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Risk factors in stock returns of U.S. oil and gas companies

Risikofaktorer for aksjeavkastningen til U.S. noterte olje- og gass selskaper

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Preface

This paper is written as our Master`s thesis at the at Norwegian University of Science and Technology (NTNU) Business School, where we both are specializing in financing and investment. We would especially like to thank our supervisor Michael Kisser, for help and guidance during our work with the thesis.

Abstract

In this paper, our objective is to examine if the oil price contributes to explain the return of the oil companies. We analyze a total of 184 U.S. stock exchange listed oil and gas companies, divided into six different subsectors. Our dataset consists of monthly observation from April 1983 to December 2017.

First, we have examined oil and gas related companies' sensitivity for changes in the oil price after adjusting for known risk factors. After comparing the different models, we have tested if the results are valid in different subsectors and through different time periods. The findings suggest by comparing the models by adding oil price to the CAPM and Fama-French model, that the oil price is significant and adds explanatory power to both models. The significant results of the oil coefficient are also valid when testing the different subsectors, where all subsectors show that they have significant exposure for changes in the oil price. This result is also persistent when we test different time periods.

Second, we have used the Fama-Macbeth procedure to examine whether the change in the oil price is a priced factor. The results from our study seems to show no signs of evidence that the oil beta is a priced risk factor.

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1. Introduction

In 2014 the Ministry of finance (Meld. St. 19 2013–2014) stated that “The analyses of the Ministry in this report show no clear relationship between the return on oil equities and oil price developments in the long run. The oil and gas sector have, in the long run, behaved more like the rest of the stock market than like the oil price.”

16. November 2017, Norway's central bank sent a letter, “Investment strategy for the Government Pension Fund Global”, to the Ministry of Finance where they advise to remove oil stocks from the benchmark index. This because Norway's central bank concludes that oil stocks are exposed to changes in oil prices and recommend that removing oil stocks from the oil fund will reduce the Norwegian state's vulnerability to a sustained fall in oil prices.

These two statements, the one from the ministry of finance and the one from the Norwegian central bank, illustrate the fact that there seems not to be a broad agreement whether or not changes in the oil price explain the return of oil and gas companies.

In their 2017 November letter, the Norwegian central bank later states “The interesting question for the fund is to what extent investments in oil and gas stocks provide exposure to factors other than the broad equity market."

This is the question we set out to examine in this paper. Whether or not the oil price contributes to explain the return of the oil companies. Do investments in oil and gas companies give significant exposure to other risk-factors than the market?

2. Literature review

Capital asset pricing model

The definition of an asset can simply be defined as the right on future cash flows, where the asset’s price is a result of these cash flows after being discounted into present value. Asset pricing models try to explain the return on assets. There are, however, different models and approaches. The first and the foundation of most asset pricing models is the Capital asset pricing model (CAPM) presented by Sharpe (1964), Lintner (1965), Mossin (1966) and is built on the work on portfolio theory by Markowitz (1952).

The CAPM builds on the assumptions that investors need to be compensated for an investment in two ways; the time value of money and risk. The time value of money is the amount of compensation an investor would want in exchange of placing his money in an investment without any risk over time. This is in asset pricing models represented with the risk-free rate (R_f).

The compensation of risk can be defined as how much an investor would need to be compensated for taking on additional risk in an investment. Beta (β) is used as a measure of the asset exposure to the overall market portfolio, where the market portfolio is a well-diversified portfolio that consists of all assets. The investor should however only get compensated for systematic risk, the risk relating to the market, and will not get compensated for the idiosyncratic risk meaning the risk that comes with an investment in individual assets and can be diversified away. Following this logic higher betas results in higher correlation with the market and more undiversifiable risk, which the investor needs to be compensated for to be willing to invest in the asset.

After the introduction of the CAPM, there have been several different attempts to verify the theory. Among them Miller and Scholes (1972) that empirically tested the CAPM. Their findings suggest that the relationship between beta and return is too "flat" resulting in investors not obtaining the predicted higher return by taking on higher risk. Black, Jensen, Scholes (1972) continued testing the CAPM model using portfolios instead of individual companies, to make the estimation more efficient, not needing to test each security separately. Their finding is in support of Miller and Scholes, concluding that the beta and risk ratio is not proportional suggesting that CAPM does not hold as a model.

Further, Richard Roll (1977) presented his widely cited critique of the CAPM, Roll`s critique. In the paper he states that the market portfolio in reality would consist of every investment opportunity in every market which in turn is impossible to observe. Without the true market portfolio, it is impossible to test if any investment is mean-variance efficient, making CAPM untestable in reality.

APT

The Arbitrage pricing theory (APT) by Ross in 1976 was presented as an alternative to the Capital Asset Pricing Model with its great advantage that it is in larger degree testable. Like the CAPM, the APT is based on a linear relationship generating return. Unlike the CAPM APT requires no assumptions about the utility besides the two conditions monotonicity and concavity

meaning that investors have stable preferences over time and that they are risk-averse, needing compensation for taking on additional risk. Further the APT does not assume mean variance efficiency in the market portfolio making it more relevant to the real world financial markets.
While CAPM is based on a linear function of a single factor generating return, APT gives the allowance for several factors explaining the return. Since the APT operates under the assumption that no long-lasting arbitrage opportunities will exist[1] the expected return in any equilibrium will have a linear relationship with the common factor loadings together with the asset's own idiosyncratic disturbance, meaning the random incidences related to each specific asset uncorrelated with both other assets and the factors.
Determining what and how many common (systematic) risk factors there are must however be determined outside the APT model but are expected to be mainly fundamental economic factors such as GNP, inflation and the interest rate.
The first published testing of the APT was done by Gehr (1975) suggesting that two to three factors were sufficient to explain the majority of variance in the expected return. Further testing was done by Rolls and Ross in 1980 where they examined 42 portfolios consisting of 30 securities each over a period of ten years. The study suggests that at least three factors are important for estimating the return but also that it is unlikely that more than four were present. A weakness with Rolls and Ross empirical results are however, that their test doesn't determine if these factors are the same over the 42 different groups, or if they are in fact unique to each individual portfolio.
Further research has since been done by Chen (1983) which measured the performance of APT in comparison to CAPM. He concluded that the APT performs well next to the CAPM and couldn't be rejected in favor of any alternative existing hypothesis at the time.

Anomalies

After the publication of CAPM several empirical tests have shown anomalies in the market which is not explainable by use of the model. Forming five portfolios of firms traded on NYSE, based on their price earnings ratio, Basu (1977) found that companies with low price to earnings ratio earned a higher absolute risk adjusted rate of return than firms having a high price earnings ratio. Later, Banz (1981) found evidence of a size effect, where smaller firms had higher risk adjusted

[1]Because aware investors will discover these riskless profit opportunities and in turn ceasing their existence.

returns on average than larger firms based on monthly data from 1926 to 1975. Banz concluded that the size effect is evidence for the capital asset pricing model being wrongly specified but could not conclude if the factor he found in fact was size or whether size is just a proxy for a true, unknown factor correlated with size. A third anomaly was presented by Rosenberg et al. (1985) that found evidence for stocks with high book relative to market values of equity outperform the market.

In 1992 Fama and French presented a study suggesting that the relation between beta and average stock return disappeared for the period 1963-1990, a finding opposing the CAPM regarding market beta (β) being the only relevant risk factor. Considering the earlier evidence, the authors therefor introduced two new explanatory variables in size and book-to-market ratio, that along the market beta tries to explain the variation in average stock returns. Their findings conclude that size and the book-to-market ratio has significant explanatory power. Size and book-to-market ratio capture the cross-sectional variation in average stock returns associated with size and book-to-market equity finding them superior to other possible factors such as leverage and the aforementioned price earnings ratio.

This hypothesis was also supported by Chan and Chen (1991) which presented arguments that there are economic reasons why small firms and large firms have different risk and return characteristics. Small firms tend to be firms that are less efficiently run and have higher financial leverage, characteristics associated with distress, and therefore are riskier. The risk of the smaller firms is not likely to be captured by a market index because these are weighted toward large firms. Fama and French (1995) presented evidence, that size and book to market ratio are related to profitability and confirmed the prediction of Chan and Chen (1991) being that size and book-to-market equity is a good proxy for underlying systematic risk factors and that it is possible that the book-to-market ratio is a proxy for the distress effect.

The Three-factor model

Following the identifications of anomalies in the CAPM, Fama and French (1993) tried to mimic the size and book to market factors by creating portfolios where they divide the companies into SMB, small-minus-big firms and HML, High-minus-low book-to-market ratio. This multifactor asset model tries to capture what they found to be the missing components of systematic risk in the CAPM model. Alongside the HML and SMB this model consists of the market risk factor making it the three-factor model finding it to do a substantially better job than the CAPM in explaining portfolio returns. Although the factors do a good job of and explaining the returns of assets, they are chosen by empirical experience, without a theory that specifies the exact form of the state variables. Fama and French (1993) did however not answer the question of what the underlying economic state variables could be.

Carhart's four-factor model

Jegadeesh and Titman (1993) examined a behavioral phenomenon of strategies which consisted of buying stocks that have performed well in the past and selling stocks that have performed poorly in the past. The study shows that stock that has performed well in the last six to twelve months are more likely to outperform in the future. A momentum lasting for 3 to 12 months. Based on these findings Carhart (1997) examined mutual funds' performance and found that funds with high returns last year have higher than average expected returns next year, but not in the following years after that. Carhart also found that individual funds does not earn higher returns from following the momentum strategy in stocks and concluded that transaction costs consume the gains from following a momentum strategy in stocks, and that the overall the evidence is consistent with market efficiency. The discovery of the momentum anomaly was, by Carhart, included into the three-factor model resulting in Carhart's four-factor model.

Behavioral explanations

Stocks can in some extent be classified into two different categories: value or growth stocks. Value stocks is often identified by the stocks steady payment of dividends used by investors to strengthen their fixed-income portfolios. When a stock is considered underpriced based on their fundamentals[2] resulting in a lower trading price the than the fundamentals otherwise indicate it is considered as a value stock. Investing in value stocks is therefor a strategy where investors try to exploit inefficiency in the market and capitalize on the underpriced asset. Growth stocks are, on the other hand, stocks in companies which revenue is expected to grow considerable relative to the market in the future. Usually not paying dividends these stocks can present a risk for investors since the investment rely solely on the stock's profitability in the future.

Lakonishok et al. (1994) examined two possible explanations for why value stock persistently outperforms the market, a behavioral explanation and a risk-based explanation. Researching

[2] Both qualitative and quantitative information used in the financial valuation of a stock.

whether value strategies have produced higher returns because they are contrarian to naive strategies or because they are fundamentally riskier.

The behavioral explanation assumes that investors do not behave fully rational, indicating expectational errors made by the investors are the cause of the mispricing. This, in turn, makes value investing outperform because investing in a value stocks is a strategy that exploits the mistakes of "naive" investor strategies. Naive investors overbuy what they describe as "Glamour stocks[3]," and overestimate the future growth of these stocks while underestimating the future growth of value stocks. This results in mispricing, an overpricing of glamour stocks, and underpricing of value stocks. An explanation which opposes the theory of efficient markets developed by Fama in 1965. This view is supported by Bondt and Thaler (1985) who argued that people tend to overreact to unexpected events and that this overaction affects stock prices, shown by the fact that prior losers tends to outperform prior winners in the long run.

Lakonishok et al. (1994) Making portfolios of glamour stocks and value stocks. Grouping stocks, doing well in the past as glamour stocks and stocks having high book-to-market in to the value portfolio. Using returns for years 1 through 5 and concluding that the size adjusted average return annually for value stocks are higher than glamour stock 90 percent of the time. Value strategies seem to be no riskier than glamour strategies meaning that the reward for bearing fundamental risk does not seem to explain higher average returns on value stocks than on glamour stocks. This supports that there is a behavioral explanation for why value strategies work.

Based on these findings by Lakonishok et al. (1994), Porta et al. (1997) examined if the overperformance of value stocks is the results of expectational errors made by investors. They formulated the expectational errors as a testable hypothesis of the source of mispricing, studying stock price reactions to earnings announcement. Their findings suggest that a significant portion of the difference in return between value and glamour stocks is because of surprise in the earnings and is significantly higher for value than glamour stocks. Evidence in favor of a behavioral view.

Further research has since been done by Engelberg et al. (2015) suggesting that anomaly returns are 50% higher on corporate news days and are six times higher on earnings announcement days,

[3] "Glamour stocks," stocks that have done very well in the past.

and that dynamic risk, mispricing via biased expectations, and data mining could explain these results. McLean and Pontiff (2016) investigated 97 anomalies shown to explain cross-sectional stock returns. Their Findings support the idea that some or all the original cross-sectional predictability is the result of mispricing and suggest that investors learn about mispricing from academic publications. Both in support of the behavioral view.

Risk-based explanations

The behavioral explanations are contradictory to the risk-based explanations. The risk-based view assumes fully rational investors and is consistent with the hypothesis of efficient markets. Higher returns of value stocks are here a result of fundamentally higher risk where the higher returns are compensation for the higher risk taken by the investor, a view advocated by Fama and French (1993). Chen and Zhang (1998) also claimed that the higher returns for value stocks are compensation for higher risk. Being that value stocks have higher returns because these are firms that are in distress, have high financial leverage and uncertainty about their future earnings.

Zhang (2005) further supported the risk-based view and found that value firms are riskier than growth firms, especially when economic conditions are bad, and the price of risk is high. This due to costly reversibility, which suggests that costs of cutting capital are higher than expanding capital. Another relevant factor was found to be the countercyclical price of risk, meaning that discount rates are higher in bad times. Zhang (2005) argue that value firms are less flexible than growth firms in cutting capital, this cause value firms to be riskier than growth firms and find this as a rational explanation to the irrational overreaction argument found in Lakonishok et al. (1994).

Later research

Chen et al. (2011) criticized the Fama-French model by its lack of ability to explain many of the capital markets anomalies. They specified a new model consisting of an investment factor, and a return-on-equity factor along with the market factor. Chen et al. (2011) results show that firms will invest a lot when their profitability is high, and the cost of capital is low. Chen et al. (2011) model adds economic intuition to the chosen risk factors and clarifies that controlling for profitability, investment should be negatively correlated with expected returns, while controlling for investment, profitability should be positively correlated with expected returns.

Novy-Marx (2013) suggested that profitable firms generate significantly higher returns than unprofitable firms. Also, profitability has about the same power as the book-to-market ratio to predict the average cross section returns.

Controlling for profitability increases the performance of value strategies. Value strategies as holding firms with inexpensive assets and short firms with expensive assets. So, controlling for profitability improves the performance of Fama and French (1993) strategy of being long companies with a high book-to-market ratio and short companies with a low book-to-market ratio.

Novy-Marx measured profitability by gross profits to assets ratio. Gross profits are defined as revenues minus cost of sold goods. Gross-profits is shown to better predict expected stock return than earnings. The profitable firms generate significantly higher returns even when the firms have lower book-to-market and higher market capitalization then average.

Evidence from Hou et al. (2015) examination of nearly 80 anomalies suggests that many claims in the anomalies literature seem exaggerated, nearly 50 % earn insignificant average return. Hou et al. (2015) use a model consisting of the market factor, a size factor, an investment factor, and a profitability factor that outperforms the Fama-French and Carhart models in capturing many of the significant anomalies.

Five-factor model

When Fama and French presented the three-factor model in 1993, the relationship between average return and size and the relationship between average return and value were the main known pattern left out of the CAPM. However as shown, new evidence argues that this is an incomplete model since it misses much of the variation in the average return related to the profitability and investments of companies. In a study by Fama and French (2014) there is found ground to add both profitability and investment in to the three-factor model. Added by Fama and French (2015) is, therefore, the factors RMW and CMA to the three-factor model resulting in the five-factor model. RMW, robust minus weak profitability, is the difference between portfolios consisting of companies with high profitability and portfolios consisting of companies with weak profitability. CMA, conservative minus aggressive investments, is the difference between portfolios consisting of companies with the need for high investments and portfolios of companies with a lower need for investments.

Research on the returns of oil and gas companies

Several studies have been made to explain the returns of oil and gas companies in different ways, where various studies find that the oil price has a significant impact on stock price returns. Faff and Brailsford (1999) investigated the industry equity returns in Australia looking at sensitivity to the oil price from 1983 to 1996. The study concluded that oil price has a significant positive impact on stock prices within this period.

Sadorsky (2001) used a multifactor market model to estimate the expected returns to Canadian oil and gas companies. Their results suggested that crude oil prices have a large and significant impacts on stock price returns. An increase in the market or oil price factor increases the return of Canadian oil & gas stock prices. Further, Osmundsen et al. (2006) sought to establish econometric relations between market valuation and financial and operational indicators. They found that the variation in company valuations is mainly explained by the oil price, oil and gas production, and to some extent reserve replacement.

Later, investigating the impact of oil price shocks on the stock market in eight industrial countries, Apergis and Miller (2009) found that the international stock market did not respond in a large way to shocks in the oil market price. The authors concluded that the results which was significant were small and negligible in magnitude.

On the contrary to earlier findings a study done by El Hedi and Fredj (2010) found a short-term but no long-term relationship between oil prices and returns of oil companies. In their research of the relationship between oil prices and stock markets in Europe by testing for short- and long-term links in the aggregate as well as sector by sector.

Tjaaland et al. (2015) identified and assess the risk factors that drive U.S. oil and gas company stock returns and whether the same risk factors sensitivities hold in four sub-sectors: exploration and production, integrated oil and gas, oil equipment and services, and pipelines. They find that U.S. oil and gas companies have statistically significant exposure to the market, oil price, and natural gas price.

3. Methodology

Our objective is to examine if the oil price contributes to explain the return of the oil companies, to do so we will use the same approach as Næs et al. (2007) where we first test if changes in the oil price has a significant effect on returns of companies in the oil sector. Then, secondly investigate whether oil prices are a priced risk factor.

Oil price sensitivities

Tjaaland et al. (2015) and Sadorsky (2001) use an approach where they run a time-series regression on a multifactor model. Sadorsky (2001) use a model including the market factor, interest rate factor and exchanger rate factor to test Canadian oil and gas industry returns. Tjaaland et al. (2015) test the return of oil and gas companies against the market factor, the return of oil, the return of gas, and the change in interest rate on US listed oil and gas companies. Both studies found significant impact of the oil price on the returns of companies in the oil and gas industry.

In our study we will be leaving the gas variable out and focus solely on how the oil return affect the return of oil and gas companies. We will test the CAPM market factor, with and without the oil factor and see if oil return is significant and add explanatory power. The same approach will be used when testing the Fama-French five factor asset pricing model, as earlier presented, a model often proven to perform better empirically than the CAPM model.

Further, the regressions will be run to compare the different models and to see how adding known risk factors change the sensitivities and explained variances, R^2. The estimated beta coefficients will show the relationship between a change in a variable and the expected change in return of the companies, explaining how sensitive the returns of the companies are for changes in the different factors.

After comparing the different models, we will test if the results are valid in different subsectors and through different time periods. We will also run regressions for each company investigating how the change in the oil price affect the individual companies.

Ordinary least squares (OLS) technique is used when running the time-series regressions. It is run on the sample companies as a group. Using OLS will be close to treating the sample as an equally weighted portfolio of stocks. To account for possible heteroskedasticity and autocorrelation, robust standard errors is reported.

Regression model:

$$E(r_{it}) = \alpha_i + \sum \beta_{ij} f_{jt} + \varepsilon_{it}$$

Where $E(r_{it})$ dentoes the expected excess return on company i in period t. f_{jt} is the return on factor j in period t. β_{ij} is the coefficient of factor j for company i. ε_{it} is the error term.

Is the oil price a priced risk factor?

To examine if the oil price is a priced risk factor, we study the cross-sectional variations in return for assets with regards to the change in the oil price, and to what extent the factor contributes to describe returns when added to the CAPM/Fama-French model. Næs et al. (2007) examine whether oil price is a priced risk factor on Oslo Børs, the Norwegian stock exchange, and do not find that to be the case for the Norwegian market. Chen et al. (1986) employ a version of the Fama and MacBeth (1973) technique and find that the risk associated with oil price changes was not priced in the US stock market in the 1968 to 1977 period.

Further, we will use the Fama-Macbeth procedure to examine whether the change in the oil price is a priced factor for US stock exchange listed oil and gas companies. If the oil price is a priced risk factor, it improves the CAPM model power to predict the future stock returns of oil and gas companies and the oil price helps to provide further insight into determining the linear CAPM relationship.

Regression model:

$$E(r_i) = \lambda_0 + \sum \lambda_j \beta_{ij}$$

Where $E(r_i)$ denotes expected excess return on an asset i , the return beyond the risk-free interest rate. β_{ij} is asset $i`s$ exposure to risk factor j and, λ_j is the risk premium linked to factor j. In other words, the regression models employ the previously estimated betas and – if they pick up systematic risk – one would expect that λj is positive and statistically different from zero.

That a variable has a significant risk premium means that it is priced in equilibrium, in the sense of that the variable contributes to all the assets that are included in the estimate.

We will also be testing to see if the intercept is significantly different from zero. If the asset pricing model is valid, from an efficient market perspective, the intercept, alpha, will not be significantly different from zero. If alpha is significantly different from zero, the model should be rejected (Jensen et al., 1972).

Approach: Fama and MacBeth (1973)

Following the Fama and Macbeth approach we first estimate the individual companies' beta by running a rolling time series regression over the last 24 months. This can be done by running a joint regression, where all the factors are regressed at the same time, or regress one factor at a time, Ødegaard (2017). We choose to regress all the factors simultaneously based on Ødegaard (2017) not finding it to be any large difference between the two approaches.

Regression model:

$$r_{it} = \alpha_{it} + \beta_{it}\, MKT + \beta_{it}\, \Delta Oil + \varepsilon_{it}$$

Then, the estimated beta from the first regression is used as input in the subsequent cross-sectional regression, which is performed monthly for the chosen time period.

$$r_{it} = \lambda_0 + \lambda_1 \beta_{MKT} + \lambda_2 \beta_{\Delta oil} + \varepsilon_{it}$$

The time-series average of the cross-sectional regressions will be examined and tested for significance with t-statistics. We will also evaluate R^2 to see how much of the variance is explained by the model. If λ_2 is not significant, it means that the oil price does not provide any further information about the expected return to the oil companies. If λ_2 turns out to be significant, it supports the hypothesis that changes in the oil price are a systematic risk factor for oil companies, thus being a risk factor that investors require compensation to be exposed to, but which are not captured by the market factor.

The Fama Macbeth procedure will provide standard errors corrected for cross-sectional correlation, but not time-series autocorrelation (Bali et al., 2016), which we will correct using Newey and West (1987) robust standard errors.

Portfolios vs. stocks

It is common in the asset pricing literature to sort the stocks into portfolios when running the Fama-Macbeth regression. This being the common approach because using portfolio is believed to give more precise estimates of factor loadings, which in turn should translate into more precise estimates and lower standard errors of factor risk premia (Ang et al., 2010).

However, as argued by Ang et al. (2010) this portfolio approach also has potential drawbacks. For example, they find that the sampling uncertainty of factor loadings is distinctly reduced by grouping stocks into portfolios, but that this does not translate into lower standard errors for factor risk premia estimates. Ang et al. (2010) elaborates that the more dispersed the cross-section of betas is, the more information the cross section contains to estimate risk premia. Aggregating stocks into portfolios causes loses in information by reducing the cross-sectional dispersion of the betas. They state that while creating portfolios does reduce the sampling variability of the estimates of factor loadings, the standard errors of factor risk premia increases. Furthermore, that it is the decreasing dispersion of the cross-section of beta when stocks are grouped into portfolios that lead to potentially substantial efficiency losses in using portfolios versus individual stocks.

We are examining only companies in the oil and gas sector, and therefore the number of companies is lower than studies testing the entire stock market. Creating portfolios can cause there to be too few stocks for the cross-section stage of the estimation when the sample contains a limited number of companies. For this reason, the Fama-Macbeth regressions will be run on individual stocks instead of portfolios.

4. Data and data sources

In this chapter the objective is to describe and give grounds for the decisions that were taken regarding the data collecting and analysis done in this study. We have collected our data using Thomson Reuters Eikon, consisting of a total of 184 American oil related companies registered on New York stock exchange (NYSE) Attempting to avoid any unnecessary biases, we choose a broad approach including every firm fitting to the six subsectors within the Oil & Gas sector we set out to examine. This approach does however also lead to inclusion of newly registered firms which in some cases leads to insignificant results due to few observations. As for the subsectors, we here followed Thomson Reuters Eikon's categorization of each firm included in our dataset.

Fama & French factor loadings

The Fama and French five factors values are gathered from the Kenneth R. French's data library. The values are constructed using six value weighted portfolios based on size and book-to-market ratio, six based on size and operating profitability and six based on size and investments. The monthly return on the portfolios were calculated based on data from July 1963 to February 2018. The Small Minus Big (SMB) factor loading is based on the average return of nine small stock portfolios minus the return of nine big stock portfolios. The High Minus Low (HML) factor loadings is derived from the average return of two value portfolios minus the average return of two growth portfolios. The Robust Minus Weak (RMW) factor loadings is derived from the average return on two robust operational profitability portfolios minus the average return of two weak operational profitability portfolios. Finally, the Conservative Minus Aggressive investment (CMA) factor loading is based on the average return on two conservative investment portfolios minus the average return on two aggressive investment portfolios.

The excess return of the market, Rm-Rf, is calculated from the value-weighted return of all US firms listed on either NYSE, AMEX or NASDAQ. Used in the calculation of the factor loadings is the one-month treasury bill rate.

Rate of return

The one-month total return, which we use to calculate the effect of changes in the oil price, incorporates price changes and any relevant dividends during the specified period and is denominated in U.S. dollars.

Time period

The data included in our dataset consists of monthly observation from April 1983 to December 2017, to give a broad perspective over time. This data is further grouped into four sub-periods from 1983 to 1989, 1990 to 1999, 2000 to 2008 and 2009 to 2017.

Survivorship bias

The problem with survivorship bias arises when companies have been declared bankrupt during our analysis period resulting in them not being included in our dataset. Companies typically goes bankrupt due to low profitability partly due to low rates of return, which in turn could result in companies included in our dataset having an abnormally high return. Further, one could argue that bankrupted companies would show a greater exposure to different risk factors like the oil price, resulting in them having financial distress in times where the oil price is low. It is important to be aware that such a bias can occur, taking it in to account analyzing the dataset.

5. Empirical results

Descriptive statistics

Subsector	Num. comp	obs	mean	min	max
Integrated Oil & Gas	10	2333	0.008	-0.487	0.622
Oil & Gas Drilling	14	3461	0.007	-0.561	1.175
Oil & Gas Exploration and Production	67	13348	0.011	-0.757	2.099
Oil & Gas Refining and Marketing	23	5528	0.013	-0.731	2.820
Oil & Gas Transportation Services	28	3764	0.007	-0.646	1.024
Oil Related Services and Equipment	42	7499	0.010	-0.750	1.606
Total	*184*	*35933*	*0.010*	*-0.757*	*2.820*

Table 1: **Descriptive statistic**. Mean, max, min is Return-RF. the table shows the number of companies, number of observations, mean, maximum, minimum and standard deviation for each subsector and in total.

Our sample involves of a total of 184 companies divided into six different subsectors consisting of Integrated Oil & Gas companies, Oil & Gas Drilling companies, Oil & Gas Exploration and Production companies, Oil & Gas Refining and Marketing companies, Oil & Gas Transportation services and Oil related Services and Equipment companies.

One can typically categorize oil and gas companies into two groups, upstream and downstream. Upstream companies are involved in exploration and production endeavors, whereas downstream companies involved in refinement, transportation and marketing. Integrated companies take part in the whole value chain, both upstream and downstream, being vertically integrated. Purely upstream subsectors include the subsectors Exploration & Production and Drilling. These subsectors include activities both onshore and offshore alongside companies involved unconventional oil and gas resources activities as shale oil and oil sand. Alongside these two subsectors, the oil-related Services & Equipment subsector consists of companies offering products and services required to construct, complete and produce oil and gas wells. The subsector is in other words, for the most part, related to the upstream activities.

The Refining & Marketing and Oil & Gas Transportation subsectors consists of companies mainly involved in the downstream activities. The Refining & Marketing subsectors include companies mainly involved in post-production activities with objective to process and purify oil and gas. The Oil & Gas Transportation services subsector, on the other hand, consist of companies undertaking the different activities of transportation as Pipelines, LNG transportation and storage, Sea-born tankers and oil and gas storage. As for the Oil & Gas Transportation services, they are sometimes referred to as midstream, including elements from both upstream and the downstream sector. They are however typically referred to as the downstream and will in our study be included as such.

The number of companies in each subsector differs from a total of 67 companies in the Refining & Marketing subsector to only 10 companies in the integrated oil and gas company's subsector. This due to the total number in each category, meeting our criteria, listed on the New York Stock exchange.

The rate of return is observed for each company in the end of each month for nearly 34 years, from April 1983 to January 2018. The total number of observation will vary by the number of firms in each subsector alongside different lifespan of the companies and in some cases due to lack of information in our dataset. The total number of observation in all subsectors combined is 35933.

The mean rate of return is given by mean return subtracted the risk-free rate of return as discussed earlier, in the data chapter. The rate varies from subsector to subsector, where Oil & Gas Refining and Marketing companies have the highest excess rate of return on average with 1.33 percent. Oil & Gas Transportation services is, in contrast, the subsector with the lowest excess return laying a little under 0.7 percent. The average excess return for the entire sector is close to 1 percent, all companies combined.

Correlation and average return for factors

When examining the correlations between the return of oil and gas companies and the other risk factors, the highest correlations is found between the return of the companies, the market factor and the oil price factor. This relationship is also persistent when examining the correlations of the different time periods. Although showing different degree of correlation in the different time periods, the market factor and the oil factor are the factors with the highest correlation with return of the oil and gas companies. The market and oil factor do, however, not show a high degree of correlation between each other. By examining the different subsectors, we see the correlation between the return of the companies and the oil factor being highest for Drilling companies with a correlation of 0.42 and lowest for Refining and Transportation companies with a correlation of 0.22 and 0.24 respectively. The correlations for the different time periods and subsectors are both shown in Appendix 2.

	RetRF	MKT	SMB	HML	RMW	CMA	Δ Oil
RetRF	1.000						
MKT	0.356	1.000					
SMB	0.170	0.237	1.000				
HML	0.094	-0.103	-0.023	1.000			
RMW	-0.136	-0.425	-0.447	0.280	1.000		
CMA	-0.004	-0.292	0.004	0.632	0.204	1.000	
Δ Oil	0.334	0.191	0.139	0.057	-0.164	-0.042	1.000

Table 2: **Matrix of correlations.** OLS timeseries regressions , $r_{it} = \alpha_i + \beta_1 MKT + \beta_2 SMB + \ \beta_3 HML + +\beta_4 RMW_t + \beta_5 CMA_t + \ \beta_6 \Delta Oil_t + \varepsilon_{it}$. All companies. Time period Apr 1983- Dec 2017.

Table 2 shows that some of the risk factors exhibit some degree of higher correlation in between each other. The RMW factor is negatively correlated with market and the SMB factor, whereas the CMA factor are positively correlated to the HML factor.

Variable	Mean	Std.Dev.	Min	Max
RetRF	0.0101	0.1315	-0.7568	2.8196
MKT	0.0070	0.0421	-0.2324	0.1247
SMB	0.0013	0.0286	-0.1485	0.1827
HML	0.0018	0.0287	-0.1110	0.1290
RMW	0.0034	0.0247	-0.1872	0.1351
CMA	0.0019	0.0193	-0.0688	0.0958
Δ Oil	0.0021	0.0934	-0.4128	0.3678

Table 3: Average summary statistics. Average return for factors. Time period Apr 1983- Dec 2017.
Number of obs. = 35 933 for all variables.

From the average summary statistics displayed in table 3 we see that the average return is positive for all variables. The average monthly return for a company in the sample, RetRF, is

1.01 percent. The highest monthly negative return by a company in the sample is -75.7 percent and the highest positive monthly return is 282 percent. The average monthly return on the market, MKT, was 0.7 percent, with a high of 12 percent and low of -23 percent. Average monthly oil return was for the sample period 0.2 percent, with a high of 37 percent and low of -41 percent. Although the oil return has a lower monthly average return than the market, the minimum and maximum values show that the oil price return consists of greater monthly average fluctuations than the market return. The table also tell us that the return of the oil companies on average exceeds the both the return of the market and the return on oil for the sample period.

Comparing models

	Mod 1	Mod 2	Mod 3	Mod 4
MKT	1.1117***	0.9467***	1.1321***	1.0312***
	(0.0355)	(0.0285)	(0.0300)	(0.0266)
Δ Oil		**0.3885*** **		**0.3754*** **
		(0.0172)		**(0.0166)**
SMB			0.4495***	0.3704***
			(0.0406)	(0.0371)
HML			0.5057***	0.3187***
			(0.0401)	(0.0362)
RMW			0.1336***	0.2903***
			(0.0387)	(0.0365)
CMA			0.1792***	0.3274***
			(0.0523)	(0.0451)
Intercept	0.0024***	0.0027***	-0.0001	-0.0005
	(0.0006)	(0.0006)	(0.0006)	(0.0006)
Obs.	35933	35933	35933	35933
R-squared	0.1267	0.2001	0.1526	0.2193

Table 4: Comparing models.
OLS timeseries regressions, models:
$Mod\ 1\colon\ r_{it} = \alpha_i + \beta_1 MKT + \varepsilon_{it}$
$Mod\ 2\colon\ r_{it} = \alpha_i + \beta_1 MKT + \ \beta_6 \Delta Oil_t + \varepsilon_{it}$
$Mod\ 3\colon\ r_{it} = \alpha_i + \beta_1 MKT + \beta_2 SMB + \ \beta_3 HML + +\beta_4 RMW_t + \beta_5 CMA_t + \varepsilon_{it}$
$Mod\ 4\colon\ r_{it} = \alpha_i + \beta_1 MKT + \beta_2 SMB + \ \beta_3 HML + +\beta_4 RMW_t + \beta_5 CMA_t + \ \beta_6 \Delta Oil_t + \varepsilon_{it}$
Time period Apr 1983- Dec 2017.
Robust standard errors are in parenthesis *** p<0.01, ** p<0.05, * p<0.1

The results from comparing the models indicates that all four models have a significant positive market beta, as seen in table 4. The Fama and French factors added in model 3 and 4 are also positive and statistical significant. The oil return coefficient is statistical significant and adds considerably explanatory power when both added to the model 1 and model 3. In model 2, 20 percent of the variance in oil and gas companies` returns can be explained by the market and the oil factor. When oil return is added to the Fama and French model, the model 4 explained nearly 22 percent of the variation, up from 15 percent when only the Fama-French factors were included.

For the different models the market coefficient is around 1, with a high of 1.13 in model 3 and a low of 0.95 in model 2. The oil coefficient of 0.38 tells us that an increase in the oil price by 1 percent on average will increase the return of oil and gas companies with 0.38 percent. Importantly, the coefficient on the oil price change is virtually the same irrespective of whether the CAPM or the Fama and French 5 factor model is employed. This suggests that the oil price change is hardly correlated with the Fama and French factors (after controlling for the market return). When the Fama and French factors are added in model 3 and 4 the intercept becomes insignificantly different from zero.
As for model 4, the F-test shows a probability of 0.00. This indicates that all the coefficients, when together added to the regression, are highly statistical significant.

Comparing subsectors

To obtain further insight in the differences within the oil and gas industry we ran a timeseries OLS regression individually for each subsector, with the objective is to investigate whether the oil price has a significant effect on all subsectors or only for a selected few of them.

Initially one could intuitively expect upstream companies, having crude oil as an output factor, to be more sensitive to changes in the oil price than the downstream companies which often has oil as an input factor in their activities.

As seen in table 5 the SMB factor has a has a significant positive effect at the 1 percent level for all subsectors except from the Integrated and Refining companies. Similar results are applicable for the HML factor which also has a significant positive effect on four of the subsectors at the 1 percent level. The HML factor is further significant positive for the Refining companies at the 10 percent level and shows no significance for the Integrated oil and gas companies. The RMW factor also has a significant positive effect on four of the subsectors at the 1 percent level, a non-significant positive effect on the oil and gas Drilling subsector and lastly a non-significant negative effect on the oil and gas Transportation subsector. The CMA factor has positive effect on all subsectors but is also only significant at the 1 percent level for four of which. The CMA factor is significant on the 5 percent level on the Exploration & Production companies and lastly, show no significant impact on the Integrated companies.

Further on, the market risk factor is positive and significant for all six subsectors. The coefficients do, however, differ between the subsectors where the results indicate that Drilling companies and Service and Equipment companies are the two riskiest subsectors with a market beta of 1.22 and 1.26 respectively. The other four subsectors have considerable lower market betas laying under 1, where oil Transportation companies have a market beta as low as 0.88.

	(1) All companies	(2) Integrated	(3) E&P	(4) Drilling	(5) Refining	(6) Transport	(7) Services & Equip.
MKT	1.0312***	0.9211***	0.9397***	1.2174***	0.9780***	0.8829***	1.2612***
	(0.0266)	(0.0572)	(0.0410)	(0.0660)	(0.0528)	(0.0760)	(0.0533)
SMB	0.3704***	0.0081	0.4026***	0.5215***	0.1690	0.1906**	0.5953***
	(0.0371)	(0.0864)	(0.0564)	(0.1100)	(0.1036)	(0.0731)	(0.0807)
HML	0.3187***	0.0294	0.4860***	0.2831**	0.1229*	0.2214***	0.3284***
	(0.0362)	(0.0686)	(0.0569)	(0.1080)	(0.0695)	(0.0646)	(0.0961)
RMW	0.2903***	0.3077***	0.4155***	0.1223	0.2418***	-0.0266	0.3522***
	(0.0365)	(0.0792)	(0.0648)	(0.0867)	(0.0708)	(0.1585)	(0.0743)
CMA	0.3274***	0.1618	0.1891**	0.6005***	0.3924***	0.3896***	0.4338***
	(0.0451)	(0.1289)	(0.0750)	(0.1370)	(0.1045)	(0.1046)	(0.1089)
Δ Oil	**0.3754***	**0.2965***	**0.4592***	**0.5375***	**0.2044***	**0.1754***	**0.4019***
	(0.0166)	**(0.0384)**	**(0.0289)**	**(0.0317)**	**(0.0350)**	**(0.0211)**	**(0.0277)**
Intercept	-0.0005	-0.0000	0.0001	-0.0051**	0.0041***	-0.0011	-0.0031**
	(0.0006)	(0.0013)	(0.0010)	(0.0020)	(0.0012)	(0.0014)	(0.0014)
Obs.	35933	2333	13348	3461	5528	3764	7499
R-squared	0.2193	0.2678	0.2158	0.3127	0.1579	0.1698	0.2781

Table 5: Comparing subsectors
OLS timeseries regressions , $r_{it} = \alpha_i + \beta_1 MKT + \beta_2 SMB + \beta_3 HML + +\beta_4 RMW_t + \beta_5 CMA_t + \beta_6 \Delta Oil_t + \varepsilon_{it}$ Timeperiod Apr 1983- Dec 2017.
Robust standard errors are in parenthesis, *** p<0.01, ** p<0.05, * p<0.1

The oil price also has a positive impact on all subsectors significant at the 1 percent level. Regarding the earlier assumption about upstream companies being the most oil price sensitive companies this is from the subsector regression found to be right for the most part. Exploration & Production companies has an oil price beta of 0.46 and is alongside Drilling companies (Oil price beta of 0.54) the two subsectors with the highest sensitivity to changes in the oil price. As suspected Transportation companies has the lowest sensitivity regarding the oil price with a beta of only 0.17 followed by Refining & Marketing companies with a beta of 0.20. The Services & Equipment subsector has on the other side a quite high oil price beta of 0.40. Somewhat contra intuitively based on the argument that these companies don't profit directly from changes in the oil price. However, on the long run, it is reasonable to expect that changing oil prices would affect their activities.

Integrated oil and gas companies has an oil price sensitivity close to 0.30. Integrated oil and gas companies (BP, Shell etc.) typically engages in the entire value chain, both upstream and downstream. Being vertically integrated makes these companies less sensitive to the rise and fall of the oil price than pure upstream companies essentially becoming less sensitive to changing oil prices than they initially would be.

By the R-squared values we see the explanatory power of the model where the total variation explained in the model, all subsectors combined, is close to 22 percent. The explanatory power of the model varies between the subsectors from 31 percent for the Drilling companies down to 16 percent for the Refining & Marketing companies. There are in other word quite a lot of variation in the oil and gas company stock return not explained in our model.

Time-series regression each company

In Appendix 4 one can see the OLS time series regression run for each company individually. Regarding the market risk factor, 145 companies are significant at the 10 percent level, 138 are significant at the 5 percent level and 119 companies are significant at the 1 percent level. When it comes to the oil price 143 companies are statistically significant at a 10 percent level, 135 are significant at a 5 percent level whereas 116 is still valid at the 1 percent level of significance.

All Integrated companies, 13 of 14 of Drilling companies and 60 of 67 Exploration & Production companies have a coefficient of oil return statistically significant at the 10 percent level. On the contrary 9 of a total of 23 Refining & Marketing companies shows no significance at all, where five of which shows an insignificant negative relationship between the oil price risk factor and return. This alongside two companies, PBF Energy (PBF) and Murphy USA Inc (MUSA), showing a significant negative relationship on the 10 percent level, making these companies viable hedging options against the oil price. That is, only after controlling for other factors and based on ex-post results only. The combined results for the subsector shows a factor risk beta of less than 0.13 corresponding with the intuition of downstream oil and gas companies being less risky regarding fluctuations in the oil price compared to companies engaged in upstream activities.

Similarly, 13 among the total of 28 oil and gas Transportation companies shows an insignificant relationship between oil price and return in the Transportation subsector. 8 companies indicate a significant oil price beta at the 1 percent level. The oil price beta for the subsector is consistent with our earlier findings indicating a beta close to 0.25, weaker than the subsectors associated upstream operations.

The oil related Services & Equipment subsector is consisting of 42 individual companies. The regression results reveal 27 companies being significant at the 1 percent level, 3 companies being significant at the 5 percent level and 11 companies having no significant impact by the oil price risk factor.

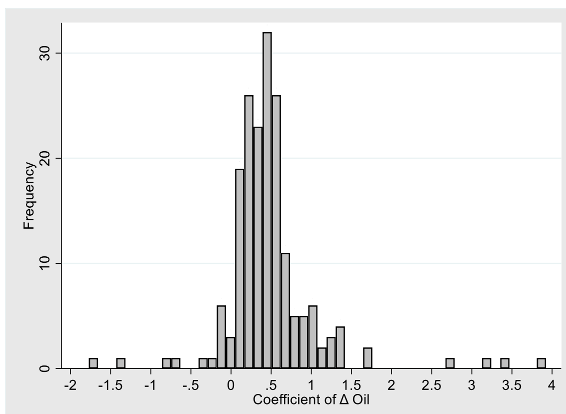

Figure 1: Histogram showing the distribution of all estimated oil price betas
OLS timeseries regressions , $r_{it} = \alpha_i + \beta_1 MKT + \beta_2 SMB + \ \beta_3 HML + +\beta_4 RMW_t + \beta_5 CMA_t + \ \beta_6 \Delta Oil_t + \varepsilon_{it}$, for each individual company. Time period Apr 1983- Dec 2017 Frequency = number of companies.

The relative large amount of insignificant oil price betas in some subsectors is partly due to our broad approach selecting companies, where few monthly observations, for some companies, will contribute to insignificant observations. Standing out of the group is the Refining & Marketing and the Transportation subsectors having a lower percentage of companies with significant coefficients of oil return. Alongside the lack of monthly observation, this could be an indication that the return of companies being more directly involved in the extraction and production of oil is more exposed to changes in the oil price. This is consistent with our earlier findings in the subsector analysis.

Comparing Sub-time periods

In this section it will be presented a brief historical review of the volatility in the oil price seen in our sample period, succeeded by the regression results from the different subperiods. Regressions for the different subperiods were run with a goal to clarify whether our results were persistent despite differences in the price level and volatility, revealing potential inconsistencies.

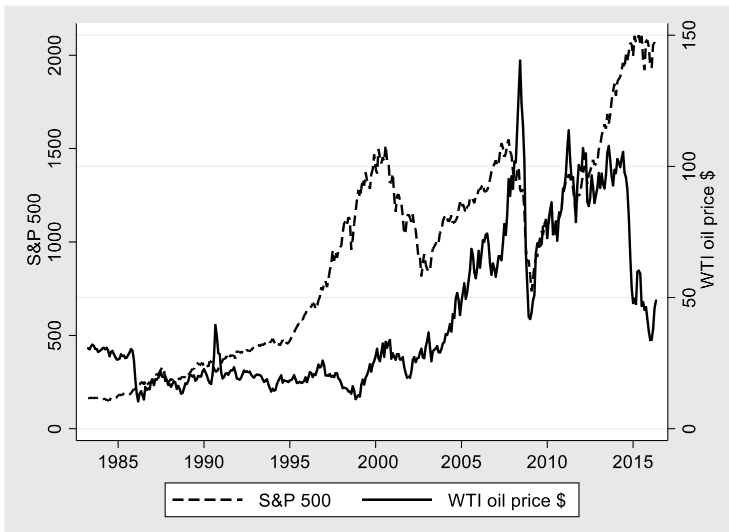

Figure 2: Historical prices
S&P 500 and WTI oil price. Time period Apr 1983- Dec 2017

The oil price has been subject of great fluctuations throughout the years, as displayed in figure 1. From a low average price of $14.4 in 1986, the oil price was again testing the lows in 1998 with a yearly average of $14.5 per barrel of WTI crude oil. This low point was followed by a subsequent surge in the oil price continuing to 2008 reaching a yearly average of $98.7. The 2008 peak was then followed by a drastic decline, rise and another decline, to a yearly average of $44.4 in 2016, showing a showing a great of volatility.

One reason for the decline in the oil price during the early 1980`s is by Baumeister and Kilian (2016) believed to be the tightened monetary policy in the US, resulting in a global recession, together with increased non-OPEC production. The test of the lows in 1998 came as a result of the Asian financial crisis in 1997 (Baffes et al., 2015). As for the surge from 2003 to 2008, Baumeister and Kilian (2016) state that this was caused by increased demand, not a shift in supply. Further, the 2008 decline in oil price is stated to be a result of the financial crisis and is seen as an effect of the drop in industrial production and demand for commodities. With help from lower interest rates, the demand for commodities shifted, and a rebound in the oil price is seen with an increase in the price up until June 2014.

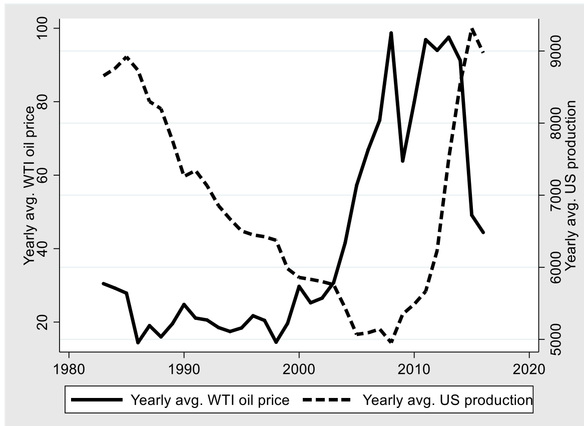

Figure 3: Yearly average US oil production and WTI oil price.
US oil production in thousand barrels per day. WTI oil price in US $. Data from US Energy Information Administration (EIA).

While the previous oil price fluctuations in 2000's are seen as a shift in demand, the steep decline beginning in June 2014 is seen as a shift in supply, primarily due to an increase in the US shale oil production, as seen in figure 3. Baffes et al. (2015) adds that a change in OPEC policy, being that the organization no longer focused on maintaining a high oil price but instead wished to compete with US producers, minimizing their loss of market share, also contributed to the decline in oil price. Moreover, an appreciation of the US dollar and less geopolitical risks are stated as contributing factors for the plunge in the oil price.

For the subperiod analysis the sample is split up to the periods 1983-89, 1990-99, 2000-08 and 2009-17, isolating certain periods of interest like the time following the oil price peak in 2008. As seen from the table 6, the market factor and the oil price are positive and statistically significant for all the different time periods after controlling for the other known risk factors SMB, HML, RMW and CMA, included in our model.

In the period 1983-89 all variables are significant at the 10 percent level of significance. The market variable shows a coefficient of 1.14 and the oil variable has a coefficient of 0.18. This is the period that the Oil and Gas companies have the substantial lowest sensitivity towards the change in oil price. The markets coefficient is here above the coefficient for the fulltime sample period. Interestingly, the coefficients of the HML and RMW variables are negative at the 5 and 10 percent level of significance respectively. This opposes the intuition behind the factors which predict a positive relationship between the factors and the stock return. CMA, however, has a coefficient as high as 1.86, which is considerable higher than CMA for the overall period with a coefficient of 0.33.

The period 1990-99 Show an increased market coefficient from the period before, with a value of 1.31, the highest market factor value throughout or sample period. The oil price coefficient also increases to 0.38, an exposure level close to the one for the full period. Meanwhile, the model's explanatory power is 18.2 percent, the lowest of all subperiods. Further, the RMW factor does not show statistical significant result during this period.

	(1) 1983-2017	(2) 1983-89	(3) 1990-99	(4) 2000-08	(5) 2009-17
MKT	1.0312***	1.1431***	1.3093***	1.1606***	0.8986***
	(0.0266)	(0.0628)	(0.0692)	(0.0368)	(0.0368)
SMB	0.3704***	0.4655***	0.4870***	0.2451***	0.5028***
	(0.0371)	(0.0984)	(0.0635)	(0.0441)	(0.0537)
HML	0.3187***	-0.2273*	0.5728***	-0.0409	0.2786***
	(0.0362)	(0.1244)	(0.0916)	(0.0553)	(0.0556)
RMW	0.2903***	-0.4142**	0.1126	0.5856***	0.0918
	(0.0365)	(0.1557)	(0.0777)	(0.0647)	(0.0745)
CMA	0.3274***	1.8571***	0.7578***	0.1643***	0.4599***
	(0.0451)	(0.2258)	(0.1387)	(0.0511)	(0.0850)
Δ Oil	**0.3754*** **	**0.1842*** **	**0.3796*** **	**0.3204*** **	**0.4542*** **
	(0.0166)	**(0.0303)**	**(0.0306)**	**(0.0148)**	**(0.0246)**
Intercept	-0.0005	-0.0016	-0.0071***	0.0135***	-0.0053***
	(0.0006)	(0.0015)	(0.0010)	(0.0010)	(0.0010)
Obs.	35933	2691	6314	10901	16027
R-squared	0.2193	0.2753	0.1822	0.2299	0.2421

Table 6: Comparing different time periods.
OLS timeseries regressions , $r_{it} = \alpha_i + \beta_1 MKT + \beta_2 SMB + \beta_3 HML + +\beta_4 RMW_t + \beta_5 CMA_t + \beta_6 \Delta Oil_t + \varepsilon_{it}$
Robust standard errors are in parenthesis *** p<0.01, ** p<0.05, * p<0.1

For the years 2000-2008 we see a market coefficient of 1.16 and an oil coefficient of 0.32, both decreasing from the previous period. The HML coefficient do not show statistical significant results within this period.

The highest oil beta is seen in the last period, 2009-17, indicating that the oil and gas companies' sensitivity for changes in the oil prices has been higher after 2008 than for the rest of the period. The oil coefficient is 0.45 increasing substantially from the 0.18 value in the 1983-89 period. The results from the 2009-2017 period shows the lowest market coefficient of the different periods, with a coefficient of 0.90.

For all time periods the sensitivity towards changes in the market are higher than the sensitivity for changes in the oil price. This indicates that oil and gas companies are more exposed to the market than the oil price within each individual period, and for the entire sample period combined. Persistent throughout all periods is also that the oil companies' sensitivity to changes in the market is highest among all tested variables (except for CMA in the 1983-89 period), suggesting that the market is the most important systematic driver for the stock return of oil and gas companies.

Fama-Macbeth regression

In figure 4 the result of the rolling regression, including the market and the oil price, is displayed. This regression is the first of the two steps in the Fama-Macbeth regression, being used as an input in step two.

The rolling regression is executed by estimating a beta for 24 months. Then adding another month, while eliminating the first month. The monthly estimated beta always consists of a sample that contains the previous 24 months where only months consisting of a full 24-month sample are included. Observations that contains below a full 24-month sample is excluded, being considered as part of the estimation period.

Damodaran (1999) states that when choosing a time period for beta estimation, there is a trade-off of advantages by choosing between a shorter or longer time period. When choosing a longer period, you are getting the advantage of having more observations in the regression. This advantage could, however, be offset by the fact that the firm itself might have changed its characteristics in terms of business mix and leverage, over that period. We chose to use a 24-month window, to include the variation and account for the changes in beta over time, while eliminating the statistical noise that comes with using shorter time periods.

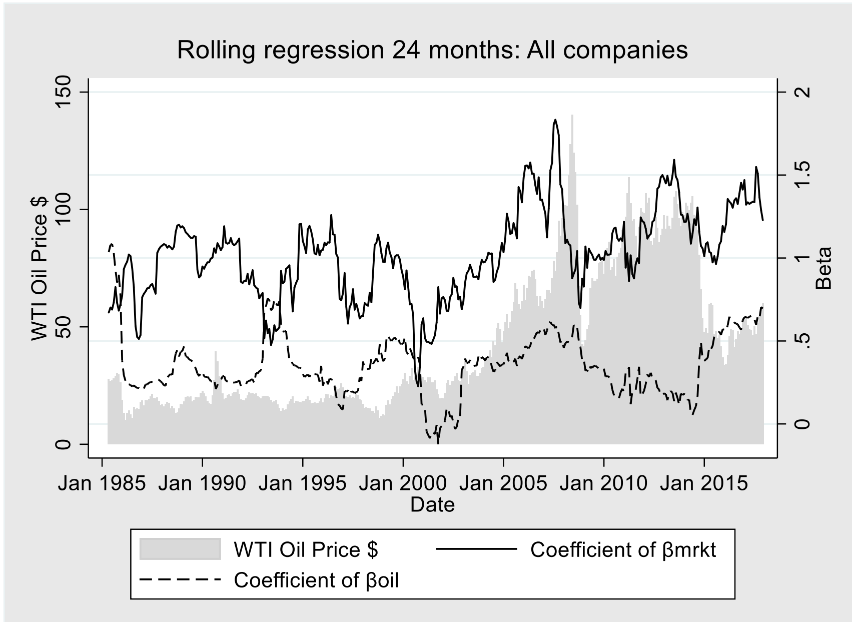

Figure 4: 24-month rolling cross-sectional regressions
$r_{it} = \alpha_i + \beta_1 MKT + \beta_2 \Delta Oil_t + \varepsilon_{it}$. Period Apr 1983- Dec 2017. Windzorized at 1% and 99%. Including all companies.

As seen in figure 4, the time series analysis of the rolling cross-sectional regression shows that neither the market beta nor the oil beta is constant. When rolling cross-sectional regression is run on all companies, the results show that one finds the highest market beta in August 2007 with 1.83, while the highest oil beta is in July 1985 with 1.08. The lowest market beta is seen in October 2000 with 0.23 whereas the lowest oil beta value can be found in October 2001 with -0.12. Like the previous run tests, time-periods the rolling cross-sectional regressions, for most part, show a higher market beta than oil beta indicating that oil companies are more sensitive to changes in the market than in the oil price.

Figure 5 shows the rolling regressions for the different sub-sectors. The strength of the fluctuations is somewhat different between the different sub-sectors. But the overall trend is that the pattern looks similar to our first stage regression run on all companies combined.

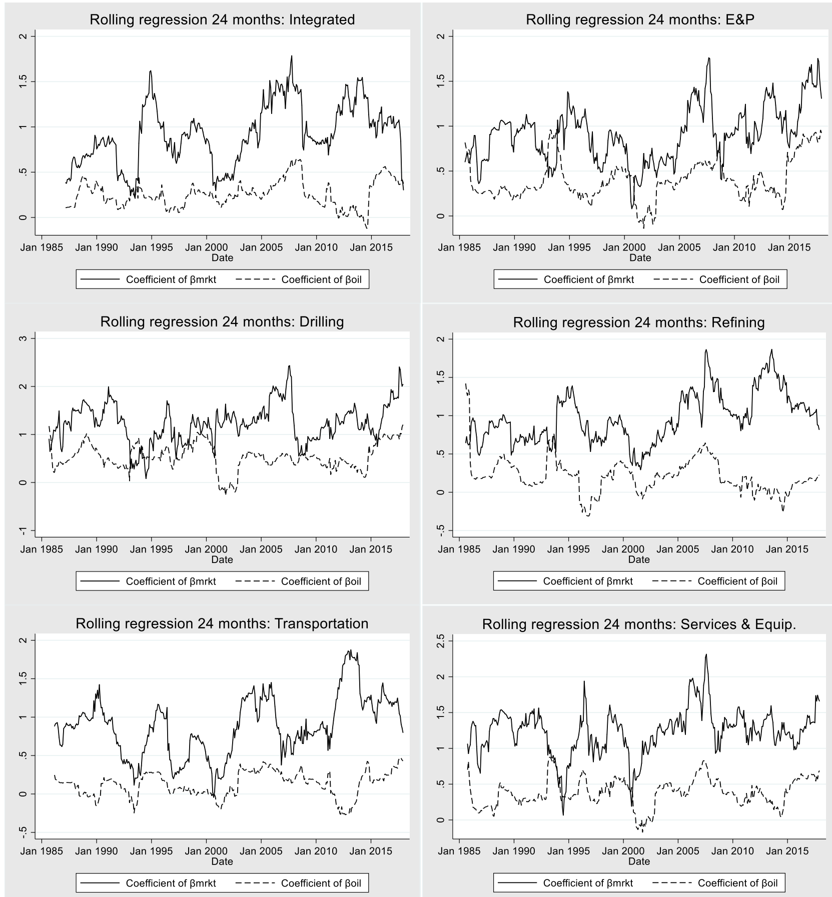

Figure 5: 24-month rolling cross-sectional regressions sub-sector analysis, $r_{it} = \alpha_i + \beta_1 MKT + \beta_{i5} \Delta Oil_t + \varepsilon_{it}$. Time period Apr 1983- Dec 2017. Windsorized at 1% and 99%.

Table 7 displays the results of step two in the Fama-Macbeth regressions. The results show us whether the average slope coefficient is statistically significant indicating the cross-sectional relationship between the independent variable excess return of oil and gas companies and the dependent variables market beta and oil beta in the average period.

We ran three models looking at the factors of interest. Model 1 consists of only the market beta, testing whether the CAPM relation holds in the sample period. As for model 2 the regression specification includes both the market beta and the oil beta. If significant, it indicates that a relation between excess return and the oil beta exist when controlling for the effects of the market beta. Finally, model 3 includes the oil price beta as the only beta, to see if the oil factor is significant when not controlling for the market factor.

	(Model 1) CAPM	(Model 2) CAPM+ βoil	(Model 3) βoil
βmrkt	**0.00153**	**-0.00101**	
	(0.00330)	(0.00297)	
P-value	0.643	0.733	
βoil		**0.00156**	**0.00146**
		(0.00703)	(0.00738)
P-value		0.825	0.843
intercept	**0.00787*** **	**0.00850*** **	**0.00922*** **
	(0.00295)	(0.00255)	(0.00282)
P-value	0.008	0.001	0.001
Obs. (Time periods)	394	394	394
R-squared	0.09713	0.19222	0.10907

Table 7: Fama-Macbeth regression
Before the Fama-Macbeth regression was run, rolling regression, $r_{it} = \alpha_i + \beta_1 MKT + \beta_2 \Delta Oil + \varepsilon_{it}$ with a 24-month window was performed and used as input on the subsequent Fama-Macbeth regression.
Fama-Macbeth regression, $r_t = \lambda_0 + \lambda_1 \beta_{MKT} + \lambda_2 \beta_{\Delta oil} + \varepsilon_{it}$. Period Apr 1983- Dec 2017. The period in months. All companies in the sample included. Windsorized at 1% and 99%. Standard errors Newey-West adjusted using five lags. Standard errors are in parenthesis, *** p<0.01, ** p<0.05, * p<0.1

Shown in the Fama-Macbeth regression the market beta measures the sensitivity of the excess return of oil and gas companies to the market and the coefficient indicates the premium of taking one unit of market beta risk. Similarly, the coefficient of the oil beta measures the premium of taking one unit of oil beta risk.

The coefficient for the market beta in model 1 is 0.00153 and are not significant at the 10 percent level. When adding the Oil beta in model 2, the market beta turns negative, with a coefficient of -0.00101, still being insignificant at a 10 percent level. The oil beta in model 2 has a coefficient of 0.00156 also insignificant at a 10 percent level. In model 3 the oil beta decreases to 0.00146, when not controlling for the market factor.

The results from the Fama-Macbeth regressions shows that adding βoil to the CAPM model adds explanatory power, and the R^2 rises from 9 to 19 percent. Both the market factor and the oil factor when included in model 2, shows high p-values, as does the oil factor when tested alone in model 3.

The intercept, alpha, is positive and significant for all three models. This indicates that the factors used here are not satisfactory to describe the return generating process of oil and gas companies. There is a large portion of excess stock return which is not explained by the factors market beta and oil beta.

Summing up, the estimated oil beta is not significant in any of the three models. Oil beta, therefore, does not appear to be a priced risk factor and thus do not provide any information about the expected return to oil and gas companies. This does not support the hypothesis that oil prices are a systematic risk factor for oil and gas companies listed on the NYSE.

The market risk premium does not seem to provide insight into determining the linear relationship between market beta and stock return. Neither does the linear relationship between the market risk premium and the oil price risk premium and the stock return for the U.S. oil and gas companies.

Our results are in line with Chen et al. (1986) and Næs et al. (2007). Chen et al. (1986) which examined whether oil price variations constitute a systematic risk factor for the stock market in general. Their analysis does not find that differences in companies' sensitivity to oil price changes give rise to return differences. And it does not seem that oil price risk is priced in the market. Næs et al. (2007) found similar results when examining the Norwegian stock market.

6. Conclusion

In this paper, the objective was to examine whether the oil price contributes to explain the return of U.S. oil and gas companies. This is done by first examining the oil and gas related companies' sensitivities to changes in the oil price, and secondly examining whether the oil price is a priced risk factor. This paper is adding to the previous literature about oil and gas companies' exposure to the oil price by investigating the sensitivities of U.S. oil and gas companies towards the oil price together with other known factors presented by Fama and French. This is done in an updated timeframe also including the period after the 2014 drop in the oil price. Further, this paper contributes to the literature by investigating whether the oil price is a priced risk factor determining if the oil price, in fact, is a systematic risk factor for the U.S. oil and gas companies.

The empirical findings suggest that when comparing the models by adding oil price to the CAPM and the Fama-French five factor model, the oil price is significant and adds explanatory power to both models. The significant results of the oil coefficient are also valid when testing the different subsectors, where all six subsectors show a significant exposure towards changes in the oil price. This result is also persistent when testing the different time periods. The Findings further confirms that all four factors added to the CAPM by Fama and French is significantly positive, a result in support of both literature and previous findings.

When testing the companies individually, we see that companies in some subsectors, more than others, show a significant exposure to the oil price, a finding consistent with the results from testing the different subsectors as an entity. The common denominator is that upstream companies is being more exposed to the oil price than companies involved in downstream operations. This suggests that companies directly involved with the extraction and production of oil and gas are the most exposed to changes in the oil price.

Concerning whether the oil beta is a priced risk factor, the results from the study of the sample period, April 1983 to December 2017, seems to show no signs of evidence that the oil beta is priced. The intercept is positive and significant, while the market beta and the oil beta show insignificant results. This result implies that the factors are not satisfactory to describe the return generating process of oil and gas companies and there is a large portion of excess stock return which is not explained by the market beta factor and the oil beta factor.

For further analysis we would recommend creating the Fama-French factors specifically for the companies in the oil and gas sector, adding these to the model to see if this has any significant effect on the Fama-Macbeth regression.

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Appendix 1 Newey-West (1987) adjusted standard error

Newey-West (1987)

- Number of lags. T= number months

When the values used in the time series displays autocorrelation or heteroscedasticity or both, this can cause the t-statistic and the p-value to be inaccurate (Bali et al., 2016). To adjust for this the methodology developed by Newey and West (1987) is used. Newey and West (1987) adjusts the standard errors of estimated values.

The number of lags that will be used is $4(\frac{T}{100})^{a}$.

$a = 2/9$ by using Bartlett kernel, and T is the number of periods in the time-series (Bali et al., 2016) .

In our case: T = 394 months.

Which gives us number of lags: $4(\frac{394}{100})^{2/9} = 5{,}43$. We will use five lags.

Appendix 2: Correlations different time periods and subsectors.

1983-2017

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) RetRF	1.000						
(2) MKT	0.356	1.000					
(3) SMB	0.170	0.237	1.000				
(4) HML	0.094	-0.103	-0.023	1.000			
(5) RMW	-0.136	-0.425	-0.447	0.280	1.000		
(6) CMA	-0.004	-0.292	0.004	0.632	0.204	1.000	
(7) Δ Oil	0.334	0.191	0.139	0.057	-0.164	-0.042	1.000

1983-1989

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) RetRF	1.000						
(2) MKT	0.401	1.000					
(3) SMB	0.139	0.177	1.000				
(4) HML	-0.120	-0.542	-0.328	1.000			
(5) RMW	-0.114	0.032	-0.180	-0.217	1.000		
(6) CMA	0.066	-0.450	-0.227	0.740	-0.251	1.000	
(7) Δ Oil	0.227	-0.080	-0.038	0.133	-0.067	0.425	1.000

1990-99

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) RetRF	1.000						
(2) MKT	0.268	1.000					
(3) SMB	0.115	0.130	1.000				
(4) HML	-0.013	-0.463	-0.233	1.000			
(5) RMW	-0.163	-0.265	-0.361	0.283	1.000		
(6) CMA	-0.076	-0.651	-0.245	0.773	0.231	1.000	
(7) Δ Oil	0.231	-0.117	0.025	-0.053	-0.304	0.017	1.000

2000-09

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) RetRF	1.000						
(2) MKT	0.379	1.000					
(3) SMB	0.112	0.216	1.000				
(4) HML	-0.039	-0.269	-0.212	1.000			
(5) RMW	-0.139	-0.586	-0.559	0.587	1.000		
(6) CMA	-0.129	-0.352	-0.020	0.588	0.304	1.000	
(7) Δ Oil	0.340	0.207	0.188	-0.086	-0.125	-0.215	1.000

2009-17

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) RetRF	1.000						
(2) MKT	0.401	1.000					
(3) SMB	0.251	0.395	1.000				
(4) HML	0.255	0.356	0.326	1.000			
(5) RMW	-0.184	-0.338	-0.407	-0.269	1.000		
(6) CMA	0.132	0.088	0.225	0.595	-0.040	1.000	
(7) Δ Oil	0.395	0.401	0.174	0.240	-0.230	0.054	1.000

All companies

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) RetRF	1.000						
(2) MKT	0.356	1.000					
(3) SMB	0.170	0.237	1.000				
(4) HML	0.094	-0.103	-0.023	1.000			
(5) RMW	-0.136	-0.425	-0.447	0.280	1.000		
(6) CMA	-0.004	-0.292	0.004	0.632	0.204	1.000	
(7) Δ Oil	0.334	0.191	0.139	0.057	-0.164	-0.042	1.000

Integrated

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) RetRF	1.000						
(2) MKT	0.429	1.000					
(3) SMB	0.112	0.245	1.000				
(4) HML	0.034	-0.084	-0.015	1.000			
(5) RMW	-0.148	-0.482	-0.443	0.321	1.000		
(6) CMA	-0.078	-0.273	0.013	0.631	0.247	1.000	
(7) Δ Oil	0.369	0.235	0.161	0.038	-0.156	-0.092	1.000

E&P

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) RetRF	1.000						
(2) MKT	0.309	1.000					
(3) SMB	0.155	0.235	1.000				
(4) HML	0.122	-0.107	-0.026	1.000			
(5) RMW	-0.100	-0.418	-0.449	0.278	1.000		
(6) CMA	0.008	-0.298	-0.000	0.635	0.204	1.000	
(7) Δ Oil	0.363	0.187	0.135	0.057	-0.168	-0.040	1.000

Drilling

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) RetRF	1.000						
(2) MKT	0.400	1.000					
(3) SMB	0.217	0.228	1.000				
(4) HML	0.072	-0.144	-0.065	1.000			
(5) RMW	-0.198	-0.408	-0.452	0.297	1.000		
(6) CMA	-0.004	-0.319	-0.022	0.645	0.206	1.000	
(7) Δ Oil	0.418	0.164	0.129	0.043	-0.167	-0.026	1.000

Refining

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) RetRF	1.000						
(2) MKT	0.346	1.000					
(3) SMB	0.116	0.227	1.000				
(4) HML	0.044	-0.142	-0.056	1.000			
(5) RMW	-0.116	-0.404	-0.445	0.289	1.000		
(6) CMA	-0.021	-0.320	-0.021	0.648	0.208	1.000	
(7) Δ Oil	0.218	0.157	0.121	0.054	-0.166	-0.010	1.000

O&G Transport

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) RetRF	1.000						
(2) MKT	0.360	1.000					
(3) SMB	0.166	0.266	1.000				
(4) HML	0.105	-0.028	0.068	1.000			
(5) RMW	-0.167	-0.412	-0.433	0.168	1.000		
(6) CMA	0.023	-0.224	0.052	0.604	0.136	1.000	
(7) Δ Oil	0.237	0.225	0.149	0.122	-0.161	-0.018	1.000

Services & Equip.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) RetRF	1.000						
(2) MKT	0.416	1.000					
(3) SMB	0.226	0.240	1.000				
(4) HML	0.100	-0.090	-0.018	1.000			
(5) RMW	-0.173	-0.447	-0.452	0.301	1.000		
(6) CMA	-0.010	-0.284	0.015	0.624	0.213	1.000	
(7) Δ Oil	0.355	0.208	0.151	0.040	-0.161	-0.073	1.000

Appendix 3. Fama-Macbeth regression full table

Fama-MacBeth (1973) Two-Step procedure

Newey-West corrected SE (lag length: 5)

Number of obs = 145
Num. time periods = 394
F(1, 393) = 0.22
Prob > F = 0.6431
avg. R-squared = 0.0971

RetRF	Fama-MacBeth Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
βmrkt	.0015296	.0032987	0.46	0.643	-.0049556	.0080148
_cons	.0078732	.0029545	2.66	0.008	.0020647	.0136817

Fama-MacBeth (1973) Two-Step procedure

Newey-West corrected SE (lag length: 5)

Number of obs = 145
Num. time periods = 394
F(2, 393) = 0.08
Prob > F = 0.9207
avg. R-squared = 0.1922

RetRF	Fama-MacBeth Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
βmrkt	-.0010127	.0029716	-0.34	0.733	-.0068549	.0048295
βoil	.0015584	.0070302	0.22	0.825	-.0122631	.0153798
_cons	.0084964	.0025542	3.33	0.001	.0034748	.0135181

Fama-MacBeth (1973) Two-Step procedure

Newey-West corrected SE (lag length: 5)

Number of obs = 145
Num. time periods = 394
F(1, 393) = 0.04
Prob > F = 0.8427
avg. R-squared = 0.1091

RetRF	Fama-MacBeth Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
βoil	.0014649	.007377	0.20	0.843	-.0130384	.0159683
_cons	.0092158	.0028222	3.27	0.001	.0036672	.0147643

Appendix 4. Regression per company and averages per industry

Table: Averages of regression per company for different subsectors

Industry:	***Ncomp***	***Nobs***	**intercept**	β_{MRKT}	β_{SMB}	β_{HML}	β_{RMW}	β_{CMA}	β_{OIL}	**adjR2**
Integrated Oil & Gas	10	2333	-0,00117	0,95386	0,08341	0,15397	0,50199	0,03509	0,32017	0,33457
Oil & Gas Drilling	14	3461	-0,00559	1,09497	0,58205	0,17979	0,35072	0,94588	0,61698	0,28305
Oil & Gas Exploration and Production	67	13348	0,00503	0,55284	0,54296	0,29001	0,36807	0,70238	0,64604	0,30211
Oil & Gas Refining and Marketing	23	5528	0,00364	1,05158	0,16864	0,18945	0,13990	0,24217	0,12562	0,21834
Oil & Gas Transportation Services	28	3764	0,00120	0,37370	0,51060	0,18154	-0,12485	0,37916	0,24688	0,20938
Oil Related Services and Equipment	42	7499	0,00502	0,54814	0,76288	0,05953	0,27792	0,97554	0,45793	0,28612

Table A1: Regression results, Oil & Gas Drilling companies

	DO	ESV	HP	HPR	ICD	JAG	NBR	NE	PDS
MKT	0.7903***	1.2761***	0.9943***	1.0534**	2.0567**	-0.1049	1.2090***	1.0625***	1.3500***
	(0.2044)	(0.2091)	(0.1191)	(0.4664)	(0.9699)	(3.7740)	(0.1690)	(0.2050)	(0.3567)
SMB	-0.1508	0.4995*	0.4475**	0.7791	1.6249	-0.8427	0.5187**	0.3572	1.0776**
	(0.2912)	(0.2953)	(0.1930)	(0.5644)	(1.4546)	(1.6744)	(0.2546)	(0.2923)	(0.5209)
HML	0.4865	-0.0666	0.3661	0.5470	-1.1920	-0.9806	0.5065	-0.1447	1.2490**
	(0.3075)	(0.3101)	(0.2244)	(0.6361)	(1.3303)	(3.3184)	(0.3377)	(0.3697)	(0.5572)
RMW	-0.2917	-0.0415	0.1711	1.1551	3.2141	-0.9927	-0.2081	0.1560	1.2531
	(0.3291)	(0.3575)	(0.2239)	(1.1203)	(1.9913)	(2.6045)	(0.2933)	(0.3580)	(0.7738)
CMA	0.0377	1.1503**	0.3434	0.0831	2.9545	1.9876	0.3671	0.4976	0.0210
	(0.3860)	(0.4881)	(0.3267)	(1.0427)	(2.4947)	(1.7160)	(0.4603)	(0.4447)	(0.8114)
Δ Oil	0.4198***	0.5171***	0.3880***	0.6313***	0.8011***	0.8654	0.5581***	0.5086***	0.5204***
	(0.1025)	(0.0919)	(0.0612)	(0.1569)	(0.2484)	(1.0373)	(0.0810)	(0.1014)	(0.1271)
Intercept	0.0022	-0.0013	0.0018	-0.0066	-0.0183	0.0168	0.0018	-0.0045	-0.0137
	(0.0068)	(0.0067)	(0.0043)	(0.0119)	(0.0264)	(0.0595)	(0.0065)	(0.0067)	(0.0100)
Obs.	267	417	417	157	41	12	396	262	146
R-squared	0.2712	0.2451	0.3290	0.2606	0.4489	0.3962	0.2861	0.3435	0.4751

Robust standard errors are in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Table A2: Regression results, Oil & Gas Drilling companies

	PES	PKD	RDC	RIG	SDRL
MKT	1.2201***	1.3737***	1.4758***	0.8489***	0.7237
	(0.3143)	(0.1437)	(0.1237)	(0.2270)	(0.5406)
SMB	1.2038***	0.8958***	0.4588**	-0.2404	1.5197
	(0.4416)	(0.2577)	(0.2247)	(0.3318)	(1.0323)
HML	0.0011	0.7460***	-0.1010	0.2167	0.8832
	(0.4902)	(0.2728)	(0.2409)	(0.3694)	(0.8120)
RMW	0.2935	0.3371	0.1480	-0.5401	0.2561
	(0.5712)	(0.3614)	(0.2468)	(0.3634)	(1.2017)
CMA	1.7178**	0.1964	0.9621***	0.3707	2.5530
	(0.7128)	(0.4500)	(0.3680)	(0.4527)	(1.6581)
Δ Oil	0.8696***	0.5789***	0.5255***	0.4722***	0.9816***
	(0.1246)	(0.0801)	(0.0603)	(0.0831)	(0.2367)
Intercept	-0.0027	-0.0110*	-0.0071	-0.0022	-0.0334*
	(0.0102)	(0.0058)	(0.0049)	(0.0067)	(0.0199)
Obs.	202	417	417	217	93
R-squared	0.4118	0.3587	0.4309	0.3409	0.3995

Robust standard errors are in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Table A3: Regression results, Oil & Gas Exploration and Production companies

	AAV	APA	APC	AR	BCEI	BTE	BXE	CEO
MKT	1.2026***	1.0035***	1.0362***	0.9388*	1.0605	0.9795***	1.0691*	0.7855***
	(0.3141)	(0.1352)	(0.1164)	(0.4782)	(1.0658)	(0.3682)	(0.6195)	(0.1383)
SMB	0.1606	0.1085	-0.1381	-1.4473**	-1.2909	0.4230	-1.1203	0.2894
	(0.4882)	(0.2001)	(0.1764)	(0.6491)	(1.3467)	(0.3974)	(0.8088)	(0.2319)
HML	0.2890	0.2919	0.1296	-0.0738	0.3289	0.2001	0.2118	-0.1418
	(0.5042)	(0.2341)	(0.2678)	(0.6285)	(1.8136)	(0.4606)	(0.9707)	(0.2476)
RMW	0.2640	0.4763**	0.3289	-1.0900	-7.9769***	1.3290*	-1.9942*	0.8364***
	(0.6477)	(0.2188)	(0.2156)	(0.8024)	(2.8508)	(0.7173)	(1.1705)	(0.2520)
CMA	0.2604	0.4860	0.5912	2.0412	3.6001	1.0598	2.5411**	-0.0913
	(0.7481)	(0.3726)	(0.3652)	(1.3084)	(2.6261)	(0.8311)	(1.2585)	(0.3915)
Δ Oil	0.3355**	0.4628***	0.4029***	0.4375**	1.1655**	0.8939***	0.5819***	0.4540***
	(0.1495)	(0.0528)	(0.0543)	(0.1680)	(0.4587)	(0.1241)	(0.1713)	(0.0729)
Intercept	-0.0089	-0.0020	-0.0011	-0.0165	-0.0126	-0.0067	-0.0346**	0.0075
	(0.0099)	(0.0044)	(0.0044)	(0.0149)	(0.0379)	(0.0099)	(0.0159)	(0.0059)
Obs.	145	417	375	51	73	142	64	203
R-squared	0.2948	0.3524	0.3304	0.3791	0.3150	0.4943	0.3022	0.3779

Table A4: Regression results, Oil & Gas Exploration and Production companies

	CHK	CLR	CNQ	COG	COP	CPE	CPG	CRC	CRK
MKT	0.9098***	0.7679**	1.0243***	0.9268***	0.9801***	1.1830***	0.9213	6.0602***	0.2482
	(0.3271)	(0.2939)	(0.1819)	(0.1593)	(0.0815)	(0.3642)	(0.5781)	(1.3008)	(0.4412)
SMB	0.6812	1.0646**	0.6843***	0.1576	-0.0570	0.7869**	0.0318	-0.2294	0.5533
	(0.5519)	(0.4253)	(0.2597)	(0.2136)	(0.1161)	(0.3904)	(0.5613)	(1.6302)	(0.4355)
HML	0.3488	0.5444	0.2694	0.1185	0.4355**	1.5390***	0.4520	1.4014	1.0811*
	(0.4657)	(0.5066)	(0.2584)	(0.2977)	(0.1698)	(0.5810)	(0.7007)	(1.9233)	(0.6451)
RMW	0.0510	0.7234	0.7013**	0.5961**	0.3924**	-0.7008	0.4046	-2.9216	-0.4419
	(0.6043)	(0.6086)	(0.3262)	(0.2466)	(0.1686)	(0.5419)	(0.9720)	(4.5279)	(0.6407)
CMA	0.9208	-1.1369	-0.8022**	0.3488	0.0877	-0.9150	1.1668	3.7083	0.2472
	(0.6328)	(0.7822)	(0.3638)	(0.4038)	(0.2214)	(0.8620)	(0.9618)	(3.7571)	(0.7718)
Δ Oil	0.6341***	0.7087***	0.5025***	0.3636***	0.2939***	0.5080***	0.6213***	1.3442***	0.5898***
	(0.1963)	(0.1343)	(0.0623)	(0.0753)	(0.0354)	(0.1170)	(0.1271)	(0.4485)	(0.1630)
Intercept	0.0020	0.0182*	0.0059	0.0033	0.0006	0.0100	-0.0197	-0.0054	0.0049
	(0.0108)	(0.0093)	(0.0054)	(0.0056)	(0.0030)	(0.0111)	(0.0147)	(0.0507)	(0.0140)
Obs.	273	128	179	335	417	237	48	38	253
R-squared	0.1918	0.5036	0.5623	0.2082	0.4099	0.3020	0.5175	0.6003	0.1354

Robust standard errors are in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Table A5: Regression results, Oil & Gas Exploration and Production companies

	CXO	DNR	DVN	ECA	ECR	EGN	EGY	EOG	EPE
MKT	0.6441***	1.1357***	0.9413***	0.6025***	2.0563**	0.7247***	0.6345	0.8342***	3.1792
	(0.2171)	(0.2826)	(0.1639)	(0.1867)	(0.9140)	(0.1026)	(0.4209)	(0.1610)	(2.0584)
SMB	0.6050*	0.9594***	0.1413	0.7376***	0.3777	0.3655**	1.2721*	0.0413	0.8456
	(0.3185)	(0.3313)	(0.1937)	(0.2821)	(1.0036)	(0.1536)	(0.6511)	(0.2154)	(1.3190)
HML	-0.6112	0.5753	0.6189**	0.4128	-2.6928*	0.5186**	0.7158	0.4242	1.5682
	(0.4180)	(0.4688)	(0.2777)	(0.2977)	(1.5529)	(0.2048)	(0.7263)	(0.2896)	(1.7193)
RMW	0.2471	0.9848**	0.3667	0.7362**	-4.1356	0.2890	1.0212	0.4659**	-0.3075
	(0.4429)	(0.4451)	(0.2853)	(0.3287)	(2.6224)	(0.1883)	(0.8800)	(0.2278)	(3.3914)
CMA	0.6280	0.2684	0.1517	0.0148	3.9517*	-0.0039	0.0062	0.1288	-0.1375
	(0.6940)	(0.5677)	(0.3732)	(0.3572)	(2.2899)	(0.2787)	(1.1545)	(0.3786)	(2.9834)
Δ Oil	0.5202***	0.7364***	0.4103***	0.5259***	1.3347***	0.2272***	0.1844	0.4043***	1.0400**
	(0.0915)	(0.1420)	(0.0634)	(0.0797)	(0.3246)	(0.0436)	(0.1785)	(0.0656)	(0.4487)
Intercept	0.0182**	-0.0059	0.0026	0.0009	-0.0132	0.0042	0.0156	0.0063	-0.0217
	(0.0074)	(0.0091)	(0.0053)	(0.0065)	(0.0331)	(0.0038)	(0.0144)	(0.0050)	(0.0307)
Obs.	125	248	351	197	43	417	267	339	48
R-squared	0.4518	0.3340	0.2795	0.4164	0.5442	0.2488	0.0496	0.2683	0.3333

Table A6: Regression results, Oil & Gas Exploration and Production companies

	EQT	ERF	ESTE	GPRK	HK	JONE	KOS	LPI	MPO
MKT	0.7138***	0.6823***	1.0382**	0.1512	1.7094***	1.7571	1.2179***	0.3955	0.6467
	(0.0908)	(0.1837)	(0.5082)	(0.9840)	(0.5374)	(1.4424)	(0.3080)	(0.6802)	(1.2251)
SMB	0.1660	0.2524	1.1092	-1.2833	0.5776	1.4297	0.7690	0.7585	1.1254
	(0.1285)	(0.2319)	(0.9295)	(1.2216)	(0.8324)	(1.5502)	(0.5293)	(0.7735)	(0.8509)
HML	-0.0691	0.4914	2.1497*	-0.5977	-0.6688	0.2286	0.2685	1.3455	-1.5156*
	(0.1743)	(0.3327)	(1.2710)	(1.9469)	(0.8780)	(1.9280)	(0.8276)	(1.0395)	(0.7295)
RMW	0.4401***	0.0499	0.1480	0.1974	3.6286***	-2.3905	0.4242	0.0438	3.3291
	(0.1645)	(0.3417)	(1.0033)	(1.9728)	(1.1493)	(2.4421)	(0.6770)	(1.6443)	(2.0066)
CMA	0.4576*	-0.0396	0.2802	1.9354	3.9100	3.6496	-0.2654	-0.2072	1.0530
	(0.2562)	(0.3961)	(1.5618)	(2.5955)	(2.4942)	(2.8361)	(1.0584)	(1.6731)	(1.7844)
Δ Oil	0.1364***	0.5034***	0.1940	0.6682**	0.9178***	0.9697**	0.4369***	1.0288***	1.2577*
	(0.0365)	(0.0820)	(0.1686)	(0.3157)	(0.1610)	(0.4321)	(0.1425)	(0.2343)	(0.5605)
Intercept	0.0021	0.0056	-0.0034	0.0250	-0.0312	-0.0079	-0.0152	0.0084	-0.0549
	(0.0034)	(0.0067)	(0.0151)	(0.0313)	(0.0207)	(0.0335)	(0.0103)	(0.0179)	(0.0330)
Obs.	417	206	84	47	140	54	80	73	15
R-squared	0.1815	0.3840	0.2821	0.1641	0.2045	0.3038	0.4267	0.4146	0.6464

Robust standard errors are in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Table A7: Regression results, Oil & Gas Exploration and Production companies

	MRO	MTDR	MTR	MUR	NBL	NFX	OAS	OBE	OXY
MKT	1.0524***	0.5198	0.4077***	1.0000***	1.0151***	0.9923***	0.6665	1.8381**	0.9078***
	(0.1043)	(0.5423)	(0.1076)	(0.0966)	(0.1432)	(0.1569)	(0.4412)	(0.8623)	(0.0861)
SMB	0.2441	1.4847**	-0.0089	0.2836**	0.0076	0.4527**	1.2014*	-0.6576	0.0779
	(0.1576)	(0.6349)	(0.1312)	(0.1428)	(0.2120)	(0.2294)	(0.6551)	(0.8858)	(0.1404)
HML	0.6493***	0.0591	0.3045	0.2828	0.0407	0.1848	1.6359***	-0.5097	0.6576***
	(0.2139)	(0.7320)	(0.2278)	(0.1859)	(0.2527)	(0.2941)	(0.6047)	(0.7753)	(0.1626)
RMW	0.2906	1.3406	0.0982	0.4243**	0.4036*	0.6313**	0.4555	1.7936**	0.4815***
	(0.2005)	(0.8866)	(0.1833)	(0.2062)	(0.2416)	(0.2872)	(0.7673)	(0.8890)	(0.1673)
CMA	0.0543	-0.6256	0.3341	0.5879**	0.6457*	0.0306	-0.7861	2.7552*	-0.0829
	(0.2969)	(1.1501)	(0.2919)	(0.2392)	(0.3544)	(0.4378)	(0.8872)	(1.5659)	(0.2313)
Δ Oil	0.3491***	0.6283***	0.2265***	0.4197***	0.4186***	0.4352***	1.0549***	0.7461***	0.2452***
	(0.0460)	(0.2101)	(0.0348)	(0.0436)	(0.0557)	(0.0795)	(0.1466)	(0.1548)	(0.0399)
Intercept	-0.0033	0.0199	-0.0013	-0.0045	-0.0020	0.0006	0.0042	-0.0198	-0.0009
	(0.0041)	(0.0142)	(0.0042)	(0.0037)	(0.0044)	(0.0057)	(0.0110)	(0.0136)	(0.0031)
Obs.	417	71	417	417	417	290	91	139	417
R-squared	0.3712	0.3180	0.1240	0.4178	0.3277	0.3215	0.6028	0.2588	0.3626

Table A8: Regression results, Oil & Gas Exploration and Production companies

	PE	PGH	PHX	PQ	PXD	REN	RRC	RSPP	SBOW
MKT	-0.2741	0.8608***	0.4341	0.9744***	1.1308***	0.0478	0.5463**	1.8072**	-20.9506
	(0.7965)	(0.3040)	(0.2828)	(0.3403)	(0.1758)	(0.8496)	(0.2651)	(0.7224)	(14.8182)
SMB	0.9239	0.4268	0.0382	0.4201	0.5017	0.6427	0.2464	0.7137	5.3274
	(0.6687)	(0.3537)	(0.4048)	(0.5084)	(0.3187)	(1.1766)	(0.4551)	(0.5763)	(5.4930)
HML	1.0996	0.3669	0.4808	1.4418**	0.6066**	0.9682	0.2604	0.1444	-1.9506
	(0.9410)	(0.4187)	(0.4462)	(0.5831)	(0.2916)	(1.0996)	(0.3750)	(0.5708)	(6.2671)
RMW	0.1318	0.3353	-0.1132	1.1770**	0.8697***	-0.8753	0.4950	-0.2069	9.6016
	(1.1334)	(0.5302)	(0.4612)	(0.5885)	(0.3269)	(1.7481)	(0.5140)	(0.8565)	(7.1665)
CMA	0.2523	0.4654	-0.1911	-0.4553	-0.0658	-1.5886	0.3153	1.6198*	3.6928
	(1.2142)	(0.5120)	(0.6448)	(0.7977)	(0.3880)	(1.9418)	(0.5526)	(0.9559)	(4.3218)
Δ Oil	0.2601	0.5822***	0.3320***	0.7128***	0.5199***	0.5587	0.6085***	0.2967*	3.2228
	(0.2615)	(0.0995)	(0.1103)	(0.1539)	(0.1007)	(0.4464)	(0.1704)	(0.1694)	(1.5664)
Intercept	0.0225	-0.0141*	0.0121	-0.0133	0.0007	0.0256	0.0041	0.0139	0.2792
	(0.0144)	(0.0082)	(0.0096)	(0.0121)	(0.0066)	(0.0271)	(0.0095)	(0.0124)	(0.1969)
Obs.	44	189	213	194	245	123	255	48	8
R-squared	0.2601	0.3300	0.1195	0.2853	0.3859	0.0940	0.1862	0.4553	0.9074

Robust standard errors are in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Table A9: Regression results, Oil & Gas Exploration and Production companies

	SD	SGY	SM	SN	SWN	TGS	TPL	UNT	VET
MKT	-6.1996***	1.5230***	1.1784***	0.5682	0.6885***	1.0602***	0.6213***	1.2862***	0.3123
	(1.4627)	(0.2712)	(0.2495)	(0.7338)	(0.1636)	(0.2529)	(0.1092)	(0.2064)	(0.2242)
SMB	0.3530	0.4395	0.8212***	1.6219*	0.6999***	-0.1612	0.3474**	0.6980**	0.2877
	(1.0172)	(0.3250)	(0.2591)	(0.8369)	(0.2190)	(0.2623)	(0.1420)	(0.2807)	(0.3525)
HML	-1.1926	0.7136	0.5500	0.4810	0.3750	-0.3818	0.2378	0.7102*	0.8589*
	(0.7970)	(0.5293)	(0.3978)	(1.1836)	(0.3175)	(0.4832)	(0.2181)	(0.3733)	(0.4634)
RMW	2.1278	0.5946	0.4539	0.0465	0.6898**	-0.1528	0.1267	0.2151	0.4658
	(1.2986)	(0.4370)	(0.3894)	(1.6052)	(0.3133)	(0.4139)	(0.1923)	(0.3656)	(0.5372)
CMA	4.1152**	0.4754	0.1019	0.5077	0.2210	0.5367	-0.4432	0.1795	0.7141
	(1.4958)	(0.6683)	(0.5072)	(1.6089)	(0.3993)	(0.6191)	(0.2834)	(0.5344)	(0.5764)
Δ Oil	1.7223***	0.6474***	0.5217***	1.0526***	0.3122***	-0.0143	0.1597***	0.5665***	0.4638***
	(0.5123)	(0.1374)	(0.1064)	(0.2448)	(0.0775)	(0.1018)	(0.0486)	(0.0862)	(0.1154)
Intercept	0.0914**	-0.0118	0.0026	0.0022	0.0011	0.0088	0.0086*	0.0031	0.0037
	(0.0287)	(0.0094)	(0.0071)	(0.0229)	(0.0059)	(0.0083)	(0.0045)	(0.0068)	(0.0065)
Obs.	15	294	301	73	417	278	417	375	58
R-squared	0.8141	0.2761	0.2831	0.3319	0.1610	0.1131	0.1507	0.3024	0.6216

Table A10: Regression results, Oil & Gas Exploration and Production companies

	WLL	WPX	WRD	WTI	XEC
MKT	1.1641***	1.4024**	-1.6571	1.0136***	0.9405***
	(0.3899)	(0.6440)	(6.3832)	(0.3283)	(0.2363)
SMB	0.9100**	1.1540	3.3275	2.1555***	0.4893
	(0.3871)	(0.7120)	(2.3921)	(0.6020)	(0.3166)
HML	0.9626**	1.9105*	-4.1561	0.2652	0.7852**
	(0.4393)	(0.9874)	(2.8433)	(0.6348)	(0.3575)
RMW	0.7722	0.6384	2.6285	1.4306**	0.7732**
	(0.8941)	(1.5428)	(4.2683)	(0.7173)	(0.3687)
CMA	-0.3732	-0.6203	5.1585	0.1316	-0.4996
	(0.8121)	(1.3918)	(3.4164)	(0.9831)	(0.5167)
Δ Oil	0.8923***	0.7880***	1.7137	0.6460***	0.3994***
	(0.1360)	(0.2164)	(1.3292)	(0.1320)	(0.0751)
Intercept	-0.0030	-0.0041	0.0362	-0.0105	0.0048
	(0.0094)	(0.0154)	(0.0732)	(0.0116)	(0.0066)
Obs.	170	73	13	156	184
R-squared	0.5060	0.4408	0.6146	0.3855	0.4082

Robust standard errors are in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Table A11: Regression results Integrated Oil & Gas companies

	E	EC	PBR	PTR	PZE	QEP	RDS	STO	TOT	YPF
MKT	0.8940***	0.6126***	1.4475***	0.9970***	0.9019***	1.2528***	0.9146***	0.7777***	0.7226***	1.0180***
	(0.1016)	(0.2169)	(0.2785)	(0.1537)	(0.1991)	(0.3886)	(0.0675)	(0.1357)	(0.0948)	(0.1884)
SMB	0.1409	-0.2002	-0.2519	-0.1989	0.5374*	1.0183**	-0.2428***	-0.0201	-0.0907	0.1422
	(0.1279)	(0.3293)	(0.3943)	(0.2601)	(0.3107)	(0.4968)	(0.0797)	(0.1725)	(0.1124)	(0.2044)
HML	-0.0990	0.3035	0.2093	0.1998	-0.3876	1.4899**	-0.0658	-0.1605	-0.0211	0.0712
	(0.1584)	(0.3448)	(0.4148)	(0.2874)	(0.3533)	(0.6016)	(0.1199)	(0.1995)	(0.1422)	(0.3250)
RMW	0.7067***	1.2983***	0.4914	0.5285*	0.4117	0.7741	0.2828***	0.3411	0.1837	0.0016
	(0.1841)	(0.4782)	(0.4190)	(0.2906)	(0.3061)	(0.9435)	(0.0996)	(0.2086)	(0.1465)	(0.3109)
CMA	0.4205*	0.3984	-0.3746	-0.3946	-0.3650	-0.6679	0.6225***	0.1117	0.1624	0.4375
	(0.2328)	(0.7161)	(0.4916)	(0.3720)	(0.4277)	(0.8731)	(0.1873)	(0.2697)	(0.1864)	(0.4263)
Δ Oil	0.2465***	0.4589***	0.4987***	0.3569***	0.1688*	0.3849***	0.2141***	0.4652***	0.2462***	0.1616**
	(0.0421)	(0.1121)	(0.1239)	(0.0779)	(0.0914)	(0.1352)	(0.0309)	(0.0572)	(0.0415)	(0.0682)
Intercept	-0.0028	-0.0035	0.0031	0.0062	-0.0000	-0.0188*	-0.0010	0.0029	0.0025	-0.0003
	(0.0035)	(0.0076)	(0.0091)	(0.0064)	(0.0080)	(0.0100)	(0.0024)	(0.0044)	(0.0032)	(0.0065)
Obs.	266	112	209	213	216	91	417	199	315	295
R-squared	0.3947	0.3742	0.3366	0.3119	0.1704	0.4467	0.4736	0.5217	0.3452	0.1762

Robust standard errors are in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Table A12: Regression results, Oil & Gas Refining and Marketing companies

	ANDV	ANW	BP	CVE	CVI	CVX	CZZ	DK
MKT	1.2707***	1.3577***	1.1031***	0.4396**	1.2500***	0.8395***	1.6123***	1.1667***
	(0.1656)	(0.3837)	(0.1931)	(0.1807)	(0.3233)	(0.0701)	(0.3486)	(0.3753)
SMB	0.4370	0.3113	-0.4564	0.2966	0.3187	-0.2215**	-0.0460	0.0964
	(0.2876)	(0.7263)	(0.3260)	(0.3572)	(0.3800)	(0.0978)	(0.6313)	(0.4522)
HML	0.2004	0.0453	-0.2896	1.3067***	0.0851	0.1739	-0.0252	-0.2868
	(0.3937)	(0.7597)	(0.3197)	(0.4236)	(0.7733)	(0.1481)	(0.7126)	(0.8855)
RMW	-0.1356	-2.2898**	0.1404	-0.1108	0.7234	0.3041**	0.8307	-0.7452
	(0.4260)	(1.0278)	(0.2530)	(0.5174)	(0.5524)	(0.1312)	(0.7816)	(0.9670)
CMA	0.8374	-1.3276	1.2965	-0.0658	0.0612	0.4010**	0.2816	0.4022
	(0.5311)	(1.5561)	(0.8084)	(0.5644)	(0.8613)	(0.2016)	(1.1704)	(1.2581)
Δ Oil	0.1341*	-0.0692	0.1914**	0.3231***	0.1687	0.2105***	0.4256***	0.0987
	(0.0753)	(0.1934)	(0.0916)	(0.0861)	(0.1268)	(0.0288)	(0.1524)	(0.1217)
Intercept	0.0037	0.0025	0.0010	-0.0079	0.0098	-0.0002	-0.0014	0.0137
	(0.0069)	(0.0162)	(0.0067)	(0.0076)	(0.0107)	(0.0024)	(0.0119)	(0.0126)
Obs.	417	133	417	98	172	417	125	140
R-squared	0.1737	0.2128	0.0907	0.4398	0.1584	0.4300	0.3619	0.1694

Table A13: Regression results, Oil & Gas Refining and Marketing companies

	HES	HFC	INT	MPC	MUSA	PARR	PBF	PSX	SHI
MKT	0.9687***	0.7320***	0.8874***	2.0566***	0.8904***	-0.1795	1.6127***	1.2851***	1.2617***
	(0.0983)	(0.1313)	(0.1518)	(0.2613)	(0.2613)	(0.6562)	(0.4140)	(0.2444)	(0.2241)
SMB	0.1595	0.8619***	0.8300***	-0.2295	0.2465	0.6475	0.1267	-0.2187	0.2810
	(0.1463)	(0.2090)	(0.2322)	(0.4688)	(0.3830)	(0.8867)	(0.7098)	(0.3602)	(0.3488)
HML	0.3418	-0.0687	-0.3059	0.9613**	-0.7834	0.3369	1.5360*	0.5179	0.2586
	(0.2142)	(0.2990)	(0.5629)	(0.4588)	(0.4798)	(0.7827)	(0.7760)	(0.3362)	(0.4286)
RMW	0.5101***	0.5299**	0.5853	-0.4707	0.6642	-0.4578	0.7351	0.0909	0.6846
	(0.1759)	(0.2524)	(0.3710)	(0.5899)	(0.6354)	(1.1172)	(1.0987)	(0.4629)	(0.4627)
CMA	0.4320	0.6872*	0.4670	-0.5894	1.0695	0.1518	-0.1322	0.5493	-0.0739
	(0.2822)	(0.4161)	(0.6755)	(0.8264)	(1.0102)	(1.4048)	(1.2400)	(0.5440)	(0.5472)
Δ Oil	0.4106***	0.1096*	-0.0254	-0.1055	-0.2066*	-0.0663	-0.3961*	0.0612	0.1764
	(0.0398)	(0.0661)	(0.0767)	(0.0988)	(0.1053)	(0.1330)	(0.2034)	(0.0901)	(0.1140)
Intercept	-0.0043	0.0117**	0.0064	0.0014	0.0048	0.0070	-0.0067	0.0057	0.0029
	(0.0035)	(0.0057)	(0.0066)	(0.0091)	(0.0091)	(0.0177)	(0.0142)	(0.0072)	(0.0085)
Obs.	417	417	367	79	53	42	61	69	294
R-squared	0.3938	0.1132	0.1263	0.4781	0.2193	0.0736	0.2262	0.3760	0.1310

Robust standard errors are in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Table A14: Regression results, Oil & Gas Refining and Marketing companies

	SNP	SSL	SU	UGP	VLO	XOM
MKT	0.9462***	0.7901***	1.0345***	1.0708***	1.1195***	0.6708***
	(0.1834)	(0.1292)	(0.1629)	(0.1563)	(0.2054)	(0.0530)
SMB	0.1088	0.0669	0.1549	0.1671	0.1463	-0.2061***
	(0.2787)	(0.1762)	(0.1751)	(0.2175)	(0.2938)	(0.0772)
HML	0.0372	0.0851	0.6234**	-0.4605	0.0730	-0.0050
	(0.2864)	(0.2204)	(0.2634)	(0.2895)	(0.3559)	(0.1115)
RMW	0.4644	0.0303	0.4359	0.3215	0.1707	0.2062**
	(0.2971)	(0.2437)	(0.2893)	(0.2560)	(0.3499)	(0.0915)
CMA	-0.1982	0.4302	-0.1471	0.1735	0.3396	0.5240***
	(0.3640)	(0.3491)	(0.3455)	(0.4378)	(0.5082)	(0.1418)
Δ Oil	0.2227***	0.4403***	0.3705***	0.0818	0.2241**	0.1092***
	(0.0649)	(0.0554)	(0.0608)	(0.0641)	(0.0931)	(0.0210)
Intercept	0.0077	0.0038	0.0001	0.0101	0.0104	0.0014
	(0.0062)	(0.0048)	(0.0057)	(0.0061)	(0.0070)	(0.0019)
Obs.	207	417	305	219	245	417
R-squared	0.2425	0.2698	0.3163	0.2454	0.2281	0.3568

Robust standard errors are in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Table A15: Regression results, OIL & GAS Transportation companies

	ASC	DHT	EEQ	ENB	EURN	FRO	GLOG	GNRT
MKT	1.2544**	0.8085***	0.5400***	0.5498***	0.5542	1.1868***	0.8719*	0.7584
	(0.4944)	(0.2758)	(0.1788)	(0.0999)	(0.3839)	(0.3473)	(0.4888)	(0.6400)
SMB	-0.6997	-0.1676	0.3388	0.0010	-1.1085*	0.6750	1.0358	0.2750
	(0.6995)	(0.4647)	(0.2277)	(0.1607)	(0.5473)	(0.5395)	(0.7554)	(0.9419)
HML	1.4682	-0.6766	-0.1072	-0.0126	0.8997	-0.1032	-0.2193	-2.3138*
	(1.1060)	(0.4927)	(0.4042)	(0.1832)	(0.5776)	(0.5781)	(0.9420)	(1.1257)
RMW	-1.4713*	-1.0861	0.3174	0.4101*	-0.6777	-0.9855	-1.1146	-1.6333
	(0.8611)	(0.7817)	(0.3079)	(0.2119)	(0.8546)	(0.6392)	(1.2726)	(1.1536)
CMA	-1.5837	0.1641	0.3333	0.5884**	-1.6201	0.3409	1.5049	1.0460
	(1.3961)	(0.9177)	(0.4546)	(0.2877)	(1.0336)	(0.8269)	(1.2685)	(2.2544)
Δ Oil	-0.0702	0.0754	0.2162***	0.1457***	0.1949	0.1626	0.5482***	0.6316**
	(0.2084)	(0.1220)	(0.0580)	(0.0521)	(0.1238)	(0.1942)	(0.1808)	(0.2655)
Intercept	-0.0163	-0.0118	0.0003	0.0070*	-0.0070	0.0056	0.0150	-0.0063
	(0.0153)	(0.0103)	(0.0053)	(0.0039)	(0.0132)	(0.0128)	(0.0155)	(0.0259)
Obs.	53	147	183	195	36	197	69	31
R-squared	0.2101	0.1188	0.2272	0.2463	0.3713	0.1751	0.3591	0.2845

Table A16: Regression results, OIL & GAS Transportation companies

	INSW	KMI	LPG	NAT	NVGS	OKE	OSG	PAGP
MKT	9.1614*	0.6106**	0.9853	0.5222***	1.0456**	0.9233***	2.5822	1.2969*
	(4.2218)	(0.2316)	(0.7446)	(0.1491)	(0.4625)	(0.1048)	(2.7759)	(0.6462)
SMB	-1.0573	0.3996	0.6153	0.5462**	-0.2615	0.0010	-0.8049	0.1504
	(2.5557)	(0.4315)	(0.8737)	(0.2354)	(0.8124)	(0.1627)	(2.3039)	(0.6319)
HML	1.2270	-0.1611	0.0808	0.3472	0.0766	0.3597*	0.2866	-0.5666
	(2.9379)	(0.4957)	(1.1929)	(0.2720)	(1.3665)	(0.1946)	(2.0892)	(0.6913)
RMW	-3.7152	0.4703	-1.5411	0.0837	-0.4220	0.4249**	0.3938	-0.7098
	(4.3867)	(0.6062)	(1.1588)	(0.2791)	(1.2868)	(0.1844)	(3.6483)	(0.8967)
CMA	4.8246	1.4546**	0.1466	0.0310	1.8632	0.4241	1.6919	1.5688
	(3.8056)	(0.7078)	(1.7212)	(0.4082)	(1.7359)	(0.3082)	(3.1471)	(1.2456)
Δ Oil	-1.7715	0.0750	0.1868	0.0559	0.2521	0.1511***	0.2700	0.3892**
	(1.0986)	(0.0882)	(0.1569)	(0.0613)	(0.1787)	(0.0474)	(0.7771)	(0.1549)
Intercept	-0.0349	-0.0063	-0.0137	-0.0017	-0.0072	0.0025	-0.0676*	-0.0115
	(0.0753)	(0.0086)	(0.0204)	(0.0064)	(0.0220)	(0.0040)	(0.0339)	(0.0147)
Obs.	14	83	44	244	50	417	25	51
R-squared	0.7015	0.1772	0.1842	0.1069	0.1264	0.2184	0.1396	0.3734

Robust standard errors are in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Table A17: Regression results, OIL & GAS Transportation companies

	PBA	SEMG	SFL	SMHI	STNG	TEGP	TK	TNK
MKT	0.4254*	1.0890**	0.9814***	-24.7937	1.4322***	1.6841**	0.8532***	1.4455***
	(0.2296)	(0.4295)	(0.2146)	(0.0000)	(0.2960)	(0.6446)	(0.1881)	(0.2733)
SMB	0.0906	0.2430	0.4685	11.3419	0.7904**	-0.2335	0.1605	1.1745***
	(0.3232)	(0.4704)	(0.3577)	(0.0000)	(0.3974)	(0.7948)	(0.2722)	(0.4351)
HML	-0.1284	-0.3859	0.3485	4.3073	0.5859	-0.5385	0.3888	-0.5735
	(0.4350)	(0.5715)	(0.4151)	(0.0000)	(0.5906)	(0.9459)	(0.3129)	(0.4559)
RMW	0.3146	-0.9873	-0.0342	11.1483	-0.6846	-0.8951	-0.3115	-0.3148
	(0.3774)	(0.8672)	(0.4760)	(0.0000)	(0.7476)	(1.1142)	(0.3741)	(0.6545)
CMA	1.2190**	1.4066	-0.6451	-5.6760	-1.7013*	1.2741	0.6877*	-0.8762
	(0.5179)	(0.9793)	(0.6991)	(0.0000)	(0.9332)	(1.6331)	(0.4138)	(0.9233)
Δ Oil	0.4048***	0.4976***	0.2060**	2.7199	-0.1676	0.5319**	0.2732***	-0.1133
	(0.1014)	(0.1535)	(0.1012)	(0.0000)	(0.1069)	(0.2330)	(0.0788)	(0.1368)
Intercept	0.0076	0.0022	0.0070	0.2116	-0.0219**	-0.0096	-0.0015	-0.0213**
	(0.0057)	(0.0126)	(0.0071)	(0.0000)	(0.0102)	(0.0190)	(0.0069)	(0.0107)
Obs.	69	86	163	7	93	32	270	121
R-squared	0.4555	0.4154	0.3379	1.0000	0.3501	0.4381	0.2118	0.3180

Table A18: Regression results, OIL & GAS Transportation companies

	TNP	TRGP	TRP	WMB
MKT	0.7289***	1.0647**	0.6373***	1.2640***
	(0.2146)	(0.4358)	(0.0670)	(0.1428)
SMB	0.0934	0.2379	0.0473	-0.0565
	(0.3423)	(0.5133)	(0.1076)	(0.2222)
HML	0.2521	-0.2715	0.1645	0.3485
	(0.3826)	(0.5571)	(0.1294)	(0.2999)
RMW	-0.4216	0.1238	0.5669***	-0.7442*
	(0.5176)	(0.8897)	(0.1252)	(0.3943)
CMA	-0.9602	2.0486**	0.5945***	0.4664
	(0.6475)	(0.9498)	(0.1788)	(0.5581)
Δ Oil	0.2286**	0.5703***	0.0902**	0.1582**
	(0.0941)	(0.1584)	(0.0370)	(0.0615)
Intercept	0.0020	0.0096	-0.0027	0.0045
	(0.0084)	(0.0136)	(0.0028)	(0.0051)
Obs.	190	85	392	417
R-squared	0.1729	0.4334	0.2311	0.2883

Robust standard errors are in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Table A19: Regression results, Oil Related Services and Equipment companies

	AMGP	AROC	BAS	BHGE	BRS	CGG	CIR	CJ
MKT	-7.3993	1.2549***	8.4597	1.1707***	1.1405***	1.7273***	1.2210***	17.1940
	(9.1416)	(0.4076)	(6.6296)	(0.1340)	(0.2944)	(0.2592)	(0.1677)	(14.3422)
SMB	3.1513	0.7890	4.2339	0.1659	0.9367*	0.5406	0.7963**	-1.1902
	(3.3888)	(0.5064)	(2.2605)	(0.1969)	(0.5026)	(0.3539)	(0.3089)	(3.1276)
HML	-2.0528	-0.0418	-3.9896	0.0391	0.5593	0.2535	0.3494	-3.8457
	(3.8663)	(0.5933)	(2.8997)	(0.2728)	(0.4644)	(0.4781)	(0.3467)	(8.0683)
RMW	2.3550	-0.2199	1.5756	0.2806	0.9257	0.4162	0.1458	-4.6877
	(4.4211)	(1.0688)	(3.1182)	(0.2677)	(0.8416)	(0.4235)	(0.2878)	(7.8023)
CMA	2.1953	1.1458	4.9152	0.8904***	0.2861	0.9101	0.6065	5.9890
	(2.6662)	(1.0039)	(2.8402)	(0.3361)	(0.8550)	(0.5875)	(0.4464)	(3.4717)
Δ Oil	1.2773	0.4511***	1.2109	0.3344***	0.3482***	0.2596**	0.0952	-0.7997
	(0.9664)	(0.1529)	(1.4660)	(0.0561)	(0.1078)	(0.1187)	(0.0810)	(1.3734)
Intercept	0.0924	-0.0073	-0.1485*	-0.0042	-0.0066	-0.0231**	-0.0007	-0.2024
	(0.1215)	(0.0115)	(0.0746)	(0.0050)	(0.0085)	(0.0095)	(0.0061)	(0.1705)
Obs.	8	125	13	369	168	248	219	10
R-squared	0.8703	0.3163	0.7336	0.3222	0.2956	0.2506	0.3541	0.6489

Table A20: Regression results, Oil Related Services and Equipment companies

	CKH	CLB	CRR	DRQ	EXTN	FET	FI	FMSA	FRAC
MKT	0.9129***	1.1289***	0.8456***	1.3166***	0.9478	0.7924**	0.7979*	1.1040	-5.2632
	(0.1555)	(0.2319)	(0.2980)	(0.2337)	(1.0132)	(0.3373)	(0.4695)	(0.9030)	(5.2908)
SMB	0.5704**	0.1887	1.3821***	-0.0561	-0.1131	1.2325**	0.4024	0.5668	0.2073
	(0.2378)	(0.3276)	(0.4284)	(0.4297)	(1.1296)	(0.4896)	(0.5362)	(1.3260)	(3.4870)
HML	0.2281	-0.2916	-0.6922	0.3434	1.2641	0.2560	-0.4895	-1.0491	0.5278
	(0.2534)	(0.3451)	(0.4496)	(0.4077)	(1.0589)	(0.5917)	(0.6636)	(1.7829)	(5.4470)
RMW	0.7138**	0.5464	1.1488**	-0.1066	-0.3229	0.0392	-0.7013	-3.3922	0.1056
	(0.2775)	(0.3521)	(0.5066)	(0.4561)	(1.9183)	(0.8021)	(0.9177)	(2.2272)	(3.1807)
CMA	-0.0404	0.6757	0.7900	-0.0297	0.6043	2.0466**	2.7132**	4.0307	5.7927**
	(0.3278)	(0.5155)	(0.5974)	(0.5887)	(1.4763)	(0.8026)	(1.1383)	(2.8374)	(1.9360)
Δ Oil	0.2397***	0.3303***	0.3748***	0.4538***	0.0440	0.6928***	0.3689**	1.3594***	1.3490
	(0.0738)	(0.0908)	(0.1311)	(0.1312)	(0.3186)	(0.1268)	(0.1435)	(0.2920)	(1.7020)
Intercept	-0.0045	0.0039	-0.0051	0.0047	0.0140	0.0004	-0.0137	0.0217	0.1292
	(0.0053)	(0.0070)	(0.0098)	(0.0083)	(0.0247)	(0.0104)	(0.0136)	(0.0351)	(0.0753)
Obs.	255	234	212	243	27	69	53	39	12
R-squared	0.3080	0.2386	0.1803	0.3139	0.2080	0.5448	0.3321	0.5018	0.6314

Robust standard errors are in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Table A21: Regression results, Oil Related Services and Equipment companies

	FTI	FTK	GLF	HAL	HLX	IO	KEG	MDR	NGS
MKT	-2.7457**	1.3068**	1.0771***	1.2598***	1.5720***	2.3076***	4.2490	1.2229***	0.6706**
	(0.8234)	(0.5193)	(0.2877)	(0.1057)	(0.3191)	(0.3664)	(4.3094)	(0.1596)	(0.2743)
SMB	0.6817	1.3240	0.7759*	-0.0622	1.3597***	1.2965***	-3.3399	0.7716***	0.9240**
	(0.7948)	(0.9964)	(0.3954)	(0.1852)	(0.4177)	(0.3021)	(3.0558)	(0.2530)	(0.4147)
HML	-0.4401	-1.2265	0.6915	-0.0191	1.2039***	1.2542***	5.6568*	1.0910***	0.6835
	(0.8848)	(0.8931)	(0.5071)	(0.2245)	(0.4610)	(0.4623)	(2.8119)	(0.3785)	(0.4356)
RMW	1.3465	-0.7476	1.0756*	-0.0276	0.2616	0.5167	1.0649	0.0249	0.2652
	(0.8720)	(1.1910)	(0.5512)	(0.2643)	(0.5684)	(0.5801)	(4.1234)	(0.3408)	(0.5463)
CMA	2.2524**	0.4364	0.6472	0.6637*	-1.7095**	0.2428	8.2695**	-0.3611	-0.6751
	(0.6406)	(1.6266)	(0.6408)	(0.3725)	(0.6688)	(0.7219)	(2.6455)	(0.5942)	(0.6673)
Δ Oil	1.0971***	0.6096***	0.4927***	0.3714***	0.5226***	0.3039**	-1.4199	0.3783***	0.4673***
	(0.1953)	(0.2127)	(0.0981)	(0.0466)	(0.1114)	(0.1189)	(1.0067)	(0.0719)	(0.1136)
Intercept	0.0363**	0.0119	-0.0234**	-0.0021	-0.0051	-0.0117	-0.0110	0.0014	0.0110
	(0.0099)	(0.0170)	(0.0105)	(0.0041)	(0.0086)	(0.0108)	(0.0640)	(0.0067)	(0.0108)
Obs.	12	150	186	417	194	278	13	417	183
R-squared	0.9314	0.2365	0.2883	0.3812	0.5170	0.2910	0.6717	0.2592	0.2539

Table A22: Regression results, Oil Related Services and Equipment companies

	NOA	NOV	NR	OII	OIS	PUMP	RES	RNGR	SLB
MKT	0.9250**	1.2798***	1.2241***	0.9730***	1.2486***	9.3963	1.1855***		1.0840***
	(0.3744)	(0.2488)	(0.2575)	(0.1590)	(0.2301)	(6.4838)	(0.1767)		(0.0812)
SMB	-0.0662	0.5062*	1.0513***	0.4834*	0.6112	1.4732	0.6199**	-0.3579	-0.0070
	(0.5838)	(0.3052)	(0.3440)	(0.2584)	(0.4289)	(1.7907)	(0.2517)	(0.0000)	(0.1386)
HML	1.5089**	-0.2118	0.0720	0.0724	-0.1490	2.7699	0.5162*		0.0231
	(0.6532)	(0.3125)	(0.4309)	(0.3299)	(0.4064)	(3.8489)	(0.2999)		(0.1576)
RMW	0.0438	0.5030	0.1166	0.1309	0.4423	3.1510	0.3325	-5.7392	-0.1771
	(0.7853)	(0.3887)	(0.4764)	(0.3258)	(0.3369)	(3.6975)	(0.3127)	(0.0000)	(0.1775)
CMA	-0.9395	0.2928	1.3839**	0.9179*	0.8161	1.9497	0.4869	3.1848	0.4049*
	(1.0998)	(0.4766)	(0.6842)	(0.5338)	(0.5111)	(1.4382)	(0.4572)	(0.0000)	(0.2413)
Δ Oil	0.7579***	0.5830***	0.3227***	0.5293***	0.5405***	-0.6741	0.0981	-1.1620	0.2954***
	(0.1986)	(0.0842)	(0.0910)	(0.0842)	(0.0857)	(0.6743)	(0.0618)	(0.0000)	(0.0413)
Intercept	0.0021	0.0030	-0.0033	0.0027	0.0043	-0.0609	0.0066	0.0203	-0.0013
	(0.0134)	(0.0068)	(0.0081)	(0.0065)	(0.0070)	(0.0747)	(0.0060)	(0.0000)	(0.0032)
Obs.	134	255	265	313	203	10	402	5	417
R-squared	0.4021	0.4211	0.2739	0.3250	0.4400	0.9118	0.1859	1.0000	0.4448

Robust standard errors are in parenthesis *** p<0.01, ** p<0.05, * p<0.1

Table A23: Regression results, Oil Related Services and Equipment companies

	SOI	SPN	TDW	TS	TTI	WFT	WTTR
MKT	-23.6952	1.3120***	1.3768***	1.0934***	1.5034***	1.6045***	-10.2899
	(10.6747)	(0.2540)	(0.1413)	(0.2014)	(0.3259)	(0.2193)	(9.6282)
SMB	5.2203	1.0468**	0.5045**	0.7508**	1.2361***	0.4853	3.5632
	(3.9570)	(0.4750)	(0.2322)	(0.3432)	(0.3757)	(0.3256)	(3.9201)
HML	-1.3720	-0.1863	0.2668	0.0215	1.1417**	-0.0309	-5.3701
	(4.5147)	(0.4216)	(0.3069)	(0.3590)	(0.5114)	(0.3536)	(6.5311)
RMW	7.1387	0.6222*	0.5443**	0.9803**	1.0296**	0.6784*	1.9954
	(5.1626)	(0.3726)	(0.2747)	(0.4336)	(0.4581)	(0.3872)	(6.0926)
CMA	2.8512	0.7117	0.8912**	-0.1746	-0.0252	0.2178	-0.1808
	(3.1133)	(0.5734)	(0.3906)	(0.5609)	(0.5552)	(0.4800)	(2.8125)
Δ Oil	3.4347	0.4930***	0.4231***	0.5409***	0.4672***	0.4815***	3.9245*
	(1.1284)	(0.0891)	(0.0721)	(0.0712)	(0.0943)	(0.1065)	(1.0401)
Intercept	0.3908	-0.0059	-0.0139**	0.0047	-0.0069	-0.0043	0.1005
	(0.1418)	(0.0076)	(0.0059)	(0.0065)	(0.0091)	(0.0068)	(0.1163)
Obs.	8	200	417	181	243	283	9
R-squared	0.9466	0.3998	0.2931	0.4823	0.3745	0.3758	0.8134

Robust standard errors are in parenthesis *** p<0.01, ** p<0.05, * p<0.1