Equity Valuation 524 Project

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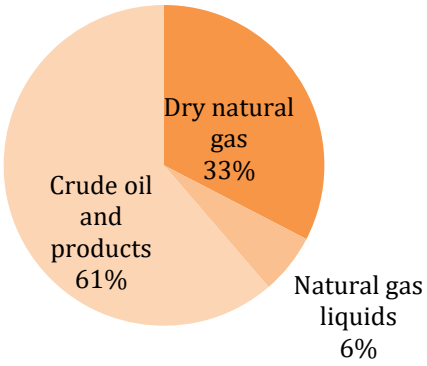
Noble Energy: Understanding Businesses

Noble Energy is an independent crude oil and natural gas exploration and production company with a diversified high-quality portfolio spanning three continents. Founded in 1932, Noble Energy is a Delaware corporation, incorporated in 1969, and has been publicly traded on the New York Stock Exchange (NYSE) since. NBL have been involved in Crude oil, Natural gas and Natural gas liquid exploration and development activities throughout United States onshore since 1932. US operations accounted for 74% of 2018 total consolidated sales volumes and 52% of total proved reserves at December 31, 2018. US Offshore and international business focuses on offshore opportunities in several countries and diversifies their portfolio. Their market and exploration basin outside US lie in Israel and Cyprus in Eastern Mediterranean area and Cameroon, Gabon and Equatorial Guinea in West Africa region. They have reliable and strong customer base in Israel and West Africa. Growing Israel and West Africa economy suggests better cash flows from outside of the US. They also lave licensing and exploration rights in Canada Energy Group ULC.

This map illustrates the locations of NBL's significant crude oil and natural gas exploration and production activities:

Products and Revenue segmentation:



Industry Analysis:

Products and Revenue segmentation:

Firms in this industry operate oil and gas fields and their major activities are Extracting and exploration of crude petroleum and natural gas and natural gas liquid. The major two ways in which firms in this industry functions are operating oil and gas filed on their own property or for others on a contract or fee basis. The Industry was facing problems with oversupply from last few years, but it is moving toward the other direction of supply crunch which looks positive for the industry. The industry feels much healthier than it did a couple of months ago as the price of oil has rebounded. After being to a range between the $52-55 per barrel Brent crude oil is now trading around $63. The industry is thus recovering from the last few years of weak prices, but it remains exposed to global commodity price fluctuations. Concentration in the industry is low, with the four largest companies estimated to account for 26.5% of industry revenue, most of which has operations worldwide Industries large size is the reason for low concentration. The concentration has decreased further as companies such as ConocoPhillips and Hess started to maximize efficiency and operating margins. The future of the industry is expected to increasingly depend on improvements in drilling technology and techniques. As industry players deplete their reserves, it will become necessary to improve efficiency and minimize waste over the next few years to sustain. Industry revenue is to expand at an annualized rate of 10.9%, however, this rate is inflated due to steep revenue declines of 41.9% and 9.8% in 2015 and 2016. This revenue growth is also supported by exports. In late 2015, Congress overturned the 40-year-old ban on US crude oil exports due to pressure from industry operators.

This will help firms to sell products abroad. According to the latest report by the US Energy Information Administration, domestic crude oil exports are anticipated to average more than 0.97 million barrels per day over 2018. Consequently, over the five years to 2018, exports are expected to increase at an annualized rate of 21.3%.

Key Drivers Affecting the Industry

1. International prices of crude oil: Oil prices have a history of high volatility, and any increase positively affects industry revenue and profit. The world price of crude oil is expected to rise in the following years.
2. Vehicle sale and increased traveling: If people travel more, there is more demand for oil products. The Oil Drilling and Gas Extraction industry provides the raw materials that refineries required to produce gasoline, diesel and other vehicle fuels. The industry can be positively influenced by an increase in the increasing number of vehicles sold and traveling.
3. Regulation for the Petrochemical Manufacturing industry: Regulation has been increasing due to environmental disasters associated with Industry operations. As environmental concerns about water contamination and pollution have not been addressed, Regulation for the industry is expected to continue increasing in the following years.

Porter's Five Forces

Buyer Power: Being a small oil and gas industry, Noble Energy doesn't have the influence necessary to affect oil and gas prices thus buyer power is minimal. Buyers consisting of consumers or even industries such as airlines who purchase products from Noble Energy cannot influence the price of oil and natural gas by going elsewhere since other companies charge the same prices as set by global standards, which are set according to the following global factors:

1. Demand for crude oil, natural gas and NGLs as impacted by economic factors that affect gross domestic product growth rates of countries around the world
2. Supply for crude oil, natural gas and NGLs as impacted by OPEC and non-OPEC countries (e.g. US, Russia, Canada)
3. Technology advances that increase crude oil, natural gas and NGL production more efficient, thereby increasing supply
4. Geopolitical conditions and events including generational leadership or regime changes, and changes in government energy policies, including imposed price controls and/or product subsidies, or instability/armed conflict in hydrocarbon-producing regions
5. Fluctuations in the US dollar exchange rates, the currency in which the world's crude oil trade is generally denominated
6. Price and availability of alternative fuels, including coal, solar, wind, nuclear energy, and biofuels, as well as the availability of battery storage
7. The long-term impact on the crude oil market of the use of natural gas and electricity as an alternative fuel for road transportation or the use of natural gas as a fuel for electricity generation impacting the demand for electricity
8. Level and effect of trading in commodity futures markets, including by commodity price speculators and others
9. Domestic and foreign governmental regulations and taxes
10. Other factors may include weather and conservation measures around the world

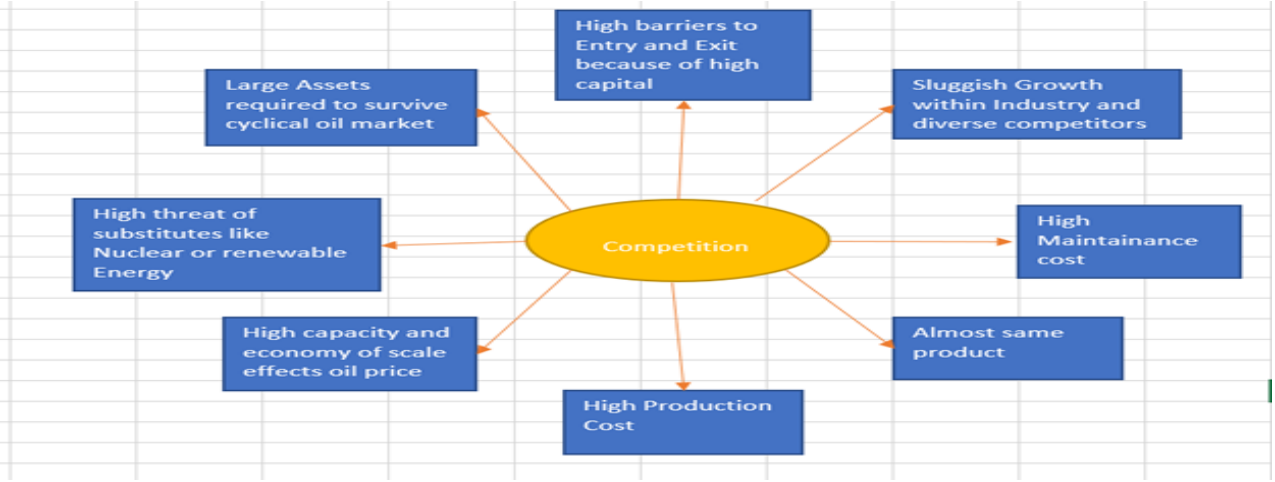
Supplier Power: Since NBL is an oil exploration and drilling company, they are the initial supplier and do not rely on anyone else to provide the core commodity of oil. However, they are vulnerable to fluctuating prices of oil industry equipment and repair parts from the suppliers of that equipment. On the contrary; due to the excessive competition amongst the very large number of suppliers of this equipment and repair parts, the suppliers' bargaining power is still quite low, for now. By accounting for the market trends to shift towards alternative and renewable energy sources, it is likely the oil industry and equipment and parts suppliers will shrink, which means less competition and increasing bargaining power for suppliers of parts and equipment.

Threat of Substitution: Due to the growing concerns associated with greenhouse emissions and the prioritization of renewable energy, the oil and gas industry is extremely vulnerable to the threat of substitution. For example, vehicles can now be fueled by biofuels like ethanol and biodiesel, hydrogen, or electricity. According to National Geographic (n.d.), even United Airlines began substituting biofuels for jet fuel in 2016 to reduce greenhouse gas emissions by up to 60%.

Homes can be energized by solar power and wind energy, and trains and power generation plants can substitute coal or other biomass energy like landfill waste for oil and gas fuel sources. According to Renewable Resources Co (2016), additional energy alternatives include nuclear energy, tidal and wave energy, geothermal power, and hydroelectric energy. With the many alternatives and renewable energy substitutes available, and the prioritization of reducing implementation costs through technological advancement associated with their use, the threat of substitution is excessively high and steadily growing.

Threat of New Entrants: Oil and gas prices and associated profits are extremely volatile with no end in sight, which is a deterrent to new players. Additionally, huge capital requirements are a barrier to entry. Since existing companies control almost 90% of the proven oil and gas reserves, it is difficult for a new firm to find oil reserves that they can leverage and take to market. National and international regulatory restrictions also make it extremely difficult for any new entrants to join the industry. Since big oil and gas companies can increase their R&D spending to boost innovation by improving existing technologies, this strategy gives them a competitive advantage over new oil and gas companies which enter the industry. Lastly, old players have leverage through economies of scale that new players cannot obtain or compete with. Combined, all these factors act as a deterrent for new entrants to join the industry.

Competitive Rivalry: To understand the competitive rivalry, we must first understand the activities and geographic location Noble Energy is involved in. NBL searches for crude oil and natural gas reserves onshore and offshore while always pursuing additional exploration rights. Approximately 70% of NBL's 2018 capital program is allocated to US onshore development while the remaining portion is designated for exploration of lease acquisition, seismic, and other developments. In addition, the majority of NBL's assets are held by production, which allows for further investment and financial flexibility with a room for acquisition and investment which allows them to maintain a diversified portfolio. NBL primarily focuses on organic growth from exploration and development drilling activities, concentrating on existing basins or plays where they have strategic competitive advantages, or in new basins with attractive geological potential and the opportunity for attractive financial returns. For these reasons and the other reasons mentioned in the threat of new entrants' section, Noble Energy faces a very small competitive rivalry force currently and, in the future.



Stock Screening:

To find the Alternative stock selection to NBL, we tried to filter various Independent Oil and Gas companies registered in US Exchanges based on Market Capitalization, P/E Ratio, and Price using finviz.com. These are the competitive stocks that may replace NBL.inc and we will investigate few of them to find an alternative stock selection. Here we have filtered companies those have large market cap ($10B to $200B) and P/E ratio of 10 or more. Larger the P/E ratio more is the investor willing to pay per dollar earning on a share and hence, larger is the growth prospects of a company. However, P/E doesn't have to be too high so, that investor feel hesitant to invest on it because of lower earning and hence lower stock earning prospect.
Our first requirement is that the stocks be traded in the USA. We will screen for stocks from the NYSE. Second, our minimum market capitalization for stocks is $2 billion. We choose only stocks with a positive dividend yield, and which held their IPO at least one year ago. Finally, we require the current trade volume for stocks be at least 500,000.

No.	▲ Ticker	Company	Sector	Industry	Country	Market Cap	P/E	Price	Change	Volume
1	APA	Apache Corporation	Basic Materials	Independent Oil & Gas	USA	12.56B	42.06	33.12	0.18%	2,729,780
2	APC	Anadarko Petroleum Corporation	Basic Materials	Independent Oil & Gas	USA	22.02B	31.88	44.95	1.08%	2,041,654
3	CLR	Continental Resources, Inc.	Basic Materials	Independent Oil & Gas	USA	16.91B	17.04	45.05	0.20%	801,298
4	COG	Cabot Oil & Gas Corporation	Basic Materials	Independent Oil & Gas	USA	10.90B	20.69	25.62	0.51%	1,151,415
5	COP	ConocoPhillips	Basic Materials	Independent Oil & Gas	USA	75.03B	12.30	65.31	-0.31%	1,989,779
6	DVN	Devon Energy Corporation	Basic Materials	Independent Oil & Gas	USA	13.60B	25.66	30.71	0.00%	1,240,349
7	EOG	EOG Resources, Inc.	Basic Materials	Independent Oil & Gas	USA	54.52B	16.20	93.32	-0.65%	1,329,326
8	EPD	Enterprise Products Partners L.P.	Basic Materials	Independent Oil & Gas	USA	64.21B	15.60	29.47	-0.44%	863,992
9	FANG	Diamondback Energy, Inc.	Basic Materials	Independent Oil & Gas	USA	16.60B	12.58	99.79	-0.17%	844,695
10	HES	Hess Corporation	Basic Materials	Independent Oil & Gas	USA	18.27B	-	59.94	0.64%	913,559
11	MRO	Marathon Oil Corporation	Basic Materials	Independent Oil & Gas	USA	13.95B	13.02	17.00	0.41%	2,893,770
12	NBL	Noble Energy, Inc.	Basic Materials	Independent Oil & Gas	USA	12.17B	-	24.92	-0.32%	1,199,932
13	OXY	Occidental Petroleum Corporation	Basic Materials	Independent Oil & Gas	USA	49.79B	12.34	66.29	0.34%	1,187,236
14	PXD	Pioneer Natural Resources Company	Basic Materials	Independent Oil & Gas	USA	24.69B	25.67	147.17	0.76%	401,345

We further going screened stocks based on price and P/E, P/B Ratio and Return on Equities. These characteristics were chosen to ensure that our valuation models will be applicable. For small-cap, newly public, illiquid, or 0 dividend yield stocks, available information may be limited and valuation more complicated. After applying these screens and eliminating stocks with any outlier characteristics, we propose the following alternatives:

Ticker	Company	Industry	Market Cap (Billions)	P/E	P/B	ROE (%)
NBL	Noble Energy	Independent Oil & Gas	10.38	23.36	1.1	12.2
APA	Apache Corporation	Independent Oil & Gas	12.06	12.05	1.62	11.6
COP	ConocoPhillips	Independent Oil & Gas	79.08	12.64	2.47	14.6
MRO	Marathon Oil Corporation	Independent Oil & Gas	12.96	20.46	1.1	5.7

Equity Snapshots:

Snapshot Descriptions of Each Stock

1. **Noble Energy (NBL):** Noble Energy is a petroleum and natural gas company with reserves in the United States, Israel, and Equatorial Guinea. Noble Energy is a well-known developer of Israel's Leviathan field. Most of its reserves are in the US, especially in the Delaware Basin. Noble Energy serves natural gas in these three primaries markets and operates a network of pipelines to service the transactions.

Market Cap:	$10.38 Billion
Price:	21.89
Dividend Yield:	0.0207
P/E:	23.36
ROE:	12.2%

Noble energy is in a unique position in the industry because of its presence in the US, Eastern Mediterranean, and West African Markets. This geographic diversity gives the firm a unique risk profile. Additionally, the firm carries low debt and is well capitalized, allowing it to withstand a market downturn for a longer period than its peers. Potential issues on the horizon include political risk in West Africa, and oil/natural gas price movements.

2. **Apache Corporation (APA):** Apache Corporation is a petroleum and natural gas company with production operations in the United States, Egypt, and the North Sea. Like Noble Energy, the company produces both crude oil and natural gas in its three markets.

Market Cap:	$12.06 Billion
Price:	32.56
Dividend Yield:	3.10%
P/E:	12.05
ROE:	11.60%

Analyst commentary on Apache Corporation tends to focus on its high sensitivity to oil prices. Since the company is highly levered (debt to equity 108%), its ability to survive a downturn in the market is questionable. Therefore, it may perform poorly in uncertain oil price environments.

3. ConocoPhillips (COP): ConocoPhillips is a petroleum and natural gas company with geographically diverse operating regions including Alaska, Continental US, Latin America, Canada, Europe, Asia Pacific, Middle East, and others. It is the world's largest independent oil and gas producer. ConocoPhillips is primarily an upstream producer, meaning it focuses on exploring and drilling for oil, rather than refining the oil or gas into products to be sold to customers. ConocoPhillips sold its downstream business in 2012. The Asia Pacific and Middle East segment has operations in China, Indonesia, Malaysia, Australia, Timor-Leste and Qatar. During 2018, Asia Pacific and Middle East contributed 14 percent of their worldwide liquids production and 60 percent of our natural gas production.

Market Cap:	$79.08 Billion
Price:	69.24
Dividend Yield:	1.80%
P/E:	12.64
ROE:	14.60%

As a primarily upstream producer, ConocoPhillips is more sensitive to oil prices than typical oil and gas supermajors. This is because they do not sell a differentiated product. Thus, they are highly dependent on the market price of that product. Recent earnings reports indicate a 1.8% dividend yield, which is below average for the industry.

4. Marathon Oil Corporation: Marathon Oil Corporation is a petroleum and natural gas producer with upstream and downstream operations and exploration in the United States, Canada, Equatorial Guinea, and Libya. Marathon is another oil and gas supermajor that has brand power in addition to operational scale. With both geographic and product line diversity (upstream and downstream) Marathon can trade at high multiples, comparable to Noble Energy, which trades at high multiples because of its clean balance sheet.

Market Cap:	$12.96 Billion
Price:	16.89
Dividend Yield:	1.29%
P/E:	20.46
ROE:	5.70%

Recent news on Marathon Oil Corporation focuses on their tendency to consolidate drilling operations into 4 major basins. The consolidation has the effect of reducing operational costs, as fewer drilling sites mean fewer fixed costs associated with those sites. The company also faces some political risk due to its African operations. In recent weeks, the Libyan military has disrupted operations at a drilling site, causing a material effect on output.

Alternate Stock Selection:

From all the companies above, we found ConocoPhillips worth of further investigation and valuation based on our initial analysis. ConocoPhillips being a world's largest independent pure-play exploration and production company. Company ranks 95 in 2018 Fortune 500 companies in terms of revenue. Company has market capitalization of $75.73B which is highest among any another company in independent oil exploration and production segment. It's P/E ratio of 12.41 suggests high return on equity when compared to other companies. Return on Equity for ConocoPhillips is 14.60% which is highest among other companies discussed above. Earning per share of $ 5.32 is also highest and makes it standout when compared to the other companies. Provided the volatility of crude oil and natural gas price in international market, assets, equity and ability to get fund from debt market plays a very important role in sustaining in this highly volatile market. ConocoPhillips has total assets of $69.88B which is highest among all other entries, and its equity is highest among its competitors.

Valuation:

One of the challenge Analyst always face is taking decision about the method to use for valuations. Two most popular methods are Free Cash Flow to Equity (FCFE) model or Dividend Discounted (DDM) model. Our valuation model estimates the future cash flows of Noble Energy (NBL) and ConocoPhillips (COP) and discounts them at their estimated costs of equity. Cash flows were forecasted for the next 5 years with terminal cash flow assumptions ascribed to the end year 5. Cost of equity estimates rely on regression analysis to estimate the parameters of a Fama-French three-factor model. After estimating the cash flows, we consider several valuations for each firm and select one of these valuations on which to base our buy/sell/hold decision. The different valuations depend on following decision:

1. Whether we forecast dividend cash flows directly or firm free cash flow (FCFE)
2. Whether we apply a terminal cash flow growth rate assumption or a terminal price/earnings ratio assumption.
3. Whether Firm's dividend policy forecast reflects company's performance. For example, both ConocoPhillips and Noble Energy has continuously given dividends irrespective of their performance. Moreover, Noble Energy has almost given constant dividends despite of decline in sales and revenue
4. Is there any relation between Earning per share and Dividend. We will further see in our report that there is almost no relation between EPS and dividend for both companies

We will discuss in detail why we prefer the dividend cash flow models with perpetual growth rate assumptions. Below, we discuss the critical inputs to valuation model and how we arrived at our parameter estimates. Our model framework gives us four valuations to choose from: A free cash flow model with terminal p/e assumption, a free cash flow model with long run growth assumption (Gordon Growth), a dividend discount model with terminal p/e assumption, and a dividend discount model with long run growth assumption (Gordon Growth).

The dividend discount model using the Gordon Growth framework is the soundest methodology for valuing oil and gas companies. The primary reasons for preferring this model are 1) highly volatile earnings yield highly volatile p/e ratios, making it risky to ascribe historically observed industry p/e ratios to forecasted earnings, 2) commodity price hedging allows oil and gas companies to pay steady dividends even when earnings are low or negative (see dividend analysis section) and 3) demand for oil is so closely related to global economic production that the long run GDP growth rate is a compelling input to a long run dividend growth assumption.

For these reasons, we will base our buy/sell/hold decisions and conduct our sensitivity analysis based on a Gordon Growth dividend discount model, using the parameters discussed in the assumptions section.

Company Specific Report of Noble Energy:

Date	4/6/2019
Ticker	NBL
SIC Code	1311
Sector Type	Basic Materials
Industry Type	Independent Oil & Gas
Stock Price ($)	25.73
Market Cap ($)	12.52B
Outstanding Shares (Millions)	482.20
P/E	-51.27
P/B	1.18
Valuations	
FCFE ($)	7.72
FCFE Advice	Sell
DDM ($)	8.34
DDM Advice	Sell

Stock Performance:

Current Stock Price ($)	25.73
52 Week High/Low ($)	37.76/17.11
Market Cap (Billion Dollars)	12.52
P/E Ratio	-51.27
Earnings per share ($)	-0.16
Annualized Dividend ($)	0.44
Beta	1.19
Current Yield	1.71%

Stock Trend over Year:(source: Nasdaq.com)

Stock Trend over 5 Years :(source: Nasdaq.com)

Investment Thesis:

Noble Energy having market capitalization of $12.52B comes under mid cap industries which are often neglected by investors. NBL has negative earnings since last few years but debt has also decreased since last 12 months. NBL's debt has fallen from $7.6B to $6.6B over the last 12 months which includes long term debt. Also, NBL's cash and short-term dividends is $885m. NBL has produced operating cash flow of $2.3B in last 12 months which makes their ratio of operating cash to total debt ratio of 35% which indicates NBL's operating cash is high enough to cover the current debt. NBL's earning has continuously decreased since last few years and that makes their P/E ratio negative at -51.27. Despite this negative earning company has continuously given almost constant dividend to share holders indicating poor reinvestment plan and retention ratio. Although company has acquired few reserves in Wes Africa and exploration rights Canada, but it still doesn't guarantee the increase in earning because of extreme volatility in crude oil and natural gas price.

After our valuations Noble Energy comes out to be overvalued. We don't see any change in company's performance in next few years making us hesitate to invest on its stock.

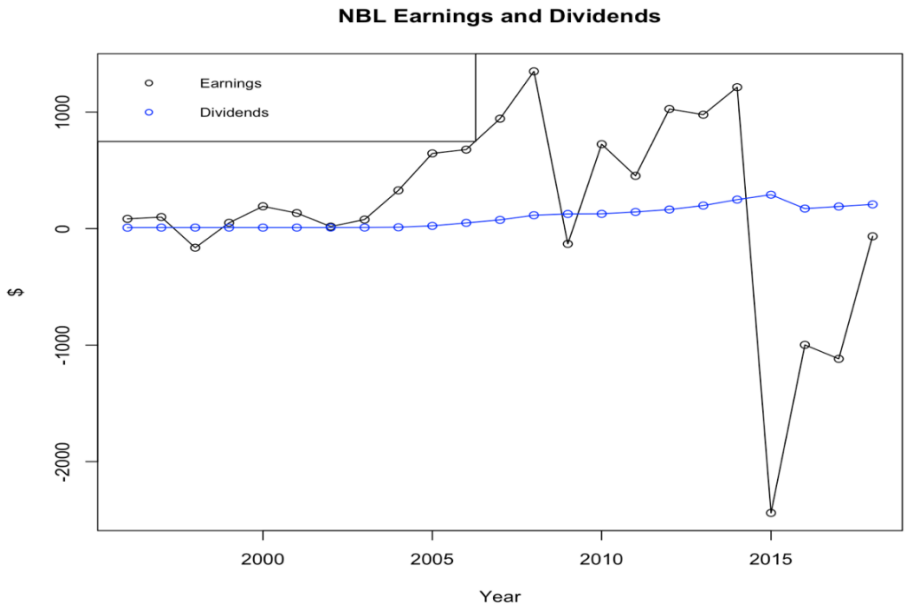
Based on our Discounted Dividend Model and Free Cash Flow to Equity Model, we want to give Noble Energy a Sell. We are getting intrinsic price of Noble Energy according to Dividend Discount model as $8.34 and Free cash flow method as $7.72 which is way below the current spot price of $25.73.

NBL Dividend Policy:

Despite volatile earnings, NBL have distributed consistently growing dividend payments, except for during periods of oil bear markets in 2015. NBL dividends have grown at an average of 12% in the last 10 years. %. In the long run, NBL's dividend growth will likely slow to be more in line with free cash flow growth. Thus, we will choose a long run dividend growth rate for NBL by considering approximately the average between historical dividend growth (12%) and expected free cash flow growth (3.2%) and settle on a conservative 7%.

Date	Dividend
2014	0.68
2015	0.72
2016	0.4
2017	0.4
2018	0.43

Source: Nasdaq.com



Cost of Capital:

We have come up with Cost of equity estimates through regression analysis to estimate the parameters of a Fama-French three-factor model. Fama French three factor model gives a better estimate than Capital Asset Pricing Model because it considers three factors to calculate stock return which are:
1. Market Risk
2.Outperformance of small cap companies relative to large cap companies
3.Outperformance of high book to market companies versus low book to market companies

And in history it is very well documented that these factors do affect the stock returns. The task of calculating these Betas was made easy using Microsoft Excels Linest function.

Sensitivity calculations:
While calculating different Beta's (Sensitivities) we are using monthly returns of Noble energy from past 20 years and regressing it with monthly factor data from the same time period. We are using long term data as it reflects more accurate estimate of sensitives. Returns and earnings has been very volatile for energy industry due to fluctuation in commodity prices. This justifies the use of long-term data to calculate sensitivities.

Annual Factor averages:
For calculating risk premium for each factor, we are suing annual factor data on factors from 1964-2018.

Risk Free rate: 10-year T-bond rate during 2018.

$$r = r_f + \beta_1(r_m - r_f) + \beta_2(SMB) + \beta_3(HML) + \varepsilon$$

Where:

r = Expected rate of return

r_f = Risk-free rate

β = Factor's coefficient (sensitivity)

$(r_m - r_f)$ = Market risk premium

SMB (Small Minus Big) = Historic excess returns of small-cap companies over large-cap companies

HML (High Minus Low) = Historic excess returns of value stocks (high book-to-price ratio) over growth stocks (low book-to-price ratio)

ε = Risk

Result of Fama-French Three-Factor model:

We performed the regression method to arrive at following factors of Fama-French Three-Factor Model and Cost of Equity.

NBL		
Factor	Annual Factors/Returns	Beta
Market (Rm-Rf)	4.48%	0.902682
Size (SMB)	2.87%	0.068116
Value (HML)	4.11%	0.441766
Risk Free Rate	2.69%	
Cost of Equity	8.74%	

Valuations Assumptions:

Assumptions Block	
Choose these yourself	
Sales growth per year for next 5 years	7.00%
Current Stock Price	25.73
Long Term Growth Rate in FCFE	5.00%
Long Term Growth Rate in Dividends	8.00%
Terminal P/E Value	22
Buy/Sell/Hold Margin	10%
Choice of Terminal Value for FCFE Model: 1= Gordon Growth, 2= Terminal PE model	1
Choice of Terminal Value for Dividend Model: 1= Gordon Growth, 2= Terminal PE model	1

Come from recent financials (or calculate yourself)	
Gross Fixed Assets (PPE)/Sales.	670.10%
Depreciation/Trailing Gross Fixed Assets	6.33%
Current assets/Sales	39.23%
Current liabilities/Sales	38.69%
COGS/Sales	39.74%
SGA/Sales	11.52%
Interest /Trailing Debt	3.89%
Dividend payout % of earnings	50.00%
Tax Rate	24.70%
Fixed Debt/Assets Ratio	41.88%
All Other Assets (Assume stays fixed $ amount)	$ 841.00
Shares Outstanding	482.203

P/E Ratio:

One fundamental input to the valuation model is a terminal value for the price to earnings (P/E) ratio. The valuation model assumes that the terminal P/E applies to the stock after the 5-year forecast period. Noble Energy's historic P/E ratios have been volatile and skewed by certain quarters of very low earnings. In the last 3 years, NBL has experienced 10 quarters of negative earnings. Thus, the recent past is not a good indicator of a terminal P/E ratio for NBL, if this model is to capture the long-term potential value of the companies. During periods of sustained earnings, NBL typically trades at multiples in the low 20's. NBL is a smaller company with high levels of expected future growth. Additionally, it carries low levels of debt relative to the industry, giving it more potential to withstand a market downturn. We believe suitable and

conservative terminal P/E values for NBL is 22. These terminal values are in line with historical data but still well below the energy sector average of 28 (CSI Market). NBL's terminal value of 22 is more conservative than historical data because of an expectation that P/E will decline as the company scales over the next five years.

Tax Rate:

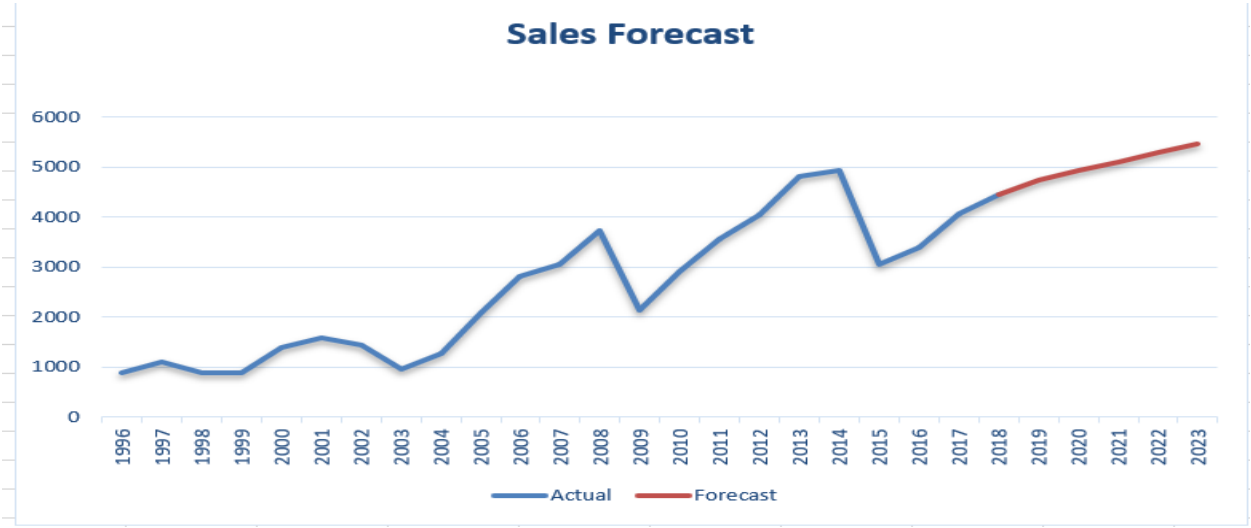
Due to the recent negative earnings of NBL, the effective tax rate is not directly observable. The American Petroleum Institute has indicated that the oil and gas industry had an average effective tax rate of 38.7% from 2010 to 2015. However, since the Tax Cuts and Jobs Act passed in 2017, US corporate taxes have been reduced from 35% to 21%. Therefore, a suitable estimate for our companies' tax rates going forward is approximately 24.7%. We will use this 24.7% estimate in the valuation models.

NBL Sales Growth:

We are calculating NBL's sales growth using 2 methods Quantitative method and Qualitative method. And we are putting equal weightage of 50% on both the methods.

1.Quantitative Method:

NBL's sales growth rate for the next five years was calculated using a Trend line method along a linear trend. Trendline Fits a straight line (using the method of least squares) This resulted in a sales growth rate (SGR) of around 3.5%-6.5%. These figures are on a bit lower side of what our fundamental analysis says. Sales growth has been rising and are expected to rise due to increased commodity prices in the recent past and are forecasted to rise for next few years as well. Sales forecast graph according to the above quantitative method:



2.Qualitative sales growth and weightage average to come up with final sales growth number:

We are breaking up sales number in different products that they are selling and see how these volume numbers have evolved in the past to forecast future sales volume for each category of products they are selling using Average growth rates of past 2 years. The Price for each product is forecasted based on what market and other industry experts are estimating the price of crude oil and natural gas. For products such as NGL (Natural gas liquids) it is difficult to get estimate of future prices. Hence, we are using past average of price to get future estimates. Using Qualitative method, we are getting sales growth rate of approximately 7-12%. By averaging both the quantitative and Qualitative methods our assumption of constant growth rate of sales for Nobel energy for the next 5 years is 6.11%

	2016	2017	2018	2019	2020	2021	2022	202
sales volume(In Million Barrells)								
Crude Oil & Condensate	46,529	47,806	48,050	48832	49626.7	50434.4	51255.2	52089.
NGLs	21,825	23,248	24,603	26122.1	27734.9	29447.3	31265.5	33195.
Natural Gas	511,115	407,976	336,364	272905	221419	179646	145753	11825
Sales price(Dollars per barrells)								
Crude Oil & Condensate	40.46	49.84	62.1	72	85.3	96.8	107.4	106.
NGLs	15.96	24.81	27.18	22.65	24.88	24.9033	24.1444	24.642
Natural Gas	2.42	3.01	2.76	3.07	2.97	2.99	3.01	2.9
Sales	3467788.64	4187441.68	4580979.18	4945387	5580816	6152524	6698411	672954
Sales from Quantitative method			4461	4745.84	4926.04	5106.24	5286.45	5466.6
Sales growth in past	2016-2017	2017-2018	Avg Growth					
Crude Oil & Condensate	1.027445249	1.00510396	1.01627461					
NGLs	1.065200458	1.05828458	1.06174252					
Natural Gas	0.79820784	0.82447007	0.81133895					
Future sales growth	2019	2020	2021	2022	2023			
	1.079548041	1.12848929	1.10244152	1.08873	1.00465			
Sales Growth in percent according to this Qualitative mo	7.954804065	12.8489287	10.2441522	8.87257	0.46484			
Sales Growth in percent according to Professor's model and trendline	6.385014347	3.7971053	3.65819959	3.5291	3.4088			
Final Average of both model sales growth	7.169909206	8.32301699	6.95117589	6.20083	1.93682			
constant average of sales growth for next 5 years	6.116351086							

Financial Projections:

We expect sales to grow from 2019 to 2023 from $4773.27M in 2019 to $6256.78M in 2023. EBIT is also expected to grow from 433.23. Assets is also expected to increase marginally during same period to $22.8B approximately, however liabilities are also going to increase in a same trend. Below are our 5 years projections for next 5 years.

Year	2019	2020	2021	2022	2023
Sales	4773.27	5107.4	5464.92	5847.46	6256.78
EBIT	433.23	463.55	496	530.72	567.87
Dividend	34.11	43.55	53.66	64.46	76.03
FCFE	1.88	16.12	31.35	47.65	65.09
Assets	21332.06	21676.66	22045.38	22439.92	22862.07
Liabilities	10781.71	11055.33	11348.09	11661.35	11996.54
Equity	10550.34	10621.33	10697.29	10778.56	10865.53

NBL Sensitivity Analysis:

We apply our dividend discount model to a best- and worst-case scenario to analyze the sensitivity of our valuation estimate to underlying assumptions. This will allow us to check the validity of our model and also to analyze how the stock may behave if global economic outlook improves or deteriorates.

To construct the scenarios, we consider a worst case in which sales growth declines to 2% (a 60% decline from our 5-year projections), free cash flow growth declines to 1%, dividend growth declines to 2% (each below the long term average interest rate and far below the cost of equity), and cost of equity rises to 11%.

For the optimistic scenario, we consider a best-case sales growth of 7%, free cash flow growth of 5%, and cost of equity decline to 8.3%. As with many economic analyses, we construct our scenarios under the assumption that "best case" and "average case" will be similar, while "worst case" will be disproportionately worse.

Scenario Summary	Current Values:	Worst Case	Best Case
Changing Cells:			
sales_growth	6.11%	2.00%	7.00%
LTgrowth_FCFE	3.35%	1%	5%
Ltgrowth_Dividend	7.50%	2%	8%
cost_equity	8.74%	11.00%	8.30%
Result Cells:			
Intrinsic_DDM	$ 8.34	$ 0.58	$ 38.53

Alternative Stock Selection: ConocoPhillips

Date	4/6/2019
Ticker	COP
SIC Code	2911
Sector Type	Basic Materials
Industry Type	Independent Oil & Gas
Stock Price ($)	66.12
Market Cap ($)	75.73B
Outstanding Shares (Billions)	1.138
P/E	17.82
P/B	2.35
Valuations	
FCFE ($)	103.29
FCFE Advice	Buy
DDM ($)	73.76
DDM Advice	Buy

Stock Performance:

Current Stock Price ($)	66.12
52 Week High/Low ($)	80.24/56.75
Market Cap (Billion Dollars)	75.73
P/E Ratio	12.41
Earnings per share ($)	5.34
Annualized Dividend ($)	1.22
Beta	0.97
Current Yield	1.85%

Stock Trend over Years:

Investment Thesis:

ConocoPhillips is world's largest independent pure play exploration and production company. It was created as a merger of American oil companies Conoco Inc. and Phillips Petroleum Co. on August of 2002. On 2012, company separated its downstream asset as a new company Phillips 66. Company has strong business momentum due to its high production growth and high oil prices. COP has average oil production of 1.3 million barrels /day which is largest for any independent exploration and production company in world. Being a pure upstream company, company is more sensitive to oil prices. COP has benefitted most from rebound of oil prices since 2016. Company increased its earning per share more than seven times last year from $0.61 in 2017 to $4.54 in 2018. OPEC has decided to cut the oil production and according to projections, oil demand is going to be all time high at 100M barrels per day. Company has been increasing its production at fast pace with 5% last year and expects 5% again this year. Company's dividend policy is very generous and makes it favorite among its competitors. Company has huge assets of almost $70B which is make it more sustainable in case of oil price downturn. Unlike NBL, COP isn't heavily dependent on US oil production as company has strong production base in Asia Pacific and Middle east. These high developing region accounts for 14% of their liquids production and 60% of natural gas production. These regions are poised to have highest oil demand in world and provided COP's high production, company is expected to have huge earnings.

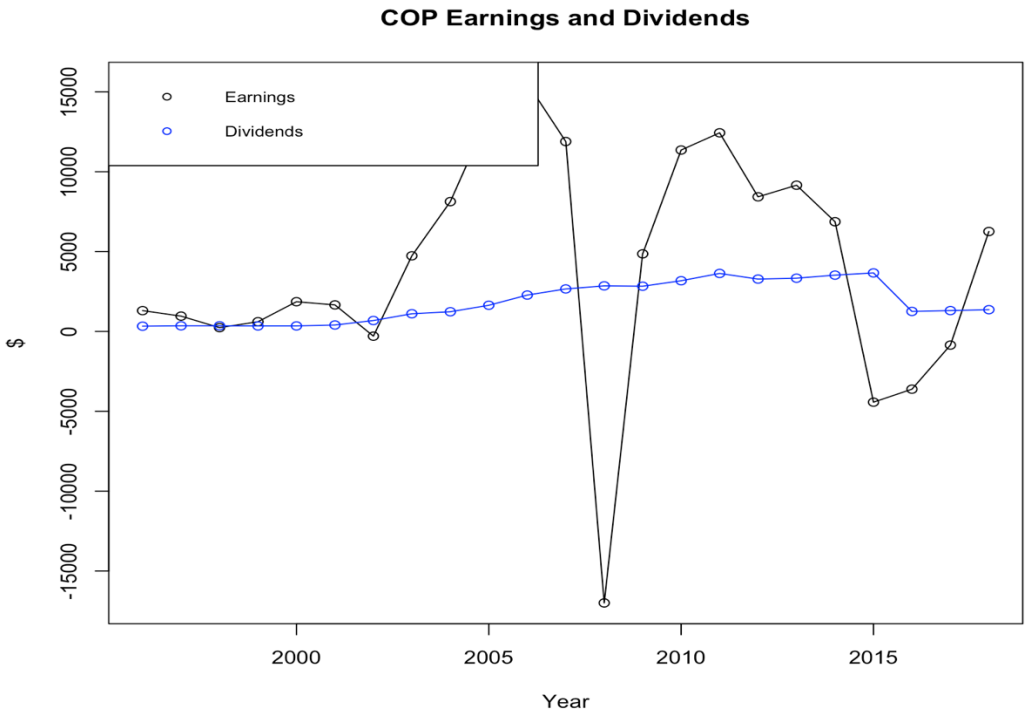
Based on our Discounted Dividend Model and Free Cash Flow to Equity Model, we want to give ConocoPhillips a buy. The intrinsic value according to DDM model is $73.76 and FCFE model is $103.29 which is way above their current market price of $66.12

COP Dividend Policy:

Despite volatile earnings, COP have distributed consistently growing dividend payments, except for during periods of oil bear markets. The only instance where dividends have decreased from their growing trend was during the oil bear market of 2015. COP's historical dividend growth rate of 6.8% is closer to its free cash flow growth rate. COP has sustained this growth rate for a longer historical period. Thus, we will use 6.8% as the long run dividend growth rate for COP.

Date	Dividend ($)
2014	2.70
2015	2.84
2016	2.96
2017	1.00
2018	1.16

Source: Nasdaq.com



Cost of Capital:

We are using the very same method for calculating cost of Equity for COP as we used for Noble Energy, due to the reasons mentioned earlier during Noble Energy cost of Equity Calculation.

Result of Fama-French Three-Factor model:

COP		
Factor	Annual Factors/Returns	Beta
Market (Rm-Rf)	4.48%	0.904697
Size (SMB)	2.87%	-0.07282
Value (HML)	4.11%	0.562881
Risk Free Rate	2.69%	
Cost of Equity	8.84%	

Valuations Assumptions:

Assumptions Block	
Choose these yourself	
Sales growth per year for next 5 years	7.65%
Current Stock Price	66.12
Long Term Growth Rate in FCFE	3.19%
Long Term Growth Rate in Dividends	6.80%
Terminal P/E Value	15
Buy/Sell/Hold Margin	10%
Choice of Terminal Value for FCFE Model: 1= Gordon Growth, 2= Terminal PE model	1
Choice of Terminal Value for Dividend Model: 1= Gordon Growth, 2= Terminal PE model	1

Come from recent financials (or calculate yourself)	
Gross Fixed Assets (PPE)/Sales.	303.70%
Depreciation/Trailing Gross Fixed Assets	5.74%
Current assets/Sales	36.45%
Current liabilities/Sales	20.31%
COGS/Sales	56.44%
SGA/Sales	2.00%
Interest /Trailing Debt	2.73%
Dividend payout % of earnings	24.00%
Tax Rate	24.70%
Fixed Debt/Assets Ratio	43.61%
All Other Assets (Assume stays fixed $ amount)	$ 11,008.00
Shares Outstanding	1138

P/E Ratio:

One fundamental input to the valuation model is a terminal value for the price to earnings (P/E) ratio. The valuation model assumes that the terminal P/E applies to the stock after the 5-year forecast period. ConocoPhillips (COP) has experienced 9 quarters of negative earnings. Thus, the recent past is not a good indicator of a terminal P/E ratio for these two companies, if this model is to capture the long-term potential value of the companies., COP trades at lower multiples during periods of sustained earnings. During 2018, COP posted 3 straight quarters of profits and averaged a P/E ratio around 15. COP is a larger company, carries more debt, and has oil resources with less growth potential than those of NBL. We believe suitable and conservative terminal P/E value for COP is 15. This terminal value is in line with historical data but still well below the energy sector average of 28 (CSIMarket)

Tax Rate:

Due to the recent negative earnings of COP, the effective tax rate is not directly observable. The American Petroleum Institute has indicated that the oil and gas industry had an average effective tax rate of 38.7% from 2010 to 2015. However, since the Tax Cuts and Jobs Act passed in 2017, US corporate taxes have been reduced from 35% to 21%. Therefore, a suitable estimate for our companies' tax rates going forward is approximately 24.7%. We will use this 24.7% estimate in the valuation models.

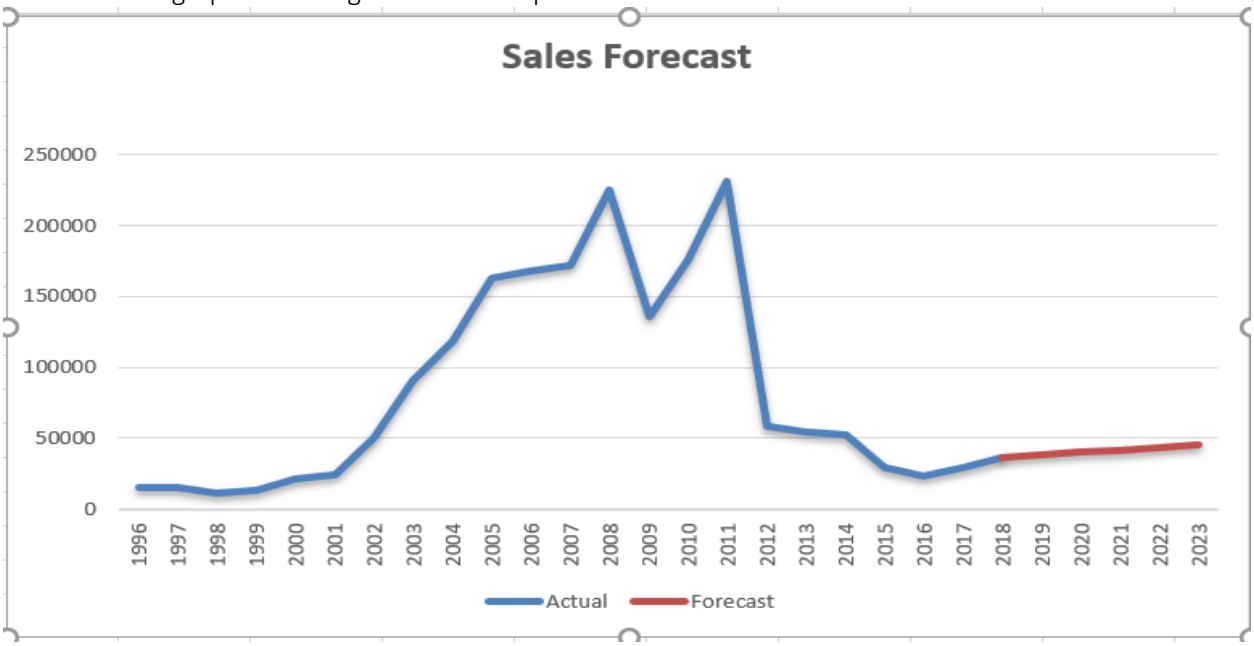
COP Sales Growth:

As mentioned for Nobel energy. We are calculating NBL's sales growth using 2 methods Quantitative method and Qualitative method. And we are putting equal weightage of 50% on both the methods.

Quantitative Method:

Cop's sales growth rate for the next five years was calculated using a Trend line method along a linear trend. Trendline Fits a straight line (using the method of least squares) This resulted in a sales growth rate (SGR) of around 2.5%-6.5%. Note we are only creating trendline using last five years sales growth as the sales growth has been violating before that. These figures are on a bit lower side of what our fundamental analysis says. Sales growth has been rising and are expected to rise due to increased commodity prices in the recent past and are forecasted to rise for next few years as well.

Sales forecast graph according to the above quantitative method:



Qualitative sales growth and weightage average to come up with final sales growth number:

We are breaking up sales number in different products that they are selling and see how these volume numbers have evolved in the past to forecast future sales volume for each category of products they are selling using Average growth rates of past 2 years.

The Price for each product is forecasted based on what market and other industry experts are estimating the price of crude oil and natural gas. For products such as NGL (Natural gas liquids), Bitumen it is difficult to get estimate of future prices. Hence, we are using past average of price to get future estimates.
Using Qualitative method, we are getting sales growth rate of approximately 10-14%

	2016	2017	2018	2019	2020	2021	2022	2023
sales volume								
Crude Oil(Thousands of barrels produced per day)	598	599	653	682.98	714.337	747.133	781.434	817.311
NGLs	145	111	102	85.9062	72.3518	60.936	51.3214	43.2238
Natural Gas(Millions of cubic feet produced per da	3,857	3,270	3,857	3909.69	3963.09	4017.23	4072.1	4127.73
Bitumen	183	122	66	39.8525	24.0639	14.5304	8.77382	5.29785
Sales price								
Crude Oil & Condensate	40.86	51.96	68.13	72	85.3	96.8	107.4	106.7
NGLs	16.68	25.22	30.48	24.1267	26.6089	27.0719	25.9358	26.5388
Natural Gas	3	4.07	5.65	7.75427	5.82476	6.40967	6.6629	6.29911
Bitumen	15.27	22.66	22.29	20.0733	21.6744	21.3459	21.0312	21.3505
Sales Growth	41218.29	49996.88	70861.04	82363.9	86463.7	100031	112574	114468
			36417	37188	38785.2	41382.4	43979.6	46576.8

Sales growth in past	2016-2017	2017-2018	Avg Growth
Crude Oil	1.00167224	1.09015025	1.04591125
NGLs	0.76551724	0.91891892	0.84221808
Natural Gas	0.84780918	1.1795107	1.01365994
Bitumen	0.66666667	0.54098361	0.60382514

Price growth in path	2016-2017	2017-2018	Avg Growth
NGLs	1.51199041	1.20856463	1.36027752
Natural Gas	1.35666667	1.38820639	1.37243653
Bitumen	1.48395547	0.98367167	1.23381357

Forecast	2019	2020	2021	2022	2023
	1.16233005	1.04977672	1.15691726	1.12538	1.01683
Sales Growth in percent according to this Qualitati	16.2330046	4.97767203	15.6917256	12.5383	1.68305
Sales Growth in percent according to Professor's model and trendline	2.11714309	4.29493385	6.69636872	6.2761	5.90547
Final Average of both model sales growth	9.17507384	4.63630294	11.1940472	9.40722	3.79426
constant average of sales growth for next 5 years	7.64138008				

Taking weighted ave

By averaging both the quantitative and Qualitative methods our assumption of constant growth rate of sales for Nobel energy for the next 5 years is 7.64%.

Financial Projections:

We expect substantial increase in sales of ConocoPhillips due to its high production and high oil demand in Asia Pacific and Middle East. EBIT is also expected to increase from $9.944B to $13.354B. Assets are expected to increase from almost $73B in 2019 to almost $88.5B however, liabilities are also expected to increase in similar trend. Here are the 5 years projections for COP.

Year	2019	2020	2021	2022	2023
Sales	39202.90	42201.92	45430.37	48905.79	52647.09
EBIT	9944.07	10704.80	11523.71	12405.28	13354.28
Dividend	1646.58	1777.32	1918.07	2069.58	2232.68
FCFE	5661.22	6114.23	6601.89	7126.85	7691.98
Assets	73110.61	76480.71	80108.62	84014.06	88218.28
Liabilities	39847.10	41925.92	44163.78	46572.83	49166.18
Equity	33263.51	34554.78	35944.84	37441.23	39052.10

COP Sensitivity Analysis:

As we know that whatever we are forecasting might not be able to hold true in future. Markets, scenarios and Economies change. So, we are doing scenario analyze alternate possible events into the future. This will help us to find the price of the stock under consideration under best and worst cases. To construct the scenarios, we consider a worst case in which sales growth declines to 5%, free cash flow growth declines to 2.5%, dividend growth declines to 6% (each below the long-term average interest rate and far below the cost of equity), and cost of equity rises to 10%. For the optimistic scenario, we consider a best-case sales growth of 9%, free cash flow growth of 5%, and cost of equity decline to 8%. We can see what prices might turn out to be in different scenarios.

Scenario Summary	Current Values:	Worst Case	Best Case
Changing Cells:			
sales_growth	7.65%	5.00%	9.00%
LTgrowth_DDM	6.80%	6.00%	7.00%
LTgrowth_FCFE	3.19%	2.50%	5%
cost_equity	8.84%	10.00%	8.00%
Result Cells:			
Intrinsic_FCFE	$ 103.29	$ 90.39	$ 147.07
Intrinsic_DDM	$ 73.76	$ 33.93	$ 159.96

Analytics and Machine learning in Stock Selection:

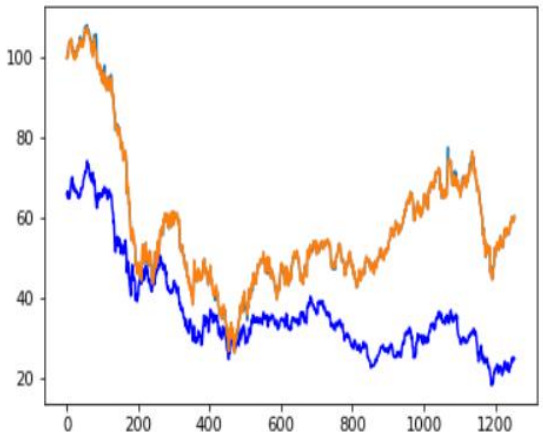
We tried to see if Machine learning techniques can help us determine behavior of stocks. In implementing any machine learning models first step is to find attributes. In an order to find perfect predictive model we need to what are the factors stock values depends upon to get the best predictions of stock price as possible. To find the attributes of stock price, we can do some data visualizations techniques.
Since Noble Energy and ConocoPhillips both are American independent oil and gas exploration and production companies, their main products are WTI Crude Oil and Henry Hub Natural gas.

First step is to determine how Spot prices are correlated to following attributes.

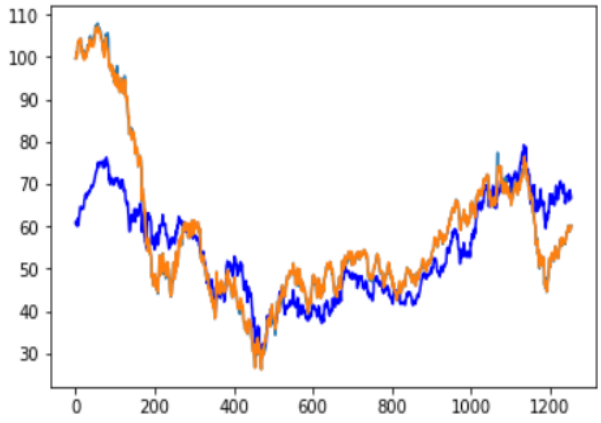
1.WTI crude Oil Spot price
2.Henry Hub Natural Gas Spot price
3.WTI crude Oil Futures Spot price
4.Henry Hub Natural Gas Futures Spot price

We have used 5 years data from 1st April 2014 to 29th March 2019 to run this visualizations and modelling method:
We can see how NBL and COP stock price varies when Crude Oil and Crude Oil Futures spot prices change. Blue plot is stock price and orange and blue line which almost coincides are Crude oil and Crude Oil Futures prices.

NBL

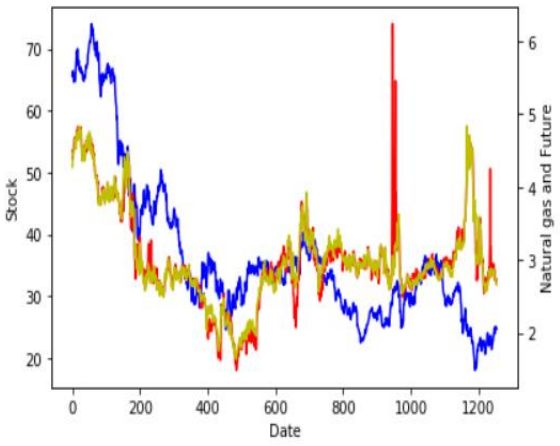


COP

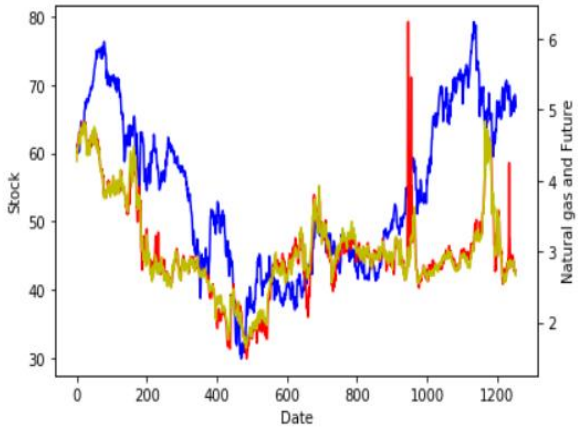


Here, we can see how NBL and COP stock prices change with Natural gas and Natural futures spot prices. Again, Blue line is stock price, red line is Natural gas price and yellow line is Natural gas futures price.

NBL



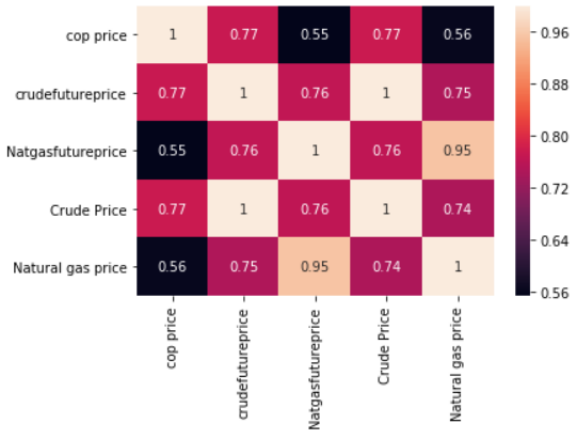
COP



If we want to quantize the relation between stock prices and crude oil and Natural gas, then we can find the correlation matrix which shows the probability percentage of change in stock price when attribute's prices changes.

NBL

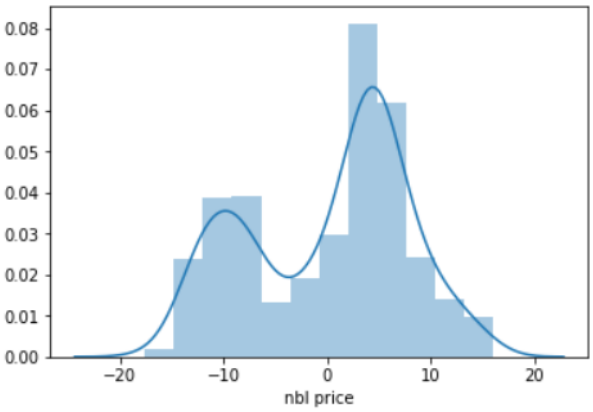
COP



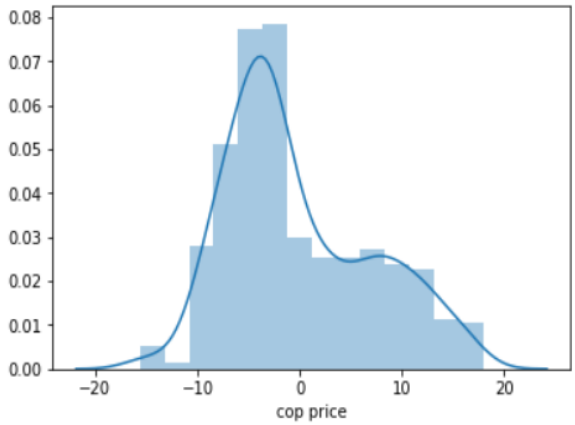
We tried to predict the stock prices of NBL using Linear Regression by training 50% of data given the strong correlation between attributes and stock prices. We get the average value of predicted stock prices to be $37 with standard deviation of 9.6 and R-squared of 0.621. Closer is the R-squared to 1, more accurate is the model. Similarly, we get stock prices of ConocoPhillips to be 54.2 with standard deviation of 8.95 and R-squared of 0.63

The plot between actual stock price and predicted price can be plotted as distribution and perfect normal distribution suggests more accuracy of stock price and model used.

NBL



COP



Summing Up the above Model and visualizations, we would like to go ahead to select ConocoPhillips a buy based on its high production, strong presence in exploration in all major part of world including Asia pacific and Middle East where oil demand is strongest in the world. Also, as crude oil and natural gas prices changes, there is more change in stocks of COP as interpreted from lower standard deviations, higher R-squared and relatively closer normal distributions of predictions.

Summary and Recommendations:

We are giving sell for Noble Energy stock price and buy for ConocoPhillips based on our qualitative quantitative and analytical analyses. This can be considered as a recommendation for SunTrust portfolio.

Noble Energy seems to be overvalued at present. We are getting intrinsic price of Noble Energy according to Dividend Discount model as $8.34 and Free cash flow method as $7.72 which is way below the current spot price of $25.73. Besides the negative earnings company continues to give dividend which shows lower retention ratio for reinvestment. Our further analyses in machine learning suggests that Noble Energy prices are having more standard deviations and less R-squared which makes us bearish for NBL.

ConocoPhillips seems to be undervalued at present according to both Discounted Dividend model and Free Cash Flow to Equity method. The intrinsic value according to DDM model is $73.76 and FCFE model is $103.29 which is way above their current market price of $66.12. The company's Earning per Share of $5.34 and annualized dividend makes this stock a buy. Our further analyses too suggest that ConocoPhillips stock price are very sensitive to Crude oil and natural gas prices. This sensitivity is going to give them an upper hand because of their strong presence all over the world, mainly in Asia Pacific and Middle East where Oil demand are highest. Our Machine learning model says ConocoPhillips price has lesser standard deviations and more R-squared when crude oil and natural gas price changes.

Citations:

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Data Source:
Stock Price of NBL and COP: Yahoo finance
https://www.eia.gov/dnav/ng/hist/rngwhhdD.htm data for natural gas
https://fred.stlouisfed.org/graph/?g=NPX data for WTI crude oil
https://www.investing.com/commodities/crude-oil-historical-data crude oil future
https://www.investing.com/commodities/natural-gas-historical-data natural gas future

Appendix:

This section includes codes for the further machine learning analysis that we did for both Noble Energy and ConocoPhillips.

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import sklearn
%matplotlib inline
```

In [2]:
```
nbl=pd.read_csv("C:/Users/deepa/Downloads/NBL.csv")
nbl.drop(['Open','High','Low','Close','Volume'],axis=1,inplace=True)
nbl=nbl.rename(columns={'Adj Close':'nbl price'})
```

In [3]:
```
nbl['Date']=nbl['Date'].astype(str)
```

In [4]:
```
crudefuture=pd.read_csv('C:/Class/mba 524/Crude Oil WTI Futures Historical Dat
a.csv')
crudefuture.drop(['Open','High','Low','Vol.','Change %'],axis=1,inplace=True)
crudefuture=crudefuture.rename(columns={'Price':'crudefutureprice'})
```

In [5]:
```
Natgasfuture=pd.read_csv('C:/Class/mba 524/Natural Gas Futures Historical Dat
a.csv')
Natgasfuture.drop(['Open','High','Low','Vol.','Change %'],axis=1,inplace=True)
Natgasfuture=Natgasfuture.rename(columns={'Price':'Natgasfutureprice'})
```

In [6]:
```
crude=pd.read_excel('C:/Class/mba 524/crudeprice.xls')
crude['Date']=crude['Date'].astype(str)
```

In [7]:
```
natgas=pd.read_excel('C:/Class/mba 524/natural gas prices.xls',sheet_name='na
t')
natgas['Date']=natgas['Date'].astype(str)
```

In [8]:
```
natgas=natgas[4314:5591]
```

In [9]:
```
df1=pd.merge(nbl,crudefuture,on='Date')
```

In [10]:
```
df2=pd.merge(df1,Natgasfuture,on='Date')
```

In [11]:
```
df3=pd.merge(df2,crude,on='Date')
```

In [12]:
```
Finaldf=pd.merge(df3,natgas,on='Date')
```

In [13]:
```
Finaldf.head()
```

Out[13]:

	Date	nbl price	crudefutureprice	Natgasfutureprice	Crude Price	Natural gas price
0	2014-04-01	65.772972	99.74	4.276	99.69	4.39
1	2014-04-02	65.595871	99.62	4.364	99.60	4.39
2	2014-04-03	66.444046	100.29	4.470	100.29	4.51
3	2014-04-04	65.567924	101.14	4.439	101.16	4.49
4	2014-04-07	64.654556	100.44	4.476	100.43	4.58

In [14]:
```
Finaldf.tail()
```

Out[14]:

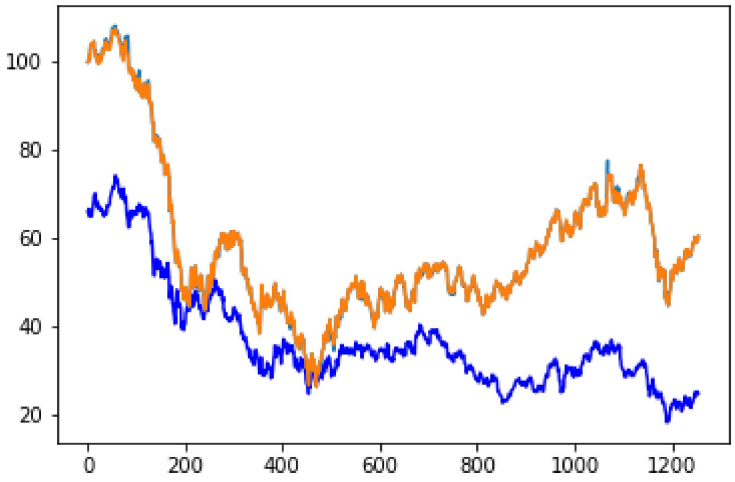
	Date	nbl price	crudefutureprice	Natgasfutureprice	Crude Price	Natural gas price
1250	2019-03-25	24.440001	58.82	2.755	58.71	2.72
1251	2019-03-26	25.080000	59.94	2.740	59.87	2.74
1252	2019-03-27	24.650000	59.41	2.713	59.39	2.69
1253	2019-03-28	24.889999	59.30	2.712	59.29	2.69
1254	2019-03-29	24.730000	60.14	2.662	60.19	2.73

In [15]:
```
sns.heatmap(Finaldf.corr(),annot=True)
```

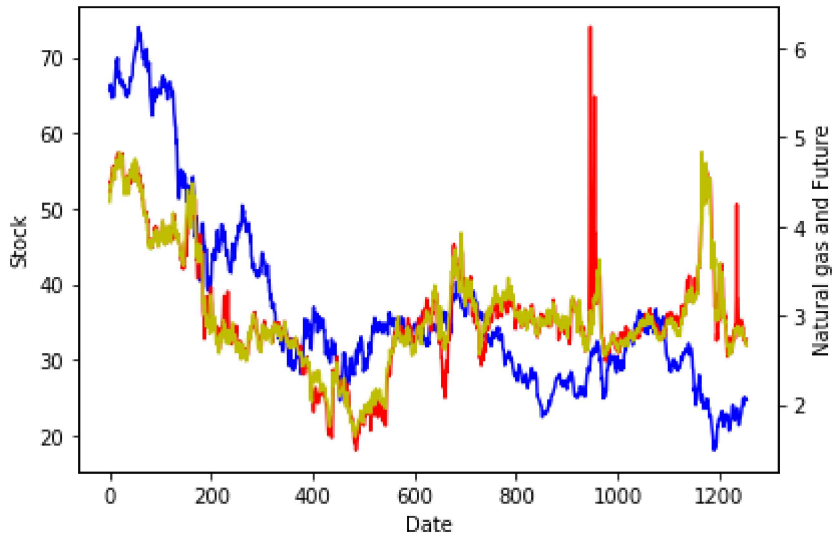
Out[15]: <matplotlib.axes._subplots.AxesSubplot at 0x19df696fdd8>

In [16]:
```
plt.plot(Finaldf['nbl price'],'b')
plt.plot(Finaldf['Crude Price'])
plt.plot(Finaldf['crudefutureprice'])
```

Out[16]: [<matplotlib.lines.Line2D at 0x19df6d5c080>]

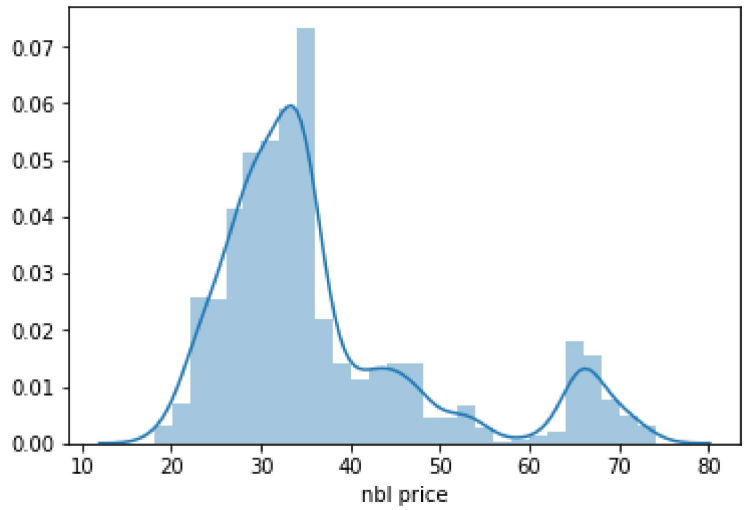


In [17]:
```
fig, ax1 = plt.subplots()

ax1.set_xlabel('Date')
ax1.set_ylabel('Stock')
ax1.plot(Finaldf['nbl price'],'b')
ax1.tick_params(axis='y')

ax2 = ax1.twinx()  # instantiate a second axes that shares the same x-axis

ax2.set_ylabel('Natural gas and Future')  # we already handled the x-label wit
h ax1
ax2.plot(Finaldf['Natural gas price'],'r')
ax2.plot(Finaldf['Natgasfutureprice'],'y')
ax2.tick_params(axis='y')

fig.tight_layout()  # otherwise the right y-label is slightly clipped
plt.show()
```



In [18]:
```
sns.distplot(Finaldf['nbl price'])
```

Out[18]: <matplotlib.axes._subplots.AxesSubplot at 0x19df6deb898>



In [19]:
```
X=Finaldf[['crudefutureprice', 'Natgasfutureprice','Crude Price', 'Natural gas price']]
Y=Finaldf['nbl price']
```

In [20]:
```
from sklearn.model_selection import train_test_split
```

In [21]:
```
X_train,X_test,Y_train,Y_test= train_test_split(X,Y,test_size=0.5)
```

In [22]:
```
from sklearn.linear_model import LinearRegression
```

In [23]:
```
nlrm=LinearRegression()
```

In [24]:
```
nlrm.fit(X_train,Y_train)
```

Out[24]:
```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None,
         normalize=False)
```

In [25]:
```
print(nlrm.intercept_)
```

```
3.570895968805182
```

In [26]:
```
nlrm.coef_
```

Out[26]:
```
array([ 1.7019292 ,  6.36140775, -1.17272369, -5.5431225 ])
```

In [27]:
```
coeff_df=pd.DataFrame(nlrm.coef_,X.columns,columns=['Coeff'])
```

In [28]:
```
coeff_df
```

Out[28]:

	Coeff
crudefutureprice	1.701929
Natgasfutureprice	6.361408
Crude Price	-1.172724
Natural gas price	-5.543123

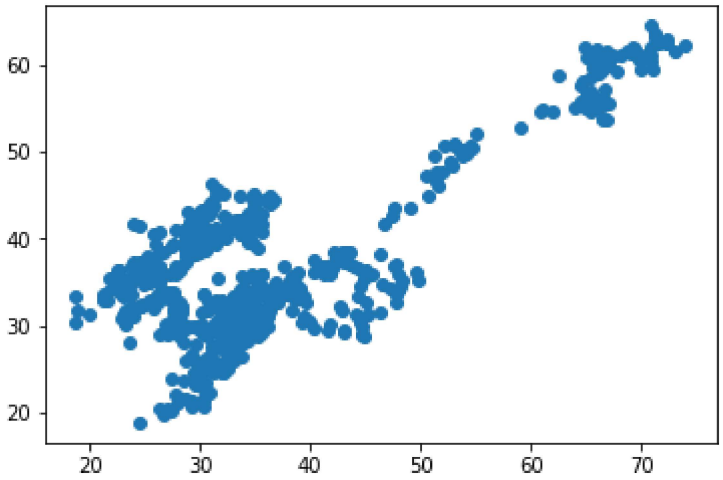
In [29]:
```
predictions=nlrm.predict(X_test)
```

In [30]:
```
print(predictions.mean(),predictions.std())
```

```
37.00560437523462 9.62735715913696
```

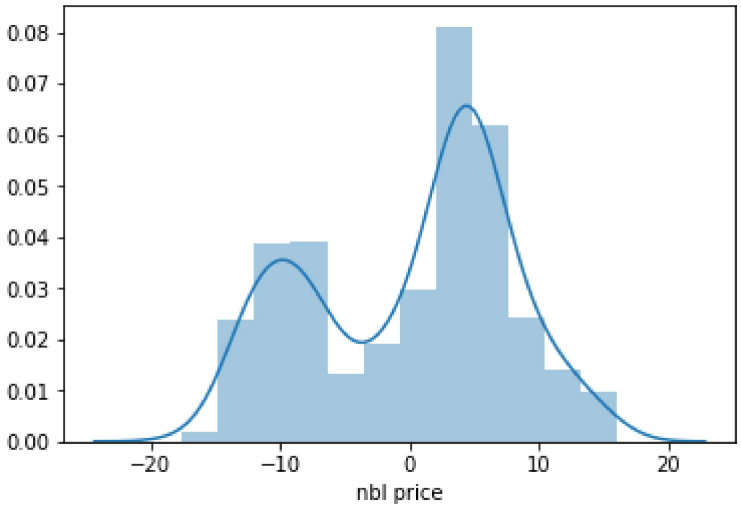
In [31]:
```
plt.scatter(Y_test,predictions)
```

Out[31]:
```
<matplotlib.collections.PathCollection at 0x19df767b320>
```



In [32]:
```
sns.distplot((Y_test-predictions))
```

Out[32]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x19df763eb70>
```



In [33]:
```
from sklearn import metrics
```

In [34]:
```
metrics.r2_score(Y_test,predictions)
```

Out[34]:
```
0.6210968550304674
```

In [35]:
```
print(metrics.mean_absolute_error(Y_test,predictions),metrics.mean_squared_err
or(Y_test,predictions),
      np.sqrt(metrics.mean_squared_error(Y_test,predictions)))
```

```
6.6871653383865794 59.528397086679576 7.71546480043034
```

In [237]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import sklearn
%matplotlib inline
```

In [238]:
```
cop=pd.read_csv("C:/Users/deepa/Downloads/COP.csv")
cop.drop(['Open','High','Low','Close','Volume'],axis=1,inplace=True)
cop=cop.rename(columns={'Adj Close':'cop price'})
```

In [239]:
```
cop.head()
```

Out[239]:

	Date	cop price
0	2014-04-01	60.767567
1	2014-04-02	61.268871
2	2014-04-03	60.672504
3	2014-04-04	60.689789
4	2014-04-07	60.050213

In [240]:
```
cop.tail()
```

Out[240]:

	Date	cop price
1253	2019-03-25	67.070000
1254	2019-03-26	68.559998
1255	2019-03-27	67.910004
1256	2019-03-28	67.379997
1257	2019-03-29	66.739998

In [241]:
```
cop['Date']=cop['Date'].astype(str)
```

In [242]:
```
crudefuture=pd.read_csv('C:/Class/mba 524/Crude Oil WTI Futures Historical Dat
a.csv')
crudefuture.drop(['Open','High','Low','Vol.','Change %'],axis=1,inplace=True)
crudefuture=crudefuture.rename(columns={'Price':'crudefutureprice'})
```

In [243]:
```
crudefuture.head()
```

Out[243]:

	Date	crudefutureprice
0	2014-04-01	99.74
1	2014-04-02	99.62
2	2014-04-03	100.29
3	2014-04-04	101.14
4	2014-04-07	100.44

In [244]:
```
crudefuture.tail()
```

Out[244]:

	Date	crudefutureprice
1312	2019-03-25	58.82
1313	2019-03-26	59.94
1314	2019-03-27	59.41
1315	2019-03-28	59.30
1316	2019-03-29	60.14

In [245]:
```
Natgasfuture=pd.read_csv('C:/Class/mba 524/Natural Gas Futures Historical Dat
a.csv')
Natgasfuture.drop(['Open','High','Low','Vol.','Change %'],axis=1,inplace=True)
Natgasfuture=Natgasfuture.rename(columns={'Price':'Natgasfutureprice'})
```

In [246]:
```
Natgasfuture.head()
```

Out[246]:

	Date	Natgasfutureprice
0	2014-04-01	4.276
1	2014-04-02	4.364
2	2014-04-03	4.470
3	2014-04-04	4.439
4	2014-04-07	4.476

In [247]:
```
Natgasfuture.tail()
```

Out[247]:

	Date	Natgasfutureprice
1311	2019-03-25	2.755
1312	2019-03-26	2.740
1313	2019-03-27	2.713
1314	2019-03-28	2.712
1315	2019-03-29	2.662

In [248]:
```
crude=pd.read_excel('C:/Class/mba 524/crudeprice.xls')
```

In [249]:
```
crude.head()
```

Out[249]:

	Date	Crude Price
0	2014-04-01	99.69
1	2014-04-02	99.60
2	2014-04-03	100.29
3	2014-04-04	101.16
4	2014-04-07	100.43

In [250]:
```
crude.tail()
```

Out[250]:

	Date	Crude Price
1299	2019-03-25	58.71
1300	2019-03-26	59.87
1301	2019-03-27	59.39
1302	2019-03-28	59.29
1303	2019-03-29	60.19

In [251]:
```
crude['Date']=crude['Date'].astype(str)
```

In [252]:
```
natgas=pd.read_excel('C:/Class/mba 524/natural gas prices.xls',sheet_name='na
t')
natgas['Date']=natgas['Date'].astype(str)
```

In [253]:
```
natgas=natgas[4314:5591]
```

In [254]:
```
natgas.head()
```

Out[254]:

	Date	Natural gas price
4314	2014-04-01	4.39
4315	2014-04-02	4.39
4316	2014-04-03	4.51
4317	2014-04-04	4.49
4318	2014-04-07	4.58

In [255]:
```
natgas.tail()
```

Out[255]:

	Date	Natural gas price
5586	2019-03-25	2.72
5587	2019-03-26	2.74
5588	2019-03-27	2.69
5589	2019-03-28	2.69
5590	2019-03-29	2.73

In [256]:
```
df1=pd.merge(cop,crudefuture,on='Date')
```

In [257]:
```
df2=pd.merge(df1,Natgasfuture,on='Date')
```

In [258]:
```
df3=pd.merge(df2,crude,on='Date')
```

In [259]:
```
Finaldf=pd.merge(df3,natgas,on='Date')
```

In [260]:
```
Finaldf.head()
```

Out[260]:

	Date	cop price	crudefutureprice	Natgasfutureprice	Crude Price	Natural gas price
0	2014-04-01	60.767567	99.74	4.276	99.69	4.39
1	2014-04-02	61.268871	99.62	4.364	99.60	4.39
2	2014-04-03	60.672504	100.29	4.470	100.29	4.51
3	2014-04-04	60.689789	101.14	4.439	101.16	4.49
4	2014-04-07	60.050213	100.44	4.476	100.43	4.58

In [261]:
```
Finaldf.tail()
```

Out[261]:

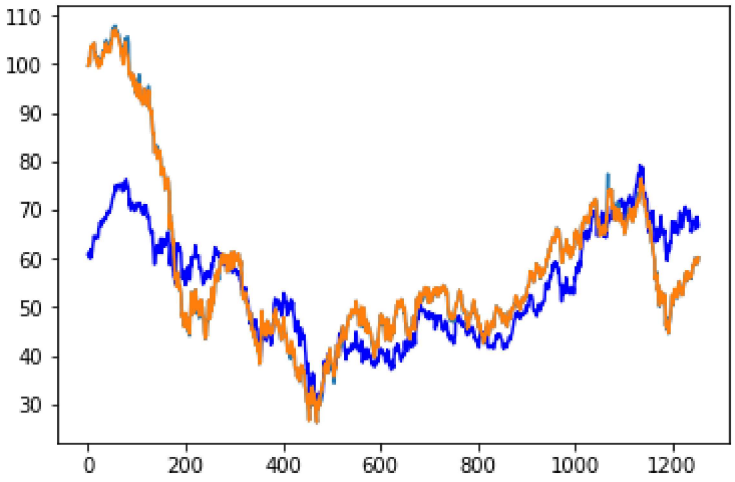
	Date	cop price	crudefutureprice	Natgasfutureprice	Crude Price	Natural gas price
1250	2019-03-25	67.070000	58.82	2.755	58.71	2.72
1251	2019-03-26	68.559998	59.94	2.740	59.87	2.74
1252	2019-03-27	67.910004	59.41	2.713	59.39	2.69
1253	2019-03-28	67.379997	59.30	2.712	59.29	2.69
1254	2019-03-29	66.739998	60.14	2.662	60.19	2.73

In [262]:
```
sns.heatmap(Finaldf.corr(),annot=True)
```

Out[262]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x2a1534a3eb8>
```

In [284]:
```
plt.plot(Finaldf['cop price'],'b')
plt.plot(Finaldf['Crude Price'])
plt.plot(Finaldf['crudefutureprice'])
```

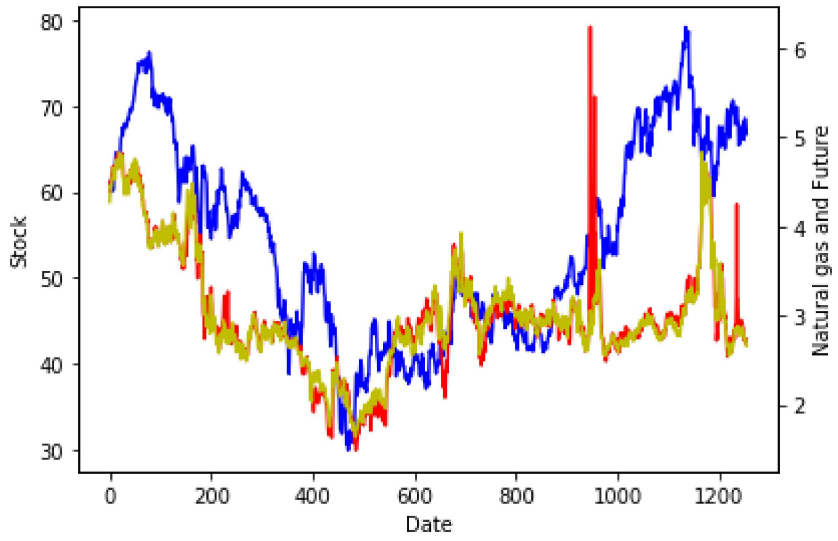
Out[284]:
```
[<matplotlib.lines.Line2D at 0x2a156a0b3c8>]
```



In [264]:
```
Finaldf.columns
```

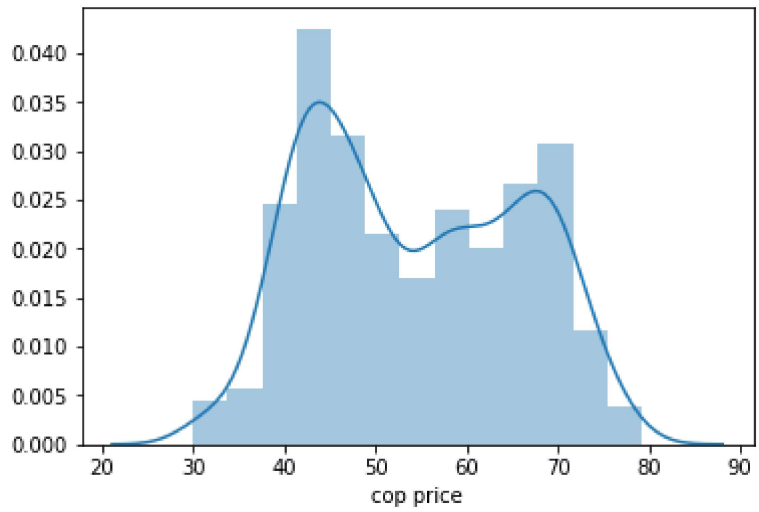
Out[264]:
```
Index(['Date', 'cop price', 'crudefutureprice', 'Natgasfutureprice',
       'Crude Price', 'Natural gas price'],
      dtype='object')
```

In [265]:
```
fig, ax1 = plt.subplots()

ax1.set_xlabel('Date')
ax1.set_ylabel('Stock')
ax1.plot(Finaldf['cop price'],'b')
ax1.tick_params(axis='y')

ax2 = ax1.twinx()  # instantiate a second axes that shares the same x-axis

ax2.set_ylabel('Natural gas and Future')  # we already handled the x-label wit
h ax1
ax2.plot(Finaldf['Natural gas price'],'r')
ax2.plot(Finaldf['Natgasfutureprice'],'y')
ax2.tick_params(axis='y')

fig.tight_layout()  # otherwise the right y-label is slightly clipped
plt.show()
```



In [266]:
```
sns.distplot(Finaldf['cop price'])
```

Out[266]: <matplotlib.axes._subplots.AxesSubplot at 0x2a155249048>



In [267]:
```
X=Finaldf[['crudefutureprice', 'Natgasfutureprice','Crude Price', 'Natural gas price']]
Y=Finaldf['cop price']
```

In [268]:
```
from sklearn.model_selection import train_test_split
```

In [269]:
```
X_train,X_test,Y_train,Y_test= train_test_split(X,Y,test_size=0.5)
```

In [270]:
```
from sklearn.linear_model import LinearRegression
```

In [271]:
```
clrm=LinearRegression()
```

In [272]:
```
clrm.fit(X_train,Y_train)
```

Out[272]:
```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None,
         normalize=False)
```

In [273]:
```
print(clrm.intercept_)
```

```
28.34326590529667
```

In [274]:
```
clrm.coef_
```

Out[274]:
```
array([-0.46198286, -5.98719263,  0.98933193,  4.45770184])
```

In [275]:
```
coeff_df=pd.DataFrame(clrm.coef_,X.columns,columns=['Coeff'])
```

In [276]:
```
coeff_df
```

Out[276]:

	Coeff
crudefutureprice	-0.461983
Natgasfutureprice	-5.987193
Crude Price	0.989332
Natural gas price	4.457702

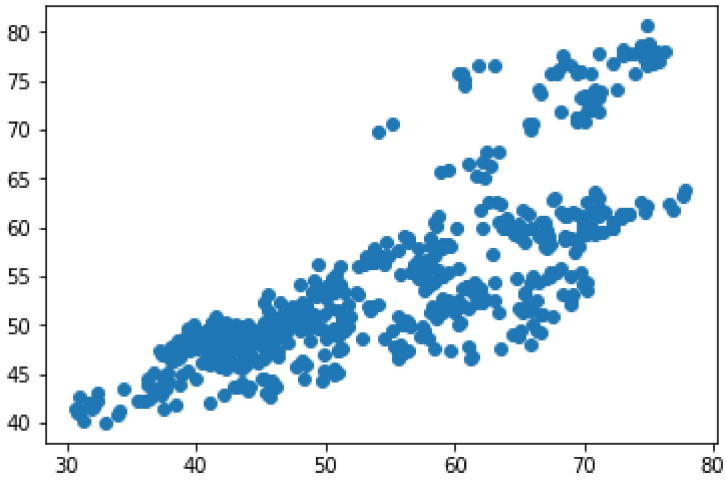
In [277]:
```
predictions=clrm.predict(X_test)
```

In [278]:
```
print(predictions.mean(),predictions.std())
```

```
54.195819409257 8.955379390812968
```

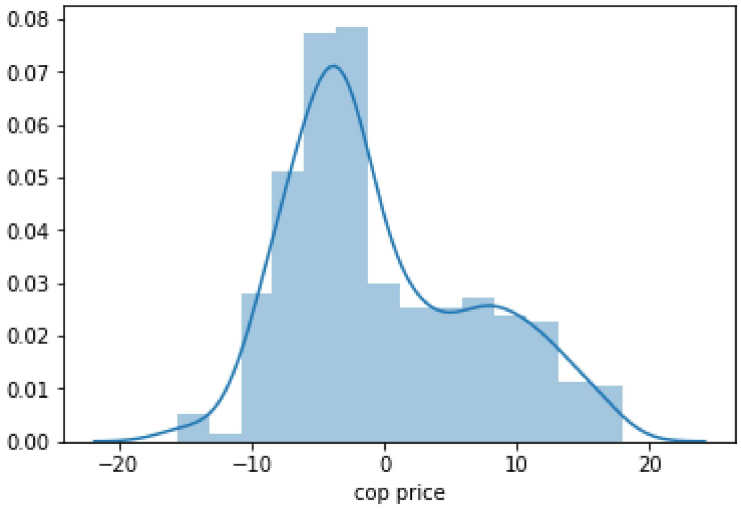
In [279]:
```
plt.scatter(Y_test,predictions)
```

Out[279]: <matplotlib.collections.PathCollection at 0x2a15692a320>



In [280]:
```
sns.distplot((Y_test-predictions))
```

Out[280]: <matplotlib.axes._subplots.AxesSubplot at 0x2a156960a20>



In [281]:
```
from sklearn import metrics
```

In [282]:
```
metrics.r2_score(Y_test,predictions)
```

Out[282]: 0.6315248021564612

In [283]:
```
print(metrics.mean_absolute_error(Y_test,predictions),metrics.mean_squared_err
or(Y_test,predictions),
      np.sqrt(metrics.mean_squared_error(Y_test,predictions)))
```

5.968127207144803 50.94106045503535 7.137300642051962