AN ASSESSMENT OF DRY BEANS MARKET INTEGRATION IN SELECTED MARKETS IN KENYA

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DECLARATION AND APPROVAL

DECLARATION

This thesis is my original work and has not been presented in this or any other university for the award of any degree.

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APPROVAL

This thesis has been presented to the graduate school for examination with our approval as university supervisors

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DEDICATION

To my Parents Samson and Sarah for their continued support throughout my studies, my beloved husband Victor Amwata for his encouragement, tolerance and enabling environment to study, my brother Zephaniah and aunt Happiness and family for Moral support. Thank you for your support.

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ABSTRACT

The agriculture sector in Kenya has put in place several strategies to ensure availability and access to food by all people. Market efficiency is one of the strategies that ensure effective movement of food commodities from surplus to deficit regions through market integration. This study assessed dry beans movement across Nairobi, Nakuru, Eldoret and Kitale markets. The main objective of the study was to contribute to knowledge towards monitoring prices of food staples between surplus and deficit areas and assess how well price movements in any one of the markets translate into price changes in other markets. Unit root test was used to test for stationarity, co-integration to test for the relationship between the markets, while Granger causality was used to test for causality across the markets and Threshold Autoregressive error correction model was applied to analyze time lags and the speed of market price adjustment. The study utilized deflated and seasonally adjusted monthly average price data over 216 months (1994 to 2011) and was analyzed using STATA and SPSS statistical softwares. This study was aimed at providing price information towards identification and improvement of efficient bean marketing chain that would lead to reduced transaction costs giving room for more competitive pricing for Kenya's dry beans in the staple food market. Results showed that all the markets were integrated of order zero before differencing and the data was stationary. Co-integration test revealed that all the markets were co-integrated while granger causality test revealed independent causality with only one market link showing bidirectional causality leading to symmetric price adjustment between Kitale and Nairobi markets. Results from the TAR model revealed that, in Nairobi and Kitale market links which granger caused each other, it took approximately 3 weeks for a shock in one market to be transmitted to the other market thus prices returning to their parity bound equilibrium. This implies that, if price transmission is symmetrical across markets, then, price differences between the markets will only be equal to transaction costs between them. The study concluded that, the government can give farmers incentives to produce dry beans in high production areas, improve marketing infrastructure like roads and communication facilities which can greatly reduce transaction costs and improve price transmission. Market information should be availed in information banks in various parts of the country so that farmers can access information on which markets offer remunerative prices for their dry beans. These will prevent traders from taking advantage of increased production to lower prices of dry beans, the end result being enhancing the degree of market integration.

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ACRONYMS AND ABBREVIATIONS

ASDS	Agriculture Sector Development Strategy
CIAT	International Centre for Tropical Agriculture
ECABREN	East Central Africa Bean Research Network
GDP	Gross Domestic Product
GoK	Government of Kenya
MDGs	Millennium Development Goals
MoA	Ministry of Agriculture
MT	Metric Tones
SSA	Sub-Saharan Africa
TVECM	Threshold Vector Error Correction Model
USAID	United States Agency for International Development

CHAPTER ONE

INTRODUCTION

1.1 Background information

The agricultural sector dominates the Kenyan economy although only 15 percent of the land is being used for agricultural production, and half of the agricultural output is marketed. Agriculture contributes 26 percent to gross domestic product and ranks second in its contribution after the service sector (Government of Kenya, 2010). The country's dependence on agriculture is manifested by its contribution of 75 percent of the country's industrial raw materials, 27 percent GDP indirectly through manufacturing, distribution, and service related sectors, and 80 percent of local food production to feed its population. Apart from food contribution, the sector employs 80% of the country's workforce (Ministry of Agriculture, 2008*)*. As a result, it is ranked among the six key economic sectors expected to drive the economy to a projected 10 percent economic growth annually over the next two decades through promotion of an innovative, commercially-oriented and modern agriculture (Kenya Vision, 2030).

Additionally, the sector is expected to deliver other regional and global commitments including achievement of the first Millennium Development Goal (MDG1) on poverty and hunger. This is to be achieved by reducing the number of people who face extreme hunger and poverty by half by 2015 given the fact that 50 percent of Kenyan population faces hunger and absolute poverty (MoA, 2008). Country statistics show that GDP growth originating from agriculture is at least twice as effective in reducing poverty compared to GDP originating outside agriculture (MoA, 2008).

The Ministry of Agriculture has embarked on several strategies aimed at improving the sector's competitiveness including increasing market access through dissemination of market information, value addition, processing, packaging and branding the bulk of agricultural produce. Despite the Ministry's efforts, agricultural marketing and trade policy in Kenya is still dominated by the challenge of how to effectively deal with food price instability, which is frequently identified as a major impediment to smallholder productivity growth and food security. These concerns relate to both the producer and the consumer whereby the challenge has been how to keep farm prices high enough to provide production incentives for farmers while at the same time keeping them low enough to ensure poor consumers' access food (Kirimi *et al.*, 2010). To address the aforementioned challenges, it is critical to determine the market performance of various crops that contribute to household incomes, food and nutrition security.

Dry beans are one of the most widely cultivated legumes in the world. They are considered second most important source of human dietary protein and the third most important source of calories for over 100 million people in rural and poor urban communities in Africa. Its protein is cheaper than the animal-based protein, making it highly competitive and important in dietary regimes of poor people in Africa "United States Agency for International Development" (USAID), (2010). The total world production of dry beans was estimated at 19.2 million MT in 2008. Figure 1 below shows, the top ten world producers of dry beans.

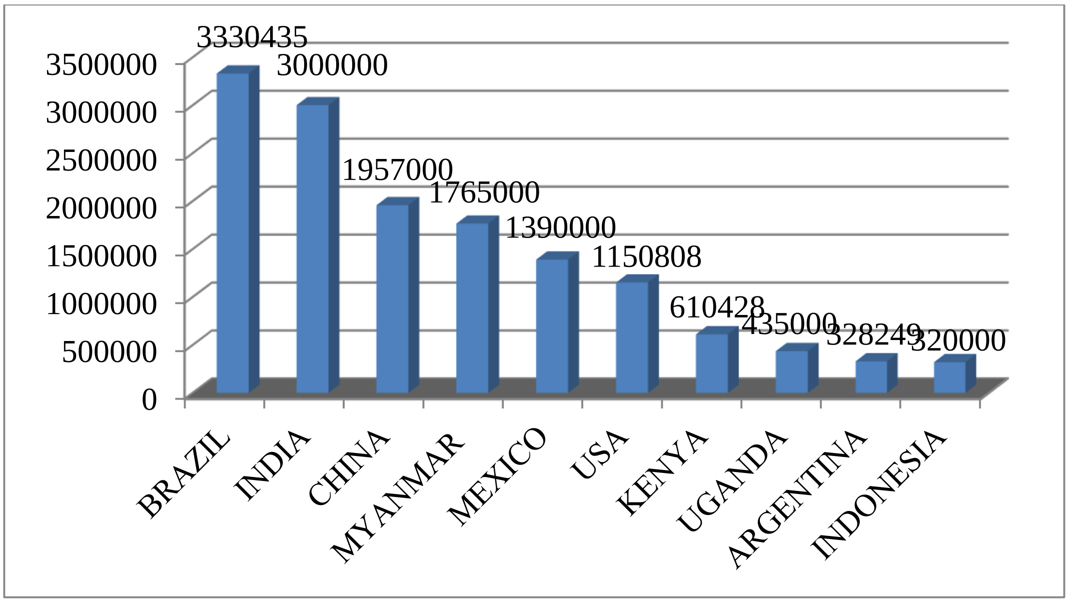


Figure 1: Top ten world producers of dry beans

Source: "United States Agency for International Development" (USAID, 2010).

Following MoA annual Report (2007) and USAID (2010), Kenya is ranked as the seventh largest world producer of dry beans which are the third most important staple food nationally, accounting for 9 percent of staple food calories and 5 percent of total food calories in the national diet (Kirimi *et al.*, 2010) hence having a critical relevance to national food security. Dry beans are the most popular sources of protein for many Kenyans, mainly the poor who cannot afford to buy meat. To the poor, beans play a strategic role in reducing food insecurity, hunger and malnutrition (Korir *et al.*, 2003), since they can be consumed as leaves, pods, green and dry seeds, and can be prepared in a wide range of recipes. Dry beans can be boiled and consumed, mashed with bananas or potatoes or mixed with other cereal grains like maize and consumed as “Githeri” (Wortman and Allen, 2008). Their utilization statistics in Kenya are presented in Table 1.

Table 1: Utilization of dry beans in Kenya, 2008

Methods of utilization	**Percentage of rural farmers**	**Percentage of urban consumers**
Cooked with maize	90	10
Mashed with bananas, potatoes, cassava greens	70	30
Stew for rice, Ugali, and chapatti	40	60

Source: Wortman and Allen, 2008.

MoA (2009) show that national production of dry beans between 2004 and 2008 increased at an estimated compound growth rate of 3% per annum. From about 232,000 MT in 2004, the country’s production grew at a compound growth rate of about 51% per annum to reach approximately 532,000 MT in 2006. However, growth in production between 2007 and 2008 declined as a result of dry climatic conditions combined with the post-election violence which rendered many farmers displaced. As a result, production in 2008 was approximately 260,000 MT. Table 2 shows beans production, consumption and the resulting deficit in the period 2004-2008.

Table 2: Dry beans production and consumption in Kenya

Year	**2004**	**2005**	**2006**	**2007**	**2008**
Production (MT)	232,072	375,820	531,800	383,900	261,137
Consumption (MT)	310,000	400,450	460,000	524,400	624,036
Surplus/(Deficits)	-77,928	-24,630	71,800	-140,500	-362,899

Source: MoA Economic Review on agriculture; 2009.

While production fluctuated widely over the five years presented above consumption continued to increase steadily at a compound growth rate of approximately 19% per annum.

Consequently, it has become increasingly common for Kenya to import beans as domestic demand overwhelms production. The country imports the deficit mainly from Uganda (Waluse, 2012), Tanzania and Central Africa. As indicated in Table 2, Kenya has experienced deficits in dry beans production in all the years since 2004, except in 2006 when the country generated surpluses estimated at 16% of total national annual consumption (MoA, 2006). In Kenya, the major dry beans production areas are shown in Figure 2 below:

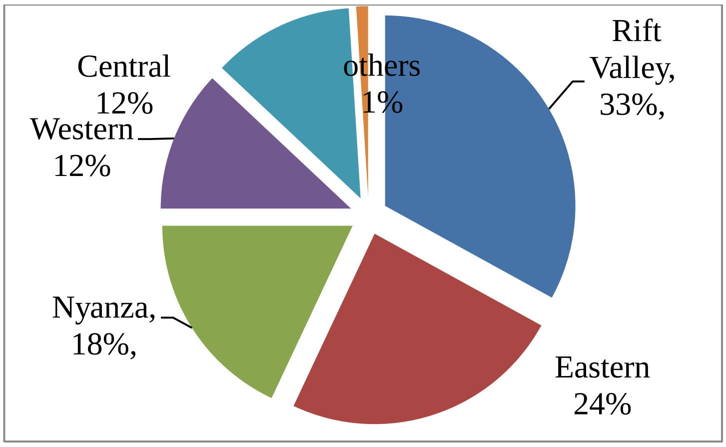


Figure 2: Main dry beans production areas in Kenya

Source: Ministry of Agriculture annual report for the year 2007.

1.2 Statement of the problem

Despite Kenya being a major consumer of dry beans, the demand for the commodity outweighs local production. The country consumes approximately 500 MT against a local production of 463 MT of dry beans harvested from 500,000 hectares. With increasing population and urbanization, there is persistent supply shortage in the face of rising demand for the dry beans especially in urban areas. The current shortage of dry beans indicates an apparent problem of local market failure to stimulate production and distribution coupled with seasonal price fluctuations, inadequate statistical data on bean marketing, bad weather conditions and poor pricing policies. These problems increasingly become a disincentive for increasing scale of production among small-scale farmers, who are the majority in dry bean production.

Regardless of the fact that the dry bean market in Kenya has operated freely, limited studies have been done on integration of markets to explain the demand and supply responses of dry beans market. Absence of information concerning the integration of these markets is what informed this study, to assess the degree of market integration and the nature of price relationships among selected beans markets in Kenya. Since beans are an important source of protein and most consumers rely on the markets for their supplies, assessing the performance of the bean markets is critical for food security

1.3 Objectives of study

1.3.1 General objective

The overall objective of the study was to contribute to knowledge and information on the integration of the selected dry bean markets in Kenya that would result in reduced transaction costs giving room for more competitive pricing for Kenya's dry beans in the staple food market.

1.3.2 Specific objectives

i. To determine the extent of dry bean market integration between selected deficit and surplus dry bean markets in Kenya
ii. To determine whether Nairobi dry bean market prices Granger cause prices in Nakuru, Eldoret and Kitale.
iii. To estimate the amount of time it takes price spread between deficit and surplus dry bean markets to move half way back to its threshold (half-life).

1.4 Research questions

i. To what extent are the selected dry bean deficit and surplus markets in Kenya integrated?
ii. Do Nairobi dry bean market prices Granger cause prices in Nakuru, Eldoret and Kitale?
iii. How long does it take price spread between deficit and surplus dry bean markets to move half way back to its threshold (half-life)?

1.5 Justification of the study

In general, an understanding of commodity price relationships and shock transmissions across markets is necessary. This is especially so, when legumes account for a large share of agricultural consumables, prices is volatile, social safety net programs are large, and modern and traditional technologies coexist. In such economies, farmers will have to be self-sufficient in basic staples to protect themselves against price risks.

While there is evidence on the importance attached to market integration, limited study has been undertaken in Kenya. As a result, price information does not end up to dry bean smallholder producers and consumers. The purpose of the study was to contribute to knowledge on the analysis of the dry bean subsector and make the information available to relevant stakeholders

Most studies in Kenya have concentrated on coffee, tea, maize, dairy sector and horticultural crops and recently on Irish potatoes, while neglecting important food staples like dry beans yet they are the third most important food staple nationally. In addition, most studies have used linear co-integration methods which have been found restrictive in investigating spatial price transmission. The linear methods do not allow for a zone of trade inactivity when price spreads fall below a threshold that reflects transfer cost between agents. To overcome the above weakness this study made use of the threshold autoregressive error correction model because it allows for a zone of trade inactivity.

The study was aimed at benefiting farmers, marketing agents, consumers, processors and policy makers by providing them with information on market integration of dry beans in Kenya. The result is expected to lead to improved farm incomes for farmers and better movement of dry beans from surplus to deficit areas. Finally this can contribute to the MDG one of eradicating extreme poverty and hunger thus meeting target two of reducing by half the proportion of people suffering from hunger by 2015**.**

1.6 Limitations/scope of the study

The study was carried out using monthly average price data collected by the Ministry of Agriculture covering a period of 18 years (1994-2011). The data would not cover earlier periods because of absence of complete data set. Although monthly averages were used to reflect the seasonal price fluctuations of beans for the periods covered under the study, such averages could not reflect the scarcity of dry beans in different regions.

The study concentrated on four markets in Kenya thus conclusions made will majorly apply to these markets since factors affecting market integration are different across markets and groups of traders.

1.7 Operational definition of terms

Market: refers to a place where goods and services are exchanged in return for something of value.

Marketing margin: refers to the difference between what consumers pay for a product and the prices received by producers for the same product, or the difference between the price received by the first seller and that which is paid by the final consumer of the product.

Market efficiency: competence with which a market structure performs its designated functions.

Price transmission: process by which upstream prices in deficit markets affect downstream prices in surplus markets causing either a decrease or an increase in price.

Symmetric price adjustment: scenario where price transmission is homogeneous with respect to characteristics which may be internal or external to the market system. If there is a price increase or decrease in a deficit market, it will cause a price increase or decrease in surplus market respectively.

Market integration: It refers to flow of excess demand from one market to another, as manifested in the physical flow of commodities, information coupled with the transmission of price shocks from one market to another.

Transaction costs: costs incurred in searching for the best supplier or customer, negotiation of sale, contracting, enforcement and monitoring costs, information costs and transportation in an attempt to consummate an economic exchange.

Half-life: time taken for a given shock in the market to return to half its initial value presented in weeks.

Threshold: band of adjustment that represents transaction costs which are expressed in the study as percentage of mean price between the two markets.

Shock: refers to any market force that disrupts equilibrium of demand and supply determinants.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This section reviews some literature on market integration, market efficiency and price transmission. Particular focus is on market integration of agricultural commodities in different countries. Further, this chapter presents how market information and market participation of farmers influence market integration. The remaining section introduces the theoretical and conceptual framework employed in the study.

2.2 Review of literature on market integration studies.

Market participation can be both a cause and a consequence of economic development which offers households in the agricultural sector opportunity to specialize according to comparative advantage and thereby enjoy welfare gains from trade. Recognition of the potential of markets as engines of economic development and structural transformation gave rise to a market-led paradigm of agricultural development during the liberalization era (Abdulai, 2006), thus promoting the liberalization policy in Sub-Saharan Africa (SSA) and other low-income regions.

Baulch (1997) points out that, issues of integration and efficiency, in the context of spatially separated markets, have attracted much attention in literature. They are often linked to concerns over the impact of market liberalization across developed; less developed, and transition country economies. Further, Barrett and Swallow (2006) observed that, farmers with access to adequate infrastructure and faced with appropriate incentives actively engaged in markets. Additionally, they observed that, those without one or more of those two essential ingredients largely did not participate in markets. Kherallah *et al.* (2000) agreed that, having the right prices in a market economy was not enough to enhance welfare of market participants and market integration. Participants therefore must have access to public goods accompanied with proper economic incentives.

The main function of markets is to signal the relative scarcity of goods and resources, guide decisions of economic agents and ensure the mobility of commodities over time and across space (Ravallion, 1986). The cost associated with the temporal and spatial transfer of commodities is the extent to which prices generated through the market process reflect the relative scarcity of goods. Thus the quality of price signals transmitted across markets is the key determinant of market performance which in turn encourages producers to specialize according to comparative advantage (Rapsomanikis *et al.*, 2006).

Structural and institutional deficiencies of various types often weaken the performance of markets, as reflected in high distribution costs, distorted market prices, and inadequate price transmission. The induced inefficiencies in the market process can have significant implications for long term growth, equity and other economic policy objectives (Goletti and Babu, 1994).

Market performance is mainly related to the function of arbitrage. Spatial arbitrage equalizes supply and demand at different market places until price differences are reduced to the level of transaction costs. The higher the level of transaction costs between markets, the smaller the probability that exchange will take place between them. Links between markets thus become more likely as transaction costs decrease (Shepherd, 1997).

Kenya has been in the process of agricultural markets reform since 1939 (GoK, 2006), with increasingly high number of retailers in food grain market in which the wholesaler markets play the greatest role in the marketing process. Nevertheless, smallholder food crop farmers in local producer markets remain vulnerable to the risk of low and unstable producer prices in the wake of the market reform process.

Staple food basket of households in developing countries typically consists of legumes as part of consumers' staple food. Shahidur (2011) notes that prices of the legumes have a long-run relationship and shocks to one of the markets will get transmitted to the rest, across space and time, if markets are integrated.

Fafchamps and Hill (2005) agree with Shahidur that, in the short run farmers are not likely to diversify toward cash crop farming if legume prices are volatile and will make less risky crop choices. These results hold in the presence of market failures (such as inadequate infrastructure, incomplete credit and insurance markets, and information asymmetry), a fact that forms the basis for public interventions in the food staple market to ensure they are integrated (Shahidur, 2011).

Thus, managing legumes price instability continues to receive policy attention in many developing countries. Kenya is one of the sub Saharan countries championing this move. This information on market integration for governments is to enable them provide a synergistic effect rather than to crowd out the role of the market and private sector. Such interventions provide evidence for recommending domestic market integration and information on degree of price transmission and speed of adjustment for a country's food security (Rashid, 2011).

One of the studies that have analyzed the effect of market integration of staple foods is Sopo (2008) who made use of bivariate correlation coefficients and linear co-integration to investigate maize price transmission across regional markets and co-integration of spatially separated maize markets in Malawi. The study focused on market integration after government policy to strengthen Market Information System (MIS) in the agricultural sector in a period with and without price band. It was concluded that spatially separated markets are linearly co-integrated in the long-run as a result of market information availability or improvements in market information flow within the regions.

Motamed *et al.* (2008) evaluated trade linkage between maize prices in United States and Mexico following North American Free Trade Agreement (NAFTA). Using linear co-integration analysis and error correction model, it was observed that prices between United States and Mexico do not share a common long run relationship. Rather Mexico prices are determined by local conditions in the regions. Such an analysis was to assist policy makers to develop complementary free trade policies, to reduce transportation and transfer cost from surplus to deficit areas within Mexico.

Abdulai (2000) noted that major maize markets in Ghana are well integrated based on the threshold co-integration model. The asymmetric threshold error correction model revealed that wholesale maize prices in local markets of Ghana respond more swiftly to increases than decreases in central market prices. Thus, viewed in relation to their long run levels, shifts in marketing margins were corrected more rapidly when there was an increase than a decrease in prices.

Further, in the absence of price distortion down the value chain, it can be presumed that market integration establishes a proportional relationship between commodity prices in the deficit and surplus markets. Existence of a proportional price relationship between spatial markets results from short run price transmissions and long run price co-movements (Kaltasais, 2000). The problems of low farm income, high risk and uncertainty that smallholder farmers face have significant consequences for food self-sufficiency and food security of farm households. In the presence of integrated domestic markets, the problem of low and unstable producer prices is less severe since local prices respond to those demand and supply conditions prevailing outside the market (Barret and Li, 2002).

Getnet *et al.* (2004) point out that, market integration is a necessary but not a sufficient condition to generate better producer prices. They introduced the need for government intervention even in integrated markets through creating conditions that help integrated markets to be efficient. They further argued that, while many people may not advocate for government market intervention, some interventions may be desirable when markets fail to raise and stabilize producer prices and strengthen the price transmission role of integrated markets. Therefore, to achieve this benefit of integrated markets, the degree of price transmission between producer and consumer markets must be known which gives reason why this information gap must be addressed to fully understand the performance of the marketing system.

In their contribution towards addressing such institutional weaknesses, Kirsten and Karaan (2005) presented the theory of new institutional economics with transaction costs and market inefficiency as some of the major factors contributing to decreased market integration. According to institutional economics, difficulties in economic exchange between two partners arise because of four exchange related problems namely, asymmetric information leading to moral hazard, opportunism, asset specificity and bounded rationality. This leads to partners behaving opportunistically with the result being inefficient markets and decreased market integration.

Getnet *et al*. (2004) added that understanding the degree to which markets are integrated serves governments in planning routine procurement of emergency stocks. It also supplements other effective demand augmenting and trading capacity such that enhancing mechanisms at the central market level may provide feasible and sustainable alternatives for raising and stabilizing producer prices. As such, the benefits reaped at the central market level due to such targeted interventions transmit to local markets and to producers if domestic markets are well integrated.

Getnet *et al*. (2004) in analyzing the effect of domestic agricultural market reform policies on spatial market integration of white teff in Ethiopia, made use of the Autoregressive Distributed Lag Model. They included model regressors to assess market integration from both the demand and supply sides from which the study confirmed existence of a non-spurious long-run relationship between producer prices in the local market and wholesale prices in the central market. Using the error correction model, it was confirmed that the wholesale price of white teff in the central consumer market was a major short- and long-run determinant of the producer price in the local supply markets. Following the results, it was concluded that, government interventions that affect central market could effectively influence the producer prices and overall market performance.

Barret and Li (2002) employed maximum likelihood estimation of a mixture of distribution models incorporating price, transfer cost, and trade flow data in pacific soybean meal markets. This approach was applied to differentiate between market integration and competitive market equilibrium, derivation of intuitive measures of inter-market tradability, perfect integration, segmented equilibrium, and segmented disequilibrium. The results suggested the existence of tradability and competitive equilibrium in pacific soybean meal markets though trade flows were intermittent at monthly frequency in most markets.

Kuan-Min and Yuan-Ming (2009) used the threshold error correction model to test whether the changes in the marketing margin between farm and retail prices can result in an asymmetric relationship between the farm and the retail prices in the rice market of Taiwan. They separated the transaction cost variation into two regimes, thus used a two-regime Threshold Vector Error Correction Model with the error correction term serving as the threshold variable to create a non-linear threshold model. The empirical results showed that when the marketing margin was lower than the threshold value, the market system operated freely and there was feedback between the farm and retail prices. However, when the marketing margin was higher than the threshold value, the government intervened in the market and the causality between the farm and retail prices no longer existed. Thus, they concluded that governments should intervene in markets when the marketing margin is higher than the threshold to prevent asymmetric price transmission between farm and retail prices.

Goodwin and Piggott (2001) utilized neutral band threshold auto regression and co- integration models to evaluate daily price linkages among four corn and four soybean markets in North Carolina. The results confirmed the presence of thresholds and indicated strong support for market integration, though adjustments following shocks may take many days to be completed. In every case, the threshold models suggested much faster adjustments in response to deviations from equilibrium than was the case when threshold behavior was ignored as in the case for linear models.

Mohammad and Wim (2010) in determining whether rice markets in Bangladesh were regionally/divisionally spatially integrated following the liberalization of the rice markets, made use of co-integration analysis and a vector error correction model (VECM) to analyze market integration. They utilized wholesale weekly rice prices at six divisional levels over the period January 2004 to November 2006. By use of the Johansen co-integration test they concluded that, there were at least three co-integrating vectors implying that, rice markets in Bangladesh during the study period were moderately linked together and, therefore, the long-run equilibrium was stable. From the results, it was concluded that the short-run market integration as measured by the magnitude of market interdependence and the speed of price transmission between the divisional markets was weak.

Observation made from the reviewed literature suggested that if markets are integrated, the price differential between surplus and deficit markets is minimized enhancing faster return to equilibrium price. To assess market integration and price transmission of various agricultural commodities several analysts have used different methodologies. From the above methodological review, results indicated existence of market integration in most markets although price transmission across the markets was calculated with transaction costs being incorporated in the model without necessarily relying on actual transaction data.

Studies on dry beans in Kenya have concentrated on cross border trade (Korir, 2005; Kibiego *et al*., 2006; Mauyo *et al*., 2007), and used the structure conduct performance approach, but no studies have been conducted on market integration and spatial transmission of dry beans in Kenya using the threshold autoregressive error correction model.

By applying the threshold autoregressive error correction model, the study account for the effects of transaction costs in price transmission without directly relying on transaction cost data. It also fits the economic requirements for the analysis of price adjustment with ability of capturing potential symmetric price adjustment processes based on the assumption of constant transaction costs through the analyzed period. Thus this model was used in this study to determine the extent to which the selected dry bean markets were integrated and contribute to knowledge on dry bean markets in Kenya.

2.3 Theoretical framework

Market integration enhances competition and trade within markets and promotes increase in production. It is a means through which common food production and marketing systems that ensure food security have developed across countries, within regions of the country and amongst the population. These contribute to alleviating malnutrition and increasing farmer incomes and, therefore, welfare of the farming and trading families (Ackello and Echessah, 1997).

The problem of farmers' access to efficient markets can be assessed using market integration or co-integration transaction cost models. High transaction costs make markets fail for smallholder farmers and can impede efficient functioning of markets by retarding the flow of price information of various agricultural commodities. These transaction costs can be fixed or variable. Fixed transaction costs are the set up costs incurred in completing the exchange process. Such costs include costs of putting up capital facilities such as investing in infrastructure and information services (like roads and telecommunication) and public and private institutions like the formal and informal associations (Larson, 2006).

On the other hand, variable transaction costs depend on the number or volume of transactions. Examples include fees levied during transportation and costs associated with quality inspection. Therefore, the greater the volume of goods transacted and the more frequent the transactions the higher the variable transaction cost of trade (Williamson, 1985).

Market integration deals with linkages among markets that include trends and integrated seasonal components. Related to integration is the co-integration concept. Co-integration is a property of two or more variables which have shown to be integrated. Since they are 'tied together' in some sense, a long-run equilibrium will exist. When two price series are co-integrated it follows that the markets are integrated in the long run (Alexander and Wyeth, 1994).

Research on the spatial integration of agricultural markets is often used to test the efficiency of agricultural markets thus helping to assess the problems smallholder farmers face to access efficient markets. The magnitude of trade relationship implies the existence of some kind of price coordination mechanism, which can be depicted econometrically.

Rapsomanikis *et al*. (2006) stated that, integrated markets are assumed to be efficient. Therefore, it is crucial to analyze whether long-run price relationships underlying trade relationships exist in agricultural markets. He further defines the two axioms of the regional price difference theory which states that; the price difference in any two regions or markets involved in trade with each other equals the transfer costs as can be presented in the relationship below,:

Consider, two spatially separated markets, where the price of a given good in time *t* is $P_{i,t}$ and $P_{j,t}$ in markets *i* and *j*, respectively. The two markets are considered integrated, if the difference between the prices in the two markets is the transaction costs denoted by k_t.

$$P_i = P_j + k \text{ ………………………………………………………………… } (1)$$

This implies trade between the two markets occurs only if $|P_i - P_j > k|$ thus confirming the theory that arbitrage ensures that prices of the same good traded in spatially separate markets equalize. If this is the case in the two markets, then the law of one price is applicable whose theory postulates that, given prices of a commodity in two spatially separated markets as $P_{i,t}$ and $P_{j,t}$at all points in time, the price differences should be the transfer cost for transporting the commodity from market *i* to market *j* (Rapsomanikis *et al*., 2006). If the joint distribution of two prices is found to be completely independent, then it implies no market integration and no price transmission leading to market segmentation (Ravallion, 1986). This can be presented as

$$P_{i,t} = P_{j,t} + c \text{ ………………………………………………………………. …… } (2)$$

where: *c* represents marginal transfer cost from market *i* to market *j.*
and market *i* and *j* represent surplus and deficit markets, respectively
If this theory between two markets holds, the markets are integrated. However, this extreme case is unlikely to occur especially in the short run. On the other hand, if the joint distribution of two prices were found to be segmented, then it implies no market integration and no price transmission. These two extreme conditions are called the strong form of 'Law of One Price' which is not the case in reality hence the weak form of the spatial arbitrage ensures that prices of a commodity will differ by an amount that is at most equal to the transfer cost and it can be presented as:

$$P_{i,t} - P_{j,t} \leq c \text{ ………………………………………………………………… . } (3)$$

This condition represents an equilibrium condition that observed prices may diverge from the relationship in equation 2 but the spatial arbitrage will cause the difference between the two prices to move towards the transfer cost.

2.4 Conceptual framework

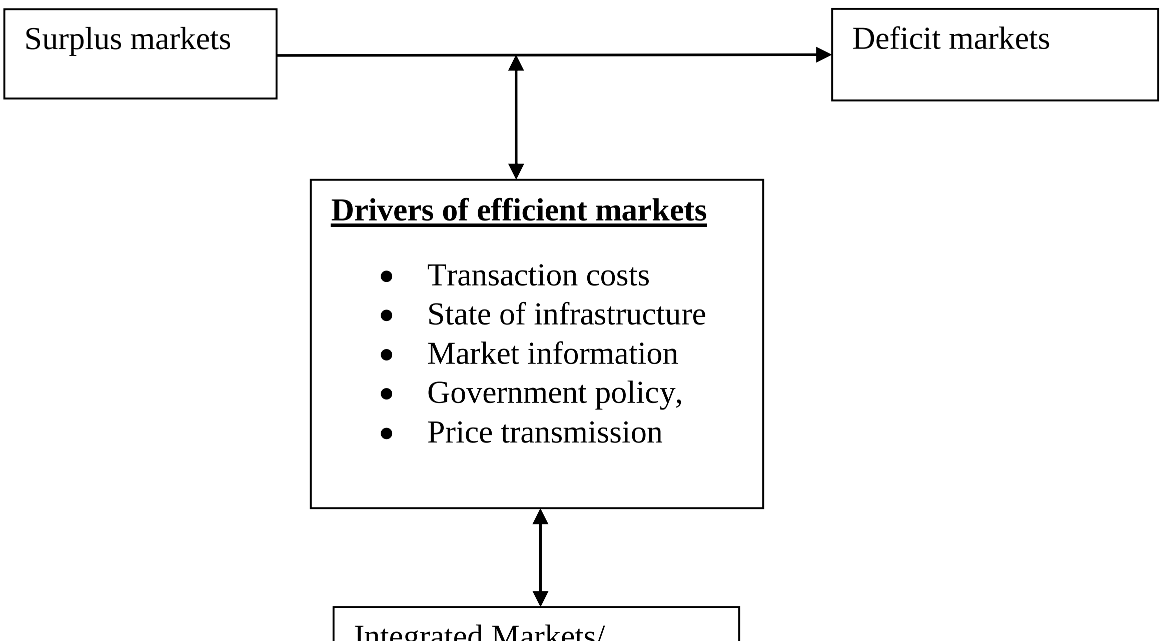
Many studies in Kenya have employed the structure conduct performance and the linear regression models for a long time in the study of market integration. However, these methods have been found restrictive for investigating spatial price transmission since they fail to allow for a zone of trade inactivity when price spread falls below a threshold that reflects transfer cost between regions. Transfer costs were found to be central to market integration because they determine the 'parity bound' within which the price of a commodity in two markets *i* and *j* can vary independently of one another. If markets are integrated, the price differential or spread between the two markets cannot exceed the transfer cost (Rashid, 2011).

Thus spatial arbitrage condition among markets implies that market integration lends itself to a co-integration test. In this case, co-integration becomes the empirical counterpart of the theoretical notion of a long run equilibrium relationship stipulating that if two spatially separated price series are co-integrated, there is a tendency for them to co-move in the long run according to a linear relationship. In the short run the prices may drift apart, as shocks in market *i* may not be instantaneously transmitted to market *j* but the arbitration opportunities ensure that these divergences from the underlying long-run (equilibrium) relationship are transitory and not permanent (Rapsomanikis *et al*., 2006).

Since market integration is important in indicating transmission of price signals and shocks among commodities over time, the model underlying market integration postulates that there exists linkages among markets and stable relations among prices in different localities. It assumes that if there are two markets and that are completely separated from each other, then the price of the same commodity should not be related. This implies that if market one experiences poor harvest and the other market receives good harvest and in the absence of information flow between them, prices will suddenly rise in market one and show no movement in the other market (Ravallion, 1986).

However, if the two markets are integrated, then the price in the other market would also show some movement. This is as a result of some food flowing from the surplus market *i* to deficit market *j*, therefore, decreasing the food supply in market *i*. The prices in market *j* would go down because of the increased supply from market *i*. This co-movement of prices gives a degree of market integration.

Taking the case of two markets, a surplus market (*i*) and a deficit market (*j*), factors determining whether the markets are integrated or not based on the reviewed literature were; state of infrastructure, market information, transaction cost and government policies. This is illustrated in Figure 3:



where: *i* is a surplus market and *j* is a deficit market.

Figure 3: Conceptual framework showing factors influencing market integration

Source: Own conceptualization

From Figure 3, market information and state of infrastructure will affect the price that is received by market participants in the dry bean subsector by influencing the transaction costs thus the incentive to participate in the market. If transaction costs are reduced the likelihood of enhancing market participation increases as a result of increased marketing margin. If the conditions are satisfied farmers will have an incentive to produce a marketable surplus and commodities will effectively flow from surplus to deficit markets eliminating possibility of segmentation.

CHAPTER THREE
METHODOLOGY

3.1 Study area

The study covered four markets in Kenya which are located in four different counties. They included Kitale which is in Uasin Gishu County, Eldoret market in Eldoret County, Nakuru market in Nakuru County and Nairobi market in Nairobi County. Kitale and Eldoret markets were chosen as producer markets since they were assumed to fairly represent production areas while Nairobi and Nakuru markets were assumed to represent destination/consumer markets of dry beans in Kenya.

3.2 Data type and sources

To achieve the outlined objectives, the study utilized deflated and seasonally adjusted monthly average price data over 216 months (1994 to 2011). The sample data was selected based on availability of continuous time series data. All the price data were obtained from the Ministry of Agriculture in Kenya. Two percent of the data gaps were filled by use of the missing value imputation method.

Using the monthly price data, the study presented an analysis that would provide a better understanding of commodity price relationships and shock transmissions across the selected markets. The analysis built on the idea proposed by Abdulai (2000), who examined spatial price transmission in three principal wholesale maize markets in Ghana.

3.3 Data analysis

Data obtained from the Ministry of Agriculture was entered, cleaned and analyzed using Excel, SPSS and STATA packages. The monthly price data for dry beans was first entered in Excel and later transferred to SPSS and STATA for analysis. In addition, the price data was deflated using the consumer price index (CPI 2000 = 100).

Descriptive statistics were used to show the spread of data depicting the maximum and minimum values of the data set. Mean as a measure of central tendency was used to condense the data and make comparisons across the four markets. In addition, coefficient of variation was used to show dispersion of prices in different markets.

3.4 Model specification

Gujarati (2004) pointed out that, regressing a non-stationary time series can result to spurious coefficients which can lead to wrong interpretation of a data set. He thus suggested that time series data has to be made stationary before being subjected to any analysis. From equation 2 and 3 transaction costs were introduced as one of the variables that affect the price received by market intermediaries. Since only dry beans price data was used in this study, a Threshold Autoregressive Error Correction Model was used to include the effect of transaction costs since they are embedded in the model. In consideration of the fact that prices are generally non stationary, this relation was of interest only if the error term $\boldsymbol{\mu_t}$was stationary, implying that price changes in surplus markets (*i*) do not drift far apart in the long-run from prices in deficit markets (*j*). When this occurs, the two series are said to be co-integrated.

However, not in all cases that the error term assumes stationarity and thus Engle and Granger (1987) two step procedure for evaluating the properties of a pair of non-stationary time series was applied in the study. Each time series was taken separately and tested for stationarity, to determine the number of times the data series needed to be differenced before transforming it into a stationary series using Augmented Dickey-Fuller test.

3.4.1 Stationarity test

The data in this study was tested for unit root using Augmented Dickey Fuller test (ADF), which is specified for any given price series as shown in equation (4):

$$\Delta P_{it} = \alpha + \beta P_{it-1} + \delta T + \sum_{\gamma-1}^{k_i} \varphi_\gamma \, \Delta P_{it-\gamma} + \varepsilon_t \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots . (4)$$

where T is the time trend and ΔP_t the price difference $(P_t - P_{t-1})$ while k_i and ε_t represent the number of lags in the time series.

The model was estimated with and without a time trend (T) which was included to ensure that the lack of stationarity in the time series data was not due to the presence of a deterministic trend. This is because trend is a relatively smooth long-term movement of a time series and it represents a general systematic linear or non-linear component that changes over time and does not repeat within the time range captured by the data in the study, thus can be predicted e.g. technological changes as suggested by Meyer (2008). The number of lags was given by k, and ε_t refers to errors which are assumed not to be auto correlated. The lag length was determined using the Akaike Information Criterion (AIC). The assumption for the null hypothesis was that unit root exists (i.e.H_O: β = 0). Failure to reject the null hypothesis confirms non-stationarity of the time series, and data has to be differenced until it becomes stationary I (0) (Gujarati, 2004).

3.4.2 Co-integration test

The presence of co-integration in a time series data justifies absence of segmentation. In this sense, co-integration was considered a powerful tool that could give a clear answer about existence of relation between two economic time series the result being integrated markets. In addition, co-integration between two stationary price series implies that a linear combination of the two series is stationary and the prices, therefore, tend to move together or follow the same path in the long-run. If p_{it} denotes the price at market *i* at time *t*, and p_{jt} denote the price in market *j* at time *t*, the coefficient, β in equation 5 below gives the long-run relationship between two markets only if the error term, ε_t is I(0) (Abdulai, 2006).

$$P_{it} = \partial_0 + \beta P_{jt} + \varepsilon_t P_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Thus co-integration between markets implies that β ≠ 0 and there exists a co-integration vector (1, -β). In this study, the Johansen Vector Autoregressive (VAR) based procedure (Johansen, 1988) of determining n - 1 co-integrating vectors was used. P_t was defined as a *nx1* vector of non-stationary prices, where P_{it} denotes the price of dry beans in market *i* at time t. Engle and Granger (1987) argued that a co-integrated series can be presented as vector autoregressive error correction mechanism of P_t as can be shown in equation 6:

$$\Delta P_t = \eta + \gamma_t + \Pi P_{t-1} + \sum_{t-1}^{k+1} \Phi_i \, \Delta P_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

From equation 6, η and γ are vectors of constants and time trend coefficients, respectively; Π and Φ are $n \times m$ matrices of coefficients; k is the number of lags; ε_t is an identically and independently distributed *n*-dimension vector of residuals with zero mean and variance matrix, Ωε. If the vector P_t contains I (1) prices, then the term ΠP_t-1~I (0). If the rank of Π is r, and r < n, then there exists *nxr* matrices, α and β each with a rank such that Π = αβ' and β'P_t is stationary. The rank r determines the number of co-integrating vectors of Pt and the matrix Π is the one that conveys information about the long run relationship among prices in the vector P_t (Katengeza *et al*., 2010).

This can be presented as shown below in equation 7 by use of the trace statistic tests which test the null hypothesis of r=1 co integrating vectors of P_t against a general alternative hypothesis of more than r co-integrating vectors r+1.

$$\lambda_{trace} = -T \sum_{i=r+1}^{n} \log\left(1 - \acute{\lambda}_i\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Where r= 0, 1, 2, …, n-1

3.4.3 Granger causality test

Granger causality is important in showing the direction of the relationship after performing co-integration tests. To assess the nature of dry beans price transmission across markets and causal relationships among spatially separated markets, Granger causality test was performed as proposed by Gujarati (2004). A dry bean market price series, P_{it} is said to Granger cause another dry bean price series P_{jt} if the current and lagged values of P_{it} improve prediction of P_{jt}.

Shahidur (2004) argues that causality is a measure of the predictability of prices i.e. price movements in one market can be used to forecast price changes in other markets which can be tested within Johansen's co-integration framework. For a pair-wise causal relationship, this can be specified as:

$$\begin{bmatrix}\Delta P_{it}\\ \Delta P_{jt}\end{bmatrix} = \begin{bmatrix}\propto_i\\ \propto_j\end{bmatrix} + \sum_{i=1}^{k-1}\begin{bmatrix}\Phi_{l,11} & \Phi_{i,12}\\ \Phi_{l,21} & \Phi_{i,22}\end{bmatrix}\begin{bmatrix}\Delta P_{it-l}\\ \Delta P_{jt-l}\end{bmatrix} + \begin{bmatrix}\beta_i\\ \beta_j\end{bmatrix}\begin{bmatrix}\delta_i & \delta_j\end{bmatrix}\begin{bmatrix}P_{it-k}\\ P_{jt-k}\end{bmatrix} + \begin{bmatrix}\varepsilon_{it}\\ \varepsilon_{jt}\end{bmatrix} \dots\dots\dots\dots\dots\dots\dots (8)$$

Granger causality in markets can be manifested in three major ways i.e. unidirectional, bidirectional or as independent price series. Unidirectional represents those markets in which shocks in market P_{it} cause prices in market P_{jt} but there is no reverse effect. Under this scenario the null hypothesis is that coefficient $\delta_{i\,t}$ is statistically different from zero i.e.($\delta_{i\,t} \neq 0$) against $\delta_{j\,t}$ is not statistically different from zero($\delta_{j\,t} = 0$). The converse is that shocks in market P_{jt} cause prices in market P_{it} with no reverse effect. Bidirectional causality results from shocks being transmitted back and forth. The null hypothesis states that, all coefficients (δ_i , δ_j β_i, β_j , $\propto_i$ and $\propto_j \neq 0$) are statistically different from zero. However, in a situation where none of the markets is causing the other there is independent causality. Under this state, the null hypothesis is that all coefficients (δ_i , δ_j β_i, β_j , $\propto_i$ and $\propto_j = 0$) are not statistically different from zero. Granger causality was conducted in this study to determine which market caused the other.

3.4.4 TAR error correction model

Based on the fact that many studies (Mauyo *et al.*, 2007; Kibiego *et al.*, 2006 and Korir, 2005), analyzed market integration based on price data alone often neglecting the role of transaction costs in influencing the direction of trade, this study endeavored to overcome this critique. By applying the threshold autoregressive error correction model, the study accounted for the effects of transaction costs in price transmission without directly relying on transaction cost data. The threshold autoregressive error correction model was used to fit the economic requirements for the analysis of price adjustment which was testable and included a "band of non-adjustment" (Meyers, 2002). It also presented the ability of capturing potential symmetric price adjustment processes based on the assumption of constant transaction costs through the analyzed period.

The empirical model was explained using Meyers (2002) argument, which states that, in spatial price transmission, the long-run equilibrium conditions for spatial market integration under competitive behavior can be presented as shown in equations (9), (10) and (11) based on spatial arbitrage:

$P_{it} - P_{jt} < C \; if \; q = 0$(regime 1) ……………………………………………………………………..(9)

$P_{it} - P_{jt} < C \; if \; q > 0$(regime 2) ………………………………………………………………….…. (10)

$P_{it} - P_{jt} < C \; if \; q < 0$(regime 3) …………………………………………………………………….. (11)

where:

P_{it} was the price in market *i* at time *t*;

P_{jt} was the price in market *j* at time *t*;

q was the quantity of commodity traded between the markets in two way direction;

If $q > 0$ amount of commodity traded from market *i* to *j*,

If $q < 0$ amount of commodity traded from market *j* to *i*, and

c was the marginal transfer cost and it was assumed symmetric irrespective of the direction of trade flow.

The first regime (equation 9) occurs when there is no trade between markets; hence the absolute value of the price spread should be less than transfer cost. The second regime (equation 10) implies that if trade flows from *i* to *j*, then the price in market *j* should be equal to the price in market *i* plus transfer cost. The third regime (equation 11) indicates that if trade flows from *j* to *i*, then the price in *i* market should be equal to the price in *j* plus the transfer cost.

The above regimes were tested using the threshold autoregressive error correction time series statistical model since it allowed for deviations from the efficiency conditions to occur both in short and long run. Following Meyers (2008), the threshold autoregressive error correction time series statistical model was presented as shown in equation (12), (13) and (14)

$$\Delta d_t = \varphi + \beta_0 d_{t-1} + \sum_{k-1}^{k} \beta_k \Delta d_{t-k} + \varepsilon_t \; if \; |d_t| \le c_t \text{ (regime 1)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$$

$$\Delta(d_t - c_t) = \alpha(d_{t-1} - c_{t-1}) + \sum_{k-1}^{k} \alpha_k \Delta(d_{t-k} - c_{t-k}) + \varepsilon_t \;\; if \; |d_t| > c_t \text{ (regime 2)} \ldots (13)$$

$$\Delta(d_t + c_t) = \alpha(d_{t-1} + c_{t-1}) + \sum_{k-1}^{k} \alpha_k \Delta(d_{t-k} - c_{t-k}) + \varepsilon_t \;\; if \; |d_t| < -c_t \text{ (regime 3)} .. (14)$$

where:

$d_t = P_{it} - P_{jt}$ is the price spread between markets at period *t*;

Δ is the first difference operator; $\Delta d_t = d_t - d_{t-1}$

C_t is the long run transfer cost at *t*; and

ε_t is the error term

There is non-linearity at the threshold which allows the price spread to display different behavior inside versus outside a 'parity bound' defined by long-run transfer costs. To evaluate the effectiveness of spatial price transmission, the size of the parity bound in regime 1 and the behavior of price spreads when they are outside the bounds in regime 2 was of interest. This was to be able to explain any deviations of price spread from the parity bound and ascertain how long it took them to return to the bound.

Threshold error correction time series statistical model can be straightforward and thus the relationship holds if price spread and transfer cost data are observable. However, data used in this study lack transaction cost information thus justifying the use of an auxiliary model for long run transfer costs c_t, which captures trends and variations over time and can be presented in equation (15)

$$C_t = \delta_0 + (\delta_1 - \delta_0)\frac{t}{T-1} + \delta_2 P_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (15)$$

Where:

t is the time index *t* = 0,1, 2,……, T-1; and

T is the total number of price observations

P_{it} is the price in market *i* at a time *t*

From equation 15, if $\delta_2 = 0$ then δ_0 is the long run transfer cost at the beginning of the sample period i.e. January 1994 while δ_1 is long run transfer cost at the end of the sample December 2011, after allowing for a linear time trend.

Inclusion of the price variable P_{it} is to allow for variation of some marginal transfer costs with the price of the product. This model may not capture all of the short run movements in transfer cost but should capture long run changes and trends. That is if the estimate of the long run transfer cost threshold c_t from the model above is a reasonable estimate of actual average transfer cost between the markets, then the result will be a good indicator of whether long run efficient, competitive inter-regional trade activity exists between the markets.

This model was used in this study because it has special features for estimating the time it took price spread between surplus and deficit dry bean markets to move half way back to its threshold (half- life) by focusing on regimes 1 and 2. In regime 1 (the price spread is inside the parity bound), trade flow should be zero according to Meyers (2008), which implies movements in the price spread follow an arbitrary stochastic process that depends on autarky supply and demand conditions in the two markets (and not transfer cost). It might be expected that, $\varphi \approx \beta_0 \approx 0$ which would imply that while the price spread is inside the parity bound, it follows a random walk without drift (price spread changes randomly inside the parity bound).

Outside the parity bound (regime 2 or 3) price transmission is not fully efficient because there should be incentive to increase trade flow until the price spread returns to the parity bound. This means for effective spatial price transmission we cannot have $\alpha \geq 0$) (because then d_t and c_t would be unrelated in the long run and there would be no tendency for spatial price spreads to return to the parity bound). This sufficient condition for ineffective spatial price transmission (i.e. $\alpha \geq 0$) is testable following (Meyers, 2008).

Hence, if $\alpha < 0$ there is a long run equilibrium relationship between d_t and c_t, and the size of α determines the spread of adjustment of the price spread back to the parity bound. Also, when $\alpha = -1$ and $d_k = 0$ for k = 1, 2… K it would imply immediate adjustment even though (price spread never moves systematically outside the parity bound). For values of α between 0 and -

1, the closer α is to 0 the slower the adjustment and the closer to -1 the faster the adjustment, hence effective spatial price transmission.

Even though the value of α gives the rate of price adjustment, it does not show the value of adjustment. Thus, use of half-life helps to show the adjustment of price spreads back to the parity bound in regimes 2 and 3 given by equation 16 below, where,

$$h = \{\ln(0.5)/\ln(1+\rho)\}. \dots \dots (16)$$

where ρ is the adjustment parameter on the lagged market price difference expressed as a percentage of the mean price in the two markets. With the example of supply or demand shock that raises the price spread above the parity bound; half- life is the time it takes for trade to increase and drive the price spread half way back to the parity bound, assuming no other shocks. Shorter half- lives imply that price transmission is effective (Meyers 2008).

CHAPTER FOUR
RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents findings of the study. The results and discussions have been outlined with reference to the research objectives and research questions of the study. The overall objective was to contribute to knowledge towards monitoring prices of food staples between surplus and deficit markets and how well price movements in any one of the markets are translated into price changes in other markets. The specific objectives were to determine the extent of market integration between selected deficit and surplus dry bean markets in Kenya; determine whether Nairobi dry bean market prices Granger cause prices in Nakuru, Eldoret and Kitale markets; and estimate the amount of time it takes price spread between deficit and surplus dry bean markets to move half way back to its threshold (half- life).

This chapter presents empirical results of market integration for the four selected markets in Kenya. Using the threshold autoregressive error correction model, the chapter analyses market integration by considering whether the markets are integrated, co integrated or whether there was price transmission among the markets using real wholesale market price data from January 1994 to December 2011, valued in Kenyan shillings with the year 2000 as the base year.

4.1 Descriptive statistics

From Table 3, Nairobi and Nakuru markets had the highest mean prices of Kshs 2,968.19 and Kshs 2,717.02, respectively, while Eldoret and Kitale markets had Kshs 2,499.49 and 2,555.03, respectively, per 90 kg/bag. From the prices, it can be shown that though Eldoret and Kitale are presumed to be source markets for dry beans, prices remain relatively high because of sale of dry beans to urban markets thus decreasing supply in source markets, and hence high prices. Similarly, as the supply of dry beans to urban markets, that is, Nairobi and Nakuru increases with expectation of higher prices, prices in Nairobi and Nakuru instead decrease because of increased quantity supplied. This can be noted from the above prices where Nakuru market though urban tends to have lower prices than Eldoret and Kitale markets (MoA, 2008). This can result from the fact that traders who are optimistic of higher prices in Nakuru oversupply dry beans to this market thus flooding the market and decreasing the prices (Korir, 2005). Nakuru prices are generally higher but may experience intermittent lower prices due to oversupply of dry beans from other markets.

Table 3: Real monthly dry beans prices (Kshs/90kg bag) between 1994 and 2011.

Variable	**N**	**Mean**	**Minimum**	**Maximum**	**Coefficient of Variation (%)**	**Standard Deviation**
Nairobi	216	2968.19	1483.43	6191.50	32.00	83.62
Nakuru	216	2717.02	1201.21	5524.04	31.36	76.69
Eldoret	216	2499.49	1013.93	5829.29	37.69	91.50
Kitale	216	2555.03	962.60	5956.45	40.66	87.84

Note: N represents number of months employed in the study

Table 3 also shows variations in dry beans prices from 1994 to 2011. From the estimated coefficient of variation, prices in all the markets had a variation of between 31.36 and 40.66 percent. Eldoret and Kitale had the highest variation of 37.69 and 40.66, respectively. The variations can be attributed to price fluctuations in the markets thus creating a temporal deficit from time to time. The descriptive statistics in Table 3 can further be presented graphically using a line graph as shown in Figure 4 below and the seasonal index in Figures 5, 6, 7 and 8.

From Figure 4, 5, 6, 7 and 8 below, it can be seen that there has been continuous dry beans price fluctuation in the four markets using seasonal variation and percentage index method. Both methods reveal that the trend has been the same in all the four markets since dry beans production, demand and supply are a function of market forces (GoK, 2008).

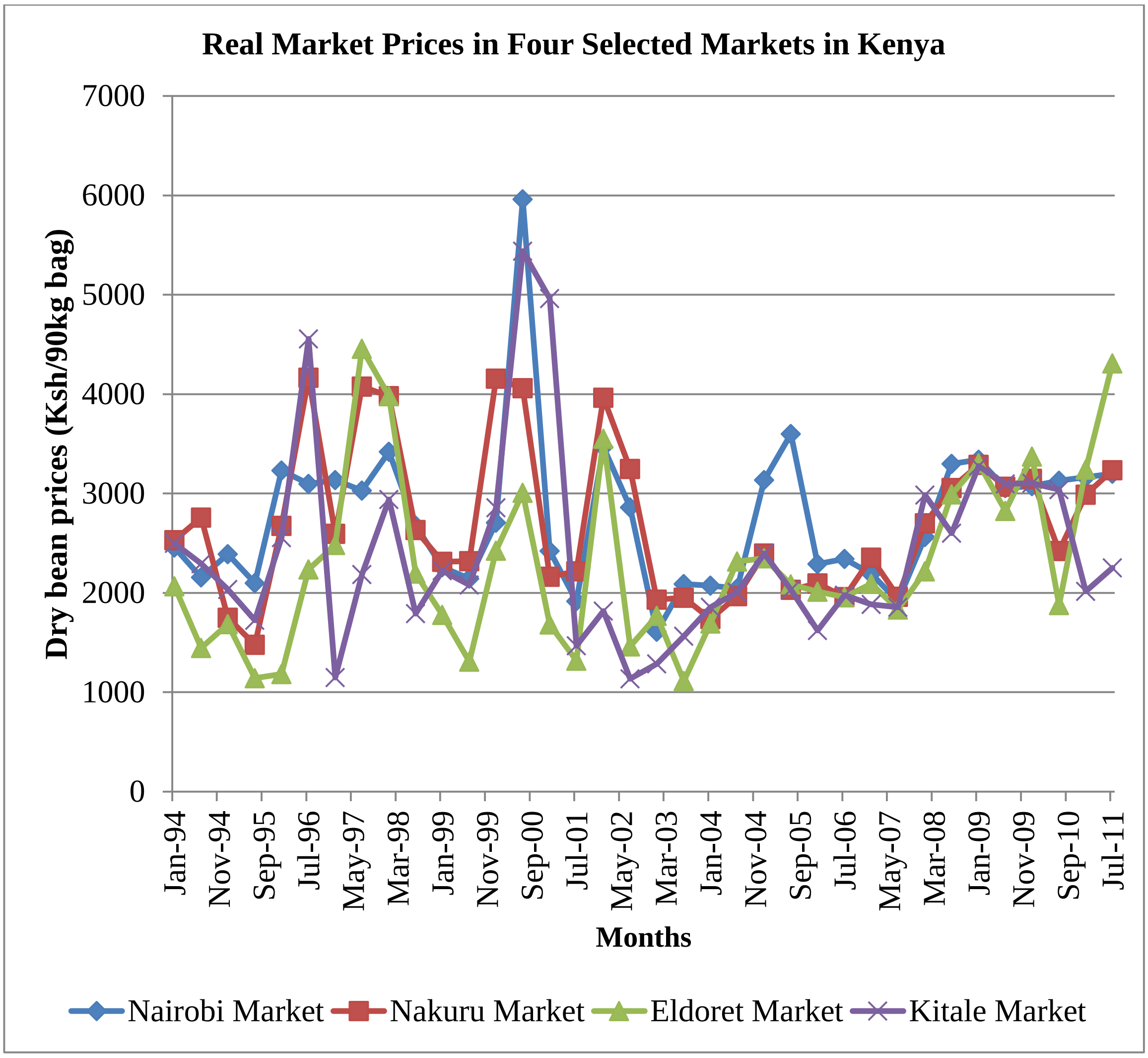


Figure 4: Seasonal distribution of dry beans prices in Nairobi, Nakuru, Eldoret and Kitale

Graph showing seasonal variation of dry beans in Nairobi market

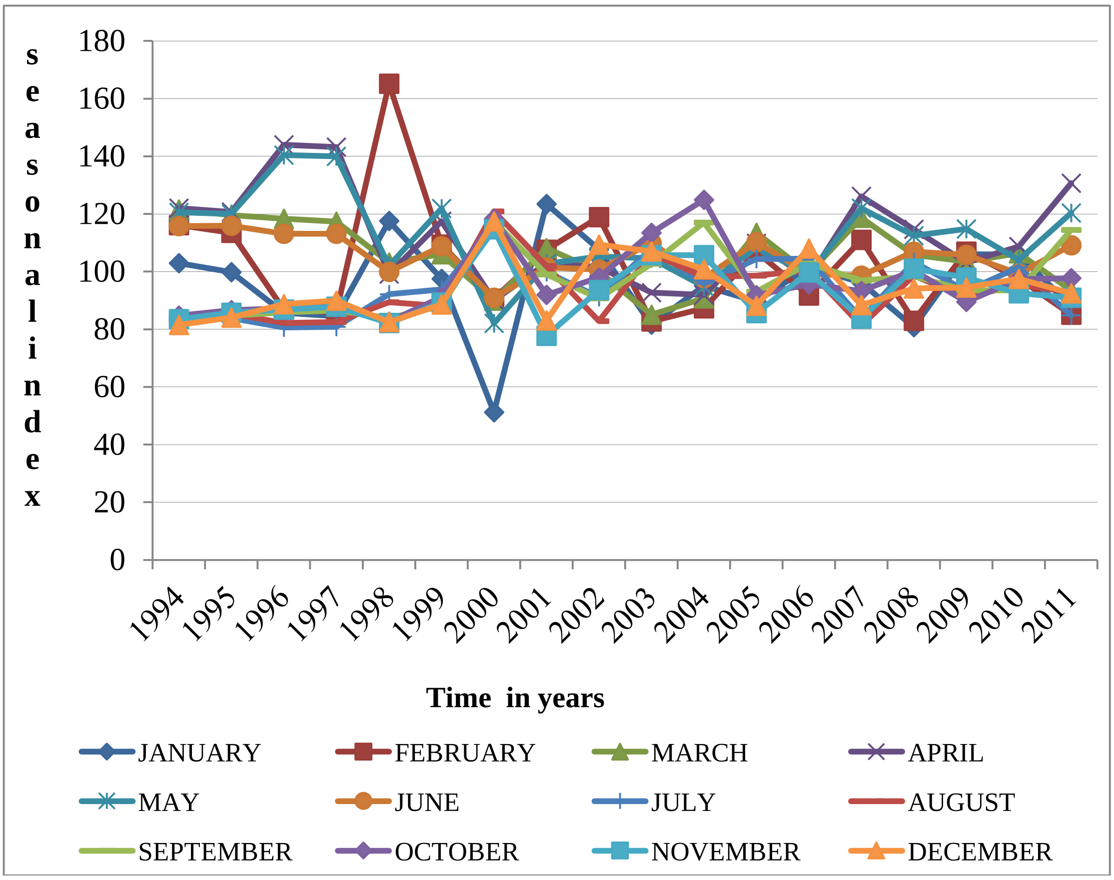


Figure 5: Graph showing seasonal index for Nairobi Market

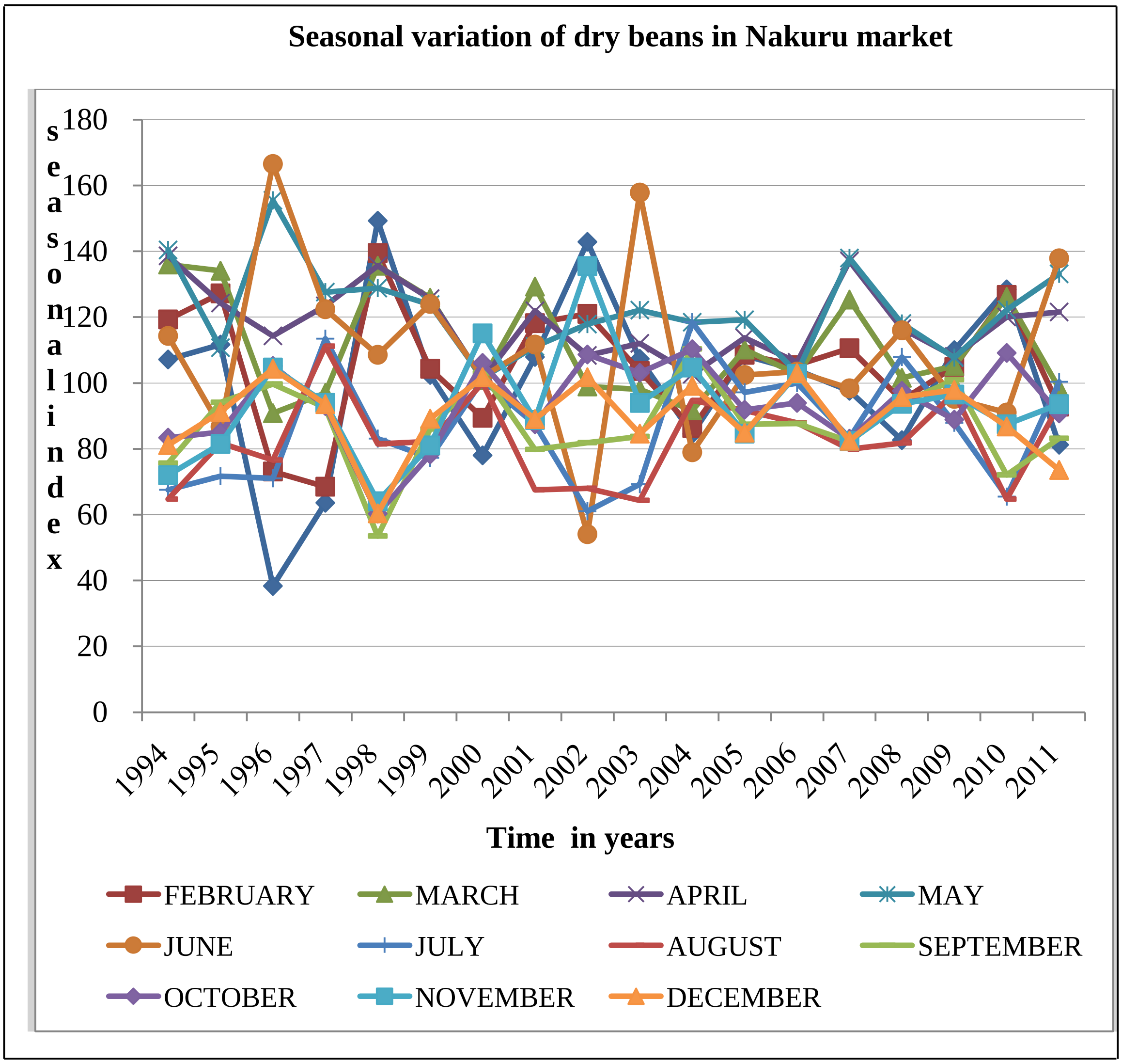


Figure 6: Graph showing seasonal index for Nakuru market

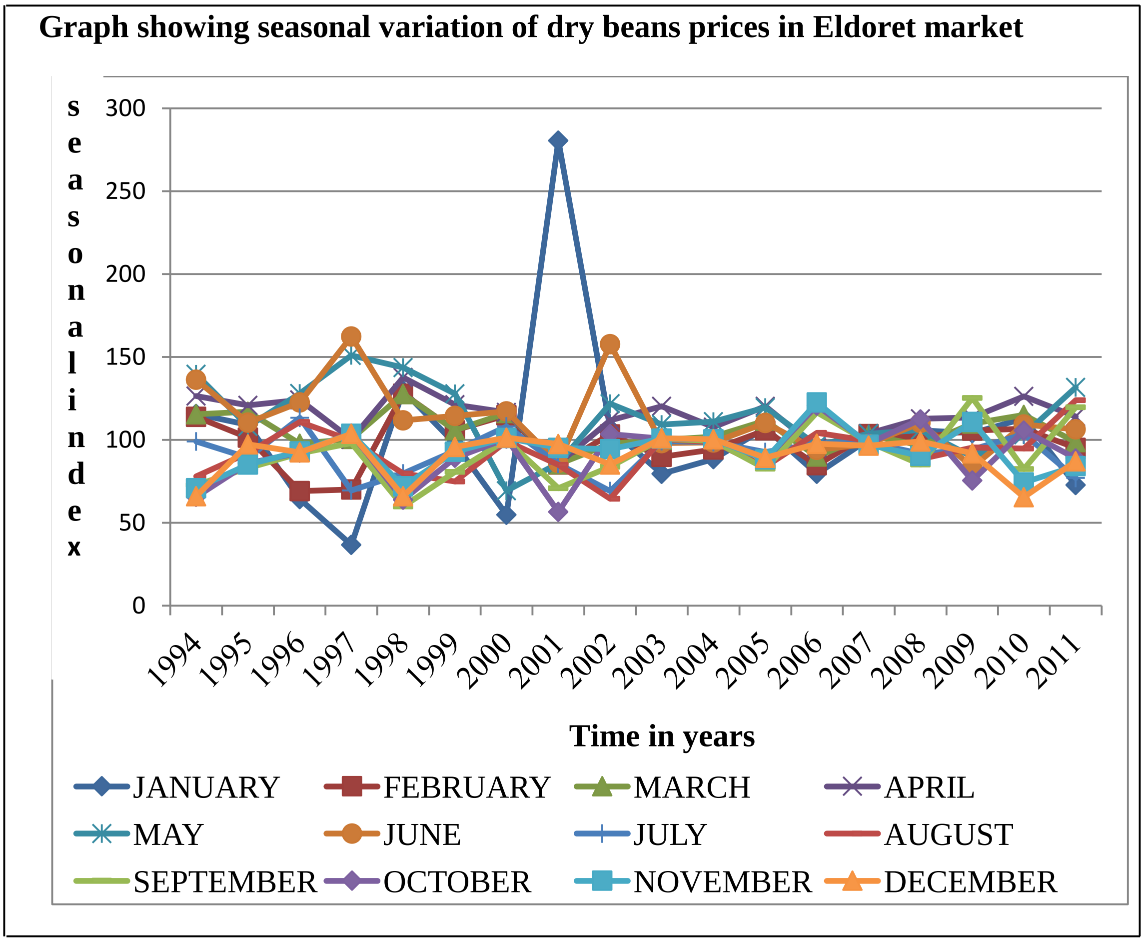


Figure 7: Graph showing seasonal index for Eldoret market

Graph showing seasonal variation of dry beans prices in Kitale market

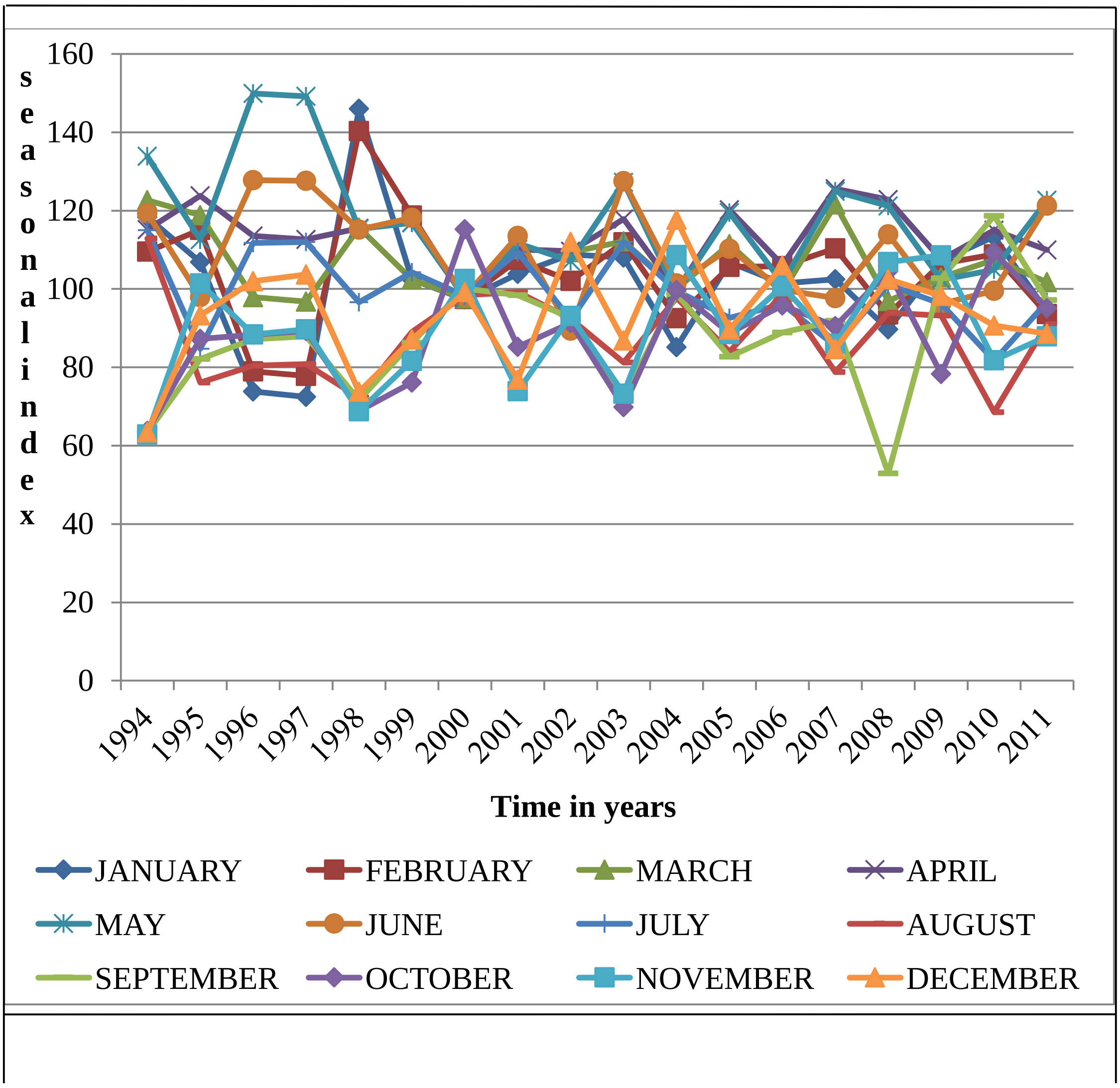


Figure 8: Graph showing seasonal index for Kitale market

4.2 Trend analysis

According to Goodwin (1994), **t**rend analysis in time series data helps to capture gradual and long-term factors that can influence markets in a way which may significantly alter seasonal patterns and make the data have spurious coefficients. This analysis covers changes in market prices over time. As indicated by Goodwin (1994), trend factors are significant if time alone explains at least 15 percent of the variation in price series. The results of trend analysis for monthly real prices from January 1994 to December 2011 are presented in Table 4.

The positive sign on the three of the coefficients in Table 4 shows that dry beans market real prices have generally been increasing over time in all the specified markets except for Kitale market which shows a negative coefficient. In all the markets, trend factors have had influence of more than 0.01 percent but less than 4.040 percent on real prices of dry bean as shown by the R-squared of the trend equation. Akibode (2011) noted that in most sub-Saharan countries, prices of dry beans have generally increased over time as a result of increase in demand. Eldoret market had the highest trend factor of 4.040 percent. In Nakuru market, trend factors influenced as much as 0.060 percent of the real price increases in the period. This study results suggests that, trend factors were significant in the specified period in all the four markets discussed above and the findings are similar to those found by Goodwin (1994).

Table 4: Dry beans real price trend analysis

Market	**Trend coefficient**	**t-statistic of linear trend**	**R-squared of trend equation (%)**
Nairobi	0.121	0.120	0.010
Nakuru	0.347	0.370	0.060
Eldoret	3.192	3.170	4.040
Kitale	-0.484	-0.430	0.080

Note: Any positive value in the trend coefficient values means prices have been significantly increasing over time.

4.3 Stationarity test

The data on real dry beans prices was tested for stationarity as a pre-condition for co-integration analysis from 1994 to 2011. Augmented Dickey Fuller (ADF) test was used to test the hypothesis that the price series are non-stationary. Table 5 presents the results of the stationarity test for the markets in the sampled period. The appropriate lag length was selected based on Akaike Information Criteria (AIC) whose value was 15.2. Considering the significance of trends in dry beans market, as estimated in Section 4.2, the stationarity test was done with and without a time trend entered as a time variable.

Table 5 shows that the analysis with and without trend factor included, all price series were integrated of order zero I(0) at 1 and 5 percent significance level confirming that without differencing, the market price series were stationary (Gujarati, 2004).

Table 5: Unit root test for real dry bean Prices

	Real market price before differencing without trend				**Real market price before differencing with trend**			
Market	t-Statistic	No of lags	Order of integration	P Values	t-Statistic	No of lags	Order of integration	P Values
Nairobi	-4.405	2	I (0)	0.000)	-4.393	2	I (0)	(0.002)
Nakuru	-4.361	2	I (0)	0.000)	-4.352	2	I (0)	(0.003)
Eldoret	-3.710	2	I (0)	0.004)	-3.861	2	I (0)	(0.014)
Kitale	-4.089	2	I (0)	0.001)	-3.081	2	I (0)	(0.007)

Note: I (0) = Integrated of order zero (Stationary)

4.4 Long-run co-integration

After confirmation of stationarity, the data set was tested for the economic order of co-integration. Co-integration between two non-stationary price series implies that a linear combination of the two series is stationary and the prices, therefore, tend to move together or follow the same path in the long-run. If p_{it} denotes the price in market *i* at time *t*, and p_{jt} denotes the price in market *j* at time *t*, the coefficient, β in the equation below gives the long-run relationship between two markets only if the error term, ε_t is I(0) (Abdulai, 2006), as presented in equation 17 below.

$$p_{it} = \partial_0 + \beta p_{jt} + \varepsilon_t \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (17)$$

The bivariate co-integration analysis used the eigenvalue and trace statistic in Johansen vector error correction model to test the spatial integration of two markets based on maximum co-integrating rank (*r*). This tests the null hypothesis that there is no co-integrating relationship *(r = 0)* between the two specified markets against the alternative that there is at least one co-integrating market *(r = 1)*. The long-run bivariate co-integration was done for the whole period to determine the co-integrating markets in the sample.

Table 6 shows the bivariate co-integrating tests done without a time trend. The results show that without a time trend, the bivariate co-integrating markets are Nairobi co- integrating with Nakuru, Eldoret and Kitale, Nakuru with Kitale and Eldoret with Kitale. Results shown in Table 6 indicate that all the markets were co-integrated at 5 percent level of significance.

Table 6: Bivariate co-integration coefficients of dry bean markets without a time trend

Market *I* *J*	**Nairobi**	**Nakuru**	**Eldoret**	**Kitale**
Nairobi	0.000			
Nakuru	27.693*	0.000		
Eldoret	23.954*	17.657*	0.000	
Kitale	27.721*	21.551*	18.187*	0.000

The asterisks (*) represent the markets that are co-integrated

Table 7 shows a co-integrating relationship between markets *i* and *j* at 5 percent level of significance with a time trend imposed. An integrating link *(r = 1)* is the one in which the trace statistic value is greater than the critical value. The critical value at 5 percent significance level is 15.41. Inclusion of a time trend did not change the relationship as all the markets were again found to be co-integrated. These results justify the supply of dry beans from surplus areas to deficit areas. This is the case especially during production periods when prices tend to be low in production areas like Eldoret and Kitale; hence, assemblers have an incentive to transport dry beans to Nairobi where they anticipate higher profit margins. The results above are in agreement with study done by Kibiego *et al*. (2006) who did an analysis of the structure and performance of the beans marketing system in Nairobi.

The integration of Eldoret and Kitale markets shown in Table 7 was because of the distance between them and also given the fact that they are border markets and are able to obtain beans from cross border trade at a lower price thus, they trade with each other when the price is high in one of the markets as also presented by Mauyo *et al*. (2007), who carried out a study on technical efficiency and regional market integration of cross-border bean marketing in western Kenya and Eastern Uganda. They found out that Uganda markets were highly integrated with Kenyan markets and integration was higher between Mbale and Kitale market.

Table 7: Bivariate co-integration coefficients of dry beans markets with a time trend

Market *i* ***J***	**Nairobi**	**Nakuru**	**Eldoret**	**Kitale**
Nairobi	0.000			
Nakuru	23.923*	0.000		
Eldoret	22.727*	17.758*	0.000	
Kitale	28.778*	19.681*	18.368*	0.000

Note: Asterisks (*) show the markets that are integrated.

4.5 Granger Causality

Co-integration alone is not enough to show the direction of the relationships because it only indicates non segmentation. Since the stationarity condition was met, Granger causality became important in showing the direction of the relationship by supplementing co- integration which forms the basis for Granger causality tests among markets (Goletti and Babu, 1994). Table 8 shows the causal relationship between co-integrating markets from 1994 to 2011 by applying the Granger causality test.

From Table 8 there was one bidirectional causal relationship and the remaining are independent relationships. From the results above, Nairobi market was observed to Granger cause Kitale market and Kitale granger caused Nairobi market. This implies that a shock in one of the markets is simultaneously translated to a shock in the other market. The other markets exhibited five independent causal relationships; between Nairobi-Nakuru, Nairobi-Eldoret, Nakuru-Eldoret, Nakuru-Kitale and Eldoret-Kitale markets. Since Nakuru and Eldoret are en route markets to Nairobi they were found not to Granger cause one another.

Kitale market Granger caused Nairobi market signifying trade between them. This justifies co-integration between Nairobi and Kitale markets as shown in Table 8 above, implying the two markets were integrated. The causal relationship between Nairobi and Kitale markets implies that prices in Nairobi could be predicted based on Kitale market prices and vice versa. Even though there was only one bidirectional causality, the independent causality in other co-integrating markets does not imply a total absence of price transmission in the five independent market links. This might mean price signals are transmitted instantaneously under special conditions like storage, inventory holding and delays in transportation. These results are similar to those of Meyer (2004) who measured market integration in the presence of transaction costs by use of a threshold vector error correction approach in evaluating European Pig market prices.

Table 8: Granger causality relationship between co-integrating markets

Market *i*	**Market *j***	**F1**	**Prob > F1**	**F2**	**Prob > F2**	**Direction of Causality**
Nairobi	Nakuru	0.084	0.772	1.909	0.169	Independent
	Eldoret	0.074	0.785	0.837	0.361	Independent
	Kitale	3.112	0.079*	3.549	0.061*	Bidirectional
Nakuru	Eldoret	0.636	0.426	0.471	0.494	Independent
	Kitale	1.827	0.178	0.148	0.701	Independent
Eldoret	Kitale	0.883	0.349	0.084	0.772	Independent

Note: Values with asterisk (*) show granger causality. That is, Prob > f is higher at 10% and we reject the null hypothesis

Ho: F1 $\neq 0$ (Market *j* does not granger cause market *i*) and

Ho: F2 $\neq 0$ (market *i* does not granger cause market *j*)

The presence of five independent causal relationships between Nairobi-Nakuru, Nairobi-Eldoret, Nakuru-Eldoret, Nakuru-Kitale and Eldoret-Kitale market links, points out inefficiency and lack of market information between market participants operating in this markets. This justifies the need for all stakeholders in the dry beans sub-sector to participate in ensuring price information is equitably relayed between the surplus and deficit markets in order to rectify market inefficiencies.

Tione (2011) did an analysis of effectiveness of modern information and communication technologies on maize marketing efficiency in Lilongwe and Dedza districts and other selected markets in Malawi. She found that provision of market information, infrastructural development and incentive structure that is able to attract both large and small-scale trader's interaction would ensure that price signals in the various markets are instantaneously transmitted across the markets hence foster competition.

4.6 Price adjustment and application of the threshold autoregressive model (TAR)

Price adjustments between Nairobi and the other three markets were computed. Nairobi market was chosen to be the reference market since it is one of the major urban centers in the country. As a central market, its impact was expected to be transmitted to all the three markets. This was done after co-integration and Granger causality tests, which were able to present the co-movement of prices and the direction of causality leaving out the amount of time it took a shock to be transmitted from one market to another.

TAR model was used in this analysis because of its appropriateness in estimating price adjustment and represents the amount that proportional price differences must exceed to cross the threshold thus trigger the 'outside-band' regime adjustments as noted by Campenhout (2007) and Goodwin and Piggott (2001). It was also important because it considers the threshold where there is no price adjustment.

The TAR error correction model was used in estimating price transmission in the four markets with a time trend imposed. Table 9 presents the price adjustment factors and half lives in the TAR model. The TAR model is a three regime symmetric model with unit root behavior imposed within the band formed by the thresholds. In this model the thresholds were estimated through a grid search whereas half-life which is the amount of time in weeks required for one-half of a deviation from equilibrium to be eliminated was estimated using the formula in equation 17 calculated as $h=(\ln 0.5)/\ln(1+\alpha))$. Table 9 presents the result of price adjustments in the four markets.

Results show that there was a faster adjustment in Nairobi- Kitale markets in the TAR model. An adjustment factor of 0.209 reveals that it took 2.964 weeks for half of the price shock to return to the equilibrium price. The TAR model also shows that the estimated transaction cost was approximately 1.3 percent of the mean price in the markets. This implies that the transaction cost of transporting a 90kg bag of dry beans to Nairobi is approximately Kshs39; to Nakuru Kshs35, Eldoret Kshs32, and Kitale Kshs33 markets. These results confirm the instantaneous transfer of price signals across the two markets as revealed in the Granger causality results in Table 9, where Nairobi market Granger caused Kitale market and vice versa.

The Nairobi -Nakuru market link with an adjustment factor of 0.182 and half-life of 3.5 it took 3.5 weeks for a price shock in Nairobi market to return half way back to parity bound or threshold that covers transaction costs. The estimated threshold was 1.2 percent of the mean price. This confirms that influencing factors such as transmission of market price information and infrastructural improvement that reduce transaction costs also affect the speed of price adjustment if there is a shock in the markets. Similarly in the link between Nairobi-Eldoret with an adjustment factor of 0.147 and half-life of 4.37 it took 4.4 weeks for a price shock in Eldoret market to return back to the parity bound while it took 3 weeks for Kitale market to get back to the threshold with an adjustment parameter of 0.209.

Table 9: Price adjustment in the TAR error correction model

Market pair	**Distance (KM)**	**TAR Model with Trend**				
		δ	**θ1**	**θ2**	**P**	**Half life**
Nairobi-Nakuru	159	0.012	655	608	-0.182 (0.000)	3.453
Nairobi – Eldoret	313	0.013	717	750	-0.147 (0.000)	4.370
Nairobi - Kitale	382	0.013	469	990	-0.209 (0.000)	2.964

δ: is the Standard error ; ρ: denotes the adjustment parameter on the lagged price difference (expressed as the percentage of mean price in the two markets); θ: Denotes the threshold also expressed as a percentage of mean price between the two markets; *Half life*: which was calculated as h= {ln (0.5)/ln (1+ρ)} and values in brackets are p-values.

The results given in Table 9 were consistent with those of Campenhout (2007) who emphasized that using a simple model that disregards transaction costs and does not include a time trend generates estimated half-lives ranging from 3.9 to more than 22 weeks. He found out that after appropriately modeling the non-linear adjustment caused by transaction costs, half-lives went down to 4–11 weeks thus adding a time trend made half-lives range from about one and a half week to about 5 weeks. He concluded that, studies that do not include a time trend frequently find values for half-lives that are unreasonably high given the market settings. From his study, half-lives from the order of 1 to 5 weeks are much more reasonable than the ones that do not take into account transaction costs. Results in Table 9 are consistent with (Campenhout, 2007).

Meyer (2008) indicated that existence of significant technological changes in an economy work to trigger efficient infrastructure and increase in the number of motor vehicles in an economy. These he said could cause a significant reduction in transaction costs and result in faster transmission of price signal across markets resulting to integrated markets.

4.7 Summary of results

The chapter estimated market integration of four selected dry bean markets in Kenya. Using stationarity test, markets were found integrated of order zero I(0). On applying Johansen vector method, co-integration test revealed that all the markets were co-integrated suggesting trade among them. Further, Granger causality tests revealed only one bidirectional causality across Nairobi and Kitale market link. This suggested an instantaneous price signal transmission between the two markets. The remaining market links, Nairobi- Nakuru, Nairobi-Eldoret, Nakuru-Eldoret and Eldoret-Kitale, showed independent causality where price in one of the markets would not be predicted based on the other market price.

On application of the TAR model, results revealed faster price adjustment given a price shock in Nairobi-Kitale market link where it took 2.964 weeks for prices to return back to their equilibrium. On the other hand, Nairobi-Eldoret market link presented the slowest rate of adjustment where a price shock took 4.370 weeks to return to equilibrium threshold. The results show that if market information is evenly transmitted to all stakeholders in the dry bean markets coupled with proper infrastructure markets will be well integrated as shown in the Nairobi-Kitale relationship.

CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary and conclusion

The main objective of this study was to contribute to knowledge towards monitoring prices of food staples between surplus and deficit areas and how well price movements in any one of the markets are translated into price changes in other markets in Kenya. The focus was to assess the extent of dry bean market integration between selected deficit and surplus dry bean markets in Kenya, thus ascertaining whether Nairobi dry bean market prices Granger cause prices in the other three markets and finally determining the amount of time taken for price spread to move halfway back to its threshold (half-life).

The research questions answered in this study were; to what extent were the selected dry bean deficit and surplus markets in Kenya integrated? Do Nairobi dry bean market prices Granger cause prices in the other three markets? and, how long does it take price spread between deficit and surplus dry bean markets to move half way back to its threshold (half life)?.

Monthly time series data obtained from the Ministry of Agriculture covering 1994 to 2011 was used to analyze market integration and price transmission of the four selected markets across the country. Augmented Dickey Fuller test was used to test if the price series were stationary and the results revealed that all the markets were integrated of order zero, I(0), as they were stationary before differencing. Bivariate co-integration test showed that, all markets were co-integrated and thus there was supply of dry beans from surplus markets to deficit markets providing an answer to research question one that all the markets were integrated of order zero.

Granger causality test confirmed that five market links (Nairobi-Nakuru, Nairobi-Eldoret, Nakuru-Eldoret, Nakuru Kitale and Eldoret-Kitale) exhibited independent causality, revealing that none of the five market links granger caused each other. Though the five market links were found to be independent, it was concluded that under special conditions such as inventory holding, price signals could be instantaneously transmitted from one market to another thus price in one market would help predict price in the other market leading to Granger causality.

Nairobi-Kitale market link on the other hand showed bidirectional causality thus their ability to granger cause one another. This implied that these markets experience shorter response period for shock transmission between them, justifying symmetric price transmission between them. Thus according to the results, Nairobi market prices only Granger caused Kitale market and leaving out Nakuru and Eldoret markets.

The study concluded that a price shock in one region can enhance integration of spatially located markets as shocks can be easily transmitted from one market to the other as was the case with Nairobi-Kitale market link thus reducing price spread between the two markets. If smallholders can have information concerning such shocks (price changes in different markets), it can enable them to access better markets and better prices for their produce. It can also empower them to access better-paying markets thus taking advantage of opportunities that exist in distant dry bean markets. Also an understanding of the period a price shock takes to be duplicated in the other market helps stakeholders in the dry bean market to put in mechanisms that will lower the period of adjustment contributing to efficient markets.

To producers, information on market integration enables them understand the price consumers are willing to pay for their dry beans in various markets while to consumers it helps them understand the cost of supplying the dry beans to them. This prevents exploitation of the two parties by traders given that the markets are operating efficiently. If such information is readily available to the parties they agree on terms of exchange as well as reducing price spread across the trading markets.

5.2 Policy recommendations

The results show that there is integration between deficit and surplus markets justifying price transmission between urban and rural markets in Kenya. Price transmission was from high producer markets to consumer markets i.e. urban markets. Therefore, it was concluded that if markets are integrated, they form an incentive for farmers to produce in surplus as they are assured of efficient markets and the fact that traders would not take advantage of increased production to lower farmer's benefits. This will foster competition, increase returns accruing to producers and decrease transaction costs between urban and rural markets.

Given the fact that distant markets like Nairobi and Kitale Granger caused each other, the government supported by the private sector can enhance efficient market signal transmission across markets by improving marketing infrastructure like roads and communication facilities which can greatly reduce transaction costs and improve price transmission and market efficiency in Kenya thus increasing market integration across markets.

Since the government through the Ministry of Agriculture collects market information of various agricultural commodities in Kenyan markets, the information should be readily available to farmers through information banks in various parts of the country so that farmers can access timely information on which markets offer remunerative prices for their dry beans. This can give them an incentive to increase production since they are guaranteed alternative markets for their dry beans as well as higher returns for their commodities thus contribute to food security.

5.3 Areas for further research

This study assessed market integration and price transmission of four selected markets using the co-integration approach and the threshold autoregressive error correction model. The TAR model here was based on the assumption of constant transaction costs and symmetric price transmission throughout analyzed period (1994 to 2011). If market integration is expected to increase over time, e.g. due to decreasing transaction costs; the TAR should be extended to allow for variable threshold in future studies.

Since the study focused on four markets which were presumed to be deficit and surplus markets, further studies can include more markets to see how dry beans flow across markets in Kenya and how the flow influences both consumer and producer decision making. This can help to develop market policies that can foster effective dry beans production and movements in the country. In return, these will decrease temporal increases in transportation costs that may prevent price instantaneous signal transmission between the markets as was the case in Nairobi-Nakuru, Nairobi-Eldoret, Nakuru-Eldoret, Nakuru Kitale and Eldoret-Kitale market links.

Future research should also attempt to quantify transaction costs for better observations and inferences by applying primary data that will present actual transaction costs of dry beans across the markets. This may involve quantifying actual costs incurred in searching for trading partners, negotiating, bargaining, contracting and enforcing a contract between producers and consumers. Furthermore, quantitative analysis of the benefits of selling through intermediaries as compared to selling directly at the market place is one of the areas that ought to be considered for future research. Further, research should also test the most preferred dry beans varieties in various markets and different parts of the country to present market integration of individual dry beans varieties.

REFERENCES

Abdulai, A. 2006. Spatial integration and price transmission in agriculture commodity markets in Sub-Saharan Africa. In Sarris, A. & Hallman, D., *Agriculture Commodity Markets and Trade: New approaches to analyzing market structure and instability*. FAO: Fiat Printing.

Abdulai A. 2002. Using threshold co integration to estimate asymmetric price transmission in the Swiss pork market. *Journal of Applied Economics.* 34: 679– 687.

Abdulai, A. 2000. Spatial price transmission and asymmetry in the Ghanaian maize market. *Journal of Development Economics.* 63: 327-349.

Akibode C. S. 2011. Trends in Production, Trade, and Consumption of Food-Legume Crops in Sub-Saharan Africa. Published Msc. thesis Michigan State University.

Ogutu, A. & Echessah, P. 1997. "Unrecorded Cross -Border Trade between Kenya and Uganda: Implications for food security''. Inc, 1997. Available at; http://www.scirp.org. Accessed on 10th January 2012.

Alemu, Z.G. & Biacuana, G.R. 2006. Measuring market integration in Mozambican maize markets: A threshold vector error correction approach. University of the Free 1State, Department of Agricultural Economics. Paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Cost, Australia, August 12-18, 2006.

Alexander, C. & Wyeth, J. 1994. Co-integration and Market Integration: An application to the Indonesian rice market. *The Journal of Development Studies.* 30: 303-328.

Barrett, C.B. & Li, J.R. 2002. Distinguishing between equilibrium and integration in spatial price analysis. *American Journal of Agricultural Economics.* 84: 292-307.

Barrett, C. & Swallow, B. 2006. Fractal Poverty Traps. *World Development*. 34: 1-15.

Baulch, B. 1997. Testing for food market integration revisited. *The Journal of Development Studies* 33: 512-534.

Campenhout, V. B. 2007. Modeling trends in food market integration: Methods and an application to Tanzanian maize markets. *Food policy* 32: 112 – 127.

Chirwa, E.W. 2000. *Liberalization of food marketing and market integration in Malarise*. Final Report of an AERC Sponsored Research Work Presented at the Bi-annual Economic Research Workshop Namibia Available at: http://www.medwelljournals.org/ref.php.Accessed on 16th February 2012.

Delgado, C. 1999. Sources of growth in smallholder agriculture in sub Saharan Africa: The role of vertical integration of smallholders with processors and marketers of high value-added items. *Agrekon.* 38:165-189.

Engle, R.F. & Granger, C. W. 1987. “Co-integration and error correction representation estimation and testing.” An example using the term structure of integration. Econometrics 55 (251-276).

Fafchamps, M. & Hill, R.V. 2005. Selling at farm gate or travelling to market. *American Journal of Agricultural Economics.* 87: 717- 734.

Getnet, K., Verbeke, W. & Viaene, J. 2004. Modeling Spatial Price Transmission in Grain Markets of Ethiopia with an Application of ARDL Approach to White Teff. *Agricultural economics.* 33: 491-502.

Goletti, F. & Babu, S. 1994. Market liberalization and market integration of maize markets in Malawi. *Agriculture Economics.* 11: 311-324.

Goodwin, B. K. & Piggott, N.E. 2001. Spatial Market Integration in the Presence of Threshold Effects. *American Journal of Agricultural Economics.* 83: 302-317.

Goodwin, J.W. 1994. *Agriculture Price Analysis and Forecasting*. John Wisley and Sons Inc. New York, Toronto, Singapore.

Government of Kenya (GoK.) 2008. *Leading Economic Indicators.* Central Bureau of. Statistics, Government Printers, Nairobi. Government of Kenya (GoK). 2006. *Statistical Abstract*. Nairobi, Kenya.

Government of Kenya (GoK). 2006. *Statistical Abstract*. Government Printers, Nairobi, Kenya.

Green, W. H. 2003. *Econometrics Analysis.* 5th Edition. Pearson Education Inc., New Jersey.

Gujarati, D.N. 2004. *Basic Econometrics*. McGraw-Hill Higher Education. International Edition.

Johansen, S. 1988. Statistical analysis of co-integrating vectors. *Journal of Economic Dynamic and Control*. 12: 231-254.

Katengeza, S.P.; Mangisoni, J.H. & Okello, J. J. 2010. *The Role of ICT-based Market Information Services in Spatial Food Market Integration: The Case of Malawi Agricultural Commodity Exchange*. Contributed Paper presented at the Joint 3rd African Association of Agricultural Economists (AAAE) and 48th Agricultural Economists Association of South Africa (AEASA) Conference, Cape Town, South Africa, September 19-23, 2010.

Kaltsas, I. 2000. *Explaining cotton Prices: A structural Model Approach.* Proceedings of the Beltwide cotton conference 1 273-275. http://www.icac.org. Accessed on 30th February 2012.

Kherallah, M., Delgado, C., Gabre-Madhin, E., Minot, N. & Johnson, M. 2000. *Agricultural Reform in Sub-Saharan Africa*: A Synthesis of Research Findings. Revised draft. IFPRI, Washington, DC.

Kibiego, M., Odhiambo, M. & Kosura, W. 2006. *Analysis of the Structure and Performance of the Beans Marketing System in Nairobi*. International Association of Agricultural Economists Conference, Gold Coast, Australia, August 12-18, 2006.

Kirimi, L., Sitko, N., Jayne, S., Karin, F., Muyanga, M., Sheahan, M., Flock, J. & Bor, G. 2010. *Farm gate to consumer value chain analysis of Kenya maize marketing system*. Tegemeo Institute of Agricultural Policy and Development. October 2010.

Kirsten, J. & Karaan, M. 2005. The economics of institutions: a review. In Kirsten, J., & Vink, N., (Ed), *The Economics of Institutions: Theory and applications to African Agriculture.* Pretoria, South Africa.

Korir, M. 2005. *Cross border bean marketing in East Africa*: *The case between Arusha Region of Northern Tanzania and Nairobi area of Kenya*. M.Sc. Thesis (draft), Moi University.

Korir M, Odhiambo M, Kimani P. Mukishi P., & Iruria D. 2003. *Spatial Price Integration: A Co integration Approach to Regional Bean Markets in Kenya and Tanzania*. African Crop Science Conference Proceedings, 6: 609-612.

Kuan-Min Wang., & Yuan-Ming, L. 2009. A measure of marketing price transmission in the rice market of Taiwan. 27: 311-326.

Larson, D. F. 2006. *Measuring the efficiency of food markets*. *Agriculture Commodity Markets and Trade: New approaches to analyzing market structure and instability*. FAO, Fiat Printing.

Mauyo, L.W. Buruchara, R. & Okalebo, J.R. 2007. Cross boarder bean marketing, Uganda Kenya. *Journal of Emerging Trends in Economics and Management Sciences.* 2: 478-482.

Meyer, J. R. 2002. *Asymmetric price transmission*: A survey of Proceedings of the 10th EAAE Conference Zaragoza (2002). http://www ideas.repec.org. Accessed on 26th June 2012.

Meyer, J. R. 2004. Measuring Market Integration in the Presence of Transaction costs. A Threshold Vector Error Correction Approach. Department of Agricultural Economics, Göttingen, Germany.

Meyers, J. R. 2008. *The effectiveness of spatial maize price transmission in Malawi.* department of Agriculture Food and Resource Economics. Michigan State University. East Lansing, MI 48906.

Ministry of Agriculture (MoA). 2008. *Strategic Plan.* Government Printers, Nairobi.

Ministry of Agriculture (MoA). 2007. Economic Review on Agriculture. Annual Report Kenya. Government Printers, Nairobi.

Ministry of Agriculture (MoA). 2009. Economic Review on Agriculture. Annual Report. Kenya

Mohammad, I. H. & Wim, V. 2010. Evaluation of rice markets integration in Bangladesh. *Lahore Journal of Economics 26:* 77-96.

Motamed, M. Foster, K. A. & Tyner, W. 2008. Applying co-integration and error correction to measure trade linkages: maize prices in the United States and Mexico. *Journal of Agricultural Economics* 39: 29 – 39.

Odhiambo, M., Kristjanson, P. & Kashangaki, J. 1996. *Comparative cost of production analysis in East Africa*: *Implications for competitiveness and comparative advantage*. SD Publication Series. Office of Sustainable Development, Bureau for Africa. Technical Paper No. 32.

Oladapo, M., Momoh, S., Yusuf, S. & Awoyinka, Y. 2007. Marketing margin and spatial pricing efficiency of pineapple in Nigeria. *Asian Journal of Marketing*, 1: 14-22.

Rapsomanikis, G., Hallman, D. & Conforti, P. 2006. Market Integration and Price Transmission in selected Food and Cash Crop Markets of Developing Countries: Review and Application. In Sarris, A. & Hallman, D., *Agriculture Commodity Markets and Trade: New approaches to analyzing market structure and instability*. FAO, Fiat Printing.

Ravallion, M.1986. Testing market Integration. *American Journal of Agricultural Economics.* 68: 102-109.

Shahidur, R. 2004. Spatial Integration of Maize Markets in Post-Liberalized Uganda. *International Food Policy Research Institute.* http://www.ifpri.org. Accessed on 30th June 2012.

Shahidur, R. 2011. *Intercommunity Price Transmission and Food Price Policies: An Analysis of Ethiopian Cereal Markets.* IFPRI Discussion Paper 01079 April 2011. Markets, Trade and Institutions Division.

Shepherd, A. W. 1997. *Market Information Services: Theory and Practice*. FAO, Rome. http://www.fao.org/ag/ags/subjects/en/agmarket/mistheory.html.

Sopo, O. P. 2008. *Analysis of spatial maize market integration in Malawi*. Unpublished Msc. thesis. University of Malawi. Bunda College of Agriculture. Lilongwe, Malawi.

Tione, S. 2011. *Analysis of Effectiveness of Modern information and Communication Technologies on Maize Marketing Efficiency in Lilongwe and Dedza Districts and Selected Markets of Malawi*. Published Msc. thesis. University of Malawi. Bunda College of Agriculture. Lilongwe, Malawi.

United States Agency for International Development (USAID). 2010. Staple Foods Value Chain Analysis in Kenya. Chemonics International Inc.

Von, B. J. 2008. *Agriculture for sustainable economic development*: *A global Research and development initiative to avoid a deep and complex crisis.* Conference Paper presented by during the Charles Valentine Riley Memorial Lecture, 28th February, 2008, Capitol Hill Forum, Washington D.C.

Waluse K. S. 2012. *Determinants of Common Bean Productivity and Efficiency: A Case of Smallholder Farmers in Eastern Uganda*. Unpublished Msc. thesis. Egerton University, Kenya.

Wortman, C. & David J. 2008. *Towards the Development of Market Driven Research Framework*. Eastern and Central Africa Beans Research Network (ECABREN). http://www. Webapp.ciat.cgiar.org. Accessed on 30th November 2011.

Williamson, O. E. 1985. *The economic institutions of capitalism: Firms, Markets, Relational Contracting*. New York.