Hedging Commodity Price Risk Exposure and the Financial Performance of Manufacturing Companies in Kenya

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Abstract

This study sought to establish how the commodity price exposure faced by manufacturing companies in Kenya influence their financial performance focusing on the earnings before interest and tax (EBIT) and return on assets (ROA). The objective of the study focused on whether commodity price risk exposure should compel manufacturing entities to use hedging strategies based on the premise that commodity risk exposure affects the financial performance. The key theory upon which the research was grounded is the game theory given that irrespective of whether the players act independently or in a group and given that there is more than one course of action, the outcome of the "game" is dependent on the interface of pursued strategies. The researcher conducted a thorough literature review focusing on the key variables of the study. The literature reviewed was critical in providing different perspectives and aspects of commodity price risk exposure and its management strategies. The study adopted an analytical research design in order to get a better understanding of the impact of the independent variables on the dependent variable. The target population consisted of all manufacturing companies in Kenya from which a representative sample of two hundred and fifty five companies was selected through stratified sampling from the key sectors as classified by the Kenya Association of Manufacturers (KAM). The study used ten year panel data given that this period was deemed to be adequate for an objective analysis. Data was collected from archival financial statements to compute the key measures under the independent and dependent variables. Data analysis was done through a general linear model for panel data analysis. From the results obtained, it was observed that manufacturing firms do not disclose any derivative usage in their financial statements. Under the EBITS model, it was observed that TITS was statistically significant and points to the need to hedge commodity price risk in order to enhance financial performance. Under the ROA model, it was observed that Lnassets and CFTA were statistically significant and points to the need maintain adequate cash flows to hedge commodity price risk in order to enhance financial performance.

Keywords: Hedging, Commodity, Price Risk Exposure, Financial, Performance, Manufacturing Companies

1.0 Introduction

Various scholars (German, 2009; Martin, Carlos, Omera & Oznur, 2011 and Pirrong, 2014) have classified commodity risks differently but the very common categorization of commodity risks include commodity price risk, quantity risk, transportation risk, settlement risk, default risk, basis risk, geopolitical risk and speculative risk. Commodity price volatility has been found to be higher in the commodities market than in the financial markets. This is compounded by the illiquidity of the market and therefore changes in supply and demand tend to have greater far reaching effects on prices and volatility making hedging of commodity price risks more difficult (Al Janabi, 2009).

Also referred to as volumetric or yield risk, quantity risk results when the quantity of the commodity to be hedged is uncertain or the demand for a commodity declines in the future. Oum and Oren (2010) in a paper on hedging quantity risk in wholesale electricity markets advanced that such risks can be hedged effectively through establishing a portfolio of put options, call options and forward contracts whereby economic agents facing such risks should use the above financial instruments to maximize expected utility. German (2009) classifies transportation risk into two major categories namely, partial or total deterioration of goods during transportation and cost of transport risks with deterioration of goods being further categorized into ordinary risks which results from natural causes such as age and obsolescence of goods and means of transport while extra ordinary risks may emanate from piracy, strikes, war, riots etc.

Further, German (2009) suggests an approach where she argues that delivery risk can be managed by crafting a very specific and customized contract or developing trust and a long term relationship with the other party in the contract given that no financial hedge may adequately cover delivery risks. According to Clarvis et al. (2014) given the volume of goods consumed by manufacturing entities, credit risk exposure is equally a significant risk as most of these consumers purchase materials in bulk and on credit from all over the world. In developed economies, credit rating institutions such as Standard & Poor's, Fitch, Moody's, Dun and Bradstreet are able to give up to date credit rating information but in developing economies this type of information is rarely available. Pirrong (2014) argues that as a way of managing basis risk, traders taking short hedges which have long basis positions stand to gain when the basis

strengthens while traders taking long hedges with short basis positions gain when the basis weakens. Therefore changes in the basis tend to influence the overall cost of the hedged commodities. In the commodities markets such as for fuel and metals, the price is influenced more by geopolitical risks and macro-economic variables rather than forces of supply and demand. Prices tend to spike any time negative information filters into the global market. Traditional approaches that have been used to manage such risks include avoiding overconcentration of investments in one region, insurance, negotiation, having joint ventures with local people and hedging where exposure to risk is inevitable (Carr, 2012). Tse and William (2013) found that speculation in commodity index futures influence individual commodity prices but does not destabilize commodity prices. The distortion results from uniformed reaction to speculation in both index-linked and non-index linked commodities resulting in persistent price destabilization and even when highly informed traders enter the market in order to take advantage of the distortions, they are unable to stabilize the market and thus volatility will remain high.

The objective of the study was to determine the relationship between hedging commodity price risk exposure and the financial performance of manufacturing companies in Kenya

Research Hypotheses

Research hypotheses formulated for the study are,

Hypothesis 1: Hedging commodity price risk exposure does not have a significant relation with the earnings before interest and tax (EBIT) of manufacturing companies in Kenya.

Hypothesis 2: Hedging commodity price risk exposure does not have a significant relation with the return on assets (ROA) of manufacturing companies in Kenya.

2.0 Literature review

The research is based on Game theory. Game theory key proponents include John Von Neumann and Oscar Morgensern who in 1944 published a book in which they argued that standard economic theory on competitive markets may not be appropriate in situations involving small business entities and bilateral engagements and the more apt explanation is through the use of zero sum games where one entity gains while the other loses (lynch,

2011). Irrespective of whether the players act independently or in a group and given that there is more than one course of action, the outcome of the "game" is dependent on the interface of pursued strategies. This concept was further developed by John Nash resulting to the Nash equilibrium which has gained wide recognition and use in economics and finance (Musolino, 2012).

Game theory use in finance has focused on crafting winning trading strategies when dealing with shares, bonds mutual funds and derivatives. One school of thought argue derivatives and use of hedging in general provides zero sum pay offs given that the net loss in monetary gain is nil but it's not always that this position holds. A different school of thought sees the use of derivatives/hedging as extending beyond monetary compensation of an entity to creation of value through insurance value created and thus generating non-monetary wealth. Besides, it results in positive externalities such as price discovery and economic activity for various intermediaries (Musolino, 2012). Carfì and Musolino (2015) argue that entities can adopt cooperative stance when using derivatives/hedging to ensure both parties gain from any given transaction. They were able to prove that without cooperation the returns an entity attains will be fractal with an elusive point of convergence. Game theory has been adopted to guide the research on hedging commodity price risk exposure by manufacturing companies in Kenya as a key assumption is that companies know the quantity of materials they need to conduct their production activities and thus can hedge their positions (Carfì & Musolino, 2014).

Risk management has been evolving very fast and in line with this, various approaches have come up on how to manage risk. Ehrhart and Guerineaua (2013) point out one area which has shown significant growth is the use of commodity derivatives/hedging as an avenue to manage commodity risk. Derivatives/hedging have the desirable quality of ensuring that commodities can be traded as financial instruments and in the process reducing various risks key among them, price risk. Even though derivatives have been traded for centuries, the market for derivatives started to take proper shape in the 1970s. Currently, the world is moving towards establishing standards to govern derivatives trading due to the phenomenal growth that they have been experiencing. Bartram et al. (2011) in a study on the effects of

derivatives on firm value, they found that business entities that use financial derivatives/hedging are able to reduce cash flow risk, total risk and systematic risks to a large extent leading to lower cash flow volatility, idiosyncratic volatility and even systematic risk. Derivative use by business entities has been linked to the level of volatility that the entity faces and therefore an entity that faces higher risk will tend to use derivatives more in order to stabilize its financial performance.

Aj Janabi (2009) advances that with appropriate prediction tools such as modified Value-at-Risk, a commodity trading entity can be able to assess its risk exposure, assess risk reduction options besides setting up optimized risk limits. The researcher argues that when using modified Value-at-Risk you should be aware that the approach is sensitive to data used in developing the estimates, the duration of forecasting horizon, level of confidence and deviations from the assumed distributions. He further argues that out of the range of approaches used to identify, measure and control commodity risk, it's up to the risk manager to identify the best approach to use as there is no right or wrong approach to managing commodity risk. The guiding principles will be to establish sound risk management procedures, practices and policies and ensure consistency in their application in all business processes and activities.

However, despite the growth in the derivative markets, it has not been all smooth sailing as derivatives trading seems to be largely leaning in one direction besides the derivatives being misused by various business entities leading to greater cash flow problems or even the entities collapsing. Bartram et al. (2009) examined seven thousand two hundred and ninety two companies from forty eight different countries and found that out of the number sampled, 59.8% used derivatives. The most used derivatives were found to be foreign exchange derivatives at 43.6% while the least traded derivatives were commodity derivatives at 10%. The researchers found that non-financial firms operating in less developed markets and with equally less developed derivative markets are less likely to hedge but in instances where a firm hedges it results into positive valuation effects. In order to establish whether a firm is a derivative user, the researchers conducted manual and electronic searches in the annual reports of selected firms. Under univariate analysis, the researchers calculated the

means, medians and standard deviations for the control and explanatory variables both for the hedgers and non-hedgers while under multivariate analysis, they used LOGIT models focusing on the country and risk types. The conclusion was that hedgers both in the United States and internationally had higher dividend yields, higher leverage, income tax credit less tangible assets and lower acid test and current ratios.

Kozarević et al. (2014) found that the demand for derivatives is still low among the non-financial firms due to lack of understanding on the benefits of derivatives and the localized nature of operations of these firms. The study conducted in Bosnia and Herzegovina found that most of the derivatives are traded in the over the counter markets and the main players are the banking institutions which has hindered the development of the organized derivative markets. The researchers reviewed the use of derivatives among the small, medium and large companies and also considered the lines of operations classifying them as trading, production and service firms. They found that in the trading firms the level of derivative usage was the highest at 57.14%, followed by production firms 28.57% and service firms 14.29%. This is a clear indicator that despite financial derivatives being in use since the 1970s, uptake of commodity derivatives and their use among companies has been slow.

Approaches used to measure derivative usage vary depending mostly on the level of disclosure in financial statements. For entities which strictly adhere to IAS 39, disclosure of financial instruments it is appropriate to use the optimal hedge ratio. The common methodology adopted to estimate the optimal hedge ratio include ordinary least squares (OLS), error correction model (ECM), generalized autoregressive conditional heteroskadisticity (GARCH) each with varying levels of accuracy (Hatemi-J & Roca, 2010).

Murungi et al. (2014) found very low derivative use as 66.7% of the non-financial firms listed in the Nairobi Securities Exchange have never used any financial derivatives to hedge risks with the rest of the firms concentrating on forward contracts and swaps. On the contrary, the researchers found that these companies extensively used non-derivative hedging techniques such as sales being denominated in a stable currency, pricing strategies, delayed and advance payments and netting. Chanzu and Gekera (2014) attributed the low derivative

usage in Kenya to managerial skepticism, lack of a developed market difficulty in pricing and valuing of derivatives and costs associated with derivatives. Other limiting factors that have been identified include poor legal framework and the slow development of the financial markets (Ithai, 2013).

3.0 Research Methodology

The target population consisted of all manufacturing companies in Kenya from which a representative sample of two hundred and fifty-five companies was selected through stratified sampling from the key sectors as classified by the Kenya Association of Manufacturers (KAM). The researcher used finite population sample formula to determine the sample. The study used ten-year panel data given that this period was deemed to be adequate for an objective analysis.

Financial performance

Capkun et al. (2009) argue that EBIT is a superior measure of financial performance as it indicates how well a business entity is able to efficiently control cost of sales, production and operating expenses. To measure financial performance, the study used earnings before interest and tax scaled by sales as a proxy of financial performance where earnings before interests and taxes for entity *i* in year *t* while sales are total sales for entity *i* in year *t*,

$$EBITS_{i,t} = \frac{EBIT_{i,t}}{Sales_{i,t}} \quad \text{.....1}$$

Ravichandran et al. (2009) argue that ROA is an adequate measure to both internal and external users of financial information when evaluating the financial performance of a business entity. The ratio scales earnings before interest and tax by total assets where earnings before interests and taxes for entity *i* in year *t* and total assets for entity *i* in year *t*, as below;

$$ROA_{i,t} = \frac{EBIT_{i,t}}{Total\ assets_{i,t}} \quad \text{.....2}$$

Hedging Commodity Price Exposure

Jorge and Augusto (2011) found out that nonfinancial entities use of derivatives focus on hedging transactions rather than engaging in speculation in their risk management activities. A common measure of hedging is the optimal hedge ratio which may be largely applicable when a business entity is using financial derivatives (Hatemi-J & Roca, 2006). But given the fact that business entities rarely disclose their hedging costs in financial statements, Ayturk et al. (2016) asserted that derivative usage can be used as a proxy for hedging and measured use of derivatives using three variables namely, derivative use as a dummy variable with a value of one if an entity used derivatives and zero if otherwise, the extent of hedging measured by total value of derivative instruments scaled by total assets and a variable to measure hedging accounting based derivative use with a value of one if an entity reports use of derivatives in financial statements. Ali, Namusonge and Sakwa (2016) measured corporate hedging by using discrete variable of with a value of 1 if a company is a hedger and 0 if otherwise besides using control variables such as liquidity, firm size, managerial risk aversion and foreign exchange exposure. The study uses the two models below to measure commodity risk exposure:

Long run model;

$$EBITS_{i,t} = \beta_0 + \beta_1 ln(assets_{i,t}) + \beta_2 CFTA_{i,t} + \beta_3 TITS_{i,t} + \beta_4 QR_{i,t} + \alpha_i + \acute{\varepsilon}_{i,t} \quad \ldots\ldots 3$$

Dynamic model;

$$EBITS_{i,t} = \beta_0 + \gamma EBITS_{i,t-1} + \beta_1 ln(assets_{i,t}) + \beta_2 CFTA_{i,t} + \beta_3 TITS_{i,t} + \beta_4 QR_{i,t} + \alpha_i + \acute{\varepsilon}_{i,t} \quad \ldots\ldots 4$$

Long run model;

$$ROA_{i,t} = \beta_0 + \beta_1 ln(assets_{i,t}) + \beta_2 CFTA_{i,t} + \beta_3 TITS_{i,t} + \beta_4 QR_{i,t} + \alpha_i + \acute{\varepsilon}_{i,t} \quad \ldots\ldots 5$$

Dynamic model;

$$ROA_{i,t} = \beta_0 + \gamma ROA_{i,t-1} + \beta_1 ln(assets_{i,t}) + \beta_2 CFTA_{i,t} + \beta_3 TITS_{i,t} + \beta_4 QR_{i,t} + \alpha_i + \acute{\varepsilon}_{i,t} \quad \ldots\ldots 6$$

γ is the autoregressive parameter

y_{it-1} is the lagged dependent variable

x_{it} is the vector of independent variables

i 1,…….,49 (individual manufacturing companies)

t 1,2……10 (time indicator)

$EBITS_{i,t}$ and $ROA_{j,t}$ measures financial performance of entity *i* at time *t*, $EBITS_{i,t-1}$ and $ROA_{i;,t-1}$ measures performance of entity *i* at time *t-1*, ln($assets_{i,t}$), the natural log of total assets is included as a control variable to factor in the size of the company. $CFTA_{i,t}$ is the operating cash flow over total assets the understanding being that business entities with large operating cash flows are less likely to hedge as adequate cash flows will cushion them from price risks (Nguyen, 2011), $QR_{i,t}$ the quick ratio has a negative effect on use of derivatives/hedging (Bartam et al., 2009) while $TITS_{i,t}$ total inventory to total sales measures level of revenues from commodity operations and therefore the need to hedge commodity prices.

4.0 Results and Discussion

The researcher evaluated the financial statements of the manufacturing companies and none of them had disclosed use of derivatives or any other commodity price risk hedging measures which was not in line with accounting guidelines on disclosure on significant risks. The common disclosures were on credit and foreign exchange risk. Table 1 shows the overall mean, standard deviation, minimum and maximum values of EBITS, ROA, Lnassets, CFTA, TITS and QR respectively.

Table 1: Summary Statistics for the Secondary Data Set

Variable	Obs	Mean	Std. Dev.	Min	Max
EBITS	351	.0044579	.6390666	-7.2	.9114011
ROA	351	.0880766	.1417519	-.4799302	.6351296
Lnassets	351	7.872095	1.996836	1.6094	12.6033
CFTA	351	.0767929	.1088787	-.3063	.662
TITS	351	.2589504	5894807	.001	6.2946
QR	351	2.986199	6.709656	.0234	70.8889

EBITS has a mean of .0044579 and a standard deviation of .6390666 while ROA has a mean of .0880766 and a standard deviation of .1417519. This points to normal fluctuation in the key

measures of performance. A similar trend is observed in Lnassets, CFTA and TITS under which we still observe average fluctuations. QR has a mean of 2.986199 and a standard deviation of 6.709656 indicating a relatively higher dispersion from the mean but otherwise the data was normally distributed and therefore appropriate for subjecting to further analysis.

Table 2 Correlation for Commodity Risk Exposure and Financial Performance

	EBITS	**ROA**	**Lnassets**	**CFTA**	**TITS**	**QR**
EBITS	1.000					
ROA	0.5889	1.000				
	(0.0000)					
Lnassets	0.110	0.1828	1.000			
	(0.039)	(0.0006)				
CFTA	0.3691	0.6316	0.2411	1.000		
	(0.000)	(0.000)	(0.000)			
TITS	-0.5088	-0.2697	-0.1717	-0.2706	1.000	
	(0.000)	(0.000)	(0.001)	(0.000)		
QR	-0.2965	-0.1126	-0.1016	-0.1116	0.8201	1.0000
	0.0000	0.0350	0.0573	0.0367	0.0000	

Key: P-values in parenthesis

The researcher used pairwise correlation analysis to check for multicollinearity and the relationship between the various variables as illustrated in Table 2. Lnassets has a low and positive correlation both under EBITS and ROA, CFTA and TITS have relatively higher correlation under EBITS and ROA while QR has low and negative correlation. All the relationships evaluated are significant as can be observed from the corresponding p values. From the results above, it can be concluded that no multicollinearity exists among various variables.

Table 3 Estimated Coefficients of Commodity Price Risk Exposure and Financial Performance

	Random Effects	**Fixed Effects**	**GMM**	
Variables	**EBITS**	**ROA**	**EBITS**	**ROA**
$EBITS_{t-1}$	-	-	-0.0779 (-0.85)	-
ROA_{t-1}	-	-	-	0.263 (1.62)
Lnassets	0.00859 (0.36)	-0.0337* (-2.21)	0.0794 (0.70)	-0.0331 (-0.82)

CFTA	1.133 (1.71)	0.386*** (6.10)	1.514 (1.27)	0.306* (2.25)
TITS	-0.570*** (-5.08)	-0.0533 (-1.66)	-0.769*** (-3.36)	-0.0843* (-2.26)
QR	0.00635 (1.13)	0.00200 (1.18)	0.00304 (0.26)	0.00522 (1.63)
_cons	-0.0389 (-0.15)	0.332** (2.73)	-0.552 (-0.56)	0.310 (0.93)
Rho	0.7488	0.6505	-	-
Sargan test chi2(1)	-	-	29.56832 (0.7275)	34.70817 (0.4821)
F test	-	13.57 (0.000)		
Wald statistic	84.19*** (0.000)	-	16.58** (0.0054)	31.40*** (0.000)
Lm test Chibar2	182.32*** (0.000)	-	-	-
Hausman test	6.63 (0.1570)	30.46 (0.000)	-	-

KEY

Standard errors in parentheses

P-Value<0.01 ***

P-Value<0.05 **

P-Value<0.1 *

Under inferential analysis, a general linear model for panel data analysis was used. Appropriate specification tests were carried out. Hausman test was applied to determine whether to use fixed or random effect models. The researcher found that the random effect model was appropriate under EBITS while fixed effect model was suitable under ROA. Lm test was used to decide between a random effects regression and a simple OLS regression and from the results, the researcher concluded that the random effect model was the better model. Wald and F tests were used to evaluate the appropriateness of the random and fixed effect models and they were found to be okay.

Under EBITS random effect model, we observe insignificant relationships across all variables except for TITS. For TITS, the size of the generated coefficient indicates that a one unit increase in the assets reduces EBITS by 0.570 if any other related conditions are held constant. These findings contrast with those of Murungi et al. (2014) who found very low derivative usage by companies listed in the NSE and they argued that because commodity price risk exposure does not affect financial performance, the companies do not see any need to hedge associated risks.

Under the ROA fixed effect model, it is evident that the variables Lnassets and CFTA have a statistically significant effect on the financial performance of manufacturing companies. The size of the generated coefficient for Lnassets indicates that a one unit increase in the assets reduces EBITS by 0.0337 while CFTA will increase EBITS by 0.386 in the long run if any other related conditions are held constant. TITS and QR are statistically insignificant. Using the GMM estimation technique for robustness check, the researcher observed that the coefficients were not significantly different from the ones under the random and the fixed effect models confirming consistency of the measures. The results of the study concur with those of Kozarević et al. (2014) found that the demand for hedging is still low among the non-financial firms due to lack of understanding on the benefits of hedging and the localized nature of operations of these firms and not due to lack of exposure to commodity risk.

5.0 Conclusion and Recommendations

The study focused on hedging commodity price risk exposure and the financial performance of manufacturing companies in Kenya and was premised on the argument that manufacturing companies are large consumers of commodities and are thus exposed to significant commodity price risks. Therefore such business entities should be using appropriate risk management tactics to ensure their operations are not adversely affected by exposure to such risks.

From the results obtained, it was observed that manufacturing firms do not disclose any derivative usage in their financial statements but that doesn't negate the need to hedge commodity price risk. Under the EBITS model, it was observed that TITS which evaluated

commodity risk exposure in manufacturing entities based on total inventory to total sales to capture level of revenues from commodity operations and therefore the need to hedge commodity prices was statistically significant and points to the need to hedge commodity price risk in order to enhance financial performance.

Under the ROA model, it was observed that Lnassets and CFTA which evaluated commodity risk exposure in manufacturing entities based on operating cash flow over total assets with the understanding that business entities with large operating cash flows are less likely to hedge as adequate cash flows will cushion them from price risks were statistically significant and points to the need maintain adequate cash flows to hedge commodity price risk in order to enhance financial performance.

The researcher recommends that manufacturing firms in Kenya should take active commodity price risk hedging as it will result in better financial performance. The focus of the hedging efforts should be centered on variables that have significant impact on financial performance namely, TITS under the random effect model and Lnassets and CFTA under fixed effect model besides exploring more formal hedging techniques such as use of derivatives.

References

Al Janabi, M. (2009). Commodity price risk management: Valuation of large trading portfolios under adverse and illiquid market settings. *Journal of Derivatives & Hedge Funds*, *15*(1), 15–50.

Ali, A., Namusonge, S., & Sakwa, M. (2016). Determinants of corporate hedging in Kenya listed companies. *Journal of Business Management*, *2*(7), 65-80.

Ayturk, Y., Gurbuz, A. O., & Yanik, S. (2016). Corporate derivatives use and firm value: Evidence from Turkey. *Borsa Istanbul Review*, *16*(2), 108-120.

Bartram, S. M., Brown, G. W., & Fehle, F. R. (2009). International evidence on financial derivatives usage. *Financial management*, *38*(1), 185-206.

Bartram, S. M., Gregory, W., Brown, G. W., & Conrad, J. (2011). The effects of derivatives on firm risk and value. *Journal of Financial and Quantitative Analysis, 46*(4), 967-999.

Capkun, V., Hameri A., & Weiss L. (2009). On the relationship between inventory and financial performance in manufacturing companies. *International Journal of Operations & Production Management*, *29*(8), 789-806.

Carfì, D. & Musolino, F. (2015). A competitive-dynamical game model for currency markets stabilization. *AAPP | Atti della Accademia Peloritana dei Pericolanti Classe di Scienze Fisiche, Matematiche e Naturali*, *93*(1), C1.

Carfí, D., & Musolino, F. (2014). Speculative and hedging interaction model in oil and US dollar markets with financial transaction taxes. *Economic Modelling*, *37*, 306-319.

Carr, G. (2012). *Managing geopolitical risk in energy markets*, retrieved from http://www.risk.net/energy-risk/feature/2144307/managing-geopolitical-risk-energy-markets.

Chanzu, N., & Gekera, M. (2014). effects of use of derivatives on financial performance of companies listed in the Nairobi Security Exchange. *International Journal of Academic Research in Accounting, Finance and Management Sciences*. *4*(4), 27–43.

Clarvis, M., Halle, M., Mulder, I., & Yarime, M. (2014). Towards a new framework to account for environmental risk in sovereign credit risk analysis, *Journal of Sustainable Finance & Investment*, *4*(2), 147-160.

Ehrhart, H., & Guerineau, S. (2013). *Commodity price volatility and tax revenues: Evidence from developing countries*. Etudes et Documents, E 2011.31, CERDI.

German, H. (2009). *Commodities and Commodity Derivatives: Pricing and Modeling Agricultural, Metals and Energy*. USA: John Wiley & Sons.

Hatemi-J, A., & Roca, E. (2010). *Estimating Optimal Hedge Ratio with Unknown Structural Breaks.* Discussion papers, finance.

Ithai, J. K. (2013). Factors leading to slow adoption of derivatives use in Kenya: A case study of commercial banks in Kenya. *International Journal of Social Sciences and Entrepreneurship, 1*(3), 454-468.

Jorge, M. J. D. S., & Augusto, M. A. G. (2011). Financial risk exposures and risk management: evidence from European nonfinancial firms. *RAM. Revista de Administração Mackenzie*, *12*(5), 65-97.

Kozarevic, E., Jukan, M. K., & Civic, B. (2014). The use of financial derivatives in emerging market economies: An empirical evidence from Bosnia and Herzegovina's Non-Financial Firms. *Research in World Economy 5*(1), 39-48.

Lynch, T. (2012). Derivatives: A twenty-first century understanding. *Loyola University Chicago Law Journal*, *43*, 1-14.

Martin, C., Carlos M., Omera K., & Oznur Y. (2011). Approaches to managing global sourcing risk, *Supply Chain Management: An International Journal, 16*(2), 67-81.

Murungi, C. M., Murage, K. & Wanjau, K. (2014). Challenges facing nonfinancial firms in hedging financial risks using derivatives. *International Journal of Social Sciences and Entrepreneurship, 1*(10), 361-374.

Musolino, F. (2012). Game theory for speculative derivatives: A possible stabilizing regulatory model. *Atti della Accademia Peloritana dei Pericolanti, Classe di Scienze Fisiche, Matematiche e Naturali*, *90*(1), 99-107.

Nguyen, H. V. (2011). Why do non-financial firms select one type of derivatives over others? *Journal of Applied Business and Economics*, *12*(3), 91-109.

Oum, Y., & Oren, S. (2010). Optimal static hedging of volumetric risk in a competitive wholesale electricity market. *Decision Analysis, 7*(1), 107-122.

Pirrong, C. (2014). *The economics of commodity trading firms*, Bauer College of Business, University of Houston, White paper.

Ravichandran, T., Yu Liu, Shu, H., & Iftekhar, H. (2009). Diversification and firm performance: Exploring the moderating effects of information technology spending. *Journal of Management Information Systems*, *25*(4), 205-240.

Tse, Y., & William, M. (2013). Does index speculation impact commodity prices? An intraday futures analysis, *Financial Review, 48*(3), 365–383.