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DETERMINANTS OF OIL PRICE INFLUENCE ON PROFITABILITY PERFORMANCE MEASURE OF OIL AND GAS COMPANIES: A PANEL DATA PERSPECTIVE

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Abstract

Current literature on the effect of oil price on accounting profitability of oil and gas companies are mixed and inconclusive. The investigations have been limited to a single country - unlike oil price impact on performance of stocks. The main objective of this research study was to develop a model to examine the relationship between the crude oil price and accounting performance measures (as represented by ROA, ROE and EPS) of oil and gas companies listed worldwide. The companies selected were in accordance with Forbes 2016 top 20 Oil and Gas Company list from the period of 2012 to 2016. The study employed panel models, random effects and fixed effects estimation to establish the required relationships. Panel models with EPS as response performed better than ROA and ROE responses. This study found that crude oil prices have positive and significant impact on the accounting returns (as represented by ROA, ROE and EPS) of the firms considered.

Keywords: Oil price, profitability performance, oil and gas, panel data, fixed effect, random effect

INTRODUCTION

Oil plays a strategic role in economies of today; oil exporting countries derive revenue from oil price, while growth initiatives in developing countries are impacted due to import cost for oil importing countries. The world oil production is capital intensive and producers of oil and gas have to contend with complex interaction involving feed stock exploration, variety of products treatment, transportation /storage and stringent environmental legislations. The oil and gas industry is unpredictable, especially in the stage of exploration and requires significant investment in properties and technology. Despite these challenges, investors in the industry expect returns on their investments. The movement in oil prices affects the financial margins of oil and gas companies, because the commodity directly impacts revenues and investments of these companies (Boyer and Filion, 2007). It is reasonable to expect oil and gas firms to reduce production and/or cut cost, when oil price falls. The volatility of oil price affect consumers and producers as well as markets in terms of costs and trading strategies (Li, Cheng and Yang, 2015).

The changes in oil prices impact on economic activities and these have been studied extensively. The relationship between oil price shock and macroeconomic performance was first investigated by Hamilton (1983), who found significant relationship between US recessions and crude oil price increases. This work formed the basis for successive studies that examined the shock of crude oil price on macroeconomic indicators such as, inflation, industrial activity and GDP growth rate (Cuñado and Pérez de Gracia, 2003; Volkov and Yuhn, 2016; Chen, Liu, Wang and Zhu, 2016). Cuñado and Pérez de Gracia (2003) assessed the dynamic relationship between oil price, inflation and economic growth (expressed as industrial output).

The impact of oil price on firm performance have been widely studied. Most researchers studied the relation of oil price and stock markets (Sadorsky, 2001; Nandha and Faff, 2007; Ramos and Veiga, 2011; Jones & Kaul, 1996). According to Kang, Perez de Gracia and Ratti (2017); Nandha and Faff (2007) and Faff and Brailsford (1999) there is a positive effect of oil price on stock prices, while Zhu, Li and Li (2014); Juncal and Fernando (2003); Faff and Brailsford (1999) found a negative effect.

Compared to literature on stocks, literature that investigated the oil price effect on accounting profitability performance were limited (Hazrika, 2015; Putra, Lahindah and Rismadi, 2014; Wattanatorn and Kanchanapoom, 2012; Dayanandan and Donker, 2011). Some researchers found oil price to positively affect accounting profits of energy and food sectors (Wattanatorn and Kanchanapoom, 2012), pharmaceutical sectors (Basha, 2014), non-financial sectors such as petrochemical, transportation, agricultural (Lele, 2016) and Oil and gas companies (Putra, Lahindah and Rismadi, 2014; Dayanandan and Donker, 2011). Other studies

have also found oil price to negatively affect accounting profitability of oil and gas companies (Hazrika, 2015) and banking sector (Molyneux and Thornton, 1992). It is evident that literature that investigated the effect of oil price on accounting profitability of oil and gas companies are inconclusive. In addition, these studies were only limited to specific countries: Indonesia - Putra, Lahindah and Rismadi (2014), Thailand - Wattanatorn and Kanchanapoom (2012) and specific region: North America: Dayanandan and Donker (2011). These gaps in literature formed the basis for this study.

This study develops a model to evaluate oil and gas companies' performance through financial information and data analysis. The study employed panel regression model estimates based on OLS, fixed and random effect models. The model could be useful to establish the influence of oil price movement on accounting profitability of oil and gas companies.

This article is structured as follows: The literature on the subject is reviewed next which is followed by discussion of the methodology and data used. The empirical results and concluding observations are presented in the last two sections of the paper.

LITERATURE REVIEW

In a related area of research, considerable investigations have been conducted to establish the relationship between oil price changes and stock returns using firm and market level data (Chen, 2010). Sadorsky (2001) used firm level data and multifactor market model to establish that crude oil prices have significant impact on stock price returns in the Canadian oil and gas industry. In a more expansive study, Ramos and Veiga (2011) used multifactor panel model to examine oil and gas industries in 35 countries and concluded that industry stock returns are positively affected by oil price increases and that oil price volatility is more important in developed countries than in emerging markets. Park and Ratti (2008) used aggregate or market level data and impulse response functions (IRFs) to examine different oil price shock definitions on US and 13 European countries. Their study showed that equity returns respond negatively to oil price shocks, except for Norway which is positively correlated. Other authors found that oil price effect on equity returns varied and depended on the industry being assessed (Faff and Brailsford, 1999).

In summary, literature study on oil price effect on stocks implied that different industries react differently to oil prices. As discussed by Boyer and Filion (2007) an increase in the oil price leads to an increase in market value of firms producing the commodity, but leads to a decrease in the value of net buyers of the commodity. This study expected that oil price fluctuation has similar effect on accounting measure of oil and gas firms; thus an increase in oil price positively affects accounting profits of oil and gas firms.

There has been several studies that have investigated impact of oil price on financial performance of various listed companies and most of these studies found changes in oil price impact on Net Profit Margin, Return on Assets and Return on Equity (Dayanandan and Donker, 2011; Wattanatorn and Kanchanapoom, 2012; Basha, 2014; Lele, 2016). This study followed that of Dayanandan and Donker (2011) empirical regression that examined the relationship between commodity prices of crude oil on accounting measures of public listed oil and gas firms in North America.

This study is different to the work by Dayanandan and Donker (2011), because their study was limited to North America oil and gas firms, which made it difficult to generalise results to the industry since industrial composition of markets vary from one market to another. This study fills the gap by extending the investigation into other markets by looking at world top oil and gas firms (with exception of North American firms). Unlike Dayanandan and Donker (2011) that only considered low frequency data (annual financial reports), this study aimed to improve previous study by using quarterly data. Finally, Dayanandan and Donker (2011) analysed oil price influence only on ROE, while this study evaluates additional accounting measures (ROA and EPS) over a different period (2012-2016).

Only some studies (Dayanandan and Donker, 2011; Wattanatorn and Kanchanapoom, 2012) captured the impact of oil price on accounting performance measures of oil and gas companies. These studies are limited to a single country, such as Thailand (Wattanatorn and Kanchanapoom, 2012) or single region, North America (Dayanandan and Donker, 2011). However, markets are different because markets have different composition of firms. Mature markets (like North America and Europe) consist of more diversified industries, while small markets (South America) are dominated by a few large industries. It remains inconclusive whether sector indices are as sensitive to oil price fluctuations as national indices. Therefore the study to determine the impact of oil price on accounting performance of oil and gas companies can be extended further by considering more oil and gas companies in other countries and stock exchanges. This helps to generalise the results.

METHODOLOGY

Data and Sampling

This is a quantitative study that uses secondary data from reputable sources and related to oil price and accounting profitability measures: return on assets, return on equity and earnings per share of oil and gas companies for several panel data regression models. We assume that oil and gas companies are listed on stock exchanges and these companies prepare their financial statements in accordance with International Financial Reporting Standards (IFRS).

The data used only considered financial statements reported using IFRS accounting measure because companies worldwide are using or switching to IFRS from GAAP. While few of the oil and gas companies considered reported their financial statements based on IFRS, most reported based on GAAP especially prior to 2012 where the reporting was subsequently changed to IFRS. The study considered data from 2012 to 2016 period in order to apply consistent IFRS accounting measures across all the oil and gas companies selected for the study. Companies in North America were excluded from this study as they mostly reported their financial statements using GAAP.

The study used financial data collected from company websites and annual reports of the Forbes 2016 Top 20 oil and gas companies worldwide. As per application of IFRS, the Forbes Top 20 oil and gas companies were reduced to eight and these companies are listed in Table 1.

Table 1. Oil and gas companies considered in the study

Company	Country
Gazprom	Russia
Rosneft	Russia
PetroChina	China
Beyond Petroleum	United Kingdom
Royal Dutch Shell	Netherlands
Petrobras	Brazil
Total	France
Statoil	Norway

Figure 1 indicates quarterly and closing prices of the Brent crude oil and West Texas Intermediate (WTI) oil and gas index. Brent crude oil price index was chosen for this study because it is more widely and actively traded globally than other benchmarks like Texas WTI and Dubai/Oman (Kiatmanaroch, and Sriboonchitta, 2014). While weekly and monthly data for oil price existed in the databases; the low occurrence average quarterly oil prices data were considered to eliminate daily/weekly noise in analysing performance of the oil and gas companies; specifically because profitability of these companies were reported quarterly and annually in financial statements.

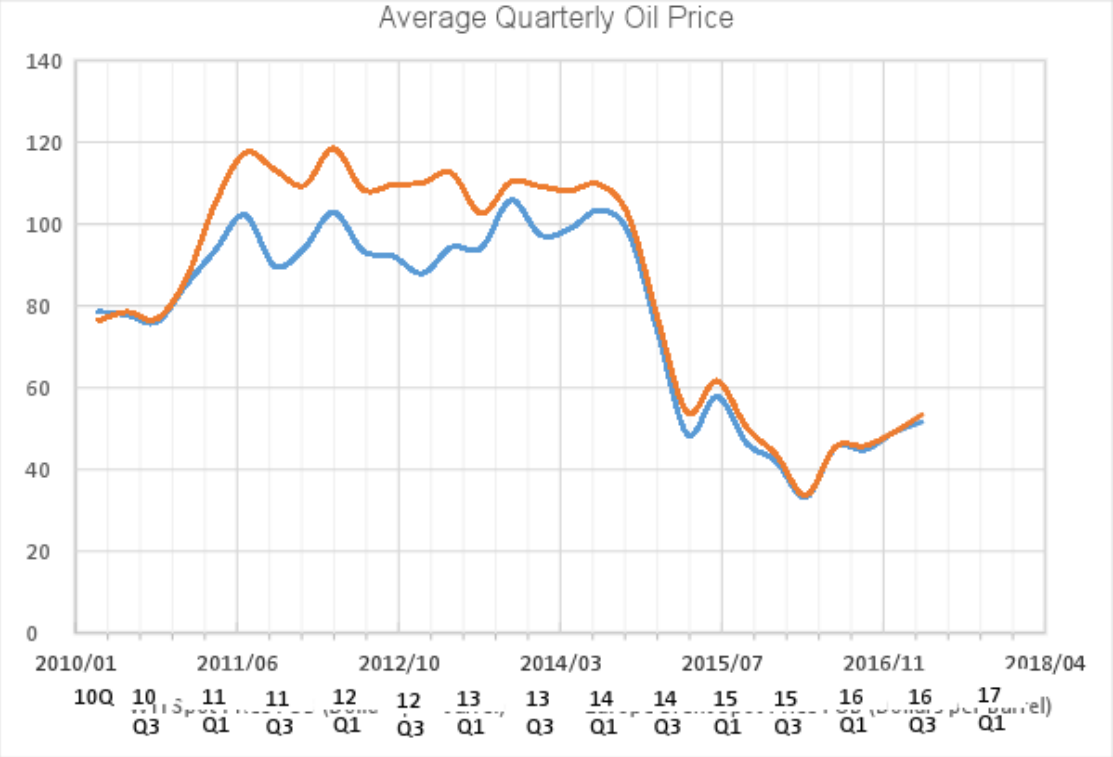

Figure 1. Average quarterly oil price movement for the period of 2010 - 2016

Empirical regression

Linear panel regression model, with mostly individual specific effects is represented by:

$$yit=\emptyset+\beta 1x'it+\varepsilon it \quad t = 1,...,T(i),\ i = i,...,N, \qquad (1)$$

Where ø is a constant, xit is a vector of explanatory variables and εit, the error term, that is represented as disturbance terms as;

$$\varepsilon it=uit+vit \qquad (2)$$

This study employed Ordinary Least Squares (OLS) estimation, the Random Effects (RE), the Fixed Effects (FE), and Dynamic panel estimation methods to explain the behaviours of the response and explanatory terms in the equations.

Equations 4-6 allow for seasonality dependency in data and the contribution of firm characteristics in explaining firm profits. The independent (or explanatory) variables in this study were oil price, leverage (debt equity) and size (log sales) of firms. The dependent (response) variable of the study was the firm profitability performance as measured by return on assets (ROA), return on equities (ROE) and earning per share (EPS). These profitability measures were presumed to have some relationship with oil price changes in the regression models. In particular, higher oil prices will lead to higher profits simply because these firms have already

realised their investments and any increase in oil price just adds to the margins of these firms. Thus performance of the firms can be defined as:

Performance=f(oil price, firm leverage, firm size) (3)

For this study the regression model in equation 3 was expanded and represented as equations 4 and 5 below. Seasonal dummy variables in the oil price were introduced in the equations to capture the full influence of changing oil prices. Linear panel data are considered in this study as it avoids analysis challenges of nonlinear panel data and is more generally used (Hsiao, 2007).

$$ROA_{it}=\beta_0+\beta_1 OIL\ P_t+\beta_2 LEV_{it}+\beta_3 SIZE_{it}+S1OILP_t+S2\ OILP_t+S3\ OILP_t \quad (4)$$

$$ROE_{it}=\beta_0+\beta_1 OIL\ P_t+\beta_2 LEV_{it}+\beta_3 SIZE_{it}+S1OILP_t+S2\ OILP_t+S3\ OILP_t \quad (5)$$

$$EPS_{it}=\beta_0+\beta_1 OIL\ P_t+\beta_2 LEV_{it}+\beta_3 SIZE_{it}+S1OILP_t+S2\ OILP_t+S3\ OILP_t \quad (6)$$

Where, $i=1\ldots8$ and $t=1\ldots20$;

Table 2. Determinants of accounting profitability performance

Variables	Description	Expected relation with profitability performance
ROA	Defined as quarterly return on assets (net income divided by total asset)	Response variable
ROE	Defined as quarterly return on equity (net income divided by total equity)	Response variable
EPS	Defined as quarterly earnings per share (net income divided by shares outstanding)	Response variable
Oil price (OIL P)	Defined as log of quarterly Brent crude oil price (U$)	+
Leverage (LEV)	Defined as quarterly total debt divided total equity	-
SIZE	Defined as quarterly log sales	+
S1,S2 ,S3	Seasonal dummy variables that have values of one in the defined quarters otherwise zero (see chapter 4).	
β0, .., β3	Generalized least squares estimators (coefficients)	

The study additionally estimated dynamic model, where lagged dependent variables represented by performance measures ROA, ROE, and EPS were included as an explanatory variable.

Research Hypotheses

The study formulated four hypotheses to direct the research questions regarding relationship of the oil price influence on financial performance of oil and gas companies:

H1: Oil price positively influence accounting profitability measures of Oil and gas companies.

An increase in the oil price is expected to have a positive effect on the revenue of the oil producers (Boyer and Filion, 2007). Thus the study expected a positive relationship between the crude oil price changes and the profitability performance measures of oil and gas companies.

H2: The size of oil and gas company influences the company's accounting profitability.

There is no consensus of what relationships exist between firm size and profitability. Some researchers report a positive relationship (Ilaboya and Ohiokha 2016; Halil and Hasan, 2012), while others report a negative relationship (Majumdar, 1997; Dogan, 2013) between firm size and profitability. However, Niresh and Velnampy (2014) found no indicative relationship between firm size and profitability. There is no conclusive measure of firm size in literature - most researchers agree that size of a firm can be measured in terms of total assets (Eriksen and Knudsen, 2003; Pasiouras and Kosmidou, 2007) and log form of total assets (Lee, 2009; Dayanandan and Donker, 2011; Ilaboya and Ohiokha, 2016). Others have used log form of sales (Pratheepan, 2014). In this study the firm size was represented by log of sales.

H3: Leverage level influences profitability performance of Oil and gas companies.

Hussain and Nguyan (2016) examined the impact of financial leverage on performance of Canadian oil and gas companies for 2004 to 2013 and found that leverage has strong negative relationship with performance; i.e, high leverage firms underperformed their low leverage counterparts. This finding is in agreement with Dayanandan and Donker (2011) and therefore it is important to evaluate similar parameter in this study.

H4: There is a lagged effect of oil price changes on oil and gas companies ROA, ROE and EPS.

Various studies (Driesprong, Jacobsen and Maat, 2008; Narayan and Sharma (2011); Kang et al., 2017) found that investors do not adapt quickly and it takes some time to react to new information and thus have difficulty assessing impact of oil price changes to their stocks. In this context, this study tested whether oil and gas companies financial performance measures are affected by oil price changes before they are reported (at least quarterly).

Statistical tests ascertained the quality of regression coefficients of regression equations, before the model was accepted. The tests included F-tests, r-squared tests, the Augmented Dickey-Fuller (ADF) and Im-Pesaran-Shin (IPS) (1999) tests.

EMPIRICAL RESULTS

The descriptive statistics of the companies used in this study are presented in Table 3. The table presented the variables that were used to analyse the measures of accounting performance of oil and gas companies.

Table 3. Descriptive Statistics

	Obs	Mean	Median	Skew	Min	Max	Std Dev
Brent crude Oil price (US$)	160	83.04	102.20	-0.34	33.70	118.5	30.15
Sales (US$ bill)	160	118.9	71.18	1.42	2.65	481.7	114.2
ROA	160	0.04	0.03	4.84	-0.04	0.53	0.07
ROE	160	0.08	0.05	3.87	-0.11	0.88	0.12
EPS	160	1.11	0.58	1.64	-1.38	7.16	1.43
LEV	160	1.17	1.18	0.37	0.37	2.92	0.46
OILP	160	1.88	2.01	-0.52	1.53	2.07	0.18
SIZE	160	10.87	10.85	-0.32	9.42	11.68	0.46

The size of the firms, in terms of sales, range between $2.65 billion and $481.7 billion. The leverage level of the firms considered were relatively high with a mean value of 117%. The firms had varied leverage from as low as 37% with the highest leverage reported as 292%.

The profitability measures (ROA, ROE and EPS) of oil and gas companies are noticeably unstable, since the standard deviations are above their average mean. The explanatory variables SIZE, LEV and OILP had standard deviations below their respective averages and therefore it was concluded that their volatility were acceptable.

The empirical results of the panel estimation using R statistical software package to fit the different panel models are presented in Tables 4 - 6. The models determine the influence and correlation of response and explanatory variables selected for the study. I.e. what effect does change in the oil price have on the profitability ratios (ROA, ROE, EPS) and other variables such as the capital structure (through debt /equity level) and the size of the company.

Table 4. Panel Results of ROA for the firms – 2012-2016

Coefficients	OLS	Random Effect	Fixed Effect	GMM
Intercepts	0.1723 (0.131)	0.2691 (0.1687)		
S1	-0.0554 (0.015)***	-0.0603 (0.0162)***	-0.0664 (0.0177)***	
S2	-0.0430 (0.014)**	-0.04616 (0.0146)**	-0.0501 (0.0154)**	
S3	-0.0214 (0.0138) .	-0.02268 (0.01357) .	-0.0241 (0.0139) .	
LEV	-0.0246 (0.0109)*	-0.0341 (0.0154)*	-0.0500 (0.02115)*	-0.01377 (0.0118)
OILP	0.0960 (0.0294)**	0.0975 (0.03077)**	0.09705 (0.0336)**	
SIZE	-0.0236 (0.0127) .	-0.0315 (0.0168) .	-0.0412 (0.02112) .	-0.00618 (0.0118)
R^2	0.167	0.1718	0.1818	0.0172
Adj R^2	0.1344	0.1393	0.1089	-0.1675
F statistics	5.113	5.289	0.1089	0.6834
p-value	8.177e-05	5.563e-05	4.522e-05	0.5637

( ): Standard errors; Statistical significance: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 5. Panel Results of ROE for the firms – 2012-2016

Coefficients	OLS	Random Effect	Fixed Effect	GMM
Intercepts	0.1155 (0.24997)	0.24274 (0.32097)		
S1	-0.0955 (0.02932)**	-0.10213 (0.0310)**	-0.01109 (0.03421)**	
S2	-0.0720 (0.02759)**	-0.07634 (0.02799)**	-0.08211 (0.02970)**	
S3	-0.0373 (0.02645)	-0.03916 (0.02604)	-0.04142 (0.02673)	
LEV	-0.0022 (0.02075)	-0.01219 (0.02926)	-0.03046 (0.04076)	0.0121 (0.0248)
OILP	0.1967 (0.05632)***	0.20052 (0.0)***	0.02027 (0.06477)**	
SIZE	-0.03288 (0.02422)	-0.04388 (0.03208)	-0.05817 (0.04072)	-0.0086 (0.0118)
R^2	0.1258	0.1334	0.1404	0.0172
Adj R^2	0.0915	0.0994	0.0638	-0.1675
F statistics	3.669	3.926	3.974	0.6834
p-value	0.001968	0.001118	0.001030	0.5637

( ): standard errors; Statistical significance: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 6. Panel Results of EPS for the firms – 2012-2016

Coefficients	OLS	Random Effect	Fixed Effect	GMM
Intercepts	-11.659 (2.647)***	-2.6915 (3.4745)		
S1	-0.71962 (0.31049)*	-1.2394 (0.3127)***	-1.4669 (0.3246)***	
S2	-0.57786 (0.29214)*	-0.9233 (0.2769)**	-1.0743 (0.2818)**	
S3	-0.29286 (0.28012)	-0.4704 (0.2536) .	-0.5464 (0.2536)*	
LEV	-0.05262 (0.21972)	-0.1462 (0.3315)	-0.2280 (0.3868)	0.07108 (0.2547)
OILP	2.52542 (0.59638)***	3.2228 (0.59270)***	3.5045 (0.61453)***	
SIZE	-0.77889 (0.25647)**	-0.1332 (0.3490)	-0.5296 (0.3864)	1.1519 (0.25125)
R^2	0.2863	0.3044	0.3251	0.16886
Adj R^2	0.2584	0.2772	0.2650	0.01258
F statistics	10.23	11.16	11.723	7.933
p-value	1.648e-09	2.5927e-10	1.0591e-10	7.4192e-05

( ): standard errors; Statistical significance: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

This study dealt with quarterly seasonal time series and the authors wanted to investigate the common deterministic seasonality that could substantially increase degrees of freedom and improve sample forecasting and parameter interpretation. The seasonal effect was represented in the model by introducing dummy variables and as the results output indicated, they were clearly statistically significant for all static panel models considered.

Based on the results obtained from the application of the static panel models, the fixed effect EPS regression had the highest R-squared and appeared to be able to explain variations in profitability; i.e. the models with EPS as response performed better than those with the other responses (ROA and ROE). Of the models fitted, the EPS fixed effects model performed best (R-squared = 0.32513). The fact that the R-squared values were generally on the low side could be attributed to the fact that the sample size considered was small.

This study concludes that there is a positive and statistically significant relationship between the crude oil price and financial performance of oil and gas firms. This results agreed with the conclusion by Dayanandan & Donker (2011), who studied similar companies in North America. The static linear models estimated coefficient of the SIZE variable to be negatively correlated with ROA and ROE profitability measures. This results are in accordance with the studies by Majumdar (1997) and Dogan (2013), but contrasted that of Dayanandan and Donker (2011). However, firm size influence on EPS was mixed for the linear models. The leverage

level of firms negatively impact profitability measures (ROA, ROE, and EPS). This finding is in agreement with Dayanandan and Donker (2011) as well as with Hussain and Nguyan (2016).

The dynamic GMM models seasonal dummy and oil price (OILP) variables are not presented due to differences being taken, i.e. the GMM method involved differencing the series and adding a lagged value for the response variable. Since the oil price movement was the same for the different companies, the variable disappeared when taking the difference. For these models the inclusion of a lagged response variable was also needed. Thus this model proved to be a poor predictor of the impact of oil price on firm profitability of oil and gas firms as oil price influence was found to be absent from the model. This is in contrast with Dayanandan and Donker (2011).

CONCLUSION

The main purpose of this research study was to develop a panel model to examine the relationship between the crude oil price and accounting performance measures as represented by ROA, ROE and EPS of oil and gas companies listed worldwide; and according to Forbes 2016 top 20 oil and gas company list from the period of 2012 to 2016.

As per hypothesis 1, this study found that crude oil prices positively and significantly impact accounting returns (as represented by ROA, ROE and EPS) of oil and gas firms listed worldwide as per Forbes 2016 top 20 oil and gas company list. The size of oil and gas companies statistically insignificant and negatively correlated with ROA and ROE. However, as per hypothesis 4 the lagged oil price does not influence the results of the panel models.

One of the limitations of this study was the lack of acceptable results on the regression models, especially the GMM dynamic models. Indeed the GMM results were quite odd and should be used with caution. This may be because that there was not enough complete data used in the study. The selection of oil and gas companies using Forbes 2016 top 20 list in combination with excluding all non IFRS data provided only few companies with quarterly data from 2012 to 2016. In addition this study was realized within a specific time period 2012 -2016, which may have proved to be too short to realise any meaningful correlations. This could explain why hypothesis 4 was not significant.

As with any other research, the findings and the conclusion provided opportunity for more research work to be conducted in this area. The low values of R-squared may be linked to the small sample size. The strict application of IFRS accounting measure excluded all companies using GAAP, including all North American Oil and gas companies. This resulted in the small sample size used in the study. The recommendation is that future studies normalise the IFRS and GAAP accounting measures to include more oil and gas companies. Secondly,

the time period was too short (2012 to 2016); future studies must extend this to a longer period to have meaningful data to analyse.

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