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Analysis of Vertical Price Transmission along Sugar Supply Chain in Kenya

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Abstract: *Asymmetry of price transmission uses price data and information to determine market performance and imperfections. The analysis may be spatial (Horizontal) or along the marketing chain (Vertical). This paper sought to analyze vertical price transmission in the Kenyan sugar market supply chains. Time series data was extracted from the Kenya Sugar Board Year Book of Statistics. Monthly Sugar prices for producers, wholesalers and retailers were obtained for the period of 2003 to 2014. Tests for unit root using Dickey Fuller test, Kwiatkowski-Phillips-Schimidt-Shin (KPSS) test and Phillips-Perron tests found out that the time series exhibited unit root. Johansen cointegration test showed no co-integrating equations. A Vector Autoregression was estimated. Granger Causality Wald tests indicated that ex-factory prices Granger caused wholesale and retail prices, while retail prices did not granger cause wholesale nor ex-factory prices. TAR and MTAR were estimated and the null hypotheses of no threshold cointegration and symmetry in prices were rejected. The Kenya sugar market showed some imperfections, and it was concluded that from the producer to the consumer, the Law of One Price does not hold for Kenyan sugar markets*.

Keywords– *Price Transmission, Symmetry, Threshold Cointegration, Vector* Autoregression

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I. Introduction

Reforms give more opportunity for developing countries to participate in international trade, but local markets may be less responsive to economic signals international markets (Kilima, 2006). According to (Goodwin, 2006)market performance is described by the degree to which market shocks are transmitted up or down along the marketing chain as well as across spatially separated markets.

Information on prices is important to by economists, although other variables, such as product characteristics, are useful to describe and explain market behaviour (Asche, Guttormsen, Sebulonsen, & Sissener, 2005). Interest in prices is justified for the reason that price data is the only data available in analysing market integration and marketing margins. According to (Asche et al., 2005)), market integration focuses on the development of prices over time for potentially competing products. They also explain that marketing margins are concerned with the supply chain, focusing on how supply and demand shocks at one level of the supply chain are transmitted to the other levels in the supply chain.

Competitiveness of different markets can be analysed using symmetric price transmission along supply chain from producer to consumer. (Ahmadi Shadmehri, 2010) explain that if price transmission is asymmetric, it means that retail prices respond to increase and decrease of producer price differently; price transmission from producer to retail is vertical.

Sugar prices in Kenya have remained relatively high, partly because of high production costs, and partly because of high transfer costs as a result of poor infrastructure. To offset this trend, imports of 250,000 metric tonnes have been used to meet the deficit in production so as to keep prices low (Kenya Sugar Board, 2014). However, this has not been the case, as the margin between producer prices and wholesale-retail prices tend to be high. Despite the imports of approximately 250,000 metric tonnes, retail prices are still not stable and they tend to be high during certain periods of the year. This is an indicator of inefficiency in the sugar market.

This paper analysed vertical price transmission in the Kenyan sugar market supply chain. To achieve this objective, the paper determined the short run and long run relationships between ex-factory sugar prices, wholesale prices and retail sugar prices in Kenya, as well as the nature of price transmission from one market level to another market level in Kenya sugar market.

II. Theoretical Literature

Price Transmission

"The degree of price transmission from one market level to another is an important parameter in empirical trade models that assess the impact on prices, output, consumption and welfare of producers and consumers", (Kilima, 2006). According to (Meyer & Cramon-Taubadel, 2004), asymmetric price transmission occurs when prices in the lower market level change differently to prices in the upper level market, depending on the characteristics of those prices.

Vertical Price Transmission

Vertical price relationships involve magnitude, speed and nature of price adjustments through the supply chain to market shocks that arise at different levels of the marketing process (Vavra & Goodwin, 2005). It describes the speed and impacts of a shock in prices at one level on the prices upwards or downwards.

Theoretical Framework

Price transmission is the effect of prices at one end of a market on prices at other ends of the market (Minot & others, 2010). Its measurement is in terms of elasticity, defined as the percentage change in the price in one market or market level to another market or market level arbitrage will have a unique price (Listorti, Esposti, & others, 2008). As a result of price transmission, the Law of One Price is formulated. According to (Kaspersen & Føyn, 2010), the law states that if the commodities in question are homogenous, at equilibrium, the prices of the commodities will equal each other, apart from the cost of moving the goods from one place to another. They further argue that price determination is endogenous, and therefore Law of One Price is represented in a simple empirical relationship as:

$$P_t^1 = \alpha + \beta P_t^2 + \varepsilon_t \quad (1)$$

P^1 and P^2 are the prices in two different markets. Here, the markets are spatially separated, and α represents a constant corresponding to price differential between two markets, which is most likely to be the transportation costs. The markets can be integrated in a perfect way, but still have different prices. $\varepsilon_t$is the error term. Mengel and Cramon-Taubadel (2014) argue that the law states that price differences for a uniform commodity in different locations are reduced by spatial arbitrage until they amount to no more than transfer costs. The limitation of LOP is that it violates two main assumptions; costless trade and good homogeneity.

III. Methodology

Test for Unit Roots

Tests for unit root was by Augmented Dickey Fuller (ADF), Phillips-Perron (PP), and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests, to fit the equation;

$$Y_t = \beta Y_{t-1} + \varepsilon_t \quad (2)$$

If β equals 1, the model is characterised by a unit root, and the time series contains characteristics of non-stationarity. β must be less than unit in absolute value ($-1<\beta<1$).

Dickey Fuller Test for Unit root

Dickey Fuller test is based on the following model:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} \Delta Y_{t-i} + \varepsilon_t \quad (3)$$

$\varepsilon_t$is a pure noise term and $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$. If there is unit root, δ will not be statistically different from zero ($\delta=0$) (Dickey and Fuller, 1979; (Dickey & Fuller, 1981) The ADF test follows a similar asymptotic distribution as δ statistic, and therefore, the same critical value can be used to test whether the price series has a unit root (Gujarati, 2003).

Phillips-Perron (PP) test for Unit Root

It involves fitting the model below:

$$\Delta Y_t = PY_{t-1} + \beta Yt + \mu_t. \quad (4)$$

(1) Where β = Constant and Yt is a time trend

PP tests correct for any serial correlation by using (Newey & West, 1986) heteroscedasticity – and autocorrelation-consistent covariance matrix estimator.

The PP test involves fitting the regression;

$$y_i = \alpha + P y_{i-1} + \varepsilon_i \quad (5)$$

Where we may exclude the constant or include a trend term (Phillips & Perron, 1988)

Kwiatkowski-Phillips-Schmidt-Shin (KPSS)

It shows a difference from the ADF and PP, such that a time series y_t is assumed to be a trend. Therefore, it tests the null hypothesis that a time series is stationary(Kwiatkowski, Phillips, Schmidt, & Shin, 1992), using the following equation:

$$Y_t = \alpha_t + \varpi t + b_t + \varepsilon_t \qquad (6)$$

Where t is a linear deterministic trend, $\varepsilon_t$is a stationary error, b_ta random walk; $b_{t-1} + \mu_t$, where μ_t is a i.i.d stationary series with mean zero and variance one.

The KPSS statistic is:

$$\eta(u) = T^2 \sum S_t^2 / S^2(k), \qquad (9)$$

where $S_t = \sum^t e_i (i = 1,2,.....t)$, e_i is the partial sum of the residuals, $S^2(k)$ is a consistent non-parametric estimate of the disturbance variance and T is the sample size (Kwiatkowski et al., 1992). According to them, the statistic $\eta(u)$ has a nonstandard distribution, and critical values are provided. If the calculated value of $\eta(u)$ is large, then the null hypothesis of stationary for the KPSS test is rejected.

Johansen Test for Cointegration

This method of testing for cointegration takes its starting point from the Vector Autoregression (VAR) of order p given by;

$$Y_t = \mu + A_1 y_{t-1} + ... + A_p y_{t-1} + \varepsilon_t, \qquad (10)$$

where y_t is an $n \times 1$ vector of variables that are integrated of order one – denoted as I(1), and ε_t is an $n \times 1$ vector of innovations.

Johansen (1995) suggested tests for significance of these correlations through the trace test and maximum eigenvalue test, as shown below;

$$J_{trace} = -T \sum_{i=r+1}^{n} \ln(1 - \lambda_i) \qquad (12)$$

$$J_{max} = -T ln(1 - \lambda_{r+1}) \qquad (13)$$

T represents the sample size; λ_i is the i^{th} largest canonical correlation. The trace tests are used to test the null hypothesis of r co-integrating vectors against the alternative hypothesis of r+1 co-integrating vectors (Osterholm, 2007) .

Presence of a cointegrating relationship shows that the univariate variables have a long run relationship. This leads to rejection of the first null hypothesis, that there was no relationship between ex-factory, wholesale and retail sugar prices in Kenya.

Since there was no cointergrating equation between the variables, the short run relationship was estimated by finding elasticities by estimating the VAR. The model was specified as;

Given g variables, where ($g \geq 2$), a variable with k lags is set as:

$$P_t = \beta_1 P_{t-1} + \beta_2 P_{t-2} + ... + \beta_k P_{t-k} + \mu_t \qquad (14)$$

The VAR equation 14 is written in the form of vector error correction model as follows:

$$\Delta P_t = \Pi P_{t-k} + \Gamma_1 \Delta P_{t-1} + \Gamma P_2 \Delta P_{t-2} + ... + \Gamma_{k-1} \Delta P_{t-1(k-1)} + \mu_t (15)$$

Where, $\Pi = \left(\sum_{i=1}^{k} \beta\beta_1\right) - I_g$and $\Gamma_i = \left(\sum_{j=1}^{i} \beta_j\right) - I_g$

Co-integration between the Pt is computed by looking at the rank of the Π matrix through its Eigenvalues. If the rank, r falls between the number of variables and 1 ($1 < r < g$), it means that there are r co-integrating variables. The numbers of markets that integrate in the long-run are (r+1). Since there was no cointergrating equation that existed between the variables, VAR was estimated using equation (15).

ii. Threshold Autoregressive (TAR) and Momentum Threshold Autoregressive (M-TAR) Models

TAR and MTAR co-integration and adjustment process are specified as

$$\Delta\mu_t = \begin{cases} \rho_1 \mu_{t-1} + \varepsilon_t & \text{if } \mu_{t-1} \geq \lambda \\ \rho_2 \mu_{t-1} + \varepsilon_t & \text{if } \mu_{t-1} < \lambda \end{cases} \quad \text{For TAR model} \qquad (16)$$

and

$$\Delta\mu_t = \begin{cases} \rho_1 \mu_{t-1} + \varepsilon_t & \text{if } \Delta\mu_{t-1} \geq \lambda \\ \rho_2 \mu_{t-1} + \varepsilon_t & \text{if } \Delta\mu_{t-1} < \lambda \end{cases} \quad \text{For MTAR model} \ (17)$$

Where λ is the threshold value; ρ_1 and ρ_2 are the speeds of adjustment parameters to be estimated. The sufficient condition for the stationarity of {μt} is $-2 < (\rho_1, \rho_2) < 0$

IV. Results And Discussions

Summary of Descriptive statistics

Table 1 below presents a summary of the descriptive statistics for the three uni-variate variables.

Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Minimum	Maximum
Retail Price per KG	87.4758	32.8066	42.1500	205.2500
Ex-factory Price Per Kg	68.4264	23.0701	36.8240	156.1600
Wholesale Price per Kg	74.0990	27.8638	38.28	189.0000

Source: Data Analysis Results, 2016

Unit Root Tests

Table 2 shows the results from the analysis for unit root tests.

Table 2: Unit Root Tests

Variables	ADF	Prob	PP	Prob	KPSS	Remarks
Exfpkg	-2.303	0.4322	-2.098	0.2453	0.752	Unit root
Wspkg	-2.258	0.4572	-2.390	0.1445	0.575	Unit root
Rtpkg	-2.620	0.2708	-1.930	0.3180	0.479	Unit root

Source: Data Analysis Results, 2016

According to Dickey-Fuller, the univariate time series variables were non-stationary, and the hypothesis; H_0: that the variables were stationary was rejected. The variables were integrated of the order 1, denoted I(1). Based on KPSS test, it was also concluded that the variables were not stationary and rejected the null hypothesis H_0: the variables were stationary. Phillip-Perron unit root test, all the univariate modelled variables had unit root. Therefore, the variables were not stationary. We rejected the null hypothesis H_0: the variables were stationary. Phillips–Perron test shows consistent results as those of Dickey Fuller and KPSS tests. In case of a small sample, Dickey Fuller, KPSS and Phillips–Perron test show consistent results Kharin (2015).

Table 3: Test for Unit Roots after First Difference

Variables	ADF	Prob	PP	Prob	KPSS	Remarks
Exfp	-8.591	0.000	-8.443	0.000	0.0457	No unit root
Wsp	-6.667	0.000	-6.542	0.000	0.0483	No unit root
Rsp	-7.932	0.000	-7.931	0.000	0.0382	No unit root

Source: Data Analysis Results, 2016

After first difference all variables became stationary. It was therefore concluded that all the univariate variables were integrated of the order one, denoted as I(1).

To carry out the Johansen Cointegration test, it was necessary to select the optimum lag in order to get rid of autocorrelation. This would make the error term a white noise disturbance term *(Uchezuba, 2010)*. In this study, an optimum lag of 2 was selected.

Johansen Test for Cointegration

The study failed to reject the null hypothesis of no cointergration. This mean that there was no cointegratingequation in the model, therefore no long run relationship existed among the price series.

Vector Autoregressive Model Results

Table 4 below show the Vector error correction results.

Table 4: Vector Autoregressive (VAR) Results

Variable		Coefficient	Std. Err	Z	P > |Z|
Exfpkg	exfpkg L1	-0.3141	0.1021	-3.08	0.002**
	L2	-0.5621	0.0975	-5.76	0.000**
	wspkg L1	0.5269	0.1132	4.66	0.000**
	L2	0.3240	0.1213	2.67	0.008**
	rtpkg L1	0.0550	0.0897	0.61	0.540
	L2	0.0566	0.8782	0.64	0.519
	Cons	0.1923	0.3765	0.51	0.610
Wspkg	exfpkg L1	-0.1473	0.1394	-1.06	0.291
	L2	-0.5119	0.1332	-3.84	0.000**
	wspkg L1	0.4849	0.1545	3.14	0.002**

	L2	0.1279	0.1657	0.77	0.440
	rtpkg L1	0.2049	0.1225	1.67	0.094
	L2	0.0331	0.1199	0.28	0.783
	Cons	0.1962	0.5141	0.38	0.703
Rtpkg	exfpkg L1	-0.0944	0.1512	-0.62	0.533
	L2	-0.3939	0.1445	-2.73	0.006**
	wspkg L1	0.6120	0.1677	3.65	0.000**
	L2	0.4478	0.1797	2.49	0.013**
	rtpkg L1	-0.0998	0.1329	-0.75	0.453
	L2	-0.2236	0.1301	-1.72	0.086
	Cons	0.5199	0.5578	0.93	0.351

Notes: ** denotes significant at 5 percent.

Source: data analysis results, 2016

Granger Causality Wald Tests

To test the magnitude and direction of price movement, Granger Causality tests were conducted. Table 5 shows Granger Causality test results from the analysis.

Table 5: Granger Causality Wald Tests

Granger Causality Wald Tests Null Hypothesis: H_0: β= 0	Chi2	df	Prob>Chi2	Remarks
wspkg does not Granger Cause exfpkg	11.858	1	0.001	Reject Null Hypothesis
rtpkg does not Granger Cause exfpkg	1.0455	1	0.307	Accept Null Hypothesis
ALL do not Granger Cause exfpkg	40.011	2	0.000	Reject Null Hypothesis
exfpkg does not Granger Cause wspkg	13.366	1	0.000	Reject Null Hypothesis
rtpkg does not Granger Cause wspkg	0.19046	1	0.663	Accept Null Hypothesis
ALL do not Granger Cause wspkg	14.646	2	0.001	Reject Null Hypothesis
exfpkg does not Granger Cause rtpkg	9.2304	1	0.002	Reject Null Hypothesis
wspkg does not Granger Cause rtpkg	13.39	1	0.000	Reject Null Hypothesis
ALL do not Granger Cause rtpkg	14.246	2	0.001	Reject Null Hypothesis

Notes: 1. exfpkg denotes ex-factory sugar price converted per kilogram; wspkg denotes wholesale sugar price converted to kilograms; rtpkg denotes retail sugar price per kilogram.

Source: Data Analysis Results, 2016

The null hypothesis for causality was rejected for all levels downstream and for one level upstream, all at 5 percent significance level. This implies that casualty occurs from ex-factory to retail levels, but also from wholesale to ex-factory.

This confirms the argument by Kohls, Uhl, (2002) that changes in prices at different levels of the supply chain are either not fully, or they are more than fully transmitted to the lower levels, and that downstream changes to retail prices show a longer time lag than upstream changes do.

To determine the nature of price transmission in the Kenya sugar supply chain, the Threshold Autoregressive (TAR) and the Momentum Threshold Autoregressive (M-TAR) models were used. To achieve this, the following null hypotheses were tested; H_{01}: $p_1=p_2=0$, showing no cointegration between two market levels, and H_{02}: $p_1=p_2$ to show symmetric adjustment between two market levels.

Threshold Cointegration Regression Test Results Using TAR

The TAR model estimated threshold value was = -3.100 for Ex-factory-Retail, = -4.668 for Wholesale-Ex-factory and = -4.656 for Wholesale-Retail as it can be seen in table 6.

Table 6: Threshold Cointegration Regression Test Results Using TAR

	Ex-factory-Retail	p-value	Wholesale – Ex-factory	p-value	Wholesale - Retail	p-value	ϕ critical values 1%	5%
τ	-3.100		-4.668		-4.656			
ρ_1	-0.225*** (0.083)	0.008	-0.459*** (0.087)	0.000	-0.267*** (0.083)	0.002		
ρ_2	-0.253** (0.125)	0.044	-0.581*** (0.157)	0.000	-0.071 (0.075)	0.075		
$\Delta\mu_{t-1}$	-0.078 (0.091)	0.390	0.221** (0.092)	0.017	-0.002 (0.087)	0.983		
$\Delta\mu_{t-2}$	-0.189*** (0.087)	0.031	0.093 (0.088)	0.289	-0.179** (0.086)	0.038		
H_{01}: $\rho_1 = \rho_2 = 0$ (Φ statistic)	4.918		16.692		5.368		9.02	6.82
H_{02}: $\rho_1 = \rho_2$		0.043		0.440		0.064		
(F-statistic)	9.638	6.738e-07	8.154	9.452e-17	5.287	0.0005453		
AIC	958.001		838.483		811.120			
SBIC	972.745		856.133		825.864			
LB (4)		0.903	0.991		0.998			
LB (8)		0.148	0.717		0.615			
LB (12)		0.056	0.818		0.488			

Notes: λ is the estimated threshold value. Between the brackets (.) are the standard errors. ** and *** denote rejection of the null hypothesis respectively at 5% and 1% level. Φ is the threshold cointegration test statistic. F-statistic is the test for symmetry adjustment. The values presented for Ljung-Box (LB) test are the p-values. The lag length used was selected using AIC and SBIC. Optimum lag length of 2 was selected.

Source: Research findings, 2016

The estimated values of ρ_1 and ρ_2 were -0.225 and 0.253 for ex-factor-retail and significant at 1 percent and 5 percent levels respectively, -0.459 and -0.581 both significant at 1 percent for wholesale-ex-factory and -0.267 and -0.071 with only ρ_1 (-0.267) being significant at 1 percent level for wholesale-Retail.

The calculated F values were 4.918, 16.692 and 5.368 for ex-factory-retail, wholesale ex-factory and wholesale retail respectively. When compared to the critical value, 4.918 was less than the critical of 9.02 and 6.82 at 1 percent and 5 percent respectively. We therefore fail to reject the null hypothesis H_{01}:$\rho_1 = \rho_2 = 0$ in favour of the alternative for ex-factory-Retail. For wholesale ex-factory levels, we reject H_{01}:$\rho_1 = \rho_2 = 0$ at 1 percent and 5 percent and for Wholesale-retail levels, we fail to reject H_{01}:$\rho_1 = \rho_2 = 0$.

To test the null hypothesis H_{02}:$\rho_1 = \rho_2$, we used the F test. The null hypothesis was rejected at 1 percent and 5 percent at ex-factory-retail, wholesale ex-factory and wholesale retail. This means that $\rho_1 \neq \rho_2$. Therefore according to TAR model, there was asymmetry in price adjustments at ex-factory-retail, wholesale ex-factory and wholesale-retail.

Threshold Cointegration Regression Test Results Using MTAR Model

MTAR model was used to test for cointegration and nature of price transmission. The results for MTAR model are presented in table7 below.

Table 7: Threshold Cointegration Regression Test Results Using MTAR Model

	Ex-factory-Retail	p-value	Wholesale – Ex-factory	p-value	Wholesale – Retail	p-value
T	1.657		2.557		2.015	
ρ_1	-0.398***	0.000	-0.563***	0.000	0.080	0.820
	(0.091)		(0.097)		(0.098)	
ρ_2	-0.026	0.794	-0.339***	0.005	-0.261***	0.000
	(0.100)		(0.118)		(0.067)	
$\Delta\mu_{t-1}$	-0.046	0.604	0.242***	0.010	0.029	0.735
	(0.089)		(0.092)		(0.086)	
$\Delta\mu_{t-2}$	-0.229***	0.007	0.066	0.453	-0.164*	0.054
	(0.084)		(0.087)		(0.086)	
H_{01}: $\rho_1 = \rho_2 = 0$		0.000		0.000		0.000
(Φ statistic)	9.560		18.047		8.266	
H_{02}: $\rho_1 = \rho_2$	8.709	0.004	2.783	0.098	8.994	0.003
(F-statistic)	9.638	6.738e-07	8.154	9.452e-17	6.838	4.767e-05
AIC	949.356		836.248		805.693	
SBIC	964.100		853.898		820.437	
LB (4)		0.997		0.984		0.850
LB (8)		0.471		0.621		0.831
LB (12)		0.263		0.620		0.792

Notes: λ is the estimated threshold value. Between the parentheses (.) are the standard errors. *, ** and *** denote rejection of the null hypothesis respectively at 10%, 5% and 1% level. Φ is the threshold cointegration test statistic. F-statistic is the test for symmetry adjustment. The values presented for Ljung-Box (LB) test are the p-values. The optimum lag length of two was selected using AIC and SBIC.

Source: Research Findings, 2016

The estimated values of ρ_1 and ρ_2 were ρ_1(-0.398) (significant at 1 percent) and ρ_2 (-0.026) for Ex-factory-Retail, ρ_1(-0.568) and ρ_2 (-0.339) both significant at 1 percent level for wholesale-ex-factory and ρ_1(-0.080) and ρ_2 (-0.261), only ρ_2 being significant for Wholesale-Ex-factory.

The computed values 9.560, 18.047 and 8.266 were greater than the critical values of 7.71at 5 percent. Therefore we reject the null hypothesis of no threshold cointegration. We therefore conclude that there was a long run relationship among the prices at the market levels. Using the F test, the null hypothesis of H_{02}: $\rho_1 = \rho_2$ was rejected since the p values showed significance at both 1 percent and 5 percent. Therefore the price adjustment was asymmetric according to M-TAR model both in positive and negative shock.

From the Ljung-Box Q-statistics presented in table 8 and table 9 above, we fail to reject the null hypothesis of no serial correlation at 5 % level of significance for both TAR and M-TAR models.

Model Selection

Both the AIC and SBIC criteria selected the M-TAR model since there values in M-TAR were lower than those in TAR. The values of AIC and SBIC were 958.001 and 972.745 in TAR and 949.346 and 964.100 in M-TAR respectively. Enders and Granger (1998) support the selection of MTAR model as opposed to TAR.

V. Conclusion

It is evident that there were long run relationships between Ex-factory-retail, wholesale-ex-factory and wholesale retail levels, it was concluded that prices at lower levels adjust in response to changes in the upper levels. M-TAR results also showed existence of asymmetric price transmission in all the markets. The negative values of ρ_1 and ρ_2 confirm long run relationship.

From the results generated in this study, LOP does not apply in the sugar supply chain because of the presence of price asymmetry. This is due to various reasons; firstly, the assumption of perfect competition does not hold. There are no zero transaction costs in the sugar markets, there are many externalities, including government policy on sugar millers and hoarding by intermediaries during scarcity. There is also no perfect factor mobility.

The above results of asymmetry from wholesale to retail price have various implications. Asymmetric Price Transmission from wholesale to retail markets means that consumers will not be able to purchase sugar at lower prices in case of a reduction in retail prices. The reason is that even if sugar prices change at the wholesale level, retailers will not reduce consumer prices immediately, and therefore consumer will pay a higher price for a longer period of time. Retailers have to clear the stock from last period at the precious price. As retail sales increase at the relatively higher price, wholesalers do not benefit from the increased sales since they sell to retailers at a lower price than what the consumers pay. In such a case, the welfare of wholesalers reduces, and that of retailers increases.

This study presents evidence of upstream causality from wholesale to ex-factory, which can be explained by the fact, that if producers fail to meet the demand from wholesalers, their prices rise as a result of sugar scarcity. A policy on price control can be effective. Price controls can be effective at the producer level. Tools for price controls can also be implemented at the wholesale level, to reduce transaction costs, as well as at the producer level, in terms of supply. Asymmetric Price Transmission may also be a result of market imperfections, where information is not quickly disclosed to all participants, and where sugar takes too long to reach the buyer from the producer. The results of this paper therefore are important to solving market imperfections arising in the Kenyan Sugar Industry.

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