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An Assessment of Spatial Integration for Major Wholesale Rice Markets in Tanzania

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ABSTRACT

This paper examines the extent of market integration of six selected rice markets in Tanzania, which include one major consumption market, three surplus and two deficit markets using monthly wholesale price data from January 2004 to December 2012. The analysis was done using Johansen co-integration and Vector Error Correction Model (VECM). The study findings reveal that markets are co-integrated in the long run. There exists four bidirectional causal relationships and eleven unidirectional relationships among markets. Dar-Es-Salaam, a major consumption market has bidirectional granger causality with Mtwara which is a deficit market and recorded a unidirectional relationship with the rest markets. Other pairs of markets with bidirectional relationships among them are Mbeya-Mtwara; Morogoro-Dodoma and Dodoma-Shinyanga. The result of VECM is significant and negative and the rate at which VECM restores deviation from equilibrium is at 60 percent which is slightly higher. The impulse response function results show that if one standard error shock is imposed to a market, its effects dissipate between two to six months. In terms of the forecast error variance decomposition (FEVD), the results show that the predominant sources of price fluctuations across markets are largely due to own shocks and Dar-es-salaam market, to a very small degree, shocks are coming from the rest markets. This implies that Dar-es-salaam market as a major consumption market influences the price behavior of rice markets in Tanzania and can be used to predict future prices. Based on these findings, the government can use market-based policies for food security since rice markets are integrated so that the effect of policy intervention in one market would be transmitted to other markets.

Key words: Market Integration, Rice Markets, Granger Causality, VECM.

JEL: D40, Q11

1.0 INTRODUCTION

Agricultural markets in many African countries are characterized by inefficiency and poor market integration. This is partly so because of infrastructure and communication problems that are coupled with high transport costs, thereby hindering the transmission of implements and key market information to stakeholders in the agriculture sector. Price is one of the signals of the efficiency and the level of integration of agricultural market as it acts as a major source of resources allocation and utilization (Ghafoor and Aslam, 2012). Increased market integration can bring significant benefits to farmers and local residents. It can raise the incomes of producers by permitting increased specialization and trade, and it can improve the welfare of risk averse consumers by reducing the variability of prices for goods that were previously non-tradable (Gonzalez-Rivera and Helfand, 2001). Therefore, the level of integration of agricultural produce markets is critical in influencing on the adoption of price policy as Dreze and Sen (1995) argue that if agricultural markets are not integrated, then any local food scarcity will tend to persist, as distant markets (with no scarcity) will not be able to respond to the price signals of such isolated markets. This means if markets are not integrated, the information they convey may not be accurate. Inaccurate price signals sent in a poorly integrated market system may distort both producers' and consumers' marketing decisions. This will tend to result in traders exploiting the market and benefitting at the expense of both producers and consumers. On the other hand, in a more integrated market, farmers specialize in their production, consumers pay less, and the society benefits from economies of scale (Goodwin and Schroeder, 1991).

Spatial market integration signifies the time lapse for the exogenous shocks to transform and reach the various geographically separated markets. The shorter the time lapse, the better, since longer time lapse leads to the conveyance of an inaccurate price signal that might distort producers' marketing decisions. Price transmission and

domestic market integration have implications for food security. The integration of markets can be considered either as: the existence of physical trade between markets, the difference in prices between two markets being equal to the cost of transporting goods between the markets, or the prices in the markets moving together over time (WFP, 2007). There is mixed evidence from previous studies regarding rice market integration across countries. While some studies show the presence of rice market integration in some countries, there are also studies that do not find any evidence particularly in developing countries. For example, Ojo et al (2015) investigated the long and short-run price integration analysis of rice markets in Kwara State, Nigeria. The results reveal that there was a stable long-run equilibrium relationship among the markets. The vector error correction estimates shows that most of the markets were not well integrated in the short run, and finally, the causality test revealed that no single market dominated the price formation either in the rural or urban markets in the study area. Further, Jha et al. (2005) examined market integration in 55 wholesale rice markets in India using monthly data from the period of January 1970 to December 1999. It was found that market integration was far from complete in India and a major reason for this was the excessive interference in rice markets by government agencies. As a result, it was hard for scarcity conditions in isolated markets to be picked up by markets with abundance in supply and a number of policy implications were also considered. On the other hand, Dawson and Dey (2002) studied the spatial market integration among major rice markets in Bangladesh using a dynamic vector autoregressive model and co-integration. The results showed that rice markets in Bangladesh were perfectly integrated with each other. The results of the causality analysis showed that Dhaka market dominated nearby markets but was itself dominated by more distant markets. Similarly, Ghafoor and Aslam (2012) studied the market integration and price transmissions in rice markets of Pakistan and found out that five major rice markets of Pakistan were integrated with each other on overall basis. The pair-wise integration of these markets showed the presence of co-integrating vectors and the adjustment vector measured through error correction mechanism showed that it takes almost 4-5 months for adjusting any short run shock in the rice markets of Pakistan. However, in case of price transmission from international markets to domestic rice markets of Pakistan, it was found that co-integration was absent and it may be due to the reason that Pakistan itself is a big exporter of rice and depend less on international markets for price formation in its domestic rice markets. Furthermore, Suryaningrum et al (2013) investigated a spatial market integration of Thailand and Vietnam rice market in Indonesia. The results show the existence of long-run relationship among Thailand, Vietnam, and Indonesian rice in the domestic market. While, Vector Error Correction Model indicates that price change in Indonesia is mainly influenced by its seasonal dummy and import ban in 2004 to 2005, Thailand and Vietnam rice prices are mainly influenced by Indonesian price at the previous period and Indonesian import ban policies. Adjustment speed of Vietnam toward long-run equilibrium is faster than Thailand. However, speed adjustment of Indonesia is not significant.

Hence, this paper examines the level of domestic market integration and price transmission of the major wholesale rice markets in Tanzania. It explores three surplus markets, two deficit markets one major consumption market (Mbeya, Morogoro, Shinyanga, Mtwara, Dodoma, and Dar-es-salaam). This paper is motivated by rice being the second most important food and commercial crop in Tanzania after maize. The growth of cities and urbanization that takes place in Tanzania makes rice the most preferred staple food. This means in a situation of food shortage in some parts of the country, rice consumption becomes an option and the integration of rice market can help address food shortage in other markets, since price changes in one market as a result of increased supply can be transmitted to another markets. Thus, testing for such integration is important in determining the (geographical) level at which agricultural price policy should be targeted by policy makers in their analysis of food security and in guiding appropriate responses to a food crisis. Further, there are limited studies in Tanzania that have focused on rice market integration specifically rice price transmission between surplus, deficit and major consumption markets. It is against this background that this study fills the existing gap.

1.1 An Overview of the current state of Tanzania's Rice Sub-Sector

Rice is the second most important food and commercial crop in Tanzania after maize; it is among the major sources of employment, income and food security for Tanzania farming households. Tanzania is the second largest producer of rice in Southern Africa after Madagascar with production level of 1.1 million tons (FAOSTAT, 2010). The leading regions in rice production in Tanzania are Mwanza, Shinyanga (Bariadi & Maswa), Morogoro (Kilombero, Wami-Dakawe); Tabora (Igunga), Kilimajaro (lower Moshi), Coast (Rufiji, Lindi), Mbeya (Mbarali, Kyela, Kapunga) and Rukwa Regions. 25 percent of the national rice production comes from two regions namely Mbeya and Morogoro. It is estimated that around 90 percent of Tanzania's rice production is done by small scale farmers who on an average, they farm a size of 1.3 hectares. About 74 of total production area in the country is rain-fed lowland rice, 20 percent is upland rice and 6 percent is irrigated. The potential rice area is estimated at 2-3 million hectares, but at present only 720,000 Ha is under production. Hence, to exploit and realize this potential, a lot of efforts have to be put in increasing and expanding the cultivable rice area under irrigation.

Figure 1: Annual Rice Production (2001-2012)

Source: FAOSTAT

The figure 1 above shows rice production trend between 2001 and 2012. The production recorded a moderate upward trend between 2001 and 2008. It dropped slightly in 2009 and peaked up again in 2010. However, production dropped rapidly for a period between 2010 and 2012. The fall in production that characterized the period between 2010 and 2012 can be explained by insufficient rainfall, and the low use of agricultural inputs, but generally production increased two folds from 867,692 MT in 2001 to 1.8 million MT in 2012.

1.2 Rice Consumption

Tanzania has one of the fastest growing urban populations in East Africa, rising at 4.7 percent per year; the growing middle class prefer rice over other staples. Rice is the second most preferred staple after maize. It is especially preferred in urban areas, in institutions such as hospitals and schools and in restaurants. Two reasons might explain the observed preference in rice consumption. Firstly, most of the people in non-rice growing urban areas of Tanzania are poor and cannot afford to buy rice on a regular basis and secondly, the preference for rice in restaurants and institutions is mainly due to its convenience in terms of catering. It is estimated that rice constitutes about 16.6 percent of cereal consumption in Tanzania. In terms of consumer preference, rice from Kyela in Mbeya region is considered to be of the highest quality, followed by rice from Shinyanga, Tabora, Morogoro and Moshi in the order of decreasing preference. These preferences are fully reflected in the prices of the different types of rice in various markets nationwide. Due to the importance of rice as food and commercial crop in Tanzania, and the rapid growth of cities and population that we witness, increases in rice price and odd price fluctuations tend to affect consumers adversely. Consumers in rice deficit regions and markets tend to experience the hardest hit. The existence of market integration in the country can lessen the negative consequences brought about by increases in rice price and odd price fluctuations as Goletti et al (1995) argue that market integration ensures that a regional balance occurs among food deficit, surplus and non-cash crop producing regions.

2.0 DATA SOURCES AND METHODOLOGY

2.1 Data Sources

The paper uses monthly prices of six major wholesale rice markets in Tanzania namely; Mbeya, Mtwara, Dodoma, Morogoro, Shinyanga and Dar-Es-Salaam for the period of January 2004 to December, 2012. The selection of these markets was based on being surplus rice producers (Morogoro, Shinyanga and Mbeya), deficit (Mtwara and Dodoma) and major rice consumption market (Dar-Es-Salaam). The data used in the analysis is rice wholesale prices (quoted in Tanzanian Shillings per bag of 100 kilogram) sourced from the Ministry of Industry and Trade in Tanzania.

2.2 Methodology

The price data series for all the markets were tested for the presence of unit roots employing Augmented Dickey-Fuller (ADF) test. The ADF test considered the null hypothesis that the series have a unit root, that is non-stationary.

The typical ADF test is given below:

$$\Delta y_t = y_0 + y_{1t} + (\beta - 1)y_{t-1} + \delta_1 \Delta y_{t-1} + \delta_2 \dots \dots \dots (1)$$

Johansen's Co-integration Test

The next step is testing the Johansen's Co-integration. The dependent variables y_t ($i=1, 2, 3\dots 6$) are prices of different rice markets ($i=1, 2, 3\dots 6$) and the independent variables β_i ($i=1, 2, 3\dots 6$) are prices of other rice markets. For instance, the co-integration equation for Dar-Es-Salaam (major consumption) market with the other markets is given as follows;

$$Dar = \beta_1 + \beta_2 Dodoma + \beta_3 Mbeya + \beta_4 Mtwara + \beta_5 Morogoro + \beta_6 Shinyanga + \delta_1 \dots \dots \dots (2)$$

The third step is about determining the Error Correction Model (ECM) to capture the long-run equilibrium and short-run disequilibrium situations as well as adjustments between prices. An ECM formulation, which describes both the short-run and the long-run behaviors of prices, is expressed as follows:

$$\Delta P_{Bt} = \gamma_1 + \gamma_2 \Delta P_{At} - \pi v_{Bt-1} + V_{it} \dots \dots \dots (3)$$

In this model,

γ_2 = the impact multiplier (the short-run effect) that measures the immediate impact that a change in P_{At} will have on a change in P_{Bt}

π = the feedback effect or the adjustment effect that shows how much of the dis-equilibrium is being corrected, that is the extent to which any disequilibrium in the previous period affects any adjustment in the P_{Bt} period.

Granger Causality

The fourth step is determining the direction of causality by Granger causality test. When two price series are co-integrated and stationary, one may proceed to carry out the granger causality test. When granger causality run one way (uni-directional) or it could also be bi-directional which indicates that both series influence each other (e.g. X causes Y and Y also causes X). The market which Granger-causes the other is tagged the exogenous market and exogeneity can be weak or strong (Adeoyo et al, 2011).

The Granger model is represented as follows;

$$\Delta P_{it} = \sum_{i=1}^m \alpha_i \Delta P_{i(t-1)} + \sum_{j=1}^n \alpha_j \Delta P_{j(t-1)} + \ell_t \dots \dots \dots (4)$$

Where m and n are the numbers of lags determined by a suitable information criterion. Rejection of the null hypothesis indicates that prices in market j Granger-cause prices in market.

H_0 : price of rice in one market does not determine (granger cause) the price in the other market

H_1 : price of rice in one market does determine the price in the other market (not granger cause)

3.0 RESULTS AND DISCUSSION

Table 1 shows the results of ADF Unit Root test of major wholesale rice price series to ascertain the time series properties of the data. The results confirm that all the price series were stationary and integrated of the same order after first difference.

Table 1: ADF Unit Root Test

Market	ADF (Level Form)	Remark	ADF (First Difference)	Remark
Dar	-0.473	Non-stationary	--6.83*	Stationary
Mbeya	0.4615	Non-stationary	-6.452*	Stationary
Mtwara	-1.021	Non-stationary	-5.835*	Stationary
Morogoro	-0.112	Non-stationary	-6.934*	Stationary
Shinyanga	-0.851	Non-stationary	-7.956*	Stationary
Dodoma	-0.041	Non-stationary	-7.021*	Stationary

* Significant at 5 percent level

The co-integration test was carried out on all the variables to determine the existence of long-run relationship between the price variables. Table 2 presents the result of the co-integration test involving the use of Johansen Maximum Likelihood test to determine the number of co-integrating relations. Both the trace statistics and Maximum Eigen statistics show that out of 12 market pairs investigated all market pairs are co-integrated at 5% level of significance. Based on this finding for both Trace and Maximal Eigen value tests, it is evident that a substantial number of rice markets in Tanzania are well linked with each other and price signals are fairly transmitted (Table 2).

Table 2: Result of Johansen's Co-integration Test

Null hypothesis	Trace Statistics	95% Critical Value	Maximum Eigen-Value	95% Critical Value
Dar-Dodoma				
r=0	23.54**	15.41	22.9**	14.07
r=1	0.646	3.76	0.646	3.76
Dar-Mbeya				
r=0	19.60**	15.41	19.28	14.07
r=1	0.316	3.76	0.316	3.76
Mtwara-Shinyanga				
r=0	20.05**	15.41	18.72**	14.07
r=1	1.33	3.76	1.33	3.76
Morogoro-Mtwara				
r=0	16.9952**	15.41	15.67**	14.07
r=1	1.320	3.76	1.320	3.76
Shinyanga-Dodoma				
r=0	20.65**	15.41	20.26**	14.07
r=1	0.39	3.76	0.39	3.76
Mbeya-Mtwara				
r=0	18.21**	15.41	17.73**	14.07
r=1	0.490	3.76	0.49	3.76
Shinyanga-Morogoro				
r=0	19.54**	15.41	18.97**	14.07
r=1	0.5775*	3.76	0.57	3.76
Shinyanga-Mbeya				
r=0	21.07**	15.41	20.79**	14.07
r=1	0.28	3.76	0.28	3.76
Dar-Shinyanga				
r=0	20.59**	15.41	19.79**	14.07
r=1	0.792	3.76	0.79	3.76
Dar-Mtwara				
r=0	23.27**	15.41	22.19**	14.07
r=1	1.08	3.76	1.08	3.76
Dar-Morogoro				
r=0	25.90**	15.41	24.75**	14.07
r=1	1.15	3.76	1.15	3.76
Mtwara-Dodoma				
r=0	13.94	15.41	20.37**	14.07
r=1	0.5663	3.76	0.57	3.76

**Significant at 0.05 level

The results of Johansen co-integration test suggests that we can continue with the analysis to vector error correction model (VECM) which means that there is a long-run equilibrium relationship among Dar-Es-Salaam, Dodoma, Mbeya, Morogoro, Mtwara and Shinyanga rice prices. To estimate co-integrating coefficients (β), we used the Johansen co-integration test. After normalization, the first co-integrating vector on Dar normalized co-integrating coefficients were estimated as follows:

$$\text{Dar} = -2.392 \text{ Dodoma} + 1.121 \text{ Mbeya} + 1.894 \text{ Morogoro} - 2.963 \text{ Mtwara} + 1.741 \text{ Shinyanga} \dots\dots\dots(5)$$

(-4.95)**
(2.85)**
(3.19)**
(-6.42)**
(5.43)**

Note: All figures in Parentheses indicate t values

** Significant at 5%

The equation indicates that a 1% increase in prices in Dodoma results in a 2.39% decrease in prices in Dar, whereas a 1% increase in prices in Mbeya increases prices in Dar by 1.12%. This implies that Dodoma being a deficit market, its price increase does not translate directly into price increases in Dar because Dar is a rice recipient market (consumption market) from various sources including Mbeya, Morogoro and Shinyanga (surplus markets), as a result, the respective markets have equally recorded positive relationships with Dar-es-salaam in the above co-integrating equation.

The causal relationship of the price series was examined using granger causality test at 1 lags level. This analysis was necessitated by the statement of Gujarati (2004) that although regression deals with the dependence of one variable on other variables, it does not necessarily imply causation. The results are presented in the Table 3.

Table 3: Pair wise Granger Causality Tests

Market <i>i</i>	Market <i>j</i>	F1	Prob > F1	F2	Prob > F2	Direction of causality
DAR	MBEYA	6.143	0.015**	0.889	0.348	Unidirectional
	MTWARA	8.029	0.006***	5.5797	0.0200**	Bidirectional
	MOROGORO	0.286	0.594	38.326	0.0000***	Unidirectional
	DODOMA	0.769	0.383	38.495	0.0000***	Unidirectional
	SHINYANGA	13.060	0.0005***	0.0099	0.9209	Unidirectional
MBEYA	MTWARA	4.825	0.0303**	9.552	0.0025***	Bidirectional
	MOROGORO	0.356	0.5518	23.486	0.00000***	Unidirectional
	DODOMA	0.895	0.3464	25.259	0.00000***	Unidirectional
	SHINYANGA	5.665	0.0191**	1.9047	0.17052	Unidirectional
MTWARA	MOROGORO	2.638	0.1074	31.878	0.00000***	Unidirectional
	DODOMA	0.243	0.622	8.970	0.0034***	Unidirectional
	SHINYANGA	22.062	0.0008***	0.533	0.4670	Unidirectional
MOROGORO	DODOMA	8.649	0.00040***	6.785	0.0105**	Bidirectional
	SHINYANGA	23.718	0.00004.***	0.0635	0.8015	Unidirectional
DODOMA	SHINYANGA	38.208	0.0001***	8.9700	0.0034***	Bidirectional

NOTE: Values with asterisk shows granger causality. Prob>F is higher at 1 (***) and 5 (**) percent statistical significance level.

There are four bidirectional causal relationships and eleven unidirectional relationships among markets as indicated in table 3. Dar-Es-Salaam is a major consumption market and has bidirectional granger causality with Mtwara which is a deficit market and has recorded a unidirectional relationship with the rest markets. Other pairs of markets with bidirectional relationships among them are Mbeya-Mtwara; Morogoro-Dodoma and Dodoma- Shinyanga. Mbeya shows a unidirectional causality with Morogoro, Dodoma and Shinyanga whereas Mtwara market shows a unidirectional causality with Morogoro, Dodoma and Shinyanga. This implies that Mbeya granger causes price formation in Morogoro, Dodoma and Shinyanga but not vice versa. In the same manner, Mtwara granger causes

price formation in Morogoro, Dodoma and Shinyanga, but no reverse mechanism of price formation was found among them. On the basis of the granger causality results, we conclude that all these markets granger causes price formation in each other so linked in efficient manner to transmit signals and related arbitrage.

Table 4: Vector Error Correction Model of selected Rice markets in Tanzania

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	943.3470	733.9980	1.285217	0.2017
D(DAR(-1))	0.123759	0.156579	0.790394	0.4312
D(DODOMA(-1))	0.058682	0.111966	0.524107	0.6014
D(MBEYA(-1))	0.145759	0.110720	1.316462	0.1911
D(MOROGORO(-1))	-0.510829	0.143219	-3.566760	0.0006***
D(MTWARA(-1))	0.417047	0.127676	3.266444	0.0015***
D(SHINYANGA(-1))	0.031988	0.107642	0.297175	0.7670
ECT(-1)	-0.602060	0.160027	-3.762246	0.0003***
R-squared	0.327463	Mean dependent var		1268.953
Adjusted R-squared	0.279424	S.D. dependent var		8697.417
S.E. of regression	7382.953	Akaike info criterion		20.72421
Sum squared resid	5.34E+09	Schwarz criterion		20.92522
Log likelihood	-1090.383	F-statistic		6.816689
Durbin-Watson stat	1.986636	Prob(F-statistic)		0.000001

Note: (***) indicates statistical significant at 1% level

On the basis of Vector Error Correction Model as indicated in Table 4 above, the coefficient of Vector Error Correction Model (VECM) is -0.6020 which is significant at 1% level of significance and it is negative. This means, it will rightly act to correct any deviations from long run equilibrium. The significant Error Correction Mechanism shows that the speed of adjustment of rice prices to the long run equilibrium is 60% which is slightly higher.

3.1 Impulse Response Function Analysis for Rice markets

In further examining the short-run dynamic properties of rice prices, Impulse Response Function (IRF) and Forecast Error Variance Decomposition (FEVD) were analyzed among rice markets. The impulse response function graphs are as shown in annex 1 (from figure 2 to figure 10). The plots (Figures 2 to 10) show that the markets reacted positively and negatively when one standard error shock was given to deficit, surplus or major consumption market. In figure 2, a one standard error shock to Dodoma has a positive effect on Dar-es-salaam, whereas its effects dissipate after 6 months. In figure 3, one standard error shock to Mbeya has a positive effect on Dar-es-salaam and its effect disappears after two months. In figure 4, a one standard error shock to Dar-es-salaam has a positive effect on Morogoro and its effects dissipate after four (4) months. In figure 7, one standard error shock to Dar-es-salaam has a negative effect on Shinyanga, its impact dies after four (4) months. In figure 8, one standard error shock on Mtwara has initially a positive impact on Dodoma then after two months, it becomes negative throughout the period and its impacts dies after 6 months.

3.2 Variance Decomposition Analysis for Rice Markets

Based on variance decomposition analysis, the results reveal that the predominant sources of price fluctuations across markets are due largely to own shocks and Dar es salaam market, to a very small degree, shocks are coming from the rest as it is indicated in Annex 2 (Table 5). This implies that Dar-es-salaam as a major consumption market has a significant role in influencing the rice price behavior in Tanzania and can be used to predict future prices.

4.0 CONCLUSION AND POLICY IMPLICATION

This paper examined the level of domestic market integration and price transmission of the major wholesale rice markets in Tanzania. The study findings show that the six wholesale rice markets which include one major consumption market, three surplus and two deficits markets are co-integrated. This is confirmed by the results of the vector error correction model, which shows that the error correction term is negative and significant at 1% level, implying that the markets have the long run relationship among them and the speed of adjustment of rice prices towards long run equilibrium is 60% which is slightly higher. On the other hand, the results of variance decomposition analysis reveal that the predominant sources of price fluctuations across markets are due largely to own shocks and Dares-salaam market. This suggests that Dar-es-salaam market, which is the major consumption market, influences

the rice markets behavior and it can be used as well to predict future prices. Thus, based on these study findings, the government can use market-based policies for food security which are appropriate if markets are integrated, so that the effect of policy intervention in one market would be transmitted to other markets.

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Annex 1

JMUUTT Tue Mar 22 09:24:47 2016

Figure 2: Orthogonalised Impulse Response functions of Dar-Dodoma

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Figure 3: Orthogonalised Impulse Response functions of Dar-Mbeya

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Figure 4: Orthogonalised Impulse Response functions of Morogoro-Dar

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Figure 5: Orthogonalised Impulse Response functions of Mtwara-Dar

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Figure 6: Orthogonalised Impulse Response functions of Mbeya-Morogoro

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Figure 7: Orthogonalised Impulse Response functions of Shinyanga-Dar

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Figure 8: Orthogonalised Impulse Response functions of Dodoma-Mtwara

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Figure 9: Orthogonalised Impulse Response functions of Mbeya-Morogoro

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Figure 10: Orthogonalised Impulse Response functions of Mtwara-Mbeya

Annex 2

Table 5: Results of Variance Decomposition Analysis for Rice Markets

VECM Forecast Error Variance Decomposition in Dar						
Horizon	Dar	Dodoma	Mbeya	Morogoro	Mtwara	Shinyanga
1	1.00	0.00	0.00	0.00	0.00	0.00
2	1.00	0.00	0.00	0.00	0.00	0.00
3	1.00	0.00	0.00	0.00	0.00	0.00
4	1.00	0.00	0.00	0.00	0.00	0.00
5	1.00	0.00	0.00	0.00	0.00	0.00
6	1.00	0.00	0.00	0.00	0.00	0.00
7	1.00	0.00	0.00	0.00	0.00	0.00
8	1.00	0.00	0.00	0.00	0.00	0.00
9	1.00	0.00	0.00	0.00	0.00	0.00
10	1.00	0.00	0.00	0.00	0.00	0.00
11	1.00	0.00	0.00	0.00	0.00	0.00
12	1.00	0.00	0.00	0.00	0.00	0.00
VECM Forecast Error Variance Decomposition in Dodoma						
Horizon	Dar	Dodoma	Mbeya	Morogoro	Mtwara	Shinyanga
1	0.18	0.82	0.00	0.00	0.00	0.00
2	0.45	0.50	0.01	0.00	0.03	0.01
3	0.58	0.33	0.01	0.00	0.06	0.02
4	0.65	0.24	0.02	0.00	0.07	0.02
5	0.68	0.19	0.00	0.00	0.08	0.02
6	0.70	0.16	0.02	0.00	0.09	0.03
7	0.72	0.14	0.02	0.00	0.09	0.03
8	0.73	0.13	0.02	0.00	0.09	0.03
9	0.74	0.12	0.02	0.00	0.09	0.03
10	0.74	0.11	0.02	0.00	0.10	0.03
11	0.75	0.10	0.02	0.00	0.10	0.03
12	0.75	0.09	0.02	0.00	0.10	0.03
VECM Forecast Error Variance Decomposition in Mbeya						
Horizon	Dar	Dodoma	Mbeya	Morogoro	Mtwara	Shinyanga
1	0.38	0.00	0.62	0.00	0.00	0.00
2	0.37	0.00	0.63	0.00	0.00	0.00
3	0.37	0.00	0.63	0.00	0.00	0.00
4	0.36	0.00	0.64	0.00	0.00	0.00
5	0.36	0.00	0.64	0.00	0.00	0.00
6	0.36	0.00	0.64	0.00	0.00	0.00
7	0.36	0.00	0.64	0.00	0.00	0.00
8	0.36	0.00	0.64	0.00	0.00	0.00
9	0.36	0.00	0.64	0.00	0.00	0.00
10	0.36	0.00	0.64	0.00	0.00	0.00
11	0.36	0.00	0.64	0.00	0.00	0.00
12	0.36	0.00	0.64	0.00	0.00	0.00
VECM Forecast Error Variance Decomposition in Morogoro						
Horizon	Dar	Dodoma	Mbeya	Morogoro	Mtwara	Shinyanga
1	0.28	0.02	0.07	0.64	0.00	0.00
2	0.35	0.01	0.07	0.57	0.00	0.00
3	0.38	0.01	0.08	0.52	0.01	0.00
4	0.41	0.00	0.08	0.50	0.01	0.00
5	0.42	0.00	0.08	0.48	0.01	0.00
6	0.43	0.00	0.08	0.47	0.01	0.00
7	0.44	0.00	0.08	0.46	0.01	0.00
8	0.44	0.00	0.08	0.46	0.01	0.00
9	0.44	0.00	0.08	0.45	0.01	0.00
10	0.45	0.00	0.08	0.45	0.02	0.00

11	0.45	0.01	0.08	0.44	0.02	0.00
12	0.45	0.01	0.08	0.44	0.02	0.00
VECM Forecast Error Variance Decomposition in Mtwara						
Horizon	Dar	Dodoma	Mbeya	Morogoro	Mtwara	Shinyanga
1	0.29	0.04	0.01	0.02	0.64	0.00
2	0.42	0.02	0.02	0.01	0.52	0.00
3	0.50	0.01	0.03	0.01	0.45	0.00
4	0.54	0.01	0.03	0.01	0.40	0.01
5	0.57	0.01	0.03	0.01	0.37	0.01
6	0.59	0.01	0.03	0.01	0.35	0.01
7	0.60	0.01	0.03	0.01	0.34	0.01
8	0.61	0.01	0.03	0.01	0.33	0.01
9	0.62	0.01	0.04	0.01	0.32	0.01
10	0.63	0.01	0.04	0.01	0.31	0.01
11	0.63	0.01	0.04	0.01	0.31	0.01
12	0.64	0.01	0.04	0.01	0.30	0.01
VECM Forecast Error Variance Decomposition in Shinyanga						
Horizon	Dar	Dodoma	Mbeya	Morogoro	Mtwara	Shinyanga
1	0.44	0.04	0.01	0.01	0.00	0.50
2	0.43	0.04	0.01	0.01	0.00	0.51
3	0.42	0.05	0.01	0.01	0.00	0.51
4	0.42	0.05	0.01	0.01	0.00	0.51
5	0.42	0.05	0.01	0.01	0.00	0.51
6	0.42	0.05	0.01	0.01	0.00	0.51
7	0.42	0.05	0.01	0.01	0.00	0.51
8	0.42	0.05	0.01	0.01	0.00	0.51
9	0.41	0.05	0.01	0.01	0.00	0.51
10	0.41	0.05	0.01	0.01	0.00	0.51
11	0.41	0.05	0.01	0.01	0.00	0.51
12	0.41	0.05	0.01	0.01	0.00	0.51