor.

### **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 as in equations (13) and (14). Then inter-cluster variations of these corrected magnitudes, after purging them of their measurement errors (using estimated variance and covariance from the first stage regression residuals) and quality effects (using Deaton's model of quality effects), are used to estimate the matrices of own and cross price elasticities, for unconstrained and symmetry constrained estimates as given in equation (25). Removing quality effects is important; from Table 3 it is evident that, though modest, quality elasticity is significantly different from zero for most goods.

There are differences between unconstrained and symmetry constrained results. Unconstrained (uncompensated or Marshallian) estimates combine income and substitution effects such that one cannot tell which one dominates. The symmetry constrained (compensated or Hicksian) estimate distinguishes substitutability and complementarity between goods because it measures only the substitution effects. In addition, for those cases where the unconstrained estimates were well determined, there is little change in the symmetry constrained estimates and the restriction brings some increase in the estimated precision. Thus the credibility and usefulness of the symmetry constrained estimates is enhanced by the fact that the important and well determined elasticities, particularly the own price elasticities, change very little by the imposition of the restriction. It is for these reasons that symmetry constrained estimates are our preferred results used in the estimation of consumer welfare in equation (8) and presented here for the 2000/01 survey.

Table 4 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 are in Table A11; sets of estimates for the other survey years are in Tables A12 and A13). 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 by making 1,000 draws from the cluster (second stage) data, recalculating the estimates for each, and then finding (half) the length of the interval that is symmetric around the bootstrapped

mean. This contains 68.3 per cent of the bootstrapped estimates; 188 out of 400 coefficients (47 per cent) are statistically significant (the coefficient is at least twice its bootstrapped 'standard error'). With 20 commodity groups, the inclusion of standard errors makes it very hard to read the table, so 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 A11). 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 drink 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.

**Table 4: Symmetry-constrained matrix of own and cross price elasticities, Tanzania, 2000/01**

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

*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:* Authors calculations using Tanzania Household Budget Survey, 2000/01.

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; 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 this, 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 drink, 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 the 1991/92 and 2007 surveys or district market prices (Appendix Tables A12-A14).

### **Price Changes and Consumer Welfare**

An important problem in welfare economics is to devise a monetary measure of the gains and losses that individuals experience when prices change. This is important for economic policy which can change prices, such as by altering taxes or subsidies. Since policy makers would like to design policies that maximize consumer welfare, we need a measure of the welfare effect. Making use of the household budget share, observed proportionate price change and the estimated consumer responses, we assess the consumption (welfare) effects of commodity price changes in Tanzania that occurred between 1991 (pre-reform) and 2001, between 2001 and 2007 and overall between 1991 and 2007. The period between 1991 and 2001 in Tanzania can be considered as the period of initial structural reforms where the government substantially reduced tariffs unilaterally. The period from 2001 onwards can be considered as a continuation of reforms initiated earlier, where in general tariffs were reduced by less (but there were other shocks to food prices). Both the static (first order) and dynamic (higher order) effects in consumption are considered.

Table 5 reports estimates of the consumption welfare effects of observed price changes (no attempt is made to attribute the change to any specific cause, such as tariff reductions). Columns 1, 3 and 5 consider only the first order effects (FOE) for the first, second and overall (long term) periods. The FOE approximates the impact of price changes holding constant consumer behavioural responses, which is the same as assuming zero cross price elasticities (or that households are not able to substitute). Even though the first order approximation may capture a large part of the effects of price changes on welfare, ignoring household behaviour in the analysis may lead to significant biases (Friedman and Levinsohn, 2002; Porto, 2006). Columns 2, 4 and 6 report full price effects, the first order and consumer response effects in consumption, using the estimated symmetry constrained (compensated or Hicksian) elasticities for 1991/92 to measure the welfare impact of commodity price change observed between 1991 and 2001. Similarly for 2000/01 when we consider changes observed between 2001 and 2007, and for 1991 for changes between 1991 and 2007. These elasticities offer better measures of substitutability and complementarity between the commodity groups than the unconstrained elasticities.

The estimated CV measures show how much money we would have to give the consumers after the price change to make them as well off as they were before the price change, so a negative CV implies an increase in welfare. However, as noted above, we alter the sign in presenting the results so that a negative value in the tables represents declining welfare. That is, end period welfare as compared to 1991 for the period between 1991 and 2001, and between 1991 and 2007; to 2001 for the period between 2001 and 2007. Price changes might not have uniform impacts across households that differ in their characteristics so estimates are reported for different groups of households given their per capita income and geographical location. The first order effects are estimated using equation (4) and, as expected (from the literature), do differ from the combined first and second order or full price effect (FPE).

The results suggest that all households groups (except the non-poor, particularly the non-poor in urban areas in the early period) suffered welfare losses from rises in commodity prices during the 1990s and 2000s. The losses were higher during the second period, from 2001 to 2007. On average, Tanzanian households would need to be reimbursed by around 9.6 per cent of their 1991 total household expenditures to compensate for food price changes (increases) in the 1990s.



**Table 5 Consumer Welfare Effects of Price Changes (Compensating Variation)\***

<i>Household Category</i>	<i>1991/92 – 2000/01</i>		<i>2000/01 -2007</i>		<i>1991/92-2007</i>	
	<i>FOE(%)</i>	<i>FPE(%)</i>	<i>FOE(%)</i>	<i>FPE(%)</i>	<i>FOE(%)</i>	<i>FPE(%)</i>
<b>Locality</b>						
<i>Rural</i>	-31.76	-15.51	-14.25	-10.48	-46.02	-26.00
<i>Urban</i>	-21.30	-3.62	-10.64	-4.96	-31.95	-8.58
<b>Poverty Status</b>						
<i>Not Poor</i>	-36.53	2.74	-13.39	-10.04	-49.92	-7.29
<i>Poor</i>	-29.40	-12.60	-13.13	-11.40	-42.54	-24.00
<b>Tanzania</b>	-28.99	-9.61	-13.38	-10.48	-42.36	-20.09
<b>Income Group</b>						
<b>Tanzania</b>						
<i>1st quintile</i>	-29.81	-10.22	-13.64	-14.23	-43.45	-24.45
<i>2nd quintile</i>	-30.52	-10.20	-13.77	-13.62	-44.29	-23.82
<i>3rd quintile</i>	-30.04	-9.58	-13.30	-11.81	43.34	-21.39
<i>4th quintile</i>	-29.04	-9.67	-13.56	-8.92	-42.60	-18.59
<i>5th quintile</i>	-25.51	-8.38	-12.63	-3.83	-38.14	-12.21
<b>Rural</b>						
<i>1st quintile</i>	-30.23	-17.28	-13.65	-10.30	-43.88	-27.59
<i>2nd quintile</i>	-31.34	-17.19	-14.56	-11.04	-45.91	-28.23
<i>3rd quintile</i>	-30.90	-16.51	-13.66	-9.98	-44.57	-26.48
<i>4th quintile</i>	-32.66	-14.89	-14.85	-10.93	-47.50	-25.82
<i>5th quintile</i>	-33.67	-11.69	-14.55	-10.16	-48.22	-21.85
<b>Urban</b>						
<i>1st quintile</i>	-24.99	-6.52	-10.63	-5.45	-35.62	-11.98
<i>2nd quintile</i>	-23.18	8.65	-14.56	-4.96	-37.74	3.69
<i>3rd quintile</i>	-20.90	-3.36	-10.45	-4.74	-31.35	-8.10
<i>4th quintile</i>	-18.45	-0.99	-11.03	-5.27	-29.48	-6.26
<i>5th quintile</i>	-19.00	0.04	-11.03	-5.27	-30.03	-5.23
<b>Poverty Status:</b>						
<b>Rural</b>						
<i>Not Poor</i>	-33.67	-11.69	-14.55	-10.13	-48.22	-21.82
<i>Poor</i>	-30.23	-17.28	-13.65	-10.28	-43.88	-27.57
<b>Urban</b>						
<i>Not Poor</i>	-19.00	0.54	-11.03	-5.33	-30.03	-4.79
<i>Poor</i>	-14.33	-6.63	-10.63	-5.61	-24.96	-12.24

Notes: \* A negative sign represents a decline in welfare (a positive CV) and a positive sign represents an increase in welfare. CV measured as a proportion of 1991 household expenditure for 1991– 2001 or 1991-2007, and 2000/01 household expenditure for 2001 – 2007.

Source: Author's calculations from the Tanzania Households Budget Surveys.

For the period between 2001 and 2007, 10.5 per cent of their 2001 total household expenditure would need to be given to make them as well off in 2007 as they were in 2001. The reasons we observe higher losses during the second period is consistent with large increases in food prices, following higher prices of petroleum, increasing world prices and drought. The results reveal heterogeneity in the effects of commodity price changes on household welfare. In the first period, the non-poor and particularly those in urban areas seem to gain in real terms from price changes, whereas welfare losses are high for the poor in rural or urban areas. In the second period both the non-poor and poor suffered welfare losses, but again the poor suffered the most; the rural-urban differences are far more pronounced than the poor/non-poor differences – whether one is poor or not it is clearly preferable to be urban rather than rural. To make the household as well off in 2007 as in 2001 the rural poor would require 10.3 per cent of 2001 income compared to 5.6 per cent for their urban counterparts.

Considering the distributional impacts of price changes for households by income group (quintiles), the results suggest that it is the richest in urban areas (the top quintiles) who suffer least from food price increases. Over the whole period (and generally for the two sub-periods), only the poorest urban quintile suffered a loss in excess of ten per cent of 1991 income. However, for all rural quintiles the losses were in excess of 20 per cent of 1991 income; the ‘richest’ rural quintile (the fifth) fared much worse than the poorest urban quintile. It would not be a great exaggeration to conclude that all rural quintiles are poor (i.e. the non-poor are a very small proportion of rural households), whereas almost no urban quintiles are poor (the lowest urban decile may compare to rural poor). Some non-poor urban households experienced a welfare increase despite food price increases; as this applies only to FPE rather than FOE the implication is that it is their ability to substitute in food expenditure that allowed them to avoid the costs of rising food prices.

Although the Fisher index was used to capture real changes in food prices, and the consumption welfare effects are implicitly relative to the numeraire of initial welfare (1991 expenditure), the estimates do not explicitly account for changes in real non-food prices. To make some allowance for what may have happened to real incomes, we can consider the effects of food price increases on consumer welfare relative to changes in prices of non-food items and real total expenditure for households groups receiving income from different sources. As shown in Tables 1 (above) and A4, there have been

large real and relative food price changes between the early 1990s (pre-reform) and 2000s (post reform) in Tanzania. Between 1991 and 2001 food prices increased on average by 200 per cent, while between 2001 and 2007 they increased by 80 per cent. As shown in Table A4.5, with the exception of clothing and footwear and education between 1991 and 2001, all non-food prices increased, but to a much lesser extent: on average, by 41 per cent between 1991 and 2001 and by 20 per cent between 2001 and 2007.

As shown in Table A6, household income from different sources increased only modestly in real terms: by 6.5 per cent between 1991 and 2001, and by 15.5 per cent between 2001 and 2007 (thus by 22.8 per cent between 1991 and 2007). Whilst incomes appear to have increased sufficiently to match the rise in non-food prices, incomes have not kept pace with increasing food prices. This implies that on average household welfare has declined. Those with the lowest incomes seem to have suffered less as headcount poverty as measured from national household budget surveys fell marginally, from 39 per cent of households in 1991/92 to 36 per cent in 2000/01 and 33 per cent in 2007. Commentators observed that ‘It is a bit of a shock that poverty has reduced so little despite our efforts’ (IPS News, 2008). It is reasonable to conclude that the huge rise in food prices during this period worsened household (consumer) welfare in Tanzania making it very difficult to reduce headcount poverty. In fact, given the adverse welfare effects of the large food price increases it is somewhat surprising that there was any reduction in poverty.

### **Tax Reforms and Consumer Welfare**

If we were able to identify the contribution of tariff (trade policy) and other tax changes to the observed change in prices we could infer the effect of trade policy changes on welfare. This is not possible with the data so we simulate the effect of observed tariff and tax changes on consumer welfare assuming full pass through to prices (see Section 6 for a discussion of the implications of this assumption). This is in line with literature that uses simulation analysis to explore the effect on welfare of hypothetical trade policy reform (Minot and Goletti, 2000; Porto, 2006). Changes in taxes, here tariff reductions (allowing for VAT levied on the tariff-inclusive price), are simulated as effects on prices to get proportional changes in the commodity prices due to tax reforms.

**Table 6: Simulated CV due to Tax Changes**

<i>Household Category</i>	<i>1991/92 – 2000/01</i>		<i>2000/01 -2007</i>		<i>1991-2007</i>	
	<i>FOE(%)</i>	<i>FPE(%)</i>	<i>FOE(%)</i>	<i>FPE(%)</i>	<i>FOE(%)</i>	<i>FPE(%)</i>
<b>Locality</b>						
<i>Rural</i>	3.41	3.62	-0.26	0.01	3.36	3.53
<i>Urban</i>	2.15	2.36	0.75	1.02	3.30	3.50
<b>Poverty Status</b>						
<i>Not Poor</i>	2.82	3.04	0.11	0.37	3.26	3.45
<i>Poor</i>	3.52	3.76	-0.38	-0.10	3.32	3.49
<b>Tanzania</b>	3.09	3.31	-0.01	0.25	3.35	3.53
<b>Income Group</b>						
<b>Tanzania</b>						
<i>1st quintile</i>	3.75	4.00	-0.67	-0.40	3.29	3.45
<i>2nd quintile</i>	3.73	3.98	-0.29	-0.02	3.41	3.58
<i>3rd quintile</i>	3.09	3.32	-0.05	0.21	3.37	3.55
<i>4th quintile</i>	2.67	2.88	0.32	0.57	3.47	3.66
<i>5th quintile</i>	2.20	2.38	0.66	0.88	3.22	3.41
<b>Rural</b>						
<i>1st quintile</i>	3.81	4.03	-0.71	-0.43	3.18	3.33
<i>2nd quintile</i>	3.83	4.05	-0.60	-0.33	3.44	3.61
<i>3rd quintile</i>	3.58	3.80	-0.27	0.01	3.36	3.52
<i>4th quintile</i>	3.17	3.37	0.05	0.31	3.55	3.73
<i>5th quintile</i>	2.66	2.84	0.22	0.47	3.27	3.45
<b>Urban</b>						
<i>1st quintile</i>	2.84	3.09	0.45	0.75	3.50	3.69
<i>2nd quintile</i>	3.83	2.36	-0.60	0.72	3.44	3.43
<i>3rd quintile</i>	2.04	2.25	0.80	1.07	3.44	3.65
<i>4th quintile</i>	1.93	2.13	0.98	1.24	3.03	3.23
<i>5th quintile</i>	1.85	2.03	1.10	1.34	3.28	3.49
<b>Poverty Status:</b>						
<b>Rural</b>						
<i>Not-Poor</i>	2.66	2.84	0.22	0.47	3.27	3.45
<i>Poor</i>	3.81	4.03	-0.71	0.43	3.18	3.33
<b>Urban</b>						
<i>Not-Poor</i>	1.85	2.03	1.10	1.34	3.28	3.49
<i>Poor</i>	2.84	3.09	0.45	0.75	3.50	3.69

Notes: As for Table 5. Implicit tariff changes incorporate VAT on the tariff element.

Table 6 reports the welfare impact of tariff changes for both first order and full price effects in the first and second periods and overall. Tariff reforms in the initial period, 1991 to 2001 when tariff reductions were significant, implied a positive welfare (CV) impact on all household groups, i.e. end income would have to be reduced to bring them

to their initial welfare level. As the main tariff reductions were in the first period, the pattern of effects applies to the overall period also. On average in real terms, tariff reductions in the 1990s increased household welfare by 3.3% in 2001 *ceteris paribus*. In the first period the tariff reductions benefit the poor relative to the non-poor, and particularly the poor in rural areas who benefit compared to poor in urban areas. This can be an effect of the assumption of full pass through: although the poor are less likely to consume imported or import-competing varieties than the non-poor, and those in urban areas are the most likely to consume imported varieties, we are assuming domestic prices are fully affected. This is plausible only to the extent that rural (staple) food prices respond to changes in imported food prices, so we probably overstate the benefits to the poor and to rural households.

In the second period 2001-2007, when tariff reductions were less pronounced, the story is different; there are small gains (marginally positive CV) for most households, but the poor (especially rural poor) suffer small welfare losses. This may be because the relatively small tax reductions were not enough to offset the large food price increases in the 2000s, but also suggests a composition effect (products more important for the poor benefitted less). To the extent that the full pass through assumption is not justified, this may be a truer reflection of effects on household welfare.

Considering the period from 1991 to 2007 overall, all households gain from tariff reductions. Although the differences are not large, it is notable that the urban poor benefit the most and the rural poor gain the least over the whole period. This reinforces the earlier point that it is location status more than position in the (local) income distribution, even at the poor/non-poor distinction, that matters for ability to accommodate the costs of food price increases. Urban households are likely to be less adversely affected than rural households, in part because they tend to be richer and in part because they have more substitution opportunities in consumption.

Appendix Tables A15-A17 report various sensitivity tests, using alternative measures of tax changes or of prices, and the qualitative results are robust. Tariff reductions (for foods) benefit urban households most (as they consume more imports), and benefit the rich more than the poor; the rural poor (who consume relatively more non-traded foods) benefit the least.

## 6 Conclusion

This paper assesses the effect of food price changes on household consumer welfare in Tanzania during the 1990s and 2000s, and simulates the effects of food price reductions attributable to tariff cuts. The focus is to measure total household consumption welfare effects. The three rounds of the Tanzania Household Budget Survey (1991/92, 2000/01 and 2007) are used, employing the method of Deaton (1997), to estimate own and cross price elasticities. Commodity budget shares provide weights that households attach to different products, with a focus on food (that accounts for most household expenditure). This establishes the basic model framework for estimating the impact of food price changes on consumer welfare in terms of compensating variation, allowing for first order (own-price) and behavioural (substitution) effects.

Having established the household consumption model, we estimate the welfare effect of observed food price changes. Tanzanian households appear sensitive and responsive to price changes of the commodities they consume, especially of staple foods (to which they attach higher weights). There has been a huge rise in real prices of these commodities during the 1990s and 2000s. As a result, *ceteris paribus*, welfare declined for most households during the 1990s and 2000s, except for the non-poor in urban areas during the initial period (1990s); most households suffer large welfare losses in the second period (2000s). This is to be expected given the large rise in real food prices since 2001. During the same period prices of non-food items have also increased, but to a much lesser extent, while real household income from different sources increased only modestly in real terms (and have not kept pace with increasing food prices).

This implies that household welfare has declined on average and in real terms, except for the richest urban households (and perhaps even for them welfare rose only in the early period). It is reasonable to conclude that the huge rise in food prices since 2001 worsened household (consumer) welfare in Tanzania making it very difficult to reduce headcount poverty. In fact, given the adverse welfare effects of the large food price increases (equivalent over 1991-2007 to a loss of a fifth of average consumer welfare and a quarter for the poor) it is somewhat surprising that there was any reduction in poverty.

Considering the distributional impacts of price changes for households by income group (quintiles), the results suggest that it is the richest in urban areas (the top quintiles) who suffer least from food price increases. Over the whole period (and generally for the

two sub-periods), only the poorest urban quintile suffered a loss in excess of ten per cent of 1991 income. However, for all rural quintiles the losses were in excess of 20 per cent of 1991 income; the 'richest' rural quintile (the fifth) fared much worse than the poorest urban quintile. It would not be a great exaggeration to conclude that all rural quintiles are poor (i.e. the non-poor are a very small proportion of rural households), whereas in comparison urban quintiles are non-poor (the lowest urban decile may compare to rural poor). Some non-poor urban households even experienced a welfare increase despite food price increases, apparently because of their ability to substitute away from those foods that become most expensive.

As it is not possible to identify the actual effect of tariff and other tax changes on food prices, we simulate the effect of observed tariff reductions on consumer welfare assuming full pass through. The results suggest that tariff reductions tend to offset the welfare losses for all household groups. While the rural poor in the initial period (1991-2001) seem to benefit more, it is the urban poor in the second period (2001-2007) and in the overall period (1991-2007) that benefit the most. This is consistent with the tendency for urban households to consume relatively more imported foods while rural households consume relatively more non-traded (staple) foods. Furthermore, as full pass through is a more reasonable assumption for urban compared to rural households the simulation will tend to have overestimated the price benefits for rural households. Nevertheless, full pass through is a strong assumption for tariffs. Imported varieties of a product, such as rice, may differ from domestic varieties so that there is only partial pass through. There may also be some degree of market segmentation, especially between rural and urban areas. This is a greater problem in examining the effects of tariff reductions as analysing the distributional effects of tax reforms is problematic in the presence of a large informal sector (Emran and Stiglitz, 2005). Given the large informal sector in Tanzania, some households (especially in rural areas) will have significant shares of consumption of own-produced foods, and many staple foods or basic goods may be purchased from traders that do not pay tax (this may be more prevalent for poor than non-poor households) so that tax changes do not pass through fully to prices.

Although the analysis is restricted to food prices, the results demonstrate the difficulty in making general statements about the distributional effects of tax reforms, in particular tariff reductions. Most studies of the distributional impacts of tax reform are based on tax incidence analysis to identify whose purchasing power is altered; Gemmill

and Morrissey (2005) review the methods and issues, noting that there is limited empirical evidence for African countries regarding the distributional impact of tax reform, in particular the effects on the poor. The Tanzanian tariff reforms could be cited as 'pro-poor' from the perspective of the urban poor as they derive the greatest proportional welfare gain. However, the rural poor derive the least benefit, and the rural non-poor benefit less than either urban group. As rural households are mostly poorer than urban households, and the majority of the poor are in rural households, and urban households tended to derive more benefit, the distributional impact is regressive. Although tariff reductions are welfare improving, they tend to enhance income inequality, especially urban-rural differentials. The tax reforms that are most likely to benefit the poor are those that reduce taxes on foods, especially staple foods.



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## Appendix A1: Elaboration of Issues in Methodology

### *Measurement Error*

One of the most important reasons why unit values cannot be treated as prices is the inherent measurement errors brought about by recall error. Reported expenditure and quantities are the first step variables from which equations (11) and (12) are derived. If these variables are recalled with error, clearly the share and unit values variables will also contain errors. Hence, measurement error in the expenditure and quantity will induce spurious correlation between quality and quantity purchases. There are a number of reasons to expect measurement errors in either expenditure or quantities. For example, if a household over-reports quantity for a correct statement of expenditure, the derived unit value will be underestimated, that is a negative spurious correlation. To illustrate this, let  $p_G$  be the price vector of commodities within the group  $G$  and  $q_G$  be the quantity vector of commodities within the group  $G$ ; such that  $E_G = p_G \cdot q_G$  is expenditure on the group while  $Q_G$  is the group quantity. In calculating a unit value from expenditure  $E_G$  and quantity  $Q_G$  for household  $i$  in cluster  $c$ , both of which are measured with error;

$$E_G = E_G^* + \varepsilon_{1i} \quad (\text{A.1})$$

$$Q_G = Q_G^* + \varepsilon_{2i} \quad (\text{A.2})$$

where the correct values are marked with asterisks such that for the unit value  $V_G$ :

$$V_G = \frac{E_G}{Q_G} = \frac{p_G \cdot q_G}{Q_G} \quad (\text{A.3})$$

Taking the logarithm we get

$$\ln V_G = \ln E_G - \ln Q_G = (\ln E_G^* + \varepsilon_{1i}) - (\ln Q_G^* + \varepsilon_{2i}) \quad (\text{A.4})$$

which is equivalent to

$$\ln V_G = (\ln E_G^* + \ln Q_G^*) + (\varepsilon_{1i} - \varepsilon_{2i}) = \ln V_G^* + (\varepsilon_{1i} + \varepsilon_{2i}) \quad (\text{A.5})$$

Since the logarithm of unit value is the difference between the logarithm of expenditure and logarithm of quantity, measurement error in the latter must be correlated with error in

the former, unless prices is recalled perfectly by the respondent. Given that unit values are critical in the estimation of elasticity, any analysis based on price elasticity needs to isolate the effects of measurement error on unit values. Such an approach is strongly advisable if one is to arrive at unbiased and plausible household demand response parameters that can be used with confidence in the formulation of policies.

### *Quality Effects*

Another reason why unit values are not the same thing as actual prices is that unit values are affected by choice of quality. This is because from equations (11) and (12) we are working with a composite of goods  $G$  such as: cereals grains, cereals flour, starch, pulses, vegetables, fruits, meat, fish, etc, each of which is aggregated over different types. Cereal grains for instance consist of maize, rice, wheat, sorghum and millets. Because unit values are computed by dividing expenditures by physical quantities, the higher quality items and mixtures with these items will have higher unit values. As better-off households tend to purchase more expensive varieties compared to the poor, the unit value of a product is a matter of choice that reflects grades. Unlike market prices over which the consumer has no control, a unit value is chosen to some degree. Because of that, there is a risk of simultaneity bias in any attempt to use them to explain the patterns of demand.

Unit values vary not only with the choice of quality but also with actual market prices, with the possibility of both own- and cross-price effects. Hence, equation (12) should be estimated with price data included. This is possible if we are prepared to make the assumption that market prices do not vary within each village over the relevant reporting period but do vary across them. From (A.3) we define the price of the group as a whole,  $\lambda_G$ , as some linear homogeneous function of  $p_G$  such that the price vector is:

$$p_G = \lambda_G \cdot p_G^* \quad (\text{A.6})$$

where  $\lambda_G$  is a scalar measure of the level of the prices in the group and  $p_G^*$  is a reference price vector. Equation (A.6) gives us a simple way of changing the level of prices while keeping fixed the structure of prices within the group  $G$ . The difference among the prices in different clusters is brought by  $\lambda_G$ . Corresponding to the group price is the group quantity  $Q_G$  defined as:

$$Q_G = k_G^0 \cdot q_G. \quad (\text{A.7})$$

where  $k_G^0$  is a vector used to add together the possibly incommensurate items in the group. If quantities are reported as weights, then each element of  $k_G^0$  will be a unit that defines the dimension of a quantity in which we are interested, such that  $Q_G$  is simply the weight of purchases. The expenditure is no longer  $E_G = p_G \cdot q_G$  (product of quantities and prices alone) but rather  $E_G = Q_G \cdot \lambda_G p_G^* / k_G^0$  (product of quantity and unit value, unit value is part price and part quality). Due to that, the unit value now becomes

$$V_G = \frac{E_G}{Q_G} = \lambda_G \frac{p_G^* \cdot q_G}{k_G^0 q_G} \quad (\text{A.8})$$

It is obvious that better-off households purchase bundles that contain larger shares of higher price per kilo, that is, the commodity for which  $p_G^* / k_G^0$  is high. This is the income elasticity of  $V_G$  which Prais and Houthakker (1955) refer to as quality elasticity. If we take the log

$$\ln V_G = \ln \lambda_G + \ln \xi_G \quad (\text{A.9})$$

where  $\xi_G$  which corresponds to the ratio  $p_G^* / k_G^0$  is the measure of quality and if everything is measured in logarithm the unit value is the sum of quality and price.<sup>15</sup> Because of this, it is important to be cautious about treating unit values as if they were actual prices. Any positive effect of income on unit value will cause price response to be absolutely overstated as higher prices will cause the consumers to shade down quality. Therefore, it is important to net out the quality effects if we are to obtain convincing estimates. Even if the response of quality to income is negligible, and so the quality shading is in response to prices, such results need to be established formally. This is the focus of the Deaton (1988) model of quality effects.

### ***Local Units and Non-Purchases***

Other issues to consider when modelling behavioural response using survey data are local units and non-purchasers. Local units of measurements are very common in most developing countries. In areas like Asia, Africa or Latin America culture, poverty and a host of other factors determine the units in use. Local units of measurement warrant

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<sup>15</sup> Commodity aggregation (Houthakker, 1952; Theil, 1952; Deaton, 1988) is one cause of quality effects; contamination bias in unit value can also be due to differences in marketing services purchased (Black, 1952), by household size (Prais and Houthakker, 1955) and prices themselves.

special attention since such units are crucial in influencing the exact magnitudes of quantities and therefore unit values. Thus, behavioural responses that disregard quantities reported in non-metric units can be biased and misleading. For that reason, some studies have dealt with the conversion issue in a rigorous fashion (Lambert and Magnac, 1997; Capeau and Dercon, 1998; Kedir, 2005). In our case, the respondent was required to state the unit of measurements used to measure the item. Since in some cases the measurement was in local units like '*kibaba*', '*fungu*', '*upawa*' or basket, enumerators were provided with weighing scales and measuring cylinders to change the local units to standard ones, their equivalents in kilogram, grams, litre or millilitres. Thus for food commodities, quantities are in grams or millilitres, with the exception of eggs that are given in number of units.

Unit values, just as the logarithmic model of demand, can only be measured if the household purchases positive amounts. But not every household in each survey purchases all they consume, and no unit value or logarithmic model can be obtained from those who do not. For narrowly defined commodities, such restrictions can eliminate a large fraction of the sample, and when we come to extend the model to many goods, the restriction that all households purchase all goods can result in an unacceptable loss of households from the sample. The key question here is whether we want to model demand conditional on making purchases, or whether we want an unconditional formulation, covering non-consumers as well as consumers. If we are trying to estimate changes in consumer welfare or government revenue due to price changes, the model must be one that includes all households – purchasers and non-purchasers. Zero purchases can arise due to infrequent purchasing, misreporting, variation in preferences across sample (Deaton and Irish, 1984; Keen, 1986), the prevalence of consumption from own production and the presence of corner solution (Garcia and Labeaga, 1996). Deaton's technique therefore models and allows for zero purchases and quantities in non-standard units.

### ***Deaton's Model of Quality Effects***

Deaton's methodology allows for the consistent estimation of price elasticities using survey data in the presence of both measurement errors and quality contamination of unit values as well as local units and zero purchases. To see this, to the modified model (11) from the logarithmic model of demand we add the special features of the current problems, that is, we observe not actual prices but unit values and that prices do not vary within villages but only between them.

One challenge we are facing in identifying the parameters in (11) and (12) is how to identify the coefficients on the price terms. Since we know nothing about prices, there is no way of pinning down either  $\theta$  or  $\psi$ . While the parameters of total household expenditure per capita and socio-demographics in the share and unit value equations can be consistently estimated by including cluster dummies or cluster means on the assumption that prices are constant within village but only vary between them, without further information on unobserved prices it is impossible to estimate the parameters. However, it is possible to say something about the ratio. If we use (12) to write  $\ln p_{Hc}$  in term of the logarithm of unit value, logarithm of total household expenditure per capita, socio-demographic characteristics plus the error term and substitute that into (11), we obtain a linear relationship between the budget share and logarithm of unit value, logarithm of total household expenditure per capita, socio-demographic characteristics and various error terms. The coefficient on the logarithm of unit values identify not  $\theta_H$  but the hybrid  $\psi_H^{-1}\theta_H$  which will be larger than  $\theta_H$  if there is quality shading and  $\psi_H$  is less than unity. Since the existence of quality effects in unit value will tend to bias upwards the estimates of price elasticities that are obtained by comparing budget share and unit value on the false supposition that the latter can be treated as if they were prices.

To disentangle  $\theta_H$  from  $\psi_H^{-1}\theta_H$  we need more information that can be obtained from a model of quality shading that is specific enough to circumvent the identification problem. The basic idea here is that quality shading in response to price increase is not likely to be very large if income elasticity derived from  $\beta^0$  is not very large. More precisely if quality elasticity,  $\beta^1$ , is close to zero then  $\psi_H$  should be close to unity such that  $\psi_H$  is close to  $\theta_H$ . If that is the case, we can ignore the quality effects and treat the unit value as actual prices, except for measurement errors. But as shown above and formally defined in equation (A.9), the issue of quality shading in response to price is a reality. The definition in (A.9) allows us to tie the response of unit value to change in price to the response of budget share to changes in price and income elasticity. But without further restrictions, there is no direct link between quality elasticity and unit value response to price change.

Deaton (1988, 1997) therefore imposed a theoretical restriction through the simple model of quality shading to make the estimation of price elasticities without information on actual prices. That is possible only if we allow goods in group  $G$ , say fish, to form a



separable branch of preferences such that the demand for individual fish depends on the total fish budget and on the prices of individual fish within the branch. As a result, changes in the level of market prices of all fish together affect the demand for individual fish in exactly the same way as do changes in the total household budget devoted to fish. But the quality,  $\xi_G$ , of fish depends on the composition of demand within the group and the group demand depends on the ratio of group expenditure  $E_G$  to group price  $\lambda_G$ . If we know how the quality of fish changes with changes in the total household expenditure, we can predict the effects of change in absolute prices on the unit value.

Thus, group price works in the same way as changes in the total household expenditure which links the unit values response to price change (shading) to the quality elasticity. Since  $p_G^*$  and  $k_G^0$  are fixed then the effects of  $\xi_G$  on  $\lambda_G$  is only through  $q_G$  which depends on  $E_G / \lambda_G$ , such that  $\xi_G$  depends only on  $\ln E_G - \ln \lambda_G$  hence;

$$\frac{\partial \ln \xi_G}{\partial \ln \lambda_G} = \frac{\partial \ln \xi_G}{\ln E_G} \left( \frac{\partial \ln E_G}{\partial \ln \lambda_G} - 1 \right) \quad (\text{A.10})$$

The term in brackets on the right hand side (RHS) is the response of budget share with respect to group price change while the first term is closely related to the Prais and Houthakker (1955) elasticity of quality which is  $\beta^1$  in (12), and by chain rule

$$\beta_1 = \frac{\partial \ln \xi_G}{\partial \ln x} = \frac{\partial \ln \xi_G}{\ln E_G} \cdot \frac{\partial \ln E_G}{\partial \ln x} \quad (\text{A.11})$$

The last term on RHS is income (total household expenditure) elasticity of the group,  $\beta^0$ , such that when we combine we have

$$\frac{\partial \ln \xi_G}{\partial \ln \lambda_G} = \frac{\beta_G^1 e_{GH}}{e_G} \quad (\text{A.12})$$

The separability restriction implies that quality shading in response to price change is determined by price, income and quality elasticity of the commodity group. The elasticity of unity value with respect to price or the parameter  $\psi_{GH}$  is one plus the elasticity of quality to price, such that finally we have

$$\psi_{GH} = \frac{\partial \ln V_G}{\partial \ln \lambda_H} = \delta_{GH} + \frac{\beta_G^1 e_{GH}}{e_G} \quad (\text{A.13})$$

where  $\delta_{GH}$  is the Kronecker delta, equal to unit when  $G = H$  and zero otherwise. If  $G = H$  the cross price effects will be identical to own price effects. Otherwise, when the price of one commodity increases the effects on quality of another are controlled by how much the price affects quantity, i.e. the cross-price elasticity. Because (A.13) provides an additional relationship between the response of budget share and unit value to price change, that is  $\theta_H$  and  $\psi_H$ , it can be used to identify the two elasticities from the estimates of the ratio of  $\psi_H^{-1}\theta_H$  which can be identified from the budget share and unit value data.

Finally, as we do not estimate tariff pass through to obtain the percentage change in prices  $\Delta p_i^h$  necessary to apply the model in (4) and (8), we simulate the effect of a given tariff reduction on domestic prices to capture the effects of trade reform. The price change is

$$\Delta p = \frac{1 + \tau_t - 1 + \tau_{t-1}}{1 + \tau_{t-1}} \quad (\text{A.14})$$

where  $\tau$  = average tariff rates (ad-valorem or implicit tariffs),  $t$  represents years 2001 and 2007 ( post reform) and  $t - 1$  represents the year 1991 ( before the reforms). In logarithm this is the same as:

$$\Delta \ln p = \ln(1 + \tau_{2001/2007}) - \ln(1 + \tau_{1991}) \quad (\text{A.15})$$

## Appendix A2: Data Sources, Description and Appendix Tables

The VAT rates applied to tariffs are aggregated either at the two or four digit levels over the relevant HS codes to match the composite commodity groups.<sup>16</sup> We use three measures of taxes: scheduled *ad valorem* tariff, implicit tariff and VAT rate applied to the tariff. As shown in Table A1 scheduled tariffs have declined, from as high as 50% on average in 1991 to as low as 24% on average in 2000 and 13% on average in 2007. Whilst implicit tariffs for some commodities have been falling there were some increases in the second period. For instance, the implicit tariff for cereal flour fell from 21% in 1991 to 7% in 2001 but rose to 18% in 2007. As VAT has been around 20% until recently, the VAT rates applied to the tariffs are driven by tariff changes. Results using the implicit tariff only are presented in Tables A6, and A7 uses scheduled tariffs. In brief, the potential positive effects of the tariff reductions as stated in tariff books (the scheduled tariff) are far higher compared to what we observed using the actually applied (implicit) tariffs.

To examine the robustness of Deaton's method of using unit values to estimate consumer responses and consumer welfare, we used market prices collected from 44 districts in Tanzania. Since all regions were covered in the 2000/01 Household Budget Survey, in theory the market prices should reflect prices faced by households across different locations and so should correspond to relevant unit values. Recall this is what we observed in the data section when we compared the mean of unit values and market prices for the 20 food commodity groups. Because of this, it is not surprising that there is no marked difference between the elasticities calculated using survey unit values as proposed in Deaton's methodology and that using market prices. Details are shown in Table A17; the results from market prices, though on the higher side, provide relatively similar results for the consumer welfare analysis to that of unit values.

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<sup>16</sup> For example cereals are aggregated at four digit level to include grains, flour, others, bread and confectionary, while fish is aggregated only at two digit level as all are in one group.

**Table A1: Average Tariff Rates by the Commodity Groups**

<i>Products</i>	<i>Ad-Valorem</i>			<i>Actually Applied</i>		
	<i>1990</i>	<i>2000</i>	<i>2007</i>	<i>1990</i>	<i>2000</i>	<i>2007</i>
<i>Cereals, grain</i>	30	14	7	10	16	8.9
<i>Cereals, flour</i>	40	24	12	21	7.1	18
<i>Other cereals</i>	50	24	12	16	16	11
<i>Bread</i>	50	23	12	22	20	23
<i>Confectionery</i>	50	23	12	21	18	15
<i>Starch, roots and tubers</i>	50	25	13	32	25	24
<i>Sugar and sweets</i>	50	25	13	19	14	11
<i>Pulses, dry</i>	50	25	13	9.0	36	9.5
<i>Nuts and Seeds</i>	50	25	13	26	23	9.4
<i>Vegetables</i>	50	25	13	18	23	14
<i>Fruits</i>	50	25	12	29	20	24
<i>Meat and meat products</i>	40	25	13	23	19	13
<i>Eggs</i>	40	25	13	9.0	15	25
<i>Fish and shellfish</i>	40	25	13	16	9.7	24
<i>Milk and dairy products</i>	40	24	12	28	22	30
<i>Oils and Fats products</i>	40	15	8	15	11	8.0
<i>Spices and other foodstuffs</i>	40	25	13	26	22	21
<i>Raw materials for drink</i>	50	25	13	24	13	23
<i>Non-alcoholic drinks</i>	30	24	12	25	22	24
<i>Alcoholic drinks</i>	50	25	13	22	20	19

*Notes:* The reported scheduled tariffs in 2007 are almost the same as in 2000. As under the EAC tariff reductions will be implemented we assume a 2007 scenario in which the 2000 tariffs are cut by 50 percent.

*Source:* Tanzania Revenue Authority, Customs Department.

**Table A2: Variable Definitions**

<b>Variable</b>	<b>Description</b>
Budget Share	The proportion of the budget devoted to a given food commodity
Unit Value	The log of unit value per gram or millimeter
Income	The log of total household expenditure per adult equivalent
Size	The log of household size
Less than 6	The proportion of household members with age less than 6 years
Male btwn 6 to 15	The proportion of boys with age between 6 and 15 years
Female btwn 6 to 15	The proportion of girls with age between 6 and 15 years
Male btwn 16 to 55	The proportion of males with age between 16 and 55 years
Female btwn 16 to 55	The proportion of females with age between 16 and 55 years
Male > 55	The proportion of males with age greater than 55 years
Female > 55	The proportion of females with age greater than 55 years
HeadMale	A dummy variable which is one if the head is a male
School1	A dummy variable which is one if the household member has no any level of formal education
School2	A dummy variable which is one if the household member has primary level of formal education
School3	A dummy variable which is one if the household member has secondary level of formal education
School4	A dummy variable which is one if the household member has tertiary level of formal education

*Note:* We have estimated the first stage equations by taking the deviations of the above variables from their respective cluster means

**Table A3: Percentage Share of Consumption by type of Item Consumed**

<b>Goods group</b>	<b>1991/92</b>	<b>2000/01</b>	<b>2007</b>
Food – Purchased	35.8	38.6	37.6
Food – Home Produced	35.5	26.8	26.5
Durable Goods	7.2	7.3	4.2
Other non-durables	19.7	25.0	26.7
Medical Expenditure	0.9	2.2	1.8
Education Expenditure	0.8	2.0	1.8
Total	100	100	100
of which, Total Food	<b>71.3</b>	<b>66.5</b>	<b>64</b>

*Source:* Tanzania Household Budget Survey for the years 1991/92, 2000/01 and 2007.

**Table A4: Mean Summary Statistics for the Budget Share and Median Unit Price**

	1991/92		2000/1		Price ratio
	Budget share	Median price per/kg	Budget share	Median price per/kg	
<i>Cereals, grain</i>	0.18	90	0.13	220	2.44
<i>Cereals, flour</i>	0.16	101	0.18	205	2.03
<i>Other Cereals</i>	0.01	174	0.01	290	1.67
<i>Bread</i>	0.01	251	0.00	562	2.24
<i>Confectionary</i>	0.01	194	0.01	1,200	6.19
<i>Starch, roots and tubers</i>	0.12	43	0.11	112	2.60
<i>Pulses, dry</i>	0.04	86	0.05	249	2.90
<i>Sugar and sweets</i>	0.07	221	0.06	592	2.68
<i>Nuts and Seeds</i>	0.02	121	0.02	291	2.40
<i>Oils and Fats products</i>	0.07	444	0.08	1,001	2.25
<i>Vegetables</i>	0.02	130	0.02	264	2.03
<i>Fruits</i>	0.10	90	0.09	373	4.14
<i>Meat and meat products</i>	0.00	201	0.00	695	3.46
<i>Eggs</i>	0.06	19,474	0.07	50,000	2.57
<i>Fish and shellfish</i>	0.03	183	0.03	745	4.07
<i>Milk and dairy products</i>	0.03	87	0.03	788	9.06
<i>Spices/ other foodstuffs</i>	0.18	257	0.13	671	2.61

*Note:* As for Table 1. The 4,823 households in 1991/92 correspond to a total population of 115,935.

*Source:* Authors own calculations from Tanzania Household Budget Surveys

**Table A5: Percentage Changes in Non-Food Prices, 1991-2007\***

	1991-2001	2002-2007
<i>Drinks and Tobacco</i>	60.0	37.4
<i>Rent</i>	32.5	35.6
<i>Fuel, Light and Water</i>	2.8	51.6
<i>Clothing and Footwear</i>	-56.8	4.3
<i>Furniture and Utensils</i>	160.5	11.4
<i>Household Operation and Maintenance</i>	13.8	12.7
<i>Personal Care and Health</i>	67.4	9.9
<i>Recreation and Entertainment</i>	136.9	6.7
<i>Transportation</i>	23.8	28.1
<i>Education</i>	-24.9	1.8
<i>Miscellaneous Goods and Services</i>	1.0	1.6
<b>Average Price Change</b>	<b>41.6</b>	<b>20.0</b>

*Note:* \* The calculation between 1991 and 2001 is based on the old CPI (1994 base year) and that between 2002 and 2007 is based on the new CPI (2001 base year).

*Source:* Author's Compilation from Central Bank Average Prices of Non-Food items.

**Table A6: Percentage Change in Real Household Income, 1991-2007**

	1991	2001	% Change	2001	2007	% Change	1991	2007	% Change
<i>Sales of food crops</i>	9746.36	10536.41	8.11	19913.81	22074.38	10.85	1.08	11679.57	19.84
<i>Sales of livestock and products</i>	9826.33	10095.30	2.74	19080.13	30540.99	10.85	1.03	16159.25	19.84
<i>Sales of cash crops</i>	10619.91	11666.45	9.85	22049.58	20724.71	-6.01	1.10	10965.46	3.25
<i>Business income</i>	16313.32	16685.93	2.28	31536.40	39540.61	25.38	1.02	20920.96	28.24
<i>Wages or salaries in cash</i>	18393.21	22094.64	20.12	41758.88	40945.93	-1.95	1.20	21664.51	17.79
<i>Other casual cash earning</i>	13297.17	14980.78	12.66	28313.68	32426.51	14.53	1.13	17156.88	29.03
<i>Cash remittances</i>	17347.64	15283.33	-11.90	28885.49	32135.12	11.25	0.88	17002.71	-1.99
<i>Fishing</i>	13137.21	14896.71	13.39	28154.79	27081.34	-3.81	1.13	14328.75	9.07
<i>Other</i>	11821.36	11964.30	1.21	22612.54	40286.84	78.16	1.01	21315.79	80.32
<b>Average Income Change</b>			<b>6.50</b>			<b>15.47</b>			<b>22.82</b>

Source: Authors' own calculations from the Tanzania Household Budget Surveys.

Note: The reported figures are weighted using survey weights

**Table A7: Expenditure Share by Deciles per capita Consumption, 1991/92**

Commodity Group	Poorest	2	3	4	5	6	7	8	9	Richest
<i>Cereals, grain</i>	0.16	0.17	0.17	0.15	0.16	0.18	0.18	0.17	0.18	0.17
<i>Cereals, flour</i>	0.14	0.16	0.16	0.18	0.17	0.15	0.13	0.13	0.11	0.08
<i>Other cereals</i>	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
<i>Bread</i>	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02
<i>Confectionery</i>	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02
<i>Starch</i>	0.03	0.04	0.03	0.04	0.03	0.04	0.05	0.05	0.06	0.07
<i>Sugar</i>	0.09	0.08	0.07	0.06	0.07	0.06	0.06	0.06	0.06	0.06
<i>Pulses, dry</i>	0.13	0.12	0.12	0.14	0.14	0.12	0.11	0.09	0.08	0.06
<i>Nuts &amp; Seeds</i>	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
<i>Vegetables</i>	0.10	0.08	0.08	0.07	0.07	0.07	0.07	0.06	0.07	0.06
<i>Fruits</i>	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.03	0.02
<i>Meat</i>	0.10	0.10	0.10	0.09	0.10	0.11	0.11	0.12	0.13	0.15
<i>Eggs</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
<i>Fish</i>	0.07	0.05	0.06	0.05	0.05	0.05	0.06	0.05	0.06	0.05
<i>Milk</i>	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
<i>Oils and Fats</i>	0.03	0.02	0.03	0.02	0.03	0.03	0.03	0.03	0.04	0.04
<i>Spices</i>	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
<i>materials for drink</i>	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
<i>Non-alcoholic drinks</i>	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
<i>Alcoholic drinks</i>	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.02
<b>All Food and drinks</b>	<b>0.66</b>	<b>0.66</b>	<b>0.69</b>	<b>0.66</b>	<b>0.69</b>	<b>0.69</b>	<b>0.64</b>	<b>0.64</b>	<b>0.64</b>	<b>0.56</b>
<i>Rural</i>	0.67	0.66	0.70	0.68	0.68	0.68	0.69	0.64	0.66	0.61
<i>Urban</i>	0.63	0.65	0.64	0.64	0.60	0.62	0.63	0.60	0.61	0.48
<b>All Non-food</b>	<b>0.34</b>	<b>0.33</b>	<b>0.32</b>	<b>0.34</b>	<b>0.31</b>	<b>0.32</b>	<b>0.36</b>	<b>0.36</b>	<b>0.36</b>	<b>0.44</b>
<i>Rural</i>	0.33	0.34	0.30	0.32	0.32	0.32	0.31	0.36	0.34	0.38
<i>Urban</i>	0.37	0.35	0.36	0.36	0.40	0.38	0.36	0.40	0.39	0.52

Source: Authors' own calculations from the Tanzania Household Budget Survey 1991/92

Note: The reported figures are weighted using survey weights

**Table A8: Expenditure Share by Deciles per capita Consumption, 2000/01**

<b>Commodity Group</b>	<b>Poorest</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>Richest</b>
<i>Cereals, grain</i>	0.123	0.126	0.122	0.125	0.137	0.137	0.135	0.148	0.146	0.127
<i>Cereals, flour</i>	0.177	0.231	0.212	0.206	0.188	0.159	0.174	0.144	0.130	0.099
<i>Other cereals</i>	0.007	0.006	0.006	0.005	0.007	0.008	0.009	0.008	0.011	0.015
<i>Bread</i>	0.001	0.001	0.002	0.002	0.003	0.004	0.005	0.007	0.010	0.015
<i>Confectionery</i>	0.008	0.010	0.012	0.013	0.014	0.017	0.020	0.018	0.020	0.018
<i>Starch</i>	0.157	0.119	0.117	0.121	0.110	0.117	0.096	0.101	0.082	0.054
<i>Sugar</i>	0.029	0.038	0.041	0.048	0.056	0.058	0.062	0.062	0.060	0.059
<i>Pulses, dry</i>	0.075	0.069	0.068	0.069	0.061	0.060	0.050	0.056	0.053	0.042
<i>Nuts &amp; Seeds</i>	0.023	0.021	0.025	0.021	0.027	0.028	0.026	0.023	0.026	0.022
<i>Vegetables</i>	0.102	0.082	0.075	0.074	0.081	0.075	0.072	0.070	0.071	0.071
<i>Fruits</i>	0.018	0.018	0.021	0.018	0.020	0.020	0.023	0.027	0.027	0.026
<i>Meat</i>	0.079	0.077	0.088	0.088	0.091	0.090	0.098	0.106	0.105	0.122
<i>Eggs</i>	0.001	0.001	0.001	0.003	0.003	0.002	0.003	0.003	0.005	0.008
<i>Fish</i>	0.089	0.076	0.071	0.071	0.072	0.066	0.065	0.059	0.061	0.063
<i>Milk</i>	0.027	0.028	0.027	0.032	0.029	0.027	0.032	0.030	0.027	0.030
<i>Oils and Fats</i>	0.020	0.025	0.029	0.031	0.032	0.035	0.039	0.043	0.042	0.049
<i>Spices</i>	0.021	0.016	0.018	0.016	0.014	0.015	0.014	0.013	0.012	0.011
<i>materials for drink</i>	0.004	0.004	0.004	0.005	0.005	0.006	0.007	0.008	0.008	0.009
<i>Non-alcoholic drinks</i>	0.005	0.005	0.013	0.008	0.009	0.014	0.014	0.015	0.027	0.035
<i>Alcoholic drinks</i>	0.011	0.010	0.011	0.008	0.008	0.014	0.007	0.011	0.012	0.024
<b><i>All Food and drinks</i></b>	<b>0.729</b>	<b>0.739</b>	<b>0.713</b>	<b>0.732</b>	<b>0.725</b>	<b>0.713</b>	<b>0.693</b>	<b>0.693</b>	<b>0.667</b>	<b>0.575</b>
<i>Rural</i>	0.722	0.745	0.729	0.722	0.733	0.723	0.727	0.717	0.715	0.639
<i>Urban</i>	0.700	0.685	0.683	0.657	0.651	0.620	0.627	0.616	0.582	0.490
<b><i>All Non-food</i></b>	<b>0.271</b>	<b>0.259</b>	<b>0.288</b>	<b>0.268</b>	<b>0.274</b>	<b>0.287</b>	<b>0.305</b>	<b>0.311</b>	<b>0.335</b>	<b>0.429</b>
<i>Rural</i>	0.277	0.257	0.271	0.278	0.267	0.275	0.273	0.283	0.286	0.358
<i>Urban</i>	0.300	0.318	0.319	0.344	0.352	0.383	0.373	0.384	0.418	0.511

*Note:* The reported figures are weighted using survey weights.

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



**Table A9: Expenditure Share by Deciles per capita Consumption, 2007**

<b>Commodity Group</b>	<b>Poorest</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>Richest</b>
<i>Cereals, grain</i>	0.15	0.16	0.17	0.17	0.18	0.16	0.16	0.16	0.16	0.13
<i>Cereals, flour</i>	0.10	0.10	0.10	0.09	0.09	0.10	0.09	0.09	0.09	0.08
<i>Other cereals</i>	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
<i>Bread</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<i>Confectionery</i>	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01
<i>Starch</i>	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
<i>Sugar</i>	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.03	0.03
<i>Pulses, dry</i>	0.13	0.12	0.11	0.11	0.10	0.10	0.10	0.09	0.09	0.06
<i>Nuts &amp; Seeds</i>	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.03
<i>Vegetables</i>	0.11	0.10	0.10	0.09	0.08	0.08	0.08	0.08	0.07	0.07
<i>Fruits</i>	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.04	0.04
<i>Meat</i>	0.12	0.13	0.14	0.15	0.17	0.16	0.16	0.18	0.18	0.14
<i>Eggs</i>	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
<i>Fish</i>	0.07	0.07	0.07	0.07	0.06	0.07	0.07	0.07	0.07	0.05
<i>Milk</i>	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
<i>Oils and Fats</i>	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.05	0.07
<i>Spices</i>	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.11
<i>materials for drink</i>	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
<i>Non-alcoholic drinks</i>	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
<i>Alcoholic drinks</i>	0.04	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04
<b><i>All Food and drinks</i></b>	<b>0.70</b>	<b>0.70</b>	<b>0.68</b>	<b>0.70</b>	<b>0.69</b>	<b>0.69</b>	<b>0.67</b>	<b>0.65</b>	<b>0.64</b>	<b>0.55</b>
<i>Rural</i>	0.72	0.75	0.73	0.72	0.73	0.72	0.73	0.72	0.71	0.64
<i>Urban</i>	0.70	0.68	0.68	0.66	0.65	0.62	0.63	0.62	0.58	0.49
<b><i>All Non-food</i></b>	<b>0.30</b>	<b>0.30</b>	<b>0.32</b>	<b>0.30</b>	<b>0.31</b>	<b>0.31</b>	<b>0.33</b>	<b>0.35</b>	<b>0.36</b>	<b>0.45</b>
<i>Rural</i>	0.28	0.26	0.27	0.28	0.27	0.28	0.27	0.28	0.29	0.36
<i>Urban</i>	0.30	0.32	0.32	0.34	0.35	0.38	0.37	0.38	0.42	0.51

*Note:* The reported figures are weighted using survey weights.

*Source:* Authors' own calculations from the Tanzania Household Budget Survey 2007.

**Table A10: Within Village Estimates: Budget Shares, Unit Values and Expenditure Elasticities, 2007**

<i>Commodity Group</i>	<i>Expenditure elasticities</i>	<i>Budget Shares</i>		<i>Unit Values</i>	
		<i>lnx</i>	<i>lnn</i>	<i>lnx</i>	<i>lnn</i>
<i>Cereals, grain</i>	0.989***	0.023***	0.025***	0.050***	-0.034***
<i>Cereals, flour</i>	0.658***	-0.030***	-0.007***	0.147***	0.061***
<i>Other cereals</i>	0.568***	-0.001***	0.000***	0.209***	0.037***
<i>Bread</i>	0.865***	0.000***	0.000***	-0.053***	-0.046***
<i>Confectionery</i>	0.668***	-0.006***	-0.004***	0.044***	0.077***
<i>Starch, roots and tubers</i>	0.565***	-0.035***	-0.006***	0.094***	0.023***
<i>Sugar</i>	<b>1.213</b> ***	0.005***	0.004***	0.019***	-0.021***
<i>Pulses, dry</i>	0.806***	-0.003***	-0.001***	0.100***	0.027***
<i>Nuts and Seeds</i>	<b>1.092</b> ***	0.003**	0.004**	0.016***	-0.008
<i>Vegetables</i>	0.708***	-0.023***	-0.017***	0.078***	0.010***
<i>Fruits</i>	0.950***	0.000***	0.001***	0.043***	0.016***
<i>Meat and meat products</i>	<b>1.408</b> ***	0.046***	0.025***	0.087***	0.094***
<i>Eggs</i>	<b>1.388</b> ***	0.002***	0.000***	0.089***	-0.008
<i>Fish and shellfish</i>	0.843***	-0.008***	-0.004***	0.051***	0.042***
<i>Milk and dairy product</i>	<b>1.513</b> ***	0.009***	0.00***6	-0.003***	0.009***
<i>Oils and Fats products</i>	<b>1.121</b> ***	0.008***	-0.004***	0.015***	-0.007***
<i>Spices and other foodstuffs</i>	0.918***	0.002***	0.000***	0.259***	0.149
<i>Raw materials for drink</i>	<b>1.144</b> ***	0.001***	-0.001***	-0.051***	-0.024***
<i>Non-alcoholic drinks</i>	0.942***	0.000***	-0.006***	0.038***	0.053***
<i>Alcoholic drinks</i>	0.759***	0.017***	-0.004***	0.684***	0.324***

Note: As for Table 3 except \*\*\* indicates significant at 1%, \* at 10%, otherwise not significant.

**Table A11: Unconstrained matrix of own- and cross price elasticities, Tanzania, 2000/01**

<i>Commodity Groups</i>	<i>Cereal grain</i>	<i>Cereal flour</i>	<i>Other cereals</i>	<i>Bread</i>	<i>Confectionery</i>	<i>Starch tubers</i>	<i>Sugar</i>	<i>Pulses, dry</i>	<i>Nut, Seeds</i>	<i>Vegetables</i>	<i>Fruits</i>	<i>Meat</i>	<i>Eggs</i>	<i>Fish</i>	<i>Milk</i>	<i>Oils, Fats</i>	<i>Spices, others</i>	<i>Materials drink</i>	<i>Non-alcoholic</i>	<i>Alcoholic</i>
<i>Cereals, grain</i>	<b>-1.41</b>	0.31	0.04	0.02	-0.01	-0.03	-0.31	0.13	-0.11	0.02	0.10	-0.20	0.03	0.03	0.09	-0.20	0.02	0.05	0.10	0.06
<i>Cereals, flour</i>	0.08	<b>-1.01</b>	-0.03	-0.05	0.05	0.07	0.28	-0.16	0.07	0.12	-0.14	-0.21	-0.09	-0.09	-0.10	0.30	0.02	0.00	0.00	-0.10
<i>Other cereals</i>	0.13	-0.13	<b>-1.23</b>	0.33	-0.10	0.12	-0.78	0.17	-0.24	-0.14	0.16	0.07	0.34	0.01	0.16	-0.18	0.32	-0.08	-0.05	0.12
<i>Bread</i>	1.13	-0.40	0.07	<b>-1.40</b>	-0.18	0.66	-2.33	1.43	-0.22	-0.79	0.55	0.07	0.58	0.11	0.08	0.89	0.11	0.18	-0.30	0.12
<i>Confectionery</i>	0.10	-0.02	0.10	-0.16	<b>-1.25</b>	0.12	-0.48	0.18	0.06	-0.02	0.28	0.18	0.35	-0.23	0.08	-0.07	0.12	0.12	0.02	0.11
<i>Starch, roots tubers</i>	0.44	0.03	0.00	-0.05	0.09	<b>-1.11</b>	0.17	-0.06	0.00	-0.07	-0.11	-0.06	-0.15	-0.07	0.10	-0.18	-0.08	-0.07	-0.16	-0.07
<i>Sugar</i>	0.13	0.29	0.02	0.02	-0.07	-0.03	<b>-1.11</b>	-0.17	0.07	0.00	0.24	-0.04	0.06	-0.03	0.01	-0.20	0.06	0.02	0.19	0.03
<i>Pulses, dry</i>	-0.01	-0.14	-0.04	0.09	0.01	-0.05	0.24	<b>-1.17</b>	0.03	0.01	0.02	-0.03	-0.11	0.07	-0.07	-0.12	-0.02	-0.01	-0.16	0.01
<i>Nuts and Seeds</i>	-0.17	-0.02	-0.01	-0.04	-0.09	-0.09	-0.12	0.26	<b>-1.46</b>	0.17	-0.05	0.05	0.08	0.01	0.03	-0.05	0.01	-0.20	-0.13	-0.02
<i>Vegetables</i>	0.02	0.05	-0.01	0.03	-0.09	0.08	-0.03	0.14	0.06	<b>-0.97</b>	0.06	0.24	0.04	0.08	-0.03	0.05	-0.06	0.00	0.02	0.00
<i>Fruits</i>	-0.10	0.25	-0.04	0.02	0.05	-0.08	-0.12	-0.17	-0.02	-0.18	<b>-0.93</b>	0.02	-0.05	0.01	0.02	0.07	0.08	-0.09	-0.31	0.05
<i>Meat, meat products</i>	-0.03	-0.11	-0.02	0.05	-0.03	0.00	-0.26	-0.12	-0.01	-0.03	0.03	<b>-0.72</b>	-0.10	0.11	-0.13	-0.05	-0.07	-0.01	0.07	0.03
<i>Eggs</i>	-0.12	0.10	0.00	-0.06	0.01	0.19	-0.94	-0.26	-0.16	-0.32	0.07	0.66	<b>-1.13</b>	0.49	-0.10	0.37	0.06	0.03	-0.09	0.09
<i>Fish and shellfish</i>	0.07	-0.13	-0.02	-0.10	0.04	-0.10	0.22	0.36	-0.09	0.14	-0.09	0.25	0.03	<b>-1.19</b>	0.14	-0.32	0.00	0.01	0.02	0.05
<i>Milk, dairy product</i>	0.01	-0.28	-0.03	0.19	-0.01	-0.01	0.29	0.12	0.02	-0.04	-0.18	-0.19	0.02	0.14	<b>-1.15</b>	0.22	0.11	-0.02	0.18	0.01
<i>Oils and Fats products</i>	0.15	0.19	0.00	0.03	-0.07	0.07	0.09	-0.05	0.15	-0.06	0.12	0.23	0.08	0.04	0.00	<b>-0.96</b>	0.00	0.01	0.18	0.07
<i>Spices, other foods</i>	-0.13	-0.09	0.00	-0.04	0.13	0.05	0.07	-0.05	0.00	0.02	0.01	-0.14	-0.13	-0.13	0.05	0.00	<b>-0.80</b>	-0.08	0.00	-0.03
<i>Materials for drink</i>	0.15	0.32	0.04	0.06	-0.34	-0.04	-0.27	-0.08	0.04	-0.02	0.19	0.39	0.07	-0.04	0.00	-0.26	0.08	<b>-1.00</b>	0.32	0.04
<i>Non-alcoholic drinks</i>	-0.04	-0.09	0.08	0.13	0.20	0.05	-0.42	-0.04	0.24	-0.19	-0.03	0.13	0.19	0.07	0.00	-0.07	0.06	0.12	<b>-1.18</b>	0.20
<i>Alcoholic drinks</i>	-0.70	-0.48	-0.05	-0.73	0.16	-0.22	1.14	-0.26	0.17	0.18	-0.06	-0.23	0.11	-0.23	-0.10	0.36	-0.16	-0.25	-0.16	<b>-0.87</b>

**Source:** Authors calculations using Tanzania Household Budget Survey, 2000/01.

**Note:** As for Table 4.

**Table A12a: Unconstrained matrix of own- and cross price elasticities, Tanzania, 1991/92**

<i>Commodity Groups</i>	<i>Cereal grain</i>	<i>Cereal flour</i>	<i>Other cereals</i>	<i>Bread</i>	<i>Confectionery</i>	<i>Starch tubers</i>	<i>Sugar</i>	<i>Pulses dry</i>	<i>Nut, Seed</i>	<i>Vegetable</i>	<i>Fruits</i>	<i>Meat</i>	<i>Eggs</i>	<i>Fish</i>	<i>Milk</i>	<i>Oils, Fats</i>	<i>Spices, others</i>	<i>Materials drink</i>	<i>Non-alcoholic</i>	<i>Alcoholic</i>
<i>Cereals, grain</i>	<b>-1.08</b>	0.06	-0.01	0.01	-0.02	-0.02	0.04	0.01	0.01	0.02	0.00	-0.02	-0.02	0.00	0.00	-0.03	0.01	0.00	0.03	-0.02
<i>Cereals, flour</i>	-0.09	<b>-0.86</b>	0.02	-0.01	0.00	0.04	-0.06	0.00	0.00	-0.02	0.00	0.00	-0.04	-0.02	-0.03	0.00	-0.02	0.01	0.03	-0.07
<i>Other cereals</i>	0.02	-0.05	<b>-1.36</b>	-0.03	0.11	0.00	-0.01	0.19	0.01	0.16	-0.02	-0.05	0.07	0.05	-0.04	0.08	-0.03	-0.04	-0.24	0.26
<i>Bread</i>	0.15	0.09	0.02	<b>-1.06</b>	0.01	0.01	-0.05	0.09	0.02	-0.04	0.00	0.00	0.04	0.03	0.05	-0.02	0.02	-0.05	-0.05	0.13
<i>Confectionery</i>	0.14	-0.02	0.01	0.04	<b>-0.99</b>	0.05	-0.16	0.14	0.02	-0.02	-0.02	0.02	-0.01	0.06	0.04	-0.03	0.05	0.04	-0.02	0.01
<i>Starch, roots tubers</i>	-0.04	-0.06	-0.01	0.01	-0.02	<b>-0.97</b>	0.02	-0.01	-0.01	0.00	0.00	0.00	0.04	-0.03	-0.01	0.02	-0.02	0.03	-0.01	-0.04
<i>Sugar</i>	0.10	0.06	0.02	-0.01	0.01	-0.01	<b>-1.05</b>	-0.02	0.02	0.03	-0.01	-0.03	-0.01	0.01	0.01	0.00	0.02	0.01	0.01	0.03
<i>Pulses, dry</i>	-0.07	-0.07	0.02	0.00	0.00	0.01	-0.05	<b>-0.91</b>	-0.03	0.04	-0.01	-0.05	-0.02	0.00	0.03	-0.03	-0.02	0.00	0.02	-0.14
<i>Nuts and Seeds</i>	0.08	-0.06	-0.02	-0.01	0.03	-0.02	0.02	-0.08	<b>-1.02</b>	0.00	-0.01	-0.01	0.02	0.00	0.03	0.00	0.02	-0.02	-0.02	0.00
<i>Vegetables</i>	0.02	0.02	0.00	-0.01	-0.02	0.00	0.01	-0.03	0.02	<b>-1.01</b>	0.00	-0.03	0.02	-0.01	-0.01	0.00	0.00	-0.01	-0.01	0.02
<i>Fruits</i>	-0.01	-0.04	0.03	0.00	0.02	0.02	0.10	0.04	-0.02	0.00	<b>-0.97</b>	0.03	0.01	-0.01	0.02	0.02	0.02	0.00	-0.04	0.07
<i>Meat, meat products</i>	0.05	-0.02	0.02	0.01	0.01	-0.01	-0.05	0.01	0.00	-0.01	0.00	<b>-0.96</b>	-0.01	0.00	-0.01	0.00	0.00	-0.01	0.04	-0.04
<i>Eggs</i>	0.07	-0.01	0.03	-0.01	-0.04	-0.04	0.09	0.16	-0.09	0.04	0.08	0.09	<b>-0.77</b>	0.03	0.01	0.04	0.01	-0.02	-0.20	0.21
<i>Fish and shellfish</i>	0.06	-0.06	0.00	0.00	0.00	-0.01	0.03	-0.02	0.01	0.02	-0.01	0.00	-0.03	<b>-0.98</b>	-0.01	-0.02	-0.02	0.00	-0.03	0.03
<i>Milk, dairy product</i>	-0.21	-0.28	0.01	0.01	0.00	0.02	0.09	-0.15	-0.05	-0.08	0.02	0.06	0.02	-0.02	<b>-0.95</b>	0.01	-0.03	0.01	-0.03	0.07
<i>Oils and Fats products</i>	0.09	0.10	0.02	-0.01	-0.01	-0.03	0.01	-0.03	0.00	-0.01	-0.01	-0.03	0.05	0.01	0.00	<b>-0.91</b>	0.03	-0.01	0.06	0.01
<i>Spices, other foods</i>	0.05	-0.11	0.03	0.00	0.03	-0.02	-0.06	0.00	-0.03	0.04	-0.01	-0.05	-0.03	-0.02	0.00	-0.07	<b>-0.89</b>	-0.02	0.01	-0.12
<i>Materials for drink</i>	0.14	-0.02	0.02	0.00	0.02	-0.02	-0.10	-0.02	-0.01	0.03	0.00	-0.02	0.01	-0.01	-0.01	0.02	0.03	<b>-1.00</b>	0.02	0.03
<i>Non-alcoholic drinks</i>	0.12	-0.07	-0.03	0.05	0.07	0.07	0.12	0.16	-0.01	0.01	0.04	0.10	0.06	0.01	0.00	0.06	-0.04	0.03	<b>-1.22</b>	0.32
<i>Alcoholic drinks</i>	-0.01	-0.12	-0.15	0.03	0.03	0.00	-0.03	0.01	-0.07	-0.19	0.05	0.13	0.00	0.09	-0.03	0.16	0.02	-0.08	0.00	<b>-0.83</b>

**Source:** Authors calculations using Tanzania Household Budget Survey, 2000/01.

**Note:** As for Table 4.

**Table A12b: Symmetry- constrained matrix of own- and cross price elasticities, Tanzania, 1991/92**

<i>Commodity Groups</i>	<i>Cereal grain</i>	<i>Cereal flour</i>	<i>Other cereal</i>	<i>Bread</i>	<i>Confectionery</i>	<i>Starch tubers</i>	<i>Sugar</i>	<i>Pulses, dry</i>	<i>Nut, Seeds</i>	<i>Vegetables</i>	<i>Fruits</i>	<i>Meat</i>	<i>Eggs</i>	<i>Fish</i>	<i>Milk</i>	<i>Oils, Fats</i>	<i>Spices, others</i>	<i>Material drink</i>	<i>Non-alcoholic</i>	<i>Alcoholic</i>
<i>Cereals, grain</i>	<b>-1.08</b>	-0.03	-0.01	0.01	-0.01	-0.02	0.04	-0.01	0.01	0.01	-0.01	0.00	-0.01	0.01	-0.01	0.00	0.01	0.00	0.02	0.00
<i>Cereals, flour</i>	-0.06	<b>-0.86</b>	0.01	-0.01	0.00	0.03	-0.02	-0.02	0.00	-0.01	0.00	0.00	-0.04	-0.02	-0.04	0.01	-0.02	0.01	0.02	-0.06
<i>Other cereals</i>	-0.11	0.14	<b>-1.29</b>	0.01	0.07	-0.05	0.08	0.06	-0.01	0.05	0.02	0.06	0.05	0.00	0.02	0.06	-0.01	-0.01	-0.02	0.00
<i>Bread</i>	0.07	-0.03	0.01	<b>-1.06</b>	0.04	0.03	-0.03	0.01	0.00	-0.03	0.00	0.05	0.01	-0.01	0.03	-0.02	0.01	-0.02	0.04	0.04
<i>Confectionery</i>	-0.07	-0.02	0.04	0.04	<b>-0.99</b>	-0.01	0.00	0.01	0.03	-0.03	0.00	0.04	-0.01	0.03	0.03	-0.02	0.03	0.03	0.03	0.01
<i>Starch, roots tubers</i>	-0.04	0.06	-0.01	0.01	0.00	<b>-0.97</b>	-0.01	0.01	-0.01	-0.01	0.00	0.01	0.01	-0.02	-0.01	-0.01	-0.01	0.01	0.00	-0.03
<i>Sugar</i>	0.10	-0.02	0.02	-0.01	0.00	-0.01	<b>-1.06</b>	-0.03	0.02	0.02	0.00	-0.03	-0.01	0.01	0.02	0.00	0.02	0.01	0.01	0.03
<i>Pulses, dry</i>	-0.05	-0.04	0.01	0.00	0.00	0.00	-0.03	<b>-0.93</b>	-0.03	0.03	-0.01	-0.04	-0.02	0.00	0.01	-0.03	-0.02	0.00	0.02	-0.11
<i>Nuts and Seeds</i>	0.08	0.03	0.00	0.00	0.03	-0.02	0.04	-0.05	<b>-1.03</b>	0.03	-0.01	0.01	0.00	0.01	-0.02	0.01	0.00	-0.01	0.00	-0.01
<i>Vegetables</i>	0.03	0.00	0.01	-0.01	-0.01	-0.01	0.02	0.03	0.01	<b>-1.01</b>	0.00	-0.02	0.01	-0.01	-0.02	-0.01	0.00	-0.01	0.00	0.00
<i>Fruits</i>	-0.06	0.03	0.01	0.00	0.00	0.00	-0.01	-0.01	-0.02	-0.02	<b>-0.96</b>	0.04	0.02	-0.02	0.03	-0.02	0.01	0.00	0.03	0.03
<i>Meat, meat products</i>	-0.03	0.00	0.01	0.01	0.01	0.00	-0.03	-0.02	0.00	-0.02	0.01	<b>-0.95</b>	0.00	0.00	0.00	-0.01	-0.01	-0.01	0.02	0.00
<i>Eggs</i>	-0.40	-0.83	0.10	0.03	-0.04	0.19	-0.12	-0.17	-0.01	0.08	0.06	0.05	<b>-0.77</b>	-0.14	0.06	0.28	-0.03	0.00	0.03	0.07
<i>Fish and shellfish</i>	0.02	0.00	0.00	0.00	0.01	-0.02	0.01	0.01	0.00	-0.01	0.00	0.02	-0.01	<b>-0.98</b>	-0.01	0.01	-0.01	0.00	-0.01	0.01
<i>Milk, dairy product</i>	-0.05	-0.18	0.01	0.02	0.02	-0.02	0.03	0.03	-0.02	-0.05	0.02	0.03	0.01	-0.03	<b>-0.96</b>	0.01	-0.02	0.01	0.01	0.01
<i>Oils and Fats products</i>	0.00	0.05	0.02	-0.01	-0.01	-0.02	0.01	-0.03	0.00	-0.01	-0.01	-0.02	0.04	0.01	0.01	<b>-0.90</b>	0.02	-0.01	0.04	0.03
<i>Spices, other foods</i>	0.08	-0.12	-0.01	0.01	0.04	-0.07	0.05	-0.07	0.00	0.01	0.01	-0.03	-0.01	-0.05	-0.04	0.04	<b>-0.89</b>	0.00	-0.03	-0.02
<i>Materials for drink</i>	0.01	0.18	-0.02	-0.04	0.08	0.11	0.07	0.03	-0.04	-0.05	0.00	-0.05	0.00	0.00	0.02	-0.03	0.00	<b>-1.00</b>	0.07	-0.05
<i>Non-alcoholic drinks</i>	0.19	0.13	-0.01	0.05	0.05	0.00	0.04	0.06	0.00	0.01	0.03	0.11	0.01	-0.03	0.02	0.10	-0.03	0.04	<b>-1.12</b>	0.17
<i>Alcoholic drinks</i>	-0.08	-0.64	0.00	0.07	0.02	-0.22	0.13	-0.59	-0.04	0.00	0.06	-0.02	0.04	0.06	0.02	0.13	-0.04	-0.05	0.25	<b>-0.94</b>

*Source:* Authors calculations using Tanzania Household Budget Survey, 2000/01.

*Note:* As for Table 4.