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The effect of crude oil prices on the valuation of energy companies

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Abstract

Companies operating in the energy sector have a considerable stake in future energy prices. Because of the high volatility in crude oil and natural gas prices, company valuation is difficult. Recent years have confirmed this, as crude oil price has experienced significant shifts and high level of volatility. This provides an opportunity to test the relationship between the valuation of energy companies and crude oil prices at different market conditions and business cycles. To study this, we apply a rolling co-integration test for 80 energy companies listed on the S&P 500 and the Oslo Stock Exchange (OSE). The companies include integrated oil companies, as well as drillers, producers and suppliers to the energy industry. We use GICS-code to differentiate between company types. In addition, to test for vulnerability from changes in prices levels, we apply the test to price volatility in order to assess the impact on volatility in stock prices from varying volatility levels in commodity prices.

1. Introduction

In its simplest form, valuation of any financial derivative is the sum of its future discounted cash flows. The estimate for future cash flows warrants substantial uncertainty, and for companies in the petroleum industry this emphasized due to the high volatility in oil and gas prices. Hamilton (2009) argues that due to this high volatility predicting future oil prices is extremely difficult. Consequently, the valuation of petroleum companies, based on future income from volatile oil prices is demanding.

A study by Misund and Mohn (2009) suggests that oil price volatility has a stimulating effect on petroleum investments. Still their results highlights the valuation difficulty, as both oil and stock price volatility cause an overall uncertainty to investments, and they explain some of the uncertainty in valuation with the irreversibility effect (Bernanke, 1983; Dixit and Pindyck, 1994). In addition, in a study of 1 287 US companies cross industries, Minton and Schrand (1999) argue that cash flow volatility reduce investment levels and increase capital cost. Henriques and Sadorsky (2011) also study US companies and find a U-shaped relationship between oil price volatility and firm investment.

Several papers confirm the importance of accounting earnings compared to operating cash flow for valuation of companies. Dechow (1994) shows the importance of accruals increases with volatile cash flows. This is also argued in Misund et al. (2008), whom find that since the late 1990s, the value relevance of book equity increased, reducing the importance of cash flows. This may be a consequence of the increased volatility in oil prices and the struggle to estimate fundamental future cash flows.

A recent paper by Kumar and Sukumaran (2016) identify the commodity price, together with reserves and production level as the key determinants in energy company valuation. A study by Osmundsen et al. (2006), considers Return on Average Capital Employed (RoACE) in a study of 14 oil companies. They find that the metric is not important in valuation of energy companies, as valuations are explained by the crude oil price, oil reserves and reserve replacement.

In this paper, we study the valuation for a set of companies related to the petroleum industry and assess how company valuation relates to the crude oil price. Companies are included from both the S&P 500 and the Norwegian stock exchange (OSE), and are categorized according to their GICS-code.

The paper is organized as follows. Part 2 introduces the data for our study and provides the method for aggregating data-series. Part 3 provides the empirical analysis and results, and finally, the conclusions is provided in part 4.

2. Data and methodology

The data considered is daily prices for a set of 80 energy companies in S&P 500 and the Oslo Stock Exchange (OSE) prices from May 1996 until March 2017, providing 4 820 observations per price series. In addition, we include both Brent and WTI crude oil prices for the same period. We differentiate the companies using GICS-code and aggregate the stock series into a value-weighted category series.

Table 1 provides a summary of the aggregated series applied to the study per GICS-category. For each parameter, the first column provides the S&P 500 statistics, and the second column provide the OSE statistics. I.e. there are 2 (8) companies categorized as Oil & Gas Drilling company in the S&P 500 (OSE), their annualized mean log-return is -0.013 (-0.043) with a volatility of 0.404 (0.656) for their annualized return. Average value for the S&P 500 Oil & Gas Drilling companies is 6.0 billion USD (0.28 billion USD for OSE Oil & Gas Drilling companies).

From Table 1, we note differences in company sizes, as S&P companies consists of the biggest companies. Second, there is substantial differences in company types between the selections. Finally, while average annualized returns are similar, there is considerable differences in volatility between S&P 500 and OSE.

Table 1. Summary of aggregated data per GICS category for both S&P 500 and OSE. Note that the first column per variable concerns S&P 500 and the second column concerns OSE. Mean log-return and volatility is annualized. Average value is in billion USD.

Category	GICS-code	Number of series		Mean log-return		Volatility		Average value	
Oil & Gas Drilling	10101010	2	8	-0.013	-0.043	0.404	0.656	6.0	0.28
Oil & Gas Equipment & Services	10101020	5	24	0.044	-0.028	0.366	0.360	39.4	0.58
Integrated Oil & Gas	10102010	4	1	0.065	0.059	0.254	0.325	142.2	54.2
Oil & Gas Exploration & Production	10102020	21	7	0.041	-0.005	0.285	0.588	22.7	0.75
Oil & Gas Storage & Transportation	10102040	3	5	-0.018	-0.031	0.187	0.558	27.8	0.57

Figure 1 provides a time-series for the indexed value of companies considered in the S&P 500 per GICS category. Comparing the levels and development with the WTI and Brent crude oil price in Figure 2, it is evident that some of the categories follow the crude oil prices. In particular, integrated oil and gas companies together with companies in oil and gas exploration and production, as well as oil and gas equipment and services have a strong relationship. For oil and gas drilling, and storage and transportation, the relationship seems weaker.

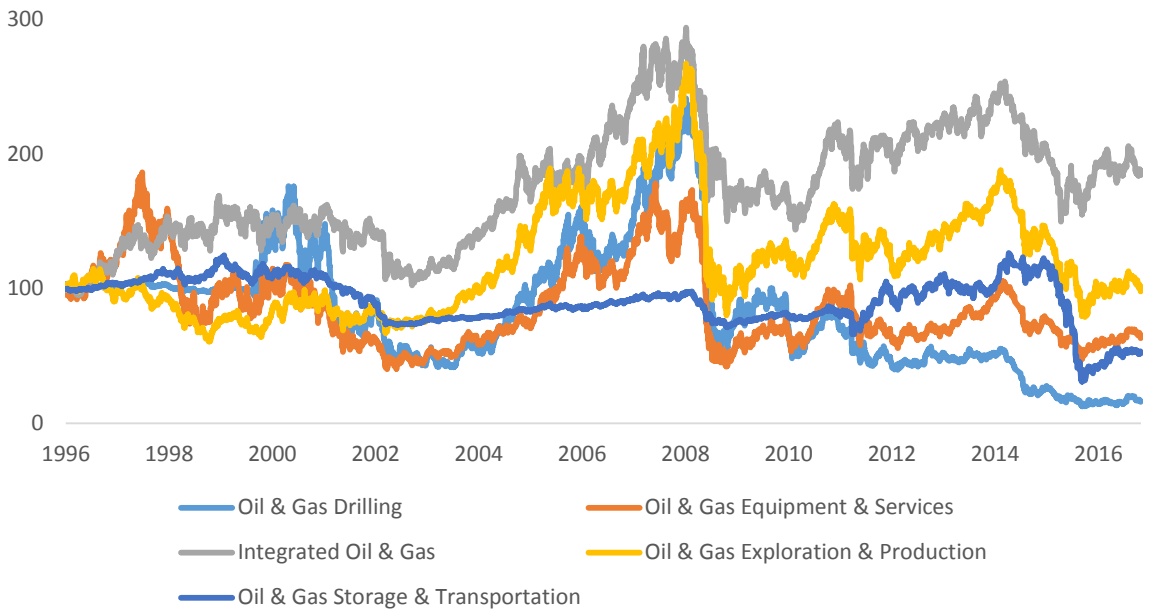

Figure 1. Indexed value (1996 = 100) per GICS-category for S&P500 companies between 1996 – 2017

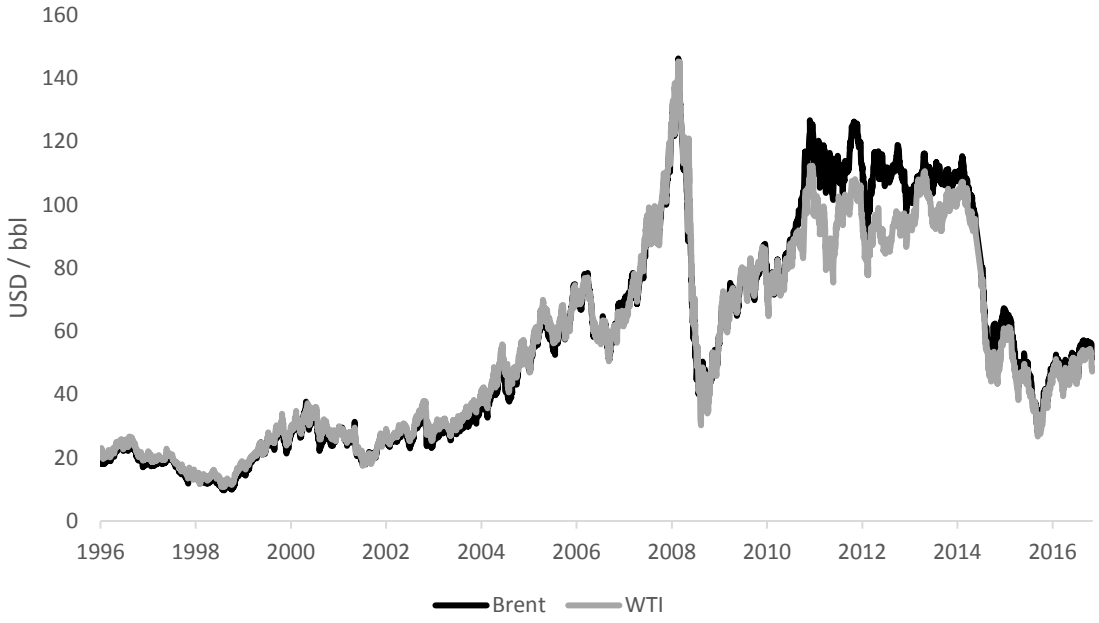

Figure 2. WTI and Brent crude oil prices in $/bbl between 1996 – 2017

3. Empirical results

We continue by applying a vector error correction model to help identify long-run and short-run relationship between the series. We create a rolling co-integration matrix by rolling the analysis with a time incremented observation window of 250 observations. This allow us to identify time-variations in the co-integration between energy stocks and crude oil prices.

First, we test for the optimal lag length for the VECM. For S&P 500 petroleum sectors, AIC and FPE finds the optimal lag length for the model at 5, while HQ criterion says 2 lags. For OSE petroleum sectors, we find that both 2 and 3 lags are optimal. For the remainder of the analysis we applied all lag lengths. However, since the models provided similar results, we only provide the results from the 2 lag model for the two markets (S&P 500 and OSE).

Next, a Johansen test for co-integration reveals one co-integrating vector between the energy company sectors and the crude oil. The co-integration test was carried out for S&P 500 combined with either Brent or WTI crude oil prices, as well as the OSE combined with Brent or WTI crude oil prices. The results were similar to Table 2 in all cases.

Table 2: Johansen test for co-integration between the OSE company sector and WTI crude oil. *number of co-integrating vectors under null hypothesis.

		Critical values		
r >= *	Test statistic	10%	5%	1%
0	125.57	110.42	114.90	124.75
1	70.86	83.20	87.31	96.58
2	43.23	59.14	62.99	70.05
3	21.93	39.06	42.44	48.45
4	8.02	22.76	25.32	30.45
5	2.81	10.49	12.25	16.26

Finally, we can estimate the rolling alphas using VECM, and study the relationship between the energy sectors and crude oils. Figure 3 presents the results for S&P 500 energy sectors and the WTI crude oil price. A positive number indicates a quick, positive adjustment from news in the other markets. Integrated oil & gas companies seem most influenced by changes in WTI crude oil price, together with oil & gas exploration & production companies. This seems especially true in 2005, around the 2008/2009 oil price fall, and again in 2014-2017 during the latest low-price regime.

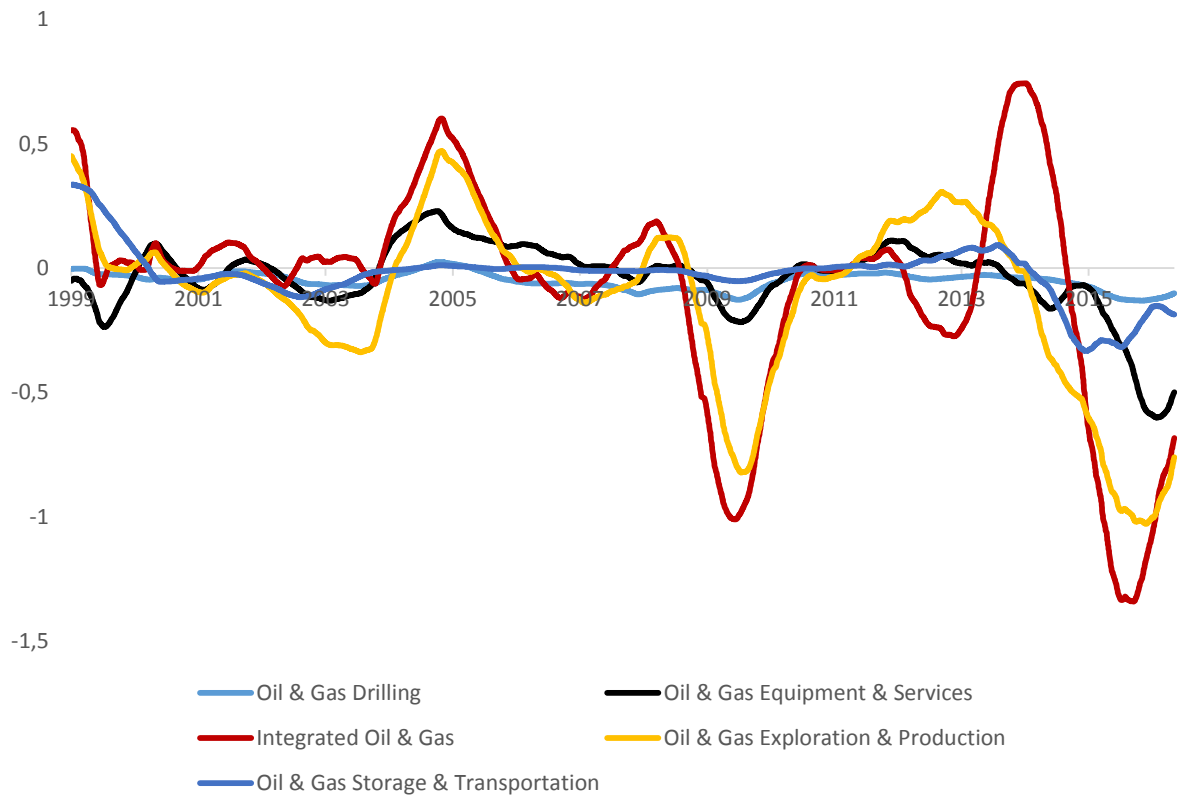

Figure 3 – Rolling speed of adjustment ($\alpha(t)$) for S&P 500 sectors and WTI crude oil 1997 – 2017.

Figure 4 presents the results from OSE energy companies together with the WTI crude oil price. In this case, the energy sectors and their companies seem unaffected by changes in the WTI crude oil price. The oil & gas exploration & production companies provide one exception, during the 2008/2009 price fall.

We continue the analysis with Brent crude oil. Figure 5 and Figure 6 compares the relationship between Brent crude oil to S&P 500 and OSE energy companies, respectively. For S&P 500, the influence from Brent crude oil to the energy sectors varies a lot for our sample period. Indeed, we find that the Integrated oil companies are in particular influenced by changes in the Brent crude oil. For other sectors, there are periods with high influence and other periods with lower influence. For OSE, the change in market value seem unaffected for most parts, although with the same exception for Exploration & Production during the 2008/2009 price fall. In addition, there seems to be a significant increase at the end of the sample period for Integrated oil companies and companies within Equipment & Services.

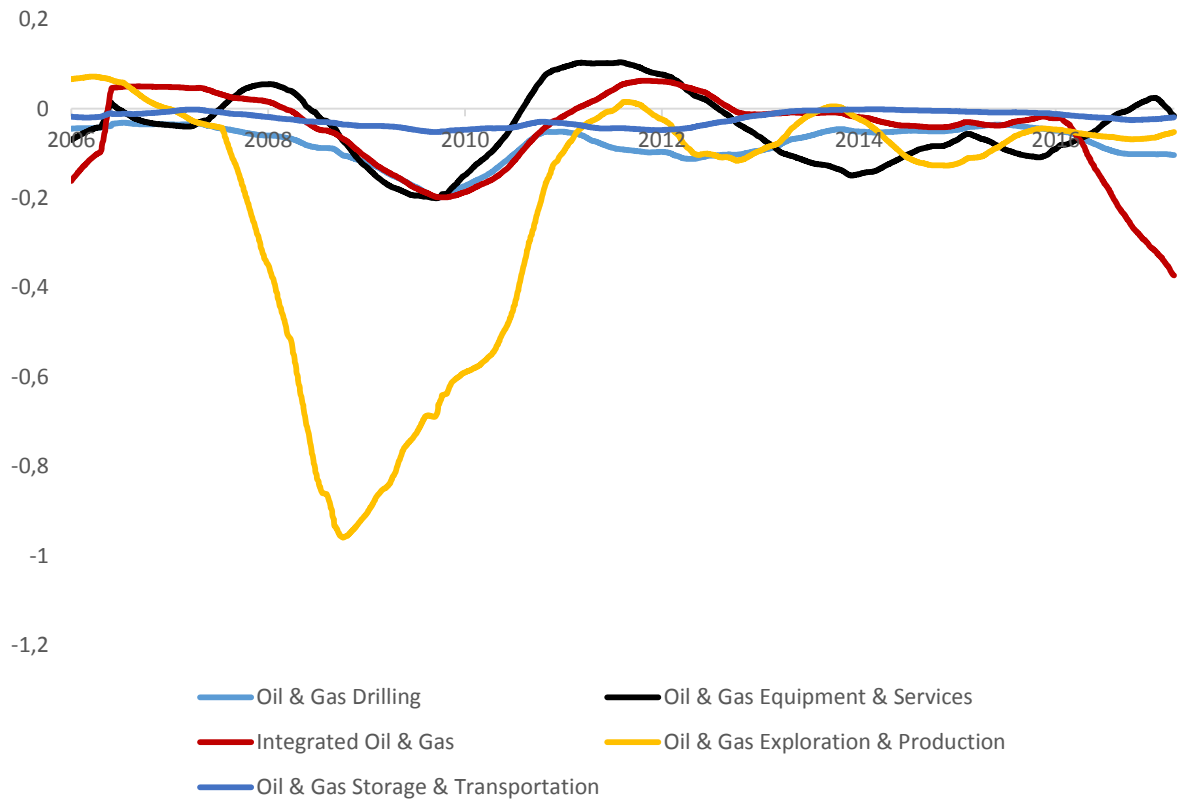

Figure 4 – Rolling speed of adjustment (α(t)) for OSE sectors and Brent crude oil 2004 – 2017.

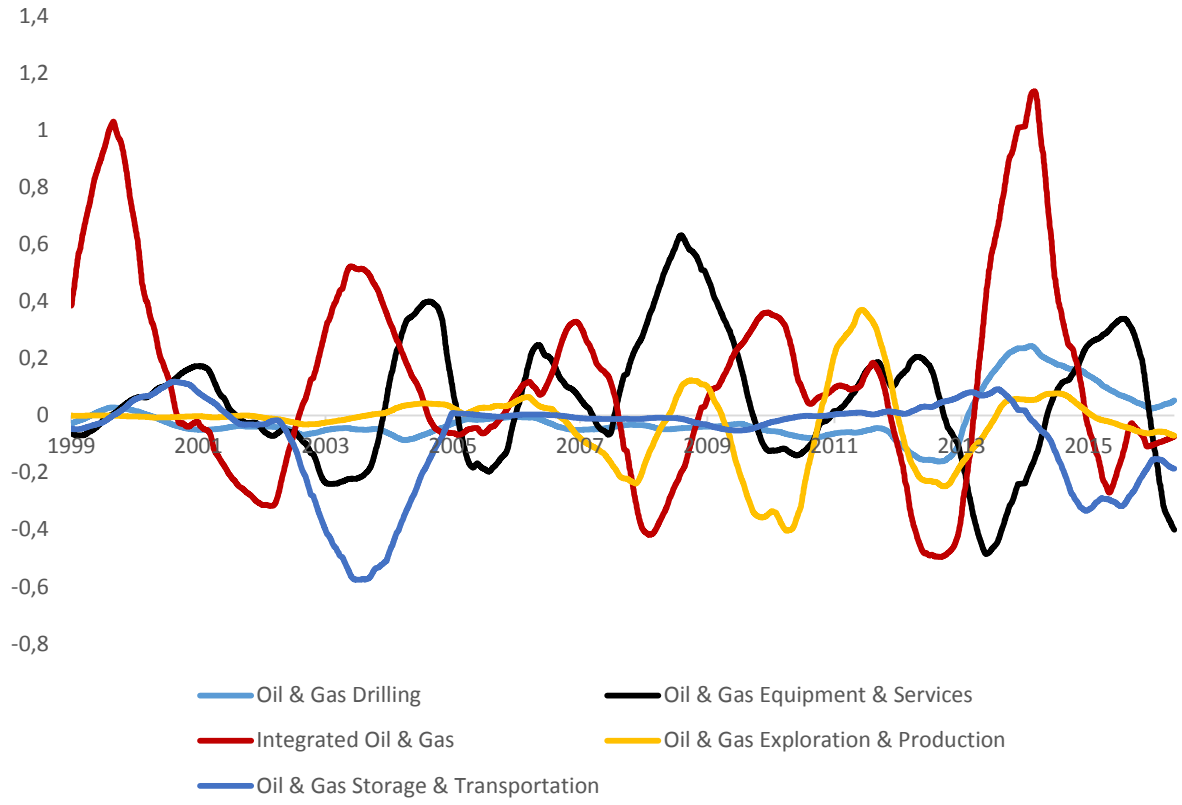

Figure 5 – Rolling speed of adjustment (α(t)) for S&P 500 sectors and Brent crude oil 1997 – 2017.

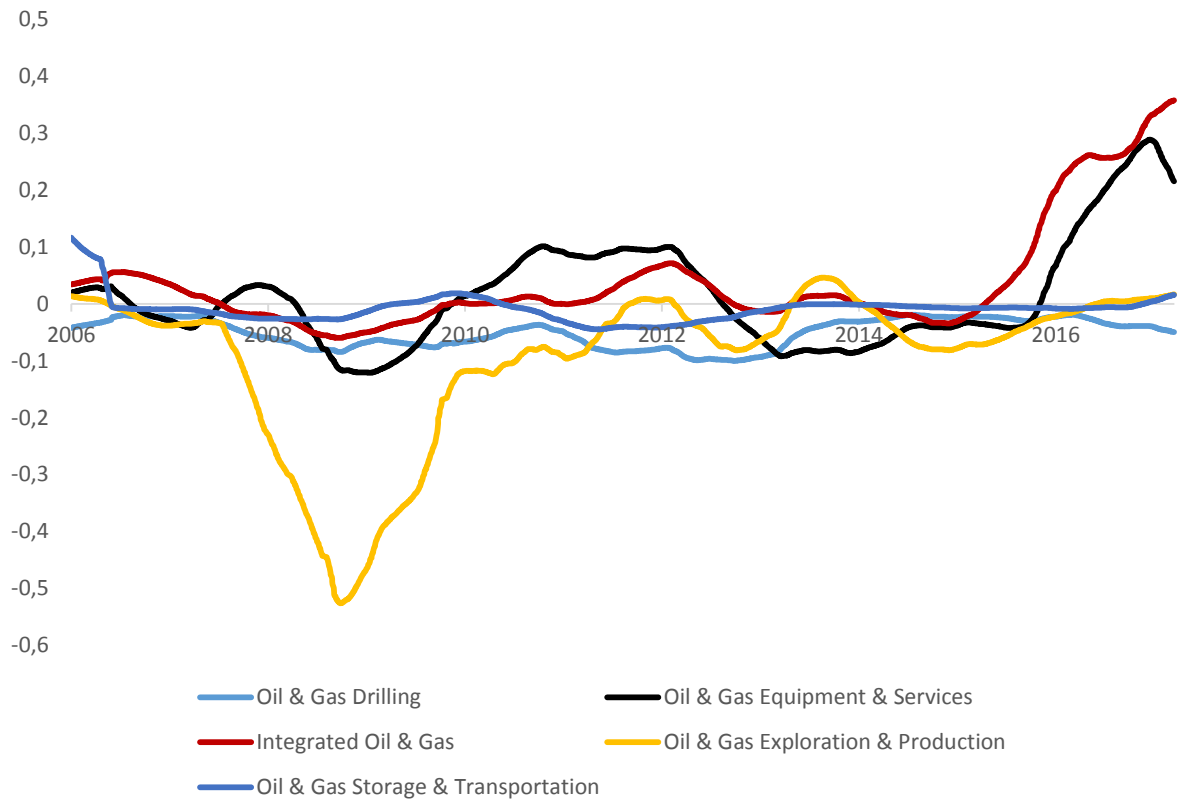

Figure 6 – Rolling speed of adjustment ($\alpha(t)$) for OSE sectors and Brent crude oil 2004 – 2017.

4. Conclusion

We use a rolling co-integration to assess the relationship between changes in the Brent and WTI crude oil prices to companies listed in five energy sectors in both S&P 500 and OSE. For both stock markets, we find time-varying relationship between the crude oils and energy sectors. However, for the S&P 500 companies, the Integrated Oil & Gas companies seem particularly vulnerable to changes in both crude oil prices, as we find a relatively high level of adjustments. Moreover, the adjustment ratio seems particularly high during price decreases. For OSE, Integrated oil & gas companies (i.e. Statoil ASA), seem less influenced by changes in the crude oil price, although with a significant shift at the end of our sample, perhaps indicating an increase in crude oil price vulnerability during the latest low price regime.

Further, we find that the valuation of Oil & Gas Exploration & Drilling companies are vulnerable to changes in the crude oil price. This is intuitive, as their services requires a high oil price, creating

optimistic investment opportunities. In addition, this confirms previous studies on the dependence between investment levels in the petroleum industry and crude oil prices. For other sectors, we find less evidence of a relationship between changes in the oil price and the valuation of companies.

The results provide insight into the vulnerability of company valuation to changes in the crude oil price for companies in the petroleum industry. Previous studies have emphasized the negative effect of company valuation when income and cash flows are volatile. With the highly volatile crude oil price, it is intuitive with a vulnerable company valuation. However, we find that not all petroleum companies are equally vulnerable, and the vulnerability varies over time. Integrated oil & gas companies are most vulnerable followed by companies in the Exploration & Drilling sector. The results indicate that these companies have the highest dependency to the crude oil price compared to other sectors in the petroleum industry.

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