

An empirical analysis of the impact of crude oil spot and futures prices volatility on the development of African equity markets

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Abstract: This study focused on the impact of crude oil, crude palm oil spot and futures of prices on African equity markets. It draws on daily data from January 2000 till July 2013, obtained from Bloomberg. The study employed Vector Error Correction (VEC). Findings from the econometric analysis show that there is relativity in the speed of adjustment among such countries' equity market index as Mauritius, whose economic backbone is tourism, which responded faster compared with other ' equity markets. Kenya's equity market index responded positively relative to those of Morocco and Nigeria, while South Africa's equity market responded slowly, unlike other equity markets. The implication of Morocco and Nigeria's equity markets adjusting slowly to the shock from crude oil market crisis was due to a high dependence of the governments of both countries on crude

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oil revenues in financing their economic activities. The study shows the existence of a long-term relation between crude oil, crude palm oil spot and futures prices on equity markets. The VECM Granger causality test was applied to examine the association and impact among these variables. The results indicate that crude oil spot and futures price granger influence the equity markets of Mauritius, Kenya and Morocco, while futures prices of crude oil granger impact Nigeria's and South Africa's equity markets.

Keywords: crude oil, volatility, equity markets, revenue

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1. Introduction

Commodity product such as crude oil is a special and lucrative resource endowment that contributes to the economic progress of an economy, where such natural resource is optimally utilized. These natural resources have contributed to the Gross Domestic Product (GDP) of a number of countries, including Nigeria, Ghana and other African nations, on the one hand, and their Asian counterparts such as: Vietnam, Indonesia, Thailand, on the other one.

Despite the attributes of these commodities, they are much susceptible to price volatility.¹ The volatility in price of these commodities has been documented by various researchers (*see: Hamilton 1989*) to have a negative or positive impact on the macro-economy variable of various countries. Fluctuations in these commodity prices pose a real obstacle to many economies, such as United State and Japan and as well expose importers and exporters to a greater risk in handling the commodities as a result of epileptic nature of their prices. Sadorsky (1999) asserted that commodity price, especially oil prices, pressurizes a country's economy, which has been confirmed to be true by other researchers. Though, the importance of crude oil to any nation's economic development can never be underestimated, its price volatility has left nothing but chaos in so many countries' economies. The first pioneer study on an oil crisis, conducted by Burbrigde et al (1984), found that the GDPs of such countries as United States of America, Great Britain, Japan, Canada and Germany are affected by the oil price volatility.

The objective of this paper is to contribute to the existing literature on equity market, as it is affected by changes in prices of crude oil in the context of African Economy known as

¹ By volatility, we mean the measure of dispersion statistically; dispersion in prices can later have an influence on asset price, currency exchange and market index ,whereby it could be concluded that volatility is the quantity change in risk of asset valve. This could be on a high or low level of volatility.

a frontier market. Despite various studies documented by various authors, only few can be said to deal with Africa's economy. This study bridges the vacuum to consider crude oil spot and its futures prices; moreover, in this study we have focused on Africa's economy based on regional market which will enhance potential investors, market regulators and other market participants to have a clearer picture of how to diversify their portfolio risk. The remaining study is organized as follows: Section 2 is devoted to the exploration of the literature of the subject to date, Section 3 and 4 discuss the data and methodology adopted in the study, Section 5 highlights empirical results, while Section 6 offers relevant conclusions.

2. Literature review

Oil prices movements have been of a great interest to researchers for over five decades, likewise has investigation on equity market reaction to price of oil changes. In this present study, the effect of crude oil impact on equity market will be investigated and this section of the literature review focuses on earlier scholars' studies in term of their objectives, adopted methodology and findings.

Onour et al (2012), in their study, investigated the question whether crude oil price has an impact on shaping the dynamic nature of stock market for oil exporting countries (Kuwait, Saudi Arabia, Dubai and UAE) and if there is any cyclical correlation between stock price and oil price. They conducted their study by using a weekly data for both Brent crude oil price and equity market of each respective countries. Autoregressive Distributed Lag (ADRL) approach was adopted and it was found that there is a cyclical relationship between oil price movement and equity market. When oil price is below \$40 per barrel, stock market moves in a favorable position to investors, but when oil price per barrel is above \$72, there is no cyclical relationship between the two assets.

Ravichandran (2010) investigated the oil price impact on the Gulf Cooperation Council countries' (GCC) equity market. Daily data on the stock market price indices and New York Mercantile Exchange (NYMEX) oil price for the period of 3 years was adopted. Generalized Autoregressive Conditional Heteroscedasticity (GARCH-M) approach was used to examine the stated objective and documented that in the long run oil price movement affect the GCC equity market, i.e. it influences the profitability of firms operating in the GCC market and its effect in the short term, except Kuwait and Bahrain, are speculative markets which are dominated by the impact of non-predictable speculative effect move together in adverse direction in predicting stock prices. These findings were different to the

those by Onour (2012), even though, the authors included two more samples to their analysis. This disparity could occur because of a difference in the data and methodology used, as well as the fact that Kuwait's and Bahrain's equity markets are illiquid compared to those of Saudi Arabia, UAE, Qatar. Bashar's (2006) findings supported this research and summarized that Saudi & Muscat oil price increase have predictive power on their equity market as supported by Wassal (2005), though Asia, Africa and Latin America were considered with the use of Vector Auto-Regressive (VAR) and co-integration techniques to conduct their studies.

Rahman (2012) addressed issues on asymmetric information by determining the effect of Malaysia crude oil futures prices movement effect on stock, export and production. Monthly data on spot price for crude palm oil and closing stock, production export in terms of volume were obtained from Malaysia palm oil Board for the period between 1998 and 2010. The vector error correction model was used to test the causal relationship and it was documented that, based on the asymmetric effect, any news of changes in crude palm oil affect production, equity and export variables.

El et al. (2012) examined long run connection between oil price and equity market in (GCC) including Bahrain, Kuwait, Oman, Qatar, UAE and Saudi Arabia. Monthly data within 1996 to 2007 were obtained from the Arab Monetary Fund (AMF) database, Organization of the Petroleum Exporting Countries (OPEC) spot price was used as proxy for oil and GCC equity market indices were adopted. Bootstrap panel co-integration and seeming unrelated regression (SUR) methods were applied by the authors who documented that SUR estimates identify increases in oil price and have a positive influence on equity market except for Saudi Arabia. Bootstrap panel co-integration test stipulated that there is a long-run relationship between the variables. Their findings using SUR contradicted the findings of Onour (2012), Ravichandran (2010) when they documented that Saudi Arabia equity market is influenced positively by changes in oil price.

Narayan and Narayan (2010) focused on Vietnam's equity market as related to oil prices. Their objective was to model the effect of oil price on Vietnam equity price. The study covered the period between 2000 and 2008, using a daily data on two stock markets namely, Ho Chin Minh City securities trading centre (HSTC) and Hanoi securities trading centre (HASTC), nominal exchange rate, and WTI spot price index obtained from Bloomberg database. The authors summarized that the oil price, stock price and exchange rate are in a long-term relation and found that oil price and exchange rate have a statistically significant positive impact on equity market in the long run. In a short-run estimate, it was discovered

that none of the variables influenced the equity return during the period of the study. However, the authors acknowledge that the results do not support theoretical expectation due to the fact that different factors contribute to Vietnam's equity market boom during a period when oil price increases rapidly.

Mohanty et al. (2010) investigated the relation between volatility in oil price and stock return in the oil and gas industry level and firm level in Central and Eastern European CEE (Czech Republic, Hungary, Poland, Romania, Slovenia and Austria). Monthly data on West Texas Intermediate (WTI) return from December 1998 to March 2010 on all the countries equity prices in CEE region were drawn from DataStream. The two-factor model was used to estimate the relation between oil price and stock return, while SUR was used to analyze the relative sensitivity of stock return to macroeconomic risk factors. They noted that market sensitivity representation (β_m) is positive and statistically significant for all countries except Romania's oil and gas companies, but significant at 5% level of significance, while others at 1% level. It was concluded that companies in CEE are significantly exposed to oil price increases. Boyer and Filion's (2007) study is supported by the work of the researchers.

Fayyad and Daly (2011) contributed to earlier studies on GCC countries by focusing on seven countries, out of which the UK and the USA were inclusive for comparison, while the other countries were Kuwait, Oman, UAE, Bahrain, Qatar. Their primary objective was to empirically examine the long-run relation between oil price and stock market return. Daily weighted equity market indices from September 2005 to February 2010 were taken into consideration for the seven countries and data concerning Brent oil spot prices, which were obtained from MSCI and energy information administration, were used in that study.

VAR was used for analyzing the impact of random series data. The authors divided the period into 3 sub-periods, i.e. the period when the oil price was constant (between 2005-2006), the second period, when there was a rise in the oil price in 2006-2008 and, finally – the global financial crisis period between 2008-2010. They documented that during the first period, no significant relation existed between the commodities while a significant relation did exist between the variables in the second period, i.e. stock market influences and could be predicted by oil price in the remaining countries except United Arab Emirate & Bahrain. During this period a direct relation existed between commodities in GCC countries and two-directional relation was noted between Kuwait, Oman, USA, Qatar equity market. While during the financial crisis changes in oil price could be used to predict the equity market in 5 countries, except (Kuwait, Bahrain).

Arouri et al. (2011) investigated the return and volatility spillover between equity market and oil in the (GCC). They conducted their study using daily data of MSCI equity index and spot price from 2005 to 2010 obtained from Energy Information Administration (EIA); the vector autoregressive generalized autoregressive conditional heteroscedasticity (VAR GARCH) model was adopted because it enables joint conditional returns, volatility and correlation between oil price and equity market in the model. They found that 3 countries out of the 6 were significantly affected by lagged oil return on their equity market (Bahrain, Qatar, Oman), while it proved negatively significant for Bahrain; impact of oil market was positive for Qatar and Oman. S.K. Mohanty et al. (2011), in their research on GCC countries, focused on oil price movement and equity market return. They based their study on both industrial and country level by using weekly data within the period of June 2005 to December 2009 on equity indices in GCC countries obtained from Thomson DataStream database. The industries in each country vary across and West Texas Intermediate (WTI) was used as proxy for oil price. Linear factoring pricing model was used to estimate the impact of oil changes on equity market and they found that equity market reacted positively to changes in the oil price in four out of six countries (Oman, UAE, Qatar, Saudi Arabia), but Bahrain equity market reaction was weakly positive to the oil price and no relationship existed for Kuwait equity market and the oil price.

Various authors have also found contrary findings. For instance, Papapetrou (2001) applied the vector error correction model to examine the effect of oil price on equity return in Greece, using monthly data collected between January 1989 and June 1996. It was documented that oil price had a negative impact on the stock return for the first four months, based on the variance decomposition analysis. This result was supported by the work of Sadorsky (1999) who proved that oil price changes had a negative effect on the US equity market. Monthly data were used for that study. Likewise, Jones et al (1996) documented that equity market reacts negatively to changes in oil prices.

Cologni and Manera (2009), in their study, examined how oil price shocks influence the growth rate of output of a subset of developed countries by using differentiating alternative regime switching models. Various Markov–Switching (MS) regime autoregressive models were estimated. Univariate MS models are extended in order to observe if the inclusion of asymmetric oil shocks as an independent variable improves the ability of each specification to identify the different phases of the business cycle for each country under

study. Quarterly data for the period 1970Q1–2005Q1 were used to calculate roil.² Zhang (2008) reported that there is no linear relationship between financial market and economic activity in relation to oil price movement in G-7 and Japan while Using Quarterly data which was obtained from international financial statistics from 1957Q1 to 2006Q4.

Toraman et al. (2011), in their study on Istanbul exchange market, investigated if oil price positively or negatively affects market return on ISE100 composite index, technology index, industrial index and service index. Daily data for respective indexes were used and Brent oil price for each market from 2009 to 2011 was used and the Vector Error Correction Model (VECM) was adopted. It was documented that a long-term relation between oil price movement and market indices exists and noted that movements in oil prices affect Istanbul equity market, especially ISE 100 index. They noted that investors should consider oil price when considering ISE index, because Istanbul index was heavily and negatively affected by crude oil prices changes.

Lee et al (2011), in their study, concluded that there exist a negative relation between oil price rise and equity market. Daily data for the period of 1992-2008 were used in their research. In turn, Apergis & Miller (2009), in their study on 8 countries (Australia, France, Canada, Germany, Italy, Japan, UK and USA), contributed to earlier scholars' findings and asserted that changes in oil price negatively affect the return of each equity market. VECM was used to test oil price changes, taking 3 periods into consideration for oil price supply shock, global aggregate-demand shocks and global oil demand shock.

Wang et al. (2013), studied the impact of oil price shocks on equity market return by categorizing the countries into importing and exporting countries, using data on 16 countries. Monthly data for the period between January 1999 and December 2011 on equity market and West Texas Intermediate (WTI) were obtained from the data stream and energy information administration was used as proxy. VAR model was adopted, which assumes that both variables are linearly related. In order to ensure stability of the model, non-linearity test was conducted and there was found no significant nonlinear relation causality for oil price change and market returns in the majority of the countries. Structural VAR model as introduced by Kilian et al. (2009) was used to examine the reaction of equity market to oil price changes. The result of their findings indicated that though significant reaction is not found in several situations which are attributed to the insignificant effect of oil supply changes on oil prices.

² Each country's real price of oil (roil) is obtained by multiplying the nominal oil price (average crude oil price) quoted in U.S. dollars by the nominal exchange rate deflating it by using the Consumer Price Index (CPI). Null hypothesis of linearity against the alternative of a MS specification is rejected.

Positive aggregate and precautionary demand shocks are shown to result in a higher degree of relationship among the stock markets in oil-exporting countries, but no relation exists among oil-importing countries and this implies there is a positive relation between the oil price and the equity market in oil exporting countries, while a negative one is typical of oil importing countries.

3. Data and methodology

This section of the study entails the methodology and data used for the purpose of this research. Daily data for West Texas Sour is the proxy used for Crude Oil spot and futures prices, while Morgan Stanley composite index (MSCI) for respective countries namely (Kenya, Mauritius, Morocco, Nigeria and South Africa) is proxy used to measure frontier equity market from 18 September 2003 to 31 July 2013 for respective data as obtained from Bloomberg database. West Texas sour is adopted as proxy for crude oil, because it is widely traded compared to other proxies and, in addition, it is widely used by firms to hedge both in Africa, Europe and South America. Not limited to this, Morgan Stanley composite index is adopted because 99% of portfolio managers used the proxy as benchmark for portfolio evaluation.

4. Methodology

This facet entails sequential empirical steps adopted to achieve the objective of this study. The first step involves subjecting series data to a unit root test by employing Augmented Dickey fuller and Phillip-Peron test, followed by Johansen co-integration test to establish the long run association between the data. The third test involves the vector error correction model which is used to capture both long and short-term relation between data and disclose how fast the dependent variable (Equity Index) returns to equilibrium, following shocks resulting from independent variables (Crude oil spot and futures prices) and lastly, Granger causality test was used to examine the uni-directional effect of crude oil on the equity market.

4.1. Unit root analysis

In this study, unit root test was conducted by adopting Augmented Dickey Fuller (ADF) test to investigate order of integration among series data. ADF test comprises three models as shown in the equation below:

$$\Delta y_t = \gamma y_{t-1} + \sum_{i=1}^p \beta_i \Delta y_{t-i} + \mu_t \quad (1)$$

$$\Delta y_t = \alpha_0 + \gamma y_{t-1} + \sum_{i=1}^p \beta_i \Delta y_{t-i} + \mu_t \quad (2)$$

$$\Delta y_t = \alpha_0 + \gamma y_{t-1} + \alpha_2 t + \sum_{i=1}^p \beta_i \Delta y_{t-i} + \mu_t \quad (3)$$

The three models presented above are not similar because of the deterministic component α_0 and $\alpha_2 t$. Lagged difference (y) is employed to ensure disturbance term is a white noise; optimum lags selection is based on Akaike Information Criterion (AIC) (see: Engle (1987)). The Null hypothesis ($H_0: \phi = 1$) should be accepted if a variable has a unit root, as disclosed by ADF analysis, i.e. if the ADF critical value is greater than the ADF test statistics.

4.2. Johansen co-integration test

Long-term relation between equity market index and crude oil spot and futures prices was examined by adopting Johansen co-integration test. A pre-requisite before using this model is that time series data should be stationary at the same order of integration (Gujarati 2010). Seiler (2004) reported that series data are co-integrated if the same order of integration exists between the variables. As noted by Alexakis et al (2015:7), for two series X_t , and Y_t , a long-term relationship can be observed if:

$$\begin{aligned} X_t, Y_t &\sim I(1) \\ Z_t &= X_t - \alpha Y_t \\ Z_t &\sim I(0) \end{aligned}$$

Where α is the co-integrating parameter whose magnitude indicates the co-integrating speed.

4.3. Vector error correction model

Following the advent of VAR model, a decade later VECM was developed, which was a more restricted version of the VAR, with the introduction of a new error correction element. The correction of the existing disequilibrium that results from an unexpected shock in the analysis is the mean idea of the error correcting term. VECM also enables a dynamic relation that exists in the model in which more than time series data is involved to be summarized in

support of the earlier method of VAR. This enables long- and short-term correlations of multiple variables to be summarized. The model is represented in the equation below:

$$EMI_{ij,t} = \beta_0 + \sum_{q=0}^m \eta_q COILSP_{i,t-q-1} + \sum_{q=0}^m \theta_q COILFP_{t-q} + \delta \varepsilon_{t-1} + \mu_t$$

Based on the above equation, ε_{t-1} represents one period lagged error correction term, m represents the lag length, whose selection is based on Akaike Information Criterion (AIC). The significance of this model is the ability to identify both long- and short-term relations between crude oil spot and futures prices and Equity market index, where EMI represents the market closing price for the respective equity index, while COILP and CPOLP represent crude oil spot and futures price for West Texas sour.

4.4. Granger causality

The empirical analysis should continue further, based on co-integration framework in as much as a co-integrating relation between variables is established. The traditional Granger causality test originated from the VAR framework and the fulfillment of stationary condition can be ascertained. Brooks (2000) noted that Granger Causality test shows that variables in the model have a significant and statistical influence on the future value of variable in the model. Since, there exists a relation, our task is to proceed by testing VEC Granger Causality/Block Exogeneity Wald Test to determine if an endogenous variable can be used as an exogenous variable, based on its properties to be detected by this test. The following model relies on Granger causality equation:

$$\Delta X_t = \alpha_0 + \sum_{i=1}^p \beta_{xi} \Delta X_{t-i} + \sum_{i=1}^p \beta_{yi} \Delta Y_{t-i} + \varepsilon_t$$

The null hypothesis (H0) is established that X does not cause Y and vice versa, as otherwise stated for alternate hypothesis (H1). The alternate hypothesis should not be rejected if the coefficient of β_{yi} is statistically significant, established on F test.

5. Analysis

5.1. Unit root analysis

Table 1 (see Appendix) discloses an analysis of unit root test; it is discovered that all variables are stationary at first difference and it which can be concluded that series data are in

integration of order one. Based on the above table, it is established by ADF test that at level, series data for equity market index and Crude oil spot and futures prices are not stationary as supported by PP test; however, subjecting the data to first difference, it was later established that all series data are stationary at first difference which is supported based by PP test as established by ADF test. Therefore, it can be concluded that all series data are in order of integration one. Hence, a long-term relation test can be investigated.

5.2. Johansen co-integration analysis

The essence of the above test is to establish the long-term association between crude oil price and equity market index for selected Africa's markets. The pre-condition for this test was fulfilled by the unit root test since all variables are in integration of same order, therefore, Johansen test could be conducted. The null hypothesis of Johansen test depicts that there are no long-run relations between equity market index and crude oil spot and futures prices for trace statistics and max-eigen value test statistic. However, based on the analysis, it can be concluded that a long-term relation between spot and future crude oil price and selected equity market index exist, since trace and max-eigen test statistics are greater than the critical value. Thus the implication is that both crude oil and equity market indexes for selected African countries tend in a similar direction; this can be summarized that there is a rise in crude oil price, which leads to a rise in equity market return for all the selected African countries in question and vice versa (see: Table 2 in Appendix).

5.3. Vector error correction model

Based on the above co-integration analysis, which is a pre-condition for VECM that at least, one co-integrating equation must exist among a series. Since the condition was satisfied, VEC model can be estimated and used in report on the VEC model analysis (see: Table 3 in Appendix).

The above-mentioned table provides an analysis of the VEC model estimated; however, the essence of the analysis is to examine the speed of adjustment of each selected country equity market from shock arising in the crude oil market. Based on the analysis, there is relativity in the speed of adjustment among the countries equity market index; however, Mauritius equity market index responds faster compared to other countries' equity markets; this is a result of the fact that the countries' backbone is tourism. Kenya's equity market index responds faster compared to that of Morocco and Nigeria, while South Africa's equity market

responds slower compared to the remaining equity markets. The implication of Morocco and Nigeria equity market adjusting slowly to shock from crude oil market is due to the high dependence of the country's economy on crude oil revenue in financing its economic activities by the government.

5.4. Granger causality analysis

The pairwise Granger causality test was examined to investigate the uni-directional causality of crude oil shock to equity market index. Based on the analysis as reported in Table 4, it can be concluded that the past price of crude oil spot and futures prices determine the future performance of Kenya, Mauritius and Morocco equity market index. However, the past futures price of crude oil only determines the future of Nigeria's and South Africa's equity market indexes, while the spot price fails (see: Table 4 in Appendix).

6. Conclusion

This study examined the impact of crude and palm oil spot and futures price on equity market of five African countries. The selected countries are frontier economies, because their equity market is still developing, coupled with their sensitivity to the international market and regional political challenges. From the analysis, long-term relation was established to exist between crude oil spot and futures prices in South Africa, Morocco, Mauritius, Nigeria and Kenya's equity markets. In addition to this finding, the sensitivity of each market to shocks from crude oil market is relative. This finding should be of interests to investors, researchers, market regulators within and outside Africa. It is suggested that the selected countries should diversify their economies into other areas in order to restructure their productive base and minimize the incidence of shocks from oil price volatility.

This study provides honor for further expansion in this research area; foremost, other commodities, such as soya oil, rubber, golf should be considered. What is more, various international events which took place within the examined period, among others, political and economic instability among African countries and the global financial crisis of 2007/2008 could have affected our variables in the study, leading to imprecise results. In addition, various countries policies like public holidays or non-trading days may also influence our findings. Therefore, it is advisable that a period in which the global market is not confronted with challenges should be considered for future research.

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ANALIZA EMPIRYCZNA WPLYWU KRYZYSU WYDOBYCIA ROPY NAFTOWEJ I NIESTABILNOŚCI CEN TERMINOWYCH NA ROZWÓJ RYNKÓW AKCJI W KRAJACH AFRYKI

Streszczenie

Praca niniejsza skupia się na wpływie jaki mają kryzys wydobycia ropy naftowej, produkcji surowego oleju palmowego oraz niestabilność cen terminowych na rynki akcji krajów afrykańskich. Autorzy analizują dane za okres od stycznia 2000 do lipca 2013, które były publikowane przez agencję Bloomberg. Wykorzystują model wektorowej korekcji błędów (VEC). Wyniki analizy ekonometrycznej wskazują, że występuje pewien związek między tempem dostosowania się wśród rynków akcji takich krajów jak Mauritius, którego podstawą gospodarki jest turystyka, i który to rynek zareagował szybciej w porównaniu z rynkami akcji innych krajów. Wskaźnik rynku akcji w Kenii kształtował się dodatnio w porównaniu z tymi w Maroko i Nigerii, podczas gdy rynek akcji w Afryce Południowej reagował wolniej, nie tak jak inne rynki akcji. Skutki wynikające dla rynków akcji w Maroko i Nigerii, które przystosowywały się wolniej do kryzysu jaki wstrząsnął rynkiem ropy, wynikały z dużego uzależnienia finansowania działalności gospodarczej od dochodów pochodzących z wydobycia ropy naftowej, jakie przyjęły rządy obu tych krajów. Badanie pokazuje istnienie długookresowego wpływu jaki wywierają niestabilny rynek wydobycia ropy naftowej, rynek surowego oleju palmowego i cen terminowych na rynki akcji. Zastosowano test VECM przyczynowości Grangera w celu zbadania związku i wpływu między tymi zmiennymi. Wyniki wskazują, że kryzys na rynku ropy naftowej oraz ceny terminowe mierzone testem Grangera wpływają na rynek akcji krajów takich jak Mauritius, Kenia i Maroko, a terminowe ceny ropy naftowej mierzone testem Grangera wpływają na rynki akcji Nigerii oraz Afryki Południowej.

Słowa kluczowe: ropa naftowa, ceny terminowe, niestabilność cen, rynki akcji, przychody

kody JEL: 013, Q48, N27, L29

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Appendix

Table 1. Unit root analysis

	LEVEL				FIRST DIFFERENCE			
	ADF		PP		ADF		PP	
	I	I&T	I	I&T	I	I&T	I	I&T
FP	-2.1364	-2.5788	-2.1368	-2.5842	-53.4872 ^a	-53.4806 ^a	-53.5094 ^a	-53.5031 ^a
SP	-2.2722	-2.9112	-2.1683	-2.7395	-51.1608 ^a	-51.1536 ^a	-51.3040 ^a	-51.2979 ^a
MSCIKEN	-1.5872	-1.8544	-1.4438	-1.6893	-37.2366 ^a	-37.2299 ^a	-36.9668 ^a	-36.9595 ^a
MSCIMAU	-1.4093	-1.3600	-1.4431	-1.4867	-46.2852 ^a	-46.2852 ^a	-46.7908 ^a	-46.7837 ^a
MSCIMO	-1.5239	-0.7934	-1.4721	-0.6455	-43.0566 ^a	-43.1214 ^a	-42.6487 ^a	-42.6754 ^a
MSCING	-1.5542	-1.5404	-1.4228	-1.4058	-32.3227 ^a	-32.3248 ^a	-31.3725 ^a	-31.3638 ^a
MSCISA	-2.2157	-2.8967	-2.1001	-2.6893	-50.0582 ^a	-50.0548 ^a	-50.3959 ^a	-50.4030 ^a

Note: Parenthesis ^a indicates significant level at 1%.

Table 2. Johansen co-integration analysis

VARIABLE	NULL	TRACE		MAX ENG	
	HYPOTHESIS	T-STA	C.V	T-STA	C.V
MSCIKEN	None *	124.8706	29.7971	110.1089	21.1316
	At most 1 *	14.7617	15.4947	8.7626	14.2646
	At most 2 *	5.9991	3.8415	5.9991	3.8415
MSCIMAU	None *	148.5782	29.7971	118.3268	21.1316
	At most 1	30.2514	15.4947	26.5115	14.2646
	At most 2	3.7399	3.8415	3.7399	3.8415
MSCIMO	None *	134.6124	29.7971	116.1048	21.1316
	At most 1 *	18.5076	15.4947	13.3357	14.2646
	At most 2 *	5.1718	3.8415	5.1718	3.8415
MSCINIG	None *	127.8110	29.7971	118.0128	21.1316
	At most 1	9.7982	15.4947	6.3378	14.2646
	At most 2	3.4604	3.8415	3.4604	3.8415
MSCISA	None *	129.8676	29.7971	110.9144	21.1316
	At most 1	18.9531	15.4947	15.0008	14.2646
	At most 2	3.9523	3.8415	3.9523	3.8415

Table 3. Vector error correction model

	MSCIKEN	MSCIMAU	MSCIMO	MSCINIG	MSCISA
ECT	-0.0483	-0.0514	-0.0482	-0.0481	-0.0452

Table 4. VECM pairwise Granger causality analysis

	VARIABLES	F-STAT	PROB
MSCIKEN	SP	3.5319	0.0294
	FP	3.5560	0.0287
MSCIMAU	SP	12.3022	0.0000
	FP	12.0684	0.0000
MSCIMO	SP	5.0413	0.0065
	FP	6.4160	0.0017
MSCINIG	SP	1.0043	0.3664
	FP	3.1252	0.0441
MSCISA	SP	2.2295	0.1078
	FP	3.0894	0.0457