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Valuing Downstream Oil & Gas Companies: The Case of Phillips 66

By

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1. Introduction:

While oil and gas prices remain volatile and often uncertain, they can provide key insight to businesses within the industry. In fact, oil and gas companies are considered to be more linked to oil prices than other day to day operations. Oil prices are affected by many factors, but typically due to the amount of supply and demand in the market. If the price of oil is more expensive, there is going to be less supply and increased demand for oil. Downstream oil and gas companies then benefit off the higher price and can buy/sell these products to other companies for more profit. In this paper, I will illustrate the relationship oil prices and crack spreads have on downstream oil and gas companies, specifically Phillips 66.

This paper displays different approaches to value commodity companies in the future, while acknowledging there are other factors that may have not been considered in this research paper. The following approaches evaluated and explained in the following paper are: Capital Asset Pricing Model and Fama & French 3-factor Model. Along with these evaluation methods, I determine the best method to valuing downstream oil and gas companies through oil price and the crack spread from regressions and calculating a normalized value per share.

The rest of the paper goes as follows: Literature Review; Research Hypothesis; Methodology; Empirical Results; Monte Carlo Simulation; Discussion; and Conclusion.

2. Literature Review:

To best know how to value oil and gas companies correctly, I will look at factors and methodology I believe will affect and/or value a downstream oil and gas company. There are four branches of relevant literature: (1) Crude Prices; (2) Crack Spread; (3) Oil Price Fluctuations; and (4) Methods of Valuing Oil and Gas Companies.

2.1 Crude Oil

Crude Oil is found in between layers of natural gas (lighter and above crude) and saline water, which is denser and causes it to sink below. In order to obtain the crude oil, companies begin to drill and process it in the refinery stage to prepare for consumer use. Due to distillation, the process of heating and separating of crude oil into different components, and hydrocarbon composition, crude can vary in color and consistency. Once refined, crude oil can be used by consumers as gasoline, diesel and other forms of petrochemicals, but is a limited resource and cannot be replaced at the rate consumers consume it (Investopedia). The two primary benchmarks for crude are: (1) West Texas Intermediate (WTI) and (2) North Sea Brent Crude.

There are three ways to buy and sell crude: forwards, futures, and spot markets. A forward contract is a private, customized agreement of two parties to buy or sell a specified quantity at a specified price. Similarly, a futures contract is an agreement to buy or sell a specific quantity of

barrels at a predetermined price and date through an exchange. With a spot market, the contract takes effect immediately, money is exchanged and delivery is accepted. Due to the immediacy of a spot market, futures contracts are more common among both parties (Investopedia). Oil price is a factor in the value of oil and gas price as it is inextricably linked to the value of a downstream oil and gas company (Damodaran, 2009).

2.2 Crack Spread

The crack spread is the difference between the price of crude oil and the prices of products such as gasoline and distillates (diesel and jet fuel). This difference is referred to as a crack spread due to the refining process "cracking" crude into a refined product available for consumer use. The crack spread represents the profit margin a petroleum refiner receives while the refiner is selling refined products in the market and procuring crude oil. The price of both is "impacted on variables of supply, demand, production economics, environmental regulations and other factors" (CME Group, 2017). Due to this, refiners and others in the market can be at risk when the price of crude rises, but the refined product declines or remains stable.

2.3 Oil Price Fluctuations

Oil prices are volatile and see larger fluctuations in price than other investment opportunities such as stocks and bonds. Key influencers of oil price fluctuations are: OPEC; Supply and Demand; Impact on Natural Disasters and Politics; and Production/Storage costs.

2.3.1 OPEC

An influencer on the price of oil is the Organization of Petroleum Exporting Countries (OPEC), which is comprised of 13 countries: Algeria, Angola, Ecuador, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates and Venezuela. With OPEC controlling over 40% of the global supply of oil, OPEC is able to influence the price by increasing or decreasing production (Lioudis, 2018). In 2018, OPEC has vowed to curb output and limit the amount of barrels produced per day (Wingfield, 2018). This will likely reduce prices and affect revenue for oil and gas companies.

2.3.2 Supply and Demand

In most markets, supply and demand is a large factor in setting prices and determining the need of production. When there is an excess supply to demand, prices will usually fall. However, when demand is greater than supply, prices will rise due to their not being enough supply to meet the demand of the consumers. This holds true for oil and gas markets as a result of oil prices continuing to fluctuate as OPEC determines production levels; however, it is noted that oil

futures have greater impact on setting the price due to the binding agreement of a futures contract (Lioudis, 2018).

2.3.3 Natural Disasters and Political Risk

Natural disasters can cause oil prices to fluctuate and often drive the price up for a substantial amount of time. For instance, when Katrina Struck in 2005, it affected 19% of US oil supply and caused the price per barrel to rise by three dollars. Additionally, political risk can affect the price per barrel globally. If countries are close to a brink of war, consumers fears rise and in return the price of oil will likely rise (Lioudis, 2018).

2.3.4 Production and Storage Costs

Production costs directly affect the price of oil. While countries in the Middle East have low extraction costs, countries like Canada are more costly due to environmental factors. When there is more oversupply in the market, usually a decline in production decreases the supply and puts upward pressure on oil prices. Another factor of oil and gas prices are storage costs. Usually, storage is located in hubs and have been at more than a 77% capacity limit. If companies fear reaching a 100% storage limit, the price of oil is likely to rise; however, the decrease in production will likely reduce the chance of storage reaching its limits (Lioudis, 2018).

2.4 Methods of Valuing Oil and Gas Companies

2.4.1 Capital Asset Pricing Model (CAPM)

The CAPM model explains the correlation between systematic risk and expected return for assets. Usually the CAPM model is used to price securities, but it can also be used to generate expected returns for assets and calculating the cost of capital. Overall, the concept is for investors to be compensated by the time value of money and risk (Investopedia). In the published work, "Ups and Downs: Valuing Cyclical and Commodity Companies" by Aswath Damodaran, the CAPM model is used to determine the relationship between oil price and operating income in a firm. Once the model is regressed, the regression provides a beta and a p-value to determine its significance (Damodaran, 2009).

2.4.2 Fama and French 3-factor Model

The Fama and French 3-factor model is an asset pricing model broadened by the capital asset pricing model (CAPM). Eugene Fama and Kenneth French began research to better measure market returns and while doing so, realized that small cap stocks typically outperform large cap stocks. This in return lead to the Fama and French 3-factor model where two additional factors (Small minus Big; and High minus Low) are added to CAPM. Having these additional factors,

the model can adjust for outperformance and will likely be a better model to evaluate performance (Investopedia).

3. Research Hypothesis:

Research on finding the profitability/revenue of oil and gas companies tend to find that a company's earnings and cash flows are heavily correlated to oil prices. With this in mind, the following hypotheses have been formulated:

H1: Valuing a downstream oil and gas company will be better evaluated through a Fama & French 3-factor model than CAPM.

H2: The p-value will be more statistically significant through profitability from the crack spread than operating income from oil prices.

4. Methodology:

I chose three experiments to evaluate in order to test my hypotheses. Below you will find methodology for each of the three evaluations: Normalizing Operating Income vs. Oil Price; Fama & French; Crack Spread vs. Profitability.

4.1 Evaluation 1: Normalizing Operating Income vs. Oil Price

Initially, I began modeling my research after Aswath Damodaran's published research of Valuing Commodity Companies. In his research, "Ups and Downs: Valuing Cyclical and Commodity Companies", Aswath begins by valuing a commodity company through the relationship of operating income to oil prices. To replicate this process, I chose Phillips 66 (PSX) due to its large presence in the downstream market from 2012 to present day.

To determine the relationship of operating income and oil prices, I gathered quarterly data from 2011 to 2017 to analyze if oil prices in the current month directly impacted operating income in the current month or if it has a one month lag. The data indicated in Figure 1 that usually oil prices do impact operating income positively in the following month.

Once both data sets were compared, I regressed the operating income against the oil price per barrel over the period with a one month lag and obtained the following from a CAPM regression:

Operating Income = Intercept + Slope (oil price)

To then get the value of the Cost of Equity, the following assumptions must be made:

- To derive a beta, I took the percentage daily change in stock price and regressed it against the percentage daily change of SPDR S&P 500 ETF Trust from 2016 to 2017. Once beta is recognized, it will represent how volatile Phillips 66 is to the market. If over 1, it is

more volatile; however, if it is less than 1, it will be less volatile. While also finding the beta, I will also look to the p-value in the CAPM model to determine how statistically significant the evaluation model is going to be.

- The 5 year Treasury bond rate is 2.5% and the market equity risk premium is 5.75%.

*Cost of equity is then calculated: Treasury Bond Rate + Beta * Market Equity Risk Premium*

Once the cost of equity is determined, I will begin gathering information to calculate cost of capital. Cost of capital needs the following information: cost of equity, debt ratio, cost of debt, default spread, and marginal tax rate. Gathering the following information determines the opportunity cost of making the specific investment; however, in this case it allows me to value the operating asset. The equation for cost of capital is below:

= Cost of Equity * (1 - Debt ratio) + Cost of Debt *(1 - Marginal Tax Rate)*(Debt Ratio)

Another key factor to recognize before valuing the operating asset is to set a stable growth rate, in which it can correlate with operating income. Additionally, a return on capital is necessary to approximate before calculating the reinvestment rate. The equation is as follows:

$$Return\ on\ Capital = \frac{Opearting\ Income}{Total\ Equity}$$

Once growth and return on capital is set, the reinvestment rate is calculated as below:

$$Reinvestment\ Rate = \frac{Growth}{Return\ on\ Capital}$$

Once all factors are calculated, I will be able to value the operating assets, which are present in day to day business operations. Below you will see the equation:

$$Value\ of\ Operating\ Assets = \frac{Operating\ Income\ (1+growth)(1-tax\ rate)(1-(\frac{g}{ROC}))}{(Cost\ of\ capital - g)}$$

After finding the value of the operating assets, I will use normalized assumptions of cash, debt and number of outstanding shares. This will then create an equation to get value per share against the oil price. The equation is below:

$$Value\ per\ share = \frac{Operating\ Assets + Cash - Debt}{Number\ of\ shares}$$

Once the value per share is calculated, I will then begin calculating operating income from the other normalized oil prices to determine the linear relationship between oil price and value per share. While recalculating at other oil price points, the capital invested number remains fixed. After all, normalized prices are calculated, it allows an investor to see if Phillips 66 is under or overvalued.

In this first scenario, I will be primarily looking at p-values to determine if the CAPM model and oil prices to operating income are statistically significant. From here, I will perform the other evaluations and then able to compare the results at the end.

4.2 Evaluation 2: Fama & French Model

To evaluate Phillips 66 with the Fama French Model, I will pull the monthly closing price of Phillips 66 from January 2012 to February 2018 and the following: Excess return on the market (Mkt-RF), Small minus Big (SMB), High minus Low (HML), and Risk free rate (RF).

After all data is gathered, I will calculate the monthly return on the Phillips 66 closing price with the following equation: $\frac{n(t)}{n(t)-n(t-1)}$

From here, I will take the monthly return of Phillips 66 and subtract the market risk free rate to determine the excess month return which is required before running the Fama French regression. The equation is as follows:

Excess Monthly Return = Monthly Return - Risk Free rate

To create a Fama French Regression Model, the output is the monthly return and the three factors were imputed to create a beta of each variable. Once the regression is complete, the following equation is created.

Y= Y intercept + Variable 1*(Mkt-Rf) + Variable 2*(SMB) + Variable 3*(HML)

The regression will be useful to evaluate if the Fama & French model has a statistically significant p-value in which is greater than the CAPM Model.

In order to calculate the cost of equity from the Fama French Model, I will gather the following data:

- Averages of each of the Mkt-RF, SMB, HML, and RF found
- Conducted a linear least function analysis of the Excess Monthly return against each of the three factors, which are Mkt-RF, SMB, and HML

After all the data is collected, I will generate the cost of equity with the following equation:

Cost of Equity=Avg. RF+(Avg.Mkt-RF*Lin Mkt-RF)+(Avg.SMB*LinSMB)+(Avg.HML*LinHML)

Once, the Fama French 3-factor cost of equity is determined, the cost of equity replaces the previous one in the cost of capital equation in *Evaluation 1*. From here, the following steps are repeated from Evaluation 1 with the all the same factors to calculate a new value per share with

the Fama & French model. The new cost of capital from the Fama & French 3-factor model will be replaced in the following equation:

$$Value\ of\ Operating\ Assets = \frac{Operating\ Income\ (1+growth)(1-tax\ rate)(1-(\frac{g}{ROC}))}{(Cost\ of\ capital - g)}$$

After the value per share is calculated, I will be able to properly evaluate if the CAPM model or Fama & French will be a better tool of valuing an oil and gas company.

4.3 Evaluation 3: Crack Spread vs. Profitability

To determine the relationship of profitability and the crack spread, I will gather quarterly data from 2011 to 2017 to analyze if the crack spread prices in the current month directly impact profitability in the current month or if it has a one month lag. The data in Figure 6 will indicate the crack spread prices do impact profitability positively in the following month.

Once both data sets are compared, I will regress the profitability against the crack spread over the period with a one month lag and obtain the following from the CAPM regression model:

Profitability = Intercept + Slope (crack spread)

Following this, I need to value the Cost of Equity. From here I will calculate the cost of capital to begin evaluating Phillips 66, so the following assumptions were equivalent from Evaluation 1 as seen below.

- To derive a beta, I took the percentage daily change in stock price and regressed it against the percentage daily change of SPDR S&P 500 ETF Trust from 2016 to 2017. Once beta is recognized, it will represent how volatile Phillips 66 is to the market. If over 1, it is more volatile; however, if it is less than 1, it will be less volatile.

- The 5 year Treasury bond rate is 2.5% and the market equity risk premium is 5.75%.

Cost of equity is then calculated: Treasury Bond Rate + Beta * Market Equity Risk Premium

Once the cost of equity is determined, I will begin gathering information to calculate cost of capital. Cost of capital remains the same as Evaluation 1 due to there being no change in the equation below as we are still working with the same cost of equity structure.

= Cost of Equity(1 - Debt ratio)+Cost of Debt *(1 - Marginal Tax Rate)*(Debt Ratio)*

After the cost of capital is calculated, it is now time to use the profitability regression that was calculated in the beginning of Evaluation 3. The equation will look like the following:

Profitability = Intercept + Slope (crack spread)

Next, the growth rate needs to be identified before calculating the reinvestment rate. The growth rate will be the same from Evaluation 1 and Evaluation 2.

Additionally, a return on capital is necessary to approximate before calculating the reinvestment rate. This allows a principal payment to be returned to stakeholders that exceed the growth of the business. The return on capital is the following equation:

Return on Capital $= \frac{Profitability}{Total\ Equity}$

Once growth and return on capital is set, the reinvestment rate is calculated below:

Reinvestment Rate $= \frac{Growth}{Return\ on\ Capital}$

After all factors are calculated, I will be able to value the operating assets, which are present in day to day business activities. Below you will see the equation:

Value of Operating Assets $= \frac{Profitability\ (1+growth)(1-tax\ rate)(1-(\frac{g}{ROC}))}{(Cost\ of\ capital-g)}$

After finding the value of the operating assets, I will gather normalized assumptions of cash, debt and number of outstanding shares. This will then create an equation to get value per share against the oil price. The equation is below:

Value per share $= \frac{Operating\ Assets+Cash-Debt}{Number\ of\ shares}$

Once the value per share is calculated, I will begin recalculating other normalized crack spread prices to determine its value per share. While recalculating, it is important to note the capital invested should remain fixed. After all calculations are complete, a graph is made to show the linear relationship of a normalized profitability of Phillips 66 to crack spread prices.

5. Empirical Results:

5.1 Evaluation 1: Normalizing Operating Income vs. Oil Price

To determine the relationship of operating income and oil prices, I gathered quarterly data from 2011 to 2017 to analyze if oil prices in the current month directly impacted operating income in the current month or if it has a one month lag. The data indicated in Figure 1 that usually oil prices do impact operating income positively in the following month.

Figure 1: Operating Income versus Oil Price for Phillips 66: 2011-2017 (Lag and no lag)
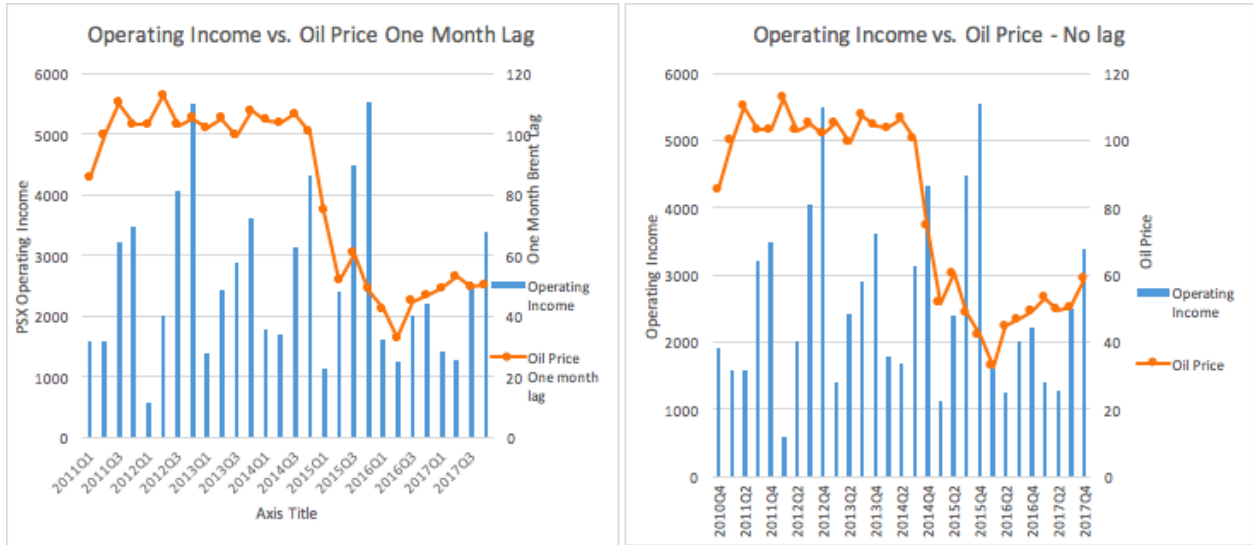
Operating Income vs. Oil Price One Month Lag

Operating Income vs. Oil Price - No lag

Once both data sets were compared, I regressed the operating income against the oil price per barrel over the period and obtained the following:

Operating Income = Intercept + Beta (Oil Price)

Operating Income = 286,844,851.88 + 5,552,257.20(Oil Price)*

Table 1: Oil Price to Operating Income Regression

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.314940148
R Square	0.099187297
Adjusted R Square	0.064540654
Standard Error	473414776.9
Observations	28

ANOVA

	df	SS	MS	F	Significance F
Regression	1	6.41621E+17	6.4162E+17	2.86282565	0.102600861
Residual	26	5.82716E+18	2.2412E+17		
Total	27	6.46878E+18			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	$ 286,844,851.88	278871036	1.0285932	0.3131454	-286382772.2	860072476	-286382772.2	860072475.9
Oil Price	$ 5,552,257.20	3281497.868	1.69198867	0.10260086	-1192958.268	12297472.7	-1192958.268	12297472.67

To then get the value of the Cost of Equity, the following assumptions were made:

- To derive Phillips 66 beta, I took the percentage daily change in stock prices and regressed it against the percentage daily change of SPDR S&P 500 ETF Trust from 2016 to 2017. I received the beta 1.17, as seen in Table 2, which means Phillips 66 is more volatile than the market. In addition, the p-value is statistically significant and will be

examined further in comparison to the Fama & French 3-factor model to test one of the current hypotheses.

Table 2: CAPM Regression of Phillips 66 against SPDR S&P 500 ETF Trust

SUMMARY OUTPUT									
Regression Statistics									
Multiple R	0.608922303								
R Square	0.370786371								
Adjusted R Square	0.369527944								
Standard Error	0.010011421								
Observations	502								
ANOVA									
	df	*SS*	*MS*	*F*	*Significance F*				
Regression	1	0.029531607	0.02953161	294.642673	2.92247E-52				
Residual	500	0.050114273	0.00010023						
Total	501	0.07964588							
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.00014152	0.000448617	-0.3154585	0.75254519	-0.001022926	0.000739886	-0.001022926	0.000739886
Phillips 66 Daily Change	1.171131317	0.068227235	17.1651587	2.9225E-52	1.037083915	1.305178719	1.037083915	1.305178719

- The 5 year Treasury bond rate is 2.5% and the market equity risk premium is 5.75% (Treasury).

Cost of equity is then calculated: 2.5% + 1.17(5.75%) = 9.23%

Having the cost of equity calculated allowed me to compute the cost of capital after the following numbers are assumed below:

- Debt ratio: .6476
  - To note: The debt ratio was determined by the total debt divided by the market cap (Compustat, 2018).
- Cost of Debt: 4.31%
  - To note: Cost of debt was calculated by (CRSP, 2018).
- Marginal Tax Rate: 38%
  - To note: The tax rate was found from the Treasury Department (Treasury).

*Cost of Capital = 9.23% * (1-.6476) + 4.31% * (1-.38) * (.6476) = 4.98%*

From this point, operating income was calculated from the regressed relationship of oil price and operating income while inputting the normalized oil price. Initially, I evaluated the oil price to be $65 in order to be relatively close to the current WTI price and evaluate how accurate the model is to the current operating income/value per share. The operating income equation with the input of $65 is as follows:

Operating Income = 286,844,851.88 + 5,552,257.20*(65) = $647,741,570.04

After I calculated the operating income, I determined my return on capital; however, to do so I needed to divide the operating income by the total equity of Phillips 66. The total equity is 25.085 billion and is held fixed as all other normalized oil prices are calculated. For the oil price of $65, I performed the following equation:

Return on Capital $= \frac{647,741,570.04}{25,085,000,000} = 2.58\%$

While the return on capital is low within the current model, oil price volatility has been frequent in the past few years which contributes to why the relationship among operating income would produce less return on capital. After determining this function, I began to model the reinvestment rate with a very conservative growth of one percent. The one percent growth was chosen due to the extreme volatility in the market and few oil and gas companies having little to no growth in the past year. This equation determines how much money is put back into the company year to year. The reinvestment rate divides the growth rate by the return on capital, which is shown below:

Reinvestment rate $= \frac{1\%}{2.58\%} = 38.73\%$

After this was calculated, I began to value the operating assets with the following formula:

Value of Operating Assets $= \frac{\text{Operating Income }(1+growth)(1-tax\ rate)(1-(\frac{g}{ROC}))}{(\text{Cost of capital} - g)}$

$= \frac{647,741,570.04 * (1+.01) * (1-.38) * (1-.3873)}{(.0498 - .01)} = \$6,240,972,994.22$

Once the value of operating assets was computed, I began to gather cash, debt and outstanding shares from Compustat IQ to determine the value per share. The following balances are below, but also held fixed when applied to other normalized oil prices as per the model based by Aswath Damodaran.

- Cash: $3,119,000,000 (Compustat-IQ, 2018)
- Debt: $29,286,000 (Compustat-IQ, 2018)
- Outstanding Shares: 466,320,000 (Compustat, IQ)

The equation for value per share is: $\frac{\text{Operating Assets} + \text{Cash} - \text{Debt}}{\text{Number of shares}}$

$= \frac{6,240,972,994.22 + 3,119,000,000 - 29,286,000}{466,320,000} = \$20.01$

From this point, I recalculated the following formulas per normalized oil price to evaluate the linear relationship oil price has on normalized operating income. In Figure 2 and 3, the linear

relationship is shown in the table and the computation of all normalized oil prices to value price per share.
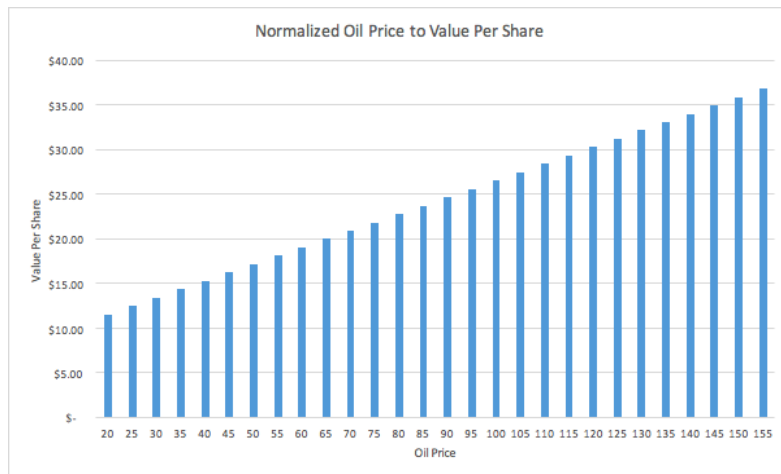
Figure 2: Normalized Oil Price to Value per Share

Figure 3: Computation of CAPM model for Evaluation 1

Total Equity	Oil Price	Operating Income	Return on Capital	Reinvestment Rate	Value of Operating Assets	Value Per Share
$ 25,085,000,000.00	20	$ 397,889,995.93	1.59%	63.05%	$ 2,312,149,496.12	$ 11.58
$ 25,085,000,000.00	25	$ 425,651,281.94	1.70%	58.93%	$ 2,748,685,440.35	$ 12.52
$ 25,085,000,000.00	30	$ 453,412,567.95	1.81%	55.32%	$ 3,185,221,384.59	$ 13.46
$ 25,085,000,000.00	35	$ 481,173,853.97	1.92%	52.13%	$ 3,621,757,328.82	$ 14.39
$ 25,085,000,000.00	40	$ 508,935,139.98	2.03%	49.29%	$ 4,058,293,273.05	$ 15.33
$ 25,085,000,000.00	45	$ 536,696,425.99	2.14%	46.74%	$ 4,494,829,217.29	$ 16.26
$ 25,085,000,000.00	50	$ 564,457,712.00	2.25%	44.44%	$ 4,931,365,161.52	$ 17.20
$ 25,085,000,000.00	55	$ 592,218,998.01	2.36%	42.36%	$ 5,367,901,105.75	$ 18.14
$ 25,085,000,000.00	60	$ 619,980,284.03	2.47%	40.46%	$ 5,804,437,049.99	$ 19.07
$ 25,085,000,000.00	65	$ 647,741,570.04	2.58%	38.73%	$ 6,240,972,994.22	$ 20.01
$ 25,085,000,000.00	70	$ 675,502,856.05	2.69%	37.14%	$ 6,677,508,938.46	$ 20.95
$ 25,085,000,000.00	75	$ 703,264,142.06	2.80%	35.67%	$ 7,114,044,882.69	$ 21.88
$ 25,085,000,000.00	80	$ 731,025,428.07	2.91%	34.31%	$ 7,550,580,826.92	$ 22.82
$ 25,085,000,000.00	85	$ 758,786,714.08	3.02%	33.06%	$ 7,987,116,771.16	$ 23.75
$ 25,085,000,000.00	90	$ 786,548,000.10	3.14%	31.89%	$ 8,423,652,715.39	$ 24.69
$ 25,085,000,000.00	95	$ 814,309,286.11	3.25%	30.81%	$ 8,860,188,659.62	$ 25.63
$ 25,085,000,000.00	100	$ 842,070,572.12	3.36%	29.79%	$ 9,296,724,603.86	$ 26.56
$ 25,085,000,000.00	105	$ 869,831,858.13	3.47%	28.84%	$ 9,733,260,548.09	$ 27.50
$ 25,085,000,000.00	110	$ 897,593,144.14	3.58%	27.95%	$ 10,169,796,492.32	$ 28.43
$ 25,085,000,000.00	115	$ 925,354,430.16	3.69%	27.11%	$ 10,606,332,436.56	$ 29.37
$ 25,085,000,000.00	120	$ 953,115,716.17	3.80%	26.32%	$ 11,042,868,380.79	$ 30.31
$ 25,085,000,000.00	125	$ 980,877,002.18	3.91%	25.57%	$ 11,479,404,325.03	$ 31.24
$ 25,085,000,000.00	130	$ 1,008,638,288.19	4.02%	24.87%	$ 11,915,940,269.26	$ 32.18
$ 25,085,000,000.00	135	$ 1,036,399,574.20	4.13%	24.20%	$ 12,352,476,213.49	$ 33.12
$ 25,085,000,000.00	140	$ 1,064,160,860.21	4.24%	23.57%	$ 12,789,012,157.73	$ 34.05
$ 25,085,000,000.00	145	$ 1,091,922,146.23	4.35%	22.97%	$ 13,225,548,101.96	$ 34.99
$ 25,085,000,000.00	150	$ 1,119,683,432.24	4.46%	22.40%	$ 13,662,084,046.19	$ 35.92
$ 25,085,000,000.00	155	$ 1,147,444,718.25	4.57%	21.86%	$ 14,098,619,990.43	$ 36.86

5.2 Evaluation 2: Fama French 3-factor Model

To evaluate Phillips 66 with the 3-factor Fama French model, I pulled monthly closing prices of Phillips 66 from Yahoo Finance from January 2012 to February 2018. Additionally, I pulled the following factors from January 2012 to February 2018 from Kenneth R. French - Data Library: Excess return on the market (Mkt-RF), Small minus Big (SMB), High minus Low (HML), and Risk free rate (RF).

After all data was gathered, I performed the monthly return on the Phillips 66 closing price with the following equation: $\frac{n(t)}{n(t)-n(t-1)}$

For example, the last previous month included the following equation: $\frac{55438000}{(55438000-37743000)} = 3.133$

From here, I was able to take the monthly return of Phillips 66 and subtract the market risk free rate to determine the excess month return which is required before running the Fama & French regression. This is then applied to all monthly returns from 2012 to 2018. An example equation is as follows:

Excess Monthly Return = 3.133 - .11 = 3.02

To create a Fama French Regression Model, the output was the monthly return and the three factors were inputs to create a beta of each variable. Once the regression was complete, the following equation was created.

Y= -0.7077783 + 1.4689*(Mkt-Rf) + 2.3920*(SMB) -1.4197*(HML)

In order to calculate the cost of equity from the Fama French Model, I had to gather the following data:

Table 3: Fama & French 3-factor model

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.17111498							
R Square	0.02928034							
Adjusted R Square	-0.0148433							
Standard Error	45.6352564							
Observations	70							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	3	4145.979747	1381.99325	0.66359779	0.577384532			
Residual	66	137450.0573	2082.57663					
Total	69	141596.0371						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.7077783	5.912345357	-0.1197119	0.90507501	-12.51215662	11.0966001	-12.512157	11.0966001
Mkt-RF	1.46890355	1.908294612	0.76974673	0.44419646	-2.341129576	5.27893667	-2.3411296	5.27893667
SMB	2.39200018	2.546461082	0.93934292	0.35097986	-2.692173414	7.47617377	-2.6921734	7.47617377
HML	-1.4197307	2.488944675	-0.5704147	0.57033334	-6.389069103	3.54960765	-6.3890691	3.54960765

The p-value in the Fama & French 3-factor model is not statistically significant due to it being greater than 10%.

- Averages of each of the following:

14

- ○ Mkt-RF = 1.169
- ○ SMB = -0.073
- ○ HML = 0.053
- ○ RF = 0.018
- Variable rate (betas) of the three factors:
  - ○ Mkt-RF = 1.4689
  - ○ SMB = 2.3920
  - ○ HML = -1.4197

After all the data was found, I was able to generate the cost of equity with the following equation:

Cost of Equity=Avg. RF+(Avg.Mkt-RF*Lin Mkt-RF)+(Avg.SMB*LinSMB)+(Avg.HML*LinHML)

= 0.018 + (1.169 * 1.4689) + (-0.073 * 2.3920) + (0.018 * -1.4197) = 1.48347%

Once, the Fama & French 3-factor cost of equity was determined, the cost of equity replaces the previous COE in Evaluation 1 to get a new Cost of Equity. The new equation was computed below holding all other factors constant:

- Debt ratio: .6476

  - ○ The debt ratio was determined by the total debt divided by the market cap (Compustat, 2018).

- Cost of Debt: 4.31%

  - ○ Cost of debt was calculated by CRSP.

- Marginal Tax Rate: 38%

  - ○ The tax rate was found from the Treasury Department (Treasury).

Cost of Capital = 1.48347% * (1-.6476) + 4.31% * (1-.38) * (.6476) = 2.25%

From here, the following steps are repeated from Evaluation 1 with the all the same factors and the set normalized oil price of $65 to calculate a new value per share with the Fama & French model. Below all steps are repeated until valuing operating assets as you will see in the following equations:

Operating Income = 286,844,851.88 + 5,552,257.20*(65) = $647,741,570.04

Return on Capital = $\frac{647,741,570.04}{25,085,000,000}$ = 2.58%

$Reinvestment\ rate = \frac{1\%}{2.58\%} = 38.73\%$

Now, the new cost of capital from the Fama & French 3-factor model will be replaced in the following equation:

$$Value\ of\ Operating\ Assets = \frac{Operating\ Income\ (1+growth)(1-tax\ rate)(1-(\frac{g}{ROC}))}{(Cost\ of\ capital - g)}$$

$$= \frac{647,741,570.04 * (1+.01) * (1-.38) * (1 - .3873)}{(.0225 - .01)} = \$19,830,484,086.44$$

After the new value of operating assets is calculated, the value per share of Phillips 66 can be configured. The following numbers are assumed below, but are held fixed when applied to other normalized oil prices as per the model based by Aswath Damodaran.

- Cash: $3,119,000,000 (Compustat-IQ, 2018)

- Debt: $29,286,000 (Compustat-IQ, 2018)

- Outstanding Shares: 466,320,000 (Compustat, IQ)

$$= \frac{19,830,484,086.44 + 3,119,000,000 - 29,286,000}{466,320,000} = \$49.15$$

From this point, I recalculated the formulas per normalized oil price to evaluate the linear relationship oil price has on operating income from the Fama & French 3-factor model. In Figure 4 and 5, the linear relationship is shown.

Figure 4: Fama French 3-factor model for Normalized Oil Price to Value per Share
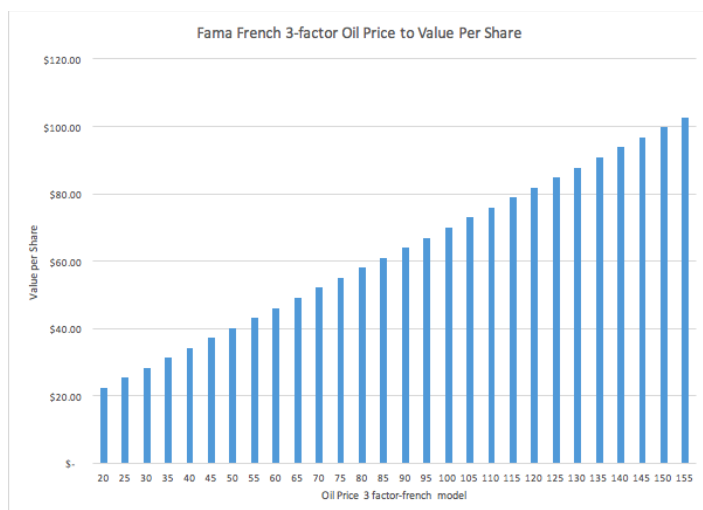

Figure 5: Computation of Fama French 3-factor model for Evaluation 2

Total Equity	Oil Price	Operating Income	Return on Capital	Reinvestment Rate	Value of Operating Assets	Value Per Share
$ 25,085,000,000.00	20	$ 397,889,995.93	1.59%	63.05%	$ 7,346,778,111.48	$ 22.38
$ 25,085,000,000.00	25	$ 425,651,281.94	1.70%	58.93%	$ 8,733,856,553.14	$ 25.36
$ 25,085,000,000.00	30	$ 453,412,567.95	1.81%	55.32%	$ 10,120,934,994.80	$ 28.33
$ 25,085,000,000.00	35	$ 481,173,853.97	1.92%	52.13%	$ 11,508,013,436.47	$ 31.30
$ 25,085,000,000.00	40	$ 508,935,139.98	2.03%	49.29%	$ 12,895,091,878.13	$ 34.28
$ 25,085,000,000.00	45	$ 536,696,425.99	2.14%	46.74%	$ 14,282,170,319.79	$ 37.25
$ 25,085,000,000.00	50	$ 564,457,712.00	2.25%	44.44%	$ 15,669,248,761.46	$ 40.23
$ 25,085,000,000.00	55	$ 592,218,998.01	2.36%	42.36%	$ 17,056,327,203.12	$ 43.20
$ 25,085,000,000.00	60	$ 619,980,284.03	2.47%	40.46%	$ 18,443,405,644.78	$ 46.18
$ 25,085,000,000.00	65	$ 647,741,570.04	2.58%	38.73%	$ 19,830,484,086.44	$ 49.15
$ 25,085,000,000.00	70	$ 675,502,856.05	2.69%	37.14%	$ 21,217,562,528.11	$ 52.13
$ 25,085,000,000.00	75	$ 703,264,142.06	2.80%	35.67%	$ 22,604,640,969.77	$ 55.10
$ 25,085,000,000.00	80	$ 731,025,428.07	2.91%	34.31%	$ 23,991,719,411.43	$ 58.07
$ 25,085,000,000.00	85	$ 758,786,714.08	3.02%	33.06%	$ 25,378,797,853.10	$ 61.05
$ 25,085,000,000.00	90	$ 786,548,000.10	3.14%	31.89%	$ 26,765,876,294.76	$ 64.02
$ 25,085,000,000.00	95	$ 814,309,286.11	3.25%	30.81%	$ 28,152,954,736.42	$ 67.00
$ 25,085,000,000.00	100	$ 842,070,572.12	3.36%	29.79%	$ 29,540,033,178.09	$ 69.97
$ 25,085,000,000.00	105	$ 869,831,858.13	3.47%	28.84%	$ 30,927,111,619.75	$ 72.95
$ 25,085,000,000.00	110	$ 897,593,144.14	3.58%	27.95%	$ 32,314,190,061.41	$ 75.92
$ 25,085,000,000.00	115	$ 925,354,430.16	3.69%	27.11%	$ 33,701,268,503.07	$ 78.90
$ 25,085,000,000.00	120	$ 953,115,716.17	3.80%	26.32%	$ 35,088,346,944.74	$ 81.87
$ 25,085,000,000.00	125	$ 980,877,002.18	3.91%	25.57%	$ 36,475,425,386.40	$ 84.85
$ 25,085,000,000.00	130	$ 1,008,638,288.19	4.02%	24.87%	$ 37,862,503,828.06	$ 87.82
$ 25,085,000,000.00	135	$ 1,036,399,574.20	4.13%	24.20%	$ 39,249,582,269.73	$ 90.79
$ 25,085,000,000.00	140	$ 1,064,160,860.21	4.24%	23.57%	$ 40,636,660,711.39	$ 93.77
$ 25,085,000,000.00	145	$ 1,091,922,146.23	4.35%	22.97%	$ 42,023,739,153.05	$ 96.74
$ 25,085,000,000.00	150	$ 1,119,683,432.24	4.46%	22.40%	$ 43,410,817,594.72	$ 99.72
$ 25,085,000,000.00	155	$ 1,147,444,718.25	4.57%	21.86%	$ 44,797,896,036.38	$ 102.69

5.3 Evaluation 3: CAPM - Crack Spread vs. Profitability

To determine the relationship of profitability and the crack spread, I gathered quarterly data from 2011 to 2017 to analyze if the crack spread prices in the current month directly impacted profitability in the current month or if it has a one month lag. The data indicated in Figure 6 that usually the crack spread prices do impact profitability positively in the following month.

Figure 6: Profitability versus Crack Spread for Phillips 66: 2011-2017 (Lag and no lag)
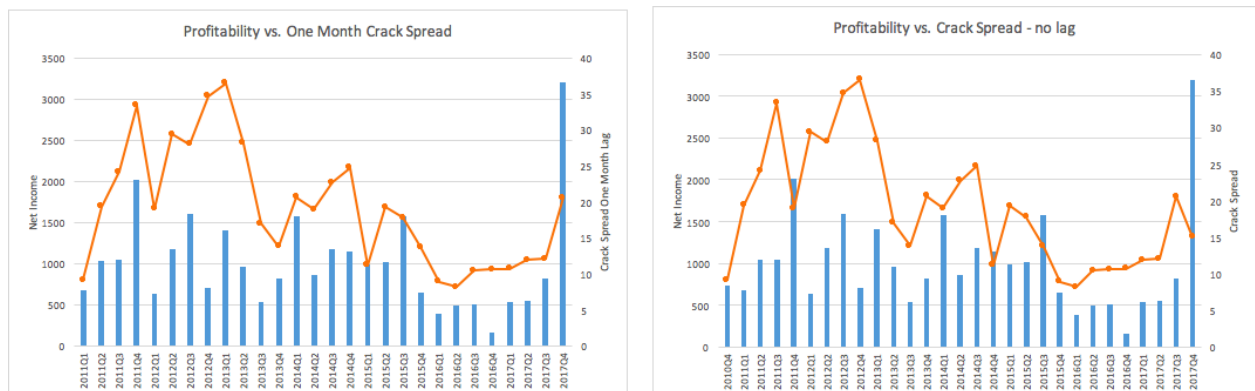
After I regressed profitability of Phillips 66 against the crack spread over the period and obtained the following:

Profitability = 50,7971,495.20 + 25,793,645.58*(Crack Spread)

Table 4: Crack Spread to Profitability Regression

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.444488408							
R Square	0.197569945							
Adjusted R Square	0.16670725							
Standard Error	438933404.7							
Observations	28							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	1.23334E+18	1.2333E+18	6.40157796	0.017798101			
Residual	26	5.00923E+18	1.9266E+17					
Total	27	6.24257E+18						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	507971495.2	211718538.6	2.39927735	0.02388874	72777806.47	943165184	72777806.47	943165183.9
Crack Spread	25793645.58	10194576.95	2.53013398	0.0177981	4838392.532	46748898.6	4838392.532	46748898.62

From this regression, I was able to identify how statistically significant the p-value is and the correlation of the crack spread on profitability. The confidence level is almost 99% and will be used to determine if the correlation of the crack spread to profitability is a better tool to forecast/model a downstream oil and gas company than oil price to operating income..

To get the value of the Cost of Equity, the assumptions from Evaluation 1 are the same:

- The 5 year Treasury bond rate is 2.5% and the market equity risk premium is 5.75% (Treasury).
- Beta: 1.17

Cost of equity is then calculated: 2.5% + 1.17(5.75%) = 9.23%

Additionally, the cost of capital is the same from Evaluation 1 with the following calculation.

*Cost of Capital = 9.23% * (1-.6476) + 4.31% * (1-.38) * (.6476) = 4.98%*

From this point, profitability was calculated from the regressed relationship of crack spread and profitability. Initially, I used the crack spread at $12 to be relatively close to the current price. The equation with the input of $12 is as follows:

*Profitability = (50,7971,495.20 + 25,793,645.58*12) = $817,495,242.11*

After I calculated the profitability, I determined my return on capital. The total equity is 25.085 billion and is held fixed as all normalized crack spread prices are calculated. For the crack spread of $12, I performed the following equation:

Return on Capital = $\frac{\$817,495,242.11}{25,085,000,000}$ *= 3.26%*

From here, I calculated the reinvestment rate with the growth rate of one percent. The calculation is below:

Reinvestment rate $= \frac{1\%}{3.26\%} = 30.69\%$

After this was calculated, I began to value the operating assets with the following formula:

Value of Operating Assets $= \frac{Profitability(1+growth)(1-tax\ rate)(1-(\frac{g}{ROC}))}{(Cost\ of\ capital - g)}$

$= \frac{\$817,495,242.11*(1+.01)*(1-.38)*(1-.3873)}{(.0498-.01)} = \$8,910,286,638.25$

Once the value of the operating asset was computed, I used the cash, debt, and outstanding shares from Evaluation 1 and 2 to determine value per share. The following balances are below, but also held fixed when applied to other normalized crack spread prices as per the model based by Aswath Damodaran.

- Cash: $3,119,000,000 (Compustat-IQ, 2018)
- Debt: $29,286,000 (Compustat-IQ, 2018)
- Outstanding Shares: 466,320,000 (Compustat, IQ)

The equation for value per share is: $\frac{Operating\ Assets + Cash - Debt}{Number\ of\ shares}$

$= \frac{8,910,286,638.25 + 3,119,000,000 - 29,286,000}{466,320,000} = \$25.73$

From this point, I recalculated the following formulas per normalized crack spread to evaluate the linear relationship crack spread has on profitability. In Figure 10 and 11, the linear relationship is shown in the table and the computation of all normalized crack spread prices to value price per share.

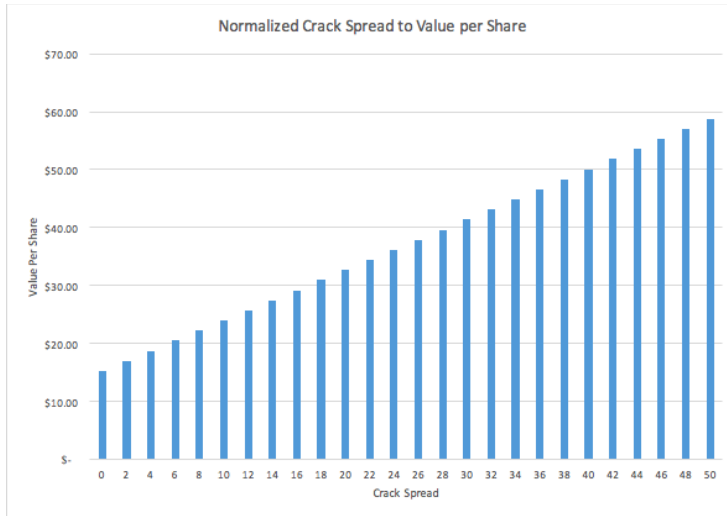*Figure 7: Normalized Crack Spread to Value per Share*

Figure 8: Computation of CAPM model for Evaluation 3

Total Equity	Crack Spread	Profitability	Return on Capital	Reinvestment Rate	Value of Operating Assets	Value Per Share
$ 25,085,000,000.00	0 $	507,971,495.21	2.03%	49.38% $	4,043,140,315.82 $	15.30
$ 25,085,000,000.00	2 $	559,558,786.36	2.23%	44.83% $	4,854,331,369.56 $	17.04
$ 25,085,000,000.00	4 $	611,146,077.51	2.44%	41.05% $	5,665,522,423.30 $	18.78
$ 25,085,000,000.00	6 $	662,733,368.66	2.64%	37.85% $	6,476,713,477.04 $	20.51
$ 25,085,000,000.00	8 $	714,320,659.81	2.85%	35.12% $	7,287,904,530.77 $	22.25
$ 25,085,000,000.00	10 $	765,907,950.96	3.05%	32.75% $	8,099,095,584.51 $	23.99
$ 25,085,000,000.00	12 $	817,495,242.11	3.26%	30.69% $	8,910,286,638.25 $	25.73
$ 25,085,000,000.00	14 $	869,082,533.27	3.46%	28.86% $	9,721,477,691.99 $	27.47
$ 25,085,000,000.00	16 $	920,669,824.42	3.67%	27.25% $	10,532,668,745.73 $	29.21
$ 25,085,000,000.00	18 $	972,257,115.57	3.88%	25.80% $	11,343,859,799.46 $	30.95
$ 25,085,000,000.00	20 $	1,023,844,406.72	4.08%	24.50% $	12,155,050,853.20 $	32.69
$ 25,085,000,000.00	22 $	1,075,431,697.87	4.29%	23.33% $	12,966,241,906.94 $	34.43
$ 25,085,000,000.00	24 $	1,127,018,989.02	4.49%	22.26% $	13,777,432,960.68 $	36.17
$ 25,085,000,000.00	26 $	1,178,606,280.17	4.70%	21.28% $	14,588,624,014.42 $	37.91
$ 25,085,000,000.00	28 $	1,230,193,571.32	4.90%	20.39% $	15,399,815,068.15 $	39.65
$ 25,085,000,000.00	30 $	1,281,780,862.47	5.11%	19.57% $	16,211,006,121.89 $	41.39
$ 25,085,000,000.00	32 $	1,333,368,153.62	5.32%	18.81% $	17,022,197,175.63 $	43.13
$ 25,085,000,000.00	34 $	1,384,955,444.77	5.52%	18.11% $	17,833,388,229.37 $	44.87
$ 25,085,000,000.00	36 $	1,436,542,735.93	5.73%	17.46% $	18,644,579,283.11 $	46.61
$ 25,085,000,000.00	38 $	1,488,130,027.08	5.93%	16.86% $	19,455,770,336.84 $	48.35
$ 25,085,000,000.00	40 $	1,539,717,318.23	6.14%	16.29% $	20,266,961,390.58 $	50.09
$ 25,085,000,000.00	42 $	1,591,304,609.38	6.34%	15.76% $	21,078,152,444.32 $	51.83
$ 25,085,000,000.00	44 $	1,642,891,900.53	6.55%	15.27% $	21,889,343,498.06 $	53.57
$ 25,085,000,000.00	46 $	1,694,479,191.68	6.75%	14.80% $	22,700,534,551.80 $	55.31
$ 25,085,000,000.00	48 $	1,746,066,482.83	6.96%	14.37% $	23,511,725,605.53 $	57.05
$ 25,085,000,000.00	50 $	1,797,653,773.98	7.17%	13.95% $	24,322,916,659.27 $	58.79

6. Monte Carlo Simulation

6.1 WTI-Oil Distribution

In evaluation 1 and 2, I valued Phillips 66 using normalized operating income to get a value per share. To determine the probability of the given oil price in a given year, I gathered the quarterly oil prices from 2010 to 2017 from Bloomberg. From here, I randomly gathered prices for 10,000 instances of the oil price to find a distribution. Below in Figure 12, you will find the distribution of oil prices.

Figure 9: Oil Price Distribution
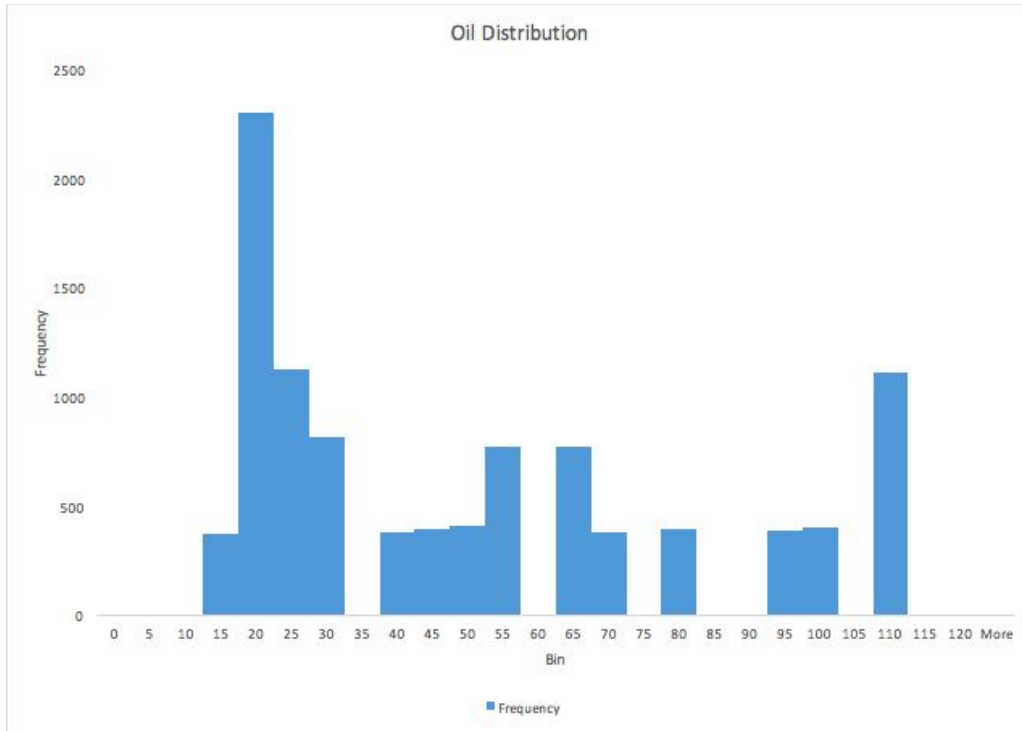
Oil Distribution

6.2 Crack Spread Distribution

In evaluation 3, I valued Phillips 66 using normalized profitability to get a value per share. To determine the probability of the given crack spread price in a given year, I gathered the monthly crack spread price from 1992 to 2017 from Bloomberg. From here, I randomly generated prices for 10,000 instances of the crack spread price to find a distribution. Below in Figure 13, you will find the distribution of crack spread prices.

Figure 10: Crack Spread Distribution

Crack Spread Distribution
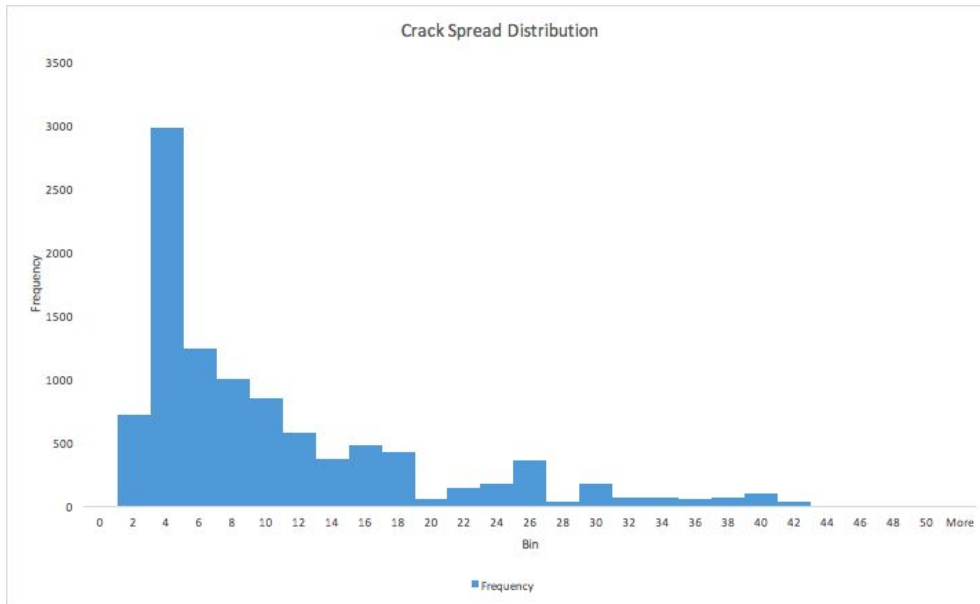
7. Discussion

7.1 Limitations

In Evaluation 1-3, the value per share did not come close to the current stock price of Phillips 66; however, there are several factors and/or limitations that were not considered while implementing the three evaluations. For instance, in my model, we assumed that there was a complete linear relationship with oil prices or crack spread prices to operating income or profitability. In addition, there is a point in oil prices where companies are least profitable and past this point, the value per share will likely turn into a curved relationship as oil and gas companies maximize income. Also, a downstream oil and gas company can be affected by new government regulations and in return this can impact how downstream oil and gas companies operate. Lastly, all calculations were dependent on fixed assumptions and these amounts will change in economic expansions and contractions.

7.2 Hypotheses Discussion

7.2.1 Hypothesis 1:

I initially believed in hypothesis 1 that the Fama & French 3-factor model is a better tool to evaluate a downstream oil and gas company than the CAPM model; however after my research, my hypothesis is incorrect. The regression in the CAPM model had a confidence level of almost 100%, which had complete correlation to the market suggesting if the market is performing well then so will Phillips 66. However, with the Fama & French model, the confidence level was 43% and does not have a statistically significant correlation to Phillips 66.

7.2.2 Hypothesis 2:

In my second hypothesis, I believed the p-value would be more statistically significant through profitability from the crack spread than operating income from oil prices and this held true. After regressing oil prices to operating income, I found a p-value of .10026 which had a confidence level of about 89.974%. However, when I regressed the crack spread price to profitability, I found a p-value of 0.017, which in return leads to a 98.3% confidence level. These findings show how the crack spread to profitability is a better tool to evaluate a downstream oil and gas company such as Phillips 66.

7.3 Future Research

Further research can be conducted to determine if having an extra factor, such as the Carhart 4-factor model, is better to determine if the p-value is statistically significant and to evaluate the normalized value per share. Additionally, gathering more information about the impacts of natural disasters and/or other factors could display kurtosis in oil prices and the crack spread.

8. Conclusion

Overall, I found my research to display how oil and gas companies are heavily impacted by oil prices, but it failed to reach an accurate share price due to the fixed factors and limitations present. However, my research was able to acknowledge CAPM as a better tool than the Fama & French 3-factor model and the correlation of crack spread to profitability as a more significant tool to evaluate a downstream oil and gas company.

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10. Figures & Tables

Figure 1: Operating Income versus Oil Price for Phillips 66: 2011-2017 (Lag and no lag)
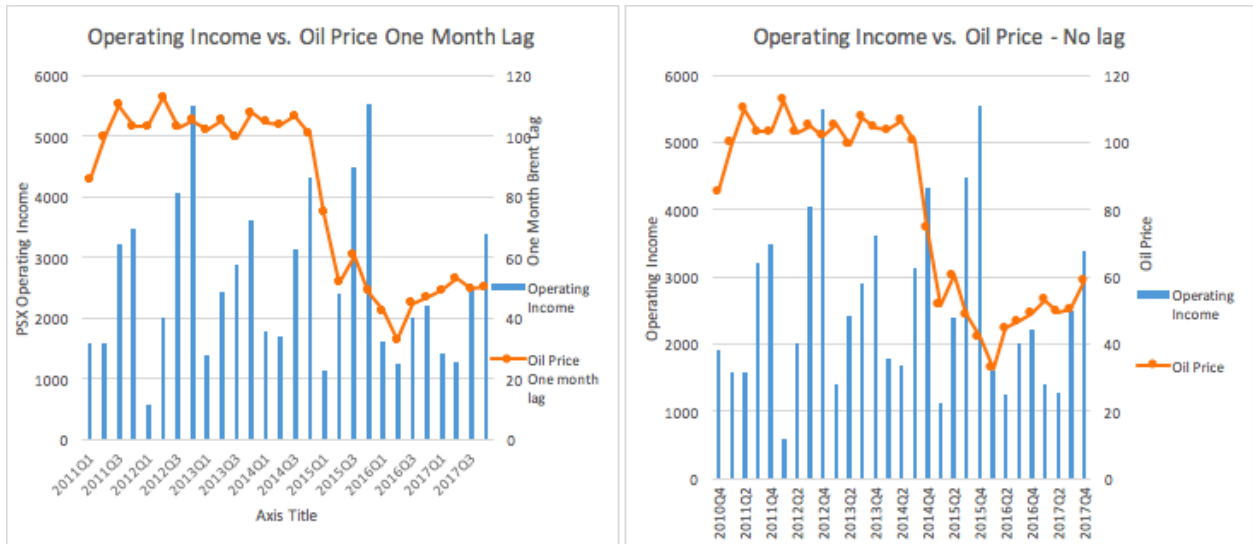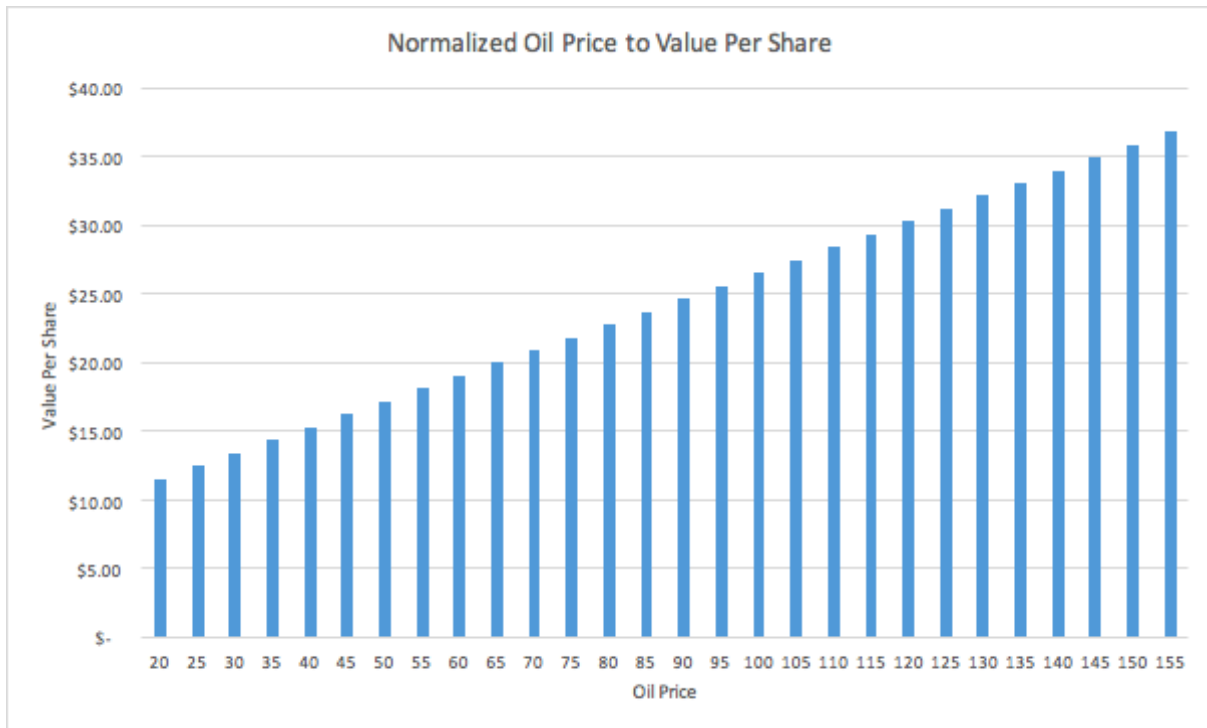

Figure 2: Normalized Oil Price to Value per Share

Figure 3: Computation of CAPM model for Evaluation 1

Total Equity	Oil Price	Operating Income	Return on Capital	Reinvestment Rate	Value of Operating Assets	Value Per Share
$ 25,085,000,000.00	20	$ 397,889,995.93	1.59%	63.05%	$ 2,312,149,496.12	$ 11.58
$ 25,085,000,000.00	25	$ 425,651,281.94	1.70%	58.93%	$ 2,748,685,440.35	$ 12.52
$ 25,085,000,000.00	30	$ 453,412,567.95	1.81%	55.32%	$ 3,185,221,384.59	$ 13.46
$ 25,085,000,000.00	35	$ 481,173,853.97	1.92%	52.13%	$ 3,621,757,328.82	$ 14.39
$ 25,085,000,000.00	40	$ 508,935,139.98	2.03%	49.29%	$ 4,058,293,273.05	$ 15.33
$ 25,085,000,000.00	45	$ 536,696,425.99	2.14%	46.74%	$ 4,494,829,217.29	$ 16.26
$ 25,085,000,000.00	50	$ 564,457,712.00	2.25%	44.44%	$ 4,931,365,161.52	$ 17.20
$ 25,085,000,000.00	55	$ 592,218,998.01	2.36%	42.36%	$ 5,367,901,105.75	$ 18.14
$ 25,085,000,000.00	60	$ 619,980,284.03	2.47%	40.46%	$ 5,804,437,049.99	$ 19.07
$ 25,085,000,000.00	65	$ 647,741,570.04	2.58%	38.73%	$ 6,240,972,994.22	$ 20.01
$ 25,085,000,000.00	70	$ 675,502,856.05	2.69%	37.14%	$ 6,677,508,938.46	$ 20.95
$ 25,085,000,000.00	75	$ 703,264,142.06	2.80%	35.67%	$ 7,114,044,882.69	$ 21.88
$ 25,085,000,000.00	80	$ 731,025,428.07	2.91%	34.31%	$ 7,550,580,826.92	$ 22.82
$ 25,085,000,000.00	85	$ 758,786,714.08	3.02%	33.06%	$ 7,987,116,771.16	$ 23.75
$ 25,085,000,000.00	90	$ 786,548,000.10	3.14%	31.89%	$ 8,423,652,715.39	$ 24.69
$ 25,085,000,000.00	95	$ 814,309,286.11	3.25%	30.81%	$ 8,860,188,659.62	$ 25.63
$ 25,085,000,000.00	100	$ 842,070,572.12	3.36%	29.79%	$ 9,296,724,603.86	$ 26.56
$ 25,085,000,000.00	105	$ 869,831,858.13	3.47%	28.84%	$ 9,733,260,548.09	$ 27.50
$ 25,085,000,000.00	110	$ 897,593,144.14	3.58%	27.95%	$ 10,169,796,492.32	$ 28.43
$ 25,085,000,000.00	115	$ 925,354,430.16	3.69%	27.11%	$ 10,606,332,436.56	$ 29.37
$ 25,085,000,000.00	120	$ 953,115,716.17	3.80%	26.32%	$ 11,042,868,380.79	$ 30.31
$ 25,085,000,000.00	125	$ 980,877,002.18	3.91%	25.57%	$ 11,479,404,325.03	$ 31.24
$ 25,085,000,000.00	130	$ 1,008,638,288.19	4.02%	24.87%	$ 11,915,940,269.26	$ 32.18
$ 25,085,000,000.00	135	$ 1,036,399,574.20	4.13%	24.20%	$ 12,352,476,213.49	$ 33.12
$ 25,085,000,000.00	140	$ 1,064,160,860.21	4.24%	23.57%	$ 12,789,012,157.73	$ 34.05
$ 25,085,000,000.00	145	$ 1,091,922,146.23	4.35%	22.97%	$ 13,225,548,101.96	$ 34.99
$ 25,085,000,000.00	150	$ 1,119,683,432.24	4.46%	22.40%	$ 13,662,084,046.19	$ 35.92
$ 25,085,000,000.00	155	$ 1,147,444,718.25	4.57%	21.86%	$ 14,098,619,990.43	$ 36.86

Figure 4: Fama French 3-factor model for Normalized Oil Price to Value per Share
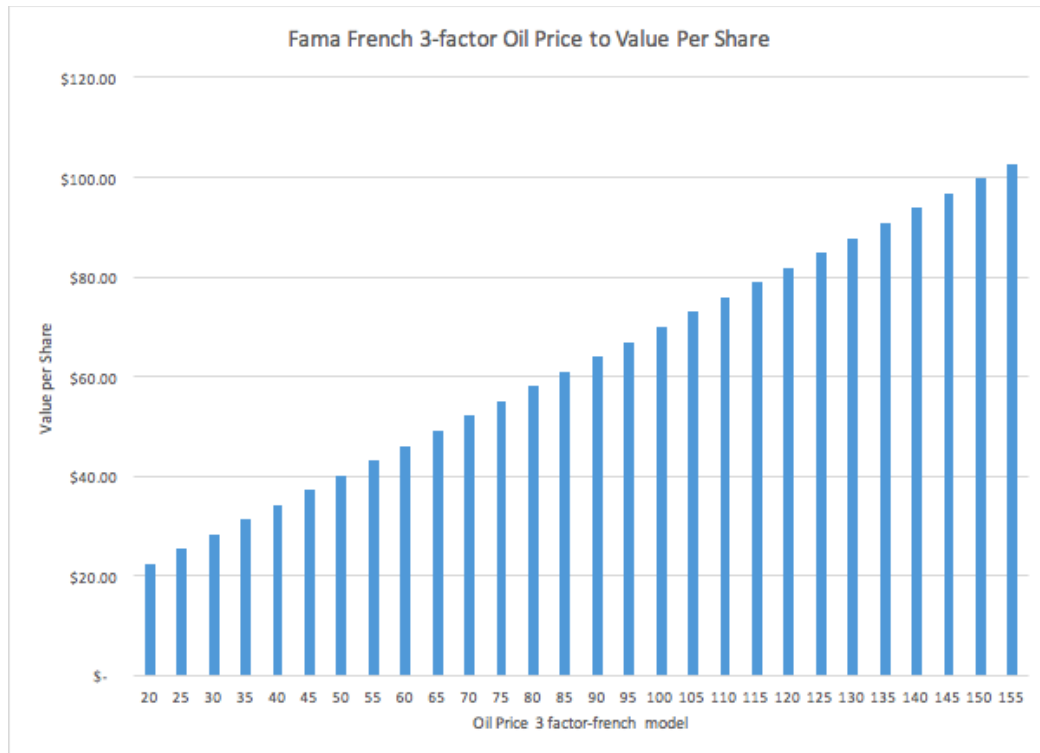

Figure 5: Computation of Fama French 3-factor model for Evaluation 2

Total Equity	Oil Price	Operating Income	Return on Capital	Reinvestment Rate	Value of Operating Assets	Value Per Share
$ 25,085,000,000.00	20	$ 397,889,995.93	1.59%	63.05%	$ 7,346,778,111.48	$ 22.38
$ 25,085,000,000.00	25	$ 425,651,281.94	1.70%	58.93%	$ 8,733,856,553.14	$ 25.36
$ 25,085,000,000.00	30	$ 453,412,567.95	1.81%	55.32%	$ 10,120,934,994.80	$ 28.33
$ 25,085,000,000.00	35	$ 481,173,853.97	1.92%	52.13%	$ 11,508,013,436.47	$ 31.30
$ 25,085,000,000.00	40	$ 508,935,139.98	2.03%	49.29%	$ 12,895,091,878.13	$ 34.28
$ 25,085,000,000.00	45	$ 536,696,425.99	2.14%	46.74%	$ 14,282,170,319.79	$ 37.25
$ 25,085,000,000.00	50	$ 564,457,712.00	2.25%	44.44%	$ 15,669,248,761.46	$ 40.23
$ 25,085,000,000.00	55	$ 592,218,998.01	2.36%	42.36%	$ 17,056,327,203.12	$ 43.20
$ 25,085,000,000.00	60	$ 619,980,284.03	2.47%	40.46%	$ 18,443,405,644.78	$ 46.18
$ 25,085,000,000.00	65	$ 647,741,570.04	2.58%	38.73%	$ 19,830,484,086.44	$ 49.15
$ 25,085,000,000.00	70	$ 675,502,856.05	2.69%	37.14%	$ 21,217,562,528.11	$ 52.13
$ 25,085,000,000.00	75	$ 703,264,142.06	2.80%	35.67%	$ 22,604,640,969.77	$ 55.10
$ 25,085,000,000.00	80	$ 731,025,428.07	2.91%	34.31%	$ 23,991,719,411.43	$ 58.07
$ 25,085,000,000.00	85	$ 758,786,714.08	3.02%	33.06%	$ 25,378,797,853.10	$ 61.05
$ 25,085,000,000.00	90	$ 786,548,000.10	3.14%	31.89%	$ 26,765,876,294.76	$ 64.02
$ 25,085,000,000.00	95	$ 814,309,286.11	3.25%	30.81%	$ 28,152,954,736.42	$ 67.00
$ 25,085,000,000.00	100	$ 842,070,572.12	3.36%	29.79%	$ 29,540,033,178.09	$ 69.97
$ 25,085,000,000.00	105	$ 869,831,858.13	3.47%	28.84%	$ 30,927,111,619.75	$ 72.95
$ 25,085,000,000.00	110	$ 897,593,144.14	3.58%	27.95%	$ 32,314,190,061.41	$ 75.92
$ 25,085,000,000.00	115	$ 925,354,430.16	3.69%	27.11%	$ 33,701,268,503.07	$ 78.90
$ 25,085,000,000.00	120	$ 953,115,716.17	3.80%	26.32%	$ 35,088,346,944.74	$ 81.87
$ 25,085,000,000.00	125	$ 980,877,002.18	3.91%	25.57%	$ 36,475,425,386.40	$ 84.85
$ 25,085,000,000.00	130	$ 1,008,638,288.19	4.02%	24.87%	$ 37,862,503,828.06	$ 87.82
$ 25,085,000,000.00	135	$ 1,036,399,574.20	4.13%	24.20%	$ 39,249,582,269.73	$ 90.79
$ 25,085,000,000.00	140	$ 1,064,160,860.21	4.24%	23.57%	$ 40,636,660,711.39	$ 93.77
$ 25,085,000,000.00	145	$ 1,091,922,146.23	4.35%	22.97%	$ 42,023,739,153.05	$ 96.74
$ 25,085,000,000.00	150	$ 1,119,683,432.24	4.46%	22.40%	$ 43,410,817,594.72	$ 99.72
$ 25,085,000,000.00	155	$ 1,147,444,718.25	4.57%	21.86%	$ 44,797,896,036.38	$ 102.69

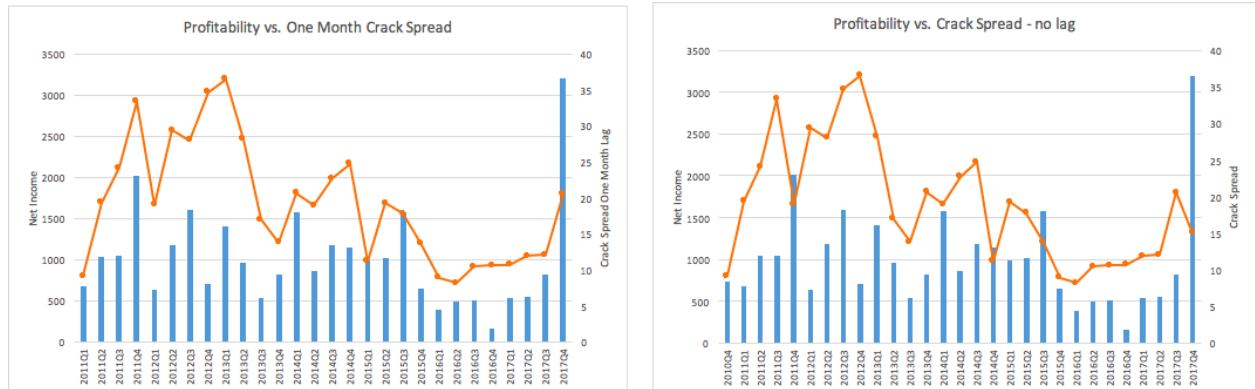*Figure 6: Profitability versus Crack Spread for Phillips 66: 2011-2017 (Lag and no lag)*

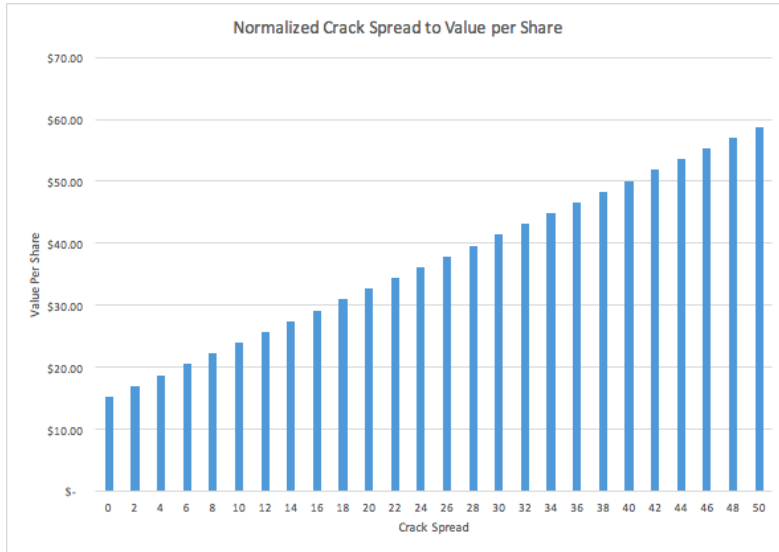*Figure 7: Normalized Crack Spread to Value per Share*

Figure 8: Computation of CAPM model for Evaluation 3

| Total Equity	Crack Spread	Profitability	Return on Capital	Reinvestment Rate	Value of Operating Assets	Value Per Share
$ 25,085,000,000.00	0	$ 507,971,495.21	2.03%	49.38%	$ 4,043,140,315.82	$ 15.30
$ 25,085,000,000.00	2	$ 559,558,786.36	2.23%	44.83%	$ 4,854,331,369.56	$ 17.04
$ 25,085,000,000.00	4	$ 611,146,077.51	2.44%	41.05%	$ 5,665,522,423.30	$ 18.78
$ 25,085,000,000.00	6	$ 662,733,368.66	2.64%	37.85%	$ 6,476,713,477.04	$ 20.51
$ 25,085,000,000.00	8	$ 714,320,659.81	2.85%	35.12%	$ 7,287,904,530.77	$ 22.25
$ 25,085,000,000.00	10	$ 765,907,950.96	3.05%	32.75%	$ 8,099,095,584.51	$ 23.99
$ 25,085,000,000.00	12	$ 817,495,242.11	3.26%	30.69%	$ 8,910,286,638.25	$ 25.73
$ 25,085,000,000.00	14	$ 869,082,533.27	3.46%	28.86%	$ 9,721,477,691.99	$ 27.47
$ 25,085,000,000.00	16	$ 920,669,824.42	3.67%	27.25%	$ 10,532,668,745.73	$ 29.21
$ 25,085,000,000.00	18	$ 972,257,115.57	3.88%	25.80%	$ 11,343,859,799.46	$ 30.95
$ 25,085,000,000.00	20	$ 1,023,844,406.72	4.08%	24.50%	$ 12,155,050,853.20	$ 32.69
$ 25,085,000,000.00	22	$ 1,075,431,697.87	4.29%	23.33%	$ 12,966,241,906.94	$ 34.43
$ 25,085,000,000.00	24	$ 1,127,018,989.02	4.49%	22.26%	$ 13,777,432,960.68	$ 36.17
$ 25,085,000,000.00	26	$ 1,178,606,280.17	4.70%	21.28%	$ 14,588,624,014.42	$ 37.91
$ 25,085,000,000.00	28	$ 1,230,193,571.32	4.90%	20.39%	$ 15,399,815,068.15	$ 39.65
$ 25,085,000,000.00	30	$ 1,281,780,862.47	5.11%	19.57%	$ 16,211,006,121.89	$ 41.39
$ 25,085,000,000.00	32	$ 1,333,368,153.62	5.32%	18.81%	$ 17,022,197,175.63	$ 43.13
$ 25,085,000,000.00	34	$ 1,384,955,444.77	5.52%	18.11%	$ 17,833,388,229.37	$ 44.87
$ 25,085,000,000.00	36	$ 1,436,542,735.93	5.73%	17.46%	$ 18,644,579,283.11	$ 46.61
$ 25,085,000,000.00	38	$ 1,488,130,027.08	5.93%	16.86%	$ 19,455,770,336.84	$ 48.35
$ 25,085,000,000.00	40	$ 1,539,717,318.23	6.14%	16.29%	$ 20,266,961,390.58	$ 50.09
$ 25,085,000,000.00	42	$ 1,591,304,609.38	6.34%	15.76%	$ 21,078,152,444.32	$ 51.83
$ 25,085,000,000.00	44	$ 1,642,891,900.53	6.55%	15.27%	$ 21,889,343,498.06	$ 53.57
$ 25,085,000,000.00	46	$ 1,694,479,191.68	6.75%	14.80%	$ 22,700,534,551.80	$ 55.31
$ 25,085,000,000.00	48	$ 1,746,066,482.83	6.96%	14.37%	$ 23,511,725,605.53	$ 57.05
$ 25,085,000,000.00	50	$ 1,797,653,773.98	7.17%	13.95%	$ 24,322,916,659.27	$ 58.79

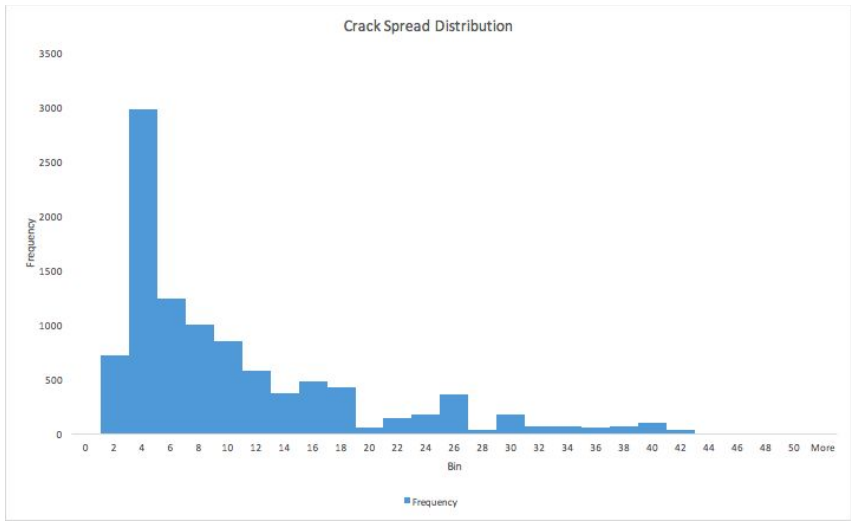*Figure 9: Oil Price Distribution*
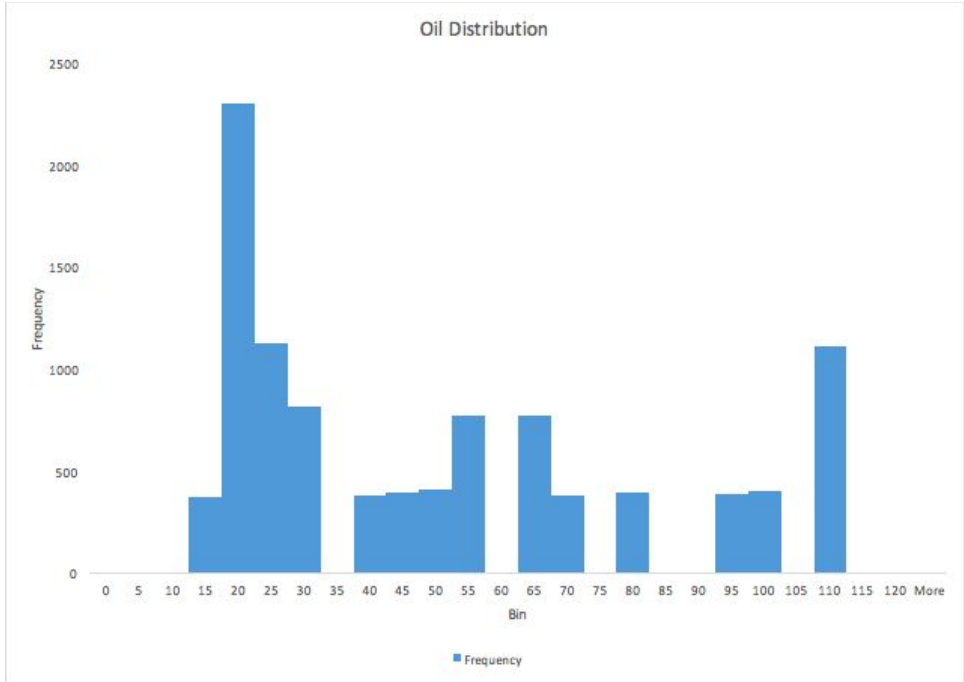
Figure 10: Crack Spread Distribution

Table 1: Oil Price to Operating Income Regression

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.314940148					
R Square	0.099187297					
Adjusted R Square	0.064540654					
Standard Error	473414776.9					
Observations	28					
ANOVA						
	df	SS	MS	F	Significance F	
Regression	1	6.41621E+17	6.4162E+17	2.86282565	0.102600861	
Residual	26	5.82716E+18	2.2412E+17			
Total	27	6.46878E+18				

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	$ 286,844,851.88	278871036	1.0285932	0.3131454	-286382772.2	860072476	-286382772.2	860072475.9
Oil Price	$ 5,552,257.20	3281497.868	1.69198867	0.10260086	-1192958.268	12297472.7	-1192958.268	12297472.67

Table 2: CAPM Regression of Phillips 66 against SPDR S&P 500 ETF Trust

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.608922303					
R Square	0.370786371					
Adjusted R Square	0.369527944					
Standard Error	0.010011421					
Observations	502					
ANOVA						
	df	SS	MS	F	Significance F	
Regression	1	0.029531607	0.02953161	294.642673	2.92247E-52	
Residual	500	0.050114273	0.00010023			
Total	501	0.07964588				

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-0.00014152	0.000448617	-0.3154585	0.75254519	-0.001022926	0.000739886	-0.001022926	0.000739886
Phillips 66 Daily Change	1.171131317	0.068227235	17.1651587	2.9225E-52	1.037083915	1.305178719	1.037083915	1.305178719

Table 3: Fama & French 3-factor model

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.17111498							
R Square	0.02928034							
Adjusted R Square	-0.0148433							
Standard Error	45.6352564							
Observations	70							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	3	4145.979747	1381.99325	0.66359779	0.577384532			
Residual	66	137450.0573	2082.57663					
Total	69	141596.0371						
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-0.7077783	5.912345357	-0.1197119	0.90507501	-12.51215662	11.0966001	-12.512157	11.0966001
Mkt-RF	1.46890355	1.908294612	0.76974673	0.44419646	-2.341129576	5.27893667	-2.3411296	5.27893667
SMB	2.39200018	2.546461082	0.93934292	0.35097986	-2.692173414	7.47617377	-2.6921734	7.47617377
HML	-1.4197307	2.488944675	-0.5704147	0.57033334	-6.389069103	3.54960765	-6.3890691	3.54960765

Table 4: Crack Spread to Profitability Regression

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.444488408							
R Square	0.197569945							
Adjusted R Square	0.16670725							
Standard Error	438933404.7							
Observations	28							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	1.23334E+18	1.2333E+18	6.40157796	0.017798101			
Residual	26	5.00923E+18	1.9266E+17					
Total	27	6.24257E+18						
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	507971495.2	211718538.6	2.39927735	0.02388874	72777806.47	943165184	72777806.47	943165183.9
Crack Spread	25793645.58	10194576.95	2.53013398	0.0177981	4838392.532	46748898.6	4838392.532	46748898.62