African Crop Science Journal, Vol. 22, Issue Supplement s4, pp. 929 - 939 ISSN 1021-9730/2014 $4.00

FOOD PRICE TREND ANALYSIS: LESSONS FOR STRENGTHENING FOOD SECURITY POLICY IN TANZANIA

F. MARO and F. MWAIJANDE[1]
Tanzania Commission for Science and Technology (COSTECH). P. O. Box 4102, Dar es Salaam, Tanzania
[1]Economic and Social Research Foundation (ESRF), P. O. Box 31226, Dar es Salaam, Tanzania
Corresponding author: marofesto@gmail.com, fmwaijande@esrf.or.tz

ABSTRACT

Increase in global prices for most key cereal crops has had an unprecented effect on local markets prices for maize (*Zea mays* L.) and rice (*Oryza sativa*), raising policy concerns especially in eastern and southern Africa. The objective of this study was to analyse maize and rice price transmission within Tanzania domestic markets. The study used monthly wholesale prices from nine local markets in Arusha, Dar es Salaam, Iringa, Lindi, Mwanza, Rukwa, Dodoma and Morogoro from January 2004 to August 2013. The Vector Error correction model was used. Markets were categorised into leading and follower markets. Results showed that 88 percent of maize prices in selected markets were stationary, while for rice it was 100 percent. Further analysis using Johansen test indicates 63 percent of selected maize market pairs and 75 percent for rice markets pairs were co-integrated. Leading markets were found to transmit relatively small percentages (20 percent) compared to more than 70 percent of prices transmitted by follower markets. It took relatively longer for smaller markets to transmit prices to their larger counterparts. This was also supported by granger causality analysis, where larger markets prices failed to be transmitted to small markets. Very few pairs of markets (5%) had bi-directional movement of prices, indicating limited flow or market rigidity in sharing price information. The speed of price adjustment was also very slow, especially when higher prices originate from smaller markets. This trend implies presence of many layers of markets and the prices were largely controlled by fewer traders rather than marketing forces or other actors like farmers who were down to the value chain. This kind of monopoly leads to price volatility and consumers are forced to pay more, hence, affecting affordability of majority net buyer consumers.

Key Words: Co-integration, Vector Error Correction Model

RÉSUMÉ

L'augmentation des prix de la plupart des céréales a eu un effet sans précédant sur les prix du maïs (*Zea mays)* et du riz (*Oryza sativa* L.) sur les marchés locaux, causant des soucis au niveau des politiques agricoles spécialement en Afrique de l'Est et du Sud. L'objectif de cette étude était d'analyser la transmission des prix de maïs et du riz sur les marchés domestiques en Tanzanie. L'étude a utilisé les prix mensuels des grossistes collectés sur neuf marchés locaux d'Arusha, Dar es Salaam, Iringa, Lindi, Mwanza, Rukwa, Dodoma et Morogoro, de Janvier 2003 à Août 2013. Le modèle de Correction d'Erreur Vectorielle était utilisé. Les marchés étaient catégorisés en marchés principaux et marchés secondaires. Les résultats ont montré que 88 et 100% respectivement des prix du maïs et du riz sur les marchés sélectionnés étaient stationnaires. Une autre analyse utilisant le test de Johansen indique que 63 % des pairs de marchés du maïs sélectionnés et 75% des pairs de marchés du riz étaient co-intégrés. L'étude a montré aussi que les marchés principaux transmettaient relativement un faible pourcentage (20%) comparés à plus de 70% des prix transmis par les petits marchés. La transmission des prix des marchés secondaires aux marchés principaux a relativement pris une longue période. Ceci était aussi confirmé par une analyse de causalité de Granger qui montra que la transmission des prix des marchés principaux aux petits marchés a échoué. Très peu de pairs de marchés (5%) avaient un mouvement bidirectionnel des prix, indiquant une certaine rigidité dans la transmission de l'information sur les prix. La vitesse dans l'ajustement des prix était aussi très lente, spécialement lorsque les prix les plus élevés provenaient des petits marchés. Cette tendance implique la présence de plusieurs couches de marchés et les prix étaient largement contrôlés par peu de vendeurs plutôt que les forces régissant les marchés ou d'autres acteurs tels les producteurs qui sont dans la partie inférieure de de la chaine de valeur. Ce type de monopole conduit à une volatilité des prix et les consommateurs sont obligés de payer plus, affectant ainsi la capacité d'achat de la majorité des consommateurs.

Mots Clés: Co-intégration, Modèle de correction d'erreur vectorielle

INTRODUCTION

Global food prices, especially for key cereal crops, oilseeds, dairy products and meat increased at unprecedented rates in sub-Saharan Africa (SSA) since 2007/08, leading to the current food price crisis among millions of people. This has had adverse effects on many countries, with significant hunger, poverty and macro-economic disorders (Karugia *et al.*, 2009). When global prices rose sharply, prices in eastern and southern Africa increased at lower rates over the same period. Toward 2010 and 2011, prices within the sub-region continued to rise in tandem with world prices (Nzuma, 2013), thus becoming an issue of concern for the government of the sub-region including, Tanzania.

Studies have revealed different causes of the higher food prices, including low levels of world cereal stocks, crop failures in major exporting countries, population growth, urbanisation, rapidly growing demand for biofuels and rising oil prices (FAO, 2008; von Braun, 2008; Balter, 2013; Nzuma, 2013). As the price surge spread across countries, several other factors emerged to reinforce the crisis; most importantly, export ban by main exporting countries such as Tanzania, weakening of the United States dollar, increase in speculation and the global fuel and financial crisis. Tanzania's scenario was associated with adhoc measures such as the cereal export ban and market functionality factors.

Other studies have extensively reported on the causes of the higher prices in domestic markets (FAO, 2008; von Braun, 2008; Balter, 2013; Nzuma, 2013). This paper examines the trend and price transmission within markets for maize and rice in Tanzania during the 2004 to 2013 period.

METHODOLOGY

This study used the modified vector error-correction model (VECM) (Minot, 2010) to examine price transmission between domestic food market prices in Tanzania during the period of January, 2004 to August, 2013 in various markets (Arusha, Dar es Salaam, Iringa, Lindi, Mwanza, Rukwa, Dodoma and Morogoro). Data for maize and rice were obtained from Ministry of Industry and Trade (MIT). The Ministry collects daily spot prices in all larger markets around the country. Daily prices were cleaned, standardised and calculated into monthly average prices and entered into the model.

Structure and operationalisation of the VECM model. VECM model consists of a domestic price for one commodity in one market against prices of the same commodity in another market (Minot, 2010). For each pair of domestic markets, the analysis consists of three steps; (i) price variables tested individually to establish whether they were non-stationary. This was tested with the Augmented Dickey-Fuller test (ADF). (ii) The Johansen test was used to determine whether the two series were co-integrated, meaning that each variable was non-stationary. The analysis also tested for a long-run relationship between prices in different markets. (iii) If the Johansen test indicated presence of a long run relationship between the two variables, then the price transmission was estimated using VECM. The model takes the following general form:

$$\Delta Pt = \propto + \cap P_{t-1} + \sum_{k=1}^{q} rk\, \Delta P_{t-k} + \varepsilon_t$$

.... Eq. 1

Where:

P_t = an nx1 vector of n price variables;

$$\Delta P_t = P_t - P_{t-1}$$

Δ = the difference operator, so
ε_t = an nx1 vector of error terms;
α = an nx1 vector of estimated parameters that describe the trend component;
Π = an nxn matrix of estimated parameters that describe the long-term relationship and the error correction adjustment; and
rk = a set of nxn matrices of estimated parameters that describe the short-run relationship between prices, one for each of q lags included in the model.

The model tests for the effect of each variable on each other under the law of one price. In the context of this study, the two-variable VECM tested the effect of price from leading or large consuming markets to follower or producing regions markets prices. In addition, tests automatically indicate that the 12 months lagged term was generally sufficient for carrying out price transmission analysis. Since the analysis is not concerned with international price transmission to domestic markets, only one portion of the VECM was sufficient for analyzing domestic price transmission. This portion can be simplified as follows:

$$\Delta P_t^d = \alpha + \theta\{P_{t-1}^d - \beta_{t-1}^s\} + \delta\Delta P_{t-1}^s + \rho\Delta P_{t-1}^d + \varepsilon_t \quad \text{.......... Eq. 2}$$

Where:

P_t^d = the log of leading market price converted to US/MT;

P_t^s = the log of follower market price of the same commodity in real US/MT:

Δ = the difference operator, so

$$\Delta P_t = P_t - P_{t-1};$$

$\alpha, \beta, \theta, \delta, and\ \rho$ are estimated parameters; and ε_t is the error term.

The data were tested for stationary series using unit root based on Equation 3.

$$\Delta P_t = \propto + \delta P_{t-1} + \varepsilon_t \quad \text{............ Eq. 3}$$

Where:
P_t = the crop price in a given market;
t = the time index and in this study data were recorded on monthly basis;
Δ = the difference operator;
α = a constant term;
ε = the error term; and
δ = unit root test.

In this model, a unit root was estimated and tested when δ is equal to zero (where δ = p-1) (Ravi, 2011). Since the test is done with presence over residual data it is impossible to use t-distribution to provide critical values. Therefore, ADF test was used with the help of e-views. The hypothesis statement was as follow:

Ho: δ = 0 (Unit root)
H1: δ ≠ 0

The decision rule is, if t>ADF critical value, do not reject null hypothesis, i.e. unit root exists; and if t>ADF critical value, reject null hypothesis i.e. unit root does not exist. Testing for Granger causality (GC) plays an important part in many VECMs to understand the direction of causality particularly to integrated markets. Therefore, P^1 prices can be said to be granger caused P^2 prices if P^2 helps in the prediction of P^1 or equivalently, if the coefficient on the lagged P^1 are statistically significant. However, the two-way causation frequently occurs, i.e. P^1 prices in market X granger cause P^2 prices in market Y, and P^2 prices in market Y granger cause P^1 prices in market X. It is important to note that the statement P^1 prices in market X granger cause P^2 prices in market Y does not imply that P^2 prices in market Y is the effect or result of price P^1. Granger causality measures precedence and information content, but does not by itself indicate causality in the more use of the term (Ravi, 2011; Worako, 2012).

E-view was used and it runs bi-variate regression in the form as shown in equation (4) and (5):

$$P_t^{2Y} = \propto_0 + \propto_1 P_{t-1}^{2y} + \cdots + \propto_t P_{t-1}^{2y} + \beta_t P_{t-1}^{1x} + \ldots + \beta_t P_{-t}^{1x} + \varepsilon_t \quad \text{............. Eq. 4}$$

$$P_t^{1x} = \propto_0 + \propto_1 P_{t-1}^{1x} + \ldots. + \propto_t P_{t-1}^{1x} + \ldots. + \beta_t P_{-t}^{2y} + \varepsilon_t \quad \text{............. Eq. 5}$$

Where:

t = time, P^{2y} = price in market Y, P^{1x} = price in market X, α = intercept, ε = the error term and β = coefficient. For all possible pairs of prices in market X and Y or (P^{1x}, P^{2y}) series in the group, the reported F-statistics were the Wald statistics for the joint hypothesis such that:

$$\beta_1 = \beta_2 = \cdots \beta_1 = 0 \quad \text{............. Eq. 6}$$

Therefore, for each equation, the null hypothesis is that price P^1 in market X does not granger cause price P^2 in market Y in the first regression and *vice versa* in the second regression equation.

Interpretation of model variables. The coefficients in the error-correction model were interpreted as follows:

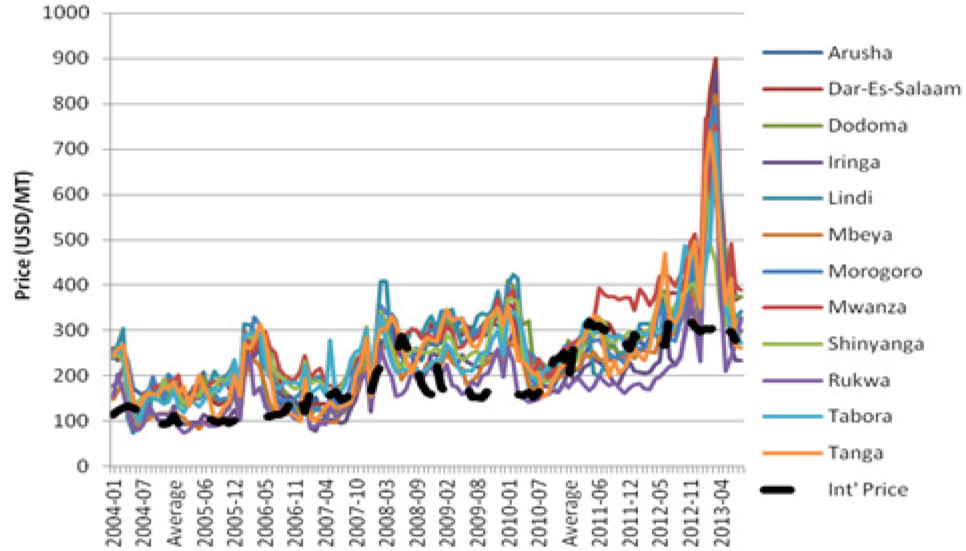
a) Since the prices are expressed in logarithms, the co-integration factor (ß) measures long-run elasticity of the follower market price with respect to the leading market price of the same commodity. Thus, ß is the long-run elasticity of price transmission. The expected value for commodities traded between leading and follower market is 1>ß>0;
b) The error-correction coefficient (θ) reflects the speed of adjustment. It is expected to fall in the range of -1<θ<0. As θ gets closer to -1, the more quickly the leading/larger market price will return to the value consistent with its long-run relationship to the follower/smaller market prices;
c) The coefficient on change (d) is the short-run elasticity of the leading market price relative to the follower price market. In this case, it measures the percentage adjustment of leading market prices by months after 1 percent shock in follower market price. The expected value is 0<d<ß.

The coefficient on the lagged change in the leading market price (p) is the autoregressive term, reflecting the effect of each change in the leading market price on the change in the follower market price in the next period. The expected value is -1<p<1.

RESULTS AND DISCUSSION

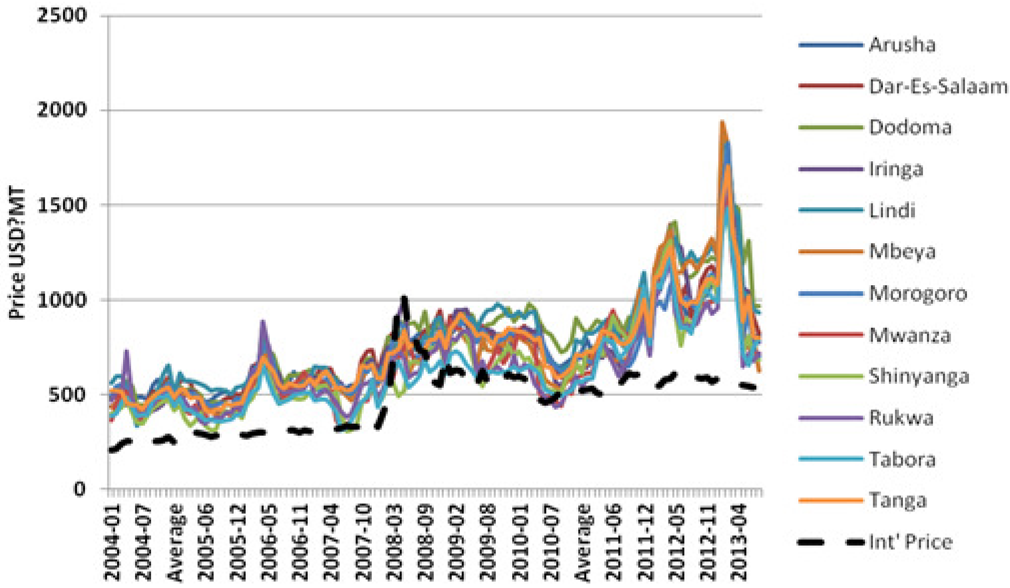
The price trends. The price surge since 2004 (except in 2007/08) for rice and maize at the beginning of 2012 when the international prices were low (Figs. 1 and 2) suggests domestic price movement and other drivers particularly at national level. For example, from January 2010 to August 2013, the margin between local and international prices for rice prices increased from 26 to 52 percent, with the local market having higher prices. On the other hand, the maize price difference between domestic and international prices, more than doubled (15 to 39%) with domestic prices being higher. The fluctuation of the supply between the harvest seasons as a result of unbalanced trade flows led to even wide variation in prices as well as food insecurity as farmers were unable to store their own production. However, the price of maize went down in the last year across certain markets in Togo, Kenya, Chad, and Uganda (between 28 and 38%) because of good supplies, and in Uganda because of reduced export pressures (World Bank, 2013).

Unit root test. The results of the unit root test are presented in Table 1. ADF test, calculated and critical values, suggest insufficient evidence to reject the null hypothesis of unit roots at the 5% level, suggesting that all the series were stationary processes and integration of the same order, except for maize prices in Lindi and Mtwara markets.



Source: Ministry of Industry and Trade (MIT), Tanzania

Figure 1. Maize price trend in markets in Tanzania during 2004 to 2013.



Source: Ministry of Industry and Trade (MIT), Tanzania

Figure 2. Rice price trend in markets in Tanzania during 2004 to 2013.

Maize co-integration. All other maize markets showed long run relationships, except for Dar es Salaam *versus* Dodoma, Arusha *vs.* Iringa, Arusha *vs.* Mbeya, and Mwanza *vs.* Rukwa (Table 2). Dar es salaam is the largest consuming region and attracts supplies from many surplus regions in the country. Dodoma is a maize auction market for eastern and southern Africa.

Dodoma *vs* Dar es Salaam did not integrate because both are large markets and compete for maize supplies from surplus regions in the country. This implies that the two markets (Dar es Salaam *vs* Dodoma) did not have a constant long-term trade flow due to reliable connectivity with other regions. Prices in Dodoma market were higher, thus it was unprofitable for traders to

TABLE 1. Unit root tests results for maize and rice monthly prices from 2004 to 2013 in Tanzania

Market	Test	Calculated values	Critical values at 0.05	
			Maize	Rice
Arusha	ADF	2.88	1.70	2.38
Bukoba	ADF	2.88	2.25	2.81
Dar es Salaam	ADF	2.88	2.23	1.89
Dodoma	ADF	2.88	1.79	2.25
Iringa	ADF	2.88	2.25	2.22
Lindi	ADF	2.88	2.09**	2.14
Mbeya	ADF	2.88	1.93	1.622
Morogoro	ADF	2.88	2.36	2.06
Moshi	ADF	2.88	1.65	1.94
Mtwara	ADF	2.88	2.57**	2.85
Musoma	ADF	2.88	1.76	2.23
Mwanza	ADF	2.88	2.39	1.91
Rukwa	ADF	2.88	2.56	3.09
Shinyanga	ADF	2.88	1.96	2.12
Singida	ADF	2.88	1.92	2.06
Songea	ADF	2.88		
Tabora	ADF	2.88		
Tanga	ADF	2.88		

ADF = Augmented Dickey Fuller Test; ** = non-stationary data

TABLE 2. Maize market co-integration data for various paired markets in Tanzania during 2004 to 2013 period

Market pair	Eigen value	Trace statistic	Critical value	P-values
Dar - Dodoma	0.09	14.55	15.49	0.07*
Dar - Iringa	0.13	18.26	15.49	0.02
Dar - Mbeya	0.14	19.47	15.49	0.01
Arusha - Iringa	0.09	15.49	15.49	0.05*
Arusha - Mbeya	0.09	12.37	15.49	0.14*
Arusha - Morogoro	0.12	18.42	15.49	0.02
Lindi - Dodoma	0.18	27.97	15.49	0.00
Lindi - Iringa	0.20	29.53	15.49	0.00
Lindi - Mbeya	0.16	23.17	15.49	0.00
Mwanza - Iringa	0.12	17.46	15.49	0.03
Mwanza - Rukwa	0.09	13.2	15.49	0.11*

* = No co-integration. Deriodr various paired markets in Tanzania during ...tion between site graphs

frequently supply Dar es Salaam market. Instead they traded more with Lindi, where prices were relatively higher than those in Dar es Salaam.

Arusha market was both a high maize producing area and a transit route for the crop to Nairobi. Significant amounts (17,916 metric tonnes) of maize in the region were exported to Kenya *via* Namanga (FEWS NET/FAO/WFP, 2011). The same route was used for export of maize produced from other regions such as Manyara, a major maize producing area in northern Tanzania. During peak deficit periods in Kenya, transit of maize through the Tanzania-Kenya border could reach 1,000 tonnes per day (Mashindano *et al.*, 2012). Overall, it was relatively a shorter distance for traders in Arusha to procure maize from Manyara than from Iringa or Mbeya, although the road connecting these regions is tarmac. Arusha - Manyara is about 118 Km compared with 686 Km Arusha-Iringa or 905 Km Arusha-Mbeya (TANROADS, 2012).

Rice co-integration. Generally, rice markets co-integration was concentrated in regions which were closer to each other (Table 3). For example, Dar es Salaam *vs.* Shinyanga, Rukwa *vs.* Morogoro, Rukwa *vs.* Mbeya, and Rukwa *vs.* Iringa were not co-integrated. Rice deficit regions such as Lindi had price co-integration with surplus Morogoro, Mbeya and Iringa. Implying long term trade relation and over dependence of Lindi for rice supplies from those regions.

Despite Lindi's co-integration with many suppliers, rice prices were higher than in many other regions. Poor connectivity was a major factor affecting food prices in southern regions of Tanzania. This translates into high transaction costs, which affect the price to the final consumers. World Bank (2009) found that transport prices per metric tonne per kilometre from farm-gate to primary markets were 3-5 times larger than those from secondary to wholesale markets located in the east African capitals. As a result, about 45 percent of average transport charges were transferred to final consumers.

Maize price transmission. Table 4 represents follower markets transmitting more than 65 percent of maize prices to leading markets. Dodoma transmitted relatively small percentages to Dar es Salaam market. This was because Dodoma was also a major auction centre in eastern and southern Africa, which makes price margin to those of Dar es Salaam very small. Similarly, it was established that surplus maize had been diverted to neighbouring countries from Dar es Salaam and central regions markets like Dodoma and Singida which are semi arid and have chronic

TABLE 3. Rice market co-integration data for paired markets in Tanzania during 2004 to 2013 period

Market pair	Eigen value	Trace statistic	Critical value	p-values
Dar – Iringa	0.13	18.64	15.49	0.02
Dar - Morogoro	0.13	18.29	15.49	0.02
Dar – Mbeya	0.14	20.68	15.49	0.01
Dar - Shinyanga	0.08	12.89	15.49	0.12*
Arusha - iringa	0.15	20.96	15.49	0.01
Arusha - Morogoro	0.16	22.07	15.49	0.00
Arusha - Mbeya	0.1	15.9	15.49	0.04
Arusha - Shinyanga	0.16	22.31	15.49	0.00
Mwanza- Shinyanga	0.15	22.33	15.49	0.00
Lindi - Mbeya	0.11	16.46	15.49	0.04
Lindi – Iringa	0.13	17.82	15.49	0.02
Lindi - Morogoro	0.12	16.61	15.49	0.03
Rukwa - Morogoro	0.06	10.79	15.49	0.23*
Rukwa - Iringa	0.09	13.26	15.49	0.11*
Rukwa - Mbeya	0.09	14.18	15.49	0.08*
Tanga - Morogoro	0.09	13.17	15.49	0.11

* = no co-integration

TABLE 4. Maize markets price transmission in paired markets in Tanzania during 2004 to 2013 period

Markets	t-value	Transmission (%)	Speed of transmission
Dar – Iringa	8.27	74.2	11.24
Dar - Shinyanga	9.36	95.8	7.38
Dar – Mbeya	8.97	81.4	3.29
Dar – Rukwa	7.21	67.9	3.08
Dar - Dodoma	6.4	60.4	8.62
Arusha - Mbeya	8.99	81.4	3.29
Arusha - Rukwa	8.96	87.8	3.76
Lindi – Iringa	10.86	93.3	4.63
Lindi - Mbeya	9.28	82.9	8.77
Lindi - Rukwa	7.38	73.7	7.75
Mwanza - Iringa	11.39	98.9	3.14
Mwanza-Rukwa	9.24	81.8	3.56

TABLE 5. Rice market price transmission in paired markets in Tanzania during 2004 period 2013

Markets	t-value	Transmission (%)	Speed of transmission
Dar – Iringa	7.34	61.9	7.58
Dar – Shinyanga	8.83	81.5	4.13
Dar – Mbeya	7.24	69.5	4.74
Dar – Morogoro	7.24	57.6	6.21
Arusha – Shinyanga	9.51	86.3	3.46
Arusha – Iringa	9.5	84.1	3.98
Arusha – Morogoro	9.51	78.1	3.06
Rukwa – Mbeya	6.61	65.3	12.35
Rukwa – Iringa	7.68	75.4	4.15
Rukwa – Morogoro	8.18	75.7	9.71
Tanga – Morogoro	7.83	60.2	4.56
Lindi – Morogoro	8.07	72.4	5.91
Lindi – Mbeya	7.37	72.9	4.79
Mwanza – Shinyanga	7.17	63.3	5.89

maize deficit due to better price margins (World Bank, 2009).

Rice price transmission. Table 5 presents follower market or small market transmissions to leading or larger consuming markets. The only exception was Morogoro market which transmitted 57 percent of prices in Dar es Salaam market. Dar es Salaam and Morogoro are much closer about (198 Km) than other major rice producing regions, but it takes more than 6 months for the prices to be transmitted from the latter to the Dar es Salaam market. Regions like Mbeya and Shinyanga take less than 4 months to transmit prices to Dar es Salaam. Arusha on the other hand, is very far but it takes 3 months to respond to prices from smaller markets from Shinyanga, Iringa and Mbeya. This is due to being close to a major export market of Nairobi. Therefore, demand in Nairobi pushes higher rice prices in Arusha, consequently affecting net buyers. However, it is not clear whether farmers benefit from the premium prices which traders get by exporting to Kenya.

Granger causality outputs. Table 6 depicts results of the granger causality and in this analysis Dar es Salaam, Arusha, Lindi and Mwanza were considered as reference markets or leading markets. Results show only maize prices of Mbeya markets depended on maize prices prevailing in Dar es Salaam market; while Iringa, Rukwa and Dodoma maize prices did not. In Ethiopia, results from similar analysis showed different results where, Addis Ababa which is equivalent to Dar es Salaam had fully bi-directional maize prices with other markets. This implies that Addis Ababa maize prices did not granger cause any markets or surplus maize regions. Maize prices in Arusha markets did not depend on prices from Mbeya and Rukwa due to the fact that Arusha was both a producing region, transit route and larger market. Lindi, unlike Arusha and Dar es Salaam, depended heavily on prevailing prices from Dodoma, Iringa and Mbeya. Also, Mwanza maize prices depended on prevailing prices in Iringa markets.

The analysis shows that there was a limitation for leading maize markets to influence prices in follower markets. This implies that maize producers did not set prices based on prices prevailing in leading markets. Van Campenhout (2007) observed slow price transmission signals to farmers due to lack of good infrastructures, as a results they were incapable of reacting to increased prices in leading markets (Kilima *et al.*, 2008).

Rice prices for Dar es Salaam market were found to granger cause prices, but with a weak effect, in Mbeya and bi-directional price

TABLE 6. Granger causality tests results for selected maize and rice markets from 2004 to 2013

Crop	Leading market	Null hypothesis	Follower market	F-statistic	Probability	Causality from follower market to leading market
Maize	Dar es Salaam	Maize prices in Dar market does not Granger Cause	Mbeya	4.54	0.01	Yes, at 5% significance level
			Iringa	16.93	0.00	No, at 5% sig level
			Rukwa	5.08	0.01	Yes, at 5% significance level
			Dodoma	9.97	0.00	Yes, at 5% significance level
	Arusha	Maize prices in Arusha market does not Granger Cause	Iringa	12.77	0.00	Yes
			Mbeya	12.79	0.00	No
			Rukwa	6.11	0.00	No
	Lindi	Maize prices in Lindi market does not Granger Cause	Dodoma	10.14	0.00	Yes
			Rukwa	7.34	0.00	No
			Mbeya	8.83	0.00	Yes
			Iringa	11.44	0.00	Yes
	Mwanza	Maize prices in Mwanza market does not Granger Cause	Iringa	7.20	0.00	Yes
Rice	Dar es Salaam	Rice prices in Dar market does not Granger Cause	Iringa	13.40	0.00	Yes
			Shinyanga	2.48	0.09	Bi-directional
			Mbeya	3.82	0.02	No
			Morogoro	9.92	0.00	Yes
	Arusha	Rice prices in Arusha market does not Granger Cause	Shinyanga	4.78	0.01	Yes
			Iringa	9.89	0.00	Yes
			Morogoro	7.60	0.00	Yes
	Lindi	Rice prices in Lindi market does not Granger Cause	Morogoro	9.72	0.00	Yes
			Mbeya	2.84	0.06	No
	Mwanza	Rice prices in Mwanza market does not Granger Cause	Shinyanga	9.61	0.00	Yes

movement with Shinyanga market. Shinyanga rice market depended lightly on prices prevailing in Arusha market (Table 6). However, Iringa and Morogoro markets depended on Arusha market prices more than Mbeya. Lindi prices had an effect on Mbeya rice prices, but with limited effect in Morogoro prices.

The analysis implies that many domestic markets for rice and maize had limited dependency on price situation in major leading markets such as Dar es Salaam and Arusha. Marketing arrangements for maize and rice in Tanzania were complex and multi-layered. Infrastructure connecting these markets were underdeveloped, causing slow price transmission (Zorya and Mahdi, 2009). However strengthening market information systems at different levels of markets in rural and urban areas is essential to improve price signal flow and producers response to higher prices.

ACKNOWLEDGEMENT

This publication is a product of a project funded by the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). The views expressed are not necessarily those of ASARECA.

REFERENCES

Baltzer, K. 2013. International to domestic price transmission in fourteen developing countries during the 2007-08 food crisis WIDER Working Paper No. 2013/031. 2-10.

FEWS NET, WFP and FAO. 2011. East Africa Cross border Trade Bulletin. Food Security and Nutrition Working Group, Market Analysis Sub group.1-3. World Food Program, Dar es Salaam, Tanzania.

FAO. 2008. Food and Agriculture Organization of the United Nations. The state of food insecurity in the world. High food prices and food security: Threats and opportunities. Rome, Italy. FAO. pp. 1-10.

Karugia, J., Waithaka, M., Freeman, A., Prabhu, R., Shiferaw, B., Gbegbelegbe, S., Massawe, S., Kyotalimye, M., Wanjiku, J. and Macharia, E. 2009. Responding to food price crisis in Eastern and Southern Africa: Policy options for national and regional action. ReSAKSS Working Paper. Washington, DC: ReSAKSS-Eastern and Central Africa.

Kilima, F., Kenkel, C.C.P. and Mbiha, E. 2008. Impacts of market reform on spatial volatility of maize prices in Tanzania. *Journal of Agricultural Economics* 59 (2): 257-270.

Minot, N. 2010. Transmission of world food price changes to African markets and its effect on household welfare. Paper presented at the COMESA policy seminar. *Food price variability: Causes, consequences, and policy options* on 25-26 January 2010 in Maputo, Mozambique under the Comesa-MSU-IFPRI African Agricultural Markets Project (AAMP). pp. 1-47.

Nzuma, J. 2013. The political economy of food price policy: Case of Kenya. WIDER Working paper No. 2013/026.3-33. World Institute for Development Economics Research, Helsinki, Finland.

Ravi K. 2011. Testing of relationship between stock return and trading volume in India. *International Journal of Multidisciplinary Research* 1 (6):377 - 378.

School of International Public Affairs (SIPA). 2010). Food security in Tanzania: Opportunities, challenges and enabling environment. Paper presented at Capstone Workshop at Columbia University/SIPA for further developing the AgCLIR program (Agribusiness Climate Legal and Institutional Reform), a USAID-funded project implemented by Booz Allen Hamilton. Proceedings of Capstone Team. Sponsored by Booz Allen Hamilton. pp. 2-18.

TANROAD. 2012. Tanzania Roads Agency. Distance Charts. Ministry of Works, Dar es Salaam, Tanzania.

von Braun, J. 2008. Food and financial crises Implications for agriculture and the poor. Food Policy Report 20. International Food Policy Research Institute (IFPRI). Washington, DC. USA.

Van Campenhout, B. 2007. Modelling trends in food market integration: Method and an application to Tanzanian maize markets. *Food Policy* 32: 112-127.

Worako, T. 2012. Dynamics of food price trends and policy options in Ethiopia. Ethiopian Development Research Institute. pp. 2-28.

World Bank. 2009. East Africa: A study of the regional maize market and marketing costs. AFTAR Report 49831, Washington, D.C. USA. pp. 1-78.

World Bank. 2013. Tanzania economic update: Opening the gates, how the port of Dar es Salaam can transform Tanzania. The World Bank Group. *Africa Region Poverty Reduction & Economic Management* 3:3-12.

Zorya, S. and Mahdi, S. 2009. High marketing costs and inefficiencies in Tanzania's maize market. A poverty perspective. Poverty reduction and economic management. Africa Region. The World Bank. pp. 3-23