WHO ARE THE REAL GAINERS OF TRADE LIBERALIZATION IN KENYA'S MAIZE SECTOR?

By

Nzuma, Jonathan M. and Sarker, Rakhal

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Jonathan M. Nzuma*

Department of Agricultural Economics,

University of Nairobi,

P.O. Box 29053-00625,

Nairobi, Kenya.

Tel: 254-722-686063

jonathan_nzuma@yahoo.com

&

Rakhal Sarker

Associate Professor

Department of Food, Agricultural and Resource Economics,

University of Guelph,

Guelph, Ontario, Canada, N1G 2W1.

Tel: 519-824-4120 Ext. 52173

rsarker@uoguelph.ca

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* The corresponding author.

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Abstract

In Kenya, trade policy reforms in the cereals sector were initiated as a key component of the economy-wide structural adjustment programmes (SAPs) during the mid 1980s. The SAPs were later strengthened and made irreversible by Kenya's commitments at the multilateral trade negotiations. However, the welfare effects of these trade policy reforms remain controversial. This paper to quantifies the market and welfare impacts of trade liberalization in Kenya's maize sector using a partial equilibrium model with market interrelationships at the farm, wholesale and retail levels. The model is calibrated to simulate a 24 percent reduction in maize import tariffs and a complete abolition of tariffs. The simulations results suggest that tariff reductions yield price decreases across the three market levels. The declining prices increase maize consumption but reduce domestic production. Consequently, consumer surplus increases while producer surplus decreases. However, the gain in consumer surplus is not sufficient to compensate the loss in producer surplus. Thus, the implementation of the multilateral agricultural trade agreement is likely to leave Kenya's maize sector worse off and cannot be considered as a viable policy based on the compensation principle.

JEL Classification: F14, F16, I32, C68, O24, Q12

Key words: Trade liberalization; maize; partial equilibrium analysis; welfare effects.

1. Introduction

Over the past two decades, Kenya like most other developing countries has implemented two types of economic reforms in her staple grain markets. In the mid 1980's, the reform of food markets was an important component of the economy-wide Structural Adjustment Programs (SAPs) adopted by developing countries (Minot and Goletti, 2000). The SAPs entailed the privatization (withdrawal of state agencies from grain pricing and marketing activities) and liberalization (the relaxation of regulatory controls on private marketing) of staple grain marketing and pricing in over 20 countries in Africa (World Bank, 1994).

In the 1990's, the cereal sector SAPs were deepened by Kenya's trade liberalization commitments at the multilateral trade negotiations that culminated in the creation of the World Trade Organization (WTO). The key multilateral rules affecting grain trade relate to the Uruguay Round's Agreement on Agriculture (URAA), whose main pillars are improved market access, reduced domestic support and the elimination of export subsidies. Among the WTO modalities, the market access commitments have had the most important impacts on grain marketing in Kenya, particularly with regard to the tariff reduction measures implemented after 1995.

In Kenya, the grain market reforms have been concentrated in the maize sector because of its strategic position as the key staple food and a source of income for a vast majority of the population. Prior to the SAPs, maize markets in Kenya were strictly controlled by the government that enforced administratively determined pan-seasonal and pan-territorial prices. Maize marketing was monopolized by the National Cereals and Produce Board (NCPB), a state sponsored single-desk marketing board.

Kenya's maize sector reforms began in the mid 1980's and intensified through the 1990's. By the time of signing the URAA in 1995, the county was implementing the SAPs and had substantially liberalized its grain markets. Moreover, Kenya has complied with its basic URAA commitments on the market access pillar, since all her agricultural tariffs are bound and their applied rates are below the ceiling (WTO, 2000). The country has no WTO commitments on the domestic support pillar since all such measures pertain to the exempt categories or are within the *de minimis* levels. In addition, Kenya does not grant export subsidies on any of her agricultural products.

Currently, the government intervenes in the maize sector via two policy instruments: the operations of the NCPB and an import tariff. The Board remains active in a liberalized market, but its role has been confined to the management of a national strategic grain reserve (Wangia *et al*, 2001). Maize imports from member states of the East African Community (EAC) and the Common Market for East and Southern Africa (COMESA) enter Kenya duty free, but must be accompanied by a certificate of origin (Nyangito *et al*, 2004). Imports from other parts of the world are subject to a 25 percent import tariff. All imports are subject to an Import Declaration Fee of 2.75 percent, pre-shipment inspection and phytosanitary certification (WTO, 2000).

However, the impacts of trade liberalization on Kenya's maize sector are mired in controversy. On the one hand, farm lobby groups argue that increased market access lowers producer prices, which serves as a disincentive to production and thus a direct threat to food security (Mghenyi, 2006). Conversely, the elimination of food subsidies under the SAPs in Africa has been thought to exacerbate food insecurity for low income consumers (Jayne and Argwings-Kodhek, 1997).

While the potential gainers and losers have generally been identified, a review of the literature indicates that the magnitudes of these gains/loses and their distributional effects remain largely unexplored. Thus, there exists an empirical gap that needs to be bridged. This paper employs an economic surplus framework to quantify the gains/loses from trade liberalization in Kenya’s maize sector. Specifically, the paper’s objectives are twofold: to estimate the market and welfare impacts of reducing maize import tariffs levels in Kenya and to draw policy recommendations.

A review of the theoretical approaches used to measure the effects of agricultural trade reforms along with their empirical applications was undertaken. In this regard, a vast majority of trade policy studies have employed simulation models owing to their structural tractability. Given the desire to derive detailed sector information, a partial equilibrium approach was adopted and thus, a PEM of trade was employed. The paper is laid out as follows. The next two sections present the basic framework of the PEM of trade and its calibration. Section four reports the simulation results and the paper closes by drawing some conclusions and policy implications for the maize sector.

2. The Simulation Model

The basic PEM of agricultural trade follows the rule of spatial arbitrage that trade between two regions occurs when the price difference between them reaches the transfer cost (Krishnaiah, 1995). It assumes perfect substitutability between domestic and imported commodities. The model entails a demand equation to determine consumption, a supply equation to determine production and a supply-demand identity to determine market clearing conditions. It can be conceptualized by a set of panel diagrams showing the responses of agents at various market levels (Figure 1).

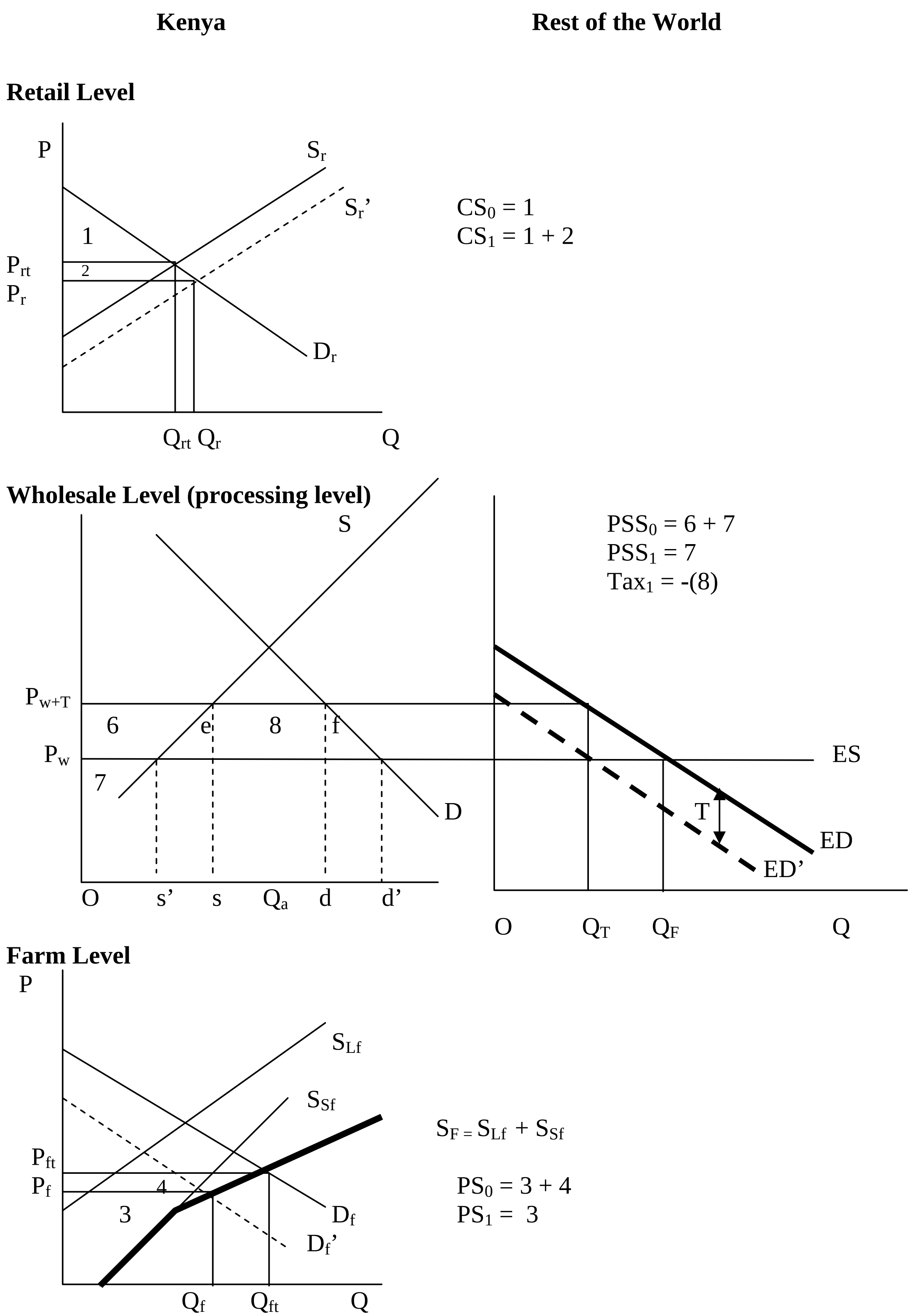


Figure 1. Effects of Import Tariffs Changes on the Maize Sector in Kenya

A graphical formulation of a PEM is used to illustrate the impacts of trade liberalization on Kenya's maize sector following the work of Houck, 1986. It features trade in maize between two spatially separated markets; Kenya and the rest of the world (RoW). The model comprises of linear supply and demand schedules at the farm, wholesale and retail levels. Maize trade occurs at the wholesale market level in the form of unprocessed grain. The model simulates the effects of a reduction in import tariff levels on the welfare of agents at the three market levels. The simulations undertaken are in line with Kenya's market access commitments at the WTO.

The small-country importer assumption is made in this model since Kenya is a net importer of maize that does not control a large share of the world market. Thus, domestic maize prices are fixed in the world market independently of the quantities imported. Suppose the demand and supply for maize in Kenya is represented by curves D and S respectively (Figure 1). In autarky, the domestic wholesale prices in Kenya are higher than the world price (Pw). Thus the country is in a potential excess demand (ED) situation equal to (d' – s') and imports OQ_F from the world market.

When external trade is allowed with a fixed import tariff (T), the initial equilibrium obtains at price $P_W + T$ where demand exceeds supply by (d – s). The tariff shifts the excess demand curve from ED to ED' and the quantity imported drops from OQ_F to OQ_T. The effects of trade liberalization at the wholesale market level can be analyzed by abolishing the import tariff. Subsequently, supply increases as wholesale prices decline from $P_w + T$ to P_w. This policy measure shifts the excess demand curve back to ED from ED' as imports climb back to OQ_F (Figure 1).

The wholesale level is linked to the farm and retail sector through marketing margins and a technical coefficient of processing. Producer prices are linked to wholesale and consumer prices through exogenously determined marketing margins. In addition, the quantities at the wholesale and retail levels are linked by a technical coefficient of processing. Subsequently, the effect of the tariff reduction at the wholesale level is transmitted to the retail and farm level via the price transmission elasticities between wholesale and farm prices and between wholesale and retail prices respectively.

The reduction in wholesale prices results to a shift in the derived supply at the retail level from S_r to S_r' (Figure 1). Consequently, retail prices fall from P_{rt} to P_r as retail demand increases from Q_{rt} to Q_r. In this model, farm supply (S_F) is an aggregate function of the output derived from commercial (S_{Lf}) and subsistence farmers (S_{Sf}) owing to the dual nature of Kenya's maize production. It might have a negative price intercept since subsistence farmers will produce for home consumption even when prices are zero (Figure 1). The decline in prices at the wholesale level results to a backward shift in farm derived demand from D_f to D_f'. Consequently, farm prices fall from P_{ft} to P_f and the derived demand at the farm level falls from Q_{ft} to Q_f.

The tariff reduction yields gains and losses that are distributed among producers, wholesalers and consumers. At the retail level, consumer surplus increases from the initial surplus with a tariff equal to the area under triangle (1) to area (1 + 2) in Figure 1. The retailer surplus at the wholesale level increases by area (6 + 8). However, the wholesaler surplus at the farm level declines from area (6 + 7) to area (7). The tariff reduction leads to a loss of government revenue equal to area (8). In addition, producer surplus at the farm level declines from area (3 + 4) to area (3).

At the wholesale level, the tariff reduction results in efficiency gains that are equal to the mirror images of the areas under the triangles marked (e and f). Overall, the economic consequences of the tariff reduction might include an increase in maize consumption and imports, and a decrease in production. These translate to an increase in consumer and wholesaler surplus, but to a decrease in producer and retailer surplus and a loss in government revenue. However, the net effect of the tariff reduction depends on the actual sizes of the gains and losses made by the respective groups, which can only be determined empirically.

3. Model Calibration

The model comprises of four blocks of equations: prices, supply, consumption and market clearing identities for maize at three market levels (Table 2). The price block defines the relationship between domestic producer and consumer prices and between world and border (wholesale) prices. The production block is composed of three equations representing supply at the three market levels. Conversely, the consumption block shows the demand for maize at the retail, wholesale and farm levels. Finally, the equilibrium conditions equate supply to demand at all three market levels.

The price block is composed of three equations that reflect the relationships between producer and consumer prices and between border and world prices. Producer prices (P_f) are linked to consumer prices (P_r) by an exogenously determined domestic marketing margin (MG_r) that reflects the transportation and distributions costs incurred in the movement of maize from producing to consuming areas (Table 2). All maize prices are exogenously determined by the fixed world price, since Kenya is a small-country importer of maize.

Consumer prices are linked to wholesale prices (P_w) by an exogenously determined margin reflecting transfer costs from the border to the consuming areas (Table 2). The border price is linked to the fixed world price (P_I), adjusted by the exchange rate (*EXR*) and the applied import tariff (*T*). Supply at the wholesale and retail levels is derived from primary supply at the farm level. Similarly, demand at the wholesale and farm level is derived from primary demand at the retail level.

Table 2. Description of the Partial Equilibrium Model of Trade

Market Relationship	Mnemonic	Behavioural Equation
Price Block (KES/MT)		
Consumer Prices	P_r	$P_r = P_w * (1 + MG_w)$
Border (Wholesale) Prices	P_w	$P_w = P_I * EXR * (1 + T)$
Producer Prices	P_f	$P_f = \{P_r\} / [1 + MG_r]$
Consumption Block ('000' MT)		
Retail Demand	Q_r^d	$Q_r^d = \alpha_0 + \gamma_i P_r$
Wholesale Demand	Q_w^d	$Q_w^d = \alpha_0 + \gamma_i P_w + \gamma_j P_r$
Farm-Level Derived Demand	Q_f^d	$Q_f^d = \alpha_0 + \gamma_i P_{ft-1} + \gamma_j P_w$
Production Block ('000' MT)		
Retail Supply	Q_r^s	$Q_r^s = \theta Q_w^d$
Wholesale Supply	Q_w^s	$Q_w^s = Q_f^d + Q_T$
Domestic Production	Q_f^s	$Q_f^s = \rho_0 + \rho_i P_{ft-1}$
Market Clearing Identities		
Retail	Q_r	$Q_r^d = Q_r^s$
Wholesale	Q_w	$Q_w^d = Q_w^s$
Farm	Q_f	$Q_f^d = Q_f^s$

Specifically, wholesale demand is the sum of supply at the wholesale level plus imports. On the other hand, wholesale supply is identically equal to the output at the farm level (Table 2). The quantity supply at the retail level is the product of wholesale demand multiplied by a technical coefficient of processing (θ). In this study, an average grain extraction rate of 97 percent is used as the coefficient of processing.

The model is closed by a block of three equations equating demand and supply at the three market levels. External trade occurs at the wholesale level where quantity demanded is an aggregate of domestic production and imports. To solve the model, estimates are required for the quantities supplied and consumed at the three market levels, their elasticities and the corresponding prices. In addition, data is required on import tariff rates, exchange rates and transfer costs. This data is derived from the central bureau of statistics (CBS), while the elasticities used are taken from Nzuma (2007) and shown in Tables 3 and 4.

Table 3. Base Data for Policy Simulation

Variable	Mnemonic	Base Values
Market Clearing Quantities ('000') MT		
Retail Level	Q_r	2662
Wholesale Level	Q_w	2755
Farm Level	Q_f	2445
Real Prices (KES/MT)		
Retail Level	P_r	11314
Wholesale Level	P_w	11249
Farm Level	P_f	10542

Source: Author's Computations from Economic Surveys and MOA Annual Reports

On the production side, acreage response for maize is assumed to depend on the expected future market prices. The own-price elasticity of supply for maize at the farm-level is set at 2.17 while the elasticities at the wholesale and retail level are 2.13 and 5.20 respectively (Table 4). These elasticities are imposed on price values of 10542, 11249 and 11314 KES/MT for the farm, wholesale and market levels respectively. Further, the elasticities are imposed on quantities of 2445, 2755 and 2662 MT respectively for the same market levels.

Table 4. Base Elasticity Values for Sensitivity Analysis

Parameter	Base Value	Standard Deviation
Own-Price Elasticities of Demand		
Retail Level	-0.80	0.120
Wholesale Level	-2.34	0.500
Farm Level	-1.41	0.165
Own-Price Elasticities of Supply		
Retail Level	5.20	0.328
Wholesale Level	2.13	0.175
Farm Level	2.17	0.124
Cross-Market Elasticities		
Retail Level	2.34	0.500
Wholesale Level	5.20	0.328
Farm Level	2.13	0.175

Source: Author's Computations

On the consumption side, aggregate demand for maize depends on its own price and the prices of other grains, all relating to the current period. Consumer expenditures in this study are held constant since the demand schedules are linear and homogeneous. The own-price elasticity of retail demand for maize is set at -0.80 while the own-price elasticities at the wholesale and farm levels are -2.34 and -1.41 respectively (Table 4). These elasticities are applied on the price and quantity values presented in Table 3.

The reliability of the results in any simulation is driven by the choice of base scenario values and the range of parameter values. A Monte Carlo experiment featuring 1000 replications of the PEM is used for sensitivity analysis. Table 4 reports the base values for the elasticities along with their standard errors. These parameters are used to generate the random numbers in the sensitivity analysis.

The General Algebraic Modeling Systems (GAMS) package was used to solve the equations in the model. It was constructed to reproduce the 1995/96 base values, which represents the period when Kenya began implementing the WTO market access commitments. The Uruguay Round negotiations in 1995 produced an agreement for developing countries to cut tariffs on agricultural products by an average of 24 percent over ten years with a minimum cut of ten percent. During this period, maize imports into Kenya were subjected to an ad valorem tariff of 25 percent.

Subsequently, a tariff reduction of 24 percent was simulated using the 1995/96 base values and used to quantify the impacts of trade liberalization. Given the existing applied tariff of 25 percent on maize imports, the change in tariffs amounts to a six percentage reduction and thus, the impacts of a 19 percent applied tariff were simulated and compared with the base solution values. The tariff reductions were assumed to be implemented in 1995/96 and maintained at that level through 2004/05 when the 10 year WTO grace period expired.

4. Simulation Results

The simulation provides quantitative measures of the welfare impacts of trade liberalization. At the base solution, a producer surplus of about KES 20 billion is estimated (Table 5). In addition, a retailer surplus at the wholesale level of KES 3.2 billion and a wholesaler surplus at the farm level of KES 15 billion are generated. Overall, the intermediate level generates a surplus of about KES 19 billion (Table 7.5). Furthermore, consumers gain about KES 49 billion while the government generates a tariff revenue of KES 0.39 billion (Table 7.5).

Overall, a social surplus of KES 88 billion is generated for the entire maize sector at the existing tariff levels. The results of the welfare analysis seem to suggest that consumers are the largest (relative) beneficiaries from maize trade reforms in Kenya while the lowest welfare gains are generated at the intermediate level. This is expected given the small-country importer assumption that ensures that prices at the wholesale level are fixed in world markets. Thus, it is reasonable to expect stable wholesale prices, which generate the low welfare changes.

Table 5. Impacts of the URAA Trade Commitments on Kenya's Maize sector

	Trade Liberalization Scenario		
Variable Description	Base Values	24% Tariff Cut	% Change
Retail Level			
Equilibrium Price (KES/MT)	11306.693	11140.331	-1.47
Equilibrium Quantity ('000' MT)	2663.375	2694.689	1.18
Consumer Surplus (Billion KES)	48.957	49.309	0.72
Wholesale Level			
Equilibrium Price (KES/MT)	11249.000	10825.100	-3.77
Equilibrium Quantity ('000' MT)	2745.748	2778.030	1.18
Imports ('000' MT)	218.375	368.645	68.81
Tariff Revenue (Billion KES)	0.386	0.495	28.24
Retailer Surplus (Billion KES)	3.168	2.616	-17.42
Wholesaler Surplus (Billion KES)	15.447	14.420	-6.65
Intermediate Level Surplus	19.000	17.532	-7.73
Farm-Level			
Equilibrium Price (KES/MT)	10542.000	10305.643	-2.24
Equilibrium Quantity ('000' MT)	2445.000	2326.044	-4.87
Producer Surplus (Billion KES)	19.836	18.596	-6.25
Social Surplus (Billion KES)	**88.179**	**85.932**	**-2.55**

Table 5 also reports the impacts of a 24 percent tariff cut in line with Kenya's market access commitments at the UR negotiations. Relative to the base solution values, the 24 percent tariff reduction leads to a decrease in maize prices across all the three market levels. At the wholesale level, prices decline by about four percent while both farm and retail prices decrease by about two percent (Table 5). The price fall causes a one percentage increase in consumption and a 69 percent increase in imports, but leads to a two percent decrease in domestic maize production (Table 5).

Consequently, the 24 percent tariff reduction leads to a six percent fall in producer surplus and a 0.72 percent increase in consumer surplus (Table 5). At the intermediate level, retailer surplus at the wholesale level falls by 17 percent while wholesaler surplus at the farm level falls by seven percent (Table 5). The increased imports lead to a 28 percent rise in government tariff revenue. The net effect of the tariff cut at the intermediate level is an eight percent decline in wholesaler surplus.

Overall, the 24 percent reduction in tariffs leads to a three percent decline in social surplus which translates to a loss of welfare of about KES 2.25 billion (Table 5). To put matters into perspective, the loss in social welfare amounts to a quarter of the budgetary allocation to the ministry of Agriculture in the 2006/7 financial year at KES 10.28 billion (GoK, 2007). The foregoing welfare analysis suggests that the gain to consumers is not large enough to offset the loss to producers. Thus, tariff reductions as a trade reform policy have no compensating potential in Kenya’s maize sector. In practice, policy changes that have no compensating potential cannot be recommended based on Harberger’s (1971) welfare postulates.

In order to verify the validity of the estimated impacts of trade liberalization in Kenya’s maize sector, the simulation results were subjected to a sensitivity analysis. The Monte Carlo experiment replicated the baseline welfare measures 1000 times. The random outcomes were generated from a multivariate normal distribution of the base values using the mean and standard deviations of the elasticities at all the three market levels. The mean and standard deviations of the surplus measures were then used to compute the 95 percent confidence intervals.

Table 6. Confidence Intervals of the Base Solution Welfare Values

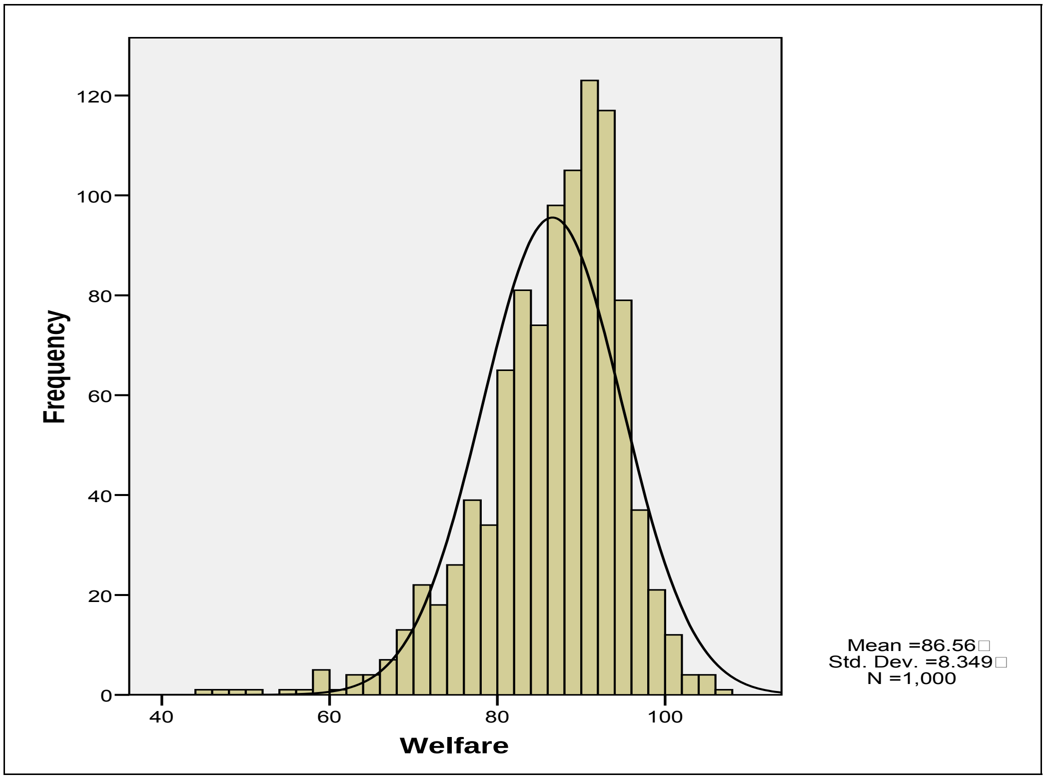
	Moment		95 % Confidence Intervals	
Surplus Measure	**Mean**	**STD**	**Lower Bound**	**Upper Bound**
Producer Surplus (Billion KES)	19.814 (1.74)	0.344	19.711	19.917
Wholesaler Surplus (Billion KES)	17.362 (45.31)	7.867	15.011	19.714
Consumer Surplus (Billion KES)	49.384 (5.93)	2.931	48.508	50.260
Social Surplus (Billion KES)	86.561 (9.65)	8.349	84.065	89.056

Notes. The figures in Parenthesis give the coefficients of variation of the variables. All numbers in the table are average values derived from model runs for 1000 periods

Source: Author's Computations in GAMS

Table 6 reports the simulated welfare measures from the Monte Carlo experiment at their 95 percent confidence intervals. The mean values of the surplus measures generated at the three market levels were within the bounds of the 95 percent confidence interval (Table 6). Thus, the estimated surplus measures in all cases were significant at the five percent level. While producer surplus was the most stable welfare measure, wholesaler surplus had the highest level of variability (Table 6). However, the variability of all welfare measures is quite low as indicated by the coefficients of variation, implying that the estimated surplus measures are stable.

To demonstrate the validity of the estimated welfare measures, a histogram of the base social surplus values is generated. Figure 2 shows the probability distribution function of the simulated social surplus at the 95 percent confidence interval. The mean, mode and median values of the social surplus run quite close to the centre of the density function (Figure 2). However, the density distribution function is slightly skewed to the right, as indicated by the skewness measure of -1.02.



Source: Author’s Computations in GAMS

Figure 2. Probability Density Function of the Base Social Surplus

The results of the sensitivity analysis validate the robustness of the simulated welfare measures with regard to the base solution values. Specifically, the results of the Monte Carlo experiment suggest that the simulated welfare measures were stable and significant at the five percent level. It can, therefore, be concluded that the GAMS simulation model performs quite well. Thus, the results generated were accurate and reliable for policy analysis.

5. Conclusions and Policy Remarks

This paper quantifies the impacts of trade liberalization in Kenya's maize sector. A PEM model of trade that takes into account the market interrelationships across three levels is used. The model incorporates external trade and simulates the welfare effects of reducing import tariffs over the liberalized period. A major finding of this analysis is that a 24 percent tariff cut would lower market prices and increases maize consumption but reduces domestic production in Kenya. Moreover, tariff reductions would stimulate increases in maize imports.

However, the declining prices are accompanied by increased price variability that dampens the gains to consumers. Even though consumers benefit from tariff reductions, the loss in producer surplus outstrips consumer benefits by a ratio of 22.32, which curtails any potential for producer compensation. The net effect is a loss in social welfare. This implies that the URAA trade commitments with regard to Kenya's maize sector cannot be passed based on the compensation principle. Instead policies that improve the responses of producers should be advocated while maize consumers should be encouraged to diversify their consumption to other cereals.

Given the fact that Kenya is a developing country with limited revenue generating sources, compensating losers from trade liberalization in the maize sector might not be viable. An alternative is to undertake complimentary reforms that are necessary to transmit world prices to consumers but at the same time improve the ability of producers to respond to incentives. The international development literature identifies such incentives to include investments in infrastructure, institutions, information services, agricultural credit, human capital development and research and extension.

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