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Economic forces and equity market returns in Ghana: symmetric dependence with quantile regressions

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Abstract

In this paper, we model the dependence structure between economic forces and stock market returns in Ghana. Quantile regressions are employed to examine the relationships between exchange rates, consumer prices, Treasury bill rate and money supply; and commodity prices such as gold, cocoa, and crude oil, on one hand, and returns on the Ghana stock market on the other hand from January 1992 to June 2015. Our results generally show dependence of the equity market returns on all economic variables in the period before oil production in Ghana. However, variations exist in the post oil production period. The results further demonstrate how equity investors in Ghana can take advantage of gold as a safe-haven to diversify most downside risk in turbulent periods of the market.

Key words: Ghana, equity returns, crude oil, symmetric dependence, volatility clustering.
JEL classification: G1; G11; E44

1. Introduction

Already, several studies abound on the nexus between macro-economic fundamentals and stock returns in Ghana (see for example, Adjasi and Biekpe, 2005; Abugri, 2008; Frimpong, 2009; Adu *et al*., 2013; and Kuwornu, 2012). However, Ghana's recent discovery of crude oil in commercial quantities followed by oil production in

2010[1], and the recent plunge in prices of Gold (example in April 2013), oil (example early 2014), and cocoa have called for a renewed interest in the investigation of the impact of economic factors on the growth prospects of the country's financial sector. As the second largest producer of high quality cocoa beans in the world and the second largest producer of gold in Africa, much is expected of these commodities to influence the financial health of Ghana's economy. In his paper on 'oil and urban development in Ghana', Obeng-Odoom (2009) gives a vivid account on what was to be expected from Ghana's newly discovered 'black gold' - crude oil. At the initial stage in 2010, about 600,000 barrels of oil were expected to be drilled in a day; 120,000 barrels a day in 2011; and thenceforth, over 200,000 barrels a day (Obeng-Odoom, 2009). It was estimated that revenue from the oil production will amount to about $836 million annually and $20 billion over the production period 2012-2030 from offshore deposits (Duffour, 2009).

Although Ghana has crude oil deposits in commercial quantities, it still purchases crude oil at the world market price and therefore unsheltered from the effects of international price fluctuations. The effects of this are the tolls on national budget and the current account components of balance of payments. On the expenditure side, Ghana's import bills have ballooned from US$520 million in 2000 to US$3,330.2 million in 2012, and a matching 2012 non-oil imports bill of US$14,432.6 million.[2] Despite calls by policy analysts for full-cost recovery, successive governments have always used cross-subsidization of crude oil in Ghana (Adu *et al.,* 2013). The main financing modes of the subsidy by government has been domestic borrowing through increased treasury securities rates and direct borrowing from public financial institutions. The concomitant effects of this are the crowding-out of private businesses, and a corollary slump in the stock market performance. In spite of the obvious challenges, Ghanaians are anticipatory of significant economic and financial gains from the production of crude oil.

Despite the strong presumptions that a high performing Ghanaian economy in the midst of oil production will significantly impact its financial sector through the stock market, not much attention has been given to this area of research in recent times. Few studies have been conducted on the relationship between the growth of the Ghana equity market and economic variables in the post oil-production era; and in most of these studies (see for example Haruna *et al.,* 2013; Muazu and Alhassan, 2014) results vary and are inconclusive. For instance, Nantwi and Kuwornu (2011) reveal

[1] *Ghana discovered oil in commercial quantities in 2007 and started production in the last quarter of 2010. For details on the history of Ghana's oil find and productions visit the African Business Magazine website on* www.africanbusinessmagazine.com

[2] *Figures are gleaned from the Institute of Statistical, Social, and Economic Research, Legon-Ghana (*http://isser.edu.gh/files/SGER_Overview-contents.pdf*).*

that with the exception of consumer price index (CPI), exchange rate and Treasury bill rate; crude oil prices do not appear to have any significant effect on stock returns. However, Kuwornu (2012) reveals that, in the long run crude oil prices and stock market returns are inversely related. Both the estimations of Nantwi and Kuwornu (2011) and Kuwornu (2012) assumed that the elasticity of the macroeconomic variables used were constant. However, by applying a local-linear non-parametric kernel regression technique to examine how macro-economic variables affect stock market performance, Adu *et al.,* (2013) complicates the discussion by suggesting that the constant elasticity estimation by previous studies may be misleading, since the relationship is non-linear. Adu *et al.,* (2013) however, corroborates the fact that stock prices are significantly affected by macro-economic variables.

The above present huge inconsistencies in results produced from extant studies. Among the few recent studies in Ghana that have investigated the impact of crude oil price on the equity market are Lin *et al* (2014) and Breisinger *et al.,* (2014). While the latter reports that both short-term Dutch disease and long-term structural impacts can hamper economic growth in Ghana, using a multivariate generalized autoregressive conditional hetereoscedasticity (GARCH) models, the former finds the existence of significant volatility spillover and interdependence between oil and the stock market returns. The data period used by Lin *et al.,* (2014) however, did not capture the post oil production period in Ghana. The bursting question then is: how have economic factors impacted returns on the Ghana equity market post the oil production period? This study addresses the paucity of contemporary literature in this field of research in Ghana by investigating the relationship between economic factors and stock market performance. The study would have important implications for portfolio management, policy formulation, decision making, and academic research.

Our study differs from the extant literature in three principal ways. First, unlike previous studies which used datasets that predate the post-oil production period (e.g. Adu *et al.,* 2013; Lin *et al.,* 2014), we expand our study to cover the post-oil production period. To enhance robustness in the results, we break our data into the pre-and post-oil production periods in order to examine the relationships between the economic factors and the stock market at each specified period.

Second, the originality of this study also lies in the methodology employed. Most importantly, the use of the quantile regression technique which appears not to have seen substantial application on the Ghana stock market constitutes a significant advancement in the empirical studies in Ghana. Altering the methodological approach has the significant consequences of providing new robust results. Previous studies have employed cointegration and Granger causality tests within the framework of the ordinary least square (OLS) estimations, which depends on the conditional mean function of the variables used. Converse to the OLS estimation, quantile regression

(QR) permits the use of the full sample of data sets to establish the impact of economic factors at varying quantiles of stock market returns. Ambassadors for the use of the QR to model dependence argue that it has the unique ability of unearthing information on the non-linear effects of conditioning variables on the regressand (Baur, 2013; Boako *et al.,* 2015). In the particular situation of the Ghana stock market characterized by periodic boom and bust cycles, changes in the concentration and sign of the effects of economic factors across different quantiles of the equity returns is eminent. It is in the light of this, and many others, that we model the dependence structure between the stock market returns and economic forces using the quantile regression.

Thirdly, most studies in the literature use data on only domestic macroeconomic variables. The shortfall associated with this is that, in situations where markets are not highly integrated and diversified, the effects of boom or bust cycles in the global markets on the local bourse may not be readily noticed. Hence the dependence on only country-specific macroeconomic data sets to model the relationship between macroeconomic factors and stock market performance may be necessary but not sufficient. Our paper addresses this concern by including in the framework some global economic variables such as gold, oil, and cocoa, whose prices are determined outside the domestic economy. The implication for the inclusion of the global factors is two-fold: a). evidence of a strong significant relationship between the global factors and the stock market will provide relevant insights germane to international asset pricing, risk management, and the dynamic interaction in the global economy (Mensi *et al.,* 2014). Commodities such as gold, oil, and cocoa can provide defense against loses when the market's long-term instruments (equities and bonds) become bearish. b). the incorporation of global economic factors may provide results that may be useful for commodity traders, academic researchers, international portfolio risk managers, and policy makers.

The remainder of the paper is structured as follows: Section 2 presents a brief overview of the relationship between stock returns and economic variables. The data sources and specification of the empirical model is given in Section 3. We present the econometric estimation technique in Section 4. Findings and discussions are presented in Section 5; and Section 6 concludes the paper with some policy implications.

2. Economic forces and equity returns: a brief sketch

Theoretically, one channel by which the influence of commodities in modeling the behaviour of financial assets (such as stocks and bonds) can be felt is the "commodity financialization" process. The process of speculative market participants' consideration of commodities as investments assets is known as the "financialization"

of commodities. This hypothesis is identified to be a major driver in defining the increases in cross-market correlations between commodities and stocks (Olson *et al.,* 2014). The commodity financialization hypothesis can be classified under three strands. The first strand suggests that financialization may strengthen cross-market nexuses between commodities and stocks provided the increases in financialization reflect new entrants or traders not previously in these markets (Buyuksahin and Robe, 2014). The increases in cross-market linkages between commodities and equity prices may enhance opportunities for diversification or hedging, provided the correlations increase in absolute terms. Since hedging entails taking a long position in one asset (as in stocks) and a short position in another (say a commodity), a surge in correlations means that a fall in the commodities futures market returns would be better offset by a long position in the stock markets, thereby making the hedge effective. Second, financialization can lead to cross-market shock contagion (Broner *et al.,* 2006; Buyuksahin and Robe, 2014) and risk-sharing (Cheng and Xiong, 2014) between commodities and equities. Thus, "financialization" can be seen as "affecting risk sharing in commodities through the double role of financial investors: as providers of liquidity to hedges when trading to accommodate hedging needs and, as consumers of liquidity from hedges when trading for their own needs" (Cheng and Xiong, 2014; pp. 2). Thirdly, financialization may affect informational discovery in commodity markets. Heterogeneous expectations among financial investors under informational asymmetry can lead to drift in commodity futures prices (Singleton, 2012). The equity pricing model proposes that changes in oil prices affect equity prices through either the expected discount rate or expected cash flow. Rising crude oil price necessitates uncertainties about the prospects of future energy market conditions which may affect investment behaviour thereby lowering investments. As investments decline, the reduced cash flows on stocks consequentially trigger adverse effects on equities since the price of a share is a function of the discounted present worth of expected cash flows.

The basic assumptions of most multifactor asset pricing models (such as the capital asset pricing model, arbitrage pricing theory) are grounded on the theory that macroeconomic shocks impact equity market returns.[3] For instance, the discounted dividend model (DDM) posits that required rate of return and share prices are inversely related. As key interest rates are adjusted, the risk free rate will change. If interest rate increases, the risk-free rate will rise as well. This will result in higher market rate. If nothing else changes, the stock's target price should drop due to the higher required rate of return. The reverse is true. *Ceteris paribus*, if interest rates fall, the

3 Even though Ross (1976)'s arbitrage pricing theory (APT) is unable to establish the number and nature of the key variables that matter in explaining the behaviour of asset returns (Dhrymes et al., 1985). Fama (1991) believes that the selection of such key factors is a natural challenge inherent in the field.

stock's price should rise because the required rate of return has dropped. Furthermore, the required rate of return will rise if the risk premium increases. Both government spending and money supply affect total spending which altogether with the economy's potential output and past changes in prices determines current price variations. Changes in total spending and price levels determine current account changes in real output. These generate expectations about inflation and real growth which in turn influence the current interest rate. As interest rates rise, investors raise the rates of return they require, causing share prices to fall. Additionally, the trade-oriented model of exchange rate determination suggests that a declining domestic currency improves the competitiveness of local firms, which in turn increases their trade and foreign currency current accounts balances. Thus, currency depreciation result in more foreign inflows into domestic stock markets. Since the value or price of a stock is the discounted present worth of a firm's expected future cash flows, stock prices may ultimately respond to the increases in expected cash flows.

Several empirical studies have been conducted on the dynamic linkages between stock returns and economic or macroeconomic factors (See for example, Mishra, 2004; Irene and Perry, 2007; Khan *et al.,* 2015). However, depending on the methodologies employed and the markets on which the studies were conducted, results show some similarities and differences from one study to the other. Xiufang (2010) investigated the relationship between stock market volatility and macroeconomic variable volatility for China and found that a unidirectional relationship exists between interest rate and stock prices, with the direction from stock prices to the interest rate. Al-Sharkas (2004) for Jordan corroborate this and establish that the nexus is negative and statistically significant. Abugri (2008) reports that the responses of equity returns to money supply are negative and significant in Brazil and Argentina, while the responses in Mexico and Chile to money supply appear insignificant. In applying the exponential GARCH model, Yu Hsing (2011) finds that South Africa's stock market index is positively influenced by money supply.

3. Data and model specification

The empirical analysis in the paper is carried out using monthly data on (i) stock prices (SP)[4] - as a measure of the performance of the Ghana stock market; (ii) the 91-day Treasury bill rate (TBR) to proxy for Interest rate; (iii) the West Texas Intermediate (WTI) Brent crude oil price (OIL), (iv) broad money supply (M2+), includ-

[4] *Two main market indices – the All-Share Index (ASI) and Composite Index (CI) are used to proxy stock prices for the sample period. The ASI is used for the pre-oil production period, while the CI is used for the post oil production period. This is because, the Ghana Stock Exchange introduced the GSE Composite Index - CI (a capitalization weighted index, using Volume Weighted Average Price [VWAP] of GSE listed companies) in January 2011, to replace the GSE All Share Index - ASI. Its base data and value is 31.12.10 and 1,000 respectively.*

ing currency deposits; (v) nominal interbank cedi[5]-dollar exchange rate (EXR); (v) log difference of Consumer price index (CPI) – to proxy the inflation rate in Ghana, (vi) gold price (GP); and (vii) Cocoa price (CP). These variables are selected due to their relevance for the performance of the Ghanaian economy. Already, the macroeconomic variables (TBR, CPI, M2+, and EXR) are hypothesized in literature to exert some level of influence on the Ghana stock market (see for example Frimpong, 2009; and Nantwi and Kuwornu, 2011). Since Ghana is a major world producer of gold and cocoa, as well as a producer-consumer of oil, the price shocks from oil, gold, and cocoa are expected to exert useful influences on stock prices.

Data on TBR, CPI, M2+, and EXR are gleaned from the Bank of Ghana (BoG) website, while that on SP is sourced from the Ghana Stock Exchange (GSE). We obtain data on OIL from the International Energy Administration (IEA) website; CP from the International Cocoa Organization (ICCO); and World Gold Council (WGC) website for GP[6]. All price series are expressed in US dollar (US$) terms for ease of comparison. The data period starts from January 1992 to June 2015. All variables are in their logarithmic differenced transformations[7]. A brief description of each variable used is presented in *Appendix A*.

Based on both theoretical and empirical literature reviewed, the paper employs the following general specification similar to Frimpong (2009) and Adu *et al.,* (2013):

$$SP_t = \lambda_0 + \lambda_1 CPI_t + \lambda_2 EXR_t + \lambda_3 M2_t + \lambda_4 OIL_t + \lambda_5 TBR_t + \lambda_6 CP_t + \lambda_7 GP_t + \varepsilon_t \qquad (1)$$

where ε_t denotes the stochastic error term. λ_0 represents the constant term in the model, $\lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5, \lambda_6, and\ \lambda_7$ are parameter estimates. All other variables are as already defined.

In order to capture the effects of the variables on the Ghana stock market from the time the country started producing oil in commercial quantities, we disaggregate our data into: pre-oil production period and post-oil production period. The critical challenge then remains selecting a start date for oil production in Ghana. Although, it is a known fact that official oil drilling commenced in the last quarter of year 2010, we consider our post-oil production period as starting from January 2011 to: (i) coincide with the introduction of the CI, and (ii) cater for the time delays required for the actual proceeds of the first oil drill to register its impact in the economy. Our

[5] *Cedi (GH¢) is Ghana's official currency called the Ghana cedi. On 3rd July 2007, the Ghanaian cedi (GHC) was redenominated. The new Ghana cedi (GH¢) is equal to 10,000 old Ghanaian cedi (1 GH¢ = 10,000 GHC). The old currency remained in circulation alongside the new until December 2007. One Ghana cedi is divided into one hundred Ghana pesewas (Gp).*

[6] *The different websites are* www.bog.gov.gh *for CPI, TBR, M2+, EXR, and SP;* www.eia.gov *for OIL,* www.icco.org*, for CP, and* www.gold.org *for gold price*

[7] *For example, we obtain our proxy for inflation data series from the relation* $CPI_t = ln\left(\frac{CPI_t}{CPI_{t-1}}\right)$. *Similarly,* $SP_t = lnSP_t - lnSP_{t-1}$. *In order to ensure uniformity, the CPI data were spliced using year 2002 as the base year.*

disaggregated data then comprise (a) a pre-oil production part (pre-period) spanning 4th January 1992 to 31st December, 2010 and (b) a post-oil production period (post-period) covering 1st January, 2011 to 30th June 2015. Although the post-oil production sample is relatively small, it is still relevant to examine whether the oil-production has influenced the local bourse's performance.

We specify equations (2) and (3) to distinguish between the impacts of our specified regressors in the two regimes. The two equations, (2) and (3) apply for the pre-period and post-period regimes respectively. The models for the two sub-periods are thus specified as:

$$SP_t = \gamma_0 \sum_{i=1}^{n} d(EV_{it}^{\gamma_i}) e^{\mu_t} \tag{2}$$

$$SP_t = \delta_0 \sum_{i=1}^{n-1} d(EVX_{it}^{\delta_i}) e^{\mu_t} \tag{3}$$

where, *EV* stands for all the economic variables implied to exert some impacts to the Ghana stock market in this study, and *EVX* represents all the economic variables under study excluding crude oil price. γ and δ are parameter estimates, and μ_1 is the error component.

4. Quantile Regression Technique

Several studies have employed different econometric approaches and standard regressions to investigate the dynamic relationship between economic factors and stock market performance. However, in this study we use the quantile regression (QR) approach developed by Koenker and Basset (1978). Converse to standard linear regression which summarizes the average relationship between a set of regressors and the outcome variable based on the conditional mean function, QR gives information on the average dependence as well as the upper and lower tail dependence, and directly relates the quantile of the dependent variable with the conditioning variables.

The robustness of the QR tool in modeling dependence of financial variables lies in its ability to test the structure and degree of dependence (see for example, Baur, 2013; Boako *et al.,* 2015) by involving the consideration of a set of regression curves that differ across different quantiles of the conditional distribution of the dependent variable (Mensi *et al.,* 2014).

Let y be a dependent variable that is assumed to be linearly dependent on x. The τ^{th} conditional quantile of y can thus be specified as:

$$Q_y(\tau \mid x) = inf\{b \mid F_y(b \mid x) \geq \tau\} = \sum \gamma_k(\tau) x_k = x'\gamma(\tau) \tag{4}$$

where $F_y\ (b \mid x)$ is the conditional distribution function of y given x, and the QR coefficient $\gamma(\tau)$ determines the dependence relationship between vectors x and the $\tau^{(th)}$ conditional quantile of y. The values of $\gamma(\tau)$ for $\tau \in [0,1]$ determine the complete dependence structure of y. The reliance of y based on a specific explanatory variable in vector x could be:

a. Persistent if the values of $y(\tau)$ remains unchanged for varying values of τ;
b. Monotonically rising or diminishing $y(\tau)$ rises or diminishes alongside the absolute value of τ, and
c. Symmetric (asymmetric) if the value of $y(\tau)$ is similar (dissimilar) in sign for low and upper quantiles[8].

The coefficients $y(\tau)$ for a given τ are estimated by minimizing the weighted absolute deviations between y and x:

$$\dot{\gamma}(\tau) = \arg min \sum_{t=1}^{T} \left(\tau - 1_{\{y_t < X_t'\gamma(\tau)\}}\right)[y_t - X_t'\gamma(\tau)] \tag{5}$$

where $1_{\{y_t < X_t'\beta(\tau)\}}$ is the usual indicator function. The solution to this problem is obtained using simplex linear programming algorithm. This estimates the model with bootstrap standard errors, retaining the assumption of independent errors but relaxing the assumption of identically distributed errors. Thus they are analogous to robust standard errors in linear regression.

To be able to examine the diverse impacts of the conditioning factors on the quantile function in the pre and post-oil production periods in Ghana, the paper considers a QR model specified as:

$$Q_y(\tau \mid x) = \pi(\tau) + \sum_{k}^{T} \gamma_k(\tau) X_k \tag{6.1}$$

$$Q_y(\tau \mid x) = \varphi(\tau) + \sum_{i}^{I} \delta_K(\tau) X_k \tag{6.2}$$

[8] *See Mensi et al., (2014) and Koenker and Basset (1978) for details on the assumptions and quantile regression respectively.*

The parameters $\varphi(\tau)$ and $\pi(\tau)$ respectively capture the additional marginal effects of the different conditional variables in the model without oil (see equation 3) and with oil (equation 2) in a sub-period for each quantile (τ). Again, $\delta_k(\tau)$ and $\gamma_k(\tau)$ are the coefficients of regressors at each quantile in a sub-period for the model without oil and with oil respectively. And (τ) has been chosen to include lower (10^{th}, 25^{th}), median (50^{th}) and upper (75^{th}, 90^{th}) quantiles. The models in equation (6) allow us to examine:

i. The kind of connectivity between the stock market and economic factors;
ii. How the relationship is affected by different regressors; and finally,
iii. How the oil production has influenced interrelationships and the co-movement between the Ghana stock market and the economic factors.

5. Empirical findings and discussion

We begin the empirical analysis with descriptive statistics for all variables in the two sub-periods shown in Table 1. Significant characteristics exist among the variables in the two data periods. As can be observed from Table 1, the total average mean value of all variables in the post period (5.81) is higher than that in the pre period (4.85). However, the variables exhibit higher average standard deviations (SDs) in the pre period (1.06) than in the post period (0.26).

In terms of skewness, variables generally exhibit varying signs across the regimes. Negative skewness indicates higher probability of declines relative to positive skewness. While the Jacque-Berra (JB) statistic of all variables in the pre-period reject the null hypothesis of normality at the 1% significance level; in the post-period, only stock price, Treasury bill rate, and exchange rate exhibit similar characteristics, but at varying degrees of significance. All variables depict platykurtic features in both periods except OIL and EXR which show leptokurtic innovations in the post-period.

Variations in the characteristics of the variables in both the pre and post-periods raise critical concerns about the correlations (see Table 2) and time plots (see Fig. 1) of all variables in their returns series to examine their degrees of association and evolutions over time, respectively. It can clearly be observed from Fig. 1 that each of CP and M2 on one hand, and stock returns on another hand exhibit signs of volatility clustering during the pre-oil production period (see Fig.1a); and this intensifies with time. In the post-period (see Fig. 1b), variables exhibit higher degrees of dispersion.

In Table 2, the upper triangle shows correlations for the post-period whilst the lower triangle shows that of the pre-period. It is clear that during the pre-period, oil and stock returns show significant positive linear dependencies but in the post period no such dependence exists between the two (See Table 2). It is also interesting to

note that in the pre-period, all variables, show significant positive correlations with stock returns except TBR (with negative correlations). However, in the post period, significant variations exist, as the correlations between stock returns and some of the variables are either significantly negative (e.g. GP, and CPI) or insignificant (CP and OIL). However, EXR, TBR and MS show significant positive correlation with returns of the equity market.

Table 1: Summary statistics of stock market returns and economic factors

Panel A: Pre-Oil Production Period[a]

	Mean	Median	SD	Skewness	Kurtosis	JB
SP	7.124	6.958	1.382	-0.328	2.318	10.038*
CP	7.480	7.421	0.319	0.249	2.188	10.172*
CPI	4.459	4.725	1.996	-0.481	2.158	18.304*
EXR	-0.680	-0.151	1.133	-0.685	2.247	27.365*
GP	6.265	5.965	0.609	0.730	2.046	34.114*
MS	7.717	7.340	1.927	-0.127	1.836	15.907*
OIL	3.612	3.395	0.745	0.231	1.608	24.093*
TBR	2.819	3.010	0.359	-0.484	1.484	5.528***

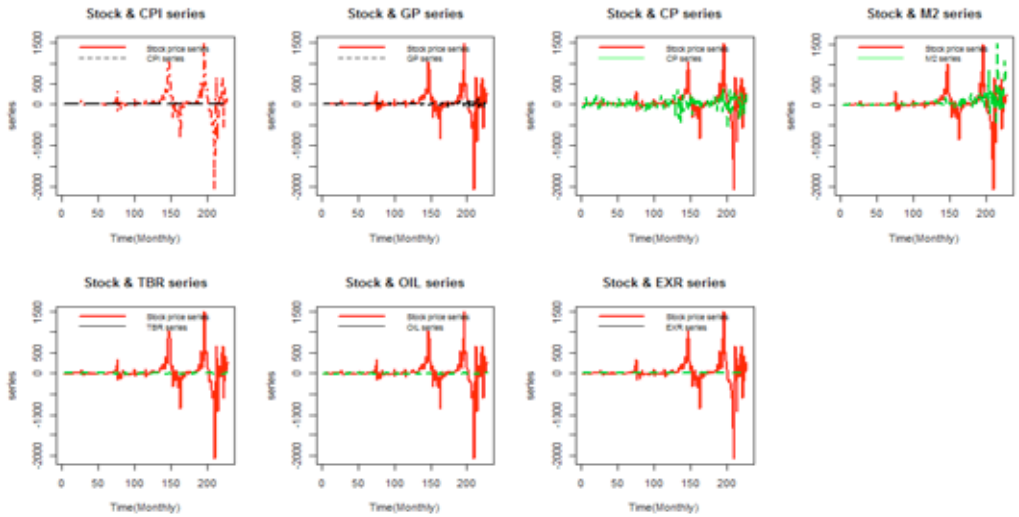
Panel B: Post-Oil Production Period[b]

SP	7.230	7.059	0.328	0.529	1.550	5.506***
CP	7.873	7.835	0.136	0.340	1.817	ns
CPI	5.681	5.924	0.593	-0.433	2.853	ns
EXR	0.609	0.631	0.176	0.826	3.319	4.841***
GP	7.324	7.362	0.119	-0.237	1.807	ns
MS	9.899	9.924	0.196	-0.490	1.976	ns
OIL	4.701	4.702	0.055	-0.242	3.899	ns
TBR	3.158	3.215	0.501	-0.347	1.981	17.034*

*[a] January 1992 – December 2010, [b] January 2011 – June 2015; ns = not significant; and *, and *** denote statistical significance at the 1% and 10% respectively.*

Pre- oil production period

Figure 1a: Time plots of stock prices and economic variables in returns series



Post-oil production period

Figure 1b: Time plots of stock prices and economic variables in returns series

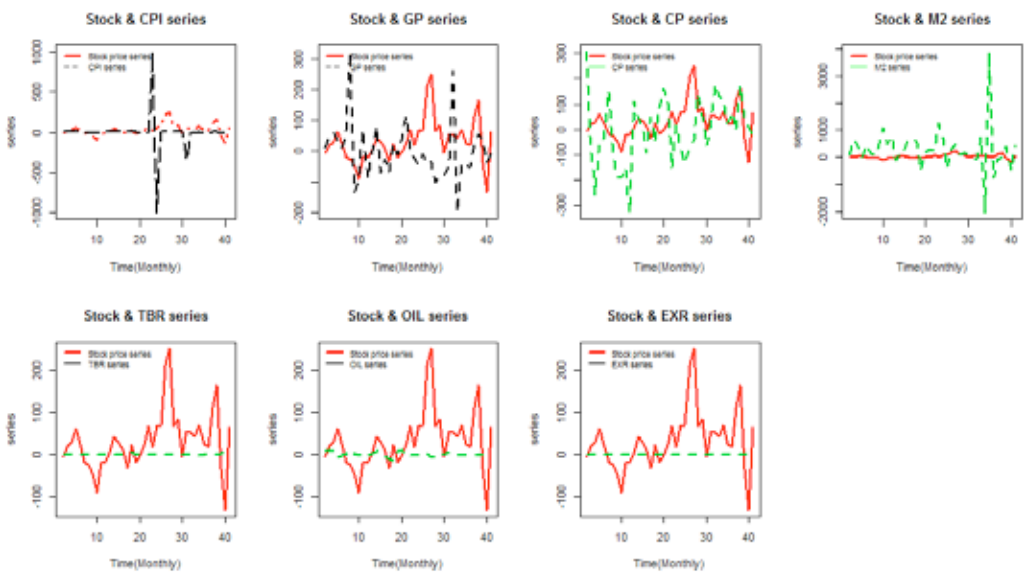


Table 2: Correlation matrix for log returns

Upper triangle: *post-oil period* **Lower triangle:** *pre-oil period*	CP	CPI	EXR	GP	SP	MS	OIL	TBR
CP		-.32	.28	-.38*	.31	-.42*	-.24	-.36*
CPI	.60**		-.60**	-.72**	-.76**	-.48**	.31	-.19
EXR	.57**	.96**		-.56**	.80**	.87**	-.83	.78**
GP	.81**	.70**	.66**		-.77**	-.41**	.32*	-.37*
SP	.46**	.85**	.84**	.45**		.76**	-.83	.60**
MS	.70**	.95**	.97**	.82**	.79**		-.85	.84**
OIL	.66**	.84**	.83**	.89**	.66**	.91**		-.34*
TBR	-.38**	-.61**	-.52**	-.61**	-.56**	-.62**	-.72**	

***Notes:** * and ** denote statistical significance at 1% and 5% levels respectively.*

We next estimate the impact of the conditioning variables on the stock market returns using QR. The QR estimations for the stock market returns are shown in Tables 3 and 4. Table 3 shows the QR estimations for the pre-period and Table 4 shows that of the post-period. As a primer, QQ graphs of all variables are plotted to examine linearity and general behavior of all series in Fig. 2. The first two rows in the upper panel of Fig. 2 show the QQ plots against normal (same mean and variance) whiles the lower panel shows the QQ plots against uniform. The plots give evidence of non-linearity and demonstrate that the behaviour of all series differ along quantiles, justifying the need for the estimation of the quantile regression. Numerical results of five quantiles ranging from Q(0.10) to Q(0.90) for both sample periods are shown in Tables 3 and 4. The QR estimation also takes into account the inclusion (exclusion) of OIL in both periods. Standard errors for the QR estimates are obtained through bootstrapping.

Tables 3 and 4, show some interesting results. For the pre-period, the effects of global commodities like cocoa and gold on the returns of the stock market are significant for all quantiles. The results are no different from that of Mensi *et al.,* (2014) in which the impact of global economic factors on BRICS stock markets is well noticed in bullish (upper quantiles) and bearish (lower quantiles) markets. Whiles the effect of cocoa is positive, symmetric, and generally increases monotonically (with the inclusion and exclusion of oil); that of gold is negative and symmetric. Additionally, effects from cocoa price fluctuations are higher in the upper tail (bullish markets) than in the lower tail (bearish periods). Gold price on the other hand is seen to show higher lower tail effects than in the upper tail. This is suggestive of the fact that the dependence of the local bourse on cocoa intensifies during boom markets whilst that on gold intensifies in bust markets. The positive effect of cocoa suggests

that increasing cocoa prices raises investors' optimism on expected future prospects of the economy and they invest more. On the other hand, the significant negative effect of gold price reflects the "store of wealth" characteristics of gold; and that equity investors could comfortably achieve optimal portfolio diversification of their unsystematic risk by using gold as a sure safe-haven, when the market goes bearish.

Despite the high dependence of the equity market on cocoa and gold in the pre-period, the intensity of the dependence sharply declines during the post-oil production era. In the post period, cocoa shows positive impact at the 0.75 and 0.90 quantiles while gold manages to show negative effects only at the 50th quartile. The decline in co-movement [see Table 2] and dependence during the post-period may be suggestive of possible shift of attention by government and policy makers from cocoa and gold as the main-stays of the Ghanaian economy[9].

The above results present serious implications for economic management and policy formulations. Since colonial days, cocoa and gold have remained the largest foreign exchange earners for Ghana with significant contributions to the growth of the over-all economy, including the financial sector. It is interesting to note from the above results that, in the pre-oil production period, these commodities maintain the significant effects they exert on the local bourse. However, during the post oil production period, the contribution of these commodities to the performance of the stock market assumes a decreasing trend.[10] Two things are worth considering here. If the above holds because Ghana is diversifying from gold and cocoa to reduce over-dependence on the two commodities, that may be seen as a good sign. But the risk of that is the fact that oil may not be a sustainable substitute to any diversification, especially in the light of recent low global prices, and the increasing need to find alternatives such as greener fuels.

Money supply shows significant positive impact in the lower quantiles from Q(0.10) to Q(0.25) during the pre-period. In examining whether or not oil production influences the impact of money supply on stock returns, it is realized that the impact of money supply intensifies in the post-oil production period in both bearish (lower quantiles) and bullish (upper quantiles) markets.

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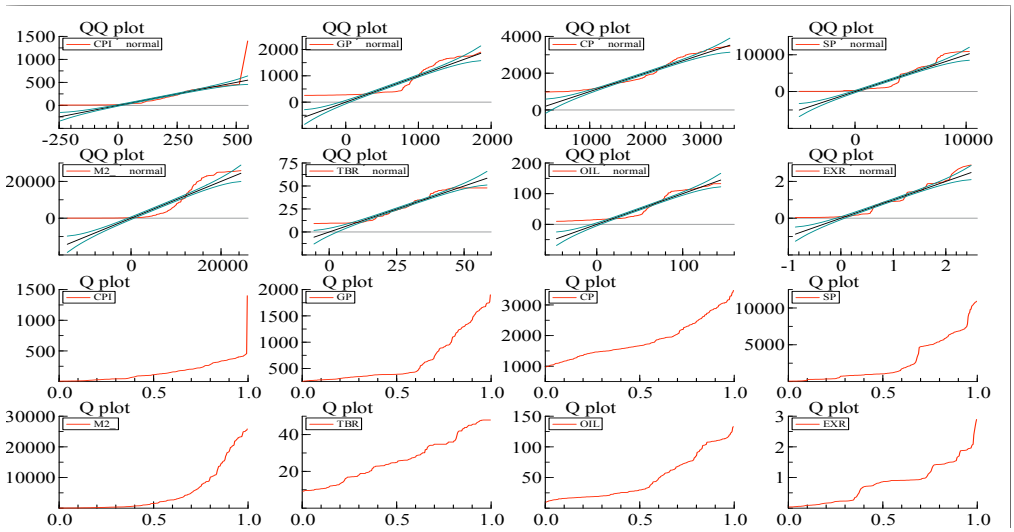
[9] *Prior to the production of oil, Ghana's cocoa production increased from 400,000 metric tons in year 2000 to 1 million metric tons in the 2010/2011 crop season. However, this sharply declined to 850,000 and 835,410 metric tons in the 2011/2012 and 2012/2013 crop seasons respectively (Business and Financial Times, 2014). Again, in 2011 the government of Ghana sold its remaining 4,883,426 shares in AngloGold Ashanti Limited a major gold mining company in Ghana in which government had shares. This clearly shows the characteristic of government's utter neglect of sensitive sectors of the economy, all in anticipation of higher oil revenue. This however, may spell doom for the nation if care is not taken.*

[10] *The trend may also have been influenced by the short span of our dataset covering the post-period relative to the pre-period. Perhaps, future research can expand the data set for comprehensive comparative analysis.*

Figure 2: QQ plot for each variable



The above results suggest that increasing money supply in either rising or falling periods of the equity market causes significant changes in investor sentiments and optimism in the stock market, and they invest more. Thus, government and policy makers can stimulate investors' interest to invest more in either tranquil or crisis periods of the market through monetary and open market operations that seek to make money available to the investor. However, this has to be done with caution because loose monetary aggregates also have implications for rising domestic prices and interest rates, both of which interact with stock prices.

In the case of TBR, the effect is negative and significant in the Q(0.50 and 0.75) quantiles during the pre-period. Clearly, the impact of the TBR during the oil production period is nill at all quantiles. Exchange rate exerts significant impact during the pre-period at the Q(0.25) in the model with oil and at Q(0.10 and 0.25) in the model without oil. However, in the post period this dependence is condensed. The impact of CPI is significant and positive at the lower, middle and upper quantiles in the pre-period for the model without oil; and in the model with oil, impact is felt at the lower and upper quantiles. Meanwhile in the post period, the impact is negative and limited to Q(0.90). Crude oil price changes shows significant positive impact on the Ghana stock market returns only for Q(0.50 and 0.75) during the pre-period. This implies that the degree of responsiveness of equity returns on the GSE to oil price changes increases (decreases) at high (low) oil prices. This finding is similar to Lee and Zeng (2011) which establish that oil price hikes in Japan between 1993 and 2009 raised stock returns, but a fall in oil price reduces stock returns. In the post-oil

production period however, oil price changes fail to show any significant effects on stock returns.

Table 3: Quantile regression estimates for pre-oil exploration period

	Q(0.10)	Q(0.25)	Q(0.50)	Q(0.75)	Q(0.90)
γ_{CPI}	0.186	0.138	0.695***	0.744***	0.881***
	[0.143]	[0.136]	[0.161]	[0.221]	[0.271]
δ_{CPI}	0.081	0.161*	0.748***	0.766	0.925***
	[0.070]	[0.093]	[0.234]	[0.195]	[0.264]
γ_{EXR}	-0.706	-0.479*	0.286	0.389	-0.171
	[0.531]	[0.524]	[0.426]	[0.581]	[0.693]
δ_{EXR}	-0.428*	-0.481*	0.354	0.135	0.427
	[0.253]	[0.283]	[0.641]	[0.546]	[1.139]
γ_{CP}	0.545***	0.429*	1.633***	1.672***	1.963***
	[0.179]	[0.229]	[0.495]	[0.553]	[0.516]
δ_{CP}	0.460***	0.529***	1.014*	1.544**	1.802***
	[0.164]	[0.202]	[0.580]	[0.603]	[0.583]
γ_{GP}	-2.251***	-1.860***	-1.660***	-1.455***	-1.729**
	[0.810]	[0.752]	[0.436]	[0.403]	[0.785]
δ_{GP}	-1.924***	-1.975***	-0.959***	-1.426***	-1.391***
	[0.266]	[0.300]	[0.238]	[0.578]	[1.053]
γ_{TBR}	0.009	-0.092	-0.881***	-0.751***	-0.622***
	[0.111]	[0.157]	[0.221]	[0.259]	[0.192]
δ_{TBR}	-0.075	-0.083	-0.822**	-0.843***	-0.396
	[0.130]	[0.174]	[0.364]	[0.266]	[0.246]
γ_{MS}	1.193***	1.128***	-0.032	-0.122	0.437
	[0.317]	[0.326]	[0.272]	[0.326]	[0.518]
δ_{MS}	1.095	1.091***	-0.017	0.143	-0.053
	[0.209]	[0.238]	[0.377]	[0.360]	[0.821]
γ_{OIL}	0.295	-0.149	0.427*	0.393**	-0.249
	[0.533]	[0.427]	[0.246]	[0.184]	[0.165]
π	5.466***	6.770	3.997	2.850	-0.367
	[1.322]	[1.817]	[1.545]	[1.677]	[1.564]
φ	6.745***	6.341***	5.279**	3.185**	0.844
	[1.474]	[1.843]	[2.041]	[1.617]	[2.872]

Notes: *The numbers in parenthesis are bootstrapped standard errors. *, **, and *** denote statistical significance at 1%, 5%, and 10% respectively.*

Table 4: Quantile regression estimates for post-oil exploration period

	Q(0.10)	Q(0.25)	Q(0.5)	Q(0.75)	Q(O.90)
γ_{CPI}	-0.231	-0.015	-0.086	-0.023	-0.649*
	[0.374]	[0.149]	[0.120]	[0.106]	[0.177]
δ_{CPI}	-0.988	-0.019	-0.079	-0.012	-0.514*
	[1.866]	[0.152]	[0.141]	[0.105]	[0.143]
γ_{EXR}	0.532	0.321	-0.559	-1.159	-1.563
	[0.383]	[0.421]	[0.682]	[0.992]	[1.795]
δ_{EXR}	0.254	0.309	-0.267	-1.383	-0.018
	[0.239]	[0.444]	[0.550]	[0.890]	[0.714]
γ_{CP}	0.291	0.629	0.957	1.610**	0.454*
	[1.121]	[0.512]	[0.505]	[0.746]	[0.127]
δ_{CP}	0.281	0.744	0.944	1.756**	0.364**
	[0.403]	[0.452]	[0.412]	[0.702]	[0.148]
γ_{GP}	-0.345	-0.891	-1.024*	-0.367	-0.210
	[1.168]	[0.834]	[0.782]	[0.737]	[0.301]
δ_{GP}	-0.480	-0.766	-0.808	-0.590	-0.068
	[0.690]	[0.744]	[0.780]	[0.594]	[0.233]
γ_{TBR}	0.245	-0.200	-0.057	0.131	0.639
	[0.340]	[0.183]	[0.160]	[0.390]	[0.756]
δ_{TBR}	-0.097	-0.218	-0.133	0.094	0.385
	[0.122]	[0.177]	[0.163]	[0.310]	[0.639]
γ_{MS}	0.084**	1.177***	1.824***	2.413	0.064**
	[0.041]	[0.405]	[0.855]	[1.458]	[0.027]
δ_{MS}	0.089**	1.255***	1.567***	2.683**	0.130*
	[0.042]	[0.377]	[0.658]	[1.222]	[0.026]
γ_{OIL}	-1.098	0.147	0.315	-0.349	-0.032
	[0.958]	[0.484]	[0.539]	[0.615]	[0.339]
π	-8.113	-3.173	-11.373	-24.424	-13.045
	[12.653]	[10.269]	[11.128]	[17.894]	[13.156]
φ	-2.564	-5.00	-8.828	-28.082	-9.056
	[5.768]	[9.647]	[9.319]	[17.894]	[11.786]

Notes: see the notes on Table 3.

6. Conclusion

The paper examines the dependence structure between returns on the Ghana stock market and economic variables across different quantiles, and over the pre and post-periods of oil production in Ghana. A set of monthly global commodities (gold, cocoa, and oil), macroeconomic variables (treasury bill rates, consumer price index, money supply, and exchange rate), as well as stock prices on the Ghana stock market are used. The significance of the study is underscored in its ability to influence portfolio diversification, asset allocation decisions of investors, and policy formulation.

The findings generally indicate symmetric dependence for all significant relationships as coefficients are either positive or negative across quantiles. First, the effect of cocoa price on the stock market returns is positive and significant in the pre-oil production period. This dependence structure however, exists only in the upper tails. Although gold price exhibits significant negative symmetric effects on the Ghana stock market along all quantiles in the pre-period, the effects are virtually non-existent in the post-period. The inference from the above results is that in the post oil production era there is a shift of attention by government and allied agencies from these two commodities (gold and cocoa), which hitherto had remained the major foreign exchange earners for the country's economic growth. The contribution of the oil find to the growth of the financial sector is not seen as oil price fails to show significant influence on the performance of the stock market in the post-period. This reinforces the findings of Breisinger *et al* (2014) that the impact of revenues from Ghana's oil sector during the post period is a fall in non-oil GDP growth compared to the base run without oil. "The lack of effect of the oil revenue also presents a great challenge to Ghana and other economies that depend on natural resources, and may weaken their efforts to industrialize" (Breisinger *et al.*, 2014).

The negative significant impact of gold prices on the stock market returns implies that investors can comfortably diversify across the two markets (i.e. the gold and stock markets). This supports the hedge and safe-haven role of gold for assets (such as stocks and bonds). Thus, gold can serve as a safe haven for investors in case the markets traditional assets (equities and bonds) begin to slump. Through this, investors can easily avoid most downside risks associated with their investments.

On the basis of the above, we recommend for policy makers to, as a matter of importance, give much attention to cocoa and gold as major foreign exchange earners of the economy, and eschew such tendencies that are likely to direct attention almost exclusively to the oil find at the expense of other important sectors of the economy. Most importantly, the oil find should be made to play augmenting and complementary roles in support of other sectors of the economy (especially gold and cocoa) rather than been made to substitute or replace them for future development. Perhaps, due to the relatively small volumes of the oil revenue, it may take some time for its (oil

revenue) impact to be adequately felt by the economy. Despite this, the trend is likely to reverse if conscious efforts are made to put the rather meager oil revenues to good use. Smart use of oil revenues requires not only the sterilization and savings of oil revenue in an oil fund, but also financing of productivity-enhancing public investments (Breisinger *et al.,* 2014). Currently, a sizeable proportion of the Benchmark oil Revenue[11] (not more than 70%) is factored into the country's Annual Budget Funding Amount (ABFA)[12]. This does not only present the problem of governments diffusing the revenues into "thin air" but also the threat of diverting oil revenues into non-optimal uses on the platform of political expediency cannot be discounted. We therefore suggest that the current Ghana Petroleum Revenue Management Act, 2011 (Act 815) be routinely reviewed to warrant oil revenue disbursement formulas that will ensure proper and traceable accountability of oil revenue in Ghana. Further, we recommend for future researchers in this field of study to use data sets that have higher observations for the post-oil production period since the rather short span of our post-period sample may have significantly affected our results.

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[11] *Is the estimated revenue from petroleum operations expected by the Government of Ghana for the corresponding financial year.*

[12] *Is the amount of petroleum revenue allocated for spending in the current financial year budget (see the Ghana Petroleum Revenue Management Act, 2011 (Act 815).*

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Appendix A: Data description and sources

Variable	Concept	Description	Unit of measurement	Source
SP	Logarithm of Ghana Stock Exchange Index	GSE All Share Index and GSE Composite Index	1990 = 77.68 points in US$	GSE
INF	Continuously Compounded CPI	Consumer Price Index	Index per month (2002=100pts)	BoG
M2+	Logarithm of Money Supply in Ghana	Broad Money Supply	Monthly growth rate of M2+	BoG
TBR	Logarithm of 91-day Treasury bill rate	91-day Treasury bill rate	% per month	BoG
OIL	Logarithm of Crude Oil Price	Brent Crude Oil Price	Monthly US$ per barrel	IEA
EXR	Logarithm of Exchange Rate	Inter Bank rate GH¢ per US Dollar	Monthly GH¢ per US Dollar	BoG
CP	Logarithm of Cocoa price	FOB price of cocoa	Monthly US$ price per ton	ICCO
GP	Logarithm of Gold price	International gold price	Monthly US$ price per ounce	WGC

Appendix B: Summary of empirical results

CPI			EXR			CP			GP			TBR			MS			OIL		
L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H
Pre-Oil production period																				
NS	+	+	-	NS	NS	+	+	+	-	-	-	NS	-	-	+	NS	NS	NS	+	+
NS	+	+	-	NS	NS	+	+	+	-	-	-	NS	-	-	+	NS	NS			
Post-Oil production period																				
NS	NS	+	NS	NS	NS	NS	NS	+	NS	-	NS	NS	NS	NS	+	+	+	NS	NS	NS
NS	NS	+	NS	NS	NS	NS	NS	+	NS	NS	NS	NS	NS	NS	+	+	+			

Notes: L, M, and H represent lower quantile, medium quantile, and high quantile respectively. NS denote not significant, + (-) denote positive (negative) and statistically significant; and represent model with oil included and model without oil.