

Spatial price integration: A cointegration approach to regional bean markets in Kenya and Tanzania

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Abstract The common bean is an important legume crop in East and Central Africa, providing protein, calories and cash income for rural households. This study identified the problem of lack of adequate information on the cross border bean marketing system between Northern Tanzania and Kenya. The objective of this study was to gauge the performance of the bean marketing system, by the measurement of the degree of market integration between regional markets in the study area. The study covered Arusha and Moshi markets of Tanzania, and Nairobi, Namanga and Taveta markets of Kenya. The monthly average wholesale bean prices for 2000 and 2001 were collected from the Ministry of Agriculture and Rural Development (Kenya) and the Ministry of Agriculture and Food Security (Tanzania). The SPSS was used to generate the Pearson's bivariate correlation coefficients while the Microfit package was used to analyse the extent of market integration under a co-integration framework using the Augmented Dickey-Fuller unit root tests and Granger causality procedures. The study revealed that in 2001, a paltry 122 tons of beans were formally exported to Kenya through Namanga border point, indicating that despite trade liberalization and the advent of the East African Community, cross-border bean marketing is still largely informal. The regional markets are weakly integrated with bean prices in deficit markets jointly interacting to form the bean prices in supply markets. This study recommends the free export of beans by Tanzanian Government and the removal by Kenya Government of the 3.5% HCDA levy on imported beans from an EAC member state.

Key words: Bean prices, cross border trade, market integration, cointegration

Introduction

The common bean is a major staple in Eastern and Southern Africa, where it is recognized as the second most important source of dietary protein and the third most important source of calories (Wortmann, 1998). Animal protein is seldom affordable by the poor in developing countries, so the bean provides the chief and sometimes the only source of protein. Bean consumption in Eastern and Southern Africa exceeds 50 kilograms per person per year, reaching 66 kilograms per person in parts of Kisii, Kenya (Wortmann, 1998). Dry beans can be consumed, boiled alone or mixed with cereal grains, especially maize (to form a meal known as 'githeri' in Kenya or 'makande' in Tanzania). Green shelled beans, tender leaves and immature pods are some of the forms in which beans are consumed (Kosgei, 1998).

Despite trade promotions and market reforms, which have to a large extent minimized exchange controls and commodity movement restrictions, inappropriate policies and other trading malpractice still inhibit formal trade linkages in the sub region. Kenya's annual bean deficits are estimated at 200,000 tons

(Odhiambo, 1994). There is significant cross border trade in beans between Kenya and Tanzania (Wortmann, 1998), yet little has been done to economically assess this market. This study was therefore done to gauge the bean market performance by the assessment of the degree of market integration in the study region.

Methodology

The study area. The study was done in the region between the Northern Zone of Tanzania and Southern Kenya. The Tanzanian markets that were covered were Arusha, Moshi, Himo and Namanga, while those of Kenya were Namanga, Taveta and Nairobi.

Type of Data. The average monthly wholesale bean prices (secondary data) from four markets, Arusha, Moshi, Taveta and Nairobi were the main type of data used. This was collected from the Ministry of Agriculture and Rural Development (Kenya) and the Ministry of Agriculture and Food Security (Tanzania).

Data Analysis

Market Integration Analysis. A number of studies have examined price integration in different markets by testing for either static or dynamic correlations between price variables (Gordon, 1993). The most common measure of spatial market integration between time series of commodity prices is the bivariate correlation coefficients. This test uses the Pearson correlation coefficient, a scale-free measure of the covariance between two price series, giving values between -1.00 and 1.00 (Steffen, 1994). Statistically significant and positive correlation coefficients indicate a spatial integration between the respective pair of markets, while negative signs indicate that there is no market integration. A coefficient of 1.00 implies that prices in the markets are perfectly correlated with each other, hence perfectly integrated markets. The use of price correlation coefficients as measures of market integration, however, has some weaknesses. There are chances that the correlations could be spurious, rather than resulting from the integrated nature of the markets (Barrett, 1996). This study recognized these weaknesses and augmented the correlation coefficient approach by cointegration analysis.

Barrett and Li (2002) suggest that market integration might be most usefully defined as tradability or contestability between markets. This implies the transfer of Walrasian excess demand from one market to another, manifest in the physical flow of commodity, the transmission of price shocks from one market to another, or both. Market integration concerns the free flow of goods and information, and thus, prices, over form, space and time, and is thus closely related to concepts of efficiency.

Using the Microfit computer package, the cointegration analysis was done in four steps enumerated as follows:

- i) A graphical plot of the price series of the four regional markets, Nairobi, Arusha, Moshi and Taveta. This enabled a visual inspection of the general price trend, so that an inference could be made on the possibility of integration.
- ii) Computation and plotting of first differences of the price series. This further aided in the visual inspection of the general trend in differences.
- iii) Testing of stationarity, both in the price series, and in the first differences, using the augmented Dickey-Fuller (ADF) test. This test enabled the decision on whether unit roots existed, and therefore, whether the price series and their differences exhibited stationarity. The model for the ADF test is given by: Under the null hypothesis of the existence of a unit root, if ρ is close to unity, then the coefficient, $(\rho-1)$ will not be significantly different from zero. If there is no unit root, Z is said to be stationary in the levels, or integrated of order zero (denoted $I(0)$). If there is a unit root, but differencing the series once makes it stationary, then it is said to be integrated of order one, denoted $I(1)$. Apart from testing for the unit root, the model

also establishes if there is a deterministic trend ($\beta \neq 0$) and or a drift ($\mu \neq 0$). If Z_t is a first order autoregressive process (denoted $AR(1)$), then the single lagged value of the dependent variable will be sufficient to ensure u_t is white noise. This test therefore indicated whether the series were integrating or not.

iv) Granger causality tests, which enabled the understanding of the direction of causality in price changes. Cointegration says nothing about the direction of the causal relationship between variables, but if two variables are found to be cointegrated, it follows that there must be Granger causality in at least one direction (Schimmelpfening and Thirtle, 1994). Granger's causality test regresses a variable y on lagged values of itself and another variable x . Granger's causality model is given by:

If x is significant, it means that it explains some of the variance on y that is not explained by lagged values of y itself. This indicates that x is causally prior to y and is said to dynamically cause or Granger cause y

Results and discussions

Cross Border Bean Trade. The study revealed that there are three distinct groups of market participants in cross border bean trade. These are: long distance wholesalers (Kenyan women who traveled to Tanzanian markets to purchase and export beans); Tanzanian exporters (mainly large scale producers and export companies; and Tanzanian bean farmers and small scale traders, who cross into Kenya to sell their beans during market days. The Tanzanian exporters do the bulk of formal cross border bean trade, while the long distance wholesalers, farmers and small-scale traders do the bulk of informal trade. It was observed that all other pulses passed through formal export channels for these did not attract Horticultural Crops Development Authority (HCDA) levy.

For any formal cross border bean trading, the Tropical Pesticides Research Institute (TPRI), Tanzania, requires a plant import permit from the importing country, a phytosanitary certificate and a letter of request for the exportation of plant materials. The phytosanitary certificate costs US\$ 15 per consignment and an additional tax of US\$ 2 charged at the border point of exit. The Tanzanian Government does not always allow the exportation of beans for food security reasons, except on special permit arrangements.

To allow bean imports into Kenya, the Kenya Plant Health Inspectorate Service (KEPHIS) requires a phytosanitary certificate from the exporting country, to confirm cleanliness of consignments from pests and diseases. The Kenyan customs authorities charge HCDA levy at Ksh. 1/kg of beans, costing about Ksh. 100 (US\$ 1.33) per 100 kg; and an import duty of 3.5% of the value, which translates to about Ksh. 63 (US\$ 0.84) per 100 kg bag of beans. Traders used informal marketing channels in their cross border bean trade to evade HCDA levy.

Formal cross border bean trade was established to be small. Data at Tanzania's Namanga agricultural office shows that in the year 2001, about 122 tons of beans were exported through Namanga border point. From January 2002 to March 2002 (the time of the survey) no beans had been recorded as exported, contrary to observations made then. The bulk of cross border bean trade is therefore unrecorded. Using offtake statistics from key informants, wholesalers and transporters in Nairobi and Arusha, this study estimates the size of cross border bean trade between Tanzania and Kenya at an annual average of 18,000 tons.

Market integration. The average monthly wholesale bean prices were analyzed for market integration, using the Pearson's bivariate correlation coefficients. Table i shows these coefficients.

Table i: Bivariate Correlation Coefficients

	Nairobi	Taveta	Arusha	Moshi
Nairobi	1			
Taveta	0.486*	1		
Arusha	0.625**	0.602**	1	
Moshi	0.577**	0.500*	0.437*	1

* Correlation is significant at 0.05 level; ** Correlation is significant at 0.01 level

Source: Computation from wholesale bean price data

Despite all the correlation coefficients being significant at 0.05 level of significance, they are low. According to Steffen 1994, correlation coefficients less than 0.9 are not reliable. Though low, the results here show that the highest level of integration exists between Arusha and Nairobi markets, with a correlation coefficient of 0.625. This correlation is significant at 0.01 level of significance. This conforms to the actual situation in the market because the beans were established to move from Arusha to Nairobi through Namanga border point. Some integration also exists between Arusha and Taveta markets. This integration is created by bean flows from Arusha to the coastal towns of Mombasa and Malindi via Taveta.

There is need, however to use cointegration analysis, a more superior tool, that allows for a better judgement of the degree of market integration in the study area. A visual inspection of the graphical presentation of the average monthly wholesale prices of Rose coco variety (Lyamungu type) in the four regional markets shows that there appears to be a general comovement or trend for prices in all the markets, except Taveta. The inspection of a similar plot of the price differences shows that there is some even distribution in the deviations, indicating the possibility of cointegration of these differences. Though inconclusive, the two graphs show that there may be some integration in the regional markets. A further analysis involving the augmented Dickey-Fuller unit root test in both the price series and the first differences gave results that are presented in table i2

All the test statistics of the price series data are insignifi-

cant at 95% confidence level. This implies that the price series are not stationary (have unit roots). However, the ADF statistics for the first differences of the price series data for Arusha and Nairobi are significant at 95% confidence level. This shows that differencing the price series data once makes it stationary, hence are said to be integrated of order one, denoted I(1).

Having established that the series are I(1), the Johansen method was used to test for the presence of cointegrating vectors in the regressions. All possible cointegrating regressions were run, with the objectives of identifying those that had cointegrating vectors. The regressions that showed presence of cointegrating vectors are shown in table 3.

These results show that there are only two cointegrating regressions. These imply that some cointegration exists. The results show that bean prices in Nairobi, Moshi and Taveta jointly interact in the generation of Arusha bean prices, and that bean prices in Nairobi, Arusha and Taveta also jointly interact to generate the Moshi bean prices. In the first cointegrating regression, we say that Nairobi, Moshi and Taveta bean prices are prior to (or dynamically cause or Granger cause) Arusha bean prices. In the second cointegrating regression, Nairobi, Arusha and Taveta bean prices are prior to (or dynamically cause or Granger cause) Moshi bean prices.

Conclusion and Recommendations

The regional bean markets are weakly integrated. The Nairobi, Taveta and Moshi market prices collectively interact to form the Arusha bean price. Similarly, the Moshi bean prices are formed by the joint interaction of Arusha, Taveta and Nairobi bean prices. There is need to improve on the status of the bean marketing system. This study recommends that Tanzania Government should allow the free exportation of beans, except in bad crop years. On the other hand, Kenya Government should scrap the 3.5% HCDA levy on imported dry beans, because the dry bean is not a horticultural crop. These will improve the performance of cross border bean marketing between Kenya and Tanzania, thereby improving integration in the regional markets. These will ensure the availability of affordable beans to consumers in Nairobi.

Acknowledgements

We acknowledge our enumerators: Mr. Peter Xavery of SARI, Tanzania; Mr. Samuel Mweu of the DEC's office, Taveta Sub-District, and Mr. Lihanda of the MIB, Nairobi. Much thanks also go to Mr. Alfred Serem, Moi University, for providing the Microfit software for cointegration analysis. Finally, we acknowledge the provision of research fund by CIAT/ECABREN, without which this research would not have been possible.

Statistic

Statistic	Price Series Data				First Differences			
	Taveta	Arusha	Nairobi	Moshi	Taveta	Arusha	Nairobi	Moshi
(95% Critical Value = -3.0199)								
(95% Critical Value = -3.0294)								
DF	-1.5955	-1.7969	-0.71914	-1.3148	-3.3692*	-4.4235*	-4.9515*	-4.1005*
ADF(1)	-1.8724	-1.7982	-0.37002	-1.3139	-2.1503	-3.6502*	-4.0219*	-2.4694
ADF(2)	-2.3320	-1.6374	0.18792	-1.6855	-1.6826	-2.6898	-2.2711	-2.0816

DF= Dickey Fuller; bracketed figures indicate the number of lags.

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