AN ANALYSIS OF DEBT IN THE EXPLORATION AND PRODUCTION INDUSTRY

by

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ABSTRACT

This study set out to determine the impact of leverage on E&P companies. It looked at how the weight of debt in E&P companies' capital structures affected their overall systematic risk to the market and to commodity prices. It also examined the impact of the commodity price shock of 2014 on the industry's capital structure. It looked specifically at how companies in the industry responded to the collapse in prices to see if an optimal capital structure or a target amount of risk presented itself. The study concluded that the more debt an E&P company employs in their capital structure, the more systematic risk they face relative to both the market and oil prices. It also concluded that the price shock had a significant impact on E&P companies' capital structure. However, the study was not able to identify a target capital structure in the industry. Overall, knowing that volatility in the oil and gas market is always around the corner, upstream oil and gas companies should take a more conservative approach when managing their capital structures.

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INTRODUCTION

The energy industry is the backbone of the global economy. It is the force that propels the world's economic engine. The production and consumption of energy resources is vital to every industry. Every product that we rely on daily—from our food, our houses and office buildings, to our household appliances, automobiles, and machinery—requires energy to produce. As the National Academies of Science, Engineering, and Medicine states, "the use of energy in industry affects every single citizen directly through the cost of goods and services, the quality of manufactured products, the strength of the economy, and the availability of jobs" (2017).

Oil is the most important resource we have on earth. Despite the trends and discussions focused on renewable and alternative energy sources, such as wind energy, hydroelectricity, nuclear power, solar power, and others, the traditional sources of energy, oil and gas, will continue to be the world's primary form of energy. Even in 2016, in the midst of the alternative energy movement, oil and gas accounted for 68% of total US energy consumption; US citizens consumed a total of 7.21 billion barrels of petroleum products, an average of about 19.69 million barrels per day (EIA, 2017). The reach of the oil and gas industry is extensive. As I mentioned previously, the oil and gas industry is also important for the jobs it provides for many across the US. According to the Bureau of Labor Statistics, over 145,000 US workers are employed by the Oil and Gas Extraction subsector (2018). Furthermore, the world's population is expected to increase by nearly two and a half billion people over the next thirty years, and energy consumption is expected to rise by 35% by the year 2050 (EIA, 2017). To keep pace with such a substantial increase in global demand, the energy industry will need to scale sizably, creating more jobs and increasing the reach of the oil and gas industry. Fossil fuels have helped shape the

world over the past two centuries and will continue to do so for the foreseeable future through their unmatched characteristics of abundance, accessibility, affordability and versatility.

In 2008, amid a US financial crisis, West Texas Intermediate (WTI) crude oil prices fell from a record high of $145.31 on July 3, 2008 to $30.28 on December 23, 2008, which was the lowest price since the financial crisis of 2007-2010 began. Oil prices quickly rebounded after the end of the crisis and rose to $82 a barrel in 2009. However, it wasn't until late February of 2011 when prices again rose above $100 per barrel. After 2011, commodity prices continued on a steady path for several years. For around three and a half years, prices hovered in the $90-$120 range (Bloomberg). During this time, the oil industry saw robust global demand, stemming from emerging markets throughout the world.

Drilling operators in the US combated the Financial Crisis of 2008 by discovering innovative drilling techniques, in which companies could extract oil via the use of hydraulic fracturing and horizontal drilling. This "Shale Revolution" allowed oil and gas production levels to rapidly increase in the US, thus reducing reliance on foreign exporters. In 2011, during the shale renaissance, oil and gas represented approximately 1.6% of the United States' GDP (Merya, 2017). This new groundbreaking technology revolutionized the oil and gas industry. The successful combination of horizontal drilling and hydraulic fracturing, known as "fracking," created an opportunity for exploration and production (E&P) companies to explore and exploit the resource-rich source rock, known as shale. Fracking is highly capital intensive. In the Permian Basin, the average well costs between $6.6 MM to $8.1 MM in 2014 and between $5.0MM to $9.3MM today (Brown, 2013). Because commodity prices remained elevated throughout the beginning of the Shale Revolution, the land around the major US plays skyrocketed, providing E&P companies with significant collateral to borrow against. Many E&P

companies levered up big, resulting in an increase in the sector's total debt from $81 billion in 2010 to a massive $169 billion in June of 2015 (Pokrovskaya, 2015). Oil and gas companies' bonds outstanding increased from $455 billion in 2006 to $1.4 trillion in 2014, a growth rate of 15% per annum (Domanski, 2015). The debt allowed E&P companies to drill and produce at incredible rates. This oil boom allowed the US to significantly reduce its dependence on foreign producers. The United States is now a leading oil and natural gas producer, allowing US global supply to diversify away from the Middle East. Reduced imports of oil and gas improve the US trade balance and minimize direct financial support for oil exporting regimes.

The rapid development created a supply gluttony and flooded the markets with crude oil. Between 2007 and 2014, US shale gas production grew more than 50 percent, with a five-fold increase in proven national reserves in the same period, bringing US production to a level not seen since 1970 (Rognerud, 2015). The markets managed to remain efficient for years, with OPEC's production adjustments, which paced supply. However, in November of 2014, with global demand leveling off and production reaching unprecedented highs, OPEC fought back against its dwindling market share by refusing to curtail production to stabilize prices, launching a price war that sent oil prices spiraling to all-time lows. WTI crude oil fell from its June 20, 2014 high of $107.95 to end 2015 at $38.17 (Bloomberg). The highly levered E&P industry relied on commodity prices remaining high, but at the depressed levels, many companies faced serious liquidity concerns. According to Bradley Olson's 2015 article, "U.S. Shale Drillers Are Drowning in Debt", half of the E&P companies in the Bloomberg Index of more than 60 producers carried debt levels that represented 40 percent of their enterprise value (Olsen, 2015).

The decline of commodity prices coupled with the industry's previous debt crisis has continued to strengthen the perception in the lending community that lending to oil and gas

companies is highly risky. Many US producers had their borrowing limits, which are calculated on the value of the company's reserves, reevaluated and lowered by their banks. The falling value of commodity prices and subsequent reserves led banks to cut back on loan facilities and debt interments, leaving some companies without enough liquidity to stay afloat. Risk is an important variable in any financial decision and should be considered carefully. Despite its importance, risk is one of the most difficult variables to measure and quantify. Considering the interest generated in risk analysis, largely resulting from the harsh realities of the oil and gas industry's recent recession and given the industry's tendency to employ high amounts of financial leverage, it is worth examining the riskiness of leverage in the E&P sector.

The focus of this paper is to empirically examine the effects of debt on exploration and production companies. Specifically, I will explore how the weight of debt in the companies' capital structures affects their beta risk. I will test the effect of leverage on stock price risk against both the Standard & Poor's 500 and the West Texas Intermediate. My hypothesis for both tests is that the more initial leverage and average leverage a company employs, the higher its beta will be. Because the E&P industry's capital intensive nature requires companies to use much more leverage than other industries, it will be interesting to see if debt has the same impact on the E&P industry as it does on other industries, characterized by less leverage. This paper will also examine the impact of the commodity price shock of 2014 on E&P companies' capital structures. I will look to see how the industry responded to the price shock and if there is an optimal capital structure or a target amount of risk that presents itself in the years following drop in commodity prices.

LITERARY REVIEW

The Exploration and Production Industry

The upstream component of the energy chain is often referred to as exploration and production, or E&P. It involves searching for potential underground deposits of hydrocarbons, drilling wells to recover the hydrocarbons, and extracting the hydrocarbons from the ground and bringing them to the surface.

Locating oil and gas hydrocarbon reservoirs is the first step in the upstream process. Hydrocarbons are organic compounds consisting entirely of hydrogen and carbon. Finding hydrocarbons while safely and successfully extracting them from the earth is an extremely complicated and difficult process that requires insight from geologists, geophysicists, engineers, and a long list of other specialists. Large pools of trapped hydrocarbons are known as conventional discoveries and can be tapped into by using traditional drilling methods.

E&P Capital Structure and Debt

How a company chooses its preferred capital structure and how specific events affect those decisions have been thoroughly researched and studied in earlier academic work. However, research surrounding capital structure in relation to the oil and gas industry remains scarce. Capital structure decisions are some of the most significant decisions companies must make. These decisions carry a crucial impact on the overall cost of capital in terms of weighted average and the resultant market value of the shares (Sabir, 2012).

Debt is a crucial piece of the capital structure. This is true even more so for E&P Companies. During the times of high commodity prices, US shale drillers financed their skyrocketing production growth with cheap money with low interest rates, which caused huge cash flow deficits across the industry. Banks were overly willing to lend to oil and gas

companies against their reserves and revenue in a time when relaxed monetary policy led to broad increases in debt levels across the board. “Since 2008, companies in the oil sector have borrowed both from banks and in bond markets. Issuance of debt securities by oil and other energy companies has far outpaced the substantial overall issuance by other sectors. Oil and gas companies’ bonds outstanding increased from $455 billion in 2006 to $1.4 trillion in 2014, a growth rate of 15% per annum” (Domanski, 2015). Drilling for oil is highly capital intensive, meaning access to debt is a vital tool for most E&P companies because revenues alone are rarely enough to support drilling projects. The upstream oil and gas industry’s day-to-day operations are characterized by heavy manufacturing, meaning these companies have a higher dependency on debt than less capital-intensive industries, such as a web-based service firm. E&P companies typically have higher leverage ratios than their counterparts in other industries, and the practice of employing high amounts of leverage is not uncommon. The E&P industry is characterized by stable income and a high level of capital expenditures which often necessitates a high weight of leverage on the industry’s balance sheets. Bradley Olson writes, “Total debt for half of the companies in the Bloomberg Index, of more than 60 producers — has risen to a level that represents 40 percent of their enterprise value, which is roughly 600 basis points higher than the average debt-to-enterprise value ratio of the S&P 500” (Olsen, 2015). Furthermore, in 2015, debt issued by oil and gas companies accounted for roughly 15 percent of both high-yield and investment grade major US debt indices (Domanski, 2015). Specifically, US oil and gas companies account for around 40 percent of both debt securities and syndicated loans outstanding in 2015 (Domanski, 2015). The authors of the article “Oil and Debt” noted that much of this debt was issued by smaller firms, primarily those engaged in shale drilling projects. These companies borrowed heavily to finance expansion of production capacity. According to

the US Energy Information Administration, in 2015, US oil producers used 83 percent of their operating cash flow to pay for debt service (Olsen, 2015).

Extreme uses of leverage can be detrimental to a firm. Debt financing has significantly greater consequences than equity financing because debt contractually locks a company into regular interest payments, while equity does not. In the event that a company defaults on its interest payments, lenders are entitled to recover what they are owed through the bankruptcy process. However, companies are not required to pay a regular dividend payment to its stockholders, meaning equity financing is inherently less risky (Brigham, 2017). The upstream sector saw 81 bankruptcy filings in the two-and-a-half-year span from 2014 through mid-2016. Of those 81 bankruptcies, 77 were filled by producers (Daugherty, 2016). High levels of debt can also inhibit a firm's ability to invest in new projects, due to its ability to increase cost of capital. Therefore, some companies may forgo investing in value-generating opportunities because of high financing costs (Grady, 2017). Jonathan O'Brien reaffirms this point when he states, "If a firm has high debt levels, managers will have both less free cash flow to invest in new markets and less leeway to borrow capital to fund market expansion" (O'Brien, 2014). This means that the tax benefits of employed leverage are only beneficial to the firm up until the point of the optimal level of debt to equity financing.

Capital Structure Theory

There are a number of studies and a couple of prevailing theories that deal with finding the optimal capital structure for a company. The theory of capital structure attempts to explain how different determinants impact the relationship between a firm's capital structure and its value. These capital structure theories compare the effects of different sources of financing, the associated tax benefit from employed leverage, and investors' required rates of return. A

company's capital structure is dynamic. Depending on specific market conditions, the rate at which a company can adjust its capital structure changes. Most of the research performed in this realm of study has concluded that the optimal capital structure depends on a variety of different factors, including: location, industry, macroeconomic indicators, taxis and other legal, social, managerial and financial factors.

Trade-off Theory

The Trade-off Theory is the oldest and most notable theory of capital structure. The theory stems from the ideas of Miller and Modigliani's research in 1958. This theory assumes that there is an optimal level of debt-to-equity financing. Snorre Myhre explains the theory, citing the work of Kraus and Liztenberger, when he writes, "There is a trade-off between the benefits from debt and the costs of debt. More current trade-off theory assumes that there are positive effects to leverage-financing within a capital structure." He continues, stating that the modern theory differs from that of Miller and Modigliani, "in the way that it takes into consideration financial distress, here in the form of taxation on corporate income and the risk of bankruptcy real risks" (Myhre, 2016).

Essentially, the theory states that debt is the preferred method of financing until a certain point. Since the interest paid on debt is tax deductible, it is advantages for the company to increase its debt-to-equity ratio. If a firm can sufficiently meet its debt obligations, an increase in the leverage ratio will provide a tax benefit, meaning the firm will reduce its corporate income tax liability, increasing after-tax income. However, if the firm cannot pay its regular interest obligations on time, then it risks becoming insolvent and the firm might be forced into bankruptcy. The theory argues that a firm should increase leverage until it reaches the point

where the tax benefit from the interest payments equals the cost of default risk from the increased exposure (Kraus, 1973).

Pecking Order Theory

The Pecking Order Theory was first conceptualized by Myers and Majulf in 1984. It is another popular theory regarding the determinants of an optimal capital structure. The two researchers based their study off of a model called, "Market for Lemons," which was created in 1970 by Akerlof. The model

> Shows that a market can deteriorate if the potential buyers cannot verify the quality of the product they are offered Akerlof´s paper discusses the issue of information asymmetry, in the sense that the person selling knows more about the product than the person buying it. This can potentially create a problem between firm insiders and outsiders having to do with adverse selection when raising capital (Myhre, 2016) (Myers, 1984).

Essentially, the theory focuses on the impact of asymmetrical information and it ranks the different forms of financing by how susceptible they are to asymmetric information. The Pecking Order Theory challenges the Trade-off Theory by stating that a firm initially prefers internal financing over external financing, and that the firm then prefers debt over equity financing if it issues securities. It is based off the assumption that the firm holds unique internal knowledge about itself that allows insiders to make capital structure decisions accordingly.

Capital Structure and Stock Performance

Capital structure plays a vital role in a company's stock performance and management teams have the fiduciary duty to increase the value of their company and in turn, increase shareholder's wealth, so it is critical for management teams to strive for the optimal ratio of debt and equity. Sabău-Popa Claudia Diana, elaborates on the benefit of an optimal capital structure

by explaining, “the optimal capital structure is one that strikes a balance between the degree of risk and the estimated rate of return; and thus maximizes the market price of shares” (Diana, 2016). When companies employ leverage, they are increasing their exposure to risk. However, an increase in leverage also increases expected shareholder returns. The addition of debt leads to higher potential profits. Furthermore, shareholders require higher rates of return for added exposure to risk.

If a firm continues to employ more and more leverage, it will eventually face a higher cost of debt, which would threaten the viability of the firm. No matter how strong a firm is, without an optimal capital structure in place, it still runs the risk of failing. Even a firm that generates positive cash flows and performs day-to-day operations adequately could falter if it has an unbalanced or imperfect capital structure. As Roberta Adami explains in the report, “How does a firm's capital structure affect stock performance?,” “Despite the best efforts of operational management dealing with day-to-day issues of corporate strategy and execution, an inappropriate capital structure can negate all such efforts to the extent of driving the company into administration or bankruptcy” (Adami, 2015). Consequently, a firm’s capital structure and financing decisions have an evident impact on the overall performance of the firm.

Commodity Prices and Capital Structure Decisions

E&P companies face enormous amounts of market risk. For oil and gas companies, and more specifically E&P companies, market risk is usually characterized as commodity price risk. Oil and gas are the most volatile commodities in the world. (EIA, 2017). There have been a couple of empirical studies that have focused on the relationship between oil and gas commodity prices and firm performance. However, research dedicated to the relationship between commodity prices and capital structure is scarce. One study performed by Al-Mudhaf and

Goodwin in 1993, found that commodity price shocks had a negative impact on E&P stock performance (Al-Mudhaf, 1993). In general, research in this realm has indicated that there is a positive correlation between the financial performance of E&P companies and oil commodity prices.

These studies don't directly relate to the research done in this thesis. However, one study performed by Dayanandan and Donker used gearing (leverage) as an independent variable. In their report they stated, "The coefficients of SIZE (total assets) and GEAR (leverage) were also statistically significant, implying that the market perceives gearing as an ineffective mechanism to control management, since gearing has a negative impact on firm performance" (Dayanandan, 2011). According to Myhre, "This means that their findings suggest that when the market is down, the firms are preforming badly, leverage is increasing. So the industries leverage-ratio is perceived as having counter-cyclical market movements. This understanding is supported by the fact that oil price shows a statistically positive relationship with ROE, which adds up when looking at the earlier studies and the effect of oil price increases on performance of firms having oil as and output" (Myhre, 2016). Myhre also notes another study performed by Korajczyk and Levy (2003), which "show that financially unconstrained firms have counter-cyclical movements in both their book and market leverage. Financially constrained firms have a pro-cyclical tendency when it comes to leverage ratios" (Myhre, 2016).

Leverage and Risk

Leverage in its most basic form is when a company borrows money from one or multiple lenders in order to invest that money elsewhere. According to Qasim Saleem, Financial leverage "is the ability of a business to use fixed financial charges to magnify the effects of changes in EBIT on the earning per share and profits. It involves the use of funds obtained at a fixed cost in

the hope of increasing the return to the shareholders in future" (Saleem, 2013). Financial leverage is commonly used in the E&P sector as a way of modifying the financial position and cash flows of a firm. However, financial leverage can also increase financial risk.

"Financial risk is generally defined as the added variability in earnings available to a firm's common shareholders due to the use of debt to finance the acquisition of assets" (Periyathampy, 2003). Financial risk increases a company's chances of becoming insolvent. Excessive debt creates a financial burden for firms as they are required to pay the added interest payments that accompany the debt. Unlike business risk or systematic risk, financial risk is not a result of the environment in which the firm operates. Financial risk is the product of the firm's conscious decisions to take on debt rather than issue equity to raise capital.

One way to measure risk of a company is Beta. Beta, in its simplest form, is the regression of an individual stock's returns compared against the returns of the market, usually the S&P 500. Yang Huo and Francis Kwansa define the regression coefficient, b (the beta coefficient), as "a market sensitivity index; it measures the relative volatility of a given stock versus the average stock, or 'the market" (Huo, 1994). A beta of one represents a stock that moves with the market and exhibits the same amount of risk as the broader market. A stock with a beta of less than one theoretically indicates that the stock is less risky than the market and a stock with a beta of negative one, indicates that the stock moves inversely to the market.

Leverage and Returns

Qasim Saleem found that,

> There is a close relationship between the financial leverage and Earning per Share of the company. If degree of financial leverage is high and the return on investment is greater than the cost of debt capital, then the impact of leverage on

EPS will be favorable. The impact of financial leverage is unfavorable when the earning capacity of the firm is less than what is expected by the lenders (i.e.) the cost of debt (Saleem, 2013).

Another study performed by Nicoleta found that "a high level of financial leverage allows shareholders to obtain a high return on equity, but they are also exposed to a higher risk of significant loss if the return on assets is low" (Bărbuță-Mişu, 2010). Returns on investment are generated from the increase in value of an underlying asset. Financial leverage allows companies to magnify that return. When a firm uses financial leverage to purchase an asset, a portion of the purchase is financed by the buyer and the remaining portion is financed by a lender. Any increase in the value of the purchased asset represents a real return on the original amount invested and the investor will make profits in the long run (Pandey, 2007).

DATA AND SAMPLE

Sampling Techniques

I began gathering my sample using Bloomberg's Equity Screen function. I set up the equity screen to filter for publicly traded exploration and production companies in the United States, sorted in descending order by market cap. Exploration and production companies are defined as firms whose main operational activity is to explore and develop oil and gas properties. The search generated a list of 150 companies. I then narrowed the results by filtering out any companies with incomplete quarterly data for net debt and market equity. The resulting sample included 100 companies, beginning with ConocoPhillips (COP) with a market cap of $65B and ending with Breitburn Energy Partners (BBEPQ) with a market cap of $9.5MM.

Data Collection

When gathering data, a need for timely, trustworthy and accurate information was of importance. The Bloomberg database met these demands and became the preferred source for data collection. To analyze the impact of the shock in oil prices which occurred in late 2014 and lasted until early 2016, I collected quarterly data for the five-year period, spanning from Q1 of 2013 to Q4 of 2017. This time frame captures the period of ballooning debt in the E&P industry leading up to the crash in prices as well as one full "boom and bust" cycle and a subsequent stabilization of prices. This period was chosen to reflect the financial position of the firms in the data set before the downturn in commodity price, and the resulting capital structure and financial effects on the firms post commodity price crash.

The Standard & Poor's 500 index (SPX) is seen as a leading indicator of US stock performance and was used in Hypothesis 01 as a proxy for the market. It is widely regarded as the most accurate representation of large-cap US equities and provides an accurate depiction of the risks and returns of the market. The S&P Index is comprised of 500 stocks selected by a committee based on liquidity, size and industry.

The West Texas Intermediate (WTI) crude oil is defined as light and sweet crude oil with a relatively low density and a low sulfur content. WTI crude is high-quality oil and easily refined. It is deliverable in Cushing, Oklahoma and is the underlying commodity of the NYMEX's oil futures contracts. West Texas Intermediate is often used to benchmark oil prices, serving as a reference price point for buyers and sellers of crude oil. The Bloomberg ticker is CL1 COMB COMDTY. WTI was used in Hypothesis 02-04 as a proxy for the price of oil.

Metrics

The key metrics used throughout my study are:

Leverage Ratio: The leverage ratio will be defined as:

$$\frac{Net\ Debt}{Net\ Debt + Market\ Value\ of\ Equity}$$

This debt measure represents the level of a firm's debt relative to its simplified capital structure. I used this metric because it allowed me to hone in on the capital structure as a whole rather than just the debt component of the firm.

Net Debt: This metric was pulled directly from Bloomberg and represents a company's overall debt situation by netting the value of a company's liabilities and debts with its cash and other liquid assets. It is calculated as:

$$Total\ Debt - (Cash, Cash\ Equivalents\ \&\ Marketable\ Securities)$$

Net debt provides a better understanding of the financial health of a company. Just because one firm holds more debt than another firm does not necessarily mean it is in a worse financial position.

Market Value of Equity: This metric was pulled directly from Bloomberg and represents the total market value of all of a company's outstanding shares. Market Value of Equity is calculates as:

$$Stock\ Price\ \times Total\ Outstanding\ Shares$$

Market value of equity is constantly changing and better depicts the current value of equity in real time. Book equity is backwards-looking and measures what has taken place in the past, while market equity is forward-looking.

Beta: Beta is a way of measuring stock price volatility in comparison to the market or to another security/commodity. Beta is calculated using regression analysis. "A security's

beta is calculated by dividing the covariance the security's returns and the benchmark's returns by the variance of the benchmark's returns over a specified period" (Staff, 2017). I used two different betas in my study, one regressed against the S&P 500 over a five-year time period and the other regressed against WTI commodity prices. These two beta calculations will be discussed more thoroughly in the methodology section of the paper.

METHODOLOGY

Hypothesis Testing Overview

Hypothesis testing is used in statistics to test an assumption regarding a population or sample. The goal of hypothesis testing is to determine if there is enough statistical evidence to accept or reject a null hypothesis. The test tells whether the main hypothesis is true or if it should be rejected in favor of the alternative hypothesis. The null hypothesis is defined as H_0, while the alternative hypothesis is defined as H_1.

Regression Analysis

To analyze the relationship between the various variables used in my study, I ran multiple linear regressions. Regression analysis is a statistical modeling tool used to estimate the relationship among variables. Single variable regression analysis uses one dependent and one independent variable and analyses how the two interact with each other. A dependent variable (Y) is the main factor that you are trying to understand or predict. The dependent variable is the output and is expected to change when the independent variable is changed. An independent variable (X) represents the input; it is the variable that is purposely changed to observe the effects on the dependent.

P-Value

A test statistic is the determining factor of the decision on the validity of a hypothesis. "If the test statistic's value is inconsistent with the null hypothesis, one rejects the null hypothesis and infers that the alternative hypothesis is true" (Keller, 2013). The test statistic is used to determine the P-Value which helps determine the significance of the results. The P-Value signifies the definiteness of the evidence in support of the null and is the "measure of the amount of statistical evidence that supports the alternative hypothesis" (Keller, 2013). A smaller P-Value signifies that there is more statistical evidence to support the alternative hypothesis.

***Figure 1**: P-value Interpretations*

If P-value is…	We Conclude…
Less than 0.01	Highly Significant
Between 0.01 and 0.05	Significant
Between 0.05 and 0.10	Not Statistically Significant
Greater than 0.10	Little to no evidence

<u>Hypothesis 01:</u>

Question: Does leverage increase systematic risk (all else equal)?

H_0: There is no statistical significance between the amount of debt E&P companies employ and their market betas

H_1: There is statistical significance between the amount of debt E&P companies employ and their market betas

Methodology:

Model Type: $y = \alpha + (\beta_1)(x_1)$

Regression 1: X = Initial leverage ratio of each company as of Q1 of 2013

Y = the 5-year S&P market beta of each company

Regression 2: X = Average leverage ratio of each company over the 5-year span

Y = the 5-year S&P market beta of each company

To test my hypothesis, I ran two separate regressions with two different dependent variables. The dependent variable in the first regression was the initial leverage ratio that each company held in Q1 of 2013, while the dependent variable in the second regression was the average amount of leverage employed by each company in the time period from Q1 of 2013 through Q4 of 2017. Initially, my thought was to just run one regression using the initial leverage of each company as my dependent variable. However, after taking a closer look at my data set, I noticed that some of the companies' debt ratios changed considerably over the 5-year span, meaning that the initial leverage ratio might not represent the true capital structure of each firm and that average leverage could be a better indicator of debt employed by each company. The independent variable, the 5-year S&P market beta of each company, was pulled using a Bloomberg formula that regressed each companies' historical stock prices against the historical returns of the S&P 500 over a five-year period beginning at year end of 2017.

<u>Hypothesis 02:</u>

Question: Does leverage increase systematic risk relative to commodity prices (all else equal)?

H_0: There is no statistical significance between the amount of debt E&P companies employ and their commodity price betas

H_1: There is statistical significance between the amount of debt E&P companies employ and their commodity price betas

Methodology:

Model Type: $y = \alpha + (\beta_1)(x_1)$

Regression 1: X = Initial leverage ratio of each company as of Q1 of 2013

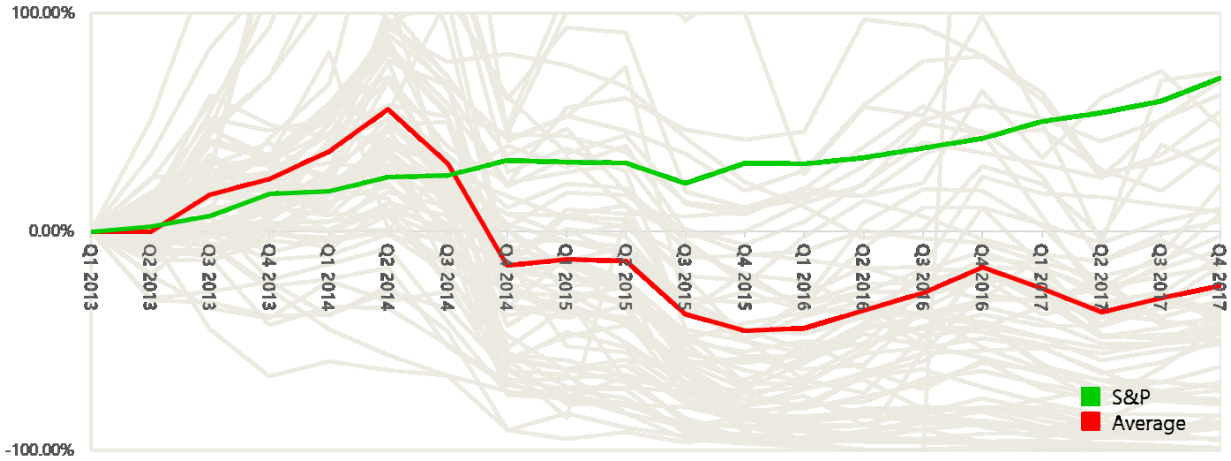
Y = Oil beta of each company generated from the Oil Beta Regression

Regression 2: X = Average leverage ratio of each company over the 5-year span

Y = Oil beta of each company generated from the Oil Beta Regression

The independent variables in Hypothesis 02 are the same as in the previous hypothesis. However, the dependent variable changes. After studying the stock returns of my data set and the returns of the S&P 500 Index, I noticed that the returns of my data set trade independently from S&P 500, implying that a beta regressed against the S&P may not be the best indicator of systematic risk as shown in *Figure 2.*

Figure 2: *Average E&P Returns vs. S&P Returns*



Moreover, E&P returns are driven by commodity prices. As shown in *Figure 3,* the average returns of my data set are highly correlated with the price of oil. Using this information, I determined that a more appropriate beta to use would be one that is regressed against commodity prices. In order to create an oil beta, I performed individual regressions of each firm in my sample that regressed the firm's stock price against WTI commodity prices. Using the following model:

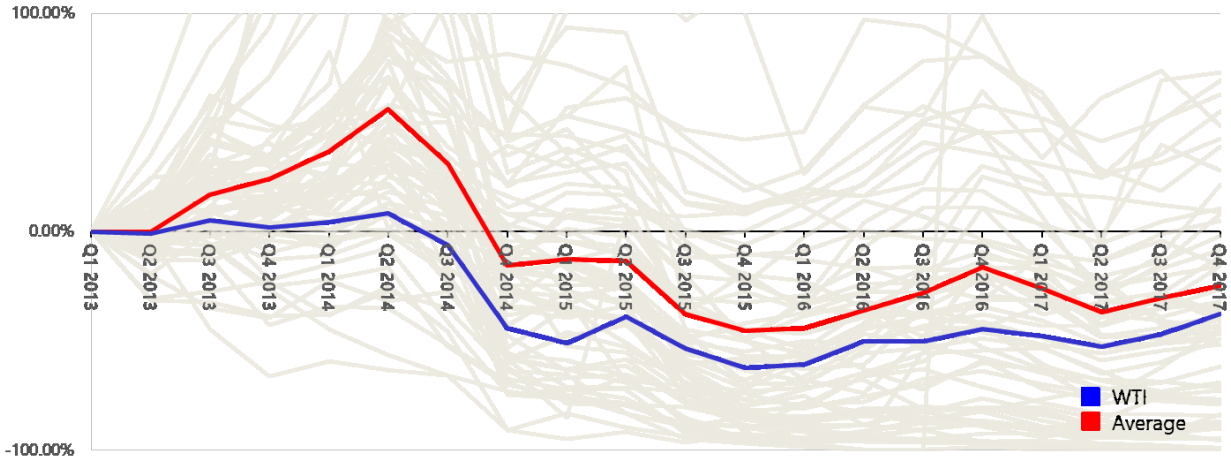
Model Type: $y = \alpha + (\beta_1)(x_1)$

Oil Beta Regression: X = Stock price as of quarter end for each firm in the data set from Q1 2013 through Q4 2017

Y = WTI spot price as of quarter end from Q1 2013 through Q4 2017

The oil betas of each company generated in the Oil Beta Regression served as the dependent variable used in both regressions to test Hypothesis 02.

***Figure 3**: Average E&P Returns vs. WTI*



The methodology for Hypothesis 03 differs from that of Hypotheses 01 and 02 in that Hypothesis 03 uses an event study framework, rather than a regression analysis, to examine the data.

Event Study Methodology Overview

An event study is a type of analysis that that studies the impact of a certain event on an industry, sector, or overall market. An event study attempts to understand if an event has or will have an impact on the financial behavior of a company or industry as a whole. While most event studies focus exclusively on stock price reactions, the study I employed will look at the specific capital structure components and leverage.

Hypothesis 03 – 04:

Questions: Immediately following the commodity price shock, is there a significant change in the capital structures of E&P companies? Following the immediate change in the capital structure of the E&P industry, is there a reversion to a more balanced capital structure? And if so, how long does it take these companies to adjust toward this target? Is there a target amount of risk in the E&P industry that presents itself after the commodity price collapse?

I will attempt to answer these questions in the following two hypotheses.

Hypothesis 03:

$H_{0:}$ The commodity price shock has no effect on the capital structure of E&P companies

$H_{1:}$ The commodity price shock has an effect on the capital structure of E&P companies

Hypothesis 04:

$H_{0:}$ E&P companies will not attempt to find an optimal capital structure after the commodity price shock

$H_{1:}$ E&P companies will attempt to find an optimal capital structure after the commodity price shock

Methodology:

I created simple cumulative percent change charts and graphs to examine the fluctuations in leverage metrics, debt, equity, and stock price during the five-year period from Q1 of 2013 through Q4 of 2017. I looked specifically at how the companies' capital structures and leverage metrics responded to the shock in commodity prices that occurred in Q2 of 2014.

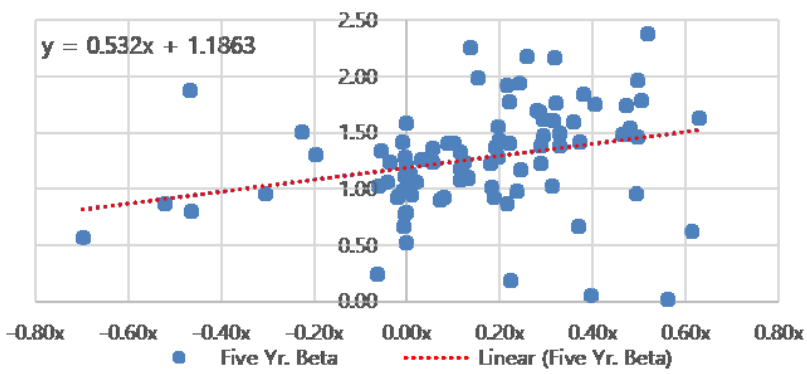
I began by looking at the change in the average leverage ratio of my sample compared to the change in WTI commodity prices. The focus of the examination was centered on the spread in the two lines and how they interacted with one another. If the leverage ratio of the sample

spiked in the periods following the decline in commodity prices, I could infer that the commodity price shock did impact the capital structure of the E&P industry. Similarly, in the periods post commodity price crash, if the leverage ratio of the sample showed signs of decline or stabilization as commodity prices began to rebound and stabilize, I could interpret this as an attempt by the sample firms to rebalance their capital structure and find a target level of risk. I then examined each element of the capital structure in the same way, looking at how each metric was affected by prices and how they changed overtime. By doing this, I was able to better understand which specific component of the capital structure explained the changes in the leverage ratio. To reduce the effect of disparity in beginning capital structure metrics and to decrease any bias related to debt and equity capacity, I further subdivided my sample into groups based on begging dollar value of debt and beginning dollar value of equity.

RESULTS

Hypothesis 01

Figure 4: *5-Year Beta and Initial Leverage Regression Results*



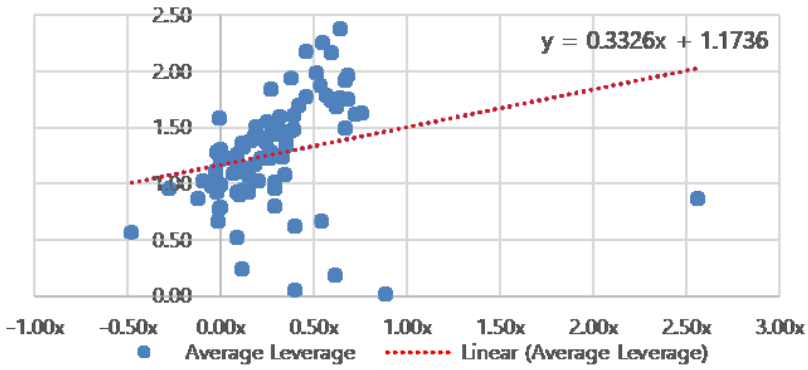
Regression Statistics	
Multiple R	0.278534408
R Square	0.077581416
Adjusted R Square	0.066978904
Standard Error	0.451358143
Observations	89

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1.4907042	1.4907042	7.317267156	0.008215908
Residual	87	17.72400305	0.203724173		
Total	88	19.21470725			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	1.18627737	0.056245661	21.09100254	5.84424E-36	1.074483029
X Variable 1	0.531999898	0.196669536	2.70504476	0.008215908	0.141097899

***Figure 5**: 5-Year Beta and Average Leverage Regression Results*



Regression Statistics	
Multiple R	0.250503315
R Square	0.062751911
Adjusted R Square	0.051978945
Standard Error	0.454971865
Observations	89

ANOVA

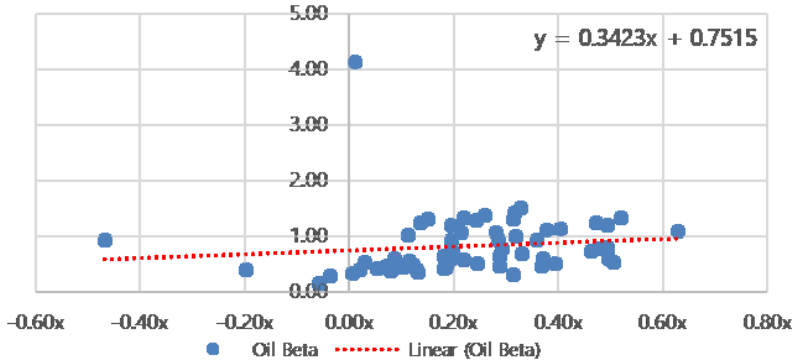
	df	SS	MS	F	Significance F
Regression	1	1.2057596	1.2057596	5.824942537	0.017898088
Residual	87	18.00894765	0.206999398		
Total	88	19.21470725			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%
Intercept	1.173630066	0.061638171	19.04063733	8.91031E-33	1.051117526
X Variable 1	0.332633623	0.137822564	2.413491773	0.017898088	0.058696355

The figures above depict the results of both regressions that were ran to answer the question pertaining to Hypothesis 01. Both regressions resulted in significant P-values and showed a strong correlation between leverage and market risk. The independent variable of initial leverage in Regression 1 had a P-value of 0.008. This P-value represents a statistically significant relationship between the amount of initial leverage employed by an E&P firm and its five-year market beta. Regression 1 also produced a slope coefficient of 0.532, meaning there is a positive relationship between the independent and dependent variable. Regression 2 yielded similar results with an independent variable P-value of 0.018 and a slope coefficient of 0.333, meaning there is both a significant relationship between average leverage and market beta as well as a positive relationship between the two variables. Thus, the null hypothesis can be rejected, consequently proving the alternative hypothesis true. In conclusion, there is statistical significance between the amount of debt E&P companies employ and their market betas.

Hypothesis 02

Figure 6: *Oil Beta and Initial Leverage Regression Results*



Regression Statistics	
Multiple R	0.115629535
R Square	0.013370189
Adjusted R Squa	-0.003939106
Standard Error	0.565542017
Observations	59

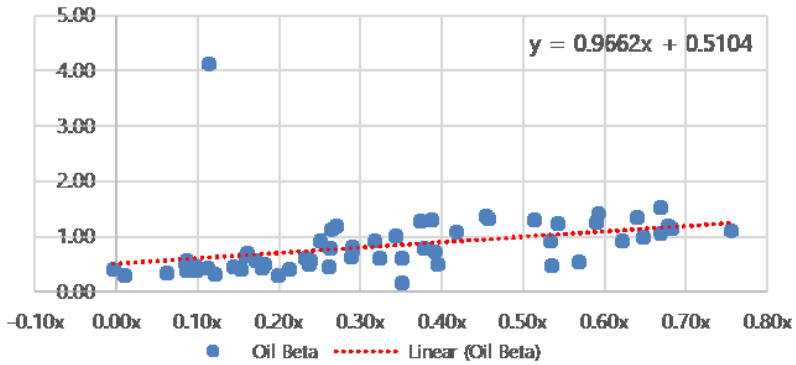
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.247051749	0.247051749	0.772428305	0.383156921
Residual	57	18.23075307	0.319837773		
Total	58	18.47780481			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.751473792	0.115737982	6.492888303	2.2157E-08	0.51971248
X Variable 1	0.3422974	0.389470448	0.878879005	0.383156921	-0.43760372

As shown in *Figure 6*, the independent variable in Regression 1, the initial leverage ratio of each E&P firm in my sample, has a P-value of 0.383 and a slope coefficient of 0.342. Although the slope value indicates a positive correlation between the two variables, leverage and oil beta, a P-value of 0.383 indicates little to no evidence in support of the alternative hypothesis. However, Regression 2 yielded significant results. Regression 2 was ran using average leverage as the independent variable and generated an X-variable P-value of 0.008 and a slope coefficient of 0.966. Using Regression 2, the null is rejected and the alternative is accepted, meaning that there is a significant relationship between the amount of leverage employed by E&P firms and systematic risk relative to commodity prices. Results for Hypothesis 2 are shown in *Figure 7* below.

***Figure** 7: Oil Beta and Average Leverage Regression Results*



Regression Statistics	
Multiple R	0.343852784
R Square	0.118234737
Adjusted R Squa	0.102765171
Standard Error	0.534643453
Observations	59

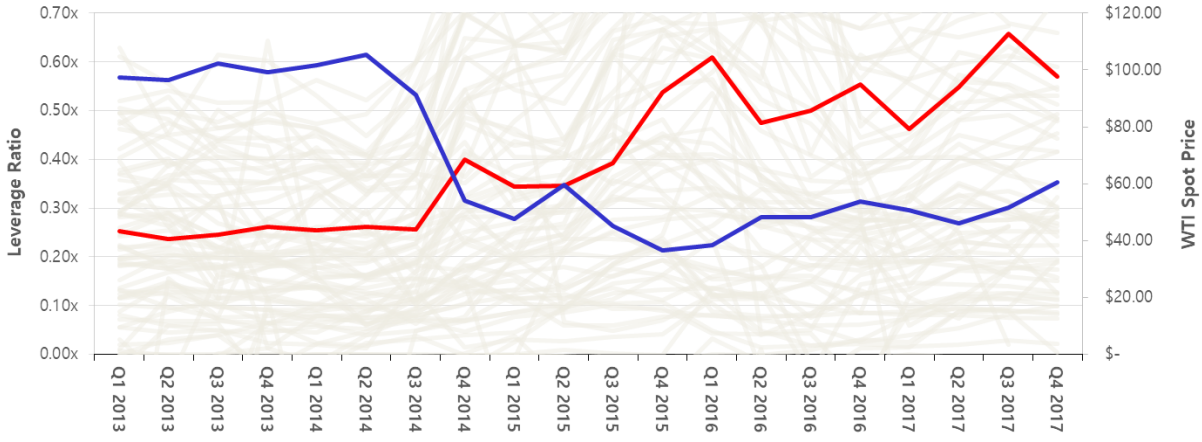
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2.184718396	2.184718396	7.643054568	0.007664233
Residual	57	16.29308642	0.285843621		
Total	58	18.47780481			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*
Intercept	0.510435476	0.134916774	3.783335911	0.000373436	0.240269296
X Variable 1	0.966230695	0.349500137	2.764607489	0.007664233	0.266368743

Hypothesis 03 – 04

***Figure 8**: Average Leverage Ratio and WTI Spot Price*



The graph above depicts the relationship between the leverage ratios of the sample E&P companies (left axis) and WTI commodity prices (right axis). The graph shows that the average leverage ratio begins relatively stable and then spikes in Q4 of 2014 in the midst of the

commodity price crash. From Q1 of 2013 through Q3 of 2014, the average leverage ratio of the E&P industry hovered around 0.25x. In Q4 of 2014 the leverage ratio jumped to 0.40x. Over the next two quarters, the amount of leverage employed begins to decline, but then precipitously spikes again to 0.61x when commodity prices fall a second time in Q1 of 2016. As commodity prices begin to stabilize and then slowly increase in Q1 of 2016 through Q4 of 2017, the E&P companies try to lower their amount of leverage, with a leverage ratio low of 0.46x in Q1 of 2017, but are not able to in the end. This indicates that the collapse in oil prices did have an effect on the capital structures of E&P companies. However, there are no signs of a reversion to a more balanced capital structure and no determinable preferred amount of risk in the E&P industry. Ultimately, there is no evidence to support a target capital structure in the E&P industry.

Discussion and Implications

The first conclusion that can be drawn from these studies is that the more debt an E&P company employs in their capital structure, the more systematic risk they face relative to both the market and oil prices. As prior research showed earlier in this paper, leverage increases systematic risk, so it comes as no surprise that this still holds true in the E&P industry. However, what makes this conclusion interesting is that these previously studied theories are still true even in such a heavily leveraged industry. It is also interesting to see how both initial leverage and average leverage, showed similar results in a sample period characterized by extreme leverage volatility in the E&P industry.

Leveraging an asset essentially increases the volatility in the assets returns, meaning leverage can also increase returns. Since both risk and expected returns increase, the net effect on the value of the asset is often unclear. However, in the E&P industry, capital is king and

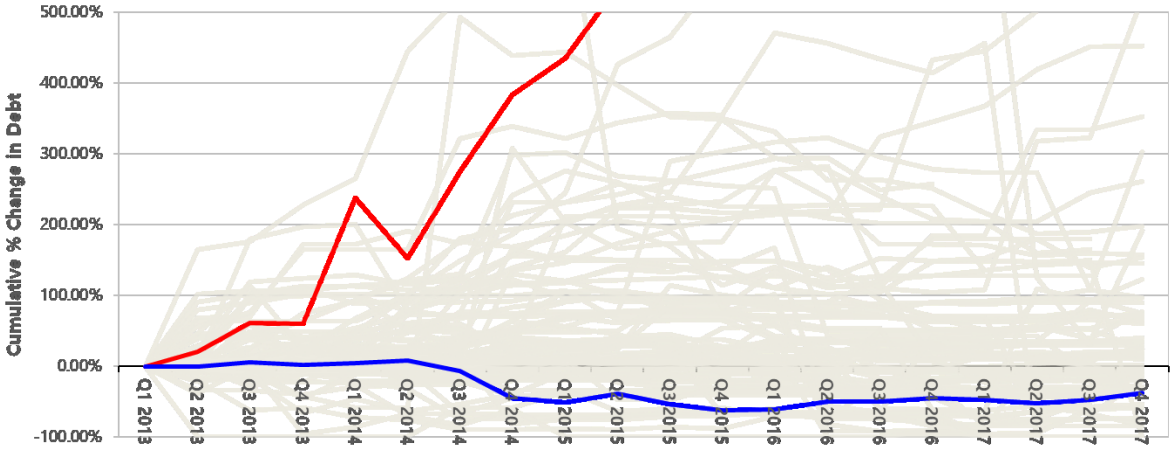
companies must acquire and reinvest more money into the company to generate profits. Generally, E&P companies are willing to stomach more risk because they can offer more collateral in the way of proven reserves and have the ability to generate large returns when projects go well. A good well project in a play like the Permian basin can harness an IRR of upwards of 50%, which is one of the reasons why E&P companies are so fixated on expanding production and doing so by employing leverage. High debt levels in the past have helped firms increase production as commodity prices soared, generating massive revenues. However, when things go bad and the oil and gas industry is forced to wrestle with declining commodity prices, as it did in my study, firms will face huge financial strains.

The problem with the high amounts of leverage seen in the E&P industry is twofold. First, E&P firms' debt is backed by their assets which are valued based on the price of oil. Lower prices reduce profitability and cash flows, increase default risk, and lead to higher costs of debt. According to Dietrich Domanski, "spreads on energy high-yield bonds widened from a low of 330 basis points in June 2014 to over 800 basis points in February 2015" (Domanski, 2015). To combat this, companies will often sell off assets or ramp up production in order to stay afloat. The second problem stems from the pressure high-debt producers feel to hedge their exposure to highly volatile revenues by buying put options in derivatives markets or selling futures. These two scenarios will only further depress commodity prices by flooding the market with excess reserves and increased futures sales, forcing further deleveraging throughout the industry.

The next portion of my study focused on finding a target capital structure in the E&P industry. In theory, an oil price shock would decrease E&P stock returns which would in turn decrease the value of equity in the capital structure, increasing the leverage ratio. The event study I performed proved this to be true. As commodity prices cratered, the leverage ratio

increased. Knowing that the E&P industry was already highly levered leading up to the crash in oil prices, I wanted to see if E&P companies would attempt to delever and find an optimal capital structure to better position themselves for future volatility. Although, after examining the companies' financials, I found that this was not the case. The average leverage ratio in the industry continued to climb throughout my sample period. While there are likely many reasons that caused this, the most logical explanation is that the oil price crash placed too much financial strain on the industry, hindering the companies' ability to delever. Instead, firms focused on doing anything to stay afloat, even taking on more debt and issuing equity to maintain any liquidity they could. Another explanation could be that the time period of this study did not provided the companies enough time to pursue a target capital structure. *Figure 9* illustrates how debt in the industry ballooned once commodity prices cratered and never returned to its previous level.

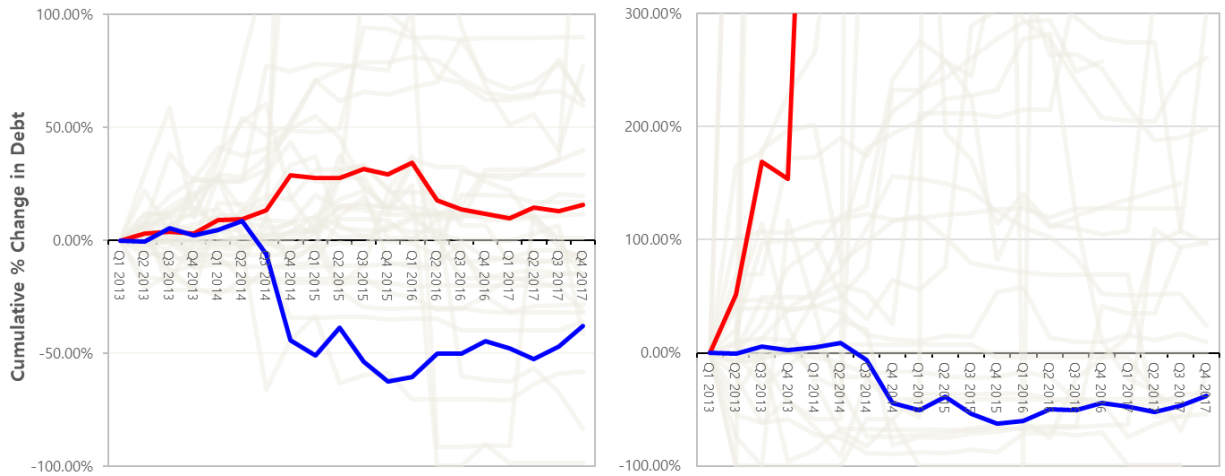
***Figure 9**: Cumulative Percent Change in Total Debt in the E&P Industry*



To better understand this massive increase in change of debt, I further subdivided my sample into equal terciles, sorting the companies based off of beginning amount of total debt held. The top and bottom terciles are displayed in *Figure 10*. In theory, companies with a smaller amount of initial debt would have a greater capacity to take on more debt and this may

skew the results. Figure 10 indicates the average change in debt for the entire sample is in fact scewed some by the bottom tercile firms. However, an increase in debt is still observed by the top tercile of the firms who held the most initial debt.

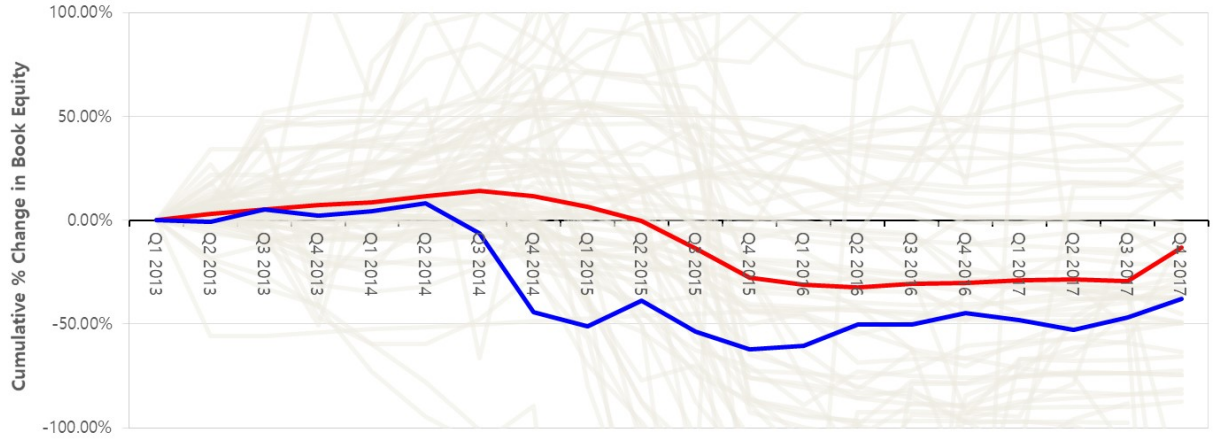
Figure 10*: Top vs. Bottom Tercile Cumulative Percent Change in Debt*



The event study also looked at book equity (*Figure 11*). Since the firms did not attempt to rebalance their capital structure by buying back debt, I wanted to see if they issued equity instead. As shown in *Figure 11*, the average amount of book equity for the sample actually decreased over time. Many companies did attempt to raise equity throughout this 5-year stretch, but at the same time, many operated with huge accounting and financial losses. These losses often outpaced any equity raises the firms had and in turn decreased shareholders equity through retained earnings. At one point in time, 24 out of the 100 companies in my sample had negative book equity values. Twenty-two companies are currently trading below $1 per share, and at least one company in the sample has filed for bankruptcy since the original data was pulled. Obviously, this has been an extremely troubling time for the industry. The profitability of industry is so heavily tied to the price of oil that it comes as no surprise to see the industry go through so much financial distress as commodity prices tank. Although the study was not able to determine a target capital structure in the industry, it is clear that high debt levels taken on by US

E&P companies in the past to increase revenues as oil prices soared has come back to hurt them. Knowing that volatility in the oil and gas market is always around the corner, upstream oil and gas companies should take a more conservative approach when managing their capital structures.

***Figure 11**: Cumulative Percent Change in Book Equity in the E&P Industry*



CONCLUSION

Oil and gas are the most important resources we have on Earth; they are vital components of the world economy. For centuries, global industry has grown substantially with oil and gas as its lifeblood. The exploration and production sector is the backbone of the energy industry, providing the rest of the industry with the necessary raw material. Fluctuations in the viability of the oil and gas industry are felt throughout every aspect of our lives. As the World's population increases, hydrocarbon producers will need to scale considerably to keep pace with the growing demand for energy. However, if the industry continues to burden itself with debt, it will not be able to do so and will ultimately collapse.

The E&P industry is characterized by stable income and a high level of capital expenditures which often necessitates a high weight of leverage on the industry's balance sheets. In recent years, E&P companies have levered up big, resulting in massive increases in the industry's debt. This has allowed companies to take advantage of high commodity prices and

drastically increase revenues throughout the period of booming oil prices. However, the oil and gas industry is extremely volatile and there is always a subsequent bust to every boom. While debt can increase profits, it also places more inherent risk on a company. When the commodity price shock of 2014 occurred, many E&P companies found themselves facing serious liquidity concerns. Risk is an important variable in any financial decision and should be considered carefully.

This study set out to determine the impact of leverage on E&P companies. It looked at how the weight of debt in E&P companies' capital structures affected their overall systematic risk to the market and to commodity prices. It also examined the impact of the commodity price shock of 2014 on the industry's capital structure. It looked specifically at how companies in the industry responded to the collapse in prices to see if an optimal capital structure or a target amount of risk presented itself. The study concluded that the more debt an E&P company employs in their capital structure, the more systematic risk they face relative to both the market and oil prices. It also concluded that the price shock had a significant impact on E&P companies' capital structure. However, the study was not able to identify a target capital structure in the industry. Overall, knowing that volatility in the oil and gas market is always around the corner, upstream oil and gas companies should take a more conservative approach when managing their capital structures. Further research on this topic could be done by expanding the time period of the search, while also looking at various other historical commodity price shocks.

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