ABC Research Alert
Vol 3, Number 2/ 2015
Published Online: 30 November, 2015
http://abcreal.weebly.com/

Effects of Rice Importation on the Pricing of Domestic Rice in Northern Region of Ghana

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Abstract

The research assessed the effects imported rice prices against domestic rice prices in Northern region of Ghana. Data from the Ministry of Food and Agricultural was used for the analysis to know the price transmission between the two prices. Johansen (1991) method of cointegration was used to test the long run co-movement of prices of imported and domestic rice prices in eight selected districts markets. Granger causality and Vector Error Correction Models (VECM) were used to detect the price leadership direction and the extent of prices response to the re-establishment of long run equilibrium when there is distortion in the market respectively. The results reflect a strong long run relationship between prices of imported rice and prices of domestic rice in the same districts markets. Also, the causality results indicate no price leadership except some few cases. Analysis from the VECM shows bilateral responses, thus, domestic rice prices in the various districts markets respond to price shock when there is disequilibrium in the long run as well as the reverse. Based on the findings, there is the need to implement appropriate government policies that will ensure fair ground for domestic rice sellers to compete with sellers of imported commodity of the same kind.

Keywords

Northern region, Ghana, Price transmission, Imported rice prices, Domestic rice prices, Integration and Marketing

Introduction

Rice alongside maize is the most widely traded agricultural commodity in Ghana and self-sufficiency in rice production is an issue of national pride, rice is Ghana's largest cereal import commodity, costing the country about $500M in foreign exchange to import annually (deGrassi, 2007; Atengdem, 2009). In 2013 alone, Ghana spent US$1.5 billion in importing consumable goods among which rice ranked highest by constituting US$374 million (state of the nation's address, 2014). Ghana is presently only about 30% self-sufficient in rice produc-

tion, producing only about 150,000MT compared to a prevailing consumption requirement of about 700,000MT (MOFA, 2014). To meet the supply deficit, Ghana imports about 70% of its rice consumption requirement from Asia viz. China, Thailand and Vietnam, and the USA. A combination of increasing urbanization, consumers' income and preference of Ghanaians for imported ("perfumed/polished") rice are driving rice imports to unprecedented high levels. Ghana's 70% deficits in rice output have several apparent causes. These include low productivity (MT/Ha of paddy), high production cost including cost of credit, farm inputs, improved seed as well as efficient processing facilities, and as a consequent of the last cause, low demand for domestically produced rice (MOFA, 2011).

Over the period 2000 to 2011, imported rice increased from 187,256MT to 543,465MT representing about 190 percent increase in imports. Over the same period, the import bill increased from US$65.03 million to US$391.17 million (MOFA, 2012). As a result, the government has initiated a number of policies; increasing tariff on rice, (FASDEP I, II, METASIP, etc) and established the Ghana Rice Inter-professional Body (GRIB). The high per capita consumption level of imported rice, i.e 26 kg per annum (SRID-MOFA, 2012) has attracted the attention of many stakeholders and policy makers, as it may has effects on the marketing and production of domestic rice in Ghana.

Opponents of Ghana's agricultural market liberalisation argue that huge imports of rice has destroyed the domestic market leading to a reduction in domestic rice prices, this led to additionally unprecedented levels of rice imports into Ghana. The opponents believe that through its high competitiveness, quality and taste, and relatively low prices, imported rice compared to domestic rice is more marketable, and this reduces the parity price for domestic rice, and distorts inter-market transmission of price signals in the domestic scene. In Ghana, negative media propaganda, hectic parliamentary debates, strong NGO advocacy campaigns and numerous formal and informal campaigns from rice farmers against rice imports is a common, daily phenomenon. These conflicts have been termed "Ghana's rice wars" in the media (Amikuzuno, et al., 2013).

Due to public criticisms and discontent arising from and inflaming in the so called rice war, Ghana's government has often thought of getting directly involved in the regulation of rice imports and prices. For instance, an increase of the tariff on rice imports from 20% to 25% was considered in 2003 in response to an import surge, an option that was eventually dropped for various reasons including government willingness to comply with conditions of the World Bank and IMF (BMOS AGRO-CONSULT, 2003 in Lançon, 2007). Again, in the peak of the global food price crises in 2008, the government of Ghana removed the import tariff of 20% on rice imports in response to the rising food prices, but indicated in its 2011 budget statement to review the import duty exemption for rice (USAID, 2009).

The above interventions among others, have always been proposed to merely satisfy lobbyists including farmers, politicians and NGOs, but have often lacked the guidance of any empirical evidence. While the ability of the domestic markets of a country to function efficiently – i.e. to transmit price signals and information between themselves and across the country's borders - is a panacea for producers and consumers to benefit from liberalised marketing systems (McCulloch, et al., 2004), whether import liberalisation can be solely blamed for the production constraints, low demand, marketability and volatile prices of domestic rice and the resultant decreasing profitability of domestic rice producers in Northern region of Ghana is highly contestable.

The government of Ghana has stated that, from 2015 a stimulus package will be given to rice and poultry farmers, to boost their production capacity and to meet the demands of the domestic market. In view of this, a proposed budget of GHC50 million is made available as a special support to these sectors of agriculture, to increase production, drastically reduce the importation of those commodities and create sufficient jobs for those who would be engaged in their production. This policy intervention is to support other policies such as taxes and levied to reduce rice importation which affects domestic market. The effects of liberalisation for that matter rice importation are viewed to trickle to domestic market through price transmission (GNA, 2014).

Based on the perception that rice importation has an inverse impact on the pricing of domestic rice which led to low income accruing to rice farmers and subsequently affecting rice farmers and sellers' income poverty status attracts much attention. As a result, the research seeks to analyse relevant secondary database from the Ministry of Food and Agriculture (MOFA), the Ghana Statistical Service (GSS) and Tamale Metropolitan Assembly (TMA) to examine the effects of rice importation on the pricing of domestic rice in Northern Region of Ghana. The analysis is based on the price transmission between imported rice and domestically produced rice with an intended aim of addressing the following questions: 1. What is the long-run relationship between prices of imported rice and prices of domestically production of the same commodity? 2. Do imported rice prices lead domestic rice prices in the price determination process or vice versa? 3. What is the extent of price linkage between imported rice and domestically produced rice in Northern Region of Ghana?The study dwelled Northern region of Ghana because of the high level production, marketing and consumption of rice and the region being ranked as the third poorest region out of ten regions in Ghana.

Literature Review

Concept of Price transmission

The key underlying theoretical explanation of spatial price transmission is the spatial arbitrage and the consequent Law of One Price (LOP). On the contrary, for cross-commodity price transmission, the co-movement of prices is mostly driven by the substitutability and complementarily relations among the products (Saadi, 2011), while transmission from non-agricultural to agricultural commodities is prevalently due to the underlying production technology and cost structure, but also due to the complex drivers (expectations, speculative behaviour, etc.) of financial markets which also underlies the linkage between spot and futures prices. However, though the background theory differs, the empirical framework and the econometric implications of these different cases of horizontal price transmission are the same.

The Law of One Price (LOP)

The law of one price (LOP) is the cornerstone of most empirical studies of market integration. The LOP in its strong form, expressed as $P^j - P^i = C^{ij}$, asserts that for a single homogenous commodity, if efficient arbitrage occurs and competitive equilibrium holds between two markets linked by trade, then a price change in one of the markets will be translated on a one-for-one basis (instantaneously) to the other market. A weaker form of the LOP allows for temporary deviations from equilibrium following a price shock, with the tendency however to return to this equilibrium in the long run.

Analysis of the LOP assume that market agents have all the relevant information required to undertake optimal arbitrage and there are no impediments to trade (Jensen, 2007). Since this assumption is rarely the case in practice, using the LOP as a measure of market integration is only idealistic. As noted in McNew (1996), the LOP is just a necessary condition for spatial price efficiency since it holds only when there are no obstacles to trade or when transportation costs between markets is insignificant. A strong LOP condition is met, when trade flows from market j to i until the price differential between both markets equals the inter-market transfer costs.

Prices Linkage

Current research dwelled on the impact of world prices on domestic prices of the same commodity. Now the question is how do changes in world prices affect domestic prices? The import price of a commodity in the domestic market P^m may be stated as:

$$P^m = P^w R(1+tm) + C^{ij} \quad (1)$$

Where P^w is the world market price of the commodity, R isthe exchange rate, tm is a proportional import tariff or tax, and C^{ij} is the transfer costs of importing the commodity from the foreign market i to the domestic market j. The P^m and P^w are assumed to be expressed in a common currency.

Alternatively, the domestic price of an exportable commodity P^d can be expressed as:

$$P^d = P^w R(1-t_x) - C^{ij} \quad (2)$$

Where $t_x$is the proportional export tariff or tax, and the other variable notations are as already defined above.

In a liberalised economy for a given commodity, a price shock on P^w first triggers, through the commodity's border price, changes in the import price (P^m) of the commodity in markets close to the country's ports, borders and hub of market information such as urban markets with highly organised network of traders and reliable telecommunication facilities. These markets then lead the commodity's prices in interior markets in the price discovery or market clearing process. The rate of price discovery however depends on whether price transmission mechanisms within the country for the commodity are strong or weak (Baldi, et al., 2011)

Our analysis examines price linkages at the domestic level but within a liberalised trade context. We state, following the Law of One Price (LOP) and the Enke-Samuelson-Takayama-Judge (ESTJ) model, the contemporaneous relationship between two prices, P_t^m and P^d respectively for imported and domestic grades of rice as:

$$P_t^m = P_t^d + D_t^{md} \quad (3)$$

Where D_t^{md} is the price differential between imported and domestic rice and is equivalent to C^{ji}. The price differential represents the difference in the attributes of the two grades of rice as a result of consumers adjusting for quality. According to the LOP, perfect price transmission across the two grades of rice holds only if (3) is met. The connection between the prices is transmitted through producer incentives to influence rice output at the farm level.

Methodology

Empirical Model

This study used the Johansen method of cointegration, Granger causality and Vector Error Correction models to determine the long term connectivity between the prices of imported and domestic rice respectively. The study uses the bivariate approach of Johansen cointegration analysis. This is because of the two variables (price of imported rice and that of local rice) analysis that we are concerned with in this study.

Trace and Maximum Eigenvalue test is used to determine the presence of cointegration relationship between the price series. Using the estimates of the characteristic roots, the test for the number of characteristic roots that are insignificantly different from unity was conducted using the following statistic:

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{n}\ln(1-\hat{\lambda}) \qquad \text{..... (4)}$$

Where $\hat{\lambda}$ = the estimated values of the characteristic roots (Eigen values) obtained from the estimated Π matrix; and T = the number of usable observations. The second statistical test is the maximum Eigenvalue test $(\lambda_{\max})$ that is calculated using the formula

$$\lambda_{\max}(r, r+1) = -T\ln\left(1-\hat{\lambda}_{r+1}\right) \qquad \text{..... (5)}$$

The test of cointegration is based on the null hypothesis of no cointegration (H_0: r=0) against the alternative of at least one cointegration (H_A: r=1). The series are tested for long run relationship after satisfying that, there is stationarity using Augmented Dicky-fuller model which states as

$$\Delta P_t = \beta_1 + \beta_2 t + \beta_3 P_{t-1} + \sum_{i=1}^{m}\alpha_i \Delta P_{t-i} + \varepsilon_t \qquad \text{..... (6)}$$

Where ε_t is a pure white noise error term, m is the maximum length of the lagged dependents variable and ΔP_{t-i} is change in price of time t less i term. The number of lagged difference terms to include is often determined empirically, the idea being to include enough terms so that the error term in equation (6) is serially uncorrelated. In ADF we still

test whether $\beta_3 = 0$. The ADF is used jointly with Philip Peron (PP) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests.

Following the logic that the existence of cointegration between two markets implies at least unidirectional Granger causality, we extend the cointegration tests to test for Granger causality using the equations.

$$P_t^d = \sum_{i=1}^{n} \alpha_i P_{t-i}^m + \sum_{i=1}^{n} \beta_j P_{t-j}^d + \varepsilon_{1t} \quad \ldots\ldots \quad (7)$$

$$P_t^m = \sum_{i=1}^{n} \lambda_i P_{t-i}^m + \sum_{i=1}^{n} \delta_j P_{t-j}^d + \varepsilon_{2t} \quad \ldots\ldots \quad (8)$$

Where the disturbances ε_{1t} and ε_{2t} are assumed to be uncorrelated.

A unidirectional Granger causality of $P_t^m \rightarrow P_t^d$ or $P_t^d \rightarrow P_t^m$ is proved by an F-test on the null hypothesis that the coefficients of P_{t-i}^m in equation (7) and P_{t-j}^d in equation (8) equal zero. i.e. $\alpha_i = \sigma_j = 0$, while the alternative hypothesis states that; at least one of the coefficients is not equal to zero. When computed F-value is greater than the F-tabulated value, we reject null hypothesis, explaining causality relationship.

The VECM tests for the effect of changes in each price variable on each other. In the context of this study, the two-variable VECM tests the effect of changes in imported rice prices on domestic rice prices as well as the effect of changes in domestic rice prices on imported rice prices at the same district market . The VECM is therefore presented as follow:

$$\begin{pmatrix} \Delta P_t^d \\ \Delta P_t^m \end{pmatrix} = \alpha + \begin{pmatrix} \theta^d \\ \theta^m \end{pmatrix} (P_{t-1}^d - \beta P_{t-1}^m) + \delta \Delta P_{t-1}^m + \rho \Delta P_{t-1}^d + \varepsilon_t \quad \ldots\ldots \quad (9)$$

where P_t^d is the log of domestic rice price ;

P_t^m is the log of imported rice price;

Δ is the difference operator, so $\Delta P_t = P_t - P_{t-1}$;

$\alpha, \theta^d, \theta^m, \beta, \delta$ and ρ are estimated parameters; and

ε_t is the error term.

Study Area and Data set

The study covers selected districts in Northern region of Ghana. The Northern Region, which occupies an area of about 70,383 square kilometres, is the largest region in Ghana in terms of land area. It shares boundaries with the Upper East and Upper West Regions to the north, Brong Ahafo and Volta Regions to the south, and two neighbouring countries, the Republic of Togo to the east, and La Cote d' Ivo ire to the west. The target districts comprised of eight in number, namely; Nanumba North, West Gonja, Gushegu, East Gonja, Savelgu, Tamale, West Mamprusi and Yendi.

We used monthly wholesale prices of domestic and imported rice for selected markets in the Northern Region of Ghana for the analysis. The data covered the period from January, 2005 to June, 2014. This period is selected on the basis of availability of a continuous time series data for the entire set of the price variables considered, the period spans the global food price crises and thus useful for this exercise.

Results and Discussion

The summary statistics for the two price categories- imported and domestic rice in Tables 1a and 1b at appendix 1 indicates that, imported rice has a high price than domestic price with a minimum and maximum average of GH¢20 in Nanumba North market as a district market and GH¢217 in Tamale market as a regional market. Domestic rice has an average minimum and maximum price of GH¢12 in Yendi market and GH¢123 in Nanumba North market respectively. Nanumba North seems to have the highest maximum price among the eight districts because; the district concentrates in the cultivation of tuber crop such as yam at the expense of cereal crop like maize and rice.

Before the test of Unit root, the two graphs in appendix 2 give clue to the nature of the time series. Both graphs in the eight series are trending upwards after deflating the prices suggesting non-stationarity of the time series at levels. In testing the price series for stationarity, Augmented Dickey Fuller (ADF), Phillip Peron test (PP) and KPSS tests are used with the help of Stata 11.0 and JMulti. The results are presented in Table 2 below.

Table 2: Results of Unit root test of variables (ADF, PP and KPSS test)

Districts	Variables	Level			First difference		
		ADF Test	PP Test	KPSS Test	ADF Test	PP Test	KPSS Test
Nanumba North	DRP	-3.776**	-2.719	4.4670***	-9.223***	-7.825***	0.0749
	MRP	-2.119	-2.678	4.3974***	-8.473***	-12.597***	0.1033
West Gonja	DRP	-3.962**	-5.266***	3.5522***	-9.668***	-15.478***	0.0196
	MRP	-3.933**	-6.406***	2.9393***	-13.695***	-19.610***	0.0201
Gushegu	DRP	-1.925	-2.118	1.9467***	-7.407***	-11.969***	0.0678
	MRP	-1.268	-1.493	2.9799***	-9.114***	-15.230***	0.1657
East Gonja	DRP	-1.851	-1.928	5.1834***	-7.206***	-10.590***	0.2006
	MRP	-3.230	-5.264***	2.5909***	-11.623***	-17.768***	0.0605
Savelugu	DRP	-2.813	-3.482**	2.9482***	-11.399***	-14.384***	0.0286
	MRP	-1.281	-1.884	1.3930***	-12.658***	-15.452***	0.1674
Tamale	DRP	-2.006	-2.231	3.5737***	-9.233***	-12.366***	0.1144
	MRP	-1.810	-2.179	2.4301***	-9.915***	-13.690***	0.1299
West Mamprus	DRP	-2.613	-2.442	5.2771***	-7.234***	-9.460***	0.0922
	MRP	-2.245	-2.018	1.4878***	-8.876***	-10.402***	0.2526
Yendi	DRP	-2.028	-2.211	4.6460***	-7.089***	-12.014***	0.0565
	MRP	-1.662	-1.663	1.7815***	-7.596***	-10.484***	0.1200

Source: Own computations using MOFA-Ghana data (January, 2005 to June, 2014)

NB: DRP and MRP denotes domestic rice price and imported rice price. *** 1% and ** 5% critical values for both the ADF and PP test are -4.036 and -3.448 while the KPSS test has ***1%, and **5% critical values of 0.739, and 0.463 respectively.

The result showed that the time series is stationary, with the ADF and PP statistic being significant at the 1% level at the first difference. This is confirmed by the KPSS test which is significant at level 1% significant level. The ADF, PP and KPSS results confirmed the

graphical test of stationarity. Though, prices of imported and domestic rice in West Gonja market as well as domestic rice price in Nanumba North seems to be stationary at level, the research take in to consideration the first difference.

Since there is enough evidence to show that the two pairs of rice prices (domestic and imported) are stationary for KPSS at level and first difference for ADF and PP test in all the eight (8) selected district markets, we continue to test for bivariate cointegration using Johansen (1988) cointegration test for the non-stationary pair of prices in each district market. The result shows both the trace and Eigen value statistics in table 3.

Table 3: Results of Johansen test of Cointegration for price pairs (Trace and Eigen value test statistic)

Market difference	Trace Statistic		No. of Lags	Max Statistics	
	H_0: r=0	H_A: r=1		H_0: r=0	H_A: r=1
Nanumba North	19.6052*	2.8594	2	16.7458*	2.8594
West Gonja	18.2821*	3.5669	2	13.7152*	3.5669
Gushegu	19.8598*	1.8627	1	17.9972*	1.8627
East Gonja	48.8648**	0.0126	1	48.8521**	0.0126
Savelugu	20.3499**	0.3419	5	20.0081**	2.1846
Tamale	23.8645**	2.1846	1	21.6798**	0.8776
West Mamprusi	9.0968	0.8776	1	8.2192	0.5986
Yendi	11.0806	0.5986	1	10.4820	
	** 1% and *5% Critical values are 20.04 and 15.41	** 1% and *5% Critical values are 6.65 and 3.76		** 1% and *5% Critical values are 18.63 and 14.07	** 1% and *5% Critical values are 6.65 and 3.76

Source: Own computations using MOFA-Ghana data (January.2005 to June, 2014)

Note: The asterisks ** and * denote non acceptance of the null hypothesis of no cointegration at the 1% and 5% levels. Lag selection is based on the suggestion of a maximum lag criterion, but much attention is given to the Hannan-Quinn criterion as it ensures there is no asymptotically overestimating the lag order (Lütkepohl and Krätzig 2004, 111.)

The results show that prices of imported rice in Nanumba North, West Gonja, Gushegu, East Gonja, Savelugu and Tamale markets are cointegrated with domestic rice prices of their respective market pairs, but no significant cointegration seems to exist between imported rice price and domestic rice price in West Mamprusi and Yendi markets even at 5% significant level. The null hypothesis of no cointegration $(H_0 : r = 0)$ is therefore rejected in the six different markets. The rejection of the null hypothesis indicates an evidence for a long-run equilibrium relationship. However, the alternative hypothesis of at least one cointegration vector between the two pairs of price could not be rejected at the given levels (1% and 5%). We then proceed with the analysis considering only the six market pairs for which a significant long-run equilibrium is found.

After establishing by the use of Johansen procedure, that the two price series, P_t^d and P_t^m of rice in each market are cointegrated; we conducted Granger and Elliot (1967) causality test to find out the order and direction of long-term equilibrium relationships. Whether prices of domestic rice (P_t^d) Granger cause prices of imported rice (P_t^m) or vice-versa. The long run causality test verifies price leadership between imported rice prices in Tamale as a re-

gional market vis-a-vis domestically produced rice prices in the other districts markets. The econometrics analysis with the support of JMulTi for causality or price leadership produced the results which shows that, the null hypothesis of no Granger causality of imported rice prices in Tamale as a regional market to domestic rice prices at the various district markets is not rejected in all the cases, except Tamale – Gushegu and West Gonja cases and its reverse. The test statistic of 7.2171, 5.6007 and 4.3223 are then compared to the critical value corresponding to a 5% level of significance. The Probability values are less than 0.05 shows that the test values are greater than the respective critical value not shown in the table, and so we reject the hypothesis that imported rice prices in Tamale market do not Granger-cause domestic rice prices in Nanumba North, East Gonja and Savelgu markets. For P values higher than 0.05 (e.g. in the case of Tamale – West Gonja and Gushegu), we fail to reject the no-causality hypothesis. In the three causality proves, only one (i.e Tamale – Savelgu) indicates a bilateral causality – given evidence that domestic rice prices in the district market leads imported rice prices in the regional market in price determination and vice versa. This implies, arbitrageurs of domestic rice in the named districts markets above are both price takers and price makers. They use information of imported rice prices in their price determination and arbitrageurs of imported rice at the regional market (Tamale) sometimes also use information on domestic rice prices in their price decision making. As Francis (2009) prefers the term predictive causality, we will conclude by saying that imported rice prices in Tamale market has a predictive causality on domestic rice prices in Nanumba North, East Gonja and Savelgu markets and the reverse is not generally true. This is in conformity with (Cudjoe et al., 2008) in Ghana grain product market that prices in Accra as a national capital market Granger causes Techiman and Wa prices.

Applying the vector error correction model (VECM) to our analysis gives the speed of price transmission between imported rice ($\hat{\theta}^m$) and that of local or domestic rice ($\hat{\theta}^d$). The error correction parameters are transformed to half-lives ($\hat{\alpha}^d$ and $\hat{\alpha}^m$) to indicate how many unit of time are required to correct 50% of a deviation from the long run equilibrium. Also, the long run elasticity coefficients were obtained as the prices were in their natural logarithms ($\hat{\beta}$)' form. The elasticity illustrates the long term effects of local to imported rice and vice versa in the various markets, while the adjustment parameters indicates how equilibrium will be restored when there is distortions in the studied markets. The Table below shows the results for adjustment parameters; cointegration elasticity coefficient and computed half-lives for those adjustment parameters that are significant.

The results of the cointegration elasticity coefficient indicate that an increase in the price of imported in Tamale market by 1% will result in a decrease in domestic rice price in the same market by 0.83%. Conversely, the figure for West Gonja depicts that a 1% increase in the price of imported rice will induce domestic rice price to also increase by 0.787% and vice versa, however, the change is statistically insignificant. It is only the long run connectivity between domestic rice and imported rice prices in the West Gonja market parameter that is not significant, the rest of the parameters are significant. Also, the Nanumba North and East Gonja markets depicts 1.004% and 2.496% respectively long term inverse price transmission between imported and domestic rice. The negative and positive signs are anticipated based on the factors affecting demand and supply. Again, Savelgu has the lowest elasticity consider-

ing the inducement of imported rice price to domestic rice price – a 1% increase in imported rice price will affect the change in domestic rice price by 0.541% negatively. This can link to the low patronage or consumption of imported rice relative to the other selected districts.

Table 4: Estimated speed of price transmission and long run effects

Market difference	Variables Pairs	$\hat{\theta}^d$	$\hat{\alpha}^d$	$\hat{\theta}^m$	$\hat{\alpha}^m$	$\hat{\beta}$
Nanumba North	DRP –MRP	-0.150*** [-3.492]	4.01	0.018 [0.354]	-	-1.004*** [-6.036]
Nanumba North	MRP –DRP	0.151 *** [3.492]	4.00	-0.018 [-0.354]	-	-0.996*** [-7.791]
West Gonja	DRP –MRP	-0.159** [-2.412]	3.78	-0.052 [-1.065]	-	0.787 [1.372]
West Gonja	MRP –DRP	-0.125** [-2.412]	4.82	-0.041 [-1.065]	-	1.271** [2.497]
Gushegu	DRP –MRP	-0.155 *** [-3.269]	3.88	-0.060 [-1.021]	-	-0.552*** [-3.906]
Gushegu	MRP –DRP	-0.186*** [-3.269]	3.24	0.033 [1.021]	-	-1.812*** [-4.660]
East Gonja	DRP –MRP	-0.009 [-0.781]	-	0.203*** [3.870]	2.96	-2.496*** [-5.206]
East Gonja	MRP –DRP	0.022 [0.781]	-	-0.106*** [-3.870]	5.68	-0.401*** [-3.652]
Savelgu	DRP –MRP	-0.088 [-1.368]	-	0.093** [2.529]	6.47	-0.541*** [-2.721]
Savelgu	MRP –DRP	0.047 [1.368]	-	-0.115** [-2.529]	5.24	-1.847*** [-3.939]
Tamale	DRP –MRP	-0.461*** [-4.906]	1.31	0.158*** [3.311]	3.81	-0.828*** [-4.972]
Tamale	MRP –DRP	0.008 [0.182]	-	-0.113*** [-3.311]	5.32	-1.207*** [-5.173]

Source: Own computations using MOFA-Ghana data (January.2005 to June, 2014)

Also, a prior expectation sign for the adjustment parameters are met and both negative and positive sign are expected to restore the equilibrium. This is critical because, for price adjustment to attain equilibrium the positive price adjustment of one brand must be accompany by a negative price adjustment of the other brand. The adjustment parameters ($\hat{\theta}^d$ and $\hat{\theta}^m$) denotes estimated margins of price adjustment of one price to ensure the formation of equilibrium. The coefficient shows deviations from the long run equilibrium relationship.The coefficients called the loading or adjustment parameters are the elasticity of price transmission or the speeds of price adjustment by the domestic and imported rice price respectively. The closer a value approaches one in absolute terms; the faster deviations from equilibrium become cor-

rected. For instance, the results in Tamale domestic rice price adjustment speed between domestic and imported rice prices of -0.461 corrects deviation from equilibrium faster compared to the imported rice price adjuster in Savelgu market which valued 0.093. The fact is that, in absolute value, the domestic rice price adjustment parameter in Tamale is closer to one (1) than the imported rice adjustment parameter in Savelgu market.

The speed of transmission involving imported rice price $\hat{\theta}^{m}$ in Tamale market corrects error significantly by -0.113% towards the attainment of equilibrium. This implies 11.3% changes of domestic rice prices are transmitted to imported rice prices as a result of shocks. But in general, 10.6% or more changes in domestic rice prices are to transmitted to imported rice prices for equilibrium to be restored. On the other hand, a speed of transmission from imported rice prices to domestic rice prices in all the six market for an error to correct towards the attainment of equilibrium is 15% or more. This means, 15% or more of the changes in imported rice prices are transmitted to domestic rice prices based on demand and supply shocks. The values at the bottoms of the estimated parameters are the test statistics.

From observation, the half-lives of domestic price adjustment suggest that, prices need a minimum of 1.3 months to correct half of the deviations from price equilibrium following market shocks as against 2.69 months require by imported rice to correct one half of the deviations. Though, domestic and imported rice prices both respond to price shocks. Domestic rice prices respond faster than imported prices and have higher adjustment parameters relatively. On average, the speed of adjustment of domestic rice prices is -0.231 (23.1%) which corresponds to a half- life of 2.6 months compared to an average of -0.111(11.1%) of imported rice price speed of adjustment which corrects half of deviations from equilibrium within 5.4 months.

In conclusion, the VECM results show that, domestically produced rice prices response significantly to price shocks at a faster rate while imported rice prices do not react significantly in re-establishment of equilibrium in Nanumba North, West Gonja and Gushegu markets. The reverse is true in the case for the pair in East Gonja and Savelgu. Tamale market domestic and imported rice prices is exceptional case in that, the adjustment parameters for the two pair are correct error significantly, but domestic rice half-life of 1.31 proves to correct 50% deviations faster approximately by a month while imported rice corrects half of deviation to equilibrium by 4 months approximately. Generally among the markets, Tamale market seems to restored equilibrium by solving one half of deviations faster as both domestic and imported rice prices have lower half-lives. This can be attributed to the larger nature of the market and the free flow of information about the prices of the two rice brands.

The response to prices shock by both domestic rice prices and imported rice prices may seems to be new. This is thus possible as Greb et al. stated in the paper No. 125 (2012) on price transmission from international to domestic market that, in most cases, domestic prices adjust to deviations from the long run price relationship, but international prices do not. The only notable exception to this rule is rice. There is evidence of a statistically significant reaction by international prices to disequilibrium between domestic and international prices in 121 market pairs of which 111 involve rice. Roughly 40% of all rice prices are affected. To Greb et al., most countries are price takers on wheat and maize markets, but their evidence for rice market is mixed.

Conclusion and Policy Recommendation

In conclusion, we can say that imported rice and domestic rice prices at the same market has a long run association. Imported rice prices alone is not the only factor that Northern region for that matter Ghana can use as a proxy to link domestic rice market to imported rice market. The connection of the two markets can occur through product improvement and standardization.

Protection of domestic rice producers and sellers based on the perception that, rice importation affects the marketing of domestically produce rice might not be the right decision. Rather integrating domestic rice prices to the imported rice prices by directly encouraging quality improvement of domestic rice through modern processing techniques and consequently enhancing competition between the two grades of rice at the domestic scene must be a key concern of government. Domestic rice sellers are not only price takers, but are in a mixed position of making and taking prices.

Domestic rice sellers are critical in price determination process; hence, local producers and sellers should be place on equal ground with imported rice sellers to compete. This gave domestic producer opportunity to grab positive price shocks from the imported rice market by increasing their output and quality of their produce to competitive level. This is especially necessary since global food prices have since 2007 has been rising.

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Appendices

Appendix 1: Summary Statistics

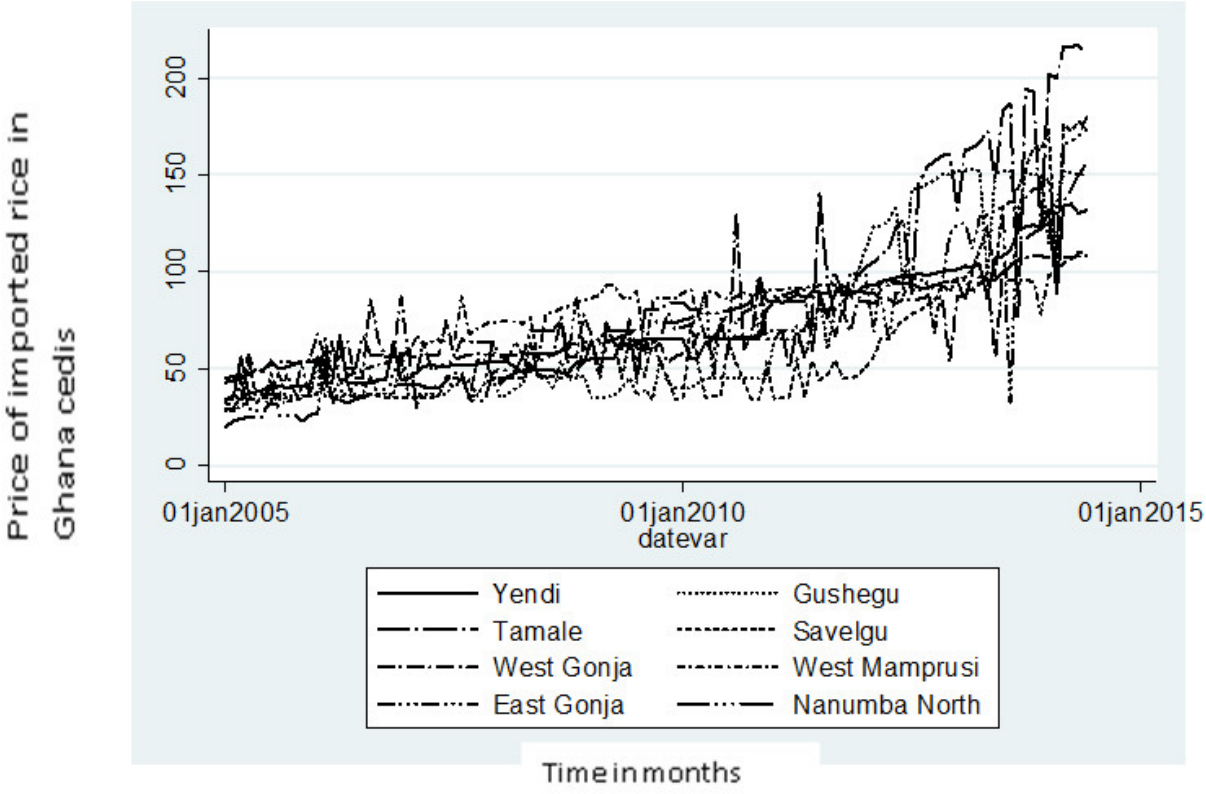
Table 1a: Summary Statistics for Average Monthly wholesale prices of domestic rice (GH¢/50kg bag)

Variable	Obs	Mean	Std. Dev.	Min	Max
	114	54	25	17	123
	114	45	24	17	93
	114	35	14	17	98
	114	45	25	15	100
	114	44	23	14	93
	114	41	22	16	93
	114	54	27	14	100
	114	44	26	12	96

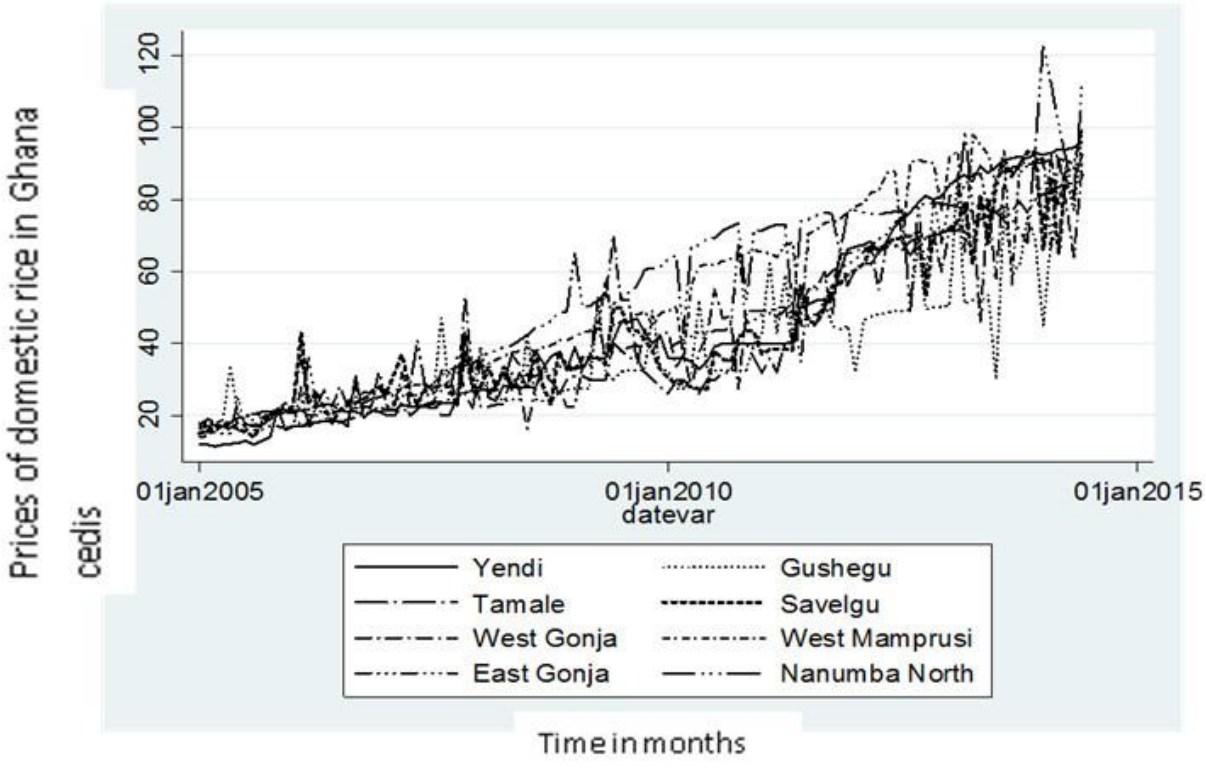
Table 1b: Summary Statistics for Average Monthly wholesale prices of imported rice (GH¢/50kg bag)

Variable	Obs	Mean	Std. Dev.	Min	Max
Nanumba North	114	70	31	20	156
West Gonja	114	71	19	45	130
Gushegu	114	71	47	28	153
East Gonja	114	75	36	26	180
Savelgu	114	63	40	31	184
Tamale	114	69	52	30	217
West Mamprusi	114	78	21	34	110
Yendi	114	71	28	34	135

Appendix 2: Graphs of the Price Series for Eight District Markets



Average Monthly Wholesale Prices for Domestic rice (GH¢/50kg bag)



Average Monthly Wholesale Prices for Imported rice (GH¢/50kg bag)