Journal of Agricultural Science; Vol. 6, No. 2; 2014
ISSN 1916-9752 E-ISSN 1916-9760
Published by Canadian Center of Science and Education

Measuring Spatial Integration in Niger Grain Markets

Seydou Zakari[1] & Liu Ying[1]

[1] College of Economics and Management, Huazhong Agricultural University, Wuhan, Hubei Province, P.R. China

Correspondence: Liu Ying, College of Economics and Management, Huazhong Agricultural University, Wuhan 430070, Hubei Province, P.R. China. Tel: 86-136-6720-1370, 86-275-982-4673. E-mail: liuyhzau@gmail.com

Received: October 8, 2013 Accepted: November 26, 2013 Online Published: January 15, 2014

doi:10.5539/jas.v6n2p15 URL: http://dx.doi.org/10.5539/jas.v6n2p15

Supported by the project (NCET-12-0868) of New Century Excellent Talents and the project (2013PY017) of the Fundamental Research Funds for the Central Universities of China

Abstract

This paper investigates the spatial integration of Niger cereal markets using monthly retail prices of four staple crops consumed daily in the country. We used co-integration techniques to analyze the price relationship between six main markets. The results revealed high co-integration in Millet and Maize market pairs. On the Contrary, the study indicates also high absence of co-integration in most of Rice and Sorghum markets. Many factors such as poor infrastructures, government interventions, may be major impediments to spatial integration between markets. Development of private grain marketing will help to improve trading between markets, thereby increasing competition and circulation of grain from surplus areas to supply deficit areas.

Keywords: market integration, co-integration, food prices, Niger

1. Introduction

Cereal crops (such as millet, sorghum, rice and maize) are key components of the diet of Niger's people. According to Niger Government surveys on household budgets, over 80 percent of daily caloric consumption came from cereals (millet, sorghum and other cereals) in 2005 and 70 percent in 2006. Over 60 percent of households rely in part on their own production to meet their consumption needs. Nevertheless, over 60 percent of households were net purchasers of millet in 2005. Unfortunately, the role of the Government of Niger in cereal production and marketing has been significantly reduced since the 1990s and food prices are now determined by market forces (World Bank, 2009).With market liberalization, most households depend on market for food supply. This market dependence increases in years of poor agricultural production. Households also rely on markets to earn income from the sale of animals, staple foods, cash crops and labor, to cover non-food expenditures (Beekhuis & Ibrahim, 2007). Thus, the knowledge of the spatial price relationship between markets is necessary for proper policy intervention. Analysis of Market integration is viewed as a basic tool to understand how markets are linked (Ravallion, 1986). Lack of infrastructures, inadequate information flow, poor competition and inadequate marketing institutions are often major constraints to market integration in most developing countries. Lack of Market integration is often associated with important food insecurity due to the fact that there is no connection between markets to supply the deficit areas. This is often the case in Niger where limited infrastructures, poor market information affected trading in the most remote areas and also households access to food. Most of Nigerien farmers do not have access to market where they can sell their products during harvest periods, thus reducing their profit and lost of most perishable goods.

Spatial market integration refers to co-movement or long run relationship of prices, the smooth transmission of price signals and information across spatially separated markets (Golleti et al., 1995). Several studies were carried out concerning spatial market integration in agricultural markets using different techniques in Africa. Abdulai (2000) employed threshold co-integration tests to analyze the spatial price transmission and asymmetry in the Ghanaian maize market. He found that major maize markets in Ghana are well integrated and wholesale maize prices respond more swiftly to increase than to decrease in central market prices. Minot (2011) examined the impact of transmission of world food price changes to markets in 11 countries of Sub-Saharian Africa using co-integration and Vector Error Correction Model (VECM) techniques. His econometric analysis revealed that

staple food prices in these countries have a long-term relationship with world prices in only 13 of the 62 African food prices examined. African rice prices are more closely linked to world markets than are maize prices. Conforti (2004) analyzed price transmission in selected markets in 16 developing countries with an econometric framework based on the estimation of Autoregressive Distributed Lag models, and of the corresponding Error Correction specification. His results indicated that the African markets included in the sample are characterized by more transmission compared to Latin American and Asian markets. Amikuzuno and von Cramon-Taubadel (2012) employed co-integration and a Vector Error Correction Model with seasonality to tomato wholesale prices in Ghana. They concluded that accounting for seasonality can generate interesting insights into the spatial price transmission for perishable products. Failure to account for seasonality leads to hybrid estimates of the parameters that depict price transmission behavior, conflating and obscuring seasonal differences in the way prices respond to one another. Nkendah and Nzouessin (2006) were interested in analyzing the spatial integration of plantain markets in Cameroun employing Co-integration and Error Correction techniques. Their results revealed a weak integration of the production to the consumption markets. Jaleta and Gebermedhin (2009) used co-integration techniques on bi-monthly retail price of wheat and teff to examine the spatial market integration. They reported that most markets are co-integrated in wheat and *teff* retail prices. In Niger, few studies were devoted in areas of food grain spatial market integration. Aker (2007) used monthly cereal (millet and sorghum) prices to examine market performance during food crises and found that markets in Niger are partially integrated, with a higher degree of integration during droughts. The purpose of this paper is to analyze the spatial integration of Niger cereal markets. It differs from the earlier studies in that it is not limited to only in the analysis of millet and sorghum prices, but included also rice and maize prices. The findings of the study are expected to help Niger government to make policy formulation to reduce food prices, thereby improving food security in the country.

2. Materials and Methods

2.1 Theoretical Framework

The intuitive idea behind the measurement of market integration is to understand the interaction among prices in spatially separated markets. In the extreme case of two markets A and B completely separated from each other, the prices of the same commodity should not be related. If the areas where market A is located experiences a bad harvest, prices will suddenly increase. In market B, there is no reason to assume that a bad harvest has also occurred. In the absence of communication flows between the two markets, prices in B would not show any movement. On the other hand, if A and B were integrated, the price in B would also increase. This is because some food would flow from B to A decreasing the available supply in B. At the same time the price in A would be lower than in the absence of market integration. When markets are integrated, it will reduce the impact of shocks during bad harvest periods.

The simplest form of this model can be represented as follows. Given prices for a commodity in two spatially separated markets p^A and p^B, a generalized equilibrium condition can be written as:

If the difference between the autarky price in market A (P^A) and in market B (P^B) is greater than the full cost of transportation between the two markets (T_c), then trade will be profitable. If

$$P^B - P^A > T_c \quad (1)$$

It is profitable to move the commodity from market A to market B. Trade will reduce the supply and raise the price in the exporting market (market A) and increase the supply and reduce the price in the importing market (market B), thus causing the prices in the two markets (P^A and P^B) to move together and reach an equilibrium when

$$P^B - P^A = T_c \quad (2)$$

If trade takes place between any two regions, then the price in the importing region equals the price in the exporting region plus the unit transportation cost. If this condition holds, then the markets are said to be integrated. If markets are integrated, then, we should expect prices to equilibrate across space and time (Minot, 2011; Sekhar, 2012). Market integration means that price difference between two trading markets or regions should be less than or equal to transaction cost. However, the main limitation in carrying research in area of market integration is that it is difficult to obtain time series data on transaction costs particularly in most developing countries. Thus, econometric modeling using price data are widely developed by researchers to investigate relationship between prices of different markets or locations.

2.2 Methodology

We employed co-integration approach to investigate the presence of co-integrating long run relationship among Niger food grain markets. First, we tested for non stationary in the data. The time series need to have the same order of integration for the co-integration tests to be valid. A time series process yt is said to be integrated of order

d, denoted by I (d), if it has to be differenced d times before it becomes stationary. Augmented Dickey Fuller (Dickey & Fuller, 1981) unit root tests were employed. The number of lags to be considered in each pair of markers tested for co-integration is selected using the Akaike Information (AIC) and SC standard criteria supplemented by the Schwartz-Bayesian, the Hannan-Quinn, and Log-Likelihood tests mainly to check for the consistency of the results.

The variables are co-integrated, meaning that there is a linear combination of the variables that is stationary. The co-integration means that the price series move narrowly together in the long run, although they can diverge in the short run, and thus in conformity with the concept of the integration of the markets. Johansen-Juselius (1990) procedure utilizes two test statistics to determine the number of co-integrating vectors. Two likelihood ratio test statistics are used (Jahansen, 1988). The null hypothesis of rank r = 0 (i.e. no co-integrating relationship) is first tested and, if rejected, subsequent null hypotheses (H0: r = 1, H0: r = 2, etc.) are tested until a null can no longer be rejected. When the rank is deemed to be r, then there are r co-integrating vectors. The likelihood ratio statistics for the trace test and for the maximum Eigen value test are the following equations:

$$\text{Trace statistic } (\lambda\text{-trace}) = -T \sum_{i=r+1}^{n} \ln(1 - \lambda_i)$$

The null of r co-integrating vector against the alternative of $r + 1$ is tested by

$$\text{Maximum Eigen value statistic } (\lambda\text{-max}) = -T \ln(1-\lambda_{r+i})$$

Where r is the co-integrated number of pair-wise vector， λ_I is the i^{th} Eigen value of matrixΠ. T is the number of observations. λTrace is not an independent test, but a series of tests correspond to different r value. λmax tests each Eigen value separately.

In practice, comparing maximal Eigen value and trace statistic with the critical values, we test the number of long-term co-integration. The null hypothesis test shows the pair-wise vectors are co-integrated when the statistic value is more than those critical values against alternative hypothesis of no co-integration between two vectors when the statistic value is less than those critical values.

2.3 Data Sources

We used monthly retail market prices downloaded from FAO database at the Global Information and Early Warning System (GIEWS) website. The series used constitute of data covered the period from January 2006 to March 2012. We selected the four main staple crops (millet, sorghum, maize and rice) consumed in Niger. Millet, Sorghum, Maize, and imported rice are the most important food commodities. Millet is consumed by both rural and poor urban households throughout the country. Maize and imported rice are most important for urban households.

Six markets were used in the investigation according to the availability of data over the study period. Niamey is the most important national market and an international trade center, and also supplies urban households. Tillabery, Dosso, Maradi, Zinder and Agadez are important national and regional markets. These are markets where households and nomads coming from the northern cereal deficit areas regularly buy their food. These markets are at least 100 km apart.

3. Results and Discussions

3.1 Unit Root Tests

The results of stationary tests are presented in Table 1. The Augmented Dickey-Fuller (ADF) test fails to reject the null hypothesis of the presence of unit root in each of the price series in levels, and rejects this null hypothesis after the first differences of each price series. Therefore, we concluded that all price series are integrated of order one, or I(1).

Table 1. ADF test for the order of integration

Markets	Level test statistics	First difference test statistics
Rice price series		
Niamey	-1.230283	-7.021931***
Agadez	-1.807269	-8.647000***
Dosso	-1.180135	-6.493678***
Maradi	-1.318675	-7.523082***
Zinder	-1.179870	-7.381390***
Millet Price Series		
Niamey	-1.316366	-7.368180***
Dosso	-2.687293	-6.528877***
Maradi	-2.399936	-6.558407***
Tillabery	-2.205242	-9.391371***
Zinder	-3.134583	6.607073***
Agadez	-1.835469	-7.424121***
Sorghum Price Series		
Niamey	-1.073678	-8.401403***
Dosso	-1.478862	-6.523039***
Maradi	-1.942371	-8.417931***
Tillabery	-2.569958	-6.714762***
Zinder	-2.718150	-6.266387***
Agadez	-1.575525	-7.730106***
Maize Price Series		
Niamey	-1.861535	-5.736580***
Dosso	-1.664151	-7.347269***
Maradi	-1.543697	-6.976662***
Tillabery	-1.409317	-9.081858***
Zinder	-1.648399	-7.537682***
Agadez	-1.467295	-7.126124***

Note: ***Rejection of the null hypothesis of presence of unit root at the 1% level.

3.2 Co-Integration Tests of Different Price Series

Five central market pairs were used in the investigation of the integration of rice price series. As shown in the Table 2, only 10% of rice market prices are integrated in Niger. Only Niamey and Dosso rice price series are found to be integrated. Rice is increasingly becoming an important part of the food basket for urban people in Niger. Niger imports two-thirds of its overall rice supply mainly from Asian markets (USAID, 2011). Local production is insufficient to meet the domestic demand and only provides 34% of total supply. Niger relies also on international trade for supply to meet domestic demand. Lack of market integration between rice markets in Niger may be attributed to an inadequate transportation system which contributes to increase transfer cost across different regions in the country. Niamey-Dosso markets are integrated because of relatively short distance separating the two regions.

Table 2. Co-integration between rice price series

Market pairs	Lag order	Max-Eigen Test	Critical values	Trace Test	Critical Values	Rank	Co-integration
Niamey-Dosso	1	15.30319**	14.26460	17.15311**	15.49471	1	Yes
Niamey-Maradi	1	8.626743	14.26460	10.40563	15.49471	0	No
Niamey Zinder	1	11.89775	14.26460	13.42989	15.49471	0	No
Niamey-Agadez	1	6.666583	14.26460	8.217765	15.49471	0	No
Dosso-Maradi	1	8.984208	14.26460	11.06185	15.49471	0	No
Dosso-Zinder	1	7.507727	14.26460	9.242006	15.49471	0	No
Dosso-Agadez	1	4.471632	14.26460	6.190353	15.49471	0	No
Maradi-Zinder	1	5.765768	14.26460	7.153538	15.49471	0	No
Maradi-Agadez	1	4.891818	14.26460	6.622857	15.49471	0	No
Zinder-Agadez	1	9.086259	14.26460	10.42242	15.49471	0	No

Note: critical value at 5% level ; *, ** ,*** indicate co-integration significant at 10% ,5% and 1% respectively.

Table 3. Co-integration among millet price series

Market pairs	Lag order	Max-Eigen Test	Critical values	Trace Test	Critical Values	Rank	Co-integration
Niamey-Tillabery	1	13.74722*	14.26460	16.27338**	15.49471	1	Yes
Niamey-Dosso	2	13.89344*	14.26460	16.47273**	15.49471	1	Yes
Niamey-Maradi	2	11.97493*	14.26460	14.28280*	15.49471	1	Yes
Niamey- Zinder	2	21.67879***	14.26460	23.09375***	15.49471	1	Yes
Niamey-Agadez	2	17.83681**	14.26460	20.70234***	15.49471	1	Yes
Tillabery-Dosso	2	10.67713	14.26460	15.49888**	15.49471	1	Yes
Tillabery-Maradi	2	14.33031**	14.26460	16.73418**	15.49471	1	Yes
Tillabery-Zinder	2	31.58939***	14.26460	36.49862***	15.49471	1	Yes
Tillabery-Agadez	1	17.59301**	14.26460	22.38606***	15.49471	1	Yes
Dosso-Maradi	2	5.851054	14.26460	9.868308	15.49471	0	No
Dosso-Zinder	2	12.36163*	14.26460	16.97591**	15.49471	1	Yes
Dosso-Agadez	2	9.993429	14.26460	13.36189	15.49471	0	No
Maradi-Zinder	2	14.77677**	14.26460	18.78490**	15.49471	2	Yes
Maradi-Agadez	1	14.63238**	14.26460	18.74997**	15.49471	2	Yes
Zinder-Agadez	2	17.09187**	14.26460	20.30712***	15.49471	1	Yes

Note: critical value at 5% level; *, **, *** indicate co-integration significant at 10%, 5% and 1% respectively.

As indicated in the Table 3, 80% of all millet market pairs in Niger are integrated. We have to note that millet is the main staple crop produced in Niger. This indicates, even the prices of millet diverge away in the short-term, they move together in the long-run dynamic relationship. This high co-integration among millet markets may be due to the fact that millet is primary staple crop consumed in Niger which makes high interactions among traders and consumers of different markets to stabilize supply and demand. Millet production represents almost 76 percent of Niger grain production and barely enough to meet domestic demand. In general, cereal prices exhibit large seasonal fluctuations that affect the nutritional status of many Niger people. In a normal year, millet prices fall immediately after the harvest (September) and reach the lowest level in November when all harvest is in and demand from food-deficient farmers is at its lowest. Starting from December, prices pick up as availability on collection markets decreases while demand starts rising. Prices peak in August when, in normal years, they reach a level 30-40 per cent higher than in November. The intensity of these seasonal fluctuations varies across regions

and is more marked in village markets where food producing households cannot arbitrage between low and high prices due to lack of finance, storage facilities, and cereal banks (Cornia & Deotti, 2008). As the results attested, the distances between different city millet market prices under may not be an obstacle for the integration of millet markets in Niger. The distance separating Tillaberi to Agadez is 1066 kilometers, but this pair of markets is still co-integrated. The pair of market Niamey - Maradi is not co-integrated, despite their short distance (664 km) compared to the distance between Tillaberi and Agadez. Other factors such as trade barriers and lack of market information may be factors affecting market integration in millet markets.

Maize is another staple crop consumed by Niger people, but less important compare to millet, sorghum and rice. The co-integration tests of different maize market pairs, presented in Table 4, shows approximately 74 percent of market pairs are co-integrated. This is an evidence of high trading among different maize markets in Niger. The traders import maize from neighboring countries mainly Nigeria, Benin and Togo as domestic production is not enough to meet national demand. Like rice, maize is also important for urban households. The bag of 100 kg of Maize is relatively cheaper compared to the bag of 100 kg of Millet. Contrary to millet markets, geographical location may be a constraint to the integration of the maize markets in Niger, as most of market pairs, which are co-integrated, are relatively not separated by long distances.

Table 4. Co-integration among Maize market price series

Market Pairs	Lag order	Max-Eigen Test	Criticalvalues	Trace Test	Critical Values	Rank	Co-integration
Niamey-Dosso	2	13.46099*	14.26460	16.19631**	15.49471	1	Yes
Niamey-Maradi	2	11.32405	14.26460	14.15586	15.49471	0	No
Niamey-Tillabery	2	18.06759**	14.26460	21.29219***	15.49471	1	Yes
Niamey-Zinder	2	13.81388*	14.26460	16.13348**	15.49471	1	Yes
Niamey-Agadez	2	16.06308**	14.26460	18.71076**	15.49471	1	Yes
Dosso-Maradi	1	13.72613*	14.26460	16.26695**	15.49471	1	Yes
Dosso-Tillabery	1	16.74323**	14.26460	18.98620**	15.49471	1	Yes
Dosso-Zinder	1	11.17040	14.26460	14.37102	15.49471	0	No
Dosso-Agadez	1	12.89818	14.26460	15.38630	15.49471	0	No
Maradi-Tillabery	1	21.11328***	14.26460	23.85113***	15.49471	1	Yes
Maradi-Zinder	1	26.71583	14.26460	30.10430***	15.49471	1	Yes
Maradi-Agadez	1	16.61562**	14.26460	19.54737**	15.49471	1	Yes
Tillabery-Zinder	1	22.16955**	14.26460	24.44578***	15.49471	1	Yes
Tillabery-Agadez	1	13.14180	14.26460	14.50461	15.49471	0	No
Zinder-Agadez	1	14.28396**	14.26460	17.25426**	15.49471	1	Yes

Note: critical value at 5% level; *, **, *** indicate co-integration significant at 10%, 5% and 1% respectively.

Sorghum is the second important staple crop in Niger and its production represents about 25 percent of total cereal output. As indicated in the Table 5, only 1/3 (34 percent) of sorghum market pairs are co-integrated. Dosso sorghum price is not co-integrated to any of the market prices under study. As we can notice, the distances between different markets may not be an obstacle to the integration of sorghum market price series as Niamey is near to Dosso and Tillabery, but their prices not co-integrated.

Table 5. Co-integration among Sorghum market price series

Market Pairs	Lag order	Max-Eigen Test	Critical values	Trace Test	Critical Values	Rank	Co-integration
Niamey-Tillabery	2	14.13583	14.26460	15.18158	15.49471	0	No
Niamey-Dosso	2	5.157856	14.26460	6.641326	15.49471	0	No
Niamey-Maradi	1	18.33323**	14.26460	19.71246**	15.49471	1	Yes
NiameyZinder	2	15.73609**	14.26460	16.94866**	15.49471	1	Yes
Niamey-Agadez	1	8.814575	14.26460	10.83556	15.49471	0	No
Tillabery-Dosso	2	10.14325	14.26460	12.20587	15.49471	0	No
Tillabery-Maradi	2	9.568023	14.26460	3.494952	3.841466	0	No
Tillabery-Zinder	2	17.09146**	14.26460	23.92394***	15.49471	2	Yes
Tillabery-Agadez	1	15.19209	14.26460	20.53301***	15.49471	2	Yes
Dosso-Maradi	2	11.35863	14.26460	13.36574	15.49471	0	No
Dosso-Zinder	2	11.75923	14.26460	13.96943	15.49471	0	No
Dosso-Agadez	1	5.212018	14.26460	7.459644	15.49471	0	No
Maradi-Zinder	2	10.16175	14.26460	12.88377	15.49471	0	No
Maradi-Agadez	1	8.223690	14.26460	11.84292	15.49471	0	No
Zinder-Agadez	2	5.68135	14.26460	20.24504***	15.49471	2	Yes

Note: critical value at 5% level; *, **, *** indicate co-integration significant at 10%, 5% and 1% respectively.

Previous studies (Aker, 2007) revealed that regional cereal markets during low production years are generally well-integrated, resulting in the flow of goods from surplus areas (with relatively lower prices) to deficit areas (with relatively higher prices), some research has concluded that local markets within Niger are only partially integrated. The flow of goods between local markets appears to be heavily influenced by transaction costs, most of which are related to the price of gas. The demand and supply of each commodity play an important role in the integration of Niger cereal markets. Generally, during low production periods, household's dependence on markets for supply is relatively high. This makes high transaction among different markets as traders move products from surplus areas to consumption areas to satisfy the consumer needs. Lack of infrastructures is likely one major factor affecting integration of food markets in Niger. Most of the traders lack adequate finance to product transfer cost and high taxes imposed by the government discourage their activities.

4. Conclusion

Cereal markets play an important role in household food supply especially for urban people in Niger. The objective of this study is to examine the spatial cereal market integration in six important markets in Niger. The co-integration technique was applied on monthly retail prices of four main cereal crops (millet, sorghum, rice and maize). The results revealed that millet and maize market pair price series are highly co-integrated. One major finding of this study is that there is lack of integration in rice and sorghum markets. The results also provide a confusing picture concerning the impact of geographical locations of markets. Some market pairs are found to be co-integrated despite the long distance separating them, while there is no integration between some less distant market pairs. The consumer preference over each commodity and the annual output of each crop may also affect the co-movement between series over time and space. Niger trades with neighboring countries especially Nigeria, thus, their food markets influence prices and supply of cereal crops in Niger.

As co-integration alone cannot tell us the factors that affect the integration of cereal markets, there is a need of further investigations to better understand how Niger food market work. This study is limited only to initial step in co-integration test using Johansen-Juselius (1990) procedure, thus further investigations that will provide short-run effects, speed of adjustments and causality tests are needed. As many previous studies revealed, agricultural commodity markets in developing countries, in general, are not well-integrated due to poor infrastructures and institutional facilities. Hence, infrastructural development, less barriers to trade and market information will help to improve integration in cereal markets in Niger. Facilitating access to credit for private

grain traders will promote development and competition in grain marketing which will increase high transaction between markets.

Acknowledgments

We are grateful for the financial support of the project (NCET-12-0868) of New Century Excellent Talents and the project (2013PY017) of the Fundamental Research Funds for the Central Universities of China.

References

Abdulai, A. (2000). Spatial price transmission and asymmetry in the Ghanaian maize market. *Journal of Development Economics, 63*, 327-349. http://dx.doi.org/10.1016/S0304-3878(00)00115-2

Aker, J. C. (2007). The Structure, Conduct and Performance of the Cereals Market in Niger: Implications for Preparing for and responding to Food Crises. *A Report prepared for the World Bank, Washington, D.C*. Retrieved from http://www.cid.harvard.edu/neudc07/docs/neudc07_poster_aker.pdf

Amikuzuno, J., & von Cramon-Taubadel, S. (2012). Seasonal Variation in Price Transmission between Tomato Markets in Ghana. *Journal of African Economies, 21*(4), 669-686. http://dx.doi.org/10.1093/jae/ejs008

Beekhuis, G., & Ibrahim, L. (2007). Cross-border trade and food markets in Niger: why market analysis is important for humanitarian action. *Humanitarian Exchange Magazine, 38*, 24-27.

Conforti, P. (2004). *Price transmission in selected agricultural markets .Commodity and Trade Policy Research Working Paper No 7*. Food and Agriculture Organization, Rome, Italy. Retrieved from ftp://ftp.fao.org/docrep../fao/006/ad766e/ad766e00.pdf

Cornia, G. A., & Deotti, L. (2008). *Niger's 2005 Food crisis: Extent, Causes and Nutritional Impact*. Working paper No.EUDN/WP 2008-15. European Commission, Brussels. Retrieved from http://www.eudnet.net/download/wp/EUDN2008_15.pdf

Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *J. Econometrica, 49*, 1057-1072. http://dx.doi.org/10.2307/1912517

Engle, R. F., & Granger, C. W. J. (1987). Co-integration and error correction: representation, estimation and testing. *J. Econometrica, 55*, 251-276. http://dx.doi.org/10.2307/1913236

Goletti, F., & Babu, S. (1994). Market liberalization and market integration of maize markets in Malawi. *J. Agricultural Economics, 11*, 311-324. http://dx.doi.org/10.1016/0169-5150(94)00005-0

Jeleta, M., & Gebermedhin, B. (2009). Price Cointegration Analyses of Food Crop Markets: The case of Wheat and *Teff* Commodities in Northern Ethiopian. *Paper prepared for presentation at the International Association of Agricultural Economists Conference, Beijing, China*. August 16-22, 2009.

Johansen, S. (1988). Statistical analysis of co-integrating vectors. *J. of Economic Dynamics and Control, 12*, 231-254. http://dx.doi.org/10.1016/0165-1889(88)90041-3

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inferences on Co-integration with application to the demand for money. *Oxford Bulletin of Economics and Statistics, 52*, 160-210.

Minot, N. (2011). *Transmission of world food price changes to markets in sub-Saharan Africa*. IFPRI Discussion Paper 01059, International Food Policy Research Institute. Washington, D.C. Retrieved from http://www.ifpri.org/sites/default/files/publications/ifpridp01059.pdf

Nkendah, R., & Nzouessin, C. B. (2006). *Economic Analysis of the Spatial Integration of plantain Markets in Cameroon*. Research Paper. Douala University. Cameroon. Retrieved from http://depot.gdnet.org/newkb/fulltext/nkendah_spatial_integeration.pdf.

Ravallion, M. (1986). Testing market integration. *American Journal of Agricultural Economics, 68*(1), 102-09. http://dx.doi.org/10.2307/1241654

Sekhar, C. S. C. (2012). Agricultural market integration in India: An analysis of selected commodities. *Food Policy, 37*, 309-322. http://dx.doi.org/10.1016/j.foodpol.2012.03.002

United State Agency for International Development (USAID). (2011). *USAID office of food for Peace Niger Bellmon Estimation*. Fintrac Inc, Washington D.C, USA. Retrieved from http://www.usaidbest.org/docs/NigerBellmon2011.pdf

World Bank. (2009). Niger Food Security and Safety Nets. *Report No. 44072-NE.World Bank, Washington, DC*. 18 February. Retrieved from http://reliefweb.int/sites/reliefweb.int/files/resources/fullreport_154.pdf