African Journal of Agricultural and Resource Economics Volume 9 Number 3 pages 183-199

Food consumption patterns and distributional welfare impact of import tariff reduction on cereals in Kenya

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Abstract

This study determines household food consumption patterns in Kenya using a QAIDS framework employing 2005/2006 household budget data. The results are used to evaluate the distributional welfare effects of import tariff reduction on three important staple cereals, namely maize, wheat and rice. The results indicate that food prices, income and demographic factors influence patterns of rural and urban household food demand. Furthermore, import tariff reduction has a progressive welfare effect on urban and upper-income rural households, but a regressive effect on lower-income rural households. The study recommends policies that will improve income generation and widen the tariff reduction bracket.

Key words: food consumption patterns, rising food prices, import tariffs, Kenya

1. Introduction

With food and nutrition insecurity concerns featuring in many policy agendas, it is imperative to understand the patterns of food consumption in rural and urban areas. There are certain differences between rural and urban households that drive the patterns of food consumption: urban households source more than 96% of their food from markets, compared to 75% for rural households; spend KSh 10 more than rural households on purchasing 1 000 Kcal; and spend KSh 28 per person per day more on their daily food consumption than rural households (KNBS 2008), despite their share of food to total-food and non-food expenditure being 36% compared to 58% for rural households (KNBS 2008). By 2009, slightly more than 32% of the Kenyan population was urbanised (KNBS 2009). Evidence suggests that improved nutrition is positively influenced by an increase in household income (Ecker *et al*. 2010), especially in developing countries. Muyanga *et al*. (2005) and Musyoka *et al*. (2010) highlighted the gradual switch from hard cereals to soft cereals occurring in the urban areas of Kenya. Several studies, including those by Bett *et al*. (2012), Musyoka *et al.* (2010), Nzuma and Sarker (2010) and Seale *et al*. (2003), have evaluated the relationship between food prices, household income and demographic factors, but without exploring the urban and rural differences in household patterns of food consumption.

The increase in food prices globally has filtered into domestic markets, thereby increasing domestic food prices and constraining households' food-purchasing capacity for net buyers, but increasing purchasing power for net sellers (Skoufias *et al*. 2011). The literature (Friedman & Levinsohn 2002; Dessus *et al*. 2008; Cudjoe *et al*. 2010; Ferreira *et al*. 2011; Alem 2012) posits that, due to their high dependency on markets for food, urban households were affected more by the food price increases from 2006 to 2008. While the developed countries engaged in price controls and targeted subsidies, many sub-Saharan African countries reduced taxes on food to mitigate the negative impact of the increase in food prices (Wodon & Zaman 2008) and, together with development partners, also scaled up social safety nets (Ackello-Ogutu 2010). Kenya reduced import tariffs for three main cereals, namely maize, wheat and rice. Cereals and cereal products contribute about 48% of the total dietary energy consumption in Kenya (KNBS 2008). The country is almost self-sufficient in maize production, producing at least 2.8 million MT annually against an annual consumption of about 3.1 million MT (MoA 2010). However, in terms of wheat and rice, domestic production levels are significantly lower than consumption, with wheat and rice production standing at 0.3 million MT and 0.047 million MT respectively, compared to consumption of 0.9 million MT and 0.3 million MT respectively (MoA 2010). Maize is widely consumed in Kenya and accounts for approximately one third of total food expenditure (Nzuma & Sarker 2010), while contributing as much as 70% of the total energy intake (Ariga *et al*. 2010; Kearney 2010). Whereas wheat and rice imports account for more than 60% of the total wheat and rice consumption, maize is imported in relatively small quantities, depending on domestic production shortfall, and usually accounts for 3.5% of the total national consumption (Ariga *et al.* 2010). Food imports are becoming increasingly important in staple food diets, as food consumption requirements are increasingly outstripping domestic food production (Ariga *et al.* 2010).

As already mentioned, previous studies have failed to explore the differences between rural and urban food consumption patterns, which constrain the simulation of policy impacts. This study provides robust and detailed evidence on how food consumption relates to food prices, household food expenditure, and demographic and regional factors, while also evaluating the welfare impact of reduced import tariffs on three important cereals in Kenya. The study at hand employed the Quadratic Almost Ideal Demand System (QAIDS) model of Banks *et al*. (1997), with the zero budget correction of Shonkwiler and Yen (1999).

The remainder of this paper is organised as follows: Section two expounds the empirical approach; section three describes the sources of the data and sampling; section four discusses the results; and section five concludes the study and provides some policy implications.

2. Empirical approach

In order to accommodate the non-linear feature of Engel's curves, the QAIDS model (Banks *et al.* 1997) was applied for the purposes of this study. The QAIDS demand function is expressed in budget-share form as follows:

$$w_i = \alpha_i + \sum_{j=1}^{n} \beta_{ij} ln\, p_{ij} + \frac{\gamma_{ij} \ln Y_i}{a(p)} + \frac{\lambda_i}{b(p)} \left\{ ln \left[\frac{Y_i}{a(p)} \right] \right\}^2 \quad (1)$$

where w_i is the food budget share of the i^{th} food item, p_i is the price of the i^{th} food item, and Y_i is the food budget outlay of the k^{th} household, while α_i, β_{ij}, γ_{ij} and λ_i are coefficients to be estimated from the full system of food demand equations. The price aggregators $a(p)$ and $b(p)$ are translog (TL) and Cobb Douglas (CD) function forms, that is:

$$lna(p) = \alpha_0 + \sum_{i=1}^{n} \alpha_i ln p_i + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \beta_{ij} lnp_i lnp_j \quad (2)$$

and

$$b(p) = \prod_{i=1}^{n} p_i^{\gamma_i} \quad (3)$$

While these price aggregators provide a non-linear estimation, it is also possible for QAIDS to be estimated in linear form (Lambert *et al*. 2006; Matsuda, 2006), and for the elasticities to be estimated on the basis of $a(p)$ to take a Paasche index corrected for invariance to measurement units (Moschini 1995), similar to Stone's price index, which linearly approximates the Translog price aggregators $a(p)$ and $b(p)$ to unity. The Cobb-Douglas price aggregator is assumed to be equal to one in this case, and although this transformation causes QAIDS not to be of full third rank, it makes it linear and easy to estimate.

Due to clustering of the 2005/2006 data released by the Kenya National Bureau of Statistics (KNBS 2008), the prices were adjusted for cluster and quality effects, as per Huang and Lin (2000) and Park *et al*. (1996), following a fixed-effects regression to demean the clusters' invariant aspects. Moreover, endogeneity in expenditures was corrected using the reduced-form food expenditure augmentation function of Blundell and Robin (1999), whereby the estimated expenditure is used as an instrument in the estimation of the system of demand equations. In addition, data selectivity bias was addressed using the approach taken by Shonkwiler and Yen (1999). Considering that the food budget share (w_i^*) representation equation is latent and is observable once a household makes a purchase, the system of demand equations in a two-step approach is modelled through limited dependent variables, as follows:

$$w_i = \begin{Bmatrix} (w_i^* + \varepsilon_i) \ iff \left(\rho_{ij}'\sigma_j + \mu_i > 0\right) \\ 0 \qquad\qquad otherwise \end{Bmatrix} \quad (4)$$

where ρ_{ij}' and σ_j are the food market participation decision variables, and the respective parameter vectors, ε_i and μ_i, are the random terms of the latent food share equation and the limited dependent decision equation. The random terms are expected to exhibit a bivariate normal distribution, with their covariance ($Cov(\varepsilon_i i \mu_i i')$)) as a diagonal matrix with *n* diagonal ∂_i elements that enter their respective food share equations as selectivity correction factors (Lambert *et al*. 2006). The decision equation is estimated as a probit, with a cumulative density function and a probability density being estimated from the probit parameters. If the cdf is specified as $\Phi\left(\rho_{ij}'\sigma_j\right)$ and the pdf as $\theta\left(\rho_{ij}'\sigma_j\right)$, then the estimable function of Equation 1 with the selectivity correction approach of Shonkwiler and Yen (1999) is represented as follows:

$$w_i = \Phi\left(\rho_{ij}'\sigma_j\right)_i \left\{\gamma_i' lnCT + \varphi_i' inT_i + \sum_j \Theta_j D_{ij} + w_i^*\right\} + \partial_i \theta\left(\rho_{ij}'\sigma_j\right) + \zeta_i \quad (5)$$

where $$w_i^* = \alpha_i + \sum_{j=1}^{n} \beta_{ij} ln p_{ij} + \frac{\gamma_{ij} \ln Y_i}{a(p)} + \frac{\lambda_i}{b(p)} \left\{ ln\left[\frac{Y_i}{a(p)}\right] \right\}^2$$

All the variables are as previously defined, while ζ_i is a heteroscedastic random term (Su & Yen, 2000; Yen *et al*. 2003), particularly due to scaling of the right-hand-side variables with the cumulative density function.

The overall estimation was done in a stepwise manner, with Equation 5 being estimated as imposing restrictions of demand theory. The demand restrictions of adding up, homogeneity and symmetry were imposed by setting the following:

$$\sum_i^n \alpha_i = 1, \sum_i^n \varphi_i = 0, \sum_i^n \gamma_i = 0, \sum_i^n \beta_{ij} = 0, \sum_i^n \lambda_i = 0, \sum_i^n \gamma_i' = 0, \sum_i^n \Theta_i = 0 \qquad (6)$$

$$\sum_j^n \beta_{ij} = 0 \quad \forall\, i = 1 \ldots\ldots\ldots n \qquad (7)$$

$$\beta_{ij} = \beta_{ji}\ \forall i,j\ \ i \neq j \qquad (8)$$

As highlighted in Drichoutis *et al*. (2008), Lambert *et al.* (2006) and Su and Yen (2000), the error covariance matrix is invertible, as there is no singularity and hence no need to drop one equation. The system of food demand was estimated through the Seemingly Unrelated Regression (SURE) method, using the Feasible Generalised Least Squares (FGLS) procedure, to correct for the heteroscedasticity of the error covariance matrix. It was presumed that the decision not to delete one equation in order to satisfy the adding-up constraint would be of little consequence, as found by Akbay *et al*. (2008). The simplified versions of expenditure and price elasticities from Equation 5 are, respectively:

$$e_i^{QAIDS} = \Phi\left(\rho_{ij}{}'\sigma_j\right)\left[\frac{\gamma_i}{w_i} + \frac{2\lambda_i}{w_i} ln\left[\frac{Y_i}{P^{\bullet}}\right]\right] + 1 \qquad (9)$$

and

$$e_{ij}^{QAIDS} = \Phi\left(\rho_{ij}{}'\sigma_j\right)\left\{\frac{\beta_{ij}}{w_i} - \left[\gamma_i - 2\lambda_i ln\left[\frac{Y_i}{P^{\bullet}}\right]\right]\frac{w_j}{w_i}\right\} - \delta_{ij} \qquad (10)$$

where $\delta_{ij} = 1\ \forall\ i = j, otherwise\ 0$. The compensated elasticities are recovered through the Slutsky equation.

Based on Friedman and Levinsohn (2002) and Porto (2003), amongst others, the study estimated the distributional welfare effects of import tariff reduction by assuming full transmission in the absence of estimates of price transmissions. The benefits of the tariff reduction are approximated as equivalent variation (EV), as described by Deaton (1989), Friedman and Levinsohn (2002) and Son and Kakwani (2009), with second-order effects due to substitution and the relationship between world and domestic prices considered as:

$$\Delta lnEV = \sum_i^n w_i \partial lnp_i + \frac{1}{2}\sum_i^n \sum_j^n w_i e_{ij}' \partial lnp_i \Delta lnp_j \qquad (11)$$

where e_{ij}' is the substitution elasticities estimated from the QAIDS food demand system.

3. Data sources and sampling

The study made use of the 2005/2006 Kenya Integrated Household Budget Survey (KNBS 2008). This survey is the only one of its kind and therefore the most recent – that is, no other household budget survey has ever been conducted in Kenya. As the last nationally representative survey conducted by the government of Kenya to measure poverty (World Bank 2013), it was conducted amongst 1 345 randomly selected clusters, comprising 861 rural and 482 urban clusters. A random sample of 10 households was selected from each cluster, giving a sample size of 13 450. Of the total sample, 13 215 observations were obtained from the Kenya National Bureau of Statistics (KNBS) for this analysis. Of the sample obtained, 719 (5.4%) were found to be insufficient in data. A total of 13 food groups (maize, wheat, rice, sorghum and millets, roots and tubers, pulses, vegetables, meat, oils and fats, dairy, fruits, sugar, and fish) were created from a total of 109 food items based on the assumption of separability and some nutritional commonalities. Since actual market prices were not collected, food-group unit values were imputed as a ratio of the group's expenditure and respective quantities. An operating presumption was that food consumption is governed by embedded institutional and behavioural patterns that change, but not within a short-term or medium-term period.

4. Estimation, results and discussion

4.1 Descriptive analysis

The significance of the differences in the allocated share of the food budget and the prices faced by rural households compared to urban households indicates differences in variation in food consumption patterns (Table 1).

With the exception of maize, rice, vegetables and sugar, food prices differ significantly between urban and rural areas. These significant differences point to differences in patterns of food consumption between rural and urban areas. An in-depth quintile analysis reveals that a 100% increase in the food price would trigger a 71% drop in the welfare of the lowest (10^{th}) income quintile of rural households, and a 55% drop in the welfare of the highest income households.

For urban households, a similar change in terms of a food price increase would trigger a decline of 62% and 32% respectively in the living standards of the lowest and highest income categories. In rural areas, the share allocation for maize increases from 19% for the lowest income category, peaking in the second and third quintiles, and declining monotonically to the highest income quintile. On the other hand, the share allocation for maize declines monotonically from 29% in the lowest income quintile to 6% in the highest income quintile. Where there is an increase in household income, households in both rural and urban areas allocate more towards the consumption of wheat and meat, and less towards maize and sugar.

Table 1: Mean household food expenditure shares and food prices in Kenya, 2005/2006

Ln of prices (KShs/kg)	Overall	Rural	Urban
Maize	2.80	2.80	2.80
Wheat	3.62	3.62	3.61[c]
Rice	3.53	3.53	3.53
SM	2.59	2.61	2.55[c]
RT	1.72	1.71	1.73[b]
Legumes	3.50	3.52	3.46[a]
Vegetables	3.49	3.50	3.48
Meat	4.32	4.32	4.31[a]
OF	5.38	5.38	5.39[b]
Dairy	3.61	3.61	3.61[b]
Fruits	2.55	2.55	2.54[a]
Sugar	4.96	4.95	4.98
Fish	2.93	2.98	2.85[a]
Ln. Food Exp (ad.eq)	3.96	3.64	4.57[a]
Demographic characteristics			
Household size	5.1	5.5	4.1
Household size (AE)	3.4	3.6	3.0
*m (0_5)	1.7	1.6	1.7
*m (6_11)	9.3	9.9	7.9
*m (12_17)	8.6	9.2	7.3
*m (18_65)	24.4	23.0	27.9
*m (_65)	1.8	2.1	1.0
*f (0_5)	8.1	8.4	7.5
*f (6_11)	9.4	9.7	8.6
*f (12_17)	8.7	9.2	7.7
*f (18_65)	26.1	24.7	29.4
*f (_65)	1.8	2.2	1.0

[c] $p < 0.1$, [b] $p < 0.05$, [a] $p < 0.01$ means are significantly different between urban and rural households. AE (adult equivalent), *m – males, *f – females, percentage of total household size, (age group), SM – sorghum and millets, RT – roots and tubers, OF – oils and fats, N = (12 496), n-rural (8 170), n-urban (4 326)
Source: Authors' estimation

4.2 Econometric results

Equation 5 was estimated using the SURE method through the FGLS procedure, imposing and maintaining all the theoretical restrictions (6, 7 and 8). A simple log-likelihood ratio test constructed as LL=$-2ln[LL^P - (LL^R + LL^U)]$, where P is the pooled sample, R is the rural sample and U is the urban sample, rejected the null hypothesis of similarity in the consumption patterns of urban and rural households. A log-likelihood test favoured the Quadratic Almost Ideal Demand System (QAIDS) model over the Almost Ideal Demand System (AIDS) model, as shown in Table 2. (The FGLS coefficient estimates are available upon request.) The sum of the price effects was zero to conform to homogeneity restrictions. The coefficients of the probability density functions, from the selectivity correction through the approach of Shonkwiler and Yen (1999) and the residual from the endogenous auxiliary function are significant, implying the importance of these corrections in food demand analysis.

Table 2: Log-likelihood ratio tests for AIDS nested in QAIDS

	Chi square (13)	p-values
Overall	63.64**	0.000
Rural	101.79**	0.000
Urban	86.75**	0.000

** $p < 0.01$, * $p < 0.05$, ** significance in favour of QAIDS against AIDS, 13 degrees of freedom is equal to the number of equations in the system
Source: Authors' estimation

4.3 Urban and rural food price elasticities in Kenya

All the own price elasticities are negative and larger in magnitude than the elasticities of alternative food items (Tables 3 to 8). The last columns of Table 3 and Table 5 show the expenditure elasticities. Similarly, the uncompensated elasticities are larger in magnitude than the compensated elasticities. Standard errors and p-values for the elasticities were calculated using the delta method. The rural food price elasticities range from -1.024 for sorghum and millets to -0.587 for roots and tubers. The study revealed that differences in food prices proportionately affect the quantities consumed of legumes (1.00), dairy (1.01) and sorghum and millets (1.02). The remaining food items show own price elasticities less than one in absolute terms, indicating that a unit price change would result in less than a proportionate decline in the quantities consumed. For instance, as shown in Table 4, a 1% increase in the price of maize, wheat and rice would result in a decline of 0.79%, 0.88 % and 0.84 % respectively in the quantities of these food items consumed. Similarly, a 1% increase in price would result in a 0.92% decrease in the quantity of meat consumed. Food price elasticities for the urban segment range from -1.058 for sorghum and millets to -0.770 for legumes. In addition, differences in own food prices have a stronger effect (price elastic) on four of the thirteen food items, including sorghum and millets (-1.06), dairy (-1.01), fruits (-1.05) and sugar (-1.01). All other food items were found to be price inelastic. For instance, Table 6 (column 4) shows how a 1% increase in the price of rice would result in a 0.84% decrease in the quantity consumed.

The results also reveal remarkable differences and similarities in terms of uncompensated food price elasticities between the two segments. The patterns of household consumption of sorghum and millets and dairy do not differ between the urban and rural segments. Sorghum and millets and dairy exhibit price elasticity that is unitary or slightly above unitary across the two segments (sorghum and millets at 1.06 for urban households and 1.02 for rural households, and dairy at 1.01 for urban households and 1.01 for rural households). The elastic behaviour of sorghum and millets is unexpected. Moreover, the inelastic household consumption pattern for rice does not vary between urban and rural areas, which implies that the household consumption of sorghum and millets, dairy and rice in both rural and urban areas would respond in similar magnitudes to changes in the respective prices. The compensated and uncompensated elasticities for sorghum and millets are almost similar, implying that households are unlikely to allocate more income towards the consumption of these items, despite the high price responsiveness. A larger number of food groups in urban areas exhibit larger magnitudes in own price responses when compared to those in rural areas, implying that urban households are more responsive to prices than rural households. For instance, in the case of fruits and sugar, the price responses in urban areas are higher (elastic) than those in rural areas (inelastic), implying that, in the event of a price decrease, consumption would increase at a faster rate in rural areas than in urban areas. A similar trend is observed for wheat, roots and tubers and maize, but not for legumes, which are a cheap alternative to meat as a protein source. The high responsiveness to prices in urban areas is ascribed to the fact that, with more than 96% of urban households' consumption being sourced from the market, these households are largely dependent on the market, while rural households source approximately 23% of their consumption from their own farm production.

The substitution elasticities reflected in Table 5 and Table 7 show that, with the exception of sorghum and millets with their elastic substitution elasticities, all the substitution elasticities are, as expected, inelastic, negative and smaller in magnitude compared to their uncompensated counterparts. Also, as theoretically expected, all the own price elasticities are negative, with respective Eigen values less than or equal to zero, confirming the concavity of the indirect utility function at the mean of the samples. The estimated substitution elasticities range between -1.018 for sorghum and millets and -0.541 for roots and tubers in the rural areas, and between -1.051 for sorghum and millets and -0.702 for maize in the urban areas. Whereas vegetables and meat reveal the largest net substitution effect for urban households, maize and sorghum and millets, and maize and roots and tubers, reveal the largest net substitution and net complementary relationship for rural households respectively.

Table 3: Uncompensated elasticities of food demand for rural households

	Maize	Wheat	Rice	SM	RT	Legumes	Veg	Meat	OF	Dairy	Fruits	Sugar	Fish	Expenditure
Maize	**-0.785****	0.010	-0.014*	0.007**	-0.042**	-0.001	-0.062**	-0.003	0.015	0.013	-0.014**	-0.042**	-0.019**	0.936**
	(0.000)	(0.248)	(0.017)	(0.006)	(0.000)	(0.889)	(0.000)	(0.640)	(0.089)	(0.089)	(0.004)	(0.000)	(0.000)	(0.000)
Wheat	0.008	**-0.882****	-0.001	-0.008	-0.016	0.020	-0.029	-0.006	-0.060**	-0.024*	0.003	-0.044**	-0.001	1.041**
	(0.741)	(0.000)	(0.921)	(0.059)	(0.096)	(0.070)	(0.120)	(0.511)	(0.000)	(0.039)	(0.662)	(0.000)	(0.843)	(0.000)
Rice	-0.064*	0.008	**-0.840****	0.010	0.019	0.016	0.021	0.000	-0.054**	0.011	0.004	-0.020	-0.019*	0.907**
	(0.022)	(0.567)	(0.000)	(0.065)	(0.096)	(0.223)	(0.334)	(0.991)	(0.000)	(0.429)	(0.635)	(0.173)	(0.034)	(0.000)
SM	0.264**	-0.031	0.077*	**-1.024****	0.202**	0.039	0.014	0.087**	-0.095**	0.015	0.079**	-0.072*	0.005	0.429**
	(0.000)	(0.437)	(0.012)	(0.000)	(0.000)	(0.247)	(0.780)	(0.002)	(0.003)	(0.661)	(0.001)	(0.020)	(0.823)	(0.000)
RT	-0.279**	-0.040*	0.012	0.037**	**-0.587****	0.017	-0.166**	-0.014	-0.046*	0.009	0.000	-0.055**	-0.048**	1.161**
	(0.000)	(0.044)	(0.423)	(0.000)	(0.000)	(0.330)	(0.000)	(0.350)	(0.021)	(0.653)	(0.985)	(0.003)	(0.000)	(0.000)
Legumes	0.018	0.040**	0.018	0.003	0.024*	**-1.007****	0.037	-0.015	0.019	0.022	0.012	0.035*	-0.005	0.796**
	(0.461)	(0.002)	(0.070)	(0.481)	(0.019)	(0.000)	(0.087)	(0.180)	(0.196)	(0.099)	(0.091)	(0.020)	(0.537)	(0.000)
Veg	-0.019*	0.004	0.009**	0.001	-0.011**	0.012**	**-0.967****	0.019**	0.043**	0.021**	0.000	0.021**	0.011**	0.854**
	(0.038)	(0.321)	(0.005)	(0.571)	(0.001)	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)	(0.957)	(0.004)	(0.000)	(0.000)
Meat	-0.026	-0.004	-0.006	0.004	-0.001	-0.028**	0.030	**-0.924****	-0.057**	-0.012	0.015**	0.009	-0.017**	1.017**
	(0.169)	(0.678)	(0.417)	(0.149)	(0.879)	(0.002)	(0.098)	(0.000)	(0.000)	(0.208)	(0.003)	(0.439)	(0.002)	(0.000)
OF	0.061**	-0.007	-0.003	-0.003*	0.004	0.019**	0.093**	-0.002	**-0.957****	0.012*	-0.007*	0.055**	0.014**	0.718**
	(0.000)	(0.246)	(0.438)	(0.041)	(0.416)	(0.001)	(0.000)	(0.719)	(0.000)	(0.049)	(0.028)	(0.000)	(0.000)	(0.000)
Dairy	0.041*	-0.011	0.008	-0.001	0.014	0.013	0.054**	0.000	-0.011	**-1.010****	0.002	0.008	0.009	0.884**
	(0.038)	(0.293)	(0.309)	(0.716)	(0.097)	(0.226)	(0.002)	(0.960)	(0.334)	(0.000)	(0.715)	(0.457)	(0.154)	(0.000)
Fruits	-0.144**	0.005	-0.003	0.019*	0.002	0.009	-0.061*	0.037*	-0.101**	-0.012	**-0.736****	-0.093**	-0.028*	1.108**
	(0.000)	(0.817)	(0.857)	(0.014)	(0.917)	(0.610)	(0.044)	(0.014)	(0.000)	(0.546)	(0.000)	(0.000)	(0.018)	(0.000)
Sugar	0.000	0.003	0.002	-0.001*	0.003*	0.007**	0.009*	0.010**	0.010**	0.006**	0.000	**-0.946****	0.002*	0.894**
	(0.921)	(0.150)	(0.063)	(0.043)	(0.038)	(0.000)	(0.032)	(0.000)	(0.001)	(0.001)	(0.815)	(0.000)	(0.011)	(0.000)
Fish	-0.185**	0.003	-0.043*	-0.004	-0.068**	-0.028	0.102*	-0.050**	0.043*	0.023	-0.027	-0.014	**-0.694****	0.941**
	(0.000)	(0.898)	(0.028)	(0.682)	(0.001)	(0.214)	(0.011)	(0.009)	(0.041)	(0.304)	(0.052)	(0.502)	(0.000)	(0.000)

** $p < 0.01$, * $p < 0.05$ (p-values in parenthesis), SM – sorghum and millets, RT – roots and tubers, OF – oils and fats

Table 4: Compensated elasticities of food demand for rural households

	Maize	**Wheat**	**Rice**	**SM**	**RT**	**Legumes**	**Veg**	**Meat**	**OF**	**Dairy**	**Fruits**	**Sugar**	**Fish**
Maize	-0.626**	0.168**	0.144**	0.166**	0.117**	0.158**	0.097**	0.156**	0.174**	0.172**	0.145**	0.117**	0.140**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Wheat	0.078**	-0.812**	0.069**	0.062**	0.054**	0.090**	0.041*	0.064**	0.009	0.046**	0.073**	0.026*	0.068**
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.023)	(0.000)	(0.476)	(0.000)	(0.000)	(0.033)	(0.000)
Rice	-0.018	0.053**	-0.795**	0.055**	0.065**	0.062**	0.067**	0.045**	-0.009	0.056**	0.049**	0.025	0.026**
	(0.503)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)	(0.540)	(0.000)	(0.000)	(0.088)	(0.004)
SM	0.270**	-0.025	0.083**	-1.018**	0.208**	0.044	0.020	0.093**	-0.089**	0.021	0.085**	-0.066*	0.011
	(0.000)	(0.524)	(0.007)	(0.000)	(0.000)	(0.184)	(0.697)	(0.001)	(0.004)	(0.550)	(0.000)	(0.032)	(0.652)
RT	-0.234**	0.006	0.057**	0.082**	-0.541**	0.063**	-0.120**	0.032*	0.000	0.054**	0.045**	-0.009	-0.002
	(0.000)	(0.758)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.031)	(0.991)	(0.004)	(0.000)	(0.613)	(0.857)
Legumes	0.069**	0.091**	0.069**	0.054**	0.075**	-0.956**	0.088**	0.036**	0.070**	0.073**	0.063**	0.086**	0.046**
	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Veg	0.075**	0.099**	0.104**	0.095**	0.084**	0.107**	-0.872**	0.114**	0.137**	0.116**	0.095**	0.116**	0.106**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Meat	0.056**	0.078**	0.077**	0.086**	0.081**	0.054**	0.112**	-0.841**	0.025*	0.070**	0.098**	0.092**	0.065**
	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.028)	(0.000)	(0.000)	(0.000)	(0.000)
OF	0.118**	0.050**	0.054**	0.054**	0.061**	0.076**	0.151**	0.055**	-0.900**	0.069**	0.050**	0.113**	0.071**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Dairy	0.108**	0.057**	0.076**	0.067**	0.082**	0.080**	0.121**	0.067**	0.057**	-0.942**	0.070**	0.076**	0.076**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Fruits	-0.114**	0.035	0.027	0.049**	0.032	0.039*	-0.031	0.067**	-0.071**	0.018	-0.706**	-0.063**	0.002
	(0.005)	(0.078)	(0.073)	(0.000)	(0.059)	(0.028)	(0.298)	(0.000)	(0.000)	(0.331)	(0.000)	(0.001)	(0.874)
Sugar	0.159**	0.162**	0.161**	0.158**	0.162**	0.166**	0.168**	0.169**	0.169**	0.165**	0.159**	-0.787**	0.161**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Fish	-0.156**	0.033	-0.014	0.026**	-0.039*	0.002	0.131**	-0.021	0.073**	0.052*	0.003	0.015	-0.665**
	(0.001)	(0.200)	(0.475)	(0.004)	(0.048)	(0.942)	(0.001)	(0.270)	(0.001)	(0.019)	(0.845)	(0.493)	(0.000)

** $p < 0.01$, * $p < 0.05$ (p-values in parenthesis), SM – sorghum and millets, RT – roots and tubers, OF – oils and fats

Table 5: Uncompensated elasticities of food demand for urban households

	Maize	Wheat	Rice	SM	RT	Legumes	Veg	Meat	OF	Dairy	Fruits	Sugar	Fish	Expenditure
Maize	-0.794**	-0.002	0.013	0.002	-0.038**	0.006	-0.021	-0.085**	0.021*	-0.016	0.054**	0.003	0.008	0.850**
	(0.000)	(0.949)	(0.264)	(0.357)	(0.001)	(0.474)	(0.227)	(0.000)	(0.017)	(0.376)	(0.001)	(0.715)	(0.216)	(0.000)
Wheat	-0.031	-0.997**	-0.012	0.001	0.003	-0.022**	-0.045**	-0.044**	-0.028**	-0.033*	0.023	0.042**	-0.009*	1.154**
	(0.198)	(0.000)	(0.157)	(0.669)	(0.791)	(0.002)	(0.006)	(0.002)	(0.001)	(0.014)	(0.064)	(0.000)	(0.031)	(0.000)
Rice	0.030	-0.011	-0.836**	-0.004	0.101**	0.000	-0.031	-0.095**	-0.036*	0.049	-0.046	0.007	-0.038**	0.908**
	(0.504)	(0.792)	(0.000)	(0.323)	(0.000)	(0.983)	(0.339)	(0.000)	(0.016)	(0.091)	(0.078)	(0.582)	(0.000)	(0.000)
SM	0.052	0.136	-0.050	-1.058**	0.089*	-0.019	0.067	0.029	-0.001	-0.029	-0.028	0.000	0.005	0.810**
	(0.633)	(0.077)	(0.310)	(0.000)	(0.029)	(0.546)	(0.163)	(0.478)	(0.966)	(0.494)	(0.476)	(0.983)	(0.773)	(0.000)
RT	-0.111**	0.039	0.070**	0.005*	-0.918**	-0.033**	-0.022	0.035**	0.007	0.005	0.000	-0.011	-0.002	0.935**
	(0.001)	(0.225)	(0.000)	(0.027)	(0.000)	(0.002)	(0.370)	(0.044)	(0.516)	(0.787)	(0.984)	(0.299)	(0.793)	(0.000)
Legumes	-0.012	-0.099*	-0.009	-0.003	-0.072**	-0.770**	0.047	-0.034	-0.038*	-0.002	0.028	-0.134**	0.005	1.095**
	(0.770)	(0.017)	(0.650)	(0.260)	(0.000)	(0.000)	(0.107)	(0.228)	(0.018)	(0.950)	(0.229)	(0.000)	(0.595)	(0.000)
Veg	0.004	0.005	0.003*	0.001**	0.003	0.006**	-0.992**	0.026**	0.005**	0.021**	0.001	0.009**	0.003**	0.904**
	(0.251)	(0.115)	(0.029)	(0.000)	(0.057)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.552)	(0.000)	(0.000)	(0.000)
Meat	-0.133**	-0.053**	-0.041**	-0.002*	0.000	-0.014*	0.060**	-0.972**	-0.006	0.010	-0.031**	-0.024**	-0.010**	1.215**
	(0.000)	(0.005)	(0.000)	(0.043)	(0.988)	(0.023)	(0.000)	(0.000)	(0.453)	(0.566)	(0.004)	(0.001)	(0.005)	(0.000)
OF	0.047	-0.071*	-0.032*	0.000	0.008	-0.019	0.006	0.025	-0.919**	0.012	0.018	-0.008	-0.009	0.942**
	(0.100)	(0.025)	(0.014)	(0.913)	(0.580)	(0.067)	(0.769)	(0.277)	(0.000)	(0.611)	(0.328)	(0.386)	(0.139)	(0.000)
Dairy	-0.018*	-0.008	0.004	-0.001	-0.001	0.000	0.019*	0.015*	0.000	-1.012**	-0.005	-0.006	-0.001	1.014**
	(0.029)	(0.281)	(0.286)	(0.117)	(0.665)	(0.884)	(0.033)	(0.033)	(0.943)	(0.000)	(0.241)	(0.090)	(0.555)	(0.000)
Fruits	0.087**	0.079**	-0.018	0.000	0.003	0.017*	-0.036	-0.014	0.013	-0.002	-1.045**	0.021*	0.005	0.889**
	(0.002)	(0.003)	(0.128)	(0.771)	(0.804)	(0.041)	(0.112)	(0.424)	(0.172)	(0.918)	(0.000)	(0.028)	(0.309)	(0.000)
Sugar	0.004	0.128**	0.009	0.001	-0.001	-0.036**	0.037*	0.014	0.003	0.006	0.024*	-1.007**	-0.002	0.820**
	(0.765)	(0.000)	(0.113)	(0.144)	(0.839)	(0.000)	(0.018)	(0.261)	(0.507)	(0.663)	(0.013)	(0.000)	(0.565)	(0.000)
Fish	0.028	-0.045	-0.109**	0.000	-0.014	0.017	0.011	-0.025	-0.033	-0.008	0.010	-0.045**	-0.771**	0.984**
	(0.661)	(0.383)	(0.000)	(0.958)	(0.581)	(0.353)	(0.786)	(0.436)	(0.075)	(0.814)	(0.739)	(0.007)	(0.000)	(0.000)

** $p < 0.01$, * $p < 0.05$ (p-values in parenthesis), SM – sorghum and millets, RT – roots and tubers, OF – oils and fats

Table 6: Compensated elasticities of food demand for urban households

	Maize	**Wheat**	**Rice**	**SM**	**RT**	**Legumes**	**Veg**	**Meat**	**OF**	**Dairy**	**Fruits**	**Sugar**	**Fish**
Maize	-0.702**	0.090**	0.105**	0.094**	0.054**	0.098**	0.070**	0.006	0.112**	0.076**	0.146**	0.095**	0.099**
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.768)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Wheat	0.090**	-0.877**	0.108**	0.121**	0.123**	0.099**	0.076**	0.077**	0.092**	0.088**	0.143**	0.162**	0.112**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Rice	0.076	0.036	-0.789**	0.043**	0.148**	0.047**	0.016	-0.049*	0.010	0.096**	0.001	0.053**	0.008
	(0.084)	(0.376)	(0.000)	(0.000)	(0.000)	(0.004)	(0.614)	(0.049)	(0.506)	(0.001)	(0.984)	(0.000)	(0.381)
SM	0.059	0.143	-0.043	-1.051**	0.096*	-0.012	0.074	0.036	0.006	-0.022	-0.021	0.007	0.012
	(0.587)	(0.063)	(0.383)	(0.000)	(0.018)	(0.704)	(0.123)	(0.379)	(0.847)	(0.603)	(0.591)	(0.751)	(0.472)
RT	-0.064*	0.085**	0.116**	0.051**	-0.872**	0.013	0.025	0.081**	0.054**	0.051	0.047*	0.036**	0.045**
	(0.040)	(0.006)	(0.000)	(0.000)	(0.000)	(0.228)	(0.293)	(0.000)	(0.000)	(0.005)	(0.010)	(0.000)	(0.000)
Legumes	0.034	-0.053	0.037	0.043**	-0.026	-0.724**	0.093**	0.013	0.009	0.044	0.074**	-0.088**	0.051**
	(0.411)	(0.195)	(0.075)	(0.000)	(0.199)	(0.000)	(0.001)	(0.648)	(0.588)	(0.156)	(0.001)	(0.000)	(0.000)
Veg	0.125**	0.127**	0.125**	0.123**	0.125**	0.128**	-0.870**	0.148**	0.127**	0.143**	0.123**	0.131**	0.125**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Meat	0.025	0.105**	0.117**	0.156**	0.158**	0.144**	0.218**	-0.815**	0.152**	0.167**	0.126**	0.134**	0.148**
	(0.280)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
OF	0.097**	-0.021	0.019	0.050**	0.058**	0.032**	0.057**	0.076**	-0.868**	0.062**	0.068**	0.043**	0.041**
	(0.001)	(0.504)	(0.144)	(0.000)	(0.000)	(0.002)	(0.010)	(0.001)	(0.000)	(0.006)	(0.000)	(0.000)	(0.000)
Dairy	0.121**	0.132**	0.143**	0.139**	0.138**	0.140**	0.158**	0.155**	0.139**	-0.872**	0.134**	0.133**	0.139**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Fruits	0.145**	0.137**	0.040**	0.057**	0.061**	0.074**	0.021	0.043*	0.071**	0.056**	-0.987**	0.079**	0.063**
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.349)	(0.012)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Sugar	0.071**	0.194**	0.075**	0.068**	0.065**	0.031**	0.104**	0.080**	0.070**	0.073**	0.090**	-0.941**	0.065**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Fish	0.060	-0.012	-0.076**	0.032**	0.018	0.049**	0.044	0.008	-0.001	0.025	0.043	-0.013	-0.738**
	(0.332)	(0.813)	(0.002)	(0.000)	(0.472)	(0.005)	(0.284)	(0.804)	(0.974)	(0.472)	(0.151)	(0.464)	(0.000)

** $p < 0.01$, * $p < 0.05$ (p-values in parenthesis), SM – sorghum and millets, RT – roots and tubers, OF – oils and fats
Source: Authors' estimation

4.4 Rural and urban food expenditure elasticities

The estimated expenditure elasticities are significant at the 1% level. An increase in the urban household income variation has a more significant effect on the consumption of wheat (1.15), legumes (1.10), meat (1.22) and dairy (1.01), whereas in the rural segment, differences in rural household income have a more than proportionate effect on the consumption of wheat (1.04), roots and tubers (1.16) and meat (1.02). As the economy grows, urban households will consume more wheat than rural households, with the opposite being true for maize. Such an increase in wheat consumption could perhaps be driven by the relatively high proportion of the population aged between 18 and 65 years of age, who require more energy for work. According to KNBS (2008), the minimum dietary energy requirement is usually higher in urban areas (1 733 Kcal/p/d) than in rural areas (1,670 Kcal/p/d). The aforementioned increase in wheat consumption supports the descriptive analysis that urban households will increase their consumption of wheat as their income increases, and also supports the conventional notion of an urban consumption shift towards soft cereals, driven by preferences for soft starch sources such as wheat. Similarly, the consumption of dairy and legumes will increase more than proportionately in the urban segment as household income grows, compared to the rural segment. The fact that household size tends to be larger in rural areas than in urban areas is likely to deter rural households from substituting their food items with better nutrient sources such as wheat and milk. The failure to upgrade to better nutrient sources is likely to perpetuate the tendency towards higher levels of nutrition deficiencies in rural areas. In urban areas, however, such an improvement in nutrition could result in the incidence of obesity. The similarity in the magnitude of expenditure elasticities for rice reveals that variations in food expenditure patterns in both rural and urban areas have an equal influence on the patterns of rice consumption.

A comparison of the expenditure and own price elasticities reveals that, within the rural segment, seven of the 13 food items in question displayed expenditure elasticities larger in magnitude than the own price counterparts, while within the urban segment the same was true for nine of the 13 food items. This points to the effectiveness of income-/expenditure-related policies compared to price-related policies. Moreover, only four food items (maize, roots and tubers, fruits and sugar) showed greater expenditure elasticities in the rural segment than in the urban segment, indicating that policies related to household food expenditure would be applied more effectively in urban areas than in rural areas.

4.5 Consumption and distributional welfare impact of import tariff reduction on cereals (maize, wheat and rice)

A reduction in the import tariff is transmitted to domestic prices as a decline in those prices, triggering increased consumption through complementary relationships with other food items. The real income that is gained results in the increased consumption of those complementary and relatively cheaper food items. Using the substitution relationships, and applying the uncompensated elasticities, a 25% drop in the price of maize would result in a 3.32% increase in the quantity of meat consumed by urban households, while the same price increase in wheat and rice would result in a 1.32% and 1.02% increase in meat consumption respectively. Similarly, in the rural areas, a price reduction of 25% for maize would translate into a 0.66% increase in the consumption of meat, while in the case of wheat it would increase meat consumption by 0.10% and in the case of rice it would increase meat consumption by 0.14%. This implies that not only would the reduction of import tariffs lead to an increase in the consumption of these particular cereals, but it would also result in the increased consumption of meat in both the rural and urban segments. Consequently, an increase in meat consumption would improve nutrition in households overall, but more proportionally in urban households. On a similar note, the reduction of import tariffs would also result in the increased consumption of fish as an alternative source of protein, as well as fruits and vegetables as excellent sources of vitamins.

The distributional effects were estimated using Equation 11. The distribution of welfare gains for the rural households increased from the lowest-income households, peaking within the fourth quintile, before declining gradually with an increase in household income (Figure 1). On the other hand, the urban household welfare gain exhibited a negative function of household income. Whereas the distribution of benefits to rural households implies that middle-income rural households would benefit more from a reduction in import tariffs than households at other points on the rural income continuum, poor urban households would benefit the most. The benefits to urban households decreased monotonically with an increase in household income. The trends in benefits derived from a reduction in import tariffs depict the maize share trend over income quintiles. The allocation to maize consumption is always substantial at the national level, outweighing all other food items, as it contributes more than 65% towards an individual's daily energy requirements (Ariga *et al*. 2010).

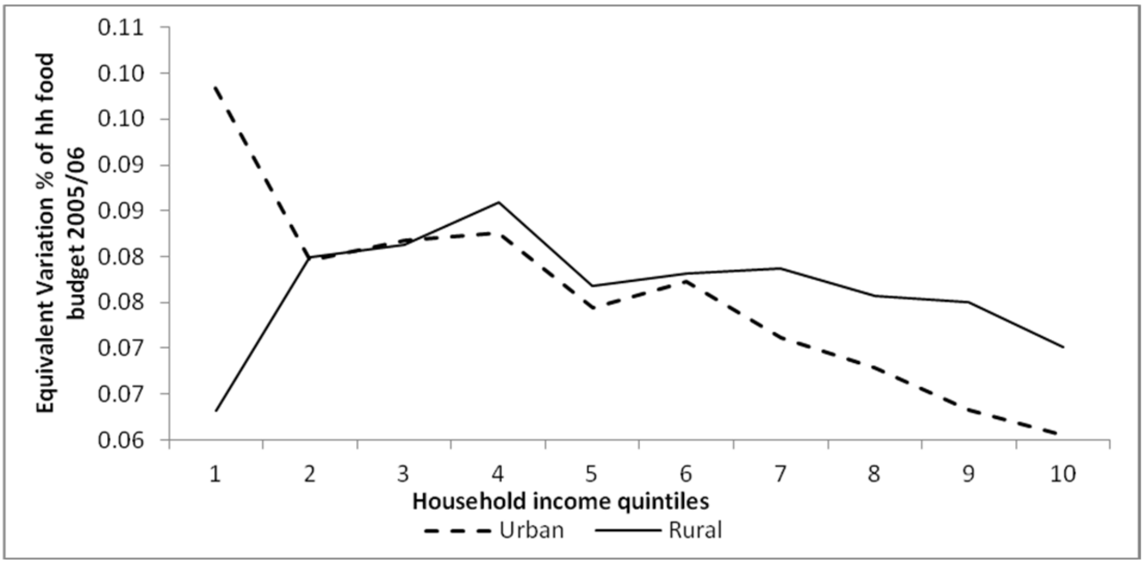

Figure 1: Benefits from the reduction of import tariffs on imported cereals (maize, wheat and rice) in Kenya

hh = household
Source: Authors' computation

5. Conclusions and policy implications

The overriding objective of this study was to determine the food consumption patterns and distributional welfare impact of the reduction of import tariffs on cereals, including maize, wheat and rice, undertaken as a measure to mitigate the impact of rising food prices in Kenya. The study employed a QAIDS model using data from the 2005/2006 household budget survey conducted in Kenya (KNBS 2008). The study established that households in both urban and rural areas would increase their consumption of wheat by 1.15 (1.04%) and meat by 1.22 (1.02%) if household food expenditure were to increase by 1%. In addition, urban households would show a more proportionate increase in their consumption of dairy (1.01) and legumes (1.10) if household food expenditure were to increase by 1%, while rural households would show a more proportionate increase in their consumption of roots and tubers (1.16) and fruits (1.11). Moreover, expenditure elasticities were found to be greater in absolute magnitude than the own price elasticities in both urban and rural areas, and greater in magnitude in urban areas compared to rural areas.

Food items were found to be more responsive to own prices than to the prices of other items. In the rural segment, consumers were found to be more responsive to the prices of sorghum and millets, legumes and dairy, while in the urban segment consumers were found to be more responsive to the prices of sorghum and millets, dairy, fruits and sugar. Most of the food items were found to be price inelastic. Variations in food prices were found to have a greater impact on the consumption of legumes by rural households, while the same was found to apply to fruits and sugar in urban households. In comparing the rural and urban segments, household patterns of food consumption were not found to exhibit any remarkable differences in the case of sorghum and millets, rice and dairy. Overall, however, urban households were found to be more responsive to food prices than rural households.

The results revealed that a reduction in import tariffs is progressive for urban households, benefiting poor urban households more than non-poor households. However, in the case of the rural segment, middle-income households were shown to benefit more than poor and non-poor households. Moreover, the urban poor were shown to benefit more than the rural poor, perhaps due to higher levels of market participation. Reducing the import tariffs on maize, wheat and rice would not only result in the increased consumption of these cereals, but would also lead to the increased consumption of meat and fish as sources of protein, as well as fruits and vegetables as sources of vitamins, in both the rural and urban segments. The consequence of this would be a progressive improvement in overall nutrition in urban households, but with a retrogressive effect on the rural poor.

These results imply several important points amenable to policy. Since expenditure elasticities are greater in absolute magnitude than the own price elasticities in both urban and rural areas, it is possible that a process of increasing household income and thus food expenditure through income transfer and the creation of on-farm and off-farm employment would do more to improve household food access than would food price policies. Moreover, variations in household income are more effective in changing the patterns of food consumption in urban areas than in rural areas, and thus could be invoked to guide food and nutrition policy. As such, price-related interventions would be more effective in urban areas compared to rural areas, and therefore could be used to improve the nutritional status in urban areas where micronutrient deficiencies have historically been problematic. The reduction of import tariffs translates directly into lower food prices, thus serving to improve the overall nutrition of households, especially in urban areas. However, this process must be accompanied by the targeted redistribution of equitable benefits to the rural poor, who inevitably would stand to gain fewer direct benefits from the reduction of import tariffs.

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