IMPACT OF DERIVATIVES TRADING ON SPOT MARKETS: PRICE DISCOVERY

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A research proposal submitted in partial fulfillment of the requirements for the Degree of Bachelor of Business Science in Actuarial Science

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Strathmore University

Nairobi, Kenya

July, 2016

DECLARATION

I declare that this work has not been previously submitted and approved for the award of degree by this or any other University. To the best of my knowledge and belief, the Research Proposal contains no material previously published or written by any other person except where due reference is made in the proposal.

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CHAPTER 1: INTRODUCTION.

1.1. Background

1.1.1. Definition of terms.

A derivative security is a financial contract whose value is derived from the value of something else, such as stock price, a commodity price, an exchange rate, an interest rate, or even an index of prices, (Sakar, 2006). Derivatives may be traded for a variety of reasons; a derivative enables a trader to hedge some preexisting risk by taking positions in derivatives markets that offset potential losses in the underlying or spot markets. Speculation, taking positions to profit from anticipated price movements, is also a major motive for derivatives trading. In practice, active markets require the participation of both hedgers (they participate in the markets to manage their spot market price risk) and speculators who speculate on the direction of the futures prices with the intention of making profits, since it may be difficult to distinguish whether a particular trade is for hedging or speculation purposes. Arbitrage trading which entails profiting from discrepancies in the relationship of spot and derivatives prices, helps to keep markets efficient and may also act as a motive for derivatives trading. Speculators face the risk of losing money form their derivatives trades depending on the price volatility in the markets.

Derivatives instruments can be divided into two broad categories; exchange- traded and over-the-counter derivative instruments. Over- the - counter contracts, such as forwards and swaps, are bilaterally negotiated between two parties. The terms of an OTC contract are flexible, and often customized to fit the specific requirements of the user. OTC contracts have substantial credit risk, which is the risk that one of the counterparties defaults

A futures contract is an agreement to later buy or sell a commodity (Commodity Research Bureau, 1977) and is a type of derivative security because the value of the contract is derived from the value of an underlying instrument. Futures contracts are managed through an organized futures exchange and requires the underlying commodity or financial instrument be clearly identified. Futures can be classified into different classes depending on the underlying ; the stock index futures whereby the underlying is the stock index, commodity futures which is an agreement to trade a set amount of commodity at a predetermined price and date, Eurodollar

futures, U.S. Treasury futures, Foreign government futures, swap futures, Forex futures and single stock futures. In this paper, however, we confine ourselves to commodity futures as our proxy.

Corn futures are standardized, exchange traded contracts in which the buyer agrees to take delivery form the seller, a specified amount of corn at a predetermined price on a future delivery date (Commodity Research Bureau, 1977). The Johannesburg Stock Exchange (JSE) commodity derivatives market provides a platform for efficient price discovery and price risk management for grains market in South and Southern Africa (JSE, 2016). The market also offers a range of foreign-referenced Derivatives on both soft (those that are planted) and hard (those that are mined) commodities which has been made possible through a licensing agreement with the CME group. In particular, corn futures and options are derivatives contracts, where the underlying contract is the corn derivative contract as traded on the Chicago Board of Trade (CBOT), which inherently give investors exposure to the international market (JSE, 2016). The contracts are cash settled in Rands and can be accessed via JSE commodity derivatives members.

1.1.2. Development of derivatives markets in Africa.

There have been many donor-supported initiatives to establish commodity exchanges in developing countries but very few have succeeded. Shortly after market liberalization in the 1990s, five African countries launched agricultural commodity exchanges but only South Africa succeeded in making its exchange sustainable. The Kenyan Agricultural Commodity exchange (KACE), also established in the 90s, no longer support actual trades but exist with donor support similar to the Uganda Commodity Exchange (UCE) which does coordinate trades but has not been able to attract sufficient trade volumes to be self-sustaining. Other notable exchanges that have been launched include Malawi Exchange in 2004 whose role has been limited to providing price information, Nigeria's Abuja securities and commodity exchange (ASCE) in 2006,which started trading in maize and soybeans then in a limited scale, the new Zambian exchange (ZAMACE) established in 2007 and the Ethiopian Commodity Exchange (ECX) in 2008, which turned its focus to export crops with the support of policies discouraging export of coffee through other outlets.

1.1.3. Liquidity of the Derivatives Markets.

Liquidity is a multi-dimensional concept, generally referring to the ability to execute large transactions with limited price impact, and tends to be associated with low transaction costs and immediacy in execution. Liquidity can be measured based on immediacy, market depth and resilience market breadth and tightness. It is a core factor for effective market functioning. The financial crisis demonstrated the advantages of having a robust financial system which is able to absorb unpredictable shocks, while maintaining market wide liquidity. Current trends driving global markets liquidity conditions include; stable and supportive global monetary conditions, increase in electrification and digitalization in financial markets which helps reduce costs of trading and links up buyers and sellers, and growing engagement of providers of alternative market-based financing in some aspects of market- making.

Markets liquidity is critical to effective market functioning. Liquidity in financial markets facilitates the efficient allocation of economic resources through the productive allocation of capital and risk. The accurate generation and dissemination of issuer specific information and the effectiveness of monetary policy and financial stability. Current research points to measurable reduction in financial markets liquidity. For instance, European corporate bond trading volume has declined by up to 45% between 2010 and 2015 and dealer inventories of corporate bonds in the US have declined by lose to 60% between 2008 and 2015. Large trades are becoming more difficult to execute without affecting prices, with market participants breaking up larger trades into smaller tranches. The reduced liquidity could be attributed to a few factors, including but not limited to banks de-risking in the wake of the financial crisis (selectively de- leveraging and unwinding large non- performing and capital intensive credit books), following the introduction of new regulatory risk frameworks. Diversity, like electronification and new entrants in providing core services, is core in supporting the real economy.

Low interest rates, strong asset valuations and generally vibrant financial markets currently are some of the factors that affect markets liquidity. However, there are emerging concerns of underlying structural markets changes which increase the vulnerability of financial markets to shocks. According to Chris Salmon, Executive director for markets of the Bank of England, the corporate debt and equity markets are now more volatile in response to price shocks in the post-crisis period, compared to the pre-crisis. However, liquidity appears to have become increasingly brittle. Although it looks adequate during normal conditions, it seems to disappear abruptly

during episodes of markets stress, (Richard Benner, 2005).The liquidity conditions can differ significantly across different asset classes, even in normal times. Financial assets with lower levels of liquidity tend to have a higher liquidity risk premia and market participants also tend to face higher transaction costs and wider bid-ask spreads when trading in these instruments. In the case of Sub Saharan African countries, majority of the economies are in the developing stage. The ongoing efforts to develop regional capital markets is relevant and of importance in derivatives markets in that it is geared towards overcoming economic constraints.

1.2. Problem Statement

There exists a gap in the study of the behavior of the stock markets before, during and after the introduction of derivatives trading in developing African countries. Commodity futures are fairly new contracts in the emerging markets, especially in the African context, which if well executed could have a significant influence on the price discovery in equity markets, and especially on the stock markets which have already been established and have been operational for a minimum of three years. (Adelegan, 2009), outlines some of the lessons that the African countries can derive from the South Africa's derivatives market and suggest that introduction of currency futures could play a vital role in improving liquidity of their markets. Could it be the same case with the introduction of agricultural futures contracts?

This study is geared towards finding out the role of corn futures trading in the price discovery of the underlying commodity's spot market on an empirical front.

1.3. Research Questions

1. What is the effect of the introduction of futures trading on the underlying commodity's market?
2. Does the corn futures market in South Africa help in price discovery?

1.4. Justification of the study.

Corn futures are traded on at least ten major exchanges as corn is a globally grown commodity. The corn futures contracts traded at the CME Group exchange is considered a benchmark and is not only for exchange cleared contracts but serves as reference price for majority of the OTC transactions consequently having significant impact on world's corn trade (Filimon, 2011). Regional developing exchanges, like the JSE, with the aim of creating cash-settled corn futures contracts traded in local currencies, have licensed the CME's settlement prices. With reference to agricultural commodities, CME traded corn futures contract is one of the most liquid market with corn having the second largest volume of trades after crude oil (Filimon, 2011).

According to FAOSTAT, South Africa is the world's fifth largest producer of green maize and maize with the agriculture sector contributing 2.6% of the G.D.P, considering the arid conditions of the country with only 13.5% of the land being available for crop production. Over the last two decades corn production has increased by approximately 50%. Maize production contributes a significant 36% majority of the South Africa's field crops. On the other hand agriculture contributes 24% of the Kenyan G.D.P (food security report prepared by KARI) with 15% arable land. According to the Kenya Agricultural Research institute (KARI) agriculture is the largest contributor to the Kenya's gross domestic product. South Africa, being the second largest economy in Africa after Nigeria, is used as a benchmark considering that it has a developed derivatives market and since it is moving away from primary production to processing and manufacturing, a direction that Kenya is likely to follow.

Little has been done on the effect of futures trading on the stock markets. Therefore considering that agriculture is crucial factor of the emerging countries' economies, it is prudent to find out the effect of futures trading and the derivatives market as a whole will have on the stock markets in terms of price discovery. The finding will be used as a reference point for the Kenyan market putting into mind the underway plans of developing a derivatives market in the country.

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction.

This chapter gives an analysis of several studies that have been conducted in relation to the derivatives markets and the various aspects affecting their functioning. This is in the attempt to answer the question whether introduction of the derivatives markets has done more harm than good to the global financial markets or otherwise. This forms a basis for the study of liquidity in the underlying stock markets in relation to the introduction of futures markets. It is worth noting that several methodologies have been developed in the analysis of the derivatives markets and different ideologies established. This study captures a couple of the studies and their consequent findings and how the results can be replicated in the emerging markets.

2.2. Implications of derivative trading on the underlying volatility and the consequent effects on liquidity.

Many aspects relating to the different derivative instruments have been previously examined. Volatility, being one of the crucial determinants of liquidity, needs to be critically examined.

2.2.1. The effect of derivatives trading on the volatility behavior of equity markets.

Following the introduction of derivatives in the equity markets, the volatility behavior of the stock market has become more complicated as derivatives open new avenues for hedging and speculation. The main objectives fostering the launching of derivatives markets were to transfer risk and to increase liquidity with the aim of ensuring better market efficiency. Considering the case of India, trading in derivatives started in June 2000 with the launch of futures contracts and in 2001 options trading was also introduced. Since then, the futures and options (F&O) segment has been continuously growing in terms of new products, traded volume, contracts and value. The F&O segment of India's National Stock Exchange outperformed the cash market segment with an average daily turnover of Rs291.91 billion, as compared to Rs114.79 billion in the cash segment from 2006-2007(derivatives update on NSE website 2007), signifying the importance of derivatives in the capital market sector of the economy. However, previous studies on the volatility effects of derivatives listing provide mixed results, suggesting case-based biases. Previous studies show that introduction of derivatives contracts improve liquidity and reduces

information asymmetries in the market. However, the volatility implications of derivatives are still debatable considering the existence of some evidence supporting increased volatility with the onset of derivatives trading.

High levels of derivatives trading are usually associated with a high level of stock trading, although volatility in underlying equity markets could also increase after introduction of related derivatives markets. Investors may become able to deal with the risks of their equity positions more easily. Increasing liquidity in the underlying equity markets owing to investors' interaction while hedging, speculating and arbitraging could then provide a certain extent of growth and stability in these markets. Debts markets may develop as the debt derivatives would allow for the hedging of the risks inherent to fluctuating interest rates and also add to the offering of debt instruments (Gautum, 2003); OECD, (OECD,World Bank & IMF., 2007).

(Singh & Kansal, 2010), using NSE S&P CNX Nifty index as their proxy, examined the impact of derivatives trading on the volatility of the Indian stock market using; the findings were that derivatives trading has significant impact on the volatility of the stock market return in the sense that the volatility in S&P CNX Nifty has declined in the period after derivatives instruments were introduced, however recognizing the fact that the decline in volatility is a function of not only introduction of derivatives trading. The decrease in volatility would be mainly attributed to attraction of additional set of traders to the market, the derivatives markets having lower transaction costs and transmitting the new information to the spot market more quickly and providing a favorable environment for entry into the financial markets which consequently help in dispersal of risk. In addition, with the increase in trading volume, a greater liquidity will be reflected in the prices of the underlying market.

2.2.2. The impact of futures trading on the volatility and liquidity of the underlying.

Existing research has come to contradictory conclusions on the effect of futures trading on volatility. (Hodges, 1992), (Mayhew, 1999) pointed out that most of the theories on the effect of futures trading on the underlying indicated that volatility of the underlying market could increase or decrease with the introduction of futures depending on the underlying assumptions and the parameters used in the models. However, (Gulen & Mayhew, 2000), having examined results from twenty five countries highlighted a pattern that in most cases futures markets were

associated with decreasing volatility and that most markets are more integrated with the world's markets after the introduction of derivatives.

(Rahman, 2001), using a simple GARCH (1, 1) model to estimate the conditional volatility of intra-day returns, examined the impact of index futures trading on the volatility of component stocks for the Jones Industrial average (DJIA). The empirical results confirmed that there is no change in conditional volatility from pre- to post-futures periods. By using error-correction models and the Garch (1, 1) regression model, (Figuerola-Ferretti & Gilbert, 2001), studied the effect of futures trading on volatility, reported the results of VAR model and presented an impulse response analysis to track the effects of a shock to each of the volatilities. The results show that volatility decreases in the post- futures period. Findings from various GARCH (1, 1) models for pre-futures ad post futures sub- periods suggest that the index futures markets reduces volatility.

2.2.3. Impact of futures trading on the volatility of the underlying spot market;

Generally, it has been argued that futures markets have a stabilizing effect on the underlying spot market as it is considered that futures trading improves price discovery, enhances market efficiency, increases market depth as well as information flows and contributes to market maturity. (Powers, 1970), (Kyle, 1985), Stoll and Whaley 1988, all agreed that introduction of futures trading reduces the volatility of the underlying spot market. However, (Turnovsky, 1983), theoretically examined and supported the notion that derivatives trading has a stabilizing effect on spot prices with (Cox C. C., 1976) and (Hiraki, Maberly, & Takezawa, 1995)presenting empirical evidence that futures traders are better informed than spot traders, resulting to the stabilization of the spot market.

2.2.3.1. Stock index futures trading on the Chinese stock market.

(Martin T. Bohl, Diesteldorf, & Siklos, 2014), examined whether the introduction of Chinese stock index futures had an impact on the volatility of the underlying spot market and compared the findings for mainland China with Chinese index futures traded in Singapore and Hong Kong. The study revealed that Chinese index futures decrease spot market volatility all three spot markets considered.

Contrary to their findings, (Chen & Zhang, 2015), having analyzed the impact of stock index futures on the Chinese stock market by using the CSI 300 index as their market proxy, with the Shanghai and Shenzhen 300 stock index futures as its subject, revealed that the stock index futures had no significant effects on the volatility of spot market, however, there exists a co-integration relationship in both long term and short term. Through quantitative analysis and inspections before and after the introduction of stock index futures, they did find out that spot market prices fluctuated. Using the Granger causality test, they investigated the order and the information content between stock index futures and spot. In the short term, following stock index futures introduction, the market's reaction on information was faster than the spot market, mainly due to stock index future market liquidity, low transaction costs, good leverage and it being a two way trade hence the suggestion that implementation efficiency be heightened so that information can be reflected faster in the market. However, in the long term spot market pricing still dominates the market and as futures approach the expiration date, the price is to naturally converge with the spot market price but and since the futures price depends on the price of the spot assets, stock index futures market still determine the trend.

2.2.3.2. Stock index futures trading in the United States

(Kuserk, Gregory j, & R.locke, 1993), having conducted empirical studies in the stock market of the United states, concluded that after the introduction of stock index futures trading, the level of trading in both stock and futures markets has increased greatly due to numbers of arbitrage traders and hedgers attracted in it . However, in Japan, there appears to an obvious phenomenon of trading shift in initial stages after stock index futures is launched, but no remarkable changes in the long term. (Fang & Xu, 2007), by comparing data from Korea, India and China's Taiwan region indicated that the introduction of the stock index futures markets increases trading volumes in stock markets , but the growth rate of trading volume does not change notably in whether short term or long term before and after stock index futures are listed.

Concomitant with the findings above, some prior studies did also shed some light on why increasing spot market volatility following the introduction of futures trading need not be construed as lurking disaster. Ross 1989, argued that effective transmission of new information from the futures market to the cash market such that the information flow into the spot market is improved following the onset of futures trading, then inevitably the spot market volatility should

increase. This raises the question whether the same is translated in emerging markets. (Floros, 2009), show that emerging spot and futures play a strong price discovery role implying that futures (spot) prices may contain useful information about spot (futures) prices indicating evidence of cointergration between markets. The conclusion is reached upon having empirically investigated the price discovery, lead-lag relationship (exists when one market reacts faster to information due to transaction costs or other capital market effects) and causality between the South African Cash and futures prices; by particularly investigating the relationship between daily spot and stock index futures traded in the South African Stock Exchange and Futures Exchange for a four year period.

On the flip side, considering the impact of the uninformed investors, futures trading can destabilize the underlying spot market by increasing stock market volatility. Poorly informed investors having been attracted by the relatively low transaction costs, ability to short sell and high leverage degrees, induce noise in the price discovery process and lower the information content of prices implying an increase in the spot market volatility. (Cox C. C., 1976), (Cagan, 1981), (Stein, 1987).

(Bhaumik & Bose, 2007), examined the impact of derivatives trading on emerging capital markets using India as the proxy. They analyzed the impact of expiration of derivatives contracts on the cash market at the India stock exchange in which their results indicate that trading volumes were significantly higher on expiration days and during the so called expiration weeks, five days leading up to expiration days, compared to the non-expiration days (weeks); with both the mean and volatility of returns to the market index at the National Stock Exchange being significantly different on expiration days compared with other days. However, they found no evidence of price reversal following the expiration day leaving the impression that either the price reversal takes place on the expiration days themselves or the magnitude of the changes in the mean and volatility on account of expiration of the derivatives contracts were not so large as to necessitate a correction the following day. However, the study did reveal presence of a statistically significant impact of expiration of derivatives contracts on both mean and variance of daily returns.

2.3. The effect of derivatives trading on the general economic growth

Similarly, it is of importance to understand the overall effect of derivatives trading on the economic growth putting into consideration the positive relationship between liquidity and economic growth. This raises the question; what really is the effect of derivatives trading on the economic growth? As a way of fostering economic growth, there has been more advocacy on embedding derivatives markets in Sub Saharan Africa, (FEED & the World Bank., 2012). Different studies have been conducted examining the relationship between derivatives trading and economic growth. However, they have unveiled contradictory conclusions. While derivatives trading can be weakly linked to economic growth in developed countries like the United States, (Haiss & Sammer, 2010), there is significant positive correlation between derivatives trading and economic growth, (Sendeniz-Yüncü, Akdeniz, & Aydo˘gan, 2007), (Baluch & Ariff, 2007) and Rodrigues et al. (2012).

Depending on the size of the country's derivatives market relative to the gross domestic product, GDP, development of these derivatives markets will have different effects on the economic growth. Those with medium sized derivatives exhibit a more significant positive relationship between the two variables than those with large and small derivatives market value relative to their GDP, (Sendeniz-Yüncü, Akdeniz, & Aydo˘gan, 2007). Evidently, countries with well-developed derivatives markets are doing well economically as compared to their counterparties with less developed derivatives markets. However it all breaks down to how well derivatives trading is implemented. The effect that derivatives markets have on economic growth is dependent on the utilization of such markets and the risk transfer function of such markets is more likely to contribute towards economic growth, (Baluch & Ariff, 2007).

Well executed, introduction of derivatives exchanges could positively influence the economic growth of a country. The establishment of vibrant, well- regulated and well supervised derivatives markets is vital to prevent the risks of derivatives aggravated disaster occurring; hence the need to anticipate the infrastructural requirements of these markets. The evolution of derivatives can only be possible if the adequate infrastructures to support such innovative financial products are in place, (Pickel, 2006). Apparently, most of the derivative instruments are ensuing products of the prevailing system of deregulated international markets that has been labelled "the casino economy", in which financial intermediaries chiefly benefit (Wahl, 2009)

and (Haiss & Sammer, 2010). The latest financial crisis was believed to be a product of this casino system which, according to (Wahl, 2009), mainly promotes the finance principle of "profit maximization at all times" but fails to allow adequate progress to be made in the domain of development and create more social inequalities. Very risky bets on movements in the price of the underlying assets are made in these markets, whereby incomes can flow among market participants without them actually trading in any underlying assets; especially in the so called Over the Counter (OTC) markets, (Kohler, 2012) and (Sylla, 2003). Optimistically, countries' average output growth could increase following the introduction of the proposed derivatives trading, but the existence of local derivatives exchanges could lead to greater volatility in the regional economies.

However, the regulated derivatives market does not make a big impact on overall growth. Considering the small size of the majority of Sub Saharan African countries' economies, the ongoing efforts to develop regional capital markets should be relevant for derivatives markets in order to overcome scale constraints. As with economic growth, the development of derivatives trading should also follow that of the exchanges (equities, bonds, etc.) that create the need for related derivatives. A derivatives exchange in Sub Saharan Africa is most likely to be more valuable if competitive instruments are offered on commodities such as oil, gold, coffee, etc., especially since other international exchanges already provide the buyers and the sellers of these underlying commodities with the opportunity to hedge their exposure. (Baluch & Ariff, 2007), cautioned that liquidity in the underlying markets is also the most critical factor driving the successful operation of any derivatives market. The issue of derivatives' induced liquidity is not only noteworthy given the illiquidity characterizing Sub-Saharan African countries capital markets, but it is even more so since derivatives markets themselves must rely on liquid underlying markets to flourish. Without liquidity in the underlying capital markets there will be little hope of there being liquidity in any related derivatives (Alberta Market Solutions).

2.4. Liquidity.

2.4.1. Definition of terms.

Liquidity has been defined in many different ways over the years. Whereas (Ivanovic, 1997), defined liquidity as the ability of continuously transforming asset from one form to another, (Amihud, Mendelson, & Pedersen, Liquidity and asset prices, 2005) referred to liquidity as the

ease of trading a security dependent on how quick is the execution of orders and the ability to convert in cash at lowest costs. However, the more conventional definition of liquidity is ability to convert stocks into cash and vice versa without affecting the price or with minimal impact on the price. Illiquidity tends to make trading of a particular security very difficult consequently leading to low prices. Therefore it is critical to understand how liquidity can be measured in emerging markets.

2.4.2. Measuring liquidity.

According to (Wyss, 2004), this could be achieved by putting into consideration and clearly distinguishing four core dimensions; trading time which can be defined as the ability to instant execution of the transaction at the current price, depth defined as the ability to trade a stock without effect on growth or decline in stock price, resiliency which is the ability to buy or sell certain amount of stocks without affecting the price and finally tightness defined as the ability to buy and sell stocks at the same time and price.

The natural measure of liquidity is the spread between the bids and ask price. The spread must be large enough to cover costs and provide a reasonable profit to the trader. According to (Plerou, Gopikrishnan, & Stanley, 2005), quantifying the statistical features of the bid-ask spread offers the possibility of understanding some aspects of market liquidity. Similarly, (Damodaran, 2006) stated that spreads as a percentage of rate are negatively correlated with the levels of prices, volume and number of market makers and positively with volatility. Apart from bid-ask spread measure, liquidity can also be measured using the trading volume, past trading volume, a measure which basically entails trying to capture the quantity of securities per time to measure the depth dimension of liquidity, an increasing function of liquidity.

Illiquid markets are highly characterized by large daily fluctuations in price with low levels of daily transactions contrary to liquid markets characterized by the high level and small impacts on price. Adhering to the notion of high risk, high return, it is then logical to argue that a less liquid market provides higher returns because of the high volatility of prices, but carries a higher risk (Bogdan, Baresa, & Ivanovic, 2010). Illiquidity could be as a result of the following variables (with the exemption of macroeconomic variables); volatile transaction costs, difficulties related to finding other counterparty who is able and willing to transact at the agreed price and quantity,

high spread between bid-ask price of the security and the possibility of investors being locked into their holding of a particular security.

2.5. Derivatives trading and market stabilization.

In relation to market stabilization, it is very crucial to examine the effect of derivatives on financial stability considering that greater financial stability encourages greater capital inflows while reduced stability does the exact opposite. (Dodd & Jones, 2007) Argued that derivatives markets make a financial system more stable by creating avenues where risks can be transferred to others therefore enabling the financial institutions to avoid unwarranted or unwanted risks.

However, while hedging can make firms more safe, the Over The Counter derivatives markets often do not operate according to safe and sound financial practices and their large and growing economic roles makes financial systems overall less stable. Speculative use of derivatives by financial institutions can potentially lead to significant losses that would cause credit losses for the derivatives dealers.

Compared to traditional banking, insurance or securities markets, derivatives markets operate at a lower prudential standard (Dodd & Jones, 2007) in the sense that; derivatives provide greater leverage and cheaper exposure to the market risk meaning that it is easier to take larger risks, losses can escalate rapidly and that rare events can have greater impacts. They are also related to greater credit exposures and greater potential credit losses. The absence of collateral requirement and lower capital requirements increases leverage leaving the derivatives markets more vulnerable in times of stress. Also, OTC derivatives markets face greater exposure of liquidity risk and can collapse at the worst ties as dealers withdraw from markets and other participants hesitating to trade with any dealer viewed to be at risk. The OTC markets also have poor clearing and settlement arrangements resulting in greater exposure to operations risk and they also have inadequate anti-fraud and anti-manipulation prohibitions. Generally, derivatives have the potential to encourage international capital inflows by improving pricing efficiency and providing means for investors to better manage their risks so as to encourage greater amounts of investments and thus positively influencing the capital markets liquidity.

2.5.1 Derivatives trading in Sub Saharan Africa and the effect on capital markets.

South Africa has been used repeatedly as a case study in attempt to explore the role of derivatives markets in sub Saharan Africa since it's the only African country with an active derivatives exchange. The South Africa's derivatives market has grown rapidly in the recent years, supporting capital inflows and helping market participants to price, unbundle and transfer risk. Properly replicated and developed in sub Saharan African countries, derivatives markets could enable market participants to self-insure against volatile capital flows and reduce their overdependence on credit as a source of funding. Needless to say, appropriate regulation and supervision will be critical in ensuring that these markets are well developed.

(Adelegan, 2009), outlines some of the lessons that Sub-Saharan Africa countries could derive from South Africa's market. They include but not limited to; the need to deepen their shallow capital markets as this would translate to increased access to finance and financial risk management. By so doing, they would be evading the risk of volatile international cashflows destabilizing the shallow markets which could precipitate to a crisis. Secondly, relaxation of exchange controls following the introduction of currency futures markets could play a major role in their efforts to increase liquidity while ensuring proper regulation and enhanced supervisory capacity.

The countries could also manage the seasonal risks by introducing commodity futures considering that most of the SSA countries have agriculture as their main source of income, with the agricultural products being affected by seasonal factors. As is being done in South Africa, proper regulations have to be put in place for derivatives to achieve the desired results. More importantly, consideration should be given to the establishment of a regional derivatives market as this could bring about synergy and reduction in operational costs. Strengthening of macroeconomic policies and political fundamentals should be fostered so as to attract and sustain foreign investors. By introduction of derivatives markets, the other SSA countries can broaden the set of investment opportunities available to domestic investors and enhance diversification of the investment portfolio. With regards to creating awareness amongst the investors on the nature of risks associated with different derivative instruments, incorporation of appropriate warnings such as "caveat emptor" in the investor contracts is crucial. The market need not be one sided but rather should have properly regulated hedging instruments as is the case in South Africa, owing to the fact that derivatives bring speculators and hedgers together thereby improving liquidity.

2.5.2 Commodity exchanges

Despite improved affordability of information technology, many critical preconditions for establishment of commodity exchanges in Africa remain binding in the short to medium term, Rashid, Nelson and Garcia 2010. The development of commodities exchanges in the region is impeded by the relatively small size of domestic commodity markets, weak physical and communication infrastructure, lack of regulatory and legal environments and likelihood of policy interventions especially in the market for staple cereals. Meanwhile, the demand for a domestic commodity exchange for export crops may be limited due to the availability of well-established exchanges abroad. Consequently, efforts to launch exchanges in Africa should realistically assess whether basic conditions for success can be met. However, if the pre-conditions cannot be met, using the already existing exchanges abroad as a reference point or developing regional exchanges may be more feasible than establishing national commodity exchanges. Nonetheless, the goals of risk management and reduced transaction costs might be achieved more effectively through investments in transportation, information services or other financial institutions which could support future establishment of a commodities exchange.

Purposes served by commodities exchange depend in part on the nature of the specific contracts that are traded. By centralizing trade in a commodity an exchange can facilitate tittle transfer, market transparency and price discovery which fosters liquidity. Costs associated with identifying market outlets, physically inspecting product quality and finding traders can be significantly reduced by coordination through a centralized exchange. By reducing transaction costs and enhancing information flows, an exchange can improve returns to market agents while reducing short term price variability and spatial price dispersion. More sophisticated contracts allowing exchanges in future can enable extensive risk management. Recent efforts in developing exchanges attempt to move beyond auction floor, where physical goods are traded, to trade in the more fungible contracts that can be used as price hedging devices.

2.5.3. Commodity futures trading.

By trading contracts for future delivery, commodity exchanges can help strengthen market liquidity, improve price discovery and facilitate price risk management (Leuthold 1989). A futures contract, being a fungible financial instrument which traders are willing to hold and

exchange, if included in an exchange can aid in improving liquidity. While futures contracts effectively remove price risk, the do not entirely remove the risk but rather they replace price risk with basis risk, where the basis is the difference between the spot market and futures market prices. Unanticipated shifts in the basis can result to losses or gains and the degree of basis risk can strongly influence the effectiveness of the exchange in risk management.

Futures markets have evolved to address the incompleteness of spot markets although most countries have not adopted or replicated futures markets. Some of the reasons behind this include government intervention, local conditions that render their activities unprofitable, market failures which include inadequacies in physical infrastructure, asymmetry in information and inadequate supporting legal and financial institutions which can impede the formation of futures markets.

(Inoue & Hamori, 2012), examined the market efficiency of the commodity futures market in the Indian context. They estimated the long-run relationship between the multi-commodity futures and spot prices and then tested for market efficiency in a weak form sense. The study revealed that a cointergration relationship is found between these indices and that the commodity futures market seems to be efficient only during the more recent sub-sample period since July 2009.

(Zhiyong Tu, Min Song, & Zhang, 2013), investigated the risk premiums for the Chinese commodity futures and found out that although the risk premiums vary across individual commodities, overall Chinese commodity futures produce a significantly positive risk premium, indicating that the commodity futures market is generally backwardated. They also verify that the commodity futures can act as an effective diversification tool in the Chinese asset management industry. Following their study, they found out that the commodity futures can hedge both the expected and unexpected inflation in China, that is, agricultural futures are found to be a signal for inflation two months earlier. Exploring the relationship between Chinese and US commodity futures markets for the years 2000-2010, the results indicate an increasingly interactive pattern between these two markets, indicating enhanced information transmission. Empirically, evidence showed that Chinese commodity futures market can affect the US market, but with less influence from the US market translating to the necessity for policy concern of improving Chinese commodity market's pricing power.

(Aggarwal, Jain, & Thomas, Do commodity futures help in price discovery and risk management? Evidence from India, 2015), examined price discovery and hedging effectiveness

of commodity futures in India following the shift from single commodity, regional exchanges to national exchanges that trade multiple commodities. The study revealed that, on average, futures prices do discover information relatively efficiently but helps to manage risk les effectively. They also examined the factors that affect the role of commodity futures in price discovery and hedging effectiveness and revealed that high volatility in spot prices increases the cost of trading by raising the margins and thus adversely impacts informed trading. Disruptions caused by various policy interventions in both spot and futures markets in addition to the mismatch between the grade specified in the futures contract and what is available for delivery in the market, highly affects the hedging effectiveness of commodity futures.

Using data on four agricultural and three non- agricultural commodities from Chicago Board of Trade (CBOT) and the Commodity Exchange (COMEX), (Garbade KD & WL, 1983) found that while there was evidence of information dissemination from the futures to the cash markets, there were considerable slippages between the two markets in short time intervals which adversely affected the arbitrage between these two markets which eventually had an impact on the risk transfer function by these markets.

Over the years, few studies have looked into the risk management function of the commodity derivatives market. Particularly, hedging in the spot market is useful in case of any long term requirement for which the prices have to be confirmed to quote a sale price but to avoid buying the physical commodity immediately to prevent blocking of funds and incurring large holding costs, (Tomek & Peterson, 2001). On the other hand, examining the efficiency of the New York Mercantile Exchange (NYMEX), (Switzer & El-Khoury, 2007) found out that crude oil futures contract prices are unbiased predictors of future spot prices with both futures and spot prices exhibiting asymmetric volatility characteristics and that hedging performance could be improved by accounting for the asymmetries.

Previous studies have revealed that there is a systematic stock market liquidity factor that influences the liquidity of individual stocks and that there is a systematic liquidity factor in bond markets and foreign exchange markets. However, it is not clear whether these findings can be translated to commodities as many commodity market participants are hedgers who trade for risk management purposes. Using data from sixteen agricultural, energy, industrial metal, precious metal and livestock commodities Ben, Nhut and Nuttawat 2011, examine liquidity commonality,

liquidity of individual securities being influenced by market-wide liquidity, in commodity futures markets. The study shows that there is a strong systematic liquidity factor in commodities with the liquidity commonality being present in 1997-2003 when commodity prices were relatively stable and during the recent boom. There is some evidence that liquidity commonality in commodities is driven by supply-side factors which would imply liquidity providers withdraw liquidity at the same time in different commodities. However, there also exists some evidence of demand-side factors affecting commodity liquidity commonality. They also found some evidence that changes in stock market liquidity positively influence changes in individual commodity liquidity; which is consistent with the notion that investors view commodities as complementary assets to stocks resulting in them purchasing (selling) both in times of lower (higher) risk aversion.

2.6. Price discovery.

Price discovery is one of the most important functions of the derivatives market. Price discovery rests on whether new information is incorporated first in futures prices or in spot prices. Black (1976) provides an early evidence on price discovery function of commodity futures markets and finds that these markets facilitate informed production, storage and processing decisions. Using data on four agricultural and three non-agricultural commodities from Chicago Board of Trade and the Commodity Exchange, (Garbade & Silber, 1983) and that while there was evidence of information dissemination from the futures to the cash market, there were considerable silppages between the two markets in short time intervals. These slippages adversely affected the arbitrage between these two markets.

Subsequent studies examine the price discovery function in various markets. Although the results tended to be mixed, however with higher trading activity, futures prices appear to play a more dominant role in the pricing process, whereas in lightly traded markets, neither long-run relationships nor the short-run leads and lags could be found between the two markets. (Chinn & Coibon, 2014) using data from 1991-2006 show that while energy and agricultural futures prices can generally be characterized as unbiased predictors of future spot prices, the same is not depicted in case of metals but rather the opposite.

2.7. Conclusion.

With derivatives becoming more prevalent in the World's financial markets, it is of great importance to understand the effect of derivatives trading on the underlying markets. However, previous researches have focused primarily on developed markets raising the question to what extent are the results are applicable in less developed markets? (Gulen & Mayhew, 2000)

Previous studies have come to conflicting conclusions regarding the impact of derivatives market on price discovery. There are relatively fewer studies that examine the price discovery aspect between the futures market and the underlying spot market. Evidence indicates that the futures market enables price discovery. However, this does not elaborate on the efficacy of futures markets. It is not clear whether futures prices play an efficient role in price discovery in a market. This study focuses on attempting to fill this deficit by examining whether corn futures aid in price discovery of corn in the South African context and whether the same can be replicate in a Kenyan context.

CHAPTER 3: METHODOLOGY

The main objective is to find out the contemporaneous relationship between the corn spot market prices and the corn futures prices. The Vector regression model as developed by (Sims, 1980) will be fitted to carry out the analysis.

3.1. Research design

The research design used in this proposal is causal. This is because this research aims to observe the cause-and-effect relationship between the corn futures and the corn spot prices, and hence develop a suitable model framework to clearly bring out the relationship between these two variables.

3.2. Population and Sampling

The population used in this research is the commodity futures data in the African markets. However, due to unavailability of data, a sample of the corn futures data in the South Africa commodities exchange is selected. On the other hand, the corn spot prices used is for the South African market to ensure uniformity and eliminate possible outliers.

3.3. Data Type and Sources.

Corn spot prices and corn futures prices used are quantitative data. The corn futures prices will be obtained from the Johannesburg Stock exchange's (JSE) Commodity Derivatives Division which references the Chicago Mercantile Exchange (CME) and spot prices also obtained from

Johannesburg Stock exchange's (JSE) for the period July 2010, when active corn futures trading started in South Africa to mid-April 2016.

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3.4. Model Technicalities

In this model we consider several endogenous variables together, with each endogenous variable being explained by its lagged or past values and the lagged values of all other endogenous variables in the model.

The standard practice in VAR analysis entails reporting results from granger-causality tests, impulse responses and variance decompositions. Granger-causality statistics examine whether lagged values of one variable helps predict another variable, impulse responses trace out the response of current and future values of each of the variables to a one unit increase in the current value of one of the VAR errors, assuming that this error term returns to zero in the subsequent periods and that all other errors are zero and lastly the variance decomposition is the percentage of the variance of the error made in forecasting a variable due to a specific shock at a given time horizon

The main objective is to investigate the intertemporal association between spot and futures markets and whether introduction of futures aid in the price discovery. . In agreement with (Amihud & H. Mendelson, 1986), liquidity may impact returns through a premium for greater trading costs and on the other hand, returns could influence future trading behavior which would consequently affect liquidity which is directly or indirectly dependent on the integration between the spot and derivatives market. Cross-market effects across derivatives and stocks need also to be considered considering that should there exist leads and lags in asset allocational trades, then trading activity in one market may in turn predict trading activity and liquidity in the other.

3.4.1. Data analysis

This study takes into account the following two fundamental variables: corn future prices and corn spot prices and the Vector Auto Regression (VAR) model was employed to test the long run and short run impact of futures trading on the spot market.

Before carrying out the VAR analysis, a unit root test needs to be carried out on the data in order to establish the order of integration of the data i.e. to test whether or not the data is stationary. This will be achieved using the Augmented Dickey Fuller (ADF) test. A cointegration test then needs to be carried out to examine if there is a long run relationship between the dependent and independent variables. This is an integration technique used to test for the presence of long-run relationships among non-stationary variables and will be carried out using the Johansen Multivariate approach.

3.4.1.1. Stationary test

Augmented Dickey Fuller (ADF) test

In order to conduct the stationary test, Augmented Dickey Fuller (ADF) is conducted to establish the order of integration. A stationary variable is mean reverting while a non-stationary variable diverts from its mean with time. A stationary variable does not contain a unit root while a non-stationary variable on the other hand contains a unit root in the autoregressive process.

$yt = \varphi yt\text{-}1 + \varepsilon t$ where $\varphi = 1$ and yt is the time invariant variable.

The basic objective of the test is to test the null hypothesis that $\varphi = 1$. The hypothesis tested is:

H0: Variable has a unit root.

H1: Variable does not have a unit root i.e. are stationary

Therefore if the ADF test statistic is less than the critical value then you fail to reject the null hypothesis.

3.4.1.2 Cointegration test

Johansen Multivariate approach

Given that our cointegration function has many explanatory variables, Johansen multivariate approach is best suited for this in determining the long-run relationship between these variables. Considering other estimation techniques such as Engle-Granger two step technique that comes along with several disadvantages such as only being suitable for bivariate testing and that it only identifies only a single cointegrating relation, the Johansen multivariate approach proves to be the best fit to test for cointegration.

The test will be conducted on the basis of the following hypotheses; reject the null hypothesis or accept the alternative.

$$H_0: \pi = 0 (no\ cointegration)$$

$$H_1: \pi < 0 (cointegration)$$

It should be noted that VAR is carried out with variables that do not exhibit cointegration. If our variables exhibit cointegration, then VAR would not be applicable and will have to use the Vector Error Correction Model (VECM) model.

3.5. Model set-up

In this proposal we will use the bivariate VAR model containing the variables; corn spot prices (S_t) and future prices (F_t). Each variable is expressed as a linear function of m-lags of itself and of the other variable, plus an error term. Assuming the variables are stationary and ergodic, the VAR will be:

$$y_t = \beta_{y0} + \beta_{yy1} y_{t-1} + \cdots + \beta_{yym} y_{t-m} + \beta_{yx1} x_{t-1} + \cdots + \beta_{yxm} x_{t-m} + v_t^y \quad (3.1)$$

$$x_t = \beta_{x0} + \beta_{xy1} y_{t-1} + \cdots + \beta_{xym} y_{t-m} + \beta_{xx1} x_{t-1} + \cdots + \beta_{xxm} x_{t-m} + v_t^x$$

Where;

y_t - represents the daily corn spot prices S_t.

x_t - represents the daily corn futures prices F_t.

β_{xym}- represents the coefficient of y in the equation for x at lag m.

$v_t^y and\ v_t^x$ - are the error terms that represent parts of y_t and x_t that are not related to past values of the two variables: the unpredictable 'innovation' in each variable.

However, we have to consider that the variables may be individually non-stationary hence there may be some degree of cointegration between the two variables, in that the variables may have common underlying stochastic trends along which they move together on a non-stationary path. It's only prudent to also run a vector- error correction model (VECM). In this case the model will be in the form:

$$\Delta y_t = \beta_{y0} + \beta_{y1}\Delta y_{t-1} + \cdots + \beta_{ym}\Delta y_{t-m} + \gamma_{y1}\Delta x_{t-1} + \cdots + \gamma_{yp}\Delta x_{t-m} - \lambda_y(y_{t-1} - \alpha_0 - \alpha_1 x_{t-1}) + v_t^y$$

$$\Delta x_t = \beta_{x0} + \beta_{x1}\Delta y_{t-1} + \cdots + \beta_{xm}\Delta y_{t-m} + \gamma_{x1}\Delta x_{t-1} + \cdots + \gamma_{xp}\Delta x_{t-m} - \lambda_x(y_{t-1} - \alpha_0 - \alpha_1 x_{t-1}) + v_t^x$$

Where;

$y_t = \alpha_0 + \alpha_1 x_t$ - is the long-run cointergration relationship between the two variables

$\lambda_x \; and \; \lambda_y$ – are the error-correction parameters that measure how y and x react to deviations from long run equilibrium.

If y_{t-1} is above its long run value in relation to x_{t-1}, then the error-correction term is positive and this should lead, other things constant, to downward movement in y in period t.

Undeniably, correlation does not necessary imply causality. With correlation being a function of covariance, it is almost impossible to infer anything about the existence or direction of causality between the variables x and y by purely observing covariance. However, we are going to implicate the concept of granger causality to shed light on the direction of possible causality between the variables x and y. Clive Granger formally defined as whether past values of x aid in the prediction of y_t, conditional on having already accounted for the effects on $y_t$of past values of y. If they do, x is said to Granger – cause y.

Considering the equations (3.1), the first equation models the y_t as a linear function of its own past values and those of x. If x Granger causes y, then some or all of the lagged x values have non-zero effects. To test for Granger causality in (3.1), we test the joint blocks of coefficients $\beta_{yxh} \; and \; \beta_{xyh}$ to see if they are zero. We test the null hypothesis x does not Granger cause y, that is;

$$H_0: \beta_{yx1} = \beta_{yx2} = \cdots = \beta_{yxp} = 0$$

This will be tested using the Chi Square test.

In attempt analyze and explain how different structural shocks affects the dynamic path of the variables in the model, we invoke two kinds of analysis. To measure the dynamic margin effects of each shock on all the variable over time, Impulse-response functions (IRFs) are used. Variance decompositions will be used to examine how important each of the shock is as a component of the overall (unpredictable) variance of each of the variables over time. The IRFs should converge to zero as the time from the shock gets large, an indication of stationarity in the variables of the model, but one time shocks should have no permanent effects.

CHAPTER 4. Data analysis, Results and Discussion.

4.1. Introduction

In this section, the empirical results are analyzed and presented. The methods and findings are in line with prior expectations and expected findings are also discussed.

4.2. Testing for Unit Root.

Table 1: *Unit- root test (Augmented Dicker-Fulley Test)*

Null Hypothesis: FUT has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=23)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.235261	0.6611
Test critical values:	1% level	-3.434404	
	5% level	-2.863217	
	10% level	-2.567711	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FUT)
Method: Least Squares
Date: 10/19/16 Time: 20:01
Sample (adjusted): 6/02/2010 4/19/2016
Included observations: 1535 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FUT(-1)	-0.002190	0.001773	-1.235261	0.2169
C	1.114758	0.959206	1.162167	0.2453

R-squared	0.000994	Mean dependent var	-0.025648
Adjusted R-squared	0.000343	S.D. dependent var	10.20029
S.E. of regression	10.19854	Akaike info criterion	7.483668
Sum squared resid	159447.6	Schwarz criterion	7.490621
Log likelihood	-5741.715	Hannan-Quinn criter.	7.486255
F-statistic	1.525870	Durbin-Watson stat	2.013034
Prob(F-statistic)	0.216923		

Null Hypothesis: SPOT has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 3 (Automatic - based on SIC, maxlag=23)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.950196	0.6274
Test critical values:	1% level	-3.964045	
	5% level	-3.412746	
	10% level	-3.128349	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SPOT)
Method: Least Squares
Date: 10/19/16 Time: 20:10
Sample (adjusted): 6/07/2010 4/19/2016
Included observations: 1532 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SPOT(-1)	-0.009326	0.004782	-1.950196	0.0513
D(SPOT(-1))	-0.479274	0.025658	-18.67906	0.0000
D(SPOT(-2))	-0.241252	0.027721	-8.702874	0.0000
D(SPOT(-3))	-0.103604	0.025484	-4.065468	0.0001
C	1.046186	0.606824	1.724034	0.0849
@TREND("6/01/2010")	0.001189	0.000749	1.587728	0.1126

R-squared	0.194872	Mean dependent var	0.142370
Adjusted R-squared	0.192234	S.D. dependent var	9.318056
S.E. of regression	8.374678	Akaike info criterion	7.092211
Sum squared resid	107026.4	Schwarz criterion	7.113103
Log likelihood	-5426.634	Hannan-Quinn criter.	7.099986
F-statistic	73.87011	Durbin-Watson stat	2.011927
Prob(F-statistic)	0.000000		

The basic objective of the test is to test the null hypothesis that $\varphi = 1$. The hypothesis tested is:

H_0: Variable has a unit root.

H_1: Variable does not have a unit root i.e. are stationary

Therefore if the ADF test statistic is less than the critical value then you fail to reject the null hypothesis. From the ADF test for unit root, the p-values for both variables are less than the t-statistics in both cases hence we fail to reject the null hypothesis. This means that futures prices and spot prices have unit roots hence are non - stationary and must be differenced once to become stationary and therefore integrated of order 1.

4.3. Testing for granger causality

Table 2. *VAR Granger causality test*.

Pairwise Granger Causality Tests
Date: 10/19/16 Time: 19:41
Sample: 6/01/2010 4/19/2016
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
SPOT does not Granger Cause FUT	1534	1.70942	0.1813
FUT does not Granger Cause SPOT		14.4874	6.E-07

Granger causality test helps us identify the causal linkages between the variables. It specifies the null hypothesis that the independent variables granger cause the dependent variable against the alternative that they do not granger cause. The decision is on whether or not to reject the null hypothesis based on the f-statistic or the p-values. In this study we reject the null hypothesis if the p-values is smaller than five percent ($p<0.05$). From table 2, both the p-values are less than 0.05 hence we reject the reject the null hypothesis and it is clear that none of the variables granger cause the other.

The results above indicate that spot price do not granger cause future price and future price do not granger cause spot price meaning that the prices in the corn markets, whether spot or future market, develop independently in the South African context.

4.4. Cointegration tests.

4.4.1. Engle – Granger two step technique

***Table 4**. Engle- Granger two-step technique*

Null Hypothesis: ECT has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=23)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.074029	0.2554
Test critical values:	1% level	-3.434406	
	5% level	-2.863219	
	10% level	-2.567712	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(ECT)
Method: Least Squares
Date: 10/21/16 Time: 11:54
Sample (adjusted): 6/03/2010 4/19/2016
Included observations: 1534 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECT(-1)	-0.004946	0.002385	-2.074029	0.0382
D(ECT(-1))	-0.088184	0.025436	-3.466891	0.0005
C	0.096535	0.325366	0.296697	0.7667

R-squared	0.010912	Mean dependent var	0.087606
Adjusted R-squared	0.009620	S.D. dependent var	12.80479
S.E. of regression	12.74305	Akaike info criterion	7.929803
Sum squared resid	248612.0	Schwarz criterion	7.940238
Log likelihood	-6079.159	Hannan-Quinn criter.	7.933686
F-statistic	8.445138	Durbin-Watson stat	2.004146
Prob(F-statistic)	0.000225		

Explanation.

The ADF- test statistic is -2.074029, non-standard. This is compared against a set of critical values provided by (Davidson & MacKinnon, 1993). In total we used two variables (Futures price and spot prices as the dependent variables and the first and second lags of these variables as the independent variables) and included a constant. The t-statistic is greater than the value at the 10%, 5% and 1% level therefore we fail to reject the null hypothesis. This means there is a unit-root in the series i.e. they are not stationary therefore there is no cointegration between the variables.

4.4.2. Johansen Test for cointegration

***Table 5**. Johansen test.*

Trend assumption: Linear deterministic trend
Series: FUT SPOT
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.004634	7.111216	15.49471	0.5647
At most 1	8.12E-08	0.000124	3.841466	0.9926

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.004634	7.111092	14.26460	0.4761
At most 1	8.12E-08	0.000124	3.841466	0.9926

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

FUT	SPOT
0.006224	0.012621
0.003930	-0.009152

Unrestricted Adjustment Coefficients (alpha):

D(FUT)	-0.584564	-0.001561
D(SPOT)	-0.328543	0.001910

1 Cointegrating Equation(s): Log likelihood -11125.18

Normalized cointegrating coefficients (standard error in parentheses)

FUT	SPOT
1.000000	2.027788
	(0.87410)

Adjustment coefficients (standard error in parentheses)

D(FUT)	-0.003638
	(0.00162)
D(SPOT)	-0.002045
	(0.00132)

The results from both statistics are similar verifying that there is no cointegration between the variables. This is also supported by the result that the probability of the null hypothesis is 0.5647 and since it is above 0.5 we fail to reject the null hypothesis (There is no cointegration).

4.5. VECTOR AUTOREGRESSIVE MODEL.

***Table 6**. VAR Model*

Vector Autoregression Estimates
Date: 10/21/16 Time: 14:22
Sample (adjusted): 6/03/2010 4/19/2016
Included observations: 1534 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	FUT	SPOT
FUT(-1)	0.990322	0.110409
	(0.02560)	(0.02134)
	[38.6860]	[5.17272]
FUT(-2)	0.006261	-0.112415
	(0.02559)	(0.02133)
	[0.24472]	[-5.26933]
SPOT(-1)	-0.022343	0.601761
	(0.02809)	(0.02342)
	[-0.79543]	[25.6934]
SPOT(-2)	0.015398	0.391901
	(0.02809)	(0.02342)
	[0.54809]	[16.7301]
C	3.021138	2.398756
	(1.45945)	(1.21688)
	[2.07006]	[1.97123]
R-squared	0.995193	0.985124
Adj. R-squared	0.995181	0.985085
Sum sq. resids	159056.5	110579.3
S.E. equation	10.19934	8.504192
F-statistic	79141.70	25313.98
Log likelihood	-5736.591	-5457.766
Akaike AIC	7.485777	7.122250
Schwarz SC	7.503168	7.139641
Mean dependent	520.9329	181.8285
S.D. dependent	146.9196	69.63485

Determinant resid covariance (dof adj.)	7505.342
Determinant resid covariance	7456.495
Log likelihood	-11192.52
Akaike information criterion	14.60563
Schwarz criterion	14.64042

From the test above, Fut and Spot represent the dependent variables futures prices and spot prices respectively. Fut (-1) and Fut (-2) are the first and the second lag of the dependent variable Fut whereas Spot (-1) and Spot (-2) are the first and the second lag of the dependent variable Spot. The lags are taken to be the independent variables. A constant C is also included in the model. From the test result above, each dependent variable has four independent variables and a constant. Each independent variable is expressed as a 1x1 matrix which comprises of its coefficient, the standard error and the t-statistic. For instance consider the independent variable Fut (-1) which under the dependent variable Fut is expressed as

$$\begin{bmatrix} 0.990322 \\ (0.02560) \\ [38.6860] \end{bmatrix}$$

where 0.990322 is the coefficient, 0.02560 the standard error and 38.6860 the t statistic

which is a function of the other two i.e. t-statistic = coefficient / standard error. In the whole model there are five coefficient for each regression model hence a total of ten coefficients in the whole model. This raises the concern of whether the independent variables are significant enough to explain the dependent variables. To determine this the p-values are required since the guideline is that if the p-value is less than 5% then the particular independent variable is significant enough to explain the dependent variable and if the p-value is greater than 5% then the independent variable is not significant enough to explain the dependent variable. However, from the representation above this cannot be determined as there are no p-values. Therefore the test below is invoked so as to estimate the p-values.

Table 7. *Estimation of coefficients and p-values*

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.990322	0.025599	38.68595	0.0000
C(2)	0.006261	0.025586	0.244718	0.8067
C(3)	-0.022343	0.028089	-0.795426	0.4264
C(4)	0.015398	0.028094	0.548086	0.5837
C(5)	3.021138	1.459447	2.070056	0.0385
C(6)	0.110409	0.021344	5.172725	0.0000
C(7)	-0.112415	0.021334	-5.269326	0.0000
C(8)	0.601761	0.023421	25.69340	0.0000
C(9)	0.391901	0.023425	16.73009	0.0000
C(10)	2.398756	1.216885	1.971227	0.0488
Determinant residual covariance		7456.495		

Equation: FUT = C(1)*FUT(-1) + C(2)*FUT(-2) + C(3)*SPOT(-1) + C(4) *SPOT(-2) + C(5)

Observations: 1534

R-squared	0.995193	Mean dependent var	520.9329
Adjusted R-squared	0.995181	S.D. dependent var	146.9196
S.E. of regression	10.19934	Sum squared resid	159056.5
Durbin-Watson stat	1.999689		

Equation: SPOT = C(6)*FUT(-1) + C(7)*FUT(-2) + C(8)*SPOT(-1) + C(9) *SPOT(-2) + C(10)

Observations: 1534

R-squared	0.985124	Mean dependent var	181.8285
Adjusted R-squared	0.985085	S.D. dependent var	69.63486
S.E. of regression	8.504192	Sum squared resid	110579.3
Durbin-Watson stat	2.158331		

Since each variable was assumed to be dependent, the following models resulted:

- FUT = C (1)*FUT (-1) + C (2)*FUT (-2) + C (3)*SPOT (-1) + C (4)*SPOT (-2) + C (5)
- SPOT = C (6)*FUT (-1) + C (7)*FUT (-2) + C (8)*SPOT (-1) + C (9)*SPOT (-2) + C (10)

Where the dependent variable is expressed as a function of the independent variables, the lags and the different coefficients. Replacing the unknowns;

- FUT = 0.990322*FUT (-1) + 0.06261*FUT (-2) – 0.022343*SPOT (-1) + 0.015398*SPOT (-2) + 3.021138
- SPOT =0.110409*FUT (-1) – 0.112415*FUT (-2) + 0.601761*SPOT (-1) + 0.391901*SPOT (-2) + 2.398756

In order to get a more comprehensive analysis, there is need to check whether all the independent variables are significant to explain the dependent variables. The first step is to check whether the lag variables of one dependent variable are jointly significant to explain the other dependent variable. For instance in equation 1 above, are the lags SPOT (-1) and SPOT (-2) jointly significant to influence the dependent variable FUT. This is achieved using the Wald test indicated below:

Wald Test:
System: {%system}

Test Statistic	Value	df	Probability
Chi-square	3.418831	2	0.1810

Null Hypothesis: C(3)=C(4)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(3)	-0.022343	0.028089
C(4)	0.015398	0.028094

Restrictions are linear in coefficients.

Wald Test:
System: {%system}

Test Statistic	Value	df	Probability
Chi-square	28.97490	2	0.0000

Null Hypothesis: C(6)=C(7)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(6)	0.110409	0.021344
C(7)	-0.112415	0.021334

Restrictions are linear in coefficients.

The null hypothesis is c (3) = c (4) = 0 implying that if the two coefficients are zero, then the independent variables SPOT (-1) and SPOT (-2) do not influence the dependent variable. If the probability is less than 5% then we can reject the null hypothesis. However, in this case the probability is greater than 5% hence we fail to reject the null hypothesis. This means that SPOT (-1) and Spot (-2) do not jointly influence the dependent variable FUT.

For the second equation, the independent variables FUT (-1) and FUT (-2) jointly are significant enough to influence the dependent variable SPOT since the probability is less than 5% hence we reject the null hypothesis c (6) =c (7) = 0. This supports answer the second research question in that the second model indicates that corn futures prices do influence the spot price discovery. From the second equation and the Wald test for the equation, it is evident that the future prices

are significant enough to influence the spot prices hence supporting the prior statement. Smaller tests are conducted on the second equation as shown in table 8 below;

Table 8 : selected model

Equation: SPOT = C(6)*FUT(-1) + C(7)*FUT(-2) + C(8)*SPOT(-1) + C(9) *SPOT(-2) + C(10)
Observations: 1534

R-squared	0.985124	Mean dependent var	181.8285
Adjusted R-squared	0.985085	S.D. dependent var	69.63486
S.E. of regression	8.504192	Sum squared resid	110579.3
Durbin-Watson stat	2.158331		

R- Squared

The model yields an adjusted R- squared of 0.985085 means that 98.5085% of the variations in the spot prices can be explained by the futures prices. Other factors not included in the model will account for the remaining 1.4915%.

Durbin – Watson Statistic

The Durbin – Watson statistic is 2.158 which means there is no evidence of serial correlation.

4.5.1 Discussion of the model

The objective of the study was to test whether the corn futures market aid in the price discovery of the spot market. Using time series data for the period June 2010 to mid-April 2016, a vector auto regression model of the futures prices and the spot prices was developed. The model yielded the results as explained above.

From the various tests and the final VAR model, the following conclusions are extracted; Futures prices have a significant long run relationship with spot prices with no short run relationship which is proven by the Johansen test, on table 5, where we fail to reject the second null hypothesis which state that there is at least one cointegrated equation. The p-value is greater than 5% hence we fail to reject the null hypothesis. This indicates that in the long run the spot prices and futures prices will move in the same direction, that is, a change in the spot market will be reflected in the futures market. However, in the short run, there is no cointegration between the corn futures market and corn spot market supported by the Engle- Granger two step test of cointegration as indicated in table 4. This supports the theoretical literature that in the short run

introduction of futures will not immediately have an effect on the spot prices. It takes sometime before the effect can be manifested in the spot market. Hence in the short term, the spot prices will have a little effect in the setting of the future prices but in the long run, the futures prices will have a significant impact on the spot prices. The result also indicate that spot price do not granger cause future price and future price do not granger cause spot price meaning that the prices in the corn markets, whether spot or future market, develop independently in the South African context.

In line with the tests conducted, the corn spot and future price exhibit negative correlation as shown in table 9 below;

Table 9: correlation test

Correlation t-Statistic Probability	FUT	SPOT
FUT	1.000000 ----- -----	
SPOT	-0.367538 -15.47848 0.0000	1.000000 ----- -----

This indicates that as the spot prices dropped, the futures prices did in deed increase. The level of association between the spot prices and futures prices is however determined by other factors like the difference in the grade of the underlying commodity and the commodity specified under the futures contract and costs involved in undertaking a futures position (Aggarwal, Jain, & Thomas, 2015). In the South African context, there are several exogenous factors that could be directly affecting the relation between the spot and the futures prices. To begin with, the grade of the commodity. The Johannesburg commodities exchanges typically trade limited high quality grades for any commodity. However, there is very little grade standardization in the spot market. This implies that there can frequently be a significant gap in the quality of what is traded and what is delivered, causing (Spot Price – Future price) to be wider than expected. Secondly could be a result of the storage facilities. Considering that the futures market is referenced to the Chicago Mercantile Exchange, costs relating to the handling of the underlying in the futures contracts may lead to the difference being high.

Finally, the regulations governing the two markets could also have an adverse effect leading to the divergence in the price of the spot market and the price in the futures market.

CHAPTER 5. Summary, Conclusions and Recommendations

5.1. Summary and conclusion.

The main objective of this paper was to investigate the effect of introduction of futures on the underlying commodity spot markets. Specifically, the study assessed whether introduction of futures had a significant effect on the underlying commodity's spot prices. This paper implemented the vector auto regression econometric model on the basis of the time series data from June 2010 when corn futures were introduced in the South African market to mid-April 2016.

The empirical results have shown that in the South African context introduction of corn futures had no statistically significant effect on the prices of corn. However, there exists a statistically small but significant correlation between the two markets in the long run. This could be attributed to the fact that the South African traded corn futures are referenced on the Chicago Mercantile Exchange, a developed and well established market. Also, the disparities between the currencies used in trading contributes to the disparity posing currency risk since the South African Rand is weaker than the U.S. dollar.

However, a concern presents itself in that South Africa being highly industrialized, very different participants trade in commodity futures compared to agriculturists, giving rise to derivative prices that are driven by different factors than those that drive the underlying commodity price. This factors cause disruptions in either spot price or the futures or both which reduces the correlation between the two markets.

Therefore, even though in the short run changes in either market do not influence the other, with the right measures being put in place, either market could be used to develop and positively influence and affect the other market.

5.2. Recommendations.

Considering that indeed the introduction of futures market does somewhat influence the underlying commodities spot prices in the South African context, it is only logical to assume that the same could be replicated in the Kenyan context. This however would only be accomplished if various measures are put in place and implementation of a derivatives market is carried out prudently.

To begin with, proper and effective regulations need not to only be set but also to be implemented. The government has to intervene in the working of these markets beginning with implementing of necessary controls and regulating the trading of the futures. A lot of mass education is also necessary to ensure that the agriculturists, especially the corn farmers are well educated on the importance of futures trading. By so doing they will benefit from the introduction of futures and hopefully improve their living standards. This will consequently enable most of the corn farmers to participate in the futures markets hence the positive correlation between the factors driving the futures prices and the spot price.

Considering all the necessary technicalities around the development of futures markets and Kenya being a developing nation, it is recommendable that in order to form a solid basis for the

futures markets there be reference to an already developed and established futures market. This will ensure a smooth integration of the future market into the Kenyan market. Proper integration will translate to positive influence on the spot market which will boost the agriculture sector as a whole consequently improving the country's food security. Arguably, South Africa is a more industrialized African nation as compared to Kenya. However, in line with Kenya's vision 2030 whose objective is to ensure more industrialization in all the sectors, it is only logical to forecast that if properly implemented, the industrialization face will put Kenya at par with South Africa in the near future. As a result, there should be correlation between the results of the study done using the South African data and the Kenyan experience should the industrialization face go hand in hand with the development of the commodity market and the introduction of agricultural futures contracts.

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