Alanya Akademik Bakış
Yıl:2019, C:3, S:2, s.181-200

Alanya Academic Review
Year:2019, Vol:3, No:2, s. 181-200

Spatial Market Integration and Price Information Flow in Nigeria Markets: The case of Yam

(Research Article)

Nijerya Pazarında Mekansal Pazar Bütünleşmesi ve Fiyat Bilgisi Akışı: Yam Örneği

Doi: 10.29023/alanyaakademik.538599

Toyin Benedict AJIBADE
Dr., Department of Agricultural Economics and Farm Management, University of Ilorin, Ilorin, Nigeria
ajibade.tb@unilorin.edu.ng
Orcid No: 0000-0001-5161-7500

Opeyemi Eyitayo AYINDE
Associate Professor, Department of Agricultural Economics and Farm Management, University of Ilorin, Ilorin, Nigeria
opeayinde@gmail.com
Orcid No: 0000-0003-3742-888X

Tahirou ABDOULAYE
Dr., Senior Agricultural Economist, International Institute of Tropical Agriculture, Ibadan, Nigeria
t.abdoulaye@cgiar.org
Orcid No: 0000-0002-8072-1363

How to cite this article: *Ajibade, B.T., Ayinde, E.O., & Abdoulaye, T. (2019). Spatial Market Integration and Price Information Flow in Nigeria Markets: The case of Yam. Alanya Academic Review, 3(2), 181-200.*

Keywords

Food price,
Market information,
Market integration,
Nigeria,
Yam

Received: 12.03.2019
Accepted: 10.05.2019

ABSTRACT

Price information cum transmission dynamics are driving factors in market integration mechanism.The role of price in transaction decisions is cogent with sustainability of agricultural activities hinged on system effectiveness.Nation targeting food security must have good grasp on functional food commodity pricing system.We designed the study to answer questions on market integration, explore existing relationship and market price responsiveness.Price collected over 52weeks from 24 markets were analysed.Markets were highly integrated however with highest prices in deficit zones. With each market generating information from others by contemporaneous periods, markets clearly had superior price information flow. Commodity association membership, linkage of traders-farm gates, active price seeking behaviours and improved Infrastructure are recommended to enhance market integration, serve price stabilization purpose and promote food affordability.

1. INTRODUCTION

Agricultural liberalization in Nigeria has seen to marketing of agricultural products mostly operating within the context of free market economy. With limited or no control by the government in price setting, the market forces of demand for and supply of agricultural commodities in Nigeria continue to determine market prices. Albeit the relevance of these two forces, they do not operate in isolation in the price setting conundrum. Cogent among factors that play active roles in transaction price setting is the marketing information system. Market information has continued to dictate reasonable tunes not just in agricultural production decision making but as well in the commodity trading and in fact, food security. According to Stienen, Bruinsma and Neuman (2007), having up-to-date market information on commodity and input prices, as well as demand trends, boosts farmers' negotiating positions and informs decisions about when and where to buy and sell, what to produce, and the quantity and quality of future production.

Trivial as farmers' decision may seem, it has far reaching implication on not only the welfare of the Nigerian populace considering up to about 70% of Nigerians are engaged in agricultural production but even in the grand scheme of attaining food security in the nation as well as in growing the economy.

Agricultural production in Nigeria is largely characterized by small holding sizes and limited financing yet with the mandate of feeding the populace. Given the natural endowment of Nigeria with large expanse of cultivable lands, production activities of diverse crops are usually seen to cut across the various agro-ecological zones that are well suited to such crops. Agricultural commodities are, hence, widely traded across the regions of the country and in fact in certain crops and situations, across country borders. The exchange of agricultural commodities across space and time is premised on the existence of spatial price linkages which is largely attributable to the flow of market information across the markets in the link otherwise explained as market integration. Dercon (1995) stated that a well-integrated market system is central to a well-functioning market economy. Ali, Bett, Kiprop and Korir (2014) described spatial market integration as markets which are in different places having prices determined interdependently or situation in which the prices of a commodity in spatially separated markets move together and price signals and information are transmitted smoothly.

Price information among other market information remains a driving factor in the market integration mechanism because prices play key roles in transaction decisions in any market involving rational trading parties. It is pertinent to mention the dynamics involved with price information transfer as accuracy, timeliness and relevance. Whereas, accuracy implies that information is free from bias; timeliness means recipients can get information when they need it, while relevance involve whether the piece of information specifically answers the users' question of what, why, when, who and how? An individual consciously or unconsciously engages in information search in order to find appropriate information which can fill the information gap thereby regaining physiological and psychological balance (Adereti, Fapojuwo and Onasanya, 2006; Asogwa, Ezihe and Ogebe, 2012). Access to adequate information is very essential to increased agricultural productivity (Mgbada, 2005) and marketing efficiency (Brunnermeier, 2006).

Yam is a commonly acceptable staple across Nigeria. Across yam belt of Nigeria, yam commands the highest socio-cultural value among food crops (Orkwor, Asiedu and Ekanayake, 1998). Grown mostly in some states in the South western and the North central Nigeria, the crop remains readily available across the other regions giving credence to its

spatial and inter-regional tradeability. With a contribution of up to 71% to world output of yam, Nigeria remains the largest producing country with rural farmers having yam as second most commonly harvested tuber crop. Given its nutritional superiority to most roots and tubers in terms of digestible proteins and minerals and its relevance as a source of income for the poor majority of rural-farmers, the importance of yam in Nigeria cannot be overemphasized (Ajibade, Ayinde, Abdoulaye and Ayinde, 2018).

General Household Survey carried out by the NBS and World Bank in 2010/2011 affirmed that yams are an integral component of food consumption and agriculture sales in Nigeria. Based on the 2011 Living Standard Measurements Study-Integrated Surveys on Agriculture (LSMS-ISA) project carried out following the household survey, it was revealed that yam's role differs for the poor and non-poor. Relatively better off households are consuming more yams (particularly those acquired through purchases), but selling less harvested yam than poorer households. Poorer households consume fewer yams, but depend more heavily on yam sales and income than their richer counterparts. Interestingly, the study further revealed that Yams represent over 12 per cent of total agricultural income from staple foods in Nigeria hence giving credence to the importance of this commonly traded crop.

The importance of yam in food security and in income generation to farmers and traders as well as the potential foreign exchange earnings to the economy makes yam a commodity of interest in this study. The market and transaction prices of yam across markets in Nigeria are influenced by the sort of integration that exists among these spatially separated markets. Generally, affordability of food commodities in terms of prices, alongside their availability and accessibility, is a major element in the attainment of food security. There is therefore the need to understand the convolutions in spatial price linkage across yam trading markets in Nigeria. This study is hence designed to answer three questions. Firstly, how are yam markets integrated across Nigeria? Second, what sorts of relationships exist among yam markets in Nigeria? Lastly, how responsive are the markets to fluctuations in prices of yam in other markets? In this study, we went beyond market integration to exploring the responsiveness of each of the selected markets to yam price signals in other markets and then examined the dynamic relationships existing among the selected markets.

This study is justified because the sustainability of agricultural activities is hinged on effective price system. While farmers will be helped in cropping and marketing decisions that may impact on their profitability cum livelihood, Commodity traders will be enlightened on the dynamics involved in market pricing of agricultural commodities. Policy implications from this study will also prove beneficial in economic and specifically, agricultural planning.

2. THEORETICAL FRAMEWORK

The theory underpinning this study is the Law of One Price. The expectation of economists and market participants from the activities that go on in the market is such that the markets can be said to be efficient. Such efficiency is tied to how well the markets are integrated and how fast information on the commodity pricing is able to get transmitted and circulated within and among markets. It is expected that if transportation costs and economic barriers are taken off from markets, each commodity should have a uniform price that cuts across all the markets. This phenomenon is referred to as the Law of One Price which is an economic theory positing that a good must sell for the same price in all locations. This law is derived from the assumption of the inevitable elimination of all arbitrage (Góes & Matheson, 2015; Mankiw 2011). The law of one price is otherwise known as the Fundamental law of one price identity (FLOPI). Assuming P^L and P^C denote the prices of a food crop in Markets L and C

respectively with the corresponding transport and transactions costs to taking the food crop from market C to L is P^{Tc}. Then the law of one price adjusted for transport and transaction costs implies the equilibrium stated as:

$$P^L = P^C + P^{Tc} \Leftrightarrow \frac{P^L}{P^C + P^{Tc}} = 1 \quad (1)$$

In case the two markets both produce and can trade a commodity in either direction the law of one price states that the price difference should be smaller or equal to transport and transaction costs. FLOPI then is smaller or equal to one. If the price difference is larger than transport and transaction costs, trade will close the gap. There are possibilities that the local demand and supply conditions in two markets may be such that price differences are smaller than transport and transaction costs and there will not be any need for trade in which case both markets are somewhat self-sufficient. (Persson, 2008).

According to Fan and Wei (2005), the law of one price implies that the prices for the same product sold in different markets tend to converge to the same level due to profit incentives and market forces. In mathematical terms, the convergence to the law of one price for a product means that the time series of its relative prices is mean-reverting or stationary. Moreover, there may be significant costs of transportation and transaction in inter-regional trade, which complicates the dynamics of price convergence. Indeed, the issues of market integration and the law of one price are central to the very foundation of the discipline of economic.

The intuition behind the law of one price is based on the assumption that differences between prices are eliminated by market participants taking advantage of arbitrage opportunities (Persson, 2008). Assume different prices for a single identical good in two locations, no transport costs and no economic barriers between both locations. The arbitrage mechanism can be performed by both the supply and/or the demand site: All sellers have an incentive to sell their goods in the higher-priced location, driving up supply in that location and reducing supply in the lower-priced location. If demand remains constant, the higher supply will force prices to decrease in the higher-priced location, while the lowered supply in the alternative location will drive up prices there.

Conversely, if all consumers move to the lower-priced location in order to buy the good at the lower price, demand will increase in the lower-priced location, and assuming constant supply in both locations - prices will increase, whereas the decreased demand in the higher-priced location leads the prices to decrease there (Persson, 2008). Either of the scenarios mentioned will result in a single, equal price per homogeneous commodity in all locations (Lamont & Thaler, 2003). The law of one price also defines the extent of the market and measures market integration (Stigler & Sherwin, 1985). If a single price exists over several spatially separate markets, it implies that these markets are integrated as a single market. Measurement of market integration can be viewed as basic to understanding how specific markets work (Ravallion, 1986).

3. MATERIALS AND METHODOLOGY

3.1. Study Area

The study area was Nigeria, located in West Africa on the Gulf of Guinea, having a total area of 923,768 km2. Nigeria has population of about 193.4 million s at 2017, having more than doubled the past twenty five (25) years (NPC, 2017). Nigeria is endowed with rich natural resources, having huge expanse of cultivable land coupled with very suitable climatic conditions well attuned to agricultural production. Despite the heavy reliance on the petroleum sector over the past decades, the agricultural sector has continued to be a key employer of labour force in the country, engaging up to about 70% of the population.

3.2. Sampling Procedure

In a four-stage sampling procedure, 24 markets were selected across 11 states and the Federal Capital Territory in Nigeria. The first stage involved the stratification of the states in Nigeria based on the agro-ecological zones. States that overlapped in terms of multiple agro-ecological zones were pooled together and eventually there were two major strata. The first stratum includes Mangrove/Fresh water swamp/Rainforest zones while the second stratum includes Short grass guinea savanna/Marginal savanna woodland/Tall grass savanna zones. The second stage involved the random and proportionate selection of 30% of the States in each stratum. Four States were selected from the first stratum while seven States were selected from the second stratum to give a total number of eleven (11) states. This was done with a level of approximation. The Federal Capital Territory was purposively selected alongside the eleven states to give total of twelve (12) locations. The third stage involved both purposive selection of the major food crop market in the state capital and random selection of one rural food crop market from each of the twelve (12) selected locations.

Information on the market listing was sourced from The States' Ministry of Commerce and Trade. Panel data for this study include prices of yam which were primarily sourced over a period of 52 weeks from the 24 selected markets. The data collection period spanned September 2015 and August 2016. Modal prices of yam were collected in each of the selected market on a weekly basis through market enumerators and these were cross-verified from traders and buyers in the marketplace in order to authenticate the veracity of the collected data. Lacking in measurement standardization, yams are mostly sold in stacks of different numbers depending on the market location and in varying sizes, prices of yam per kilogram (N/Kg) were calculated from the prevailing stacks selling prices at data collection periods.

3.3. Analytical techniques

Data collected were analysed using descriptive and inferential statistics. Descriptive statistics used to describe the price data include mean, standard deviation and coefficient of variation. The data were econometrically analysed successively with the preliminary process involving testing the price data for stationarity for which we used the Augmented Dickey Fuller test. Market integration was then examined using the co-integration technique which typically involves the regression of a unit root time series on another unit root time series. For two variables to be co-integrated, they must have a long term or equilibrium relationship between them. This study followed the Johansen and Juselius (1990) method to test for the existence of a relationship between co-integrated variables. The Johansen and Juselius maximum likelihood test for cointegration is based on a Vector Auto regressive process of order p and the Vector Error Correction Model representation can be stated as:

$$\Delta y_t = \prod y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + Bx_t + \varepsilon_t \quad (2)$$

the difference operator Δy_t denotes a k×1-vector of co-integrated variables of order 1, x_t is a k-vector of deterministic variables, and ε_t the innovations-vector. The coefficients matrix

$$\prod = \sum_{i=1}^{p} A_i - I, \ \Gamma_i = -\sum_{j=i+1}^{p} A_j \quad (3)$$

where the matrices A_i and B are from the Vector Auto regressive model and are coefficients to be estimated while I is the identity matrix.

Following the test for co-integration, other econometrics tests were carried out and these includes the test for exclusion and VAR granger causality test following which the innovation correlation matrix indicating the contemporaneous correlation between the error terms, otherwise known as innovations, from the estimated VECM was derived.

In order to examine the dynamic relationship existing among the selected yam markets the Impulse response function was applied to the fitted Vector Autoregressive model in order to enable one interpret and describe the reactions of dynamic system existing in each of the modeled market to external changes resulting from the other markets that parameterize the dynamic behaviour of the entire system. This exhibit result in the form of how price in each of the market responds to a one-time-only shock on every other sampled market price.

According to Rossi (2010), Impulse response function traces the effect of an exogenous shock or innovation in one of the markets on all the other markets modelled in this study and thereby supplies information of the types of causality that exist in the modelled markets.

The impulse response function can be stated as:

$$y_{t+n} = \sum_{i=0}^{\infty} \Psi_i \epsilon_{t+n-i}$$

$$\{\Psi_n\}_{i,j} = \frac{\partial y_{it+n}}{\partial \epsilon_{jt}} \quad (4)$$

with the response of $y_{i,t+n}$ to a one-time price shock or impulse in $y_{j,t}$ with all other markets dated t or earlier held constant. The response of price in market *i* to a one-time price shock in market *j* is mostly depicted graphically to have a visual impression of the dynamic inter-relationships within the system.

Results of the impulse response function were generated both in a tabular form as well as in graphical forms. The graphs indicate a broad pictorial representation which may easily be understood while the tabular form states the percentages associated with each of the graphs. The impulse responses are zero if price in one of the markets does not granger cause prices in the other markets in the modelled system whereas, an innovation in price in market *k* has no effect on the prices in other markets. In other words, market *k* price does not granger cause the set of remaining markets within the modelled system.

Forecast Error Variance Decomposition (FEVD) was used to explore responsiveness of each of the selected markets to price signals of yam in the other markets. FEVD was applied to partition the price uncertainties in each market at different time periods in order to reveal how each market responded to externalities in price signals. Forecast error variance decomposition was used to further interpret the VAR model that was fitted by indicating the amount of information each market price contributed to the prices in the other markets included in the Autoregressive model. The Forecast error variance decomposition measured the contribution of each shock type to the Forecast error variance and determined the quantity of the Forecast error variance of each of the markets that

could be explained by exogenous shocks to the other markets. According to Zivot and Wang (2006), FEVDs answers the question: what portion of the variance of the forecast error in predicting $y_{i,T+h}$ is due to the structural shock η_j? Using the orthogonal shocks η_t the h-step ahead forecast error vector with known VAR coefficients, may be expressed as:

$$Y_{T+h} - Y_{T+h|T} = \sum_{s=0}^{h-1} \Theta_s \, \eta_{T+h-s} \qquad (5)$$

Whereas, for a particular variable $y_{i,T+h}$, the forecast error is of the form:

$$y_{i,T+h} - y_{i,T+h|T} = \sum_{s=0}^{h-1} \Theta_{i1}^{s} \eta_{1,T+h-s} + \ldots + \sum_{s=0}^{h-1} \Theta_{in}^{s} \eta_{n,T+h-s} \qquad (6)$$

Since the structural errors are orthogonal, the variance of the h-step forecast error may therefore be written as:

$$\text{var}\,(y_{i,T+h} - y_{i,T+h|T}) = \sigma_{\eta 1}^2 \sum_{s=0}^{h-1} (\Theta_{i1}^{s})^2 + \ldots + \sigma_{\eta n}^2 \sum_{s=0}^{h-1} (\Theta_{in}^{s})^2 \qquad (7)$$

where $\sigma^2_{\eta j} = \text{var}(\eta_{jt})$. The portion of var $(y_{i,T+h} - y_{i,T+h|T})$ due to shock η_j is therefore stated as:

$$FEV\,D_{i,j}(h) = \frac{\sigma_{\eta j}^2 \sum_{s=0}^{h-1} (\theta_{ij}^{s})^2}{\sigma_{\eta 1}^2 \sum_{s=0}^{h-1} (\theta_{i1}^{s})^2 + \cdots + \sigma_{\eta n}^2 \sum_{s=0}^{h-1} (\theta_{in}^{s})^2}, \quad i,j = 1, \ldots, n \qquad (8)$$

Zivot and Wang (2006) further stated that Forecast error variance decomposition largely depends on the recursive causal ordering used to identify the structural shocks η_t and is not unique therefore different causal orderings will produce different FEVD values. Some underlining information in the report on Forecast Error Variance Decomposition in this study is the fact that a market may be regarded as being exogenous or endogenous at a point in time on the basis of how much proportion of the market's uncertainty is being explained by other markets being sampled alongside the market.

In a situation whereby a large proportion of the forecast error decomposition is accounted for by other markets, then the market is taken to be an endogenous one which implies the market is a dependent market. However, when only a minimal proportion of the forecast error decomposition of that market is accounted for by other markets, then the market under scrutiny is taken to be an exogenous one, in other words such a market is independent.

A second important observation to the tabular report given on the Forecast Error Variance Decomposition as well as the corresponding points on the graph is that there are ten variance periods indicated in the report with these representing the weeks under investigation. Variance period one indicates the contemporaneous time while variance periods two, five and ten signify the short run, intermediate run and the long run respectively. It is worthy to note that summation of all the observations across each of the variance periods will give an approximate value of One hundred percent which as well explains the percentage as indicated on the graphs. In order to generate the impulse response functions and decompose the forecast error variance obtained on the interaction of prices of the selected commodities in the sampled markets, the EVIEWS statistical package was employed.

4. RESULTS and DISCUSSION

Table 1 presents descriptive statistics of price data collected from the sampled markets.

Table 1. Descriptive Statistics on Prices of Yam from Twenty-Four Nigerian Markets (2015-16)

Location	Market	Mean price ₦/kg	Mean Rank	Standard Deviation	Standard Deviation Rank	Coefficient of Variation	Coefficient of Variation Rank
Kwara	Onile aro oloogun(R)	117.38	9	9.32	5	0.07940	6
Kwara	Ago (U)	141.89	14	17.90	14	0.12615	12
Abuja	Genge pada (R)	157.17	17	17.92	15	0.11402	8
Abuja	Wuse (U)	183.62	22	36.72	19	0.19998	16
Kano	Garun Baba (R)	153.37	16	54.12	23	0.35287	23
Kano	Dawanou (U)	175.60	20	68.34	24	0.38918	24
Kaduna	Kasarami (R)	144.68	15	41.05	21	0.28373	18
Kaduna	Kawo (U)	167.99	19	51.69	22	0.30770	20
Nasarawa	Odapu ogaji (R)	104.51	6	36.14	18	0.34580	22
Nasarawa	Alamis (U)	128.99	11	40.59	20	0.31468	21
Imo	Umugunwa (R)	197.31	23	14.33	10	0.07263	4
Imo	Eke-Onunwa (U)	204.38	24	14.66	11	0.07173	3
Lagos	Garafa (R)	80.41	3	8.61	2	0.10708	7
Lagos	Mile 12 (U)	87.47	4	11.27	7	0.12884	14
Ogun	Odeda (R)	130.40	12	15.96	12	0.12239	9
Ogun	Kuto (U)	136.29	13	10.56	6	0.07748	5
Oyo	Kogijo (R)	53.77	2	16.07	13	0.29887	19
Oyo	Bodija (U)	127.23	10	8.92	3	0.07011	2
Osun	Ogba-agba (R)	41.56	1	9.27	4	0.22305	17
Osun	Igbona (U)	97.57	5	5.65	1	0.05791	1
Anambra	Afo Mbaukwu (R)	163.08	18	27.55	17	0.16894	15
Anambra	Eke-Awka main(U)	177.69	21	22.89	16	0.12882	13
Enugu	Ugwuokpa (R)	105.45	7	13.02	8	0.12347	10
Enugu	Ogbete main (U)	107.50	8	13.48	9	0.12540	11

Source: Market Survey 2016

From Table 1, it can be seen that the mean price of yam is highest in markets in Imo State. Based on findings from focus group discussion, one may attribute this to the pressure on markets in Imo States by traders from Rivers state, especially Port Harcourt city due to the proximity considering the fact that there is large dependence on such neighbouring states in order to meet the food demands by the core oil producing states. The least mean prices were observed in Igbona rural market and Kogijo rural markets in Osun and Oyo States respectively.

The region is known to be a major yam producing one as there even exist markets that are basically yam markets in some locations in those states. At 236 percent and 234 percent respectively, prices of yam in each of the urban markets sampled in Oyo and Osun States more than doubled the prices in the respective rural markets and one would wonder the reason behind the existence of such high price disparity in markets within the same state. Based on the observation during data collection, one may attribute this to the exceptionally bad state of the roads leading to the rural communities which results in the availability of yams in the rural communities but with no easy means to transport the goods to the urban communities. This place the middlemen or traders who decide to visit the rural farm gates to buy produce despite the despicable roads at a vantage point as they are able to buy yams at ridiculously low prices and make even higher profits.

Along the South-western region, the case of Lagos and Ogun States is quite intriguing because the mean prices of yam can be seen to be lower in Lagos than Ogun State which is not consistent with apriori expectation considering the fact that yams are produced more in Ogun State. Interactions with the traders indicated that there is usually an influx of yams into Lagos from neighbouring states in the quest for better profits by the traders. Likewise, reasonable patronage are gotten from residents of Lagos and other travellers who visit or pass through Ogun State to make purchases. Eventually, markets in Ogun State are put in a deficit position having sold the bulk of their produce off under such circumstances hence leaving little quantity available for consumers in those areas which invariably results in higher prices based on the excess demand over supply. In most cases, having taken huge quantities of yams into Lagos, there is a resultant lower prices below prices obtainable in the supposed feeder markets.

Lagos State rural market ranked second in terms of standard deviation in the prices of yam and this may be due to the fact that some level of production also goes on in the rural areas hence they are not entirely dependent on the supplies from other markets. The highest standard deviations in prices were observed in markets across Kano and Kaduna States. This region is largely a deficit region as yam is not a commonly eaten staple in the region, however yam is still produced in some parts of Southern Kaduna but the bulk of yam traded in the markets actually inflow from the North-central and South-western markets.

The coefficients of variation in yam prices indicated that urban markets in both Oyo and Osun States ranked the least which implies that prices of yam were least volatile in those locations hence prices in those markets were relatively stable all through the year that was investigated in this study. Coefficient of variation ranking indicated that prices were most volatile in Kano markets which ranked 23rd and 24th respectively for the rural and urban market respectively, followed by markets in Nasarawa State. So much production and trading activities of yams go on in Nasarawa State as was observed in the markets during visitation and this may likewise account for the volatility in the prices since prices will expectedly fall during the post-harvest periods as a result of glut in the market and afterwards peak since the demand is persistent being a commonly consumed staple food in the area.

Table 2 presents the results of the unit root test carried out to examine stationarity in the price data.

Table 2. Summary of Unit Root Test for Yam Price in Selected Nigerian Markets

S/N	Location	Market	Levels			First Difference		
			t-stat	p value	lag	t-stat	p value	lag
1	Kwara	Onile aro oloogun(R)	-1.1045	0.9182	0	-5.1324	0.0006	0
2	Kwara	Ago (U)	-2.0481	0.5615	0	-5.9704	0.0000	0
3	Abuja	Genge pada (R)	-2.7093	0.2374	0	-6.9049	0.0000	0
4	Abuja	Wuse (U)	-3.4799	0.0524	0	-8.5518	0.0000	0
5	Kano	Garun Baba (R)	-2.0255	0.5736	0	-6.8235	0.0000	0
6	Kano	Dawanou (U)	-2.1212	0.5219	0	-7.0583	0.0000	0
7	Kaduna	Kasarami (R)	-1.8163	0.6822	0	-5.8024	0.0001	0
8	Kaduna	Kawo (U)	-2.4145	0.3680	0	-7.8193	0.0000	0
9	Nasarawa	Odapu ogaji (R)	-1.5175	0.8103	1	-5.0298	0.0008	0
10	Nasarawa	Alamis (U)	-2.3373	0.4068	1	-5.5800	0.0002	1
11	Imo	Umugunwa (R)	-2.2626	0.4458	1	-5.8197	0.0001	0
12	Imo	Eke-Onunwa (U)	-1.8334	0.6738	0	-7.4409	0.0000	0
13	Lagos	Garafa (R)	-1.5814	0.7866	0	-7.8419	0.0000	0
14	Lagos	Mile 12 (U)	-1.2574	0.8869	1	-4.9033	0.0012	0
15	Ogun	Odeda (R)	-2.3756	0.3874	0	-5.2351	0.0004	0
16	Ogun	Kuto (U)	-2.0452	0.5630	0	-7.3285	0.0000	0
17	Oyo	Kogijo (R)	-1.4889	0.8206	0	-5.7659	0.0001	0
18	Oyo	Bodija (U)	-2.7545	0.2204	0	-5.3538	0.0000	0
19	Osun	Ogba-agba (R)	-2.4811	0.3358	0	-6.5076	0.0000	0
20	Osun	Igbona (U)	-1.7709	0.7042	0	-6.1558	0.0000	0
21	Anambra	Afo Mbaukwu (R)	-1.5499	0.7987	0	-7.9073	0.0000	0
22	Anambra	Eke-Awka main(U)	-3.3248	0.0738	0	-12.5233	0.0000	0
23	Enugu	Ugwuokpa (R)	-1.6745	0.7482	0	-6.8355	0.0000	0
24	Enugu	Ogbete main (U)	-1.8563	0.6623	0	-6.9675	0.0000	0

Source: Data analysis, 2016 (U – urban market, R – rural market)

The unit root test results revealed that prices in the markets under study were non-stationary at levels i.e. I(0) which suggest integration of those markets. After first differencing, I(1), prices in sixteen of the twenty-four markets became completely stationary while the other eight markets still exhibited some triviality and only became completely stationary after second differencing i.e. I(2) and were hence excluded from subsequent analysis having established markets in which prices co-moved.

Table 3 presents a series of Trace tests for co-integration carried out on the investigated markets. The results presented indicate the Unrestricted Co-integration Rank Test using the trace statistics as shown with the corresponding result associated with the number of co-integrating vectors and the decisions to reject (R) or Fail to reject (F) the null hypothesis on the number of co-integrating vectors ($r = 0, r \leq 1,...., r \leq 15$) at a 5% level of significance.

image.

Table 3. Test of Co-integration among Prices for Yam from Nigerian Markets in 2015-16

Hypothesized No. of CE(s) H0: r	Eigen value	Trace Statistic	Critical Value(0.05)	Prob.**	Decision
None	0.994223	1325.733	NA	NA	-
At most 1	0.98044	1068.044	NA	NA	-
At most 2	0.96704	871.3307	NA	NA	-
At most 3	0.921488	700.7073	NA	NA	-
At most 4 *	0.865699	573.4819	334.9837	0.0000	R
At most 5 *	0.852936	473.0983	285.1425	0.0000	R
At most 6 *	0.839326	377.2539	239.2354	0.0000	R
At most 7 *	0.732101	285.8351	197.3709	0.0000	R
At most 8 *	0.622669	219.9778	159.5297	0.0000	R
At most 9 *	0.579788	171.2462	125.6154	0.0000	R
At most 10 *	0.522926	127.8964	95.75366	0.0001	R
At most 11 *	0.46112	90.89223	69.81889	0.0004	R
At most 12 *	0.428498	59.97908	47.85613	0.0024	R
At most 13 *	0.312522	32.00471	29.79707	0.0274	R
At most 14	0.219957	13.26846	15.49471	0.1053	F#
At most 15	0.01682	0.848131	3.841466	0.3571	F

**MacKinnon-Haug-Michelis (1999) p-values

Source: Data analysis, 2016

The result of Trace test revealed the first failure to reject the null hypothesis (denoted by F#) was observed at fourteen co-integrating vectors which suggest that fourteen long run stationary relations are present in the markets that were investigated. While fourteen long run stationary relations are present in the sixteen markets modeled, it is likely that price in some of the markets will not be a part of the identified fourteen long run relations.

The test of exclusion was therefore carried out to exclude each of the markets from the co-integration space and then observe which of the markets do exist or do not exist within the co-integration space. The result is as presented in Table 4.

Table 4. Test of Exclusion on Yam Markets Modeled in the study

		Lag 1			Lag 2		
Location	Market	Chi-squared test	p-value	Decision	Chi-squared test	p-value	Decision
Anambra (R)	Afo Mbaukwu	9.003384	0.913274	F	12.48565	0.709927	F
Kwara (U)	Ago	22.83556	0.118202	F	20.06754	0.217194	F
Oyo (U)	Bodija	38.49606	0.001285	R	30.4915	0.015614	R
Kano (U)	Dawanou	90.84884	1.74E-12	R	38.58433	0.001248	R

Anambra (U)	Eke-Awka main	12.0684	0.739258	F	18.59034	0.290478	F
Imo (U)	Eke-Onunwa	23.87403	0.092292	F	16.51115	0.41789	F
Lagos (R)	Garafa	15.97956	0.454388	F	12.72477	0.692765	F
Kano (R)	Garunbaba	93.68202	5.22E-13	R	46.36656	8.54E-05	R
Abuja (R)	Gengepada	54.179	4.85E-06	R	36.9858	0.002107	R
Osun (U)	Igbona	54.9008	3.69E-06	R	30.16586	0.017161	R
Kaduna (U)	Kawo	22.86973	0.117261	F	19.74632	0.231864	F
Ogun (U)	Kuto	32.60628	0.00833	R	24.12406	0.08683	F
Enugu (U)	Ogbete main	32.59242	0.008365	R	23.29332	0.106115	F
Osun (R)	Ogbagba	23.35912	0.104467	F	28.13364	0.030477	R
Enugu (R)	Ugwuokpa	99.53378	4.24E-14	R	39.21109	0.001014	R
Abuja (U)	Wuse	15.35696	0.498666	F	13.21222	0.657182	F

Source: Data analysis, 2016

The null hypothesis is that the respective market excluded is not in the co-integration space with the test being the distributed Chi Squared with fourteen degree of freedom as zero is being associated with markets in each of the vectors and where R indicates rejection of the null hypothesis while F indicates failure to reject the null hypothesis in which case the null hypothesis that the particular market is not within the co-integration space is accepted. The result is presented both for a lag order of one and two. However, the decisions are reasonably similar in both cases, although lag one is used in the rest of this section based on the lag selection procedure performed.

From Table 4, it can be seen that there was failure to reject the null hypothesis of exclusion on price from both rural and urban markets in Anambra State, Ogbaagba rural market in Osun, Ago urban market in Kwara, Garafa market in Lagos, Kawo and Wuse urban markets in Kaduna State and FCT respectively and in Imo local market. One can make an inference that these mentioned markets are likely not in the co-integration space. Of all the markets identified as not being in the co-integration space, both the rural and urban markets sampled in Anambra showed exceptionally high exclusion having p values of about seventy-three percent and ninety-one percent. This might be a subtle indication that these markets do not particularly influence food commodity prices across other markets.

In order to know the price dynamic patterns among the markets, VAR Granger Causality otherwise known as Exogeneity Wald test was carried and the results is as presented in Table 5. The Exogeneity Wald test is meant to establish if a causal relationship exists between each of the market which is in turn made a dependent variable and all other fifteen markets that were excluded. The test is run singly for each of the excluded markets and also for the whole group of fifteen excluded markets against the market made an endogenous variable. Table 5 presents a summary of the results obtained from each group test for each of all the sixteen markets examined. The null hypothesis for the VAR granger causality test in this case is that the lagged prices in the fifteen other markets excluded cannot jointly granger cause prices observed in the one market taken as the endogenous or dependent variable.

Table 5. VAR Granger Causality /Block Exogeneity Wald Test on the Yam Markets Modeled in the Study

Location	Market	Chi-squared tes	p-value	Decision
Anambra (R)	Afo Mbaukwu	50.99811	0.0097	R
Kwara (U)	Ago	43.41538	0.0538	F
Oyo (U)	Bodija	87.1593	0.0000	R
Kano (U)	Dawanou	126.3442	0.0000	R
Anambra (U)	Eke-Awka main	38.18429	0.1451	F
Imo (U)	Eke-Onunwa	38.92945	0.1273	F
Lagos (R)	Garafa	23.70564	0.7852	F
Kano (R)	Garunbaba	136.5235	0.0000	R
Abuja (R)	Gengepada	75.43766	0.0000	R
Osun (U)	Igbona	49.47351	0.0141	R
Kaduna (U)	Kawo	45.22462	0.0368	R
Ogun (U)	Kuto	52.5823	0.0066	R
Enugu (U)	Ogbete main	68.4694	0.0001	R
Osun (R)	Ogbagba	54.90264	0.0036	R
Enugu (R)	Ugwuokpa	156.1752	0.0000	R
Abuja (U)	Wuse	29.39058	0.4972	F

Source: Data analysis, 2016

As shown in the result on Table 33, there is a failure to reject null hypotheses in the cases of Ago urban market in Kwara, urban markets in Anambra and Imo State, Garafa rural market in Lagos State and Wuse urban market in Abuja. This implies that for these five markets, the null hypothesis that the lagged prices in the fifteen other grouped markets excluded cannot jointly granger-cause prices observed in each of the market, having taken it as the endogenous or dependent variable was accepted. For all other cases, the null hypotheses were rejected which implies that prices in each of those markets were actually jointly granger caused by the lagged prices in the fifteen other markets as the case may be.

The innovation correlation matrix indicating the contemporaneous correlation between the error terms, otherwise known as innovations, from the estimated error correction model in each of the sixteen markets modeled for yam prices is as shown in the correlation matrix as Corr(εt) being equal to:

	AFO	AGO	BOD	DAW	EKE	ONUN	GAF	GARB	GGPD	IGBN	KAWO	KUT	OGBT	OGB	UGW	WUS
AFO	1.000															
AGO	0.238	1.000														
BOD	0.094	0.203	1.000													
DAW	0.173	-0.033	-0.303	1.000												
EKE	0.212	0.328	-0.284	0.625	1.000											
ONUN	-0.116	0.298	0.410	-0.332	-0.051	1.000										

GAF	-0.307	-0.028	0.387	-0.104	-0.156	-0.075	1.000									
GARB	0.249	-0.154	-0.348	0.836	0.498	-0.436	0.012	1.000								
GGPD	-0.056	0.315	-0.019	-0.075	0.373	0.088	-0.069	-0.210	1.000							
IGBN	-0.021	0.084	0.424	0.232	-0.007	0.347	0.090	-0.078	0.014	1.000						
KAWO	-0.148	-0.121	0.133	-0.183	-0.373	0.140	0.341	-0.208	0.227	0.211	1.000					
KUT	-0.240	0.142	0.149	-0.239	-0.294	-0.005	0.478	-0.125	-0.185	-0.211	-0.033	1.000				
OGBT	0.054	0.009	0.064	-0.288	-0.351	-0.150	0.429	-0.134	-0.144	0.022	0.183	0.356	1.000			
OGB	0.049	-0.016	0.367	-0.378	-0.259	0.315	0.140	-0.189	0.229	-0.329	0.402	0.047	-0.146	1.000		
UGW	-0.014	-0.327	0.175	-0.226	-0.466	-0.184	0.348	-0.219	-0.249	0.045	0.054	0.423	0.695	-0.073	1.000	
WUS	-0.018	0.126	0.260	-0.124	-0.240	-0.049	0.244	-0.225	0.538	0.196	0.592	0.159	0.338	0.415	0.321	1.000

(9)

From the correlation matrix shown in equation 9, it can be observed that Garunbaba rural market and Dawanou market in Kano State exhibited the highest level of correlation with a value of 0.836. This implies that market information of yam gets promptly transmitted between these two markets. This may be attributed to the proximity of the market. It is worthy to mention that a larger percentage of yam traded in these markets are brought in by traders from other regions in the country since the area is a deficit zone being a non-producer of yam. However, yam is also not a commonly eaten staple in the area. Garunbaba rural Kano market also exhibit correlation with another market in Anambra State. It is however unclear how this price transmission occurs but one may attribute them to the relay of information made possible by the Hausa traders who frequently visit the Eastern markets where they sell grains. Wuse urban market and Genge pada rural markets in FCT also demonstrated high correlation innovation with a value of 0.538 which was observed.

There is a reasonable level of yam production going on in Abuja environs and interactions during market survey indicated that yams traded in the territory are procured from farm gates in the rural areas. Most traders in this area likewise take good advantage of mobile communication as some even indicated they requested price information up to twice weekly. This implies that there is the free flow of timely market information which definitely is revealed in the degree of correlation between this pair of markets. The same is also observed between Wuse urban Abuja market and Kawo urban market in Kaduna.

The correlation coefficient was estimated to be 0.592 which is even greater than what existed between Abuja markets. A reasonable level of yam production goes on in some part of Southern Kaduna however, there were no evidence from the sampled traders in Abuja that the scale of production is large enough to warrant them patronizing the area. However, one may attribute the observation to the fact that grain traders patronizing Kawo market may be instrumental to linking the markets in terms of prices. Some yam traders in Kawo market go to Abuja, Niger, Benue to make purchase as explained by them. It is therefore possible that Kawo yam traders seek out price information from Abuja among other locations and hence the correlation between the markets.

The market pair of Kuto in urban Ogun State and Garafa rural market in Lagos State exhibited correlation of up to 0.478. This may be attributed to the proximity of these States and also to the fact that information seeking behaviour is a more popular attribute of traders in this region. Likewise, there is a lot of patronage in Ogun markets from residents of Lagos

who believe that the prices are better off in the state even after minding the attributed transportation cost. Similar observation is made in respect of Ugwuopa rural market and Ogbete main market of Enugu State as a correlation estimate of 0.695 was observed between these two markets and this may be due to proximity of the markets which may aid free information flow between them.

Ugwuopa market in Enugu and Eke-awka market in Anambra State indicated the least correlation with a value of -0.466 followed closely by Garunbaba market in Kano and Eke onunwa market in Imo State which is an indication that these markets do not belong to the same co-integration space. No correlation between Afo mbaukwu market in Anambra State and any other market that was sampled for yam exceeded 0.249 which implies that prices in that market is somewhat aloof of price occurrences in any other market within the system that was modeled. The generally high correlation values shown in the matrix in equation 9 is an indication that there is a very good flow and exchange of market information as related to yam prices.

Result of the Impulse response function applied to the VAR model to examine the dynamic relationship existing among the selected yam markets is presented in Figure 1 (See supplementary material for the tabular form). The markets modeled for yam seem to generate price information from other markets right from the contemporaneous i.e. immediate period. One way to explain this finding may be as a result of high perishability of yams due to the high moisture content. For this reason, quite a large number of yam farmers will prefer to sell off their yams as soon as they harvest in order to be able to transfer post-harvest loss risks to the traders sooner. The result revealed that only 43.75% of the markets sampled in this study generated more than half of the price information from within the market itself while the other markets garnered more price information from all other markets than what the market itself generates.

Clearly, there is a superior flow of price information in yam markets which implies that yam traders communicate better on pricing. Yams being perishable, farmers may leave the tubers in soil on their farm and then go about harvesting and assemblage at farm gate when they have some sort of assurance of expected patronage. This helps to put them out of a place of desperation which may be the case if they have the products on ground yet with no patronage. It is not unlikely that farmers and traders as well as traders and traders interact more whenever they decide to make trips for the commodity procurement. Information gathered during the survey also revealed the existence of stronger networking among yam traders which suggest that information is more likely to flow freely and timely among them. The report also revealed that majority of the markets where the market only generated little price information within itself and got more influences from price externalities were the yam deficit zones.

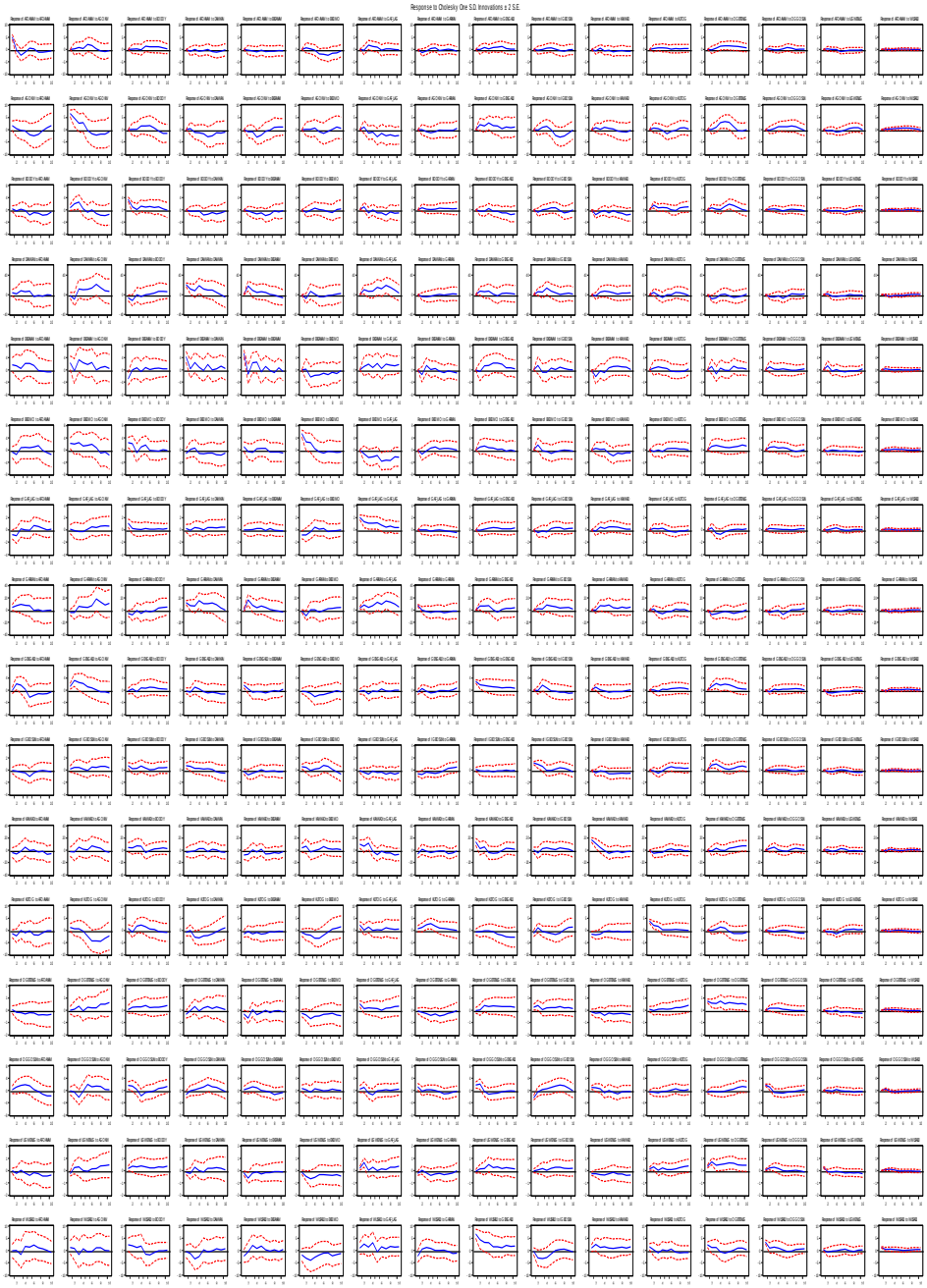

Figure 1. Impulse Response Function for Yam Markets Modeled

Forecast error variance decomposition was employed to partition the price uncertainties in each market at different time periods in order to explore the responsiveness of each market to externalities in price signals. The result is as presented in Figure 2. Wuse market can be seen to generate negligible price information for all other fifteen markets including itself whereas some of the other markets generated price information for it in the contemporaneous, short, intermediate and long run. In the contemporaneous run, slightly more than 50% of the price information for Wuse market was generated by Genge pada rural Abuja market while Wuse market only generated less than 2% of price information from within itself.

In the short run, the markets examined still exhibited the same nature as in the contemporaneous run. In the case of Genge pada rural Abuja market, one could see that the price information generated by the market from within reduced from 61.85% to 30.85% in the short run whereas Ago market in Kwara became more prominent, generating up to 33% price information for Genge pada market. In the contemporaneous run, Igbona urban market generated 40.98% of price information from within the market while Bodija and Dawanou Kano markets jointly generated more than 33% price information for the market. Markets that generated the least price information from within itself in the contemporaneous run are Ogba agba, Ugwuopa and Wuse markets in which case each generated 15.27%, 14.09% and 1.81% respectively from within itself. This is an indication that prices have gotten readily transmitted among the market right from the immediate period.

At the intermediate run which is the variance period five, almost all the markets generated far less than half of the internal price information they generated at the short run. This implies that all the markets had become endogenous at this point, being largely dependent on price information generated from other markets in the system. In the long run, Dawanou and Garunbaba markets in Kano State can be seen to generate significantly large price information for other markets. Dawanou market generated 20.4% price information within itself in the long run while the next largesse information generated from Ago market in Kwara State which generated 21.84%. Dawanou on another hand generated 13.08% and 18.93% of price information for Eke-awka market in Anambra and Garunbaba market respectively. In the long run likewise, Dawanou generated 8.64% of price information for Bodija which is more than half of the 14.09% price information that Bodija generated from within itself.

It should be noted that Dawanou market is situated in a deficit region for yam production and although yam is not a commonly consumed staple food in the area among households, it is still a preferred product in the elite restaurants which are found all around the town suggesting high patronage from consumers. It was indicated that yam is in demand all year round especially by such restaurants which indicate there may be excess demand over supply considering the crop is not produced in the area.

The observation made on Dawanou market is consistent with the VAR granger causality test which indicated large chi-squared values of 126.34 and 136.52 respectively for the markets and with these being highly significant. A cursory look at the correlation coefficients for yam revealed that the values were high hence indicating that the markets were highly correlated. One may conclude that price information flow in yam markets occur very rapidly.

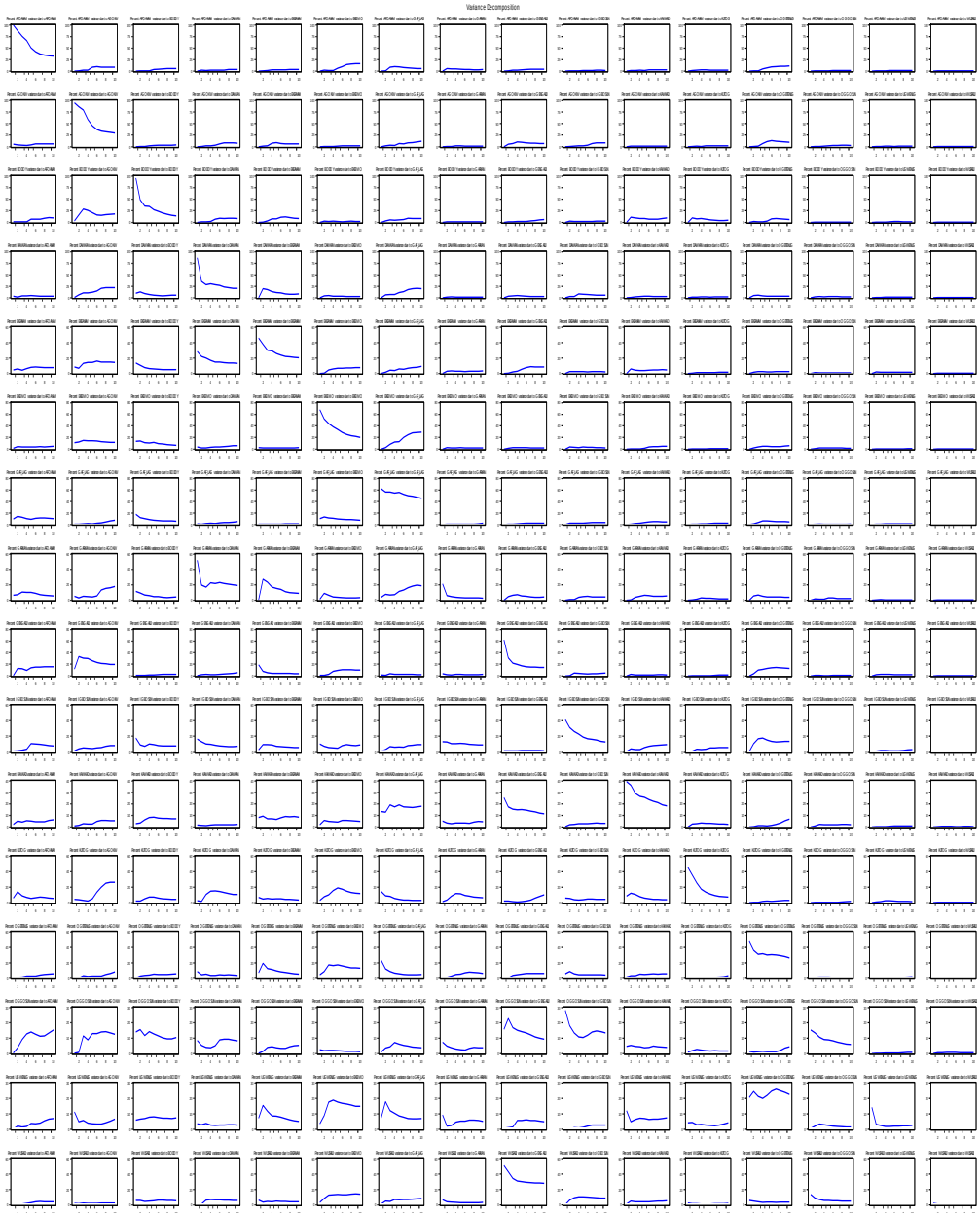

Figure 2. Forecast Error Variance Decomposition for Yam Markets modeled

5. CONCLUSION AND RECOMMENDATIONS

The study concluded that yam markets in Nigeria are well integrated, having high efficiency in price transmission and a well-articulated spatial price linkage. If well harnessed, this is a good attribute, positioning the marketing system for easy strategic interventions and policy implementation. The high speed of market price information sharing among the yam markets gives credence to the commendable structure which is in place in yam marketing. The aforementioned is not to downplay the fact that there are limitations in the yam marketing system.

To this extent, the importance of linkage roads and communication network in enhancing price transmission can be observed among the markets understudied, supported by markets with good linkage roads and communication networks exhibiting high price innovation correlations with one another. This is in tandem with the findings of Ajibade, Ayinde, Abdoulaye (2019) which emphasized the relevance of linkage, stating that low production zones have pivotal roles to play in price stabilization, guaranteeing farmers in producing areas get good recompense and of course in improving the welfare of farmers, traders and consumers. The structured yam marketers association that exists in quite a number of the locations studied may be said to contribute towards enhancing the level of integration observed in the Nigerian yam markets.

Based on the foregoing, the study recommended adoption of some of the modus operandi such as commodity association membership, linkage of traders directly to farm gates, active price seeking behaviours which were observed in the yam markets in other food crops marketing in Nigeria. Achieving these will go a long way in enhancing market integration and invariably serve price stabilization purpose in food crop markets having installed some checks on super-normal profit seekers hence preventing such from exploiting farmers and crop buyers. It is also recommended that infrastructure such as good feeder roads and communication networks should be made available especially in the producing area. An effective food marketing system is worth the effort because it will help in catering for the food availability and accessibility component of Food security.

Acknowledgments: The authors acknowledge International Institute of Tropical Agriculture (IITA) for granting the fellowship for this research.pharmaceutical products.

REFERENCES

ADERETI, F.O., FAPOJUWO, O.E., and ONASANYA, A.S. (2006). Information utilization on cocoa production techniques by farmers in Oluyole Local Government area of Oyo State, Nigeria. European Journal of Social Science 3 (1): 1-7.

AJIBADE, T.B., AYINDE, O.E., ABDOULAYE, T. and Ayinde, K. (2018). Determinants of Price of Yam in Nigeria: A Times-Series Analysis. Nigerian Journal of Agricultural Economics 8 (1): 109-119

AJIBADE, T.B., AYINDE, O.E., ABDOULAYE, T. and AYINDE, K. (2019) Discovery of Maize Price and Food Crop Market Dynamics in Nigeria. Review of Agricultural and Applied Economics, 22(1): 51-64

ALI, W.O., BETT, H.K., KIPROP, S.K. and KORIR, H. (2014)Economic Analysis of Spatial Integration of Pulse Market in Ethiopia; A case of Selected Pulse Market in Ethiopia. European Journal of Business and Management, 6 (33): 100-108. www.iiste.org

ASOGWA, B. C., EZIHE, J. A. C. and OGEBE, F.O. (2012). Agricultural Marketing Information Usage among Soybean Farmers in Nigeria. International Journal of Innovation and Applied Studies, 1 (2) Pp. 160-170

BRUNNERMEIER, M.K. (2005). Information leakage and market efficiency. Review of Financial Studies, 18(2): 417-457.

DERCON, S., (1995). On market integration and liberalization: Method and application to Ethiopia. Journal of Development studies 32(1):112-143.

FAN, C.S. & WEI, X. (2005). The Law of One Price: Evidence from the Transitional Economy of China Review of Economics and Statistics 88 (4):682-697 DOI:10.1162/rest.88.4.682. Source:RePEc

GÓES, C., & MATHESON, T. (2015). Domestic Market Integration and the Law of One Price in Brazil. IMF Working Paper, Western Hemisphere Department. International Monetary Fund (Working Paper No. 15/213). Retrieved 11 October 2016.

JOHANSEN, S. & JUSELIUS, K., (1990). Maximum Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money. Oxford Bulletin of Economics and Statistics,Vol. 52, No. 2, pp. 169–210.

LAMONT, O.A. & THALER, R.H. (2003). Anomalies: The Law of One Price in Financial Markets. Journal of Economic Perspectives 17 (Fall 2003), pp. 191–202.

MANKIW, N. G. (2011). Principles of Economics (6th ed.). Mason, OH: South-Western Cengage Learning. Page 686.

National Population Commission (2017). Publication of National Population Commission, Abuja, Nigeria

MGBADA, J.U. (2006). Effectiveness of information sources on improved farming practices to women farmers in Enugu State, Nigeria. Global Approaches to Extension Practice, 2 (1): 67-78, 2006.

ORKWOR, G.C., ASIEDU, R. & EKANAYAKE, I.J. eds (1998). Food Yams: Advances in Research. IITA, Ibadan and NRCRI, Umudike, Nigeria. 249pp

PERSSON, K.G. (2008). Definitions and Explanation of the Law of One Price. eh.net. Economic History Services. Retrieved 6 July 2017.

RAVALLION, M. (1986). Testing Market Integration. American Journal of Agricultural Economics (73):102–109

ROSSI, E. (2010). Impulse Response Functions. Econometrics 10, 1-42 Università di Pavia

STIENEN, J., BRUINSMA, W., & NEUMAn, F. (2007). How ICT can make a difference in agricultural livelihoods. In Commonwealth ministers reference book (pp.2–4). Retrieved from http://www.iicd.org/files/ICT%20and%20agricultural%20livelihoods.pdf

STIGLER, G.J. & SHERWIN, R.A. (1985). The Extent of the Market. Journal of Law and Economics (27):555–585.

ZIVOT, E., and WANG, J. (2006). Vector autoregressive models for multivariate time series. Modeling Financial Time Series with S-Plus®, 385-429.