

OIL AND GAS INDUSTRY: KEY METRICS AND STOCK PERFORMANCE

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ABSTRACT:

The petroleum or oil and gas industry includes the global processes of exploration, extraction, refining, transporting, and marketing of petroleum products. This industry is considered as the biggest global industry in dollar. The oil and gas industry is also considered as a global powerhouse employing hundreds of thousands of workers worldwide as well as generating hundreds of billions of dollars each year. Despite investing in the oil and gas industry has to face a number of significant risks, it can be highly profitable. In order to make appropriate investment decision, investors need to consider key financial metrics that are helpful in analyzing and evaluating oil and gas firms. This study is to analyze some key financial metrics for oil and gas companies, analyze annual financial and operating data of some biggest oil and gas companies around the world to find out whether there are positive or negative linear correlations between stock returns and each key financial metric of these companies. The study also finds out some useful multiple regression models between stock returns and key financial metrics of oil and gas firms.

Keywords: Oil and gas, linear correlation, financial metrics.

1. Introduction

The US State Board of Administration (SBA) sponsored an executive compensation research study by Farient Advisors LLC, covering 1,800 US companies, 24 Industry groups, and fourteen years of data (from 1998-2011). The research project identifies the primary metrics used in executive compensation plans, overall and by industry, company size and valuation premiums, and then tests these metrics to determine whether the metrics used have the highest impact on total stock returns (or total shareholder returns - TSR). The study found that, in aggregate, performance metrics are generally well-aligned with shareowner value. Earnings growth, followed by returns and revenue growth, has the greatest impact on stock prices. This review also found that many industries have a number of metrics to choose from; with half of the 24 industrial groups studied having

at least three metric categories with strong correlations to TSR. However, the optimal use of measures differs considerably by industry ([1]).

The limitation of Farient's research: They only study standard metrics in corporate finance; They only study US companies; They only consider correlations between key metrics and stock returns which are positive, hence does not provide a complete picture.

Also there is a plenty of research which intends to enlighten the relationship between capital structure and performance of listed firms. For examples: Fama and French ([2]) analyzed stock return average on market risk, company size, finance leverage, stock holders' salary bond value to market value, stockholders' salary and profit to price ratio by regression; Hobarth ([3]) examined the relationship between financial indicators and firm's performance of listed firms in USA for 19

years period by using 17 financial indicators and three variables to measure firm's performance, namely market performance (stock market value), cash flow performance (dividend per share), and profitability (Return on Investment - ROI).

The petroleum or oil and gas industry, also known as the oil industry or the oil patch, includes the global processes of exploration, extraction, refining, transporting (often by oil tankers and pipelines), and marketing of petroleum products. The largest volume products of the industry are fuel oil and gasoline (petrol). Considered to be the biggest sector in the world in terms of dollar value, the oil and gas industry is a global powerhouse employing hundreds of thousands of workers worldwide as well as generating hundreds of billions of dollars globally each year. In regions which house the major national oil companies, these oil and gas companies are so vital they often contribute a significant amount towards national gross domestic product (GDP) ([4]).

The industry is usually divided into three major components: upstream, midstream and downstream. The Upstream component is also referred to as the E&P (exploration and production). This involves search for underwater and underground natural gas fields or crude oil fields and the drilling of exploration wells and drilling into established wells to recover oil and gas. Downstream refers to the filtering of the raw materials obtained during the upstream phase. This means refining crude oil and purifying natural gas. The marketing and commercial distribution of these products to consumers and end users in a number of forms including: natural gas, diesel oil, petrol, gasoline, lubricants, kerosene, jet fuel, asphalt, heating oil, LPG (liquefied petroleum gas) as well as a number of other types of petrochemicals. Midstream is generally classified under the downstream category ([4]).

In recent years there has been a growing negative sentiment towards the oil and gas industry and "big energy". Major environmental disasters such as the Deepwater Horizon Gulf Of Mexico Oil Spill have cast a negative spotlight up on the industry. The trend towards Renewable and Alternative energy is also another threat to traditional oil and gas companies. Coupled with the rise in pro-eco legislation and governmental pressure has meant the oil and gas industry is under more scrutiny than ever ([4]).

However the oil and gas industry is still extraordinarily successful and still experiences massive growth. Petroleum is vital to many industries, and is of importance to the maintenance of industrial civilization in its current configuration, and thus is a critical concern for many nations. It's estimated that 30 billions barrels are consumed globally each year - primarily by developed nations. Petroleum is also the raw material for many chemical products, including pharmaceuticals, solvents, fertilizers, pesticides, synthetic fragrances, and plastics ([4]).

Investors face a wide array of public traded oil and gas companies to choose the best one to invest. Investing in the oil and gas industry carries a number of significant risks, but can be highly profitable as well. In order to make an informed choice, investors need to consider key financial metrics that are most helpful in analyzing and evaluating oil and gas firms.

For all these reasons, this study is quite necessary in finding out the relationship between key metrics and stock performance of oil and gas companies. In this paper, we study some key metrics for oil and gas companies and analyze annual financial and operating data of some biggest oil and gas companies around the world to find out whether there is positive/negative linear relationship between stock returns and each key metric of these companies. We also find out a multiple regression model between stock returns and key metrics.

2. Research questions, methodology and scope of research

We answer three main questions: 1) What are key financial metrics for oil and gas industry; 2) What metrics have a positive/negative linear relationship with total shareholder returns (TSR) for some biggest oil and gas companies in the world; 3) Find out different linear multiple regression models between TSR and key metrics based on a studied sample of companies.

Methodology & scope of analysis:

Qualitative: study key metrics for oil and gas companies such as Production to Reserves, Reserve Life Index, Reserve-Replacement Ratio, etc.

Quantitative: analyze data from 24 biggest oil and gas companies in the North America, South America, Europe and Asia. We obtain 12 years of data (2007-2018) from official annual reports of

these companies and their stock prices from Yahoo Finance.

3. Total shareholder returns and key financial metrics of oil and gas industry

3.1. Total shareholder returns (TSR)

TSR is the total return of a stock for a given period, or the capital gain plus dividends. The annual TSR is calculated by the following formula:

$$\frac{\begin{aligned} & \text{Price at end of year} \\ & - \text{Price at beginning of year} + \text{Dividends} \end{aligned}}{\begin{aligned} & \text{Price at beginning of year} \\ & \text{Adjusted closing price at end of year} \\ & - \text{Adjusted closing price at beginning of year} \\ & \text{Adjusted closing price at beginning of year} \end{aligned}}$$

The stock price used in this study is the adjusted closing price that already includes dividend. We obtain this stock price from Yahoo Finance ([10]).

3.2. Featued metrics for oil and gas companies ([5], [6], [7])

a) Production to Reserves

Reserves are the amount of resource still in the ground. Production is the average amount of resource being pulled from the ground. This ratio is used to determine if a company is replacing the reserves depleted through production. To perform this calculation, first the amount of natural gas reserves needs to be converted from cubic feet (cf) to **barrels of oil equivalent** (BOE), usually at a ratio of 6,000 (or 5,800) cf to 1 BOE.

$$\text{Production to Reserves} = \frac{\text{Production}}{\text{Reserves}}$$

b) Reserve Life Index (RLI)

The RLI is the reciprocal of the Production to Reserves Ratio, showing how long reserves will last at the current production rate with no additions to reserves.

$$\text{RLI (years)} = \frac{1}{\text{Production to Reserves Ratio}}$$

c) Reserve-Replacement Ratio

The Reserve-Replacement Ratio is used to see if a company is replacing production. Basically, it shows whether a company is increasing reserves or depleting them. The main objective of any oil and gas company is to maximize profit while increasing the value of the company year after year. In order to do this, the company must generate more revenue while cutting costs. To achieve this, the

company must enhance its oil and gas production year after year. This is to say that a company needs to continually invest its financial resources in exploration and development activities to broaden their portfolio. The greater the proved oil and gas reserves added to the company's resource base, the greater the value of the company.

$$\text{Reserve-Replacement Ratio} = \frac{\text{Increase in Reserve} + \text{Production}}{\text{Production}}$$

d) Finding Cost (Technical) per BOE

Finding cost is used to estimate a company's cost to find new reserves, measuring technical efficiency of that company.

$$\text{Finding Cost (Technical) per BOE} = \frac{\text{Exploration Cost}}{\text{Reserves changed from extensions and discoveries}}$$

e) Production Costs per BOE

Production costs for the period are divided by combined oil and gas production volumes, to be analyzed on a per BOE basis.

$$\text{Production Costs per BOE} = \frac{\text{Production Costs}}{\text{Total Oil and Gas Production}}$$

3.3. Standard corporate finance metrics ([8])

We also consider some standard metrics, which are usually used to evaluate the performance of companies in corporate finance.

a) Diluted Earnings per Share (EPS)

Diluted EPS is a very important performance metric used to gauge the quality of a company's earnings per share (EPS) if all convertible securities were exercised. Companies usually report both primary and diluted EPS, but the focus is generally more on the diluted EPS, as it is more conservative and indicates a worst-case scenario in terms of EPS.

b) Diluted EPS Growth

EPS Growth is defined as the percentage change in EPS over the previous 12-month period to the latest year end. It gives a good picture of the rate at which a company has grown its profitability.

$$\text{Diluted EPS Growth} = \frac{\begin{aligned} & \text{Current year's diluted EPS} \\ & - \text{Previous year's diluted EPS} \end{aligned}}{\text{Previous year's diluted EPS}}$$

c) Revenue Growth

Revenue Growth is the percentage increase (or decrease) in a company's sales from one period to the next.

$$\text{Revenue Growth} = \frac{\text{Current year's revenue} - \text{Previous year's revenue}}{\text{Previous year's revenue}}$$

d) Return on Equity (ROE)

ROE is the amount of net income returned as a percentage of shareholders equity. Return on equity measures a corporation's profitability by revealing how much profit a company generates with the money shareholders have invested.

Return on Equity

$$\frac{\text{Income attributable to shareholders}}{\text{Total shareholders' equity}}$$

e) Free Cash Flow (FCF) Growth

FCF growth is the percentage change in FCF from year to year.

Free Cash Flow

Net cash provided by operating activities
- Capital expenditures

FCF Growth

$$= \frac{\text{Current year's FCF} - \text{Previous year's FCF}}{\text{Previous year's FCF}}$$

f) Earnings Margin (Net Profit Margin)

We calculate this ratio as net income divided by revenue. This ratio measure how much out of every dollar of sales a company actually keeps in earnings.

Earnings Margin

$$= \frac{\text{Income attributable to shareholders}}{\text{Revenue}}$$

4. Main results

4.1. Correlations between TSR and key metrics

We analyze annual financial and operating data in a 12-year period (2007-2018) of 24 biggest oil and gas companies around the world, which includes (9):

- Eleven (11) companies in the United States: ExxonMobil, Chevron, ConocoPhillips, EOG Resources, Occidental Petroleum, Marathon Oil, Anadarko Petroleum, Murphy Oil, Noble Energy, Hess, Pioneer Natural Resources;

- Four (04) companies in Canada: Suncor Energy, Canadian Natural Resources, Imperial Oil, Husky Energy;

- One (01) company in Brazil: Petrobras;
- Six (06) companies in Europe: Royal Dutch Shell (Netherlands), BP (UK), Total (France), Ente Nazionale Idrocarburi (ENI, Italy), Equinor (Norway);

- Two (02) companies in China: PetroChina, Sinopec.

We find out the correlation between TSR and each key metric. We also run the Pearson test to see if the sample data supports a positive/negative linear relationship between two populations.

We summarize the finding of correlations in the following table, note that we only list entries which are statistically significant (p-value < 0.1):

Company	Best metric(s) showing positive relationship with TSR			Best metric(s) showing negative relationship with TSR		
	Metric	Correlation	P-value	Metric	Correlation	P-value
US						
ExxonMobil	Production/ Reserves	0.54	0.035	RLI; Reserve-Replacement Ratio	-0.53; -0.5	0.037; 0.048
Chevron	Production/ Reserves	0.43	0.082	RLI, Reserve-Replacement Ratio	-0.44, -0.53	0.079, 0.04
ConocoPhillips	EPS; ROE, FCF Growth, Earnings Margin; EPS Growth	0.81; 0.78, 0.62; 0.53; 0.41	0.00; 0.00; 0.02; 0.04; 0.09	Finding Cost/BOE	-0.65	0.01

Company	Best metric(s) showing positive relationship with TSR			Best metric(s) showing negative relationship with TSR		
	Metric	Correlation	P-value	Metric	Correlation	P-value
EOG Resources						
Occidental Petroleum	RLI	0.48	0.058	Production Costs/BOE; Production/ Reserves	-0.65; -0.44	0.01; 0.076
Marathon Oil						
Anadarko Petroleum						
Murphy Oil						
Noble Energy				Production Costs/BOE	-0.58	0.02
Hess Corporation						
Pioneer Natural Resources				Revenue Growth	-0.43	0.08
Canada						
Sunoco Energy	Reserve-Replacement Ratio	0.46	0.067			
Canadian Natural Resources	Reserve-Replacement Ratio	0.45	0.073			
Imperial Oil	EPS Growth	0.74	0.00	ROE	-0.5	0.049
Husky Energy	Earnings Margin; EPS Growth, EPS	0.58; 0.54; 0.43	0.02; 0.03; 0.08			
Brazil						
Petrobras				Production Costs/BOE	-0.67	0.01
Europe						
BP				FCF Growth	-0.73	0.01
Royal Dutch Shell	EPS Growth	0.59	0.02	Finding Cost/BOE	-0.62	0.02
Total						
ENI				Finding Cost/BOE; FCF Growth	-0.66; -0.48	0.01; 0.06
Repsol				FCF Growth	-0.62	0.02
Equinor				Finding Cost/BOE; Production Costs/BOE	-0.66; -0.41	0.01; 0.09
China						
PetroChina	Reserve-Replacement Ratio	0.41	0.09			
Sinopec				Production Costs/BOE	-0.41	0.09

Here we can conclude that investors may want to pay attention to key metrics which have a strong enough positive/negative linear relationship with TSR (p-value < 5%).

4.2. Multiple regression models

Regression analysis helps to understand how the value of the dependent variable changes when independent variables are varied. We start with:

- Dependent variable: $\ln(1 + \text{TSR})$. That is, we consider logarithm of returns rather than simple returns.

- Independent variables: Eleven (11) key metrics listed in Sections 3.2 and 3.3 (Production to Reserves, RLI, etc).

We use a sample of 288 observations from 24 companies listed in Section 4.1. Notice that for companies that do not use US dollars on their financial reports, we use an annual exchange rate to convert to USD.

By using the Bayesian Model Average (BMA) package in R, we find out that Reserve-Replacement Ratio, Production Costs/BOE, EPS Growth, Revenue Growth, Earnings Margin have high posterior probabilities of being in the model, while other six variables, such as RLI, have low posterior probabilities.

The BMA package gives us the following best 5 models (cumulative posterior probability = 0.5913):

- Model 1(05 independent variables):
- Model 2 (04 independent variables):
- Model 3 (04 independent variables):
- Model 4 (03 independent variables):
- Model 5 (03 independent variables):

One can see a surprise here that Revenue Growth has a significantly negative linear relationship with log-returns. On the other hand, there is no surprise that Production Costs/BOE has a significantly negative linear relationship with log-returns and Earnings Margin has a significantly positive linear relationship with log-returns.

Model 1(05 independent variables)

Significant F (p-value): 1.52e-05		
	Coefficients	P-value (two –tail)
Intercept	0.098378	0.011400
Reserve-Replacement Ratio	0.012958	0.061168
Production Costs/BOE	-0.009067	0.001204
EPS Growth	0.009312	0.023283
Revenue Growth	-0.228117	0.000728
Earnings Margin	0.239579	0.010316

Model 2 (04 independent variables)

Significant F (p-value): 2.566e-05		
	Coefficients	P-value (two –tail)
Intercept	0.106297	0.006229
Production Costs/BOE	-0.008437	0.002482
EPS Growth	0.009643	0.019253
Revenue Growth	-0.225740	0.000868
Earnings Margin	0.261148	0.005079

Model 3 (04 independent variables)

Significant F (p-value): 5.533e-05		
	Coefficients	P-value (two –tail)
Intercept	0.098437	0.01196
Reserve-Replacement Ratio	0.013637	0.05032
Production Costs/BOE	-0.008903	0.00159
Revenue Growth	-0.202171	0.00251
Earnings Margin	0.265704	0.00448

Model 4 (03 independent variables)

Significant F (p-value): 0.0001062		
	Coefficients	P-value (two –tail)
Intercept	0.106789	0.00640
Production Costs/BOE	-0.008233	0.00337
Revenue Growth	-0.198691	0.00310
Earnings Margin	0.289426	0.00192

Model 5 (03 independent variables)

Significant F (p-value): 0.000332		
	Coefficients	P-value (two –tail)
Intercept	0.107343	0.00635
Production Costs/BOE	-0.007890	0.00503
EPS Growth	0.011146	0.00711
Revenue Growth	-0.176291	0.00756

5. Conclusion

We analyze annual data of 24 biggest oil and gas companies around the world in a 12-year period (2007-2018) to see if there are positive/negative linear relationships between total shareholder returns and some key metrics including standard metrics used in corporate finance and featured metrics for oil and gas companies. We find out that in many cases, the correlation between total shareholder returns and some key metrics are statistically significant (p -value $< 5\%$).

We also use the BMA package in R to find out

five multiple regression models to test the impact of key metrics on total shareholder returns. The result shows that Reserve-Replacement Ratio, EPS Growth and Earnings Margin may have significant positive impact on stock returns while Production Costs/BOE and Revenue Growth may have significant negative impact on stock returns (p -value $< 5\%$).

But we still need to analyze more companies to get a better picture of correlation between key metrics and stock returns and also to get better multiple regression models ■

REFERENCES:

1. Farient Advisors LLC. 2013. *Performance Metrics and Their Link to Value*. [online] Available at: <https://corpgov.law.harvard.edu/2013/02/20/performance-metrics-and-their-link-to-value/>
2. Fama, E., French, K., 1993. *Common risk factors in the returns on stocks and bonds*. *Journal of Financial Economics*. Vol.33. pp.3-56.
3. Hobarth, Mag Lukas L., 2006. *Modeling the relationship between financial indicators and company performance - An empirical study for US listed companies*. France: Dissertation Vienna University of Economics and Business Administration
4. Adam Muspratt. 2019. *Introduction to Oil and Gas Industry*. [online] Available at: <https://www.oilandgasiq.com/strategy-management-and-information/articles/oil-gas-industry-an-introduction>.
5. David Johnston, Daniel Johnston, 2005. *Introduction to Oil Company Financial Analysis*. Publisher: PennWell Corp. USA.
6. Salman Ghouri, 2017. *The Single Most Important KPI For Oil & Gas Companies*. [online] Available at: <https://oilprice.com/Energy/Crude-Oil/The-Single-Most-Important-KPI-For-Oil-Gas-Companies.html>.
7. EKI Interactive. 2019. *Upstream Oil and Gas Production Performance Metrics*. [online] Available at: <https://www.ekiinteractive.com/upstream-oil-and-gas-production-performance-metrics/>.
8. Ross, S., Westerfield, R. and Jaffe, J., 2008. *Corporate Finance*, 6th edition. Publisher: McGraw-Hill/Irwin. USA.
9. *Financial reports of 24 companies: ExxonMobil, Chevron, ConocoPhillips, EOG Resources, Occidental Petroleum, Marathon Oil, Anadarko Petroleum, Murphy Oil, Noble Energy, Hess, Pioneer Natural Resources, Suncor Energy, Canadian Natural Resources, Imperial Oil, Husky Energy; Petrobras; Royal Dutch Shell, BP, Total, Ente Nazionale Idrocarburi, Equinor; PetroChina, Sinopec*. Available at the official websites of these companies.
10. Yahoo Finance. [online] Available at: <https://finance.yahoo.com/>.

Received: 13/8/2019

Revised: 23/8/2019

Accepted for Publication: 5/9/2019

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TÓM TẮT:

Ngành công nghiệp dầu khí hay dầu mỏ bao gồm các quá trình toàn cầu về thăm dò, khai thác, tinh chế, vận chuyển và tiếp thị các sản phẩm dầu khí. Được coi là ngành lớn nhất thế giới tính theo giá trị đồng đô la, ngành dầu khí sử dụng hàng trăm ngàn công nhân trên toàn thế giới cũng như tạo ra hàng trăm tỷ đô la mỗi năm. Đầu tư vào ngành dầu khí có một số rủi ro đáng kể, nhưng cũng có thể mang lại lợi nhuận cao. Để lựa chọn sáng suốt, nhà đầu tư cần xem xét các chỉ số then chốt rất hữu ích trong phân tích và đánh giá một công ty dầu khí. Trong bài báo này, chúng tôi nghiên cứu một số chỉ số tài chính then chốt cho các công ty dầu khí và phân tích dữ liệu tài chính hàng năm của một số công ty dầu khí lớn trên thế giới để tìm hiểu mối liên hệ tuyến tính cùng chiều/ngược chiều giữa hiệu suất lợi nhuận cổ phiếu với mỗi chỉ số tài chính then chốt của các công ty này. Chúng tôi cũng tìm ra một số mô hình hồi quy tuyến tính đa biến giữa hiệu suất lợi nhuận cổ phiếu và các chỉ số tài chính then chốt.

Từ khóa: Dầu khí, dầu mỏ, mối liên hệ tuyến tính, chỉ số tài chính.