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The Influence of OPEC Meetings on Abnormal Returns During Times of High Volatility or Prices

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PREFACE AND ACKNOWLEDGEMENTS

Starting of I would to express my appreciation for the guidance of Dr. Lemmen who was there every step of the way in writing this thesis and thoroughly reviewed every new version in a timely fashion. The writing of the thesis took longer than I expected but I am happy about what I have accomplished. The help from my family was invaluable and I would like to thank them for being there at each step and for their support.

ABSTRACT

This thesis examines the effect of OPEC announcements on abnormal returns in five industries during periods of high and low oil prices and during periods of high and low oil price volatility. In order to assess the impact of OPEC announcements, an event study methodology was used. It is found that industries which are more closely related to the oil price show a higher likelihood of presenting abnormal returns than companies which are not related to the oil price. During periods of high oil prices, you are more likely to obtain a positive abnormal returns in the short run (-5,5). This abnormal return turns negative in the longer run (-20,20). During periods of higher oil price volatility in the short run (-5,5) there are higher positive abnormal returns but in the long run (-20,20) these disappear.

Keywords: Crude oil; Event study; OPEC; Abnormal return; CAAR.
JEL Classification: D82, L71, G14, O19.

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CHAPTER 1 Introduction

The oil market has gained importance over the past 50 years, oil plays a key role in everyday life such as: energy generation, plastics and fuels. Life as we know it would be impossible without this commodity (Penrose, 1979). Due to the increased importance of this commodity in the world market, there has been an increase in presence of financial institutions, the so called financialization of the oil market. This has led to an increase in participants (internal and external) and attention to the oil market (Fattouh et al., 2012). During 2014-2015 we have seen a large decrease in the Western Texas Intermediate (WTI) price and an increase in price-volatility. This resulted in a 12 year low reached on the 11th of February 2016 of $26.14 per barrel, which was widely covered in the media (Shenk, 2016).

In light of the increased attention spent on the oil market, news organizations have tried to find a way to better report on this obscure market. This has lead them to report every new meeting and decision by the Organization of the Petroleum Exporting Countries (OPEC) as a signalling device to financial investors on the direction of the oil price. Academic research on OPEC can be considered inconclusive, but it has found that OPEC’s role has evolved throughout the years and thus it is impossible to make the organization fit one model. Most of this research has been done through empirical studies, but they fail as OPEC’s role changes with relative oil price changes. Very few studies of an empirical nature have been done looking at the power of OPEC through time (Fattouh & Mahadeva, 2013).

Additionally, the academic literature on the possibility of obtaining abnormal returns on OPEC meetings has not been conclusive (Fattouh & Mahadeva, 2013). As such in this thesis the goal will be to look if it is possible to obtain abnormal returns taking into account the changing role of OPEC through time. This has led to the following research question:

Does the predictive power of OPEC change during periods of high oil prices or high oil price volatility and if so is it possible to obtain abnormal returns from this event?

This question can be applied to those investing into the spot market of oil, but due to the limitations of buying a physical commodity, most investment in the oil market is done using oil futures in which one can buy the product and then short sell the future just before it is due. In addition to purely being beneficial to those investing in commodities, it can also apply to the large number of companies exposed to oil. Not only those directly related to production but in all sectors of the economy.

This question will be answered using an event study methodology on indexes of various sectors in the economy and the oil price surrounding OPEC meetings. The meetings will be separated into different categories: decisions made in a time of high volatility or low volatility and decisions made in a time of high or low oil prices. The abnormal returns will be analysed for each category and they will be analysed statistically to see if they differ significantly. This thesis will also include numerous broad indexes specific to sectors in the economy to see if there are any sectoral differences. This will be done to cover all bases surrounding the OPEC meetings.

This thesis will contribute to studies such as Jones (1990) which looked at the behaviour and influence of OPEC under falling prices and Stephen et al. (2004) which did a similar study but only analysed the type of meeting and did not analyse empirically the circumstances surrounding the meeting. By expanding the existing research base by and looking empirically at the circumstances surrounding the meeting, this thesis will contribute to the existing body of research of event studies surrounding OPEC meetings.

In addition to benefiting academic research, this thesis will give a broader understanding of the effect of OPEC decisions on the stock market. By showing if OPEC decisions carry any predictive value investors might be able to obtain abnormal returns. On the other hand, managers can focus on other items as OPEC decisions might not affect their business as they thought it did, resulting in a more useful and more optimal use of time and resources.

This thesis is constructed in the following manner: it will start off with a review of research done surrounding OPEC decisions, followed by stating the hypotheses used in this thesis, continuing with an explanation into how the study was conducted and where the data was extracted from, next we will look at the empirical results and analyse the results, continuing with a short robustness test checking the assumptions made, this thesis will then be concluded with a conclusion in which the research question will be answered, deficiencies will be highlighted and suggestions on further research will be given.

CHAPTER 2 Literature review

This chapter will give an overview of the existing research in this area, starting off with an overview of the history and workings of OPEC, followed by the research done on OPEC, research done on the relationship between the oil price and the macro economy, research on the oil price and stock market concluding with research on the signalling role of OPEC and abnormal returns in various sectors/industries of the economy.

2.1 History and workings of OPEC

The Organization of the Petroleum Exporting Countries (OPEC) was originally founded in 1961 by 5 upcoming oil producing nations (Iran, Iraq, Kuwait, Saudi Arabia, and Venezuela). The industry at the time, outside the nations with large materials resources (such as: The United States, Canada, the USSR, and China), was dominated by large multinational oil corporations, largely known as the seven sisters. This organisation mostly acted as a cartel and forced smaller producers (before OPEC) to adhere to their wishes. This lead to OPEC's foundation with the following mission: "to coordinate and unify the petroleum policies of its Member Countries and ensure the stabilization of oil markets in order to secure an efficient, economic and regular supply of petroleum to consumers, a steady income to producers and a fair return on capital for those investing in the petroleum industry" (OPEC secetariat, 2012).

Before the founding of OPEC, member countries purely sold the concessions for the oil on their territories and didn't take part in the production or marketing of oil. This lead to competition between the countries, as the seven sisters had complete control over the international oil market and the countries were unable to sell their oil concession to other companies. At the heart of the seven sister's system there was a posted price which was purely a fiscal parameter which determined the revenue received by the governments, this price was purely constructed and wasn't affected by market forces. OPEC was formed to prevent a decline in this posted price (Penrose, 1979).

After the formation of OPEC, the oil market grew exponentially, most of this growth came from OPEC producers. OPEC's share of production grew from 44% in 1965 peaking at 51% in 1973, and declining to 41% in 2001 and since then it has stabilized. In line with this increase in power they tried to renegotiate contracts and increase their earnings. This lead to the 1971 and 1979 oil crises and brought renewed attention to its power (Skeet, 1991). In addition to growing their share of production, the number of member countries also expanded, growing to 13 members by 2007 (OPEC, 2016). At this moment OPEC accounts for 81% of proven reserves and this is seen as its power over the market, as it can easily increase production and flood the market with oil (OPEC, 2015).

The OPEC members normally meet twice a year for an "ordinary meeting"; at the request of a member country an extraordinary meeting can be convened. Such an extraordinary meeting was last held on December the 11th 2010 in Ecuador. On average a meeting takes approximately 1 day and leads to severe media scrutiny. In addition to the general meetings, OPEC also has various committees' and sub-committee's which form policy recommendations and then are proposed at the general meeting. In general, there is a lot less attention paid to these committees by the media and it is quite hard to find more information on these policy meetings.

2.2 Research on OPEC

Since its founding in 1961, OPEC has been the focus of a lot of academic research. At the time of its founding most of the research has focused on its cartel position within the oil market. Theory has speculated that OPEC acts like a monopoly, but that this monopoly will be broken due to customer switching, leading to a perpetual cycle and its downfall (Friedman, 1974). A lot of research at this time focused on OPEC as a single entity (Hnyilicza & Pindyck, 1976), since then research has moved away from this concept towards it being an organization with different actors who each have their own interests and incentives which might collude with other participants.

In 1982 OPEC formally introduced price quotas, one of the key issues with implementing this policy concerned output sharing, this policy was quickly abandoned in 1985. In the period before, OPEC set the price and thus had to live with its consequences, which were quite severe due to the 1971 and 1979 crises, which lead the world to move away from oil. During this period OPEC's market share rapidly declined and internal conflicts arose as Saudi Arabia wanted to retain market share and others wanted a higher price and export more.

This event lead the academic world to move away from seeing OPEC as a single entity to seeing OPEC as an entity that adjusts its output through the quota system to keep prices above a certain floor and that it does not necessarily optimize its revenues (Mabro, 1992). Further research also found that prior to 1990 there was evidence of collusion but that this ended after the first gulf war, after that there is evidence of non-cooperation within OPEC (Almoguera, Douglas, & Herrera, 2011). In addition to the models discussed here there are many others which are examined in more detail in a paper by Almoguera et al. (2011)[1].

[1] Such as: no cooperative behaviour, Cournot competition in the presence of a competitive fringe, Cournot competition without a fringe, cooperative cartel in the presence of a competitive fringe, and an efficient cartel without a fringe (Almoguera et al., 2011)

Empirical evidence hasn't helped in providing an indefinite answer on which model best fits the workings of OPEC. The competing models often offer predictions that are hard to tell apart, as such the empirical evidence can be consistent with various models which all draw different conclusions from this data. Overall we can split empirical evidence into two different categories: pricing models and output models. Pricing models are built upon the principles outlined by microeconomics concerning the profitability of a firm. These models assume that in a scenario where there is perfect competition the price should be equal to the marginal cost of producing an extra unit;

$Price = Marginal\ Cost$

If OPEC exercised any power over the oil market, the market would not be a perfect competition. As such there should be a significant deviation between the oil price and its marginal cost for OPEC producers. A key weakness in building these kinds of models is the assumption concerning the marginal cost. Using this data one can distinguish a variety of different models with each having a different relationship between the price and the underlying marginal cost. The largest issue with this research is that it is hard to define if the difference is due to monopoly power or due to scarcity rents (Smith, 2005).

Output models on the other hand look at the production output of the members, such as Griffin (1985) which made a simple regression of the a country production in relation to the oil price and other countries' production. He finds support for partial market sharing indicating that OPEC can be considered a loose cartel. In contrast Gülen (1996) used a similar approach and argues that production should move in parallel with other producers if they are colluding, but this could also be a sign of a competitive market.

The latest trend and most interesting research trend is to look at models which allow for a change of conduct as its pricing power depends on market conditions. Geroski et al. (1987) was one of the first researchers to look at this phenomenon, he argued that it is very hard to have perfect collusion and that some producers may change their behaviour as a consequence of rival's previous actions. The empirical evidence presented in his article proves that a model which allows for varying behaviour outperforms similar constant behaviour models. In a similar vein Almoguera et al. (2011) finds that OPEC switches between cooperative and non-cooperative behaviour, as discussed above. Overall this new trend in research is relatively unexplored but OPEC's action cannot only be explained by its share of production but can also be explained by its internal state.

2.3 The oil price and macroeconomic indicators

In looking at OPEC it is important to first understand the effect the actual oil price has on the economy as a whole. Hamilton (1983) was one of the first papers to look at the connection, he finds that during his sample (1948-1972) there is a significant relationship between a large oil price increase followed by a recession, approximately three-fourth of a year later. He speculates that the oil price was a contributing factor for several US recessions.

Instead of purely looking at a small set of indicators, Huntington (1998) decided to take a broader view of the economy. He finds that sustained oil price increases have a different effect than a sustained oil price decreases This observed asymmetry between effects is mostly due to how the energy sector reacts to price increases. As such the singular focus on the oil price is misplaced and one should look at the aggregate effect he argues.

Since then research has moved towards looking at the changing relationship between the oil price and macro economy. Hooker (1996) proved that post 1973, the relationship between a large oil price increase followed by a recession proven in Hamilton (1983) has ceased to exist, he speculates on numerous hypotheses but none are deemed significant. Reacting to this academic paper Hamilton (1996) argues that this relationship has only strengthened when looking at recent data. He also finds that many of the oil price increases since 1985 are corrections to larger price decreases in the previous quarter.

Continuing on this trend looking at the changing nature and market dynamics of oil, Blanchard & Gali (2007) looked at effect of large oil shocks on the macro economy. They find that the effect of oil shocks on employment, wages and prices has diminished over time in addition they find that that these oil price shocks coincided with other large shocks of a different nature. On the effect of the oil price on macroeconomic data Carruth, Hooker, & Oswald (1994) constructed a model trying to explain the unemployment based upon the real interest rate and real price of oil. They find that the real price of oil is especially important for the unemployment rate. Another paper to mention looking at macroeconomic data is Gisser & Goodwin (1986) they looked at some popular notions on the relationship between oil and macroeconomic indicators. They tested if the impact of oil price only impacts the economy in the form of extra inflation (which they reject), if crude oil prices affect the economy differently pre- 1973 (which they also reject) and the last notion that oil prices are determined differently in the post-1973 regime (they find limited support).

Burbidge & Harrison (1984) explore the impact of the two main oil price shocks (1973 and 1980) to the level of oil innovation. They find a much larger effect during the first crises in 1973 when compared to the crises in 1980 this is valid in all the countries examined with the exception of Japan.

2.4 The oil price and the stock market

In recent years there has been a trend towards more financial participants in the oil market and a larger role for financial markets in the price formation process (Fattouh et al., 2012). As the market has become more liquid, it has become a market in which it is easier to speculate and invest in. As such it is important to also ask if there is any relationship between the oil market and stock market. Mowry & Pescatori (2008) directly examine this question, they barely find any siginificant relationships. They do find that these correlations change through time and are very sector dependent.

This has lead academic research to focus on oil price shocks. The most cited article focused on this subject is Jones and Kaul (1996). This article looks at the reactions of the stock market to oil shocks and if this can be justified by the change in their future cash flow. This is done by using the classic model established by Campbell and Shiller, (1988) which states that a stocks return is due to changes in expected and unexpected return. The paper introduces an extra dummy variable signifying an Oil shock. The paper finds that in the United States and Canada, markets can be seen as rational and that the oil shock is fully reflected in stock prices, this contrasts with markets in the United Kingdom and Japan, in these market stock prices react too strongly to oil price shocks in relation their future cash flows.

Most of the academic research has continued to focus on shocks to the oil price such as: Park and Ratti (2008) which looked the effect of oil price shocks on the real stock returns during a time frame stretching from 1986 till 2005. They find that oil price shocks have a significant impact during or in the next month on real stock returns. In addition, they find that Norway as an oil exporter shows a statistically significant positive response of real return on the stock returns during oil price increases. Lutz & Park (2009) also looked at oil price shocks but they purely focused on the US market and classified shocks into demand and supply shocks. They find that shocks to production are less important for understanding changes to stock prices than shocks to global aggregate demand.

Miller and Ratti (2009) also looked at the effect of oil shocks. They use an econometric approach with data ranging from 1971 to 2008. They find that over the long run there is a negative relationship between the oil market and the stock market of 6 OECD countries, but that there are numerous brakes and the relationship appears to disintegrate at the end of 1999. This suggests that during this time frame there has been a change in this relationship suggesting that there have been stock market bubbles or oil price bubbles since the turn of the century. Sadorsky (1999) also looked at oil shocks but decided to focus on market activity, they show that oil prices and oil price volatility affect real stock returns. They also find that dynamics in the oil market change, after 1986 they can explain a larger fraction of the forecast error variance using the oil price than using interest rates.

Continuing with an econometric based approach Maghyereh (2004) decided to purely look at 22 emerging market economies. He finds that inconsistent with the research done on more developed economies, in emerging economies oil shocks have no significant impact on stock return indexes, suggesting that in emerging markets, market returns do not rationally signal shocks in the oil market.

In trend with oil price shocks and the stock market Dalakouras (2009), purely looked at oil volatility and the stock market. He finds that one month lagged oil price volatility has significant predicting power on numerous stock market indices. He also finds that oil price volatility has a greater influence on non-oil related industries than oil related ones.

This seems a relatively new phenomenon according to Huang, Masulis, & Stoll (1996); they find that during their time frame in the 1980s they only find that there is a one day lag between stock returns of certain oil stocks and daily returns of oil futures, for the rest they cannot conclude on any lags between stock market returns and oil future returns.

Not all academic research has focused on the effects of oil price shocks to the stock market. Pollet (2005) tried to use forecastable oil events to predict asset returns, he finds an under reaction to predictable oil related events, he argues that this is in line with the efficient market hypotheses but he prefers to see it as an under reaction to information on the expected change of the price of oil. Driesprong, Jacobsen, & Maat, (2008) looked at a more direct effect by looking if they could use oil prices to predict stock market returns worldwide. They found significant prediction capabilities in both developed and emerging markets which could not be predicted by time varying risk premiums. As such they speculate that investors underreact to information contained in the oil price, and this was confirmed by introducing a lag of several trading days between monthly stock returns and monthly oil price changes (which is in line with Pollet (2005).

Fan & Jahan-Parvar (2012) further support the effect proven in the previous paper, by purely looking only at US-industry level returns. They find that in 20 percent of the industries studied returns can be predicted by using logarithmic differences in oil spot prices. This predictability disappears when looking at the entire US market. They also find that when including a two week lag the effect disappears; this is in line with previous research. Sørensen (2009) argues that this underrection to information is not caused by changes in the oil price but that it can be attributed to exogenous events of extreme turmoil, such as conflicts in the middle east.

2.5 Signalling role and abnormal return of OPEC announcements

Analysts have conceived that OPEC may have a role in influencing the oil price and market. By holding their biannual meeting, they might introduce extra information into the market by cutting or raising their targeted output. Participants in the market might be able to use this extra information to obtain abnormal returns.

To understand the effects of OPEC we have to first look at general research on event based trading. Solnik (1993) is considered one of the more important papers in this field, he compared a model in which they have a dynamic allocation strategy based on an information set with a normal market benchmark. In comparing the two allocation strategies they find that the dynamic strategy is significantly superior in addition to “economically large” differences. A similar paper was written by: Hong & Stein (1999), they created a model in which a market has two segments: News-watchers and Momentum-watchers. They find that if one group underreacts to any kind of news in the short term, there must be a long-term overreaction in the market due to arbitrage strategies.

An interesting field is to incorporate these theories on overreaction and to look at the direct effect an OPEC meeting has on the market using the event study methodology and seeing if it’s possible to obtain abnormal returns. Wirl and Kujundzic (2004) looked at the effect of meeting decisions on the subsequent market development, they find that the impact is weak at best, in contrast to literature they also reject the claim that OPEC only follows the market. In a similar study Stephen et al. (2004) looked at the effect of OPEC decisions on the implied volatility of the oil market; implied volatility should accurately reflect investor sentiment and react quickly to OPEC decisions. They find that prior to the meeting implied volatility drifts upwards, after the meeting it drops by 3 percent and 5 percent in the 5-day window after the event. This drop was most pronounced for meetings of the Ministerial Monitoring Committee, which makes policy recommendations but the biannual meetings saw a much smaller drop.

Other studies that have used the event study methodology to assess the impact of OPEC on the stock and oil market are listed below in chronological order:

Hyndman (2008) did an event study during 1986 to 2002, they found that announcements which reduced the quota resulted in positive excess returns over pre-announcements levels, this contrasts with announcements of no action which result in negative excess returns and announcements in which there is an increase in the quota there is no result. He speculates that this is due to, as demand increases it is easier to secure an agreement but when there is a drop in demand it is harder to come to an agreement. He uses this empirical evidence to form a stylized model with one-sided private information. This model operates in a world in which there are only two cartel members and they must bargain for an “aggregate-production quota” (in a world of asymmetric information). He finds that if both players are sufficiently different, the chance of reaching an agreement is much lower when demand is low (production is relatively high) than when there is a high demand for oil (production is relatively low). This is in line with his empirical evidence.

Christensen (2009) decided to focus on the Scandinavian market and various sectors in the stock market. He found that OPEC was not able to influence the oil market and its effect on the stock market was limited during the period from 1999 till 2008. He speculates that this is due to company’s risk management practices, in addition to the announcement of the meeting being far in advance of the meeting, giving a lot of time for the market to adjust.

Demirer and Kutan (2010) looked at both OPEC and SPR (U.S. Strategic Petroleum Reserve) announcements between 1983 and 2008. They looked for abnormal returns in both the spot and futures market. They find similar results to Hyndman (2008), as OPEC announces production cuts there is significant positive impact with this impact being smaller for longer maturities. For SPR announcements they find that the market reacts efficiently to the news.

Jonsson and Lin (2011) took a much shorter time frame (2005 to 2007) and purely looked at the Stockholm stock market. More specifically they looked at the Energy, Telecommunications and Financial sectors. In addition to the traditional event study methodology they also construct an extended version of the CAPM in which each meeting date had its own dummy variable. They find that none of the dummy variables are significant. The traditional event study methodology only found that the telecommunication sector reacted to the announcements, they speculate that this is due to the extra returns generated during the research dates.

Ji and Guo (2015) decided to take a different approach in addition to using the traditional event study methodology, they introduced an AR-GARCH model which investigated the relationship between abnormal returns on oil prices and “internet concern for oil-related-events” this item was measured using google search volumes. They find that when OPEC increases their production quota, this has a negative effect on oil price returns, in contrast to a decrease in production which results in a positive effect on oil price returns.

The table below gives an overview of the exact outcomes to make it easier to compare results at a later stage:

Author(s)	Event Window	Magnitude
Hyndman (2008)	(-20,20)	CAR +5% if no action or reduction in quota not significant if the quota is raised
Christensen (2009)	(-1, 1) (-4, 2) (-20, 9)	No significant reaction to OPEC announcements in the Scandinavian stock market
Demirer and Kutan (2010)	(-20, 20)	No significant reaction to quota increases, small negative returns with no action, but excessive positive returns with quota reductions in the spot market (0.16%)
Ji and Guo (2015)	(-5, 5)	Increases in oil production resulted in no significant impact on spot prices, while maintaining and reducing oil production resulted in a significant positive impact on the oil price
Jonsson and Lin (2011)	(-2, 2)	No significant reaction to OPEC announcements in the Stockholm stock market

Table 1 Comparison of different event studies and their conclusions

A special mention should go to Buyuksahin et al. (2010) which looked at statements made by officials from OPEC members. These officials comment quite frequently on the “fair price” of oil, in many cases this contrasted with the current price of oil. Looking at the time range between 2000 and 2009 they looked at every statement. Using several methodologies, they conclude that these “fair price” announcements have no significant influence on the market price of oil and thus do not supply any additional news to the market.

CHAPTER 3 Hypothesis development

After having explored the academic research behind the research question it is important to try to formulate the actual hypotheses which form the basis for concluding on the research question.

As discussed in the literature review there exists a large body of research exploring the connection between OPEC and a variety of economic indicators. This thesis shall be focussing on the process of obtaining short term abnormal returns using OPEC announcements. As seen by e.g. Christensen (2009), the effect of oil and OPEC on the economy changes through time. In this thesis, we will explore if this also applies to abnormal returns generated through OPEC.

Currently in academic literature there is no conclusive way in defining when the influence of OPEC on oil prices changes, numerous papers assume one date and see if the effect is different before this date, than after this date such as Sadorsky (1999). Almoguera et al. (2011) take a more fluid approach in which the state of OPEC is determined by a combination of the oil price, GDP growth of OECD countries and non-OPEC oil production.

H1: If the oil price is at a relatively low price, there is a higher likelihood of generating any abnormal returns using OPEC meeting dates.

The decision was made to look at the relative level of the oil price, as most OPEC members are highly dependent on oil to finance public services and budget shortfalls (Rascouet, 2016). As such when the oil price is relatively high countries, find that it is easier to cut or raise production as their budget is in a better shape. Compared to when the oil price is relatively low, governments are very hesitant in cutting production as this directly impacts their bottom line and might even cause unrest within their population. This has lead countries to export more oil than their quota allows them to (Fattouh & Mahadeva, 2013).

As such at when the oil price is high there should be little movement in the oil price as it is not in OPEC’s interest to change the status quo. If the price is low, it is in OPEC’s best interest to raise the oil price and thus the likelihood of market movements are higher. The expectation is that a price rise would be beneficial to oil & gas related industry and negatively affect large oil consuming industries or companies remotely connected to the oil price as disposable income decreases for the general economy, due to a larger amount of income spent on oil & oil based products. This hypothesis will test if the market is fully aware of the relative position of the oil price and if it has fully priced in OPECs capabilities.

Another item that might affect the power of OPEC is the volatility of the oil price, as such we will look at the following hypothesis:

H2: If the oil price is relatively volatile in the months leading to an OPEC meeting there is a higher likelihood of generating any abnormal returns.

If there is a period of high volatility in the months leading up to an OPEC meeting, the market will be highly uncertain of the direction that the oil price might go in the near future, as such an OPEC meeting might be able to exert more influence on the oil price and the general stock market by stabilizing the oil price. As the oil price becomes more stable it becomes a more interesting investment and due to the increased demand the oil price will rise affecting various industries.

In this hypothesis, the assumption is made that the market undervalues the influence of OPEC and as such it might be easier to generate positive abnormal returns. As the oil price rises, this is beneficial to the closely related to the oil & gas industry while all other industries will be adversely affected due to the rise in oil related products and the reduction in spending power.

CHAPTER 4 Data and Methodology

In this chapter an overview is given of the sources of the data, how the hypothesis stated in the previous chapter will be answered and how the results will be tested.

4.1 Data

4.1.1 OPEC meetings

As stated in the literature overview OPEC normally meets on a biannual basis, each member has the option to call for an extraordinary meeting at its discretion. Since the founding of OPEC in 1960 there have been 169 general meetings. For this study we will be looking at the period ranging from the beginning of 1987 till mid-2016. In this time frame there have been 90 OPEC meetings. These dates were chosen as OPEC introduced the current quota system in 1986 which is still in use today. As such this should represent a time frame in which the way OPEC does business hasn't fundamentally changed.

Data for the period 2001 till 2016 was obtained from press releases published on the OPEC website. For the data preceding this period no data is published in online OPEC sources as such this data was obtained from Hyndman (2008), this paper published a complete list of OPEC meetings from 1986 till 2002. To partly check the data, the data from 1998 till 2001 was checked with the published annual reports of OPEC. The annual reports published before 1998 couldn't be retrieved.

4.1.2 Stock market data

To get a clear result on the effect of OPEC decisions on abnormal returns, the decision was made to focus on the global market. The oil price is a global phenomenon and as such the results should also be, this will also remove most local effects. As OPEC tries to influence the oil price to increase its profits therefore indirectly influencing the profit of companies which are connected to the oil market. Conducting an event study on companies related to the oil price, should reflect the influence of OPEC on the oil price and indirectly on the stock market.

To fully reflect these different effects on the oil price, 5 different sectors will be examined, in order of most likely being influenced by the oil price: Oil & Gas, Utilities, Basic Materials, Industrials and Technology. Some sectors are directly connected to the Oil price such as the Oil & Gas industry, other industries have a less obvious connection such as Industrials, these industries are quite often connected to the oil market through indirect effects such as changes in the electricity & packaging prices due to higher oil prices or decreases in the global growth due to a higher oil price. In choosing these 5 sectors a broad selection of the global economy is examined. All the indexes where obtained from DataStream. These stock indexes were also composed by DataStream; they do not provide the exact composition but only the companies that participate in the index. A complete list of the composition of these indexes is provided in appendix A. Each index has from 350 to 1200 constituents, heavily balanced towards the developed world, but also contains companies in the developing world (China). These time series range from the 1st of January 1986 till the 30th of June 2016. All indexes are classified in US Dollar (USD).

4.1.3 Oil price data

In determining the volatility and price level of the oil market, the spot price of the Western Texas Intermediate Cushing (WTI) is used. This oil price was chosen as it is the most prevalent oil price, it is denoted in USD and is obtained from DataStream. To normalise the oil price (to determine the real oil price), the US GDP deflator will be used. The choice was made to use a US based GDP Deflator as WTI is mostly used in the United States. This data series was obtained from the US Federal reserve (US. Bureau of Economic Analysis, 2016). The oil price volatility will be measured using the daily standard deviation of the WTI oil price, the reasoning for this choice will be discussed in the next section.

4.2 Methodology

The goal of this thesis is primarily to assess the role that information surrounding OPEC meetings has on abnormal returns for various sectors in the stock market and if this differs during periods of high oil prices or volatility and thus categorize the OPEC meetings. First, this thesis will discuss how one can determine if the oil price is high or low and how volatility can be looked at. Next, the classic event study methodology will be examined, which allows us to examine the abnormal returns generated by the various sectors. Continuing with the various methods of looking at normal returns.

4.2.1 Categorizing OPEC meetings

To verify our hypothesis, it is important to categorize the OPEC meetings for two items; price and volatility level. Each meeting will get a classification of high or low relative price level and high or low volatility.

In defining the relative price level oil, there is currently no consensus of what one can define as a high oil price. This thesis will be using the methodology applied in Rodríguez & Sánchez (2009), they define a high oil period , as “a period in which the real oil price exceeds the mean over the whole sample”. This is quite a simple definition but will be suitable for this item. They use the US GDP deflator to deflate the oil price and as such obtain the real oil price.

In defining the oil price volatility, there are various ways of measuring this item as discussed in literature such as: historical volatility, implied volatility, stochastic volatility, conditional volatility (measured with ARCH and GARCH, for example) and realized volatility (Rafiq, Salim, & Bloch, 2009). This thesis will be using historical volatility as for this thesis it is important to look at the period preceding the meeting. A similar methodology will be applied as in the relative price level. A period of high volatility will be defined as a period in which the historical volatility is higher than the sample mean. A 60-day horizon will be used to reflect the sentiment preceding the OPEC meeting. This is approximately three months

4.2.2 Event study

The event study methodology is an often-used analytical tool in the empirical finance literature, the goal of this tool is to assess the information effect of an event such as a merger announcements or corporate earnings by looking into the excess returns generated by an underlying security around a relevant event. A more detailed explanation on the methodology can be found in: Brown & Warner (1980, 1985), Thompson (1995) and Binder (1998). Initially this methodology was mostly applied to corporate events, but there has been a movement towards using this methodology for non-corporate events as seen in the literature review. In this thesis the methodology described by Mackinlay (1997) will be used as the principal guide.

The core of event study methodology is the estimation of excess or abnormal returns; this can be defined as the difference between the actual ex post return of an underlying asset deducted by the normal return. This can be defined as:

$$AR_{it} = R_{it} - E(R_{it}) \tag{1}$$

In this equation R_{it} is the return of security i on day t and $E(R_{it})$ is the normal expected return for event i at time t. This thesis will consider each OPEC meeting during our time frame as an event.

One can define the expected normal return as the returns generated in a non-event related period without any influence of the event. There are a variety of ways of calculating this return, the two most commonly used models: are the constant mean return model and market model. In this thesis both models will be used and compared. Both of these models rely on the assumption that asset returns are jointly multi- variate normal and independently and identically distributed through time as pointed out by McWilliams & Siegel (1997). In theory this is a strong assumption, but studies by Brown & Warner (1985) and Dyckman, Philbrick, & Stephan (1984) have found that non-normality in daily returns used for short-run event studies, do not have a serious impact on the power of parametric tests. The T-tests used in this study are thus well specified under the null hypothesis.

4.2.3 Constant mean return model

This model assumes that the mean return of a security is constant through time. Assuming that μ_i is the mean return of a security i. The return then can be defined as follows:

$$R_{it} = \mu_i + \varepsilon_{it} \tag{2}$$

Where R_{it} is the return for period t on a security i, ε_{it} is the error term for the security i at time period t. This error term has an expectation of 0 and a variance of σ_ε^2 as noted below.

$$E(\varepsilon_{it}) = 0 \qquad var(\varepsilon_{it}) = \sigma_\varepsilon^2$$

This is one of the simplest models to calculate expected return but empirical research performed by Brown & Warner (1980, 1985) finds that the results of this simple model are often similar to more complex models.

4.2.4 Market model

This model assumes a stable linear relation between the market return and the return of the security. This linear payoff follows the assumption of joint normality of asset returns. The market model can be defined as follows:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \tag{3}$$

Where R_{it} is the return for period t on for security i and R_{mt} is the return of a market portfolio for period t, ε_{it} is the error term for security i at time period t, α and β are the model parameters, α should not significantly differ from 0 which is the case in this thesis. The error term has an expectation of 0 and a variance of σ_ε^2 as noted below.

$E(\varepsilon_{it}) = 0$

$var(\varepsilon_{it}) = \sigma_\varepsilon^2$

Often in practice a broad-based market portfolio is used in determining the market return. In this study DataStream's global index, will be used as the market portfolio. This model is often seen as superior to the constant return model, in removing a portion of the return related to variation in market returns and as such reducing the variance of the abnormal return.

4.2.5 Models estimation and hypothesis testing

Author(s)	Estimation window	Event window	Model (market index)
Hyndman (2008)	(-151, -21)	(-20,20)	Market model (S&P500)
Christensen (2009)	(-252, -2) (-255, -5) (-271, -21)	(-1, 1) (-4, 2) (-20, 9)	Market model (OMXC20, OSEBX, OMXS30, OMXH25)
Demirer and Kutan (2010)	(-80, -21)	(-20, 20)	Market model (Dow Jones AIG Commodity Index), ARCH model, 3-factor Fama-French model
Ji and Guo (2015)	/	(-5, 5)	Assumes expected returns to be equal to 0
Jonsson and Lin (2011)	/	(-2, 2)	CAPM model
Stephen et al. (2004)	/	(-20, 20)	No AR

Table 2 Comparison of different academic event studies based on the length of estimation/event window and market index

In assuming the T=0 is an OPEC meeting, the return of the security has to be measured during an event window. To take into account information leakage before and after the event this study will use 20 days before (T-20) and 20 days (T+20) after the event as the event window, leading to a period of 41 days in which returns can be generated. In addition, an event window of T-10 till T+10 and T-5 till T+5 will be used to test for shorter run effects. This is in line with other studies conducted in this field, this standard model has endured heavy criticism as seen in Boehmer, Musumeci, & Poulsen (1991). The standard model was criticized for not taking into account the changes in variance due to increased uncertainty surrounding the event period. However as reported in the next section this issue will be taken into account.

For the estimation period a period of 130 days is chosen, the estimation period ends on the day before the start of the event window (-151 till -21). This range should be large enough to get a clear return and is the same event window used in Hyndman (2008). Then using equation (1) the daily abnormal return will be calculated using one of the two models discussed and then averaged as seen in equation in (4):

$$AAR_t = \sum_{i=1}^{n} AR_{it}/n \quad (4)$$

Where n is the number of events which exist for the category being looked at. This average abnormal return is used to construct a cumulative average abnormal return (CAAR) which is the sum of average abnormal returns from day -20 till a specified day T using the following formula:

$$CAAR_t = \sum_{t=-20}^{T} AAR_t \quad (5)$$

To understand if the markets reacted efficiently to the announcements, the significance of the cumulative average return should be tested. To be more precise, first we test if there are cumulative abnormal returns to begin with:

$$H_0: CAAR_t = 0 \quad (6)$$

This will be explored with T being ±5, ±10, and ±20 days subsequent to the first day of the meeting. This should give us a good indication if the CAAR exists and then it will be tested with the tests discussed in section 4.3.

An alternative approach to an event study can be conducted as seen in Guidolin & La Ferrara (2010). This sort of event study classifies every event into several types and a dummy variable is created for every type. This dummy variable takes the value 1 in a small window surrounding the event and 0 otherwise. Then the model is estimated over the entire sample, the influence of a type is given by its sign and magnitude of the dummy. In this thesis, the choice was made not to implement this model as using the entire sample ignores market expectations at the time of the event in a way that a traditional event study does not. The results of this methodology are not qualitatively different than the traditional methodology used in this thesis (Hyndman, 2008).

4.2.6 Comparing the results

The main goal if this thesis is to see if there is any difference between situations when there is a period of high volatility preceding an OPEC meeting or if the oil price is relatively high. So now we will look if there are any differences between the category for events with a high and low price (for the first hypothesis) and for high volatility and low volatility (for the second hypothesis). To test this, a test of means will be conducted to prove this statement in addition the Levene's test of equal variances will be conducted, to test if the variance between the two categories significantly differs, this test will add power to the test of means. The null hypothesis of the test of means is stated below:

$$H_0: CAAR_1 = CAAR_2 \quad (7)$$

The test uses the following test statistic:

$$T = \frac{CAAR_1 - CAAR_2}{MSE} \quad (8)$$

In which SE is the estimated standard deviation of the test statistic which is calculated as follows:

$$MSE = \sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}} \quad (9)$$

To estimate the standard deviation, we take the average of the standard deviation of both samples. s_1 and $s_2$being the estimated standard deviation of each CAAR and N_1 and N_2 being the number of events. The null hypothesis of the Levene's test of equality of variances is stated below:

$$H_0: \sigma_1^2 = \sigma_2^2 \quad (10)$$

This test uses the following test statistic:

$$W = \frac{(N-2)}{(2-1)} \frac{\sum_{i=1}^{2}(CAAR_i - CAAR)^2}{\sum_{i=1}^{2}\sum_{j=1}^{N_i} CAAR_{ij} - CAAR_i} \tag{11}$$

In which N is the number of events in the entire sample, N_i is the number of events in group i. This test statistic is tested against (F, 1, N-2), in which F is the F-distribution, 1 and N-2 are the degrees of freedom.

4.3 Testing abnormal returns

As applied in most research concerning abnormal returns induced by an external event (such as Bartholdy, Olson, & Peare (2007)), a large battery of tests has to be conducted to prove the significance of the hypothesis. This thesis will conduct both parametric and non-parametric tests. Parametric tests are conducted with the assumption that abnormal returns follow a normal distribution.

In contrast a non-parametric test assumes that returns do not follow a certain distribution. The parametric test should be sufficient due to the large number of event, the non-parametric will be conducted as a robustness test. In the coming sections you'll find an overview of how to conduct these tests. All test statistics formulated below have the following null hypothesis: $H_0: CAAR_t = 0$.

4.3.1 T1 Cross-sectional T-test

This is one of the most common tests conducted in all statistical research often called the MacKinlay t test. Due to its simplicity it has a relatively low power. It uses the following test statistic:

$$T_{CAAR} = \sqrt{N} \ \frac{CAAR}{S_{CAAR}} \tag{12}$$

In which S(CAR) is the estimated standard deviation of the abnormal returns in the estimation window as calculated below:

$$S_{CAAR} = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(CAR_i - CAAR)^2} \tag{13}$$

This test has had to endure a lot of criticism over the past years, it has been proven that this test has issues due to event clustering. It assumes that residuals are uncorrelated and that the variance induced by the event is insignificant. This may be an issue if testing for stocks which have a common event date, but this is not the case in this study.

4.3.2 T2 Time-series standard deviation or crude dependence test

First proposed by Brown & Warner (1980), this a widely use parametric test conducted on event studies, and tries to improve on the issues surrounding event induced variance.

This test uses the T statistic which is calculated in the following manner:

$$T_{CAAR} = \frac{CAAR}{\sqrt{T_2 - T_1} S_{AAR}} \tag{14}$$

With S(AAR) being the estimated standard deviation and T_0 is the beginning of the estimation window and $T_1$is the end of the estimation period. The event window then starts at T_1 and ends at T_2. For this test the standard deviation is estimated from a time-series of the mean excess return as seen below:

$$S_{AAR_t} = \sqrt{\frac{1}{M-2} \sum_{t=T_0}^{T_1} (AR_t - AAR)^2} \tag{15}$$

$$AAR = \frac{1}{M} \sum_{t=T_0}^{T_1} AR_t \tag{16}$$

M is the count of non-missing return values in the estimation window.

4.3.3 T3 Standardized cross-sectional or BMP test

The BMP as proposed by Boehmer, Musumeci, & Poulsen (1991) is an often test used in event studies. It was constructed to mitigate the problems of the cross-sectional T-test

$$Z_{BMP} = \sqrt{n} \frac{\overline{SCAR}}{S_{\overline{SCAR}}} \tag{17}$$

Where $S_{\overline{SCAR}}$ is the cross-sectional standard deviation of SCAR as defined below:

$$S_{SCAR} = \sqrt{\frac{1}{N-1} \sum_{i=1}^{N} (SCAR_i - \overline{SCAR})^2} \tag{18}$$

$$\overline{SCAR} = \frac{1}{Nu} \sum_{i=1}^{N} SCAR_i \tag{19}$$

With $SCAR_i = \frac{CAR_i}{S_{\overline{CAR_i}}}$ being the forecasted error standard deviation adjusted for the forecast error for firm i as proposed by Mikkelson & Partch (1989). For each method of calculating the normal correction they have different terms as outlined below:

Market model:

$$S^2_{\overline{CAR_i}} = S^2_{AR_i}\left(L_i + \frac{L_i^2}{M_i} + \frac{\left(\sum_{t=T_1+1}^{T_2}(R_{m,t} - \overline{R}_m)\right)^2}{\sum_{t=T_0}^{T_1}(R_{m,t} - \overline{R}_m)^2}\right) \quad (20)$$

Mean adjusted model:

$$S^2_{\overline{CAR_i}} = S^2_{AR_i}\left(L_i + \frac{{L_i}^2}{M_i}\right) \quad (21)$$

Where L_i is the count of the non-missing values in the event window and M_i is the count of non-missing return values in the estimation window for event I, $\overline{R}_m$ is the mean of the market returns in the estimation window and S_{AR} is the standard deviation of the abnormal returns for event i. The advantage of this test is that it is immune to the way abnormal returns are distributed across the event window, in addition it accounts for event induced variance and serial correlation. Its only weakness is that it is prone to cross-sectional correlation (Schimmer, Levchenko, & Müller, 2014).

4.3.4 T4 Sign test

The sign test is one of the most common performed non-parametric tests in finance methodology. This test is based upon Cowan (1992). Under the null hypothesis of no abnormal returns, the number of events with a positive CAR is expected to be in line with the fraction ($\hat{P}$) of the number of CARs in the estimation period. If this number of positive CARs is significantly higher than the number expected from the fraction, one can reject the null hypothesis. The fraction $\hat{p}$ is estimated as follows:

$$\hat{p} = \frac{1}{N}\sum_{i=1}^{N}\frac{1}{L_1}\sum_{t=T_0}^{T_1}\rho_{i,t} \quad (22)$$

In which $\rho_{i,t}$ is equal to 1 if the sign is positive if otherwise it is 0 the test statistic for $H_0{:}\, CAAR_t = 0$ is as follows:

$$T_{sign} = \sqrt{N}\left(\frac{\hat{p} - 0.5}{\sqrt{0.5 * (1 - 0.5}}\right) \quad (23)$$

This test statistic follows a normal approximation of the binomial distribution with the parameters $\hat{p}$ and N being used.

4.3.5 T5 Wilcoxon signed rank test

The Wilcoxon rank test can be seen as a combination of the Generalized sign test and rank test, as it considers both the sign and the magnitude of abnormal returns. This test is a non-parametric test, making it not reliant on the normal distribution. This is in contrast to the majority of tests conducted in event studies. As such it is often used as a confirmation test in event studies,

$$W_t = \sum_{i=t}^{N} rank(CAR_i)^+ \quad (24)$$

In which $rank(CAR_i)$ is the positive rank of the absolute value of Cumulative Abnormal Return This is calculated by ranking the absolute values of the events, and then only summing the ranks of the positive returns. The test statistic is defined as follows:

$$z = \frac{W - N(N-1)/4}{\sqrt{N(N+1)(2N+1)/12}} \quad (25)$$

CHAPTER 5 Results

This section will give an overview of all the results obtained in this study. It will start off with classifying each OPEC meeting into its relative price environment and relative volatility environment, followed by an analysis on each index.

5.1 Classification of events

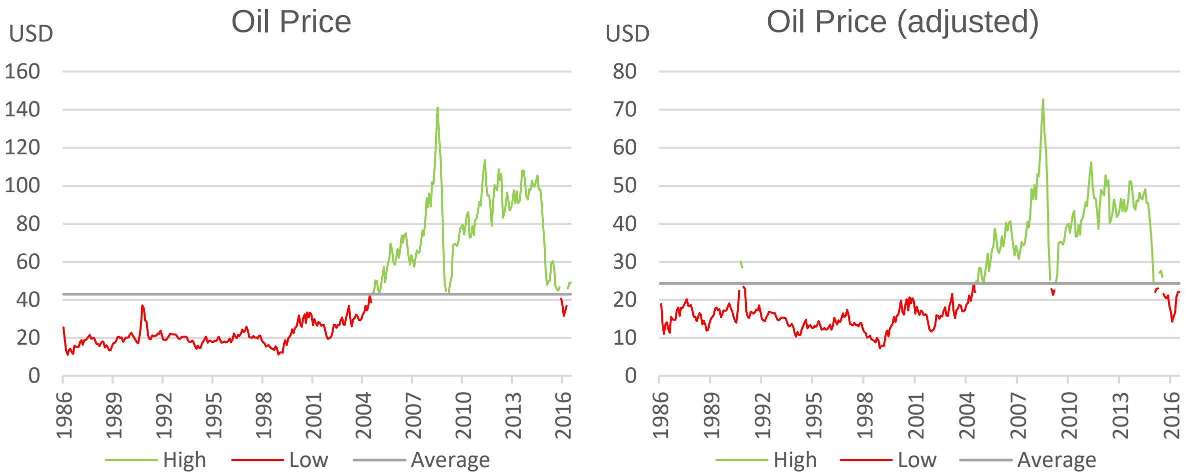


Figure 1 Oil price through time classified on price and price adjusted for inflation.

In applying the methodology discussed we get the charts as seen above, by adjusting the oil price for inflation we get a more compact chart giving a clearer indication that we are in a low-price scenario at the time of writing. All results detailed below will be using the adjusted oil price as this gives a more realistic oil price. OPEC meetings will be classified according the price environment on the day preceding the start of a meeting.

As seen from the pie chart, the majority of meetings take place when the adjusted oil price is lower than average. This is logical as the oil price is more likely to be relatively low due it having a floor while in theory the price doesn't have an upper boundary (a higher oil price will incentivize more expensive production but this has a long development time). Of the 90 meetings, 55 take place during a low-price environment while 35 take place in a high-price environment. This might also support the thesis that OPEC tries to influence the oil price by organising more meetings in low-price environments.

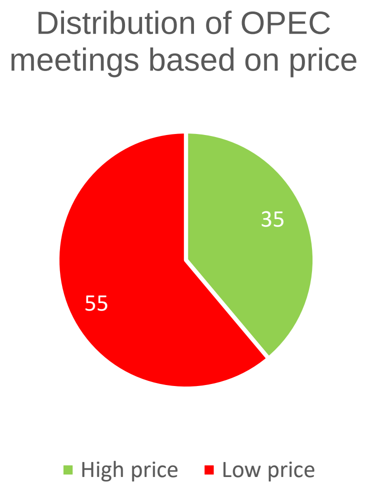


Figure 2 Pie chart of OPEC meetings classified on price

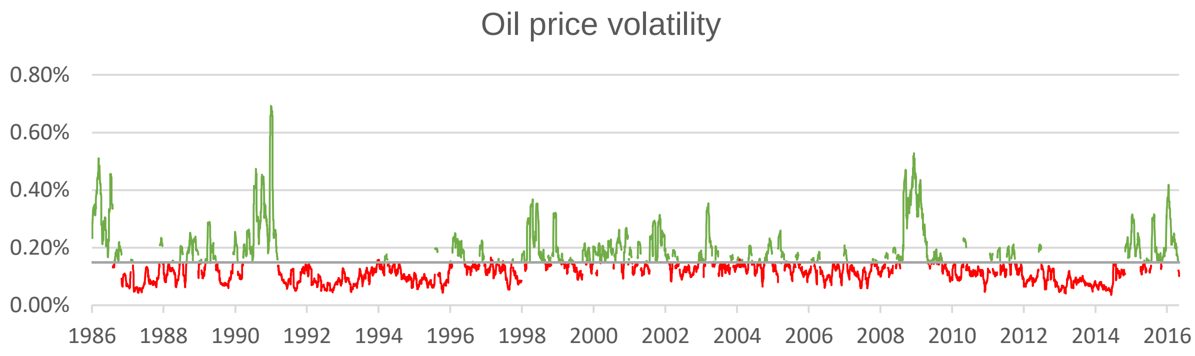


Figure 3 Oil price through time classified on volatility

In applying the methodology discussed in 4.2.1, we get the charts as seen above (figure 3). This charts the annualized standerd deviation of the oil price over a period of twenty days preceeding an OPEC meeting. In finance theory this is often described as historical volatility. It is quite clear that oil price volatiltiy spikes In times of crises such as the great recession and the oil embargo in 1991.

Looking at this indicator there is a more even distribution of OPEC meetings in comparison to the oil price. There is still no perfect distribution, there is a tendency for OPEC to organise meetings in periods with a high-volatility. Of the 90 meetings in this sample 41 took place in a low volatility period and 49 took place in a high-volatility environment, supporting the hypothesis that the OPEC might try to meet during periods of high volatility to influence the oil market.

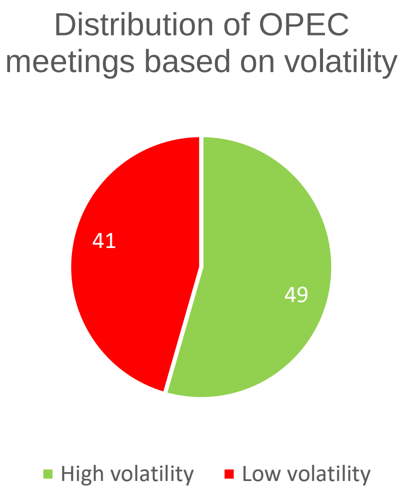


Figure 4 Pie chart of OPEC meetings classified on volatility

5.2 Oil & Gas index

The first index to be analysed in this thesis is an index constructed of Oil & Gas related companies. The constituents of this index range from vertically integrated oil giants such as: Shell, to specialised niche players such as: SBM offshore. Overall this index consists of all large listed companies remotely related to the exploration, refining and marketing of oil & gas related products. The companies in this index are thus directly related of the fluctuations to the oil price and as such by OPEC decisions. As this is their principal input for all their inputs, it is very hard for them to hedge against large fluctuations in the oil price.

First the events will be classified based on the state of the oil price adjusted for inflation as discussed above and then abnormal returns will be calculated using the mean adjusted returns model and market adjusted return model to answer the first hypothesis. Second, the events will be classified based on the state of oil price volatility and then the returns will be calculated using the mean adjusted returns model and market adjusted return model to answer the second hypothesis

5.2.1 Events classified on the oil price

The charts below represent the average abnormal return (AAR) for the event window ranging from the beginning of the event window (-20) till the end of the event window (+20). Each event was classified into one of two categories; high price (high P) or low price (low P), this classification was dependent on the state of the adjusted oil price on the day preceding the event. After having classified the meetings, the adjusted returns were calculated using one of the above mentioned models and averaged depending on their classification.

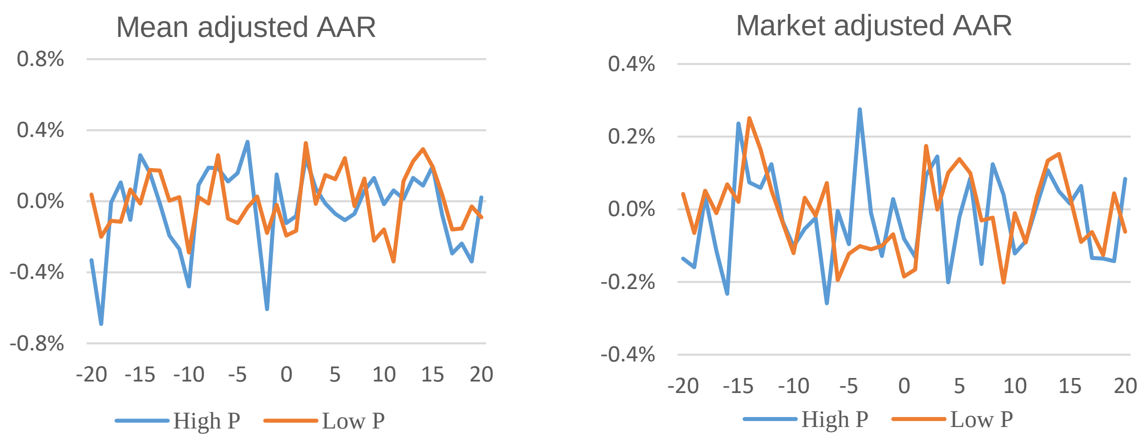


Figure 5 Oil & gas index price reaction to OPEC meetings AAR, classified on price (High P denotes a high relative oil price enviroment preceeding the event and Low P denotes a low relative oil price enviroment preceeding the event)

Both charts presented above in figure 5 show quite volatile returns. Generally, it can be seen that the abnormal returns (both positive and negative) are much larger when using the mean adjusted returns model. Below in table 3 you can find more detail on these returns and their significance from zero.

	AAR Mean Adjusted Returns Model		AAR Market Adjusted Returns Model	
	High P	Low P	High P	Low P
-20	-0.3%	-0.1%	-0.1%	-0.1%
-19	-0.7%*	0.0%	-0.2%	0.1%
-18	0.0%	0.1%	0.0%	0.1%
-17	0.1%	0.0%	-0.1%	0.0%
-16	-0.1%	0.2%	-0.2%**	0.1%
-15	0.3%	0.0%	0.2%**	0.0%
-14	0.2%	0.2%	0.1%	0.2%
-13	0.0%	0.2%	0.1%	0.2%
-12	-0.2%	0.1%	0.1%	0.1%
-11	-0.3%	-0.1%	0.0%	-0.1%
-10	-0.5%	-0.3%*	-0.1%	-0.1%
-9	0.1%	0.1%	-0.1%	0.0%
-8	0.2%	0.2%	0.0%	0.1%
-7	0.2%	0.0%	-0.3%	-0.1%
-6	0.1%	-0.2%	0.0%	-0.2%*
-5	0.2%	0.1%	-0.1%	-0.1%
-4	0.3%	0.1%	0.3%	-0.1%
-3	-0.1%	0.1%	0.0%	0.0%
-2	-0.6%**	-0.1%	-0.1%	0.1%
-1	0.2%	-0.2%	0.0%	-0.2%
0	-0.1%	-0.3%**	-0.1%	-0.2%*
1	-0.1%	0.0%	-0.1%	0.0%
2	0.2%	0.2%	0.1%	0.1%
3	0.1%	0.0%	0.1%	0.0%
4	0.0%	0.2%	-0.2%*	0.1%
5	-0.1%	0.2%	0.0%	0.2%*
6	-0.1%	0.1%	0.1%	0.0%
7	-0.1%	-0.1%	-0.2%	-0.1%
8	0.1%	0.1%	0.1%	0.0%
9	0.1%	-0.3%**	0.0%	-0.3%**
10	0.0%	-0.2%	-0.1%	-0.2%
11	0.1%	-0.1%	-0.1%	0.0%
12	0.0%	0.0%	0.0%	0.0%
13	0.1%	0.3%*	0.1%	0.2%*
14	0.1%	0.3%*	0.0%	0.2%
15	0.2%	0.1%	0.0%	0.1%
16	-0.1%	0.2%	0.1%	0.1%
17	-0.3%	0.0%	-0.1%	0.1%
18	-0.2%	-0.1%	-0.1%	0.0%
19	-0.3%	0.0%	-0.1%	0.1%
20	0.0%	-0.1%	0.1%	0.1%

Table 3 AAR results for the oil & gas index classified on price (denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, High P denotes a high relative oil price enviroment preceeding the event, and Low P denotes a low relative oil price enviroment preceeding the event)*

Mean adjusted returns model

Examining table 3, at T-10 there is a significant drop for the mean adjusted model (-0.3%), this drop is significant for the low-price environment but not for the high-price environment. Continuing with the mean adjusted model, there is a significant drop at T-2 (-0.6%) for the low-price environment while there is a similar drop on event day (-0.2%) for the high-price environment. This signifies that the market expects more from meetings in a high-price environment while this expectation is not there for the low-price environment. When the meeting does take place the market adjusts to the meeting.

Market adjusted returns model

Continuing to the market adjusted returns model, there are less significant values in the high-price environment in contrast to the low-price environment. At T-6 (-0.2%), T+0 (-0.2%) and T+5 (0.2%) there is a significant drop in abnormal return for the low-price environment this is in contrast to the high-price environment which only has a significant drop in abnormal returns on event day (-0.1%).

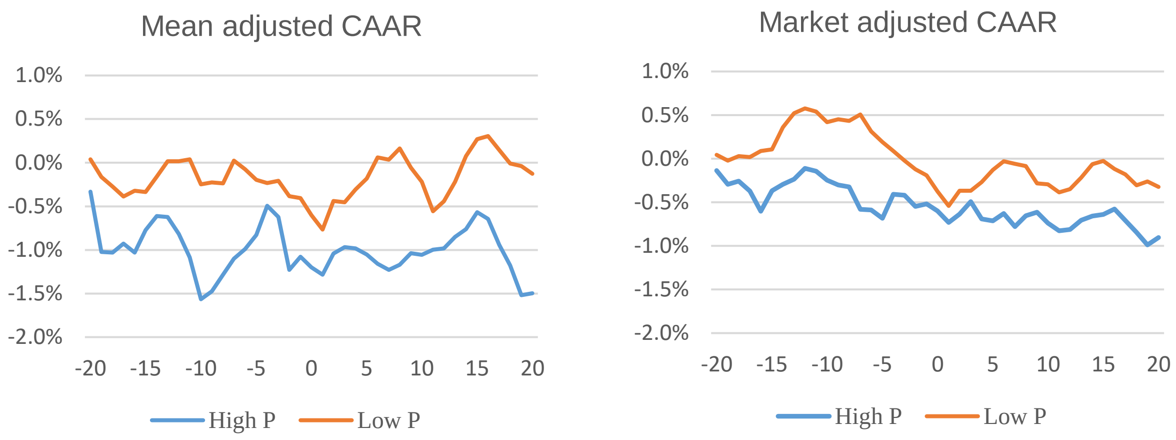


Figure 6 Oil & gas index price reaction to OPEC meetings CAAR price classification (High P denotes a high relative oil price enviroment preceeding the event and Low P denotes a low relative oil price enviroment preceeding the event)

Next the cumulative average abnormal returns (CAAR) are examined, these are calculated by taking the values seen above in table 3 and summing them starting off at the beginning of the event window (-20).

Mean adjusted returns model

When comparing both the high-price environment and low-price environment. The low-price environment has a more stable progression through time. In the high-price environment there is a positive trend from T-10 till T-4 after this positive trend there is a steep drop reaching a local minimum at T-3. The low-price environment shows a similar trend but from event day T+0 till T+8 followed by a drop till T+10.

Market adjusted returns model

In the market adjusted returns model there are not many trends which can be recognized, there is small negative trend for the low-price environment from T-9 till the event day T+0. For the high-price environment there is a general negative starting at the beginning at the start of the event window (T-20) till the end of the event window (T+20).

		Mean adj. model CAARs						Market adj. model CAARs					
		CAAR	T1	T2	T3	T4	T5	CAAR	T1	T2	T3	T4	T5
High P	(-20,20)	-1.5%	24%	14%	36%	43%	39%	-0.9%	24%	14%	36%	43%	39%
	(-10,10)	-0.2%	42%	41%	49%	43%	46%	-0.5%	42%	41%	49%	43%	46%
	(-5,5)	0.1%	44%	43%	28%	31%	43%	-0.1%	44%	43%	28%	31%	43%
Low P	(-20,20)	-0.1%	46%	44%	41%	25%	34%	-0.3%	46%	44%	41%	25%	34%
	(-10,10)	-0.1%	46%	45%	40%	25%	38%	-0.9%	46%	45%	40%	25%	38%
	(-5,5)	-0.3%	27%	24%	14%	17%	28%	-0.8%	27%	24%	14%	17%	28%

*Table 4 CAAR results for the oil & gas index classified on price (T1: Cross sectional tests T2: Crude dependence test T3: BMP test T4: Sign test T5: Wilcoxon signed rank test, * denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, High P denotes a high relative oil price enviroment preceeding the event, and Low P denotes a low relative oil price enviroment preceeding the event)*

	Equal means test				Levene test			
	Mean adj. returns		Market adj. returns		Mean adj. returns		Market adj. returns	
	T	P	T	P	W	P	W	P
(-20,20)	-0.19	42%	0.03	49%	-0.13	28%	0.02	10%
(-10,10)	-0.03	49%	0.14	44%	0.00**	2%	0.02	10%
(-5,5)	0.10	46%	0.38	35%	0.02	10%	0.01	9%

Table 5 Equal means test and Levene test on the oil & gas index classified on price (denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, T denotes T-score, W denotes F-score, and P denoted the relative probability)*

Finally, 3 different event windows are examined to see if the returns obtained during these windows are significant, as one of the questions in this thesis relates to the difference between different scenario, an equal means test and Levene test are conducted.

Mean adjusted returns model

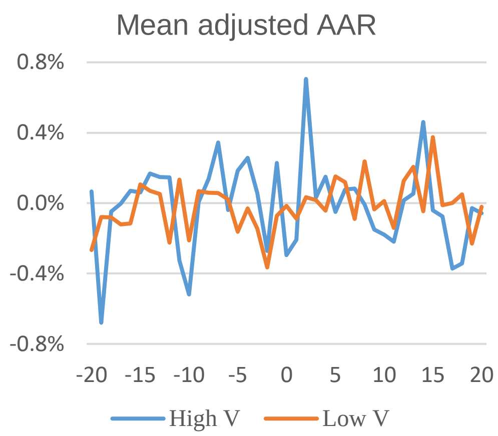
Examining the results obtained in table 4, there are only two values which come close to being significant. There is a -1.5% drop at the end of (-20,20) event window in the high-price environment, and a -0.3% at the end of the (-5,5) event window in the low-price environment, these drops are not found to be significant by any of the tests conducted, all other event windows are barely different from zero. Continuing to look at the difference of means test, there is no significant difference between any of the different price scenarios. This conclusion is reinforced using the Levene test with the exception of the (-10,10) event window.

Market adjusted returns model

In this model the same trends as in the mean adjusted returns models are apparent. There is a drop of -0.9% in the high-price environment at (-20,+20) and -0.8% in the low-price environment at (-5,5), these drops are not significant. As most of the results barely differ from zero, there is no significant difference between the different scenarios. This conclusion is reinforced using the Levene test.

5.2.2 Events classified on the oil price volatility

The charts below represent the average abnormal return (AAR) for the event window ranging from the beginning of the event window (-20) till the end of the event window (+20). Each event was classified into one of two categories; high volatility (high V) or low volatility (low V), this classification was dependent on the state of the 20-day average oil price volatility on the day preceding the event. After having classified the meetings, the adjusted returns were calculated using one of the above mentioned models and averaged depending on their classification.



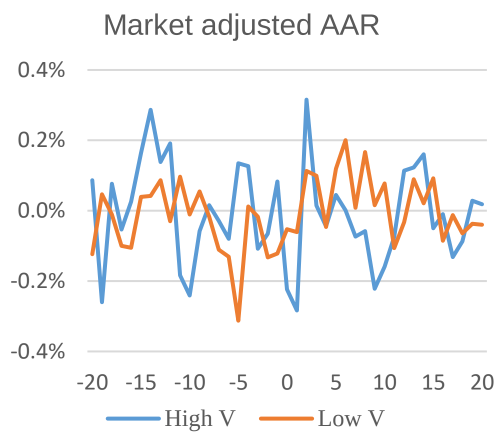


Figure 7 Oil &gas index price reaction to OPEC meetings AAR classified on volatility (High V denotes a high relative oil price volatility enviroment preceeding the event and Low V denotes a low relative oil price volatility enviroment preceeding the event)

In line with the classification methodology, the high-volatility environment is much more volatile compared to the low-volatility environment. From looking at the graphs no other clear trend can be perceived through time.

Mean adjusted returns model

In examining table 6 there is a significant negative drop of -0.5% at T-10 this drop is redeemed at T+2 with a significant increase of 0.7% in the high-volatility environment. In contrast the low-volatility environment which also has a significant drop of -0.2% at T-10, at T-2 there is another significant negative drop of -0.4%. After the event day T+0 there are no significant abnormal returns until T+15.

Market adjusted returns model

Continuing to look at the market adjusted returns model, there is a significant drop of -0.2% at T-10 and a significant abnormal return of 0.3% at T+2 in the high-volatility environment, this is similar to the mean adjusted return. In the low-volatility environment there is a significant drop of -0.3% at T-5 and -0.1% at T-2 after the event there is a significant rise of 0.1% at T+5.

	AAR Mean Adjusted Returns Model		AAR Market Adjusted Returns Model	
	High V	Low V	High V	Low V
-20	0.1%	-0.3%**	0.1%	-0.1%
-19	-0.7%**	-0.1%	-0.3%*	0.0%
-18	0.0%	-0.1%	0.1%	0.0%
-17	0.0%	-0.1%	-0.1%	-0.1%
-16	0.1%	-0.1%	0.0%	-0.1%
-15	0.1%	0.1%	0.2%	0.0%
-14	0.2%	0.1%	0.3%*	0.0%
-13	0.1%	0.1%	0.1%	0.1%
-12	0.1%	-0.2%	0.2%*	0.0%
-11	-0.3%	0.1%	-0.2%	0.1%
-10	-0.5%**	-0.2%*	-0.2%*	0.0%
-9	0.0%	0.1%	-0.1%	0.1%
-8	0.1%	0.1%	0.0%	0.0%
-7	0.3%	0.1%	0.0%	-0.1%
-6	0.0%	0.0%	-0.1%	-0.1%
-5	0.2%	-0.2%	0.1%	-0.3%***
-4	0.3%	0.0%	0.1%	0.0%
-3	0.1%	-0.1%	-0.1%	0.0%
-2	-0.3%	-0.4%***	-0.1%	-0.1%*
-1	0.2%	-0.1%	0.1%	-0.1%
0	-0.3%	0.0%	-0.2%	-0.1%
1	-0.2%	-0.1%	-0.3%	-0.1%
2	0.7%**	0.0%	0.3%***	0.1%
3	0.0%	0.0%	0.0%	0.1%
4	0.1%	0.0%	0.0%	0.0%
5	-0.1%	0.2%	0.0%	0.1%**
6	0.1%	0.1%	0.0%	0.2%
7	0.1%	-0.1%	-0.1%	0.0%
8	0.0%	0.2%	-0.1%	0.2%
9	-0.1%	0.0%	-0.2%**	0.0%
10	-0.2%	0.0%	-0.2%	0.1%
11	-0.2%	-0.1%	-0.1%	-0.1%
12	0.0%	0.1%	0.1%	0.0%
13	0.1%	0.2%	0.1%	0.1%
14	0.5%*	0.0%	0.2%	0.0%
15	0.0%	0.4%***	-0.1%	0.1%
16	-0.1%	0.0%	0.0%	-0.1%
17	-0.4%*	0.0%	-0.1%	0.0%
18	-0.3%	0.1%	-0.1%	-0.1%
19	0.0%	-0.2%	0.0%	0.0%
20	-0.1%	0.0%	0.0%	0.0%

Table 6 AAR results for the oil & gas index classified on volatility (denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, High V denotes a high relative oil price volatility enviroment preceeding the event, and Low V denotes a low relative oil price volaitiliy enviroment preceeding the event)*

Next the cumulative average abnormal returns (CAAR) are examined, these are calculated by taking the values seen above in table 6 and summing them starting off at the beginning of the event window (-20). They are then graphed through time as seen in figure 8.

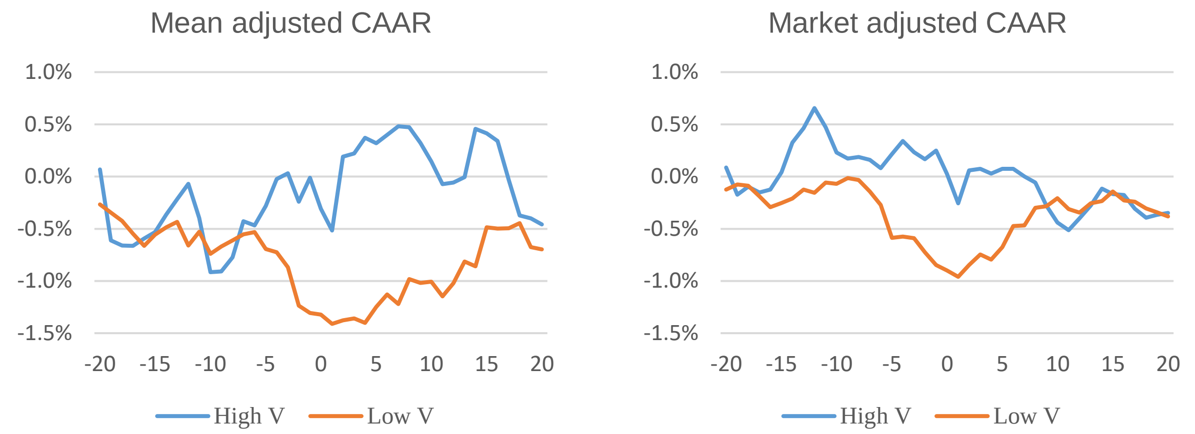


Figure 8 Oil &gas index price reaction to OPEC meetings CAAR classified on volatility (High V denotes a high relative oil price volatility enviroment preceeding the event and Low V denotes a low relative oil price volatility enviroment preceeding the event)

Mean adjusted returns model

When comparing both the high-volatility environment and low-volatility environment. Between T-20 and T-5 both environments stay in each other's proximity with more volatility in the high-volatility environment. At T-5 there is a bifurcation with the high-volatility environment having an upward trend while the low-volatility environment has a negative trend. Both environments reach their respective maximum/minimum at T+5 and then meet again at T+20.

Market adjusted returns model

In the market adjusted returns model a similar bifurcation can be seen in this time frame, but this time to a much lesser extent and instead of meeting at the end of the time frame the two scenarios meet around T+10.

		Mean adj. model CAARs						Market adj. model CAARs					
		CAAR	T1	T2	T3	T4	T5	CAAR	T1	T2	T3	T4	T5
High V	(-20,20)	-0.5%	40%	36%	48%	44%	46%	-0.3%	38%	34%	37%	8%	27%
	(-10,10)	0.4%	36%	33%	35%	44%	42%	-0.9%	11%	7%	26%	22%	48%
	(-5,5)	0.8%	12%	11%	30%	44%	27%	-0.1%	49%	38%	34%	14%	25%
Low V	(-20,20)	-0.7%	29%	45%	47%	34%	43%	-0.4%	31%	27%	23%	44%	49%
	(-10,10)	-0.4%	34%	47%	48%	34%	41%	-0.1%	42%	38%	42%	16%	19%
	(-5,5)	-0.8%	8%	4%*	33%	34%	48%	-0.7%	6%	2%**	11%	16%	39%

*Table 7 CAAR results for the oil & gas index classified on volatility (T1: Cross sectional tests T2: Crude dependence test T3: BMP test T4: Sign test T5: Wilcoxon signed rank test, * denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, High V denotes a high relative oil price volatility enviroment preceeding the event, and Low V denotes a low relative oil price volatility enviroment preceeding the event)*

	Equal means test				Levene test			
	Mean adj. returns		Market adj. returns		Mean adj. returns		Market adj. returns	
	T	P	T	P	W	P	W	P
(-20,20)	-0.19	42%	0.03	49%	-0.13	28%	∞	100%
(-10,10)	-0.03	49%	0.14	44%	0.00**	2%	∞	100%
(-5,5)	0.10	46%	0.38	35%	0.02	10%	∞	100%

Table 8 Equal means test and Levene test on the oil & gas index classified on volatility (denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, T denotes T-score, W denotes F-score, and P denoted the relative probability)*

Finally, 3 different event windows are examined to see if the returns obtained during these windows are significant, as one of the questions in this thesis relates to the difference between different scenario, an equal means test and Levene test are conducted.

Mean adjusted returns model

Examining the results obtained in table 7, there is only one event window which comes close to being significant. In the (-5,5) event window for the low-volatility environment there is a CAAR of 0.8%, while in the high-volatility environment this is -0.8%. Only the high-volatility environment is deemed significant by the crude dependence test. Most other results are not significantly different from zero, as deemed by the battery of tests conducted. Due to the insignificant results presented in table 7, the equal means test doesn't present any significant results. The Levene test reinforces these conclusions with the exception for the (-10,10) event window.

Market adjusted returns model

In this model, the event window of (-5,5) in the low-volatility environment also has a significant CAAR of -0.7% (significant using the crude dependence test) but this is not present in the high-volatility environment as in the mean adjusted model. Instead there is also an almost significant value for the (-10,10) event window in the high-volatility environment. As in the other model, due to the insignificant results, the equal means test doesn't present any significant results. The Levene test reinforces these conclusions.

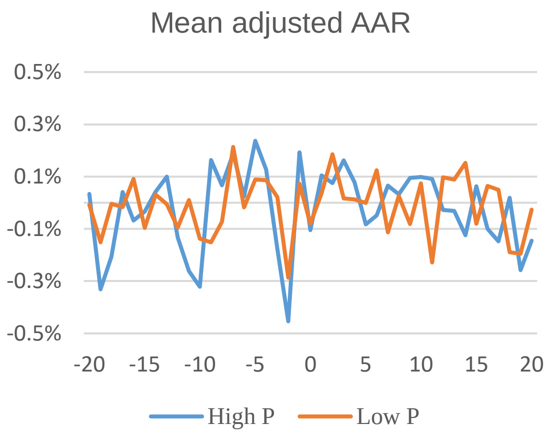
5.3 Utilities index

Next the utilities industry will be analysed, this is an industry strongly related to the oil price, globally 31.3% of primary energy is produced by oil (International Energy Agency, 2016). This industry index is composed of market listed utility companies; these not only include electricity & gas providers but also water providers but these are in the minority. Quite often utility companies are attached to long term contracts for their inputs which give them little leeway in the pricing towards consumers. Despite big price changes not directly impacting their prices they do have an influence on their long-term business.

First the events will be classified based on the state of the oil price adjusted for inflation as discussed above and then the adjusted returns model will be calculated using the mean adjusted returns model or market adjusted return model to answer the first hypothesis. Second, the events will be classified based on the state of oil price volatility and then abnormal returns will again be calculated using the mean adjusted returns model or market adjusted return model to answer the second hypothesis.

5.3.1 Events classified on the oil price

The charts below represent the average abnormal return (AAR) for the event window ranging from the beginning of the event window (-20) till the end of the event window (+20). Each event was classified into one of two categories; high price (high P) or low price (low P), this classification was dependent on the state of the adjusted oil price on the day preceding the event. After having classified the meetings, the adjusted returns were calculated using one of the above mentioned models and averaged depending on their classification.



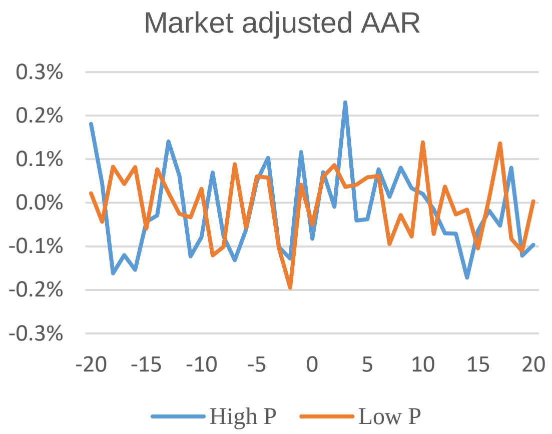


Figure 9 Utilities index price reaction to OPEC meetings AAR classified on price (High P denotes a high relative oil price enviroment preceeding the event and Low P denotes a low relative oil price enviroment preceeding the event)

The figures above represent the AAR at each moment of time. Generally, the price scenarios follow each other and there is no clear difference to be seen from the two environments.

Mean adjusted returns model

In examining table 9 there is a significant negative drop of -0.5% in abnormal returns at T-2 in the high-price environment, this drop is also present in the low-price environment but is only -0.3% (but still significant). In addition, in the low-price environment there is a drop at T-7 (-0.2%) and a significant rise at T+2 (0.2%).

Market adjusted returns model

Continuing to look at the market adjusted returns model, there is a significant drop in abnormal returns of -0.1% at T-3 and a significant abnormal return of 0.2% at T+3 in the high-price environment,. In the low-price environment there is a significant drop of -0.2% at T-2 (similar to the mean adjusted returns model).

	AAR Mean Adjusted Returns Model		AAR Market Adjusted Returns Model	
	High P	Low P	High P	Low P
-20	0.0%	0.0%	0.2%	0.0%
-19	-0.3%*	-0.2%	0.0%	0.0%
-18	-0.2%	0.0%	-0.2%*	0.1%
-17	0.0%	0.0%	-0.1%*	0.0%
-16	-0.1%	0.1%	-0.2%**	0.1%
-15	0.0%	-0.1%	0.0%	-0.1%
-14	0.0%	0.0%	0.0%	0.1%
-13	0.1%	0.0%	0.1%**	0.0%
-12	-0.1%	-0.1%	0.1%	0.0%
-11	-0.3%	0.0%	-0.1%	0.0%
-10	-0.3%	-0.1%	-0.1%	0.0%
-9	0.2%	-0.2%	0.1%	-0.1%
-8	0.1%	-0.1%	-0.1%	-0.1%
-7	0.2%	0.2%*	-0.1%	0.1%
-6	0.0%	0.0%	-0.1%	-0.1%
-5	0.2%	0.1%	0.0%	0.1%
-4	0.1%	0.1%	0.1%	0.1%
-3	-0.2%	0.0%	-0.1%*	-0.1%
-2	-0.5%**	-0.3%**	-0.1%	-0.2%**
-1	0.2%	0.1%	0.1%	0.0%
0	-0.1%	-0.1%	-0.1%	-0.1%
1	0.1%	0.0%	0.1%	0.1%
2	0.1%	0.2%*	0.0%	0.1%
3	0.2%	0.0%	0.2%**	0.0%
4	0.1%	0.0%	0.0%	0.0%
5	-0.1%	0.0%	0.0%	0.1%
6	0.0%	0.1%	0.1%	0.1%
7	0.1%	-0.1%	0.0%	-0.1%
8	0.0%	0.0%	0.1%	0.0%
9	0.1%	-0.1%	0.0%	-0.1%
10	0.1%	0.1%	0.0%	0.1%
11	0.1%	-0.2%**	0.0%	-0.1%
12	0.0%	0.1%	-0.1%	0.0%
13	0.0%	0.1%	-0.1%	0.0%
14	-0.1%	0.2%	-0.2%*	0.0%
15	0.1%	-0.1%	-0.1%	-0.1%
16	-0.1%	0.1%	0.0%	0.0%
17	-0.1%	0.0%	-0.1%	0.1%*
18	0.0%	-0.2%	0.1%	-0.1%
19	-0.3%	-0.2%	-0.1%	-0.1%
20	-0.1%	0.0%	-0.1%	0.0%

Table 9 AAR results for the utilities index classified on price (denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, High P denotes a high relative oil price enviroment preceeding the event, and Low P denotes a low relative oil price enviroment preceeding the event)*

Next the cumulative average abnormal returns (CAAR) are examined, these are calculated by taking the values seen above in table 9 and summing them starting off at the beginning of the event window (-20). This progression is charted in figure 10.

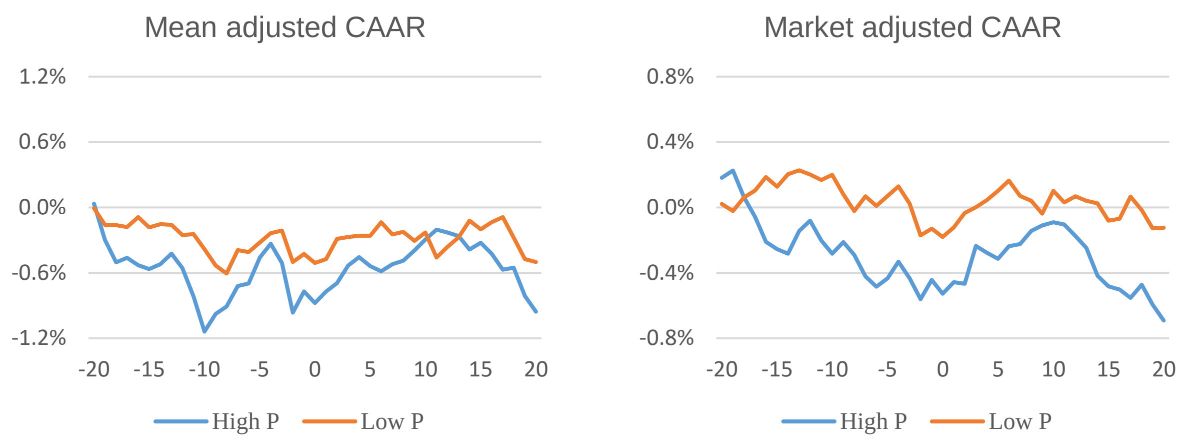


Figure 10 Utilities index price reaction to OPEC meetings CAAR classified on price (High P denotes a high relative oil price enviroment preceeding the event and Low P denotes a low relative oil price enviroment preceeding the event)

Mean adjusted returns model

When comparing both the high-price environment and low-price environment. The high-price graph is a lot more volatile than the low-price graph. The trends which can be seen in the high-price environment can also be seen in the low-price environment but less extreme. There is a negative trend from T-15 till T-10 followed by an upwards movement till T-3 with another drop just before the event date. After the event date there is a general upward trend.

Market adjusted returns model

In the market adjusted returns model again the two graphs closely follow each other. There is a bifurcation at T-20 opening up a gap between the two environments but at T-13 the two environments move in unity.

		Mean adj. model CAARs						Market adj. model CAARs					
		CAAR	T1	T2	T3	T4	T5	CAAR	T1	T2	T3	T4	T5
High P	(-20,20)	-1.0%	24%	14%	42%	31%	35%	-0.7%	24%	14%	42%	31%	35%
	(-10,10)	0.2%	42%	40%	42%	4%*	10%	0.0%	42%	40%	42%	4%*	10%
	(-5,5)	0.3%	32%	28%	44%	43%	30%	0.1%	32%	28%	44%	43%	30%
Low P	(-20,20)	-0.5%	30%	24%	39%	17%	33%	-0.1%	30%	24%	39%	17%	33%
	(-10,10)	-0.1%	46%	46%	50%	34%	32%	-0.2%	46%	46%	50%	34%	32%
	(-5,5)	0.1%	38%	35%	42%	12%	28%	0.0%	38%	35%	42%	12%	28%

*Table 10 CAAR results for the utilities index classified on price (T1: Cross sectional tests T2: Crude dependence test T3: BMP test T4: Sign test T5: Wilcoxon signed rank test, * denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, High P denotes a high relative oil price enviroment preceeding the event, and Low P denotes a low relative oil price enviroment preceeding the event)*

	Equal means test				Levene test			
	Mean adj. returns		Market adj. returns		Mean adj. returns		Market adj. returns	
	T	P	T	P	W	P	W	P
(-20,20)	-0.08	47%	-0.13	45%	-0.01	9%	0.01	8%
(-10,10)	0.05	48%	0.05	48%	-4.00	85%	0.00	3%*
(-5,5)	0.03	49%	0.06	48%	0.00	2%**	0.00	2%**

Table 11 Equal means test and Levene test on the utilities index classified on price (denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, T denotes T-score, W denotes F-score, and P denoted the relative probability)*

Finally, 3 different event windows are examined to see if the returns obtained during these windows are significant, as one of the questions in this thesis relates to the difference between different scenario, an equal means test and Levene test are conducted.

Mean adjusted returns model

Examining the results obtained in table 10, there are only two values which come close to being significant. There is a -1.0% drop at the end of (-20,20) event window in the high-price environment, and a -0.5% at the end of the (-20,20) event window in the low-price environment, these drops are not found to be significant by any of the tests conducted, there are is a significant test for the high-price environment in the (-10,10) event window but this is a non-parametric test and it is not confirmed by any of the parametric tests. Continuing to look at the difference of mean test, there is no significant difference between any of the different price scenarios. This test is reinforced by the Levene test except in the (-5,5) event window.

Market adjusted returns model

In this model the same trends as in the mean adjusted returns models are apparent. There is a drop of -0.7% in the high-price environment at (-20,+20) and -0.1% in the low-price environment at (-20,20), these drops are not significant. Again there is a significant result for the low-price environment (-10,10) but this is again only a non-parametric test. As most of the results barely differ from zero, there is no significant difference between the different scenarios. This conclusion is reduced in power as the variance between two samples is different, except in the (-20,20) event window as seen in the Levene test.

5.3.2 Events classified on the oil price volatility

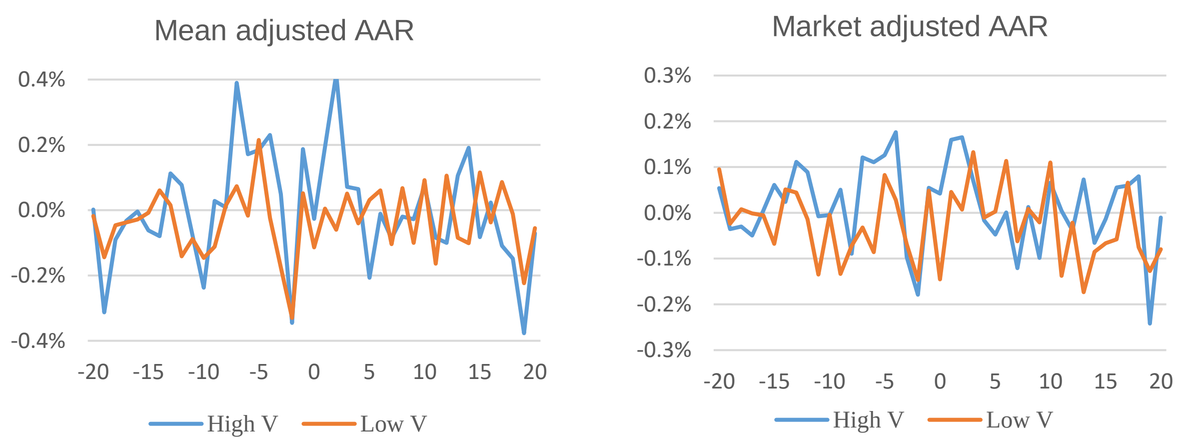


Figure 11 Utilities index price reaction to OPEC meetings AAR classified on volatility (High V denotes a high relative oil price volatility enviroment preceeding the event and Low V denotes a low relative oil price volatility enviroment preceeding the event)

The charts in figure 11 represent the average abnormal return (AAR) for the event window ranging from the beginning of the event window (-20) till the end of the event window (+20). Each event was classified into one of two categories; high volatility (high V) or low volatility (low V), this classification was dependent on the state of the 20-day average oil price volatility on the day preceding the event. After having classified the meetings, the adjusted returns were calculated using one of the above mentioned models and averaged depending on their classification.

As consistent with the other indexes examined there is more volatility present in the mean adjusted returns. In both models the two scenarios follow each other closely.

	AAR Mean Adjusted Returns Model		AAR Market Adjusted Returns Model	
	High V	Low V	High V	Low V
-20	0.0%	0.0%	0.1%	0.1%
-19	-0.3%*	-0.1%	0.0%	0.0%
-18	-0.1%	0.0%	0.0%	0.0%
-17	0.0%	0.0%	0.0%	0.0%
-16	0.0%	0.0%	0.0%	0.0%
-15	-0.1%	0.0%	0.1%	-0.1%
-14	-0.1%	0.1%	0.0%	0.1%
-13	0.1%	0.0%	0.1%	0.0%
-12	0.1%	-0.1%	0.1%	0.0%
-11	-0.1%	-0.1%	0.0%	-0.1%**
-10	-0.2%	-0.1%	0.0%	0.0%
-9	0.0%	-0.1%	0.1%	-0.1%
-8	0.0%	0.0%	-0.1%	-0.1%
-7	0.4%*	0.1%	0.1%	0.0%
-6	0.2%	0.0%	0.1%	-0.1%**
-5	0.2%	0.2%*	0.1%	0.1%
-4	0.2%	0.0%	0.2%*	0.0%
-3	0.0%	-0.2%*	-0.1%	-0.1%
-2	-0.3%*	-0.3%***	-0.2%*	-0.1%**
-1	0.2%*	0.1%	0.1%	0.0%
0	0.0%	-0.1%	0.0%	-0.1%*
1	0.2%	0.0%	0.2%	0.0%
2	0.4%**	-0.1%	0.2%*	0.0%
3	0.1%	0.1%	0.1%	0.1%*
4	0.1%	0.0%	0.0%	0.0%
5	-0.2%	0.0%	0.0%	0.0%
6	0.0%	0.1%	0.0%	0.1%
7	-0.1%	-0.1%	-0.1%	-0.1%
8	0.0%	0.1%	0.0%	0.0%
9	0.0%	-0.1%	-0.1%	0.0%
10	0.1%	0.1%	0.1%	0.1%*
11	-0.1%	-0.2%	0.0%	-0.1%**
12	-0.1%	0.1%	0.0%	0.0%
13	0.1%	-0.1%	0.1%	-0.2%*
14	0.2%	-0.1%	-0.1%	-0.1%
15	-0.1%	0.1%	0.0%	-0.1%
16	0.0%	0.0%	0.1%	-0.1%
17	-0.1%	0.1%	0.1%	0.1%
18	-0.1%	0.0%	0.1%	-0.1%
19	-0.4%*	-0.2%	-0.2%*	-0.1%
20	-0.1%	-0.1%	0.0%	-0.1%

Table 12 AAR results for the utilities index classified on volatility (denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, High V denotes a high relative oil price volatility enviroment preceeding the event, and Low V denotes a low relative oil price volatility enviroment preceeding the event)*

Mean adjusted returns model

In examining table 12 there is a significant negative drop of -0.3% in abnormal returns at T-2 in both environments, there are also abnormal returns present at T-1 (0.2%) and at T+2 (0.4%) in the high-volatility environment. In the low volatility-environment, there are also abnormal returns present at T-5 (0.2%) and at T-3 (-0.2%).

Market adjusted returns model

Continuing to look at the market adjusted returns model, there are again abnormal returns at T-2 for both models, -0.2% (high V) and -0.1% (low V). In the high-volatility environment there are abnormal returns at T-4 (-0.2%) and at T+2 (0.2%). In the low-volatility environment there are abnormal returns at T-6 (-0.1%), event day T+0 (-0.1%) and at T+3 (0.1%).

Next the cumulative average abnormal returns (CAAR) are examined, these are calculated by taking the values seen above in table 9 and summing them starting off at the beginning of the event window (-20).

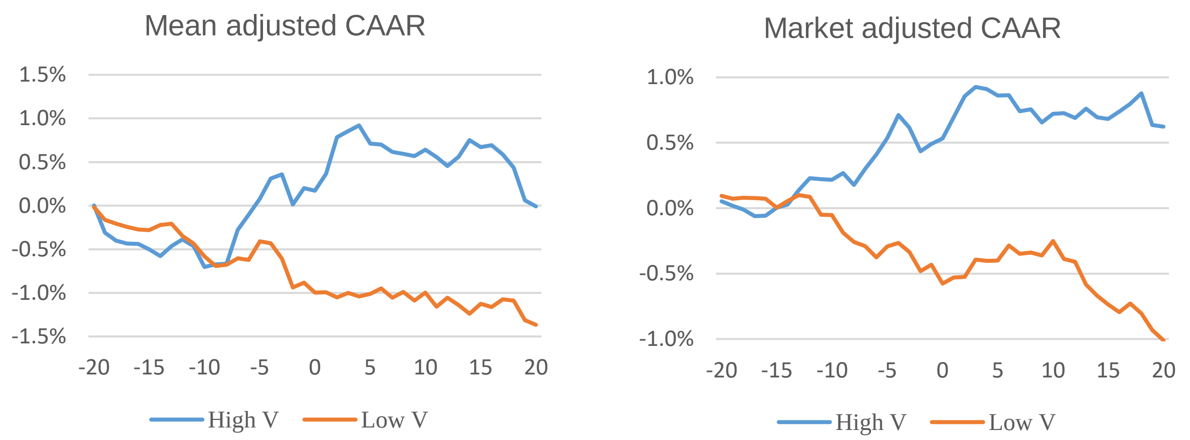


Figure 12 Utilities index price reaction to OPEC meetings CAAR classified on volatility (High V denotes a high relative oil price volatility enviroment preceeding the event and Low V denotes a low relative oil price volatility enviroment preceeding the event)

Mean adjusted returns model

When comparing both the high-volatility environment and low-price environment. The two graphs are closely interlinked until T-11 when there is a big bifurcation. The low-volatility graph shows a negative trend until event day T+0 this is in contrast to the high-volatility environment which has an upward trend until T+2. After these trends the two graphs move in unison.

Market adjusted returns model

In the market adjusted returns model, similar trends are present as in the mean adjusted returns model. But in this model the bifurcation takes place around T-15, with the low-volatility environment taking a nose dive while the high-volatility environment has a positive trend.

		Mean adj. model CAARs						Market adj. model CAARs					
		CAAR	T1	T2	T3	T4	T5	CAAR	T1	T2	T3	T4	T5
High V	(-20,20)	0.0%	50%	50%	33%	32%	31%	0.6%	25%	11%	22%	44%	47%
	(-10,10)	1.0%	10%	8%	21%	14%	35%	0.4%	21%	12%	25%	22%	34%
	(-5,5)	1.2%	1%**	1%**	6%	5%*	32%	0.6%	42%	1%**	15%	32%	41%
Low V	(-20,20)	-1.4%	8%	39%	30%	16%	37%	-1.0%	6%	1%**	4%*	6%	29%
	(-10,10)	-0.7%	14%	41%	31%	44%	27%	-0.4%	12%	7%	9%	2%*	11%
	(-5,5)	-0.4%	18%	12%	27%	34%	40%	-0.1%	35%	31%	45%	16%	25%

Table 13 CAAR results for the utilities index classified on volatility (T1: Cross sectional tests T2: Crude dependence test T3: BMP test T4: Sign test T5: Wilcoxon signed rank test (denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, High V denotes a high relative oil price volatility enviroment preceeding the event, and Low V denotes a low relative oil price volatility enviroment preceeding the event)*

	Equal means test				Levene test			
	Mean adj. returns		Market adj. returns		Mean adj. returns		Market adj. returns	
	T	P	T	P	W	P	W	P
(-20,20)	0.23	41%	0.34	37%	∞	100%	∞	100%
(-10,10)	0.38	35%	0.24	41%	-0.07	21%	∞	100%
(-5,5)	0.43	33%	0.23	41%	∞	100%	∞	100%

Table 14 Equal means test and Levene test on the utilities index classified on volatility (denotes significance at 10%, ** denotes significance at 5%, and *** denotes significance at 1%, T denotes T-score, W denotes F-score, and P denoted the relative probability)*

Finally, 3 different event windows are examined to see if the returns obtained during these windows are significant, as one of the questions in this thesis relates to the difference between different scenario, an equal means test and Levene test are conducted.

Mean adjusted returns model

Examining the results obtained in table 13, there are a lot more variables which are deemed significant by some of the tests conducted. For all the event windows examined with the exception of the long event window (-20,20) in the high-volatility environment, the tests conducted come close to being deemed significant. The only event window witch is actually significant is the (-5,5) event window in the high-volatility environment (-1.2%) which is deemed significant by 3 out of the 5 tests conducted. In the difference of mean test, there are again little significant values to be found. These tests are reinforced using the Levene test.

Market adjusted returns model

In the market adjusted returns model, we don't see the same pattern as in the previous model. This time the high-volatility environment at (-20,20) is closer to being significant. The only values which are significant are the high-volatility environment at (-5,5) by the crude dependence test and low-volatility environment at (-20,20) by the crude dependence test and the BMP test and at (-10,10) by the sign test. Again the results of the equal means test are inconclusive and reinforced by the Levene test.

5.4 Basic materials index

The next index to be analysed in this thesis is an index constructed of basic material producers. This index is mostly comprised of companies that have a focus on mining and the production of chemical. These companies are remotely connected to the oil price and OPEC price decisions, due to oil and oil based products being a large part of their input costs.

5.4.1 Events classified on the oil price

The charts below represent the average abnormal return (AAR) for the event window ranging from the beginning of the event window (-20) till the end of the event window (+20). Each event was classified into one of two categories; high price (high P) or low price (low P), this classification was dependent on the state of the adjusted oil price on the day preceding the event. After having classified the meetings, the adjusted returns were calculated using one of the above mentioned models and averaged depending on their classification.

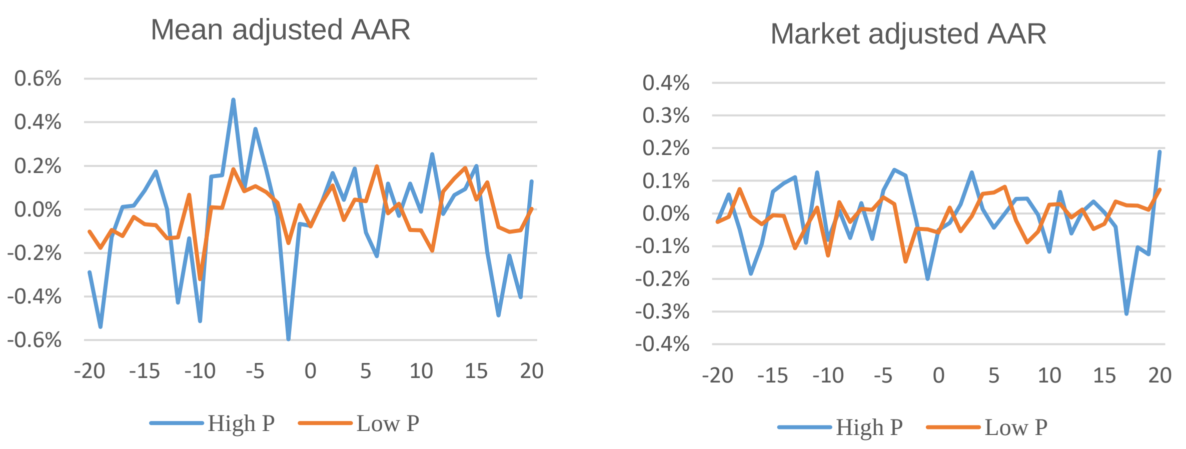


Figure 13 Basic materials index price reaction to OPEC meetings AAR classified on price (High P denotes a high relative oil price enviroment preceeding the event, Low P denotes a low relative oil price enviroment preceeding the event)

Both charts presented above in figure 13 show quite volatile returns. Generally, it can be seen that the abnormal returns (both positive and negative) are much larger when using the mean adjusted returns model, this is in line with the other indexes examined previously Below in table 15 you can find more detail on these returns and their significance from zero.

	AAR Mean Adjusted Returns Model		AAR Market Adjusted Returns Model	
	High P	Low P	High P	Low P
-20	-0.3%	-0.1%	0.0%	0.0%
-19	-0.5%	-0.2%	0.1%	0.0%
-18	-0.1%	-0.1%	0.0%	0.1%
-17	0.0%	-0.1%	-0.2%*	0.0%
-16	0.0%	0.0%	-0.1%	0.0%
-15	0.1%	-0.1%	0.1%	0.0%
-14	0.2%	-0.1%	0.1%	0.0%
-13	0.0%	-0.1%	0.1%	-0.1%
-12	-0.4%	-0.1%	-0.1%	0.0%
-11	-0.1%	0.1%	0.1%	0.0%
-10	-0.5%*	-0.3%**	-0.1%	-0.1%**
-9	0.2%	0.0%	0.0%	0.0%
-8	0.2%	0.0%	-0.1%	0.0%
-7	0.5%	0.2%	0.0%	0.0%
-6	0.1%	0.1%	-0.1%	0.0%
-5	0.4%	0.1%	0.1%	0.0%
-4	0.2%	0.1%	0.1%	0.0%
-3	0.0%	0.0%	0.1%*	-0.1%*
-2	-0.6%*	-0.2%	0.0%	0.0%
-1	-0.1%	0.0%	-0.2%*	0.0%
0	-0.1%	-0.1%	0.0%	-0.1%
1	0.0%	0.0%	0.0%	0.0%
2	0.2%	0.1%	0.0%	-0.1%
3	0.0%	0.0%	0.1%	0.0%
4	0.2%	0.0%	0.0%	0.1%
5	-0.1%	0.0%	0.0%	0.1%
6	-0.2%	0.2%	0.0%	0.1%
7	0.1%	0.0%	0.0%	0.0%
8	0.0%	0.0%	0.0%	-0.1%**
9	0.1%	-0.1%	0.0%	-0.1%
10	0.0%	-0.1%	-0.1%	0.0%
11	0.3%	-0.2%	0.1%	0.0%
12	0.0%	0.1%	-0.1%	0.0%
13	0.1%	0.1%	0.0%	0.0%
14	0.1%	0.2%	0.0%	0.0%
15	0.2%	0.0%	0.0%	0.0%
16	-0.2%	0.1%	0.0%	0.0%
17	-0.5%*	-0.1%	-0.3%**	0.0%
18	-0.2%	-0.1%	-0.1%*	0.0%
19	-0.4%	-0.1%	-0.1%	0.0%
20	-0.3%	-0.1%	0.2%**	0.1%

Table 15 AAR results for the basic materials index classified on price (denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, High P denotes a high relative oil price enviroment preceeding the event, and Low P denotes a low relative oil price enviroment preceeding the event)*

Mean adjusted returns model

Examining table 15 in a high-price environment there are significant abnormal returns at T-10 (-0.5%) and at T-2 (-0.6%), in the low-price there is also an significant abnormal return at T-10 (-0.3%). All other values do not differ significantly from zero.

Market adjusted returns model

Continuing to the market adjusted returns, there are more significant results. In the high-price environment there are significant abnormal returns at T-3 (0.1%) and at T-1 (-0.2%). Looking at the low-price environment there is again a significant abnormal return at T-3 (-0.1%), but there are also significant abnormal returns at T-10 (-0.1%) and at T-8 (-0.1).

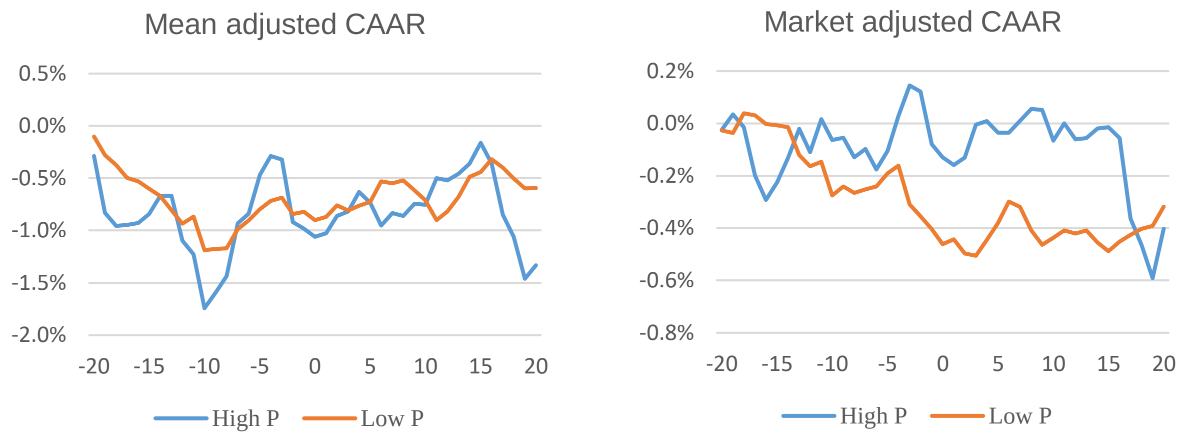


Figure 14 Basic materials index price reaction to OPEC meetings CAAR classified on price (High P denotes a high relative oil price enviroment preceeding the event, Low P denotes a low relative oil price enviroment preceeding the event)

Next the cumulative average abnormal returns (CAAR) are examined, these are calculated by taking the values seen above in table 15 and summing them starting off at the beginning of the event window (-20).

Mean adjusted returns model

In the market adjusted returns model the two environments closely move in unison except at T-14 when the high-price environment shows a negative trend reaching a minimum at T-10 and rebounding to a maximum at T-3, after reaching this maximum it falls again to meet the low-price environment around event day. After event day the two lines mostly move in unison except at T+15.

Market adjusted returns model

Looking at the graphs, the environments move in unison till T-5 when the high-price environment show an upwards trend, but after this short move the two graphs move in unison till T+15, when the high-price environment comes crashing down and join the low-price environment towards the end of the event window.

		Mean adj. model CAARs						Market adj. model CAARs					
		CAAR	T1	T2	T3	T4	T5	CAAR	T1	T2	T3	T4	T5
High P	(-20,20)	-1.3%	31%	17%	29%	31%	37%	-0.4%	31%	17%	29%	31%	37%
	(-10,10)	0.4%	40%	36%	40%	43%	46%	0.2%	40%	36%	40%	43%	46%
	(-5,5)	0.3%	37%	34%	28%	43%	37%	0.1%	37%	34%	28%	43%	37%
Low P	(-20,20)	-0.6%	31%	24%	10%	25%	46%	-0.3%	31%	24%	10%	25%	46%
	(-10,10)	0.3%	36%	30%	30%	45%	45%	-0.3%	36%	30%	30%	45%	45%
	(-5,5)	0.2%	36%	30%	13%	25%	29%	-0.2%	36%	30%	13%	25%	29%

*Table 16 CAAR results for the basic materials index classified on price (T1: Cross sectional tests T2: Crude dependence test T3: BMP test T4: Sign test T5: Wilcoxon signed rank test, * denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, High P denotes a high relative oil price enviroment preceeding the event, and Low P denotes a low relative oil price enviroment preceeding the event)*

	Equal means test				Levene test			
	Mean adj. returns		Market adj. returns		Mean adj. returns		Market adj. returns	
	T	P	T	P	W	P	W	P
(-20,20)	-0.09	46%	-0.02	49%	-0.02	11%	0.05	17%
(-10,10)	0.01	50%	0.13	45%	0.00**	1%	1.83	82%
(-5,5)	0.02	49%	0.09	46%	0.00**	2%	0.10	25%

Table 17 Equal means test and Levene test on the basic materials index classified on price (denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, T denotes T-score, W denotes F-score, and P denoted the relative probability)*

Finally, 3 different event windows are examined to see if the returns obtained during these windows are significant, as one of the questions in this thesis relates to the difference between different scenario, an equal means test and Levene test are conducted.

Mean adjusted returns model

Examining the results obtained in table 16, all of the values obtained cannot be considered significantly different from zero. One CAAR that can be highlighted is the high-price environment at (-20,20) which has a CAAR of -1.3%. Continuing to look at the difference of mean test, there is no significant difference between any of the different price scenarios. This conclusion is not reinforced by using the Levene test as the variance between the two samples is significantly different in the case of (-10,10) and (-5,5).

Market adjusted returns model

In this model the same trends as in the mean adjusted returns models are apparent. None of the results are significantly different from zero. But this time the low-price environment at (-20,20) comes close. Continuing to look at the difference of means test, there is no significant difference between any of the different price scenarios. This conclusion is reinforced by using the Levene test.

5.4.2 Events classified on the oil price volatility

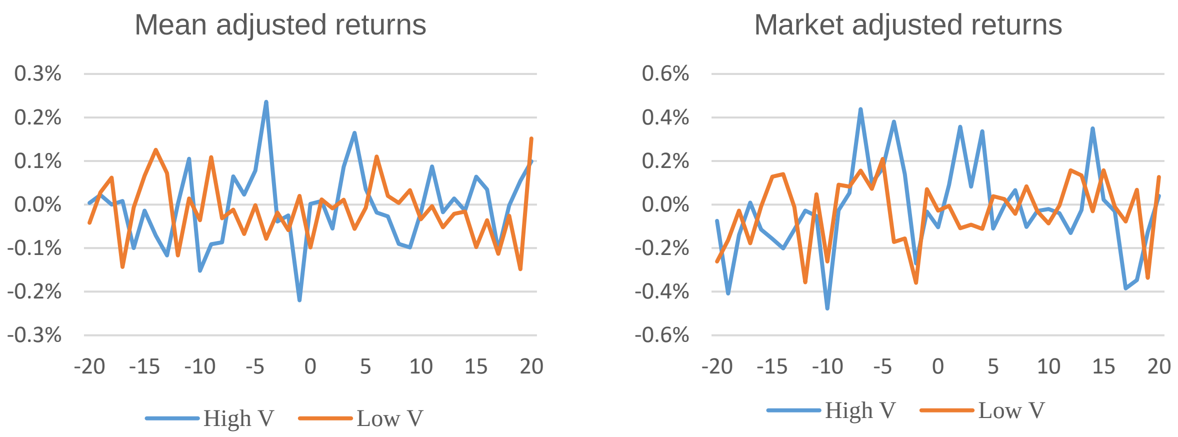


Figure 15 Basic materials index price reaction to OPEC meetings AAR classified on volatility (High V denotes a high relative oil price volatility enviroment preceeding the event and Low V denotes a low relative oil price volatility enviroment preceeding the event)

The charts above represent the average abnormal return (AAR) for the event window ranging from the beginning of the event window (-20) till the end of the event window (+20). Each event was classified into one of two categories; high volatility (high V) or low volatility (low V), this classification was dependent on the state of the 20-day average oil price volatility on the day preceding the event. After having classified the meetings, the adjusted returns were calculated using one of the above mentioned models and averaged depending on their classification.

Both graphs are quite volatile with the high-volatility scenario being even more volatile, in general the two scenarios closely track each other.

	AAR Mean Adjusted Returns Model		AAR Market Adjusted Returns Model	
	High V	Low V	High V	Low V
-20	-0.1%	-0.3%**	0.0%	0.0%
-19	-0.4%	-0.2%	0.0%	0.0%
-18	-0.1%	0.0%	0.0%	0.1%
-17	0.0%	-0.2%	0.0%	-0.1%*
-16	-0.1%	0.0%	-0.1%	0.0%
-15	-0.2%	0.1%	0.0%	0.1%
-14	-0.2%	0.1%	-0.1%	0.1%*
-13	-0.1%	0.0%	-0.1%	0.1%
-12	0.0%	-0.4%**	0.0%	-0.1%*
-11	-0.1%	0.0%	0.1%	0.0%
-10	-0.5%*	-0.3%**	-0.2%*	0.0%
-9	0.0%	0.1%	-0.1%	0.1%
-8	0.1%	0.1%	-0.1%	0.0%
-7	0.4%	0.2%	0.1%	0.0%
-6	0.1%	0.1%	0.0%	-0.1%
-5	0.2%	0.2%	0.1%	0.0%
-4	0.4%*	-0.2%	0.2%**	-0.1%
-3	0.1%	-0.2%	0.0%	0.0%
-2	-0.3%	-0.4%***	0.0%	-0.1%
-1	0.0%	0.1%	-0.2%**	0.0%
0	-0.1%	0.0%	0.0%	-0.1%
1	0.1%	0.0%	0.0%	0.0%
2	0.4%	-0.1%	-0.1%	0.0%
3	0.1%	-0.1%	0.1%	0.0%
4	0.3%	-0.1%	0.2%	-0.1%
5	-0.1%	0.0%	0.0%	0.0%
6	0.0%	0.0%	0.0%	0.1%*
7	0.1%	0.0%	0.0%	0.0%
8	-0.1%	0.1%	-0.1%	0.0%
9	0.0%	0.0%	-0.1%	0.0%
10	0.0%	-0.1%	0.0%	0.0%
11	0.0%	0.0%	0.1%	0.0%
12	-0.1%	0.2%	0.0%	-0.1%
13	0.0%	0.1%	0.0%	0.0%
14	0.4%	0.0%	0.0%	0.0%
15	0.0%	0.2%	0.1%	-0.1%
16	0.0%	0.0%	0.0%	0.0%
17	-0.4%*	-0.1%	-0.1%	-0.1%
18	-0.3%	0.1%	0.0%	0.0%
19	-0.1%	-0.3%	0.1%	-0.1%*
20	0.0%	0.1%	0.1%	0.2%***

Table 18 AAR results for basic materials index classified on volatility (denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, High V denotes a high relative oil price volatility enviroment preceeding the event, and Low V denotes a low relative oil price volatility enviroment preceeding the event)*

Mean adjusted returns model

In examining table 18 there is a significant negative drop in abnormal returns at T-10 in both environments, -0.5% for the high-volatility environment and -0.3% in the low-volatility environment. In addition, there are significant abnormal returns present at T-4 (0.4%) in the high-volatility environment. In the low volatility-environment, there are also abnormal returns present at T-2 (-0.2%).

Market adjusted returns model

Continuing to look at the market adjusted returns model, there are significant abnormal returns at T-10 (-0.2%), at T-4 (0.2%%) and at T-1 (-0.2%) in the high-volatility environment, after the event none of the events are significant. In the low-volatility environment there are significant abnormal returns at T+6 (0.1%).

Next the cumulative average abnormal returns (CAAR) are examined, these are calculated by taking the values seen above in table 9 and summing them starting off at the beginning of the event window (-20).

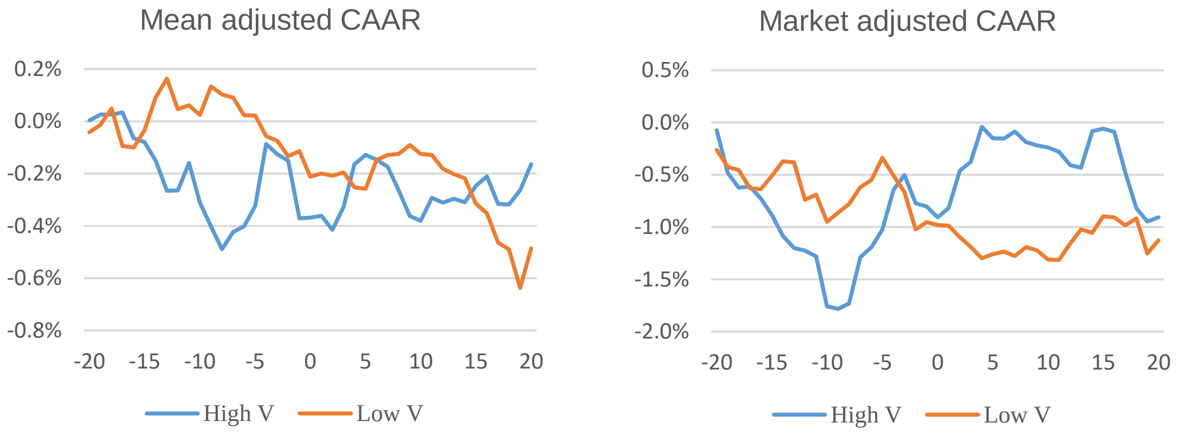


Figure 16 Basic materials index price reaction to OPEC meetings CAAR classified on volatility (High V denotes a high relative oil price volatility enviroment preceeding the event and, Low V denotes a low relative oil price volatility enviroment preceeding the event)

Mean adjusted returns model

When comparing both the high-volatility environment and low-price environment, there is a negative return from T-10 till T+15 in the low-volatility environment while the high-volatility environment doesn't show any distinguishable trend. Using this model, the swings are very minor.

Market adjusted returns model

In the market adjusted returns model, similar trends are present as in the mean adjusted returns model. There is a minimum at T-10 for the high-volatility environment, after reaching this minimum there is a general positive trend. The low-volatility has a general negative trend from the beginning (-20) till the end of the event window (+20).

		Mean adj. model CAARs						Market adj. model CAARs					
		CAAR	T1	T2	T3	T4	T5	CAAR	T1	T2	T3	T4	T5
High V	(-20,20)	-0.9%	35%	22%	26%	32%	43%	-0.2%	42%	39%	41%	22%	38%
	(-10,10)	1.0%	24%	12%	48%	44%	49%	-0.1%	42%	41%	42%	44%	48%
	(-5,5)	1.3%	6%	2%**	22%	44%	27%	0.3%	49%	20%	27%	44%	45%
Low V	(-20,20)	-1.1%	20%	42%	32%	44%	37%	-0.5%	20%	8%	20%	34%	43%
	(-10,10)	-0.5%	29%	45%	33%	44%	43%	-0.1%	35%	29%	30%	24%	27%
	(-5,5)	-0.7%	16%	7%	22%	24%	38%	-0.3%	14%	3%*	16%	34%	30%

*Table 19 CAAR results for the basic materials index classified on volatility (T1: Cross sectional tests T2: Crude dependence test T3: BMP test T4: Sign test T5: Wilcoxon signed rank test, * denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, High V denotes a high relative oil price volatility enviroment preceeding the event, and Low V denotes a low relative oil price volatility enviroment preceeding the event)*

	Equal means test				Levene test			
	Mean adj. returns		Market adj. returns		Mean adj. returns		Market adj. returns	
	T	P	T	P	W	P	W	P
(-20,20)	0.03	49%	0.07	47%	∞	100%	∞	100%
(-10,10)	0.26	40%	0.01	50%	-0.03	13%	∞	100%
(-5,5)	0.41	34%	0.19	43%	∞	100%	∞	100%

Table 20 Equal means test and Levene test on the basic materials index classified on volatility (denotes significance at 10%, ** denotes significance at 5%, and *** denotes significance at 1%, T denotes T-score, W denotes F-score, and P denoted the relative probability)*

Finally, 3 different event windows are examined to see if the returns obtained during these windows are significant, as one of the questions in this thesis relates to the difference between different scenario, an equal means test and Levene test are conducted.

Mean adjusted returns model

Examining the results obtained in table 19, most of the variables are not deemed significant by the battery of tests conducted. An exception is the high-volatility environment at (-5,5), with a return of 1.3%, which is deemed significant by the crude dependence test. In contrast with the low-volatility environment which has a return of -0.7%. In the difference of mean test, there are again little significant values to be found. These tests are reinforced using the Levene test.

Market adjusted returns model

In the market adjusted returns model, we don't see the same pattern as in the previous model. This time the low-volatility environment at (-5,5) is deemed significant by the crude dependence test. The only values which come close to being significant is the low-volatility environment at (-20,20). Again the results of the equal means test are inconclusive and reinforced by the Levene test.

5.5 Industrials index

The industrials index is the broadest index used in this study, it is composed of companies which even are remotly relatted to industrial production such as large conglomerates specialised in variuous aspects of the indusial process (3M) to postage delivery services (PostNL). All the companies in this index have in common that they are all listed and mostly serve other businesses. They are mostly affected by the general state of the economy and are indirectly linked to the oil price as they have a couple of inputs which rely on oil but these are very minor elements of their business.

5.5.1 Events classified on the oil price

The charts below represent the average abnormal return (AAR) for the event window ranging from the beginning of the event window (-20) till the end of the event window (+20). Each event was classified into one of two categories; high price (high P) or low price (low P), this classification was dependent on the state of the adjusted oil price on the day preceding the event. After having classified the meetings, the adjusted returns were calculated using one of the above mentioned models and averaged depending on their classification.

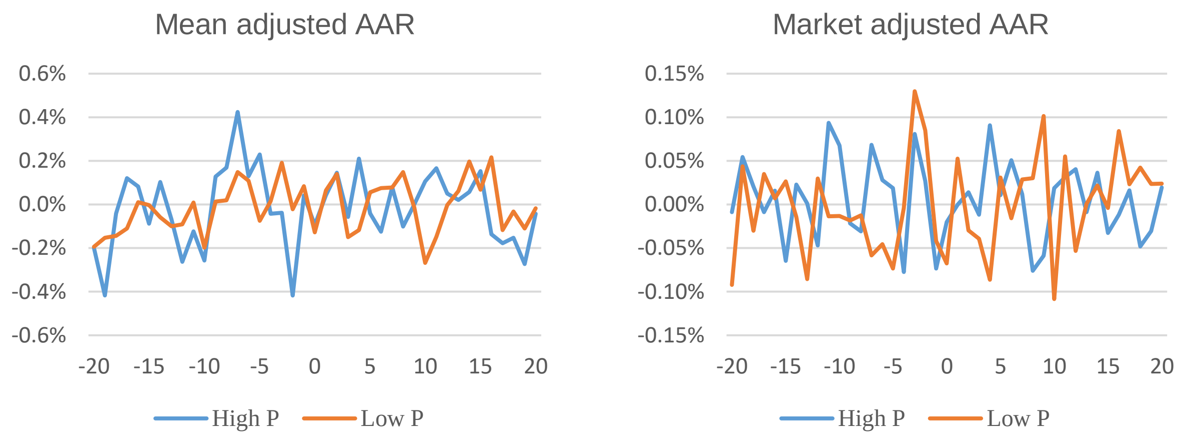


Figure 17 Industrials index price reaction to OPEC meetings AAR classified on price (High P denotes a high relative oil price enviroment preceeding the event and Low P denotes a low relative oil price enviroment preceeding the event)

Both charts presented above in figure 17 show quite volatile returns. Generally, it can be seen that the abnormal returns (both positive and negative) are much larger when using the mean adjusted returns model, this is in line with the other indexes examined previously. Below in table 21 you can find more detail on these returns and their significance from zero.

	AAR Mean Adjusted Returns Model		AAR Market Adjusted Returns Model	
	High P	Low P	High P	Low P
-20	-0.2%	-0.2%*	0.0%	-0.1%**
-19	-0.4%	-0.2%	0.1%	0.0%
-18	0.0%	-0.1%	0.0%	0.0%
-17	0.1%	-0.1%	0.0%	0.0%
-16	0.1%	0.0%	0.0%	0.0%
-15	-0.1%	0.0%	-0.1%	0.0%
-14	0.1%	-0.1%	0.0%	0.0%
-13	-0.1%	-0.1%	0.0%	-0.1%**
-12	-0.3%	-0.1%	0.0%	0.0%
-11	-0.1%	0.0%	0.1%**	0.0%
-10	-0.3%	-0.2%	0.1%	0.0%
-9	0.1%	0.0%	0.0%	0.0%
-8	0.2%	0.0%	0.0%	0.0%
-7	0.4%	0.1%	0.1%	-0.1%
-6	0.1%	0.1%	0.0%	0.0%
-5	0.2%	-0.1%	0.0%	-0.1%
-4	0.0%	0.0%	-0.1%**	0.0%
-3	0.0%	0.2%	0.1%*	0.1%**
-2	-0.4%*	0.0%	0.0%	0.1%
-1	0.0%	0.1%	-0.1%	0.0%
0	-0.1%	-0.1%	0.0%	-0.1%
1	0.0%	0.1%	0.0%	0.1%
2	0.1%	0.1%	0.0%	0.0%
3	-0.1%	-0.1%	0.0%	0.0%
4	0.2%	-0.1%	0.1%	-0.1%*
5	0.0%	0.1%	0.0%	0.0%
6	-0.1%	0.1%	0.1%*	0.0%
7	0.1%	0.1%	0.0%	0.0%
8	-0.1%	0.1%	-0.1%	0.0%
9	0.0%	0.0%	-0.1%	0.1%**
10	0.1%	-0.3%**	0.0%	-0.1%*
11	0.2%	-0.1%	0.0%	0.1%
12	0.1%	0.0%	0.0%	-0.1%
13	0.0%	0.1%	0.0%	0.0%
14	0.1%	0.2%	0.0%	0.0%
15	0.2%	0.1%	0.0%	0.0%
16	-0.1%	0.2%*	0.0%	0.1%*
17	-0.2%	-0.1%	0.0%	0.0%
18	-0.2%	0.0%	0.0%	0.0%
19	-0.3%	-0.1%	0.0%	0.0%
20	0.0%	0.0%	0.0%	0.0%

Table 21 AAR results for the industrials index classified on price (denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, High P denotes a high relative oil price enviroment preceeding the event, and Low P denotes a low relative oil price enviroment preceeding the event)*

Mean adjusted returns model

Examining table 21 in a high-price environment there are significant abnormal returns only at T-2 (-0.4%), in the low-price there is also an significant abnormal return at T+10 (-0.3%). All other values close to the event do not differ significantly from zero.

Market adjusted returns model

Continuing to the market adjusted returns, there are more significant results. In the high-price environment there are significant abnormal returns at T-4 (-0.1%), at T-3 (-0.1%) and at T+6 (0.1 %). Looking at the low-price environment there is again a significant abnormal return at T-3 (0.1%), but there are also significant abnormal returns at T+4 (-0.1%), at T+9 (0.1%) and at T+10 (-0.1%) and at T-8 (-0.1).

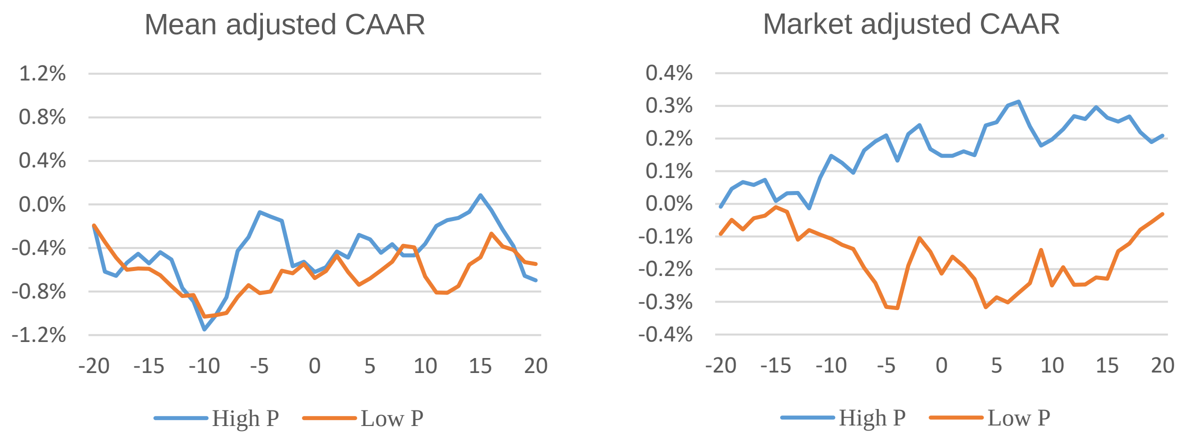


Figure 18 Industrials index price reaction to OPEC meetings CAAR classified on price (High P denotes a high relative oil price enviroment preceeding the event and Low P denotes a low relative oil price enviroment preceeding the event)

Next the cumulative average abnormal returns (CAAR) are examined, these are calculated by taking the values seen above in table 21 and summing them starting off at the beginning of the event window (-20).

Mean adjusted returns model

In the market adjusted returns model the two environments closely move in unison until T-10, whit the high-price environment showing a positive trend reaching a maximum at T-5 and falling back in line at T-2 with the low-price environment and moving in unison till after the event with another bifurcation at T+4 and at T+9.

Market adjusted returns model

Looking at the graphs, they move in unison till T-13 when the high-price environment shows an upwards trend, and the low-price environment which shows a negative trend. The low–price environment reaches a minimum at T-5 with a quick rebound till T-3 after this period both environments move in unison.

Finally, 3 different event windows are examined to see if the returns obtained during these windows are significant, as one of the questions in this thesis relates to the difference between different scenario, an equal means test and Levene test are conducted.

		Mean adj. model CAARs						Market adj. model CAARs					
		CAAR	T1	T2	T3	T4	T5	CAAR	T1	T2	T3	T4	T5
High P	(-20,20)	-0.7%	36%	25%	25%	43%	44%	0.2%	36%	25%	25%	43%	44%
	(-10,10)	0.3%	38%	35%	38%	43%	49%	0.2%	38%	35%	38%	43%	49%
	(-5,5)	0.1%	40%	39%	42%	43%	47%	0.1%	40%	39%	42%	43%	47%
Low P	(-20,20)	-0.5%	32%	26%	29%	7%	15%	0.0%	32%	26%	29%	7%	15%
	(-10,10)	0.4%	29%	23%	47%	45%	49%	-0.1%	29%	23%	47%	45%	49%
	(-5,5)	0.1%	43%	40%	24%	45%	47%	-0.1%	43%	40%	24%	45%	47%

*Table 22 CAAR results for the industrials index classified on price (T1: Cross sectional tests T2: Crude dependence test T3: BMP test T4: Sign test T5: Wilcoxon signed rank test, * denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, High P denotes a high relative oil price enviroment preceeding the event, and Low P denotes a low relative oil price enviroment preceeding the event)*

	Equal means test				Levene test			
	Mean adj. returns		Market adj. returns		Mean adj. returns		Market adj. returns	
	T	P	T	P	W	P	W	P
(-20,20)	-0.02	49%	0.07	49%	0.00**	2%	0.02	11%
(-10,10)	-0.03	49%	0.09	46%	0.01	8%	0.02	10%
(-5,5)	0.01	50%	0.09	47%	0.00**	1%	0.01	6%

Table 23 Equal means test and Levene test on the industrials index classified on price (denotes significance at 10%, ** denotes significance at 5% *** denotes significance at 1%, T denotes T-score, W denotes F-score, and P denoted the relative probability)*

Mean adjusted returns model

Examining the results obtained in table 22, all of the values obtained cannot be considered significantly different from zero. One CAAR that can be highlighted is the low-price environment at (-10,10) which has a CAAR of 0.4%, but it not close to being significant. Continuing to look at the difference of mean test, there is no significant difference between any of the different price scenarios. This conclusion is not reinforced by using the Levene test as the variance between the two samples is significantly different in the case of (-20,20) and (-5,5).

Market adjusted returns model

In this model the same trends as in the mean adjusted returns models are apparent. None of the results are significantly different from zero. But this time the low-price environment at (-10,10) comes close. Continuing to look at the difference of mean test, there is no significant difference between any of the different price scenarios. This conclusion is reinforced by using the Levene test.

5.5.2 Events classified on the oil price volatility

The charts below represent the average abnormal return (AAR) for the event window ranging from the beginning of the event window (-20) till the end of the event window (+20). Each event was classified into one of two categories; high volatility (high V) or low volatility (low V), this classification was dependent on the state of the 20-day average oil price volatility on the day preceding the event. After having classified the meetings, the adjusted returns were calculated using one of the above mentioned models and averaged depending on their classification.

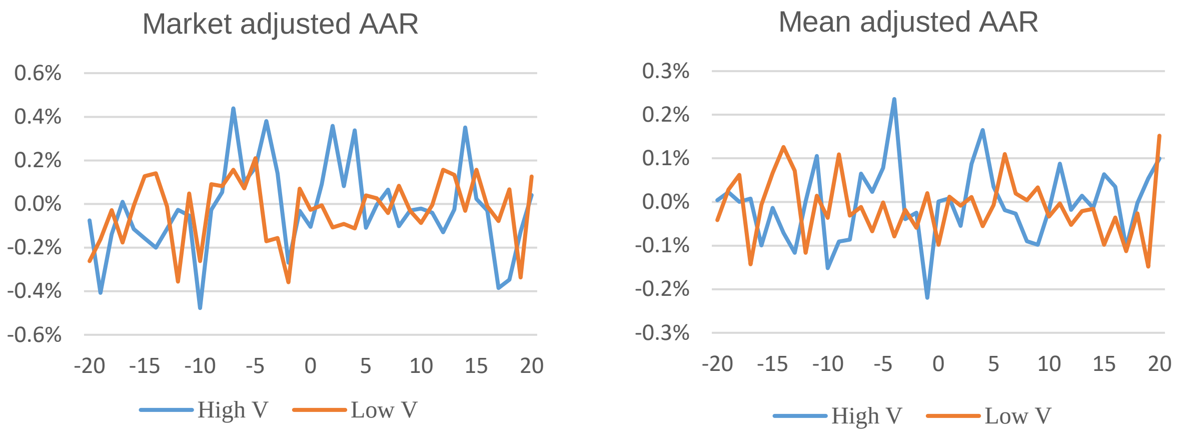


Figure 19 Industrials index price reaction to OPEC meetings AAR classified on volatility (High V denotes a high relative oil price volatility enviroment preceeding the event and Low V denotes a low relative oil price volatility enviroment preceeding the event)

Both graphs are quite volatile with the high-volatility scenario being even more volatile, in general the two scenarios closely track each other, with a couple of large exceptions.

	AAR Mean Adjusted Returns Model		AAR Market Adjusted Returns Model	
	High V	Low V	High V	Low V
-20	-0.1%	-0.2%*	-0.1%**	0.0%
-19	-0.2%	-0.2%	0.2%***	0.0%
-18	-0.1%	-0.1%	0.0%	0.0%
-17	0.0%	-0.1%	0.0%	0.0%
-16	0.0%	0.0%	0.0%	0.0%
-15	-0.2%	0.1%	-0.1%	0.0%
-14	-0.1%	0.0%	0.0%	0.0%
-13	0.0%	-0.1%	-0.1%	0.0%
-12	0.0%	-0.2%	0.0%	0.0%
-11	-0.1%	0.0%	0.1%*	0.0%
-10	-0.3%	-0.1%	0.0%	0.0%
-9	0.1%	0.0%	0.0%	0.0%
-8	0.1%	0.1%	-0.1%	0.0%
-7	0.4%	0.1%	0.0%	0.0%
-6	0.1%	0.1%	0.0%	0.0%
-5	0.0%	0.1%	-0.1%**	0.0%
-4	0.2%	-0.2%	0.0%	-0.1%
-3	0.2%	0.0%	0.1%*	0.1%**
-2	-0.2%	-0.1%	0.0%	0.1%*
-1	0.1%	0.1%	-0.1%	0.0%
0	-0.2%	0.0%	0.0%	0.0%
1	0.1%	0.0%	0.0%	0.0%
2	0.4%*	-0.1%	0.0%	-0.1%*
3	0.0%	-0.1%	0.0%	0.0%
4	0.2%	-0.1%	0.0%	0.0%
5	-0.1%	0.1%	0.0%	0.1%
6	0.0%	0.0%	0.0%	0.0%
7	0.2%	0.0%	0.1%	0.0%
8	0.0%	0.1%	0.0%	0.0%
9	0.1%	-0.1%	0.1%*	0.0%
10	-0.2%	0.0%	-0.1%*	0.0%
11	-0.1%	0.0%	0.0%	0.1%**
12	-0.1%	0.1%	0.0%	0.0%
13	-0.1%	0.1%	0.0%	0.0%
14	0.3%	0.0%	0.1%	0.0%
15	-0.1%	0.2%*	-0.1%	0.0%
16	0.1%	0.1%	0.1%	0.0%
17	-0.3%**	0.1%	0.0%	0.0%
18	-0.3%	0.1%	0.0%	0.0%
19	-0.2%	-0.2%	0.1%	0.0%
20	0.0%	0.0%	0.1%	0.0%

Table 24 AAR results for industrials index classified on volatility (denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, High V denotes a high relative oil price volatility enviroment preceeding the event, and Low V denotes a low relative oil price volatility enviroment preceeding the event)*

Mean adjusted returns model

In examining table 24 there are significant abnormal returns at T+2 (+0.4%) in the high-volatility environment. Continuing to look at the low-volatility environment, there are no significant abnormal returns present close to the event date.

Market adjusted returns model

Continuing to look at the market adjusted returns model, there are significant abnormal returns at T-5 (-0.1%), at T-3 (0.1%), at T+9 (0.1%) and at T+10 (-0.1%) in the high-volatility. In the low-volatility environment there are significant abnormal returns at T-3 (0.1%), at T-2(0.1%), at T+2 (-0.1%) and at T+11 (0.1%).

Next the cumulative average abnormal returns (CAAR) are examined, these are calculated by taking the values seen above in table 24 and summing them starting off at the beginning of the event window (-20).

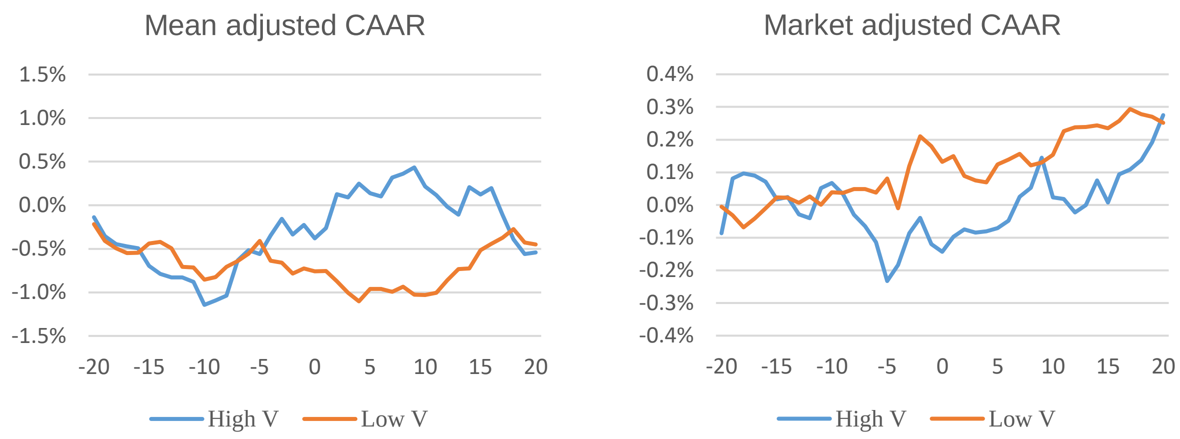


Figure 20 Industrials index price reaction to OPEC meetings CAAR classified on volatility (High V denotes a high relative oil price volatility enviroment preceeding the event and Low V denotes a low relative oil price volatility enviroment preceeding the event)

Mean adjusted returns model

In the CAAR progression through time, the two scenarios closely track each other until T-5 with the low-volatility environment having a negative trend at T+5 and the high-volatility having an upward trend reaching a peak at T+9, after extremes these environments meet each other towards the end of the event window

Market adjusted returns model

In the market adjusted returns model, there is a general positive trend from the beginning of the event window. The two environments mostly move in unison until T-10, when the high-volatility environment has a big drop until T-5 after this drop, the two environments move in unison again.

		Mean adj. model CAARs						Market adj. model CAARs					
		CAAR	T1	T2	T3	T4	T5	CAAR	T1	T2	T3	T4	T5
	(-20,20)	-0.5%	38%	30%	32%	8%	14%	0.3%	29%	18%	32%	22%	36%
High V	(-10,10)	1.3%	14%	4%*	38%	32%	23%	0.2%	28%	20%	43%	22%	34%
	(-5,5)	0.9%	10%	5%*	43%	44%	39%	0.0%	50%	46%	40%	44%	42%
	(-20,20)	-0.5%	35%	47%	35%	44%	45%	0.3%	27%	19%	23%	16%	32%
Low V	(-10,10)	-0.3%	35%	47%	49%	34%	32%	0.1%	33%	30%	33%	44%	48%
	(-5,5)	-0.5%	22%	13%	41%	44%	39%	0.0%	45%	44%	38%	34%	36%

*Table 25 CAAR results for the industrials index classified on volatility (T1: Cross sectional tests T2: Crude dependence test T3: BMP test T4: Sign test T5: Wilcoxon signed rank test, * denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, High V denotes a high relative oil price volatility enviroment preceeding the event, and Low V denotes a low relative oil price volatility enviroment preceeding the event)*

	Equal means test				Levene test			
	Mean adj. returns		Market adj. returns		Mean adj. returns		Market adj. returns	
	T	P	T	P	W	P	W	P
(-20,20)	-0.01	49%	0.01	50%	-∞	100%	∞	100%
(-10,10)	0.31	38%	0.03	49%	-0.03	14%	∞	100%
(-5,5)	0.31	38%	-0.02	49%	-∞	100%	-∞	100%

Table 26 Equal means test and Levene test on industrials index classified on volatility (denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, T denotes T-score, W denotes F-score, and P denoted the relative probability)*

Finally, 3 different event windows are examined to see if the returns obtained during these windows are significant, as one of the questions in this thesis relates to the difference between different scenario, an equal means test and Levene test are conducted.

Mean adjusted returns model

Examining the results obtained in table 25, most of the variables are not deemed significant by the battery of tests conducted. An exception is the high-volatility environment at (-5,5), with a return of 1.3%, which is deemed significant by the crude dependence test. In contrast with the low volatility scenario which has a return of -0.7%. In the difference of mean test, there are again little significant values to be found. These tests are reinforced using the Levene test.

Market adjusted returns model

In the market adjusted returns model, we don’t see the same pattern as in the previous model. This time the low-volatility environment at (-5,5) is deemed significant by the crude dependence test. The only values which come close to being significant is the low-volatility environment at (-20,20). Again the results of the equal means test are inconclusive and reinforced by the Levene test.

5.6 Technology index

The final index examined in this thesis is also the furthest removed from the oil price. The technology index is composed of companies that focus on software development (Microsoft) and the production of computer related hardware (Intel). These companies have very little to do with the oil price, the only effect that they might feel from an oil price shift is its effect on general economic growth.

5.6.1 Events classified on the oil price

The charts below represent the average abnormal return (AAR) for the event window ranging from the beginning of the event window (-20) till the end of the event window (+20). Each event was classified into one of two categories; high price (high P) or low price (low P), this classification was dependent on the state of the oil price (adjusted for inflation) on the day preceding the event. After having classified the meetings, the adjusted returns were calculated using one of the above mentioned models (market and mean adjusted) and averaged depending on their classification.

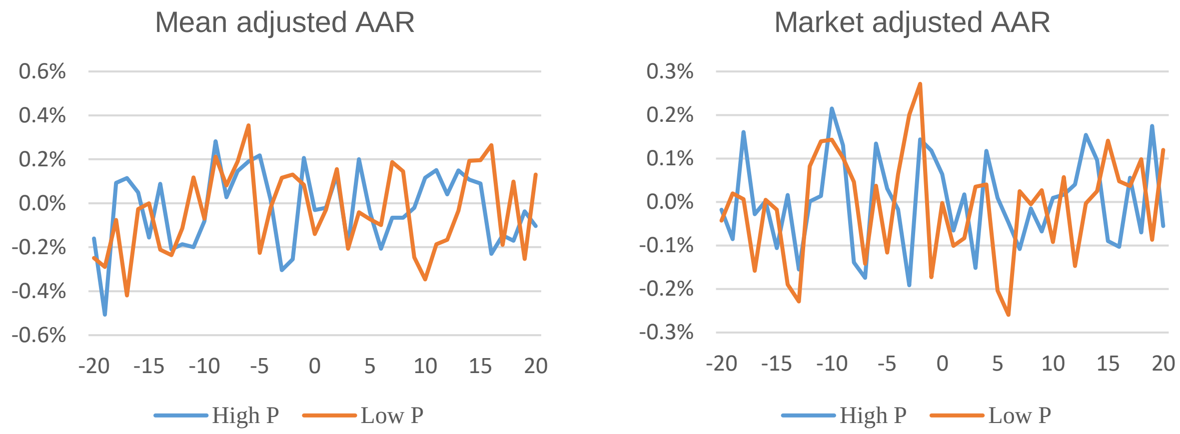


Figure 21 Technology index price reaction to OPEC meetings AAR classified on price (High P denotes a high relative oil price enviroment preceeding the event and Low P denotes a low relative oil price enviroment preceeding the event)

Both charts presented above in figure 21 show quite volatile returns. The two graphs do not move in unison as in the other indexes examined. Below in table 27 you can find more detail on these returns and their significance from zero.

Mean adjusted returns model

Examining table 27, in a high-price environment there is not a single abnormal return which significantly differs from zero. Continuing to look at the low-price there are significant abnormal returns at T-6 (-0.4%) and T-10 (-0.3%). All other values close to the event do not differ significantly from zero.

Market adjusted returns model

Continuing to the market adjusted returns, there are more significant results than in the other model. In the high-price environment there are significant abnormal returns at T-10 (0.2%), at T-3 (-0.2%) and at T+4 (0.1 %). Looking at the low-price environment there are significant abnormal returns at T-2 (0.3%), and at T+6 (-0.3%).

	AAR Mean Adjusted Returns Model		AAR Market Adjusted Returns Model	
	High P	Low P	High P	Low P
-20	-0.2%	-0.2%	0.0%	0.0%
-19	-0.5%	-0.3%	-0.1%	0.0%
-18	0.1%	-0.1%	0.2%	0.0%
-17	0.1%	-0.4%**	0.0%	-0.2%
-16	0.0%	0.0%	0.0%	0.0%
-15	-0.2%	0.0%	-0.1%	0.0%
-14	0.1%	-0.2%	0.0%	-0.2%
-13	-0.2%	-0.2%	-0.2%	-0.2%*
-12	-0.2%	-0.1%	0.0%	0.1%
-11	-0.2%	0.1%	0.0%	0.1%
-10	-0.1%	-0.1%	0.2%**	0.1%
-9	0.3%	0.2%	0.1%	0.1%
-8	0.0%	0.1%	-0.1%	0.0%
-7	0.1%	0.2%	-0.2%	-0.1%
-6	0.2%	0.4%*	0.1%	0.0%
-5	0.2%	-0.2%	0.0%	-0.1%
-4	0.0%	0.0%	0.0%	0.1%
-3	-0.3%	0.1%	-0.2%*	0.2%
-2	-0.3%	0.1%	0.1%	0.3%*
-1	0.2%	0.1%	0.1%	-0.2%
0	0.0%	-0.1%	0.1%	0.0%
1	0.0%	0.0%	-0.1%	-0.1%
2	0.1%	0.2%	0.0%	-0.1%
3	-0.2%	-0.2%	-0.2%	0.0%
4	0.2%	0.0%	0.1%*	0.0%
5	0.0%	-0.1%	0.0%	-0.2%
6	-0.2%	-0.1%	0.0%	-0.3%*
7	-0.1%	0.2%	-0.1%	0.0%
8	-0.1%	0.1%	0.0%	0.0%
9	0.0%	-0.2%	-0.1%	0.0%
10	0.1%	-0.3%*	0.0%	-0.1%
11	0.2%	-0.2%	0.0%	0.1%
12	0.0%	-0.2%	0.0%	-0.1%
13	0.1%	0.0%	0.2%*	0.0%
14	0.1%	0.2%	0.1%	0.0%
15	0.1%	0.2%	-0.1%	0.1%
16	-0.2%	0.3%	-0.1%	0.0%
17	-0.1%	-0.2%	0.1%	0.0%
18	-0.2%	0.1%	-0.1%	0.1%
19	0.0%	-0.3%	0.2%**	-0.1%
20	-0.1%	0.1%	-0.1%	0.1%

Table 27 AAR results for the technology index classified on price (denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, High P denotes a high relative oil price enviroment preceeding the event, and Low P denotes a low relative oil price enviroment preceeding the event)*

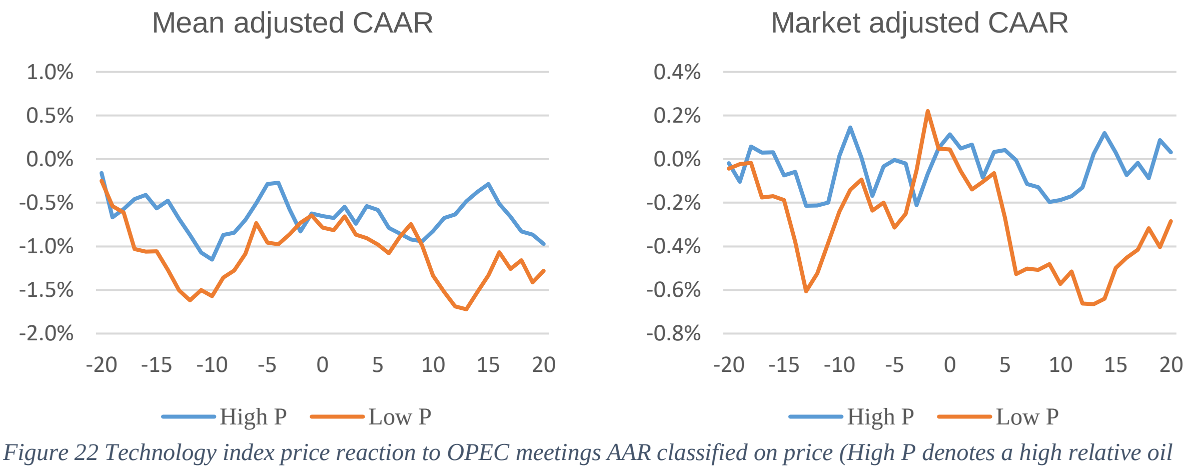


Figure 22 Technology index price reaction to OPEC meetings AAR classified on price (High P denotes a high relative oil price enviroment preceeding the event and Low P denotes a low relative oil price enviroment preceeding the event)

Next the cumulative average abnormal returns (CAAR) are examined, these are calculated by taking the values seen above in table 27 and summing them starting off at the beginning of the event window (-20).

Mean adjusted returns model

In this model the two environments start of unison but quickly the high-price environment at T-19 but at T-15 the two environments move in unison. At T-5 the low-price graph has a similar drop, putting it on the same level as the high-price environment. During the period close to the event day the two environments stay close to each other. Till T+8 when there is a big drop again for the low-price environment, while the high-price environment shows an upward trend.

Market adjusted returns model

Looking at the graphs, they are quite volatile but this is exacerbated due to the difference in scale when compared to the mean adjusted returns graph. The high-price environment is relatively stable while the low-price environment is more volatile. There is a big drop at T-15 reaching a minimum at T-13 and recovering at T-9, after this drop the two environments move in unison until after the event. At T+3 there is a big drop for the low-price environment reaching a minimum at T+5 and they the two environments move in unison.

Finally, 3 different event windows are examined to see if the returns obtained during these windows are significant, as one of the questions in this thesis relates to the difference between different scenario, an equal means test and Levene test are conducted.

		Mean adj. model CAARs						Market adj. model CAARs					
		CAAR	T1	T2	T3	T4	T5	CAAR	T1	T2	T3	T4	T5
High P	(-20,20)	-1.0%	32%	19%	30%	31%	30%	0.0%	32%	19%	30%	31%	30%
	(-10,10)	-0.1%	47%	46%	49%	43%	44%	0.0%	47%	46%	49%	43%	44%
	(-5,5)	0.2%	39%	39%	49%	31%	45%	0.2%	39%	39%	49%	31%	45%
Low P	(-20,20)	-1.3%	20%	20%	16%	34%	48%	-0.3%	20%	20%	16%	34%	48%
	(-10,10)	0.6%	28%	29%	46%	45%	37%	0.0%	28%	29%	46%	45%	37%
	(-5,5)	0.2%	41%	41%	17%	25%	27%	0.2%	41%	41%	17%	25%	27%

*Table 28 CAAR results for the technology index classified on price (T1: Cross sectional tests T2: Crude dependence test T3: BMP test T4: Sign test T5: Wilcoxon signed rank test, * denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, High P denotes a high relative oil price enviroment preceeding the event, and Low P denotes a low relative oil price enviroment preceeding the event)*

	Equal means test				Levene test			
	Mean adj. returns		Market adj. returns		Mean adj. returns		Market adj. returns	
	T	P	T	P	W	P	W	P
(-20,20)	0.04	48%	0.06	48%	0.00*	4%	0.06	19%
(-10,10)	-0.13	45%	-0.01	50%	-0.03	13%	0.57	55%
(-5,5)	0.01	50%	0.01	50%	0.00***	0%	0.00***	0%

Table 29 Equal means test and Levene test on technology index classified on price (denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, T denotes T-score, W denotes F-score, and P denoted the relative probability)*

Mean adjusted returns model

Examining the results obtained in table 28, all of the values obtained cannot be considered significantly different from zero. Two CAARs that can be highlighted are the low-price an high-price environment at (-20,20) which has a CAAR of -1.0% and a CAAR of -1.3% respectively, but they are not close to being significant. Continuing to look at the difference of mean test, there is no significant difference between any of the different price scenarios. This conclusion is not reinforced by using the Levene test as the variance between the two samples is significantly different in the case of (-20,20) and (-5,5).

Market adjusted returns model

In this model the same trends as in the mean adjusted returns models are apparent. None of the results are significantly different from zero. But this again the low-price environment at (-20,20) comes closest. Continuing to look at the difference of mean test, there is no significant difference between any of the different price scenarios. This conclusion is reinforced by using the Levene test, except for the (-5,5) event window.

5.6.2 Events classified on the oil price volatility

The charts below represent the average abnormal return (AAR) for the event window ranging from the beginning of the event window (-20) till the end of the event window (+20). Each event was classified into one of two categories; high volatility (high V) or low volatility (low V), this classification was dependent on the state of the 20-day average oil price volatility on the day preceding the event. After having classified the meetings, the adjusted returns were calculated using one of the above mentioned models and averaged depending on their classification.

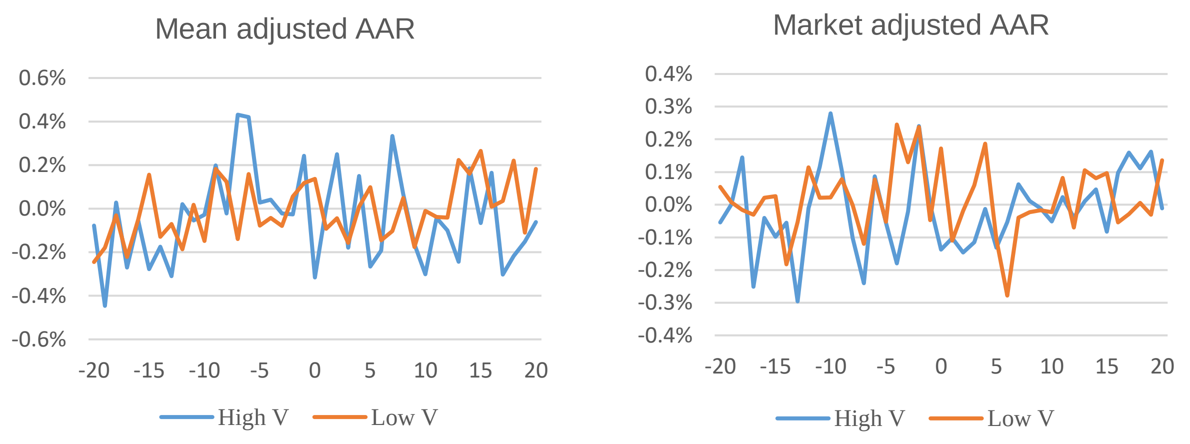


Figure 23 Technology index price reaction to OPEC meetings AAR classified on volatility (High V denotes a high relative oil price volatility enviroment preceeding the event and Low V denotes a low relative oil price volatility enviroment preceeding the event)

Both graphs are quite volatile with in most of the environments moving in opposite directions.

	AAR Mean Adjusted Returns Model		AAR Market Adjusted Returns Model	
	High V	Low V	High V	Low V
-20	-0.1%	-0.2%	-0.1%	0.1%
-19	-0.4%*	-0.2%	0.0%	0.0%
-18	0.0%	0.0%	0.1%	0.0%
-17	-0.3%	-0.2%	-0.3%**	0.0%
-16	-0.1%	-0.1%	0.0%	0.0%
-15	-0.3%	0.2%	-0.1%	0.0%
-14	-0.2%	-0.1%	-0.1%	-0.2%
-13	-0.3%	-0.1%	-0.3%**	-0.1%
-12	0.0%	-0.2%	0.0%	0.1%
-11	-0.1%	0.0%	0.1%	0.0%
-10	0.0%	-0.1%	0.3%**	0.0%
-9	0.2%	0.2%	0.1%	0.1%
-8	0.0%	0.1%	-0.1%	0.0%
-7	0.4%	-0.1%	-0.2%	-0.1%
-6	0.4%*	0.2%	0.1%	0.1%
-5	0.0%	-0.1%	-0.1%	-0.1%
-4	0.0%	0.0%	-0.2%	0.2%**
-3	0.0%	-0.1%	0.0%	0.1%
-2	0.0%	0.1%	0.2%	0.2%*
-1	0.2%	0.1%	0.0%	0.0%
0	-0.3%	0.1%	-0.1%	0.2%
1	0.0%	-0.1%	-0.1%	-0.1%
2	0.3%	0.0%	-0.1%	0.0%
3	-0.2%	-0.2%	-0.1%	0.1%
4	0.1%	0.0%	0.0%	0.2%
5	-0.3%	0.1%	-0.1%	-0.1%
6	-0.2%	-0.1%	-0.1%	-0.3%*
7	0.3%	-0.1%	0.1%	0.0%
8	0.1%	0.0%	0.0%	0.0%
9	-0.2%	-0.2%	0.0%	0.0%
10	-0.3%	0.0%	-0.1%	0.0%
11	0.0%	0.0%	0.0%	0.1%
12	-0.1%	0.0%	0.0%	-0.1%
13	-0.2%	0.2%	0.0%	0.1%
14	0.2%	0.2%	0.0%	0.1%
15	-0.1%	0.3%	-0.1%	0.1%
16	0.2%	0.0%	0.1%	-0.1%
17	-0.3%	0.0%	0.2%	0.0%
18	-0.2%	0.2%	0.1%	0.0%
19	-0.2%	-0.1%	0.2%	0.0%
20	-0.1%	0.2%	0.0%	0.1%

Table 30 AAR results for technology index classified on volatility (denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, High V denotes a high relative oil price volatility enviroment preceeding the event, and Low V denotes a low relative oil price volatility enviroment preceeding the event)*

Mean adjusted returns model

In examining table 30 there are significant abnormal returns at T-6 (+0.4%) in the high-volatility environment. Continuing to look at the low-volatility environment, there are no significant abnormal returns present close to the event date.

Market adjusted returns model

Continuing to look at the market adjusted returns model, there are a couple of significant abnormal returns early in the event window at T-17 (-0.3%), at T-13 (-0.3%) and, at T-10 (0.3%). After T-10 none of the dates are significant in the high-volatility environment. In the low-volatility environment there are significant abnormal returns at T-4 (0.2%), at T-2 (0.2%) and, at T+6 (-0.3%).

Next the cumulative average abnormal returns (CAAR) are examined, these are calculated by taking the values seen above in table 9 and summing them starting off at the beginning of the event window (-20).

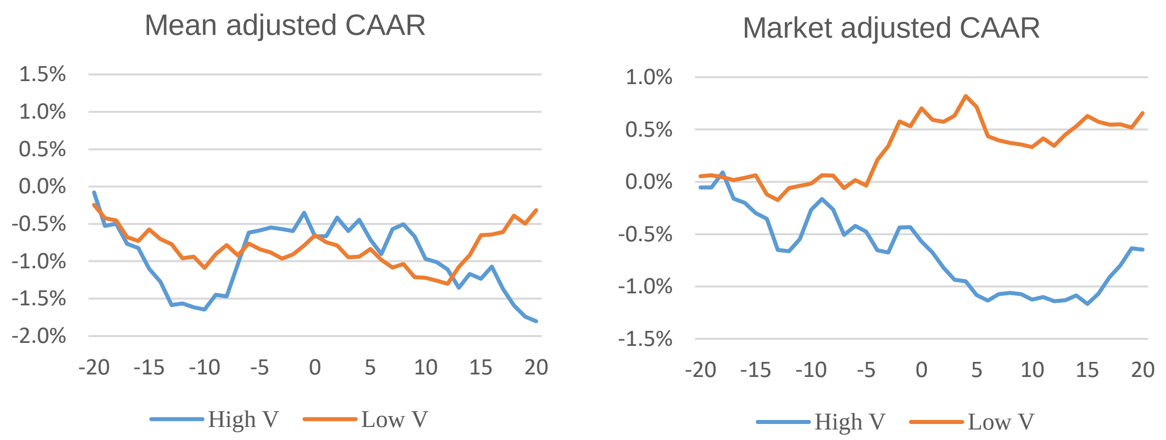


Figure 24 Technology index price reaction to OPEC meetings CAAR classified on volatility (High V denotes a high relative oil price volatility enviroment preceeding the event and Low V denotes a low relative oil price volatility enviroment preceeding the event)

Mean adjusted returns model

In the CAAR progression through time, the two scenarios closely track each other until T-18 diverging with the high-volatility environment having a negative trend until T-13 and the low-volatility staying relatively stable. After this negative trend the high-volatility environment moves upwards meeting the low-volatility environment at T-7. At T+13 there is another divergence with the high-volatility environment moving downwards while the low-volatility environment moves upwards until the end of the event window.

Market adjusted returns model

In T-7 there is a divergence between the two environments with the high-volatility environment falling to a minimum at T+5 and the low-volatility environment has an upwards reaching a maximum at T+4. After reaching their respective maximum/minimum they move in unison.

		Mean adj. model CAARs						Market adj. model CAARs					
		CAAR	T1	T2	T3	T4	T5	CAAR	T1	T2	T3	T4	T5
High V	(-20,20)	-1.8%	20%	11%	15%	22%	39%	-0.6%	30%	20%	31%	44%	47%
	(-10,10)	0.9%	25%	20%	40%	32%	37%	-0.4%	24%	23%	16%	32%	39%
	(-5,5)	0.6%	23%	22%	46%	32%	25%	-0.4%	42%	13%	15%	8%	26%
Low V	(-20,20)	-0.3%	41%	48%	30%	44%	45%	0.7%	19%	20%	16%	16%	42%
	(-10,10)	-0.3%	42%	48%	41%	34%	45%	0.4%	22%	22%	18%	16%	39%
	(-5,5)	0.0%	49%	49%	26%	44%	44%	0.9%	7%	1%**	10%	6%	35%

*Table 31 CAAR results for the technology index classified on volatility (T1: Cross sectional tests T2: Crude dependence test T3: BMP test T4: Sign test T5: Wilcoxon signed rank test, * denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, High V denotes a high relative oil price volatility enviroment preceeding the event, and Low V denotes a low relative oil price volatility enviroment preceeding the event)*

	Equal means test				Levene test			
	Mean adj. returns		Market adj. returns		Mean adj. returns		Market adj. returns	
	T	P	T	P	W	P	W	P
(-20,20)	-0.20	42%	-0.24	41%	-∞	100%	-∞	100%
(-10,10)	0.20	42%	-0.20	42%	-0.01	9%	∞	100%
(-5,5)	0.13	45%	-0.34	37%	∞	100%	∞	100%

Table 32 Equal means test and Levene test on the technology index classified on volatility (denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%, T denotes T-score, W denotes F-score, and P denoted the relative probability)*

Finally, 3 different event windows are examined to see if the returns obtained during these windows are significant, as one of the questions in this thesis relates to the difference between different scenario, an equal means test and Levene test are conducted.

Mean adjusted returns model

Examining the results obtained in table 31, again most of the variables are not deemed significant by the battery of tests conducted. Especially in the case of the high-volatility environment, the values come closer to being significant than in the other models. In the difference of mean test, there are again little significant values to be found. These tests are reinforced using the Levene test.

Market adjusted returns model

In the market adjusted returns model, we don’t see the same pattern as in the previous model. This time the low-volatility environment comes closer to being significant, with only the (-5,5) being deemed significant by the crude dependence test. Again the results of the equal means test are inconclusive and reinforced by the Levene test.

CHAPTER 6 Robustness test

A key assumption used in conducting this research is the identification of periods of high or low price/volatility. The state of the oil price was determined by its relative position in regards to the mean during the study, this methodology is highly dependent on the exact time frame taking in calculating this number. In this thesis the mean used is the one from the beginning of the time frame (1-jan-1986) till the start of writing this thesis (1-july-2016). Assuming that this is a large enough time frame to correct for any kinds of bubbles or large market movements. Due to this large time frame the price was also corrected for inflation.

But the oil price is more volatile than the average consumer index as seen by the chart presented below the oil price is roughly below its average in the first half of the time frame and is above its mean in the later part of the timeframe. There are a couple of exceptions, such as the big decline of oil prices at the end of 2015 and the economic recession of 2008 but this are far and between.

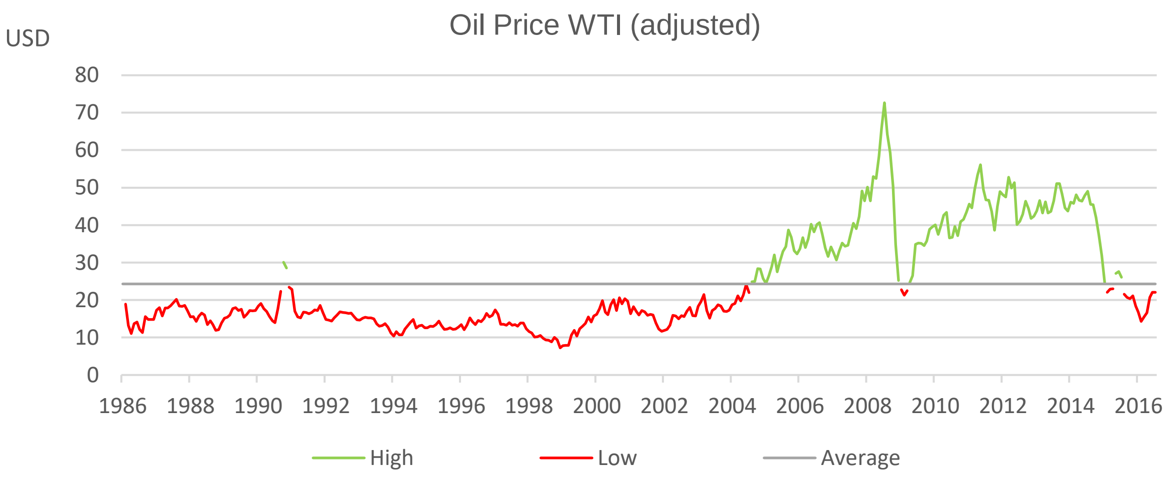


Figure 25 Oil price through time classified on price and price adjusted for inflation.

As such there could also be other options in determining the standing of the oil price. People's perception of a price is not always linked with the actual standing in its historical time frame. People are much more likely to compare a price to a more recent reference point (anchoring) (Kahneman, 2003). As such an option, would be to use a moving average of the past years as a reference point for determining the relative position of the oil price.

This theory will be examined using two different moving averages, a 5-year moving average and a 10-year moving average. Due to the WTI only being established in 1986 and it is necessary to have at least 10 years to establish a baseline. the following chart was constructed using the Brent oil price, in addition it wasn't corrected for inflation as the Brent is used more globally and there is no index available which would correct for global shifts.

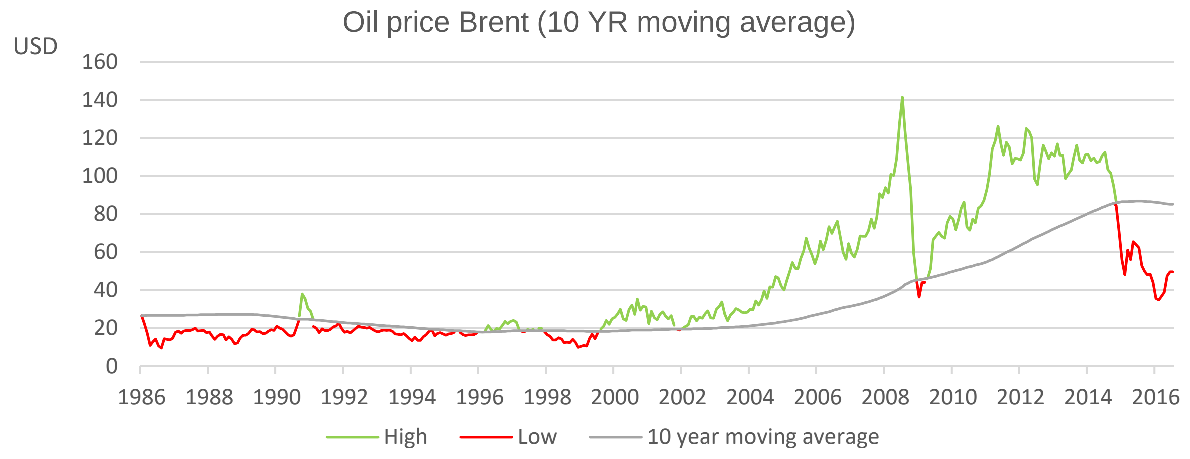


Figure 26 Oil price through time classified on price using a 10 year moving average

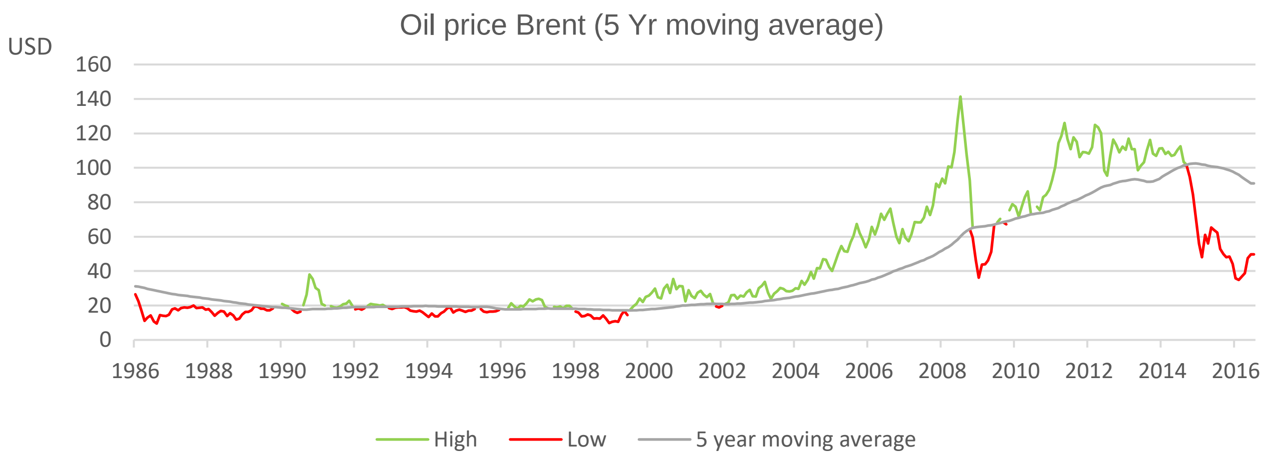


Figure 27 Oil price through time classified on price using a 5 year moving average

When comparing the two new graphs created using a moving average, it can be seen that using this method in the majority of times the same trends are captured. Using the moving average does create an extra period of high prices during the 1990 oil shock created by the invasion of Kuwait and it reacts faster to the upward trend starting in 2000, this is especially the case for the 5-year average. Overall it can be concluded that this extra manipulation of the data does not add enough information warranting rerunning the data using this barometer of price level.

A similar graph could also be constructed for determining the relative value of the volatility of the oil price but this would not be possible for the time frame used as oil was traded less before 1986 and only weekly price data is available for the period before sept-1983. As this thesis uses daily historical volatility, this would give a wrong baseline in the first ten years of the time period examined.

CHAPTER 7 Conclusion

The main goal of this thesis was to analyse the following research question:

Does the predictive power of OPEC change during periods of high oil prices or high oil price volatility and if so is it possible to obtain abnormal returns from this event?

This question was divided into mainly 2 hypotheses, the first being that:

H1 If the oil price is at a relatively high price, there is a higher likelihood of generating any abnormal returns using OPEC meeting dates.

This question was answered looking at 5 different industries with varying levels of connection to the oil price. The relative position of the oil price was determined by looking at the adjusted oil price on the day preceding an OPEC meeting and comparing it to the mean of the sample. As seen in all the models and industries examined in the results section there is not a single CAAR which is deemed significant by all the different tests conducted.

Looking into more detail into the differences between the various sectors as the CAARs are all insignificant, one can only look at the relative difference of absolute returns between the difference price scenarios, the numbers for the difference between scenarios (high-price return – low-price return) is presented below:

		Oil &Gas			Utilities			Basic Materials			Industrials			Technology		
	Window	Δ	High P	Low P	Δ	High P	Low P	Δ	High P	Low P	Δ	High P	Low P	Δ	High P	Low P
Mean adjusted	(-20,20)	**-1.4%**	-1.5%	-0.1%	**-0.5%**	-1.0%	-0.5%	**-0.7%**	-1.3%	-0.6%	**-0.2%**	-0.7%	-0.5%	**0.3%**	-1.0%	-1.3%
	(-10,10)	**-0.1%**	-0.2%	-0.1%	**0.2%**	0.2%	-0.1%	**0.0%**	0.4%	0.3%	**-0.1%**	0.3%	0.4%	**-0.7%**	-0.1%	0.6%
	(-5,5)	**0.4%**	0.1%	-0.3%	**0.1%**	0.3%	0.1%	**0.1%**	0.3%	0.2%	**0.0%**	0.1%	0.1%	**0.0%**	0.2%	0.2%
Market adjusted	(-20,20)	**-0.6%**	-0.9%	-0.3%	**-0.6%**	-0.7%	-0.1%	**-0.1%**	-0.4%	-0.3%	**0.2%**	0.2%	0.0%	**-1.4%**	-1.5%	-0.1%
	(-10,10)	**0.4%**	-0.5%	-0.9%	**0.2%**	0.0%	-0.2%	**0.5%**	0.2%	-0.3%	**0.3%**	0.2%	-0.1%	**-0.1%**	-0.2%	-0.1%
	(-5,5)	**0.7%**	-0.1%	-0.8%	**0.2%**	0.2%	-0.0%	**0.3%**	0.1%	-0.2%	**0.2%**	0.1%	-0.1%	**0.4%**	0.1%	-0.3%

Table 33 Summary of the different price scenario's in different industries (High P denotes a high relative oil price enviroment preceeding the event, Low P denotes a low relative oil price enviroment preceeding the event, and Δ denotes the difference between these values)

As can be seen in the table above, industries which are more related to the oil price (such as the Oil & Gas and the Utilities index) have the biggest difference between the two scenarios in the longer run (-20,20), the return for the high-price environment is a lot more negative than the low-price scenario, this is the case in all observations with the exception of technology in the market adjusted model. As the event window narrows, this difference narrows for all industries but now the low-price scenario is more negative. The magnitude of this difference is again much larger for industries which are closely related to the oil price. This confirms our hypothesis but due to the insignificance of the values recorded a definitive answer cannot be backed by statistics

The next hypothesis to be examined is the following:

H2: If the oil price is relatively volatile in the months leading to an OPEC meeting there is a higher likelihood of generating any abnormal returns.

A similar framework as in hypothesis 1 was used in examining this hypothesis, for calculating the volatility the 20-day historical volatility was used. As this is a daily volatility it is impossible to adjust if for inflation, as these values are only available on a monthly basis. A similar conclusion can be reached concerning the significance of the CAARs recorded. As such one should look into more detail into the differences between the various sectors as the CAARs are all insignificant, one can only look at the relative difference of absolute returns between the difference price scenarios (low-volatility return –high-volatility return), as presented below:

		Oil &Gas			Utilities			Basic Materials			Industrials			Technology		
	Window	Δ	high V	low V	Δ	high V	low V	Δ	high V	low V	Δ	high V	low V	Δ	high V	low V
Mean adjusted	(-20,20)	**0.2%**	-0.5%	-0.7%	**1.4%**	0.0%	-1.4%	**0.2%**	-0.9%	-1.1%	**-0.1%**	-0.5%	-0.5%	**-1.5%**	-1.8%	-0.3%
	(-10,10)	**0.8%**	0.4%	-0.4%	**1.7%**	1.0%	-0.7%	**1.5%**	1.0%	-0.5%	**1.6%**	1.3%	-0.3%	**1.1%**	0.9%	-0.3%
	(-5,5)	**1.6%**	0.8%	-0.8%	**1.6%**	1.2%	-0.4%	**1.9%**	1.3%	-0.7%	**1.3%**	0.9%	-0.5%	**0.6%**	0.6%	0.0%
Market adjusted	(-20,20)	**0.0%**	-0.3%	-0.4%	**1.6%**	0.6%	-1.0%	**0.3%**	-0.2%	-0.5%	**0.0%**	0.3%	0.3%	**0.2%**	-0.5%	-0.7%
	(-10,10)	**-0.8%**	-0.9%	-0.1%	**0.9%**	0.4%	-0.4%	**0.0%**	-0.1%	-0.1%	**0.1%**	0.2%	0.1%	**0.8%**	0.4%	-0.4%
	(-5,5)	**0.5%**	-0.1%	-0.7%	**0.7%**	0.6%	-0.1%	**0.6%**	0.3%	-0.3%	**0.0%**	0.0%	0.0%	**1.6%**	0.8%	-0.8%

Table 34 Summary of different volatility scenario's in the different industries (High V denotes a high relative oil price volatiliy enviroment preceeding the event, Low V denotes a low relative oil price volatility enviroment preceeding the event, and Δ denotes the difference between these values)

Looking at the results presented in table 34, a similar observation can be made as with the previous hypothesis that industries which are more closely related to the oil price are more affected by OPEC decisions and thus are more likely to display abnormal returns. Continuing to look at the longest event window (-20,20), there is very little difference between the two scenarios, with the exception of utilities and technology. Moving to a shorter event window (-5,5), a larger difference can be seen, generally the high volatility scenarios have a much greater abnormal return than scenarios in which the volatility is low. The hypothesis is valid looking at a shorter term horizon but due to insignificant results it can’t be backed by statistics.

As this is the first study of its kind examining the price environment surrounding an OPEC meeting, there are no precedents to compare these results with. There have been a number of studies that looked at the significance of the abnormal returns around event studies. The insignificance of the CAAR results is in line with the results of Christensen (2009) and Jonsson & Lin (2011).

Several limitations can be highlighted in conducting this research. This thesis relies on the use of DataStream composed indexes, the exact composition is not publicly known and cannot be traded and as such cannot be profited on. Another item is that the methodology applied uses a mean across the study, in the robustness test another methodology is tested but it is only compared graphically but not quantitatively. Finally, the purpose of an event study is to examine an event which isn't known yet to financial markets. OPEC meetings are announced well in advance giving the market significant time to react and prepare for the meeting.

In expanding the current body of research concerning different classifications at OPEC meetings, there are a couple of other items which can be looked at. As mentioned in the previous paragraph, a key element is the calculation of the mean oil price. As such it could be interesting to examine a 10 year moving average mean for both the price and volatility another thing on which further research is necessary is the calculation of volatility. This thesis uses historical volatility, it could be examined if using another volatility calculation, results in another conclusion.

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APPENDIX A Geographical distribution of indexes used

Appendix A1 Oil & Gas index composition

Full Name	Market
Abengoa B Shares	Spain
Advantage Oil and Gas	Canada
Afriquia Gaz	Morocco
Aker BP	Norway
Aker Solutions	Norway
Alexandria Mineral Oils	Egypt
Altagas	Canada
Amber Grid AB	Lithuania
Amec Foster Wheeler	UK
Aminex	Ireland
Anadarko Petroleum	USA
Antero Resources	USA
APA Group	Australia
Apache	USA
Arc Resources	Canada
Attock Petroleum	Pakistan
Avner L	Israel
Badger Daylighting	Canada
Baker Hughes	USA
Bashneft	Russia
Baytex Energy	Canada
Beach Energy	Australia
Bharat Petroleum	India
Birchcliff Energy	Canada
Boardwalk Pipeline Partners	USA
Bonavista Energy	Canada
Bourbon Corporation	France
BP	UK
Brightoil Petroleum (Holdings)	Hong Kong
Buckeye Partners	USA
Bumi Armada	Malaysia
Cabot Oil and Gas 'A'	USA
Cairn Energy	UK
Cairn India	India
Caltex Australia	Australia
Canadian Energy Services and Technology	Canada
Canadian Natural Resources	Canada
Cape	UK
Cenovus Energy	Canada
Centrotec Sustainable	Germany
CGG	France
Cheniere Energy	USA
Cheniere Energy Partners Limited Partnership Holdings	USA
Chesapeake Energy	USA
Chevron	USA
Chevron Lubricants Lanka	Sri Lanka
China Aviation Oil (Singapore)	Singapore
China Conch Venture Holdings	Hong Kong
China Gas Holdings	Hong Kong
China Longyuan Power Group 'H'	China
China Petroleum and Chemical 'H'	China
Cimarex Energy	USA
CNOOC	Hong Kong
Company Cyprus Opportunity Energy	Cyprus
Concho Resources	USA
ConocoPhillips	USA
Conoil	Nigeria
Continental Resources	USA
Core Laboratories	USA
Cosco Capital	Philippines
Cosmo Energy Holdings	Japan
CPFL Energias Renovaveis On	Brazil
Crescent Point Energy	Canada
Cropenergies	Germany
DCP Midstream Partners	USA
Delek Drillin L	Israel
Delek Energi Systems	Israel
Devon Energy	USA
Dialog Group	Malaysia
Diamondback Energy	USA
DNO	Norway
Doosan Heavy Industries and Construction	South Korea
Dynex Energy	France
Ecopetrol	Colombia
Empresas Copec	Chile
Enable Midstream Partners	USA
Enbridge	Canada
Enbridge Energy Partners Limited Partnership	USA
Enbridge Income Fund Holdings Unit Trust	Canada
Encana	Canada
Enerflex When Issued	Canada
Energen	USA
Energy Transfer Equity	USA
Energy Transfer Partners	USA
Enerplus	Canada
Eni	Italy
Enlink Midstream Partners	USA
Enquest	UK
Ensign Energy Services	Canada
Enterprise Products Partners Limited Partnership	USA
EOG Resources	USA
Equitable	USA
Equitable Group Holdings Units	USA
Equitable Midstream Partners	USA
ERG	Italy
Esso	France
Exxon Mobil	USA
First Solar	USA
Fluxys Belgium 'D'	Belgium
FMC Technologies	USA
Formosa Petrochemical	Taiwan
Forte Oil	Nigeria
Freehold Royalties	Canada
Gail (India)	India
Galp Energia SGPS	Portugal
Gamesa Corporacion Technologica	Spain
Gas Malaysia	Malaysia
Gas Plus	Italy
Gazprom	Russia
Gazprom Neft	Russia

Genesis Energy Unit	USA
Gibson Energy	Canada
Golar Long (Oslo)	Norway
Grupa Lotos	Poland
GS Holdings	South Korea
Gujarat State Petronet	India
Gulf International Services	Qatar
Gulfport Energy	USA
Halliburton	USA
Hellenic Petroleum	Greece
Helmerich and Payne	USA
Hess	USA
Hindustan Petroleum	India
Hollyfrontier	USA
Hunting	UK
Husky Energy	Canada
Idemitsu Kosan	Japan
Imperial Oil	Canada
INA Industrija Nafte	Croatia
Indian Oil	India
Inpex	Japan
Inter Pipeline Fund	Canada
Isramco Negev 2 Partnership	Israel
Jadranski Naftovodi	Croatia
Japan Petroleum Exploration	Japan
Joel	Israel
Jordan Petroleum Refinery	Jordan
JX Holdings	Japan
Keppel	Singapore
Keyera	Canada
Kinder Morgan	USA
KOC Holding	Turkey
Kunlun Energy	Hong Kong
Lamprell	UK
Lundin Petroleum	Sweden
Magellan Midstream Partners Units	USA
Maire Tecnimont	Italy
Manz	Germany
Marathon Oil	USA
Marathon Petroleum	USA
Mari Gas	Pakistan
Maurel et Prom	France
Medserv	Malta
MEG Energy	Canada
Mesaieed Petrochemical	Qatar
MNGL Refinery and Petrochemicals	India
Mobil Oil Nigeria	Nigeria
Modec	Japan
Mol Magyar Olaj-ES Gazipari	Hungary
Motor Oil	Greece
MPLX	USA
Murphy Oil	USA
Nabors Industries	USA
National Oilwell Varco	USA
National Refinery	Pakistan
Neste	Finland
New Zealand Refining	New Zealand
Newfield Exploration	USA
Noble Energy	USA
Nordex	Germany
Nostrum Oil and Gas	UK
Novatek	Russia
Nustar Energy Limited Partnership	USA
Nuvista Energy	Canada
Oando	Nigeria
OC Rosneft	Russia
Occidental Petroleum	USA
OGE Energy	USA
Oil and Gas Development	Pakistan
Oil and Gas Exploration and Production	Bulgaria
Oil and Natural Gas	India
Oil Company Lukoil	Russia
Oil India	India
Oil Refineries	Israel
Oil Search	Australia
Oil Terminal	Romania
OMV	Austria
OMV Petrom	Romania
Oneok Partners	USA
Ophir Energy	UK
Organizacion Terpel	Colombia
Pakistan Oilfields	Pakistan
Pakistan Petroleum	Pakistan
Pakistan State Oil	Pakistan
Paramount Resources 'A'	Canada
Parex Resources	Canada
Parsley Energy Class A	USA
Pason Systems	Canada
Patterson UTI Energy	USA
Paz Oil	Israel
PDC Energy	USA
Pengrowth Energy	Canada
Penn West Petroleum	Canada
Petrobras Energia 'B'	Argentina
Petrochina 'H'	China
Petrofac	UK
Petrol	Slovenia
Petroleo Brasileiro On	Brazil
Petroleo Brasileiro PN	Brazil
Petrolera Pampa	Argentina
Petrolina Holdings	Cyprus
Petron	Philippines
Petronas Dagangan	Malaysia
Petroneft Resources (ESM)	Ireland
Petrovietnam Drilling	Vietnam
Petrovietnam Gas	Vietnam
Peyto Exploration and Development	Canada
Phillips 66	USA
Phillips 66 Partners	USA
Pioneer Natural Resources	USA
Plains All American Pipeline Limited Partnership Unit	USA
Plains Group Holdings Class A	USA
PLKNC Naftowy Orlen	Poland
Polish Oil and Gas	Poland
Prairiesky Royalty	Canada
Precision Drilling	Canada
Premier Oil	UK
Promigas	Colombia
Providence Resources (ESM)	Ireland
PTT	Thailand
PTT Exploration and Production	Thailand
PTT Global Chemical	Thailand
QEP Resources	USA
Raging River Exploration	Canada
Range Resources	USA
Ratio Oil Exploration L Limited	Israel
Refineria La Pampilla	Peru
Reliance Industries	India

Renaissance Services	Oman
Repsol YPF	Spain
Rice Energy	USA
Rompetrol Refinery	Romania
Rompetrol Well Service	Romania
Rosetti Marino	Italy
Royal Dutch Shell A (London)	Netherlands
Royal Dutch Shell B	UK
RPC	USA
RSP Permian	USA
S N T G N Transgaz	Romania
Saipem	Italy
Santos	Australia
Sapura-Kencana Petroleum	Malaysia
Saras	Italy
SBM Offshore	Netherlands
Schlumberger	USA
Schoeller-Bleckmann	Austria
Seadrill	Norway
Secure Energy Services	Canada
Sembcorp Industries	Singapore
Sembcorp Marine	Singapore
Senvion	Germany
Seplat Petroleum Development	Nigeria
Seven Generations Energy	Canada
Shawcor	Canada
Shell Midstream Partners	USA
Shell Oman Marketing	Oman
Shell Pakistan	Pakistan
Showa Shell Sekiyu	Japan
SIF Holding	Netherlands
SK Innovation	South Korea
Slovnaft	Slovakia
Slovnaft 2	Slovakia
SM Energy	USA
SMA Solar Technology	Germany
Soco International	UK
S-Oil	South Korea
Solaria Energia y Medio Ambiente	Spain
Southwestern Energy	USA
Spartan Energy	Canada
Spectra Energy	USA
Spectra Energy Partners	USA
Statoil	Norway
Subsea 7	Norway
Suelopetrol CA	Venezuela
Suncor Energy	Canada
Sunoco Logistics Partners	USA
Surgutneftegas	Russia
Surgutneftegaz Preference	Russia
Tallgrass Energy Partners Units	USA
Targa Resources	USA
Tatneft	Russia
TC Pipelines	USA
Technip	France
Tecnicas Reunidas	Spain
Tesoro	USA
Tesoro Logistics	USA
TGS-Nopec Geophysical	Norway
Thai Oil	Thailand
Tonengeneral Sekiyu KK	Japan
Torc Oil and Gas	Canada
Total	France
Total Gabon	France
Total Maroc	Morocco
Total Nigeria	Nigeria
Tourmaline Oil	Canada
Transcanada	Canada
Transneft Preference	Russia
Transocean	USA
Transportadora de Gas del Sur	Argentina
Tullow Oil	UK
Tupras Turkiye Petrol Rafineleri	Turkey
Unipetrol	Czech Republic
Valero Energy	USA
Verbio Vereinigte Bioenergie	Germany
Veresen	Canada
Vermilion Energy	Canada
Vestas Windsystems	Denmark
Weatherford International	USA
Western Gas Equity Partners	USA
Western Gas Partners	USA
Whitecap Resources	Canada
Williams	USA
Williams Partners	USA
Wood Group (John)	UK
Woodside Petroleum	Australia
Worleyparsons	Australia
WPX Energy	USA
YPF	Argentina
Z Energy	New Zealand

Appendix A2 Utilities index composition

Full Name	**Market**
A2A	Italy
Aboitiz Power	Philippines
Abu Dhabi National Energy Company	Abu Dhabi
Acea	Italy
ACSM-Agam	Italy
ACWA Power Barka	Oman
Adani Power	India
AES	USA
AES Gener	Chile
AES Tiete Energia Unit	Brazil
AGL Energy	Australia
Aguas Andinas	Chile
Al Batinah Power Company	Oman
Al Kamil Power	Oman
Al Suwaidi Power Company Saoc	Oman
Albioma	France
Algonquin Power and Utilities	Canada
Alliant Energy Corporation	USA
Almendral	Chile
Alpiq Holding	Switzerland
Alteo Energy	Hungary
Alupar Investimento Units	Brazil
American Electric Power	USA
Ameren	USA
American Water Works	USA

Amerigas Partners L P Unit L P Interest	USA
Aqua America	USA
Arendals Fossekompani	Norway
Areva	France
Ascopiave	Italy
Atco Class 1	Canada
Athens Water Supply and Sewage	Greece
Atmos Energy	USA
Ausnet Services	Australia
Avangrid	USA
Aygaz	Turkey
Beijing Enterprises Water Group	Hong Kong
BKW	Switzerland
Black Hills	USA
Boralex 'A'	Canada
Brookfield Renewable Partners	Canada
Budapest Electricity	Hungary
Burgenland Holding	Austria
Calpine	USA
Camuzzi Gas PAM 'B'	Argentina
Can Don Hydro Power	Vietnam
Canadian Utilities 'A'	Canada
Canadian Utilities 'B'	Canada
Capex	Argentina
Capital Power	Canada
CEG On	Brazil
Centerpoint Energy	USA
Centrais Eletr Bras- Eletrobras On	Brazil
Centrais Eletricas do Para Celpa On	Brazil
Central Hydropower	Vietnam
Central Puerto	Argentina
Centrica	UK
CEZ	Czech Republic
CEZ Distribution Bulgaria	Bulgaria
CEZ Electro Bulgaria	Bulgaria
CGN Power 'H'	China
Cheung Kong Infrastructure Holdings	Hong Kong
Chilectra	Chile
China Everbright Water	Singapore
China Jinjiang Environmental Holdings	Singapore
China Resources Power Holdings	Hong Kong
China Resources Gas Group	Hong Kong
Chubu Electric Power	Japan
Chugoku Electric Power	Japan
CIA Catarinense de Aguas E Saneamento On	Brazil
CIA Catarinense de Aguas E Saneamento PN	Brazil
CIA Energetica de Minas Gerais PN	Brazil
CIA Paranaense de Energia Copel PN	Brazil
CIA Transmissao Energia Eletrica Paulista On	Brazil
Citic Envirotech	Singapore
CLP Holdings	Hong Kong
Companhia Energetica Minas Gerais On	Brazil
CMS Energy	USA
Cntee Transelectrica	Romania
Colbun Machicura	Chile
Consolidated Edison	USA
Contact Energy	New Zealand
Corporation IND Energia	Venezuela
Cpad Saneamento Basico de Sao Paulo On	Brazil
Cpad Saneamento de Minas Gerais On	Brazil
CPFL Energia On	Brazil
Cteep Cpad Transmissao de Energia Eletrica Paulista PN	Brazil
CTI Eletr Bras- Eletrobras Series B PN	Brazil
Dana Gas	Abu Dhabi
Direct Energie	France
Dist Gas Cuyana	Argentina
Dominion Resources	USA
Dong Energy AS	Denmark
Drax Group	UK
DTE Energy	USA
Duet Group	Australia
Duke Energy	USA
E On	Germany
E4U	Czech Republic
Edegel	Peru
Edelnor	Peru
Edenor Empresa Distribuidora y Comercializadora Norte	Argentina
EDF	France
Edison International	USA
EDP Energias de Portugal	Portugal
Electric Power Development	Japan
Elecnor	Spain
Electricite Strasbourg	France
Electricity Generating	Thailand
Elia System Operator	Belgium
Eltech Anemos	Greece
Emera	Canada
Empresa de Energia de Bogota	Colombia
Empresa de Energia del Pacifico	Colombia
Empresa Nacional de Electricidad	Chile
Enagas	Spain
Enbw Energie Baden-Wuerttemberg	Germany
Endesa	Spain
Endesa Americas	Chile
Endesa Costanera	Argentina
Enea	Poland
Enel	Italy
Energa	Poland
Energias do Brasil On Brazil	Brazil
Energiedienst Holding	Switzerland
Energijos Skirstymo Operatorius	Lithuania
Energisa PN	Brazil
Energisa Units	Brazil
Energoaqua	Czech Republic
Energoremont Holding	Bulgaria
Energy Absolute	Thailand
Energy Development	Philippines
Enersis	Chile
Enersis Chile	Chile
Engie	France
Engie Brasil Energia On	Brazil
Engie Energia Chile	Chile
Engie Energia Peru	Peru
ENN Energy Holdings	Hong Kong
Entergy	USA
Equatorial Energia On	Brazil
Eversource Energy	USA
EVN	Austria

Exelon	USA
Falck Renewables	Italy
Federal Grid Company of Unified Energy System	Russia
First General	Philippines
Firstenergy	USA
Fortis	Canada
Fortum	Finland
Gas de Sao Paulo On	Brazil
Gas Natural	Colombia
Gas Natural	Argentina
Gas Natural SDG	Spain
Gelsenwasser	Germany
Genesis Energy	New Zealand
Global Power Synergy	Thailand
Glow Energy	Thailand
Great Plains Energy	USA
Guangdong Investment	Hong Kong
Hafslund 'A'	Norway
Hafslund 'B'	Norway
Hawaiian Electric Industries	USA
Hera	Italy
Hong Kong Electric Investments	Hong Kong
Hokkaido Electric Power	Japan
Hokuriku Electric Power	Japan
Hong Kong and China Gas	Hong Kong
Huaneng Power International 'H'	China
Hub Power Company	Pakistan
Hydro One	Canada
Iberdrola	Spain
Idacorp	USA
Indraprastha Gas	India
Infraestructura Energetica Nova	Mexico
Innergex Renewable Energy	Canada
Innogy	Germany
Inter RAO UES	Russia
Interconexion Electrica	Colombia
Inversiones Aguas Metropolitanas	Chile
Irbid District Electricity	Jordan
Iren	Italy
Irkutskenergo	Russia
Isagen	Colombia
Iwatani	Japan
Jordan Electric Power	Jordan
JSW Energy	India
Kansai Electric Power	Japan
Karachi Electric Supply	Pakistan
Kauno Energija	Lithuania
Keppel Infra Trust REIT	Singapore
Korea Electric Power	South Korea
Korea Gas	South Korea
KOT Addu Power	Pakistan
Kyushu Electric Power	Japan
Laugfs Gas	Sri Lanka
Lechwerke	Germany
Lietuvos Energija	Lithuania
Light On	Brazil
Litgrid	Lithuania
Luz del Sur	Peru
Lydec	Morocco
Malakoff	Malaysia
Manila Electric	Philippines
Manila Water	Philippines
Mercury New Zealand	New Zealand
Meridian Energy	New Zealand
Metro Pacific Investments	Philippines
Metrogas	Argentina
MMC	Malaysia
Mosenergo	Russia
MVV Energie	Germany
National Fuel Gas	USA
National Gas	Oman
National Grid	UK
Nextera Energy	USA
NHPC	India
Nippon Gas	Japan
Nisource	USA
NLC India	India
Northland Power	Canada
NRG Energy	USA
North Hungarian Electricity Supply	Hungary
NTPC	India
Okinawa Electric Power	Japan
One Gas	USA
Oneok	USA
Origin Energy (ex Boral)	Australia
Osaka Gas	Japan
Pampa Energia	Argentina
Pannergy	Hungary
Pehuenche	Chile
Pembina Pipeline	Canada
Pennon Group	UK
Perusahaan Gas Negara	Indonesia
Petronas Gas	Malaysia
Petronet L N G	India
Petrovietnam Low Pressure Gas Distribution	Vietnam
Petrovietnam Power Nhon Trach 2	Vietnam
PG&E	USA
PHA Lai Thermal Power	Vietnam
Phoenix Power	Oman
Pinnacle West Capital	USA
Polska Grupa Energetyczna	Poland
Portland General Electric	USA
Power Assets Holdings	Hong Kong
Power Grid Corporation of India	India
PPL	USA
Public Service Enterprise Group	USA
Public Power	Greece
Qatar Electricity and Water	Qatar
Ratchaburi Electricity	Thailand
Red Electrica Corporacion	Spain
Reliance Infrastructure	India
Reliance Power	India
Ren	Portugal
Renova Energia On	Brazil
Romande Energie Holding	Switzerland
Rosseti	Russia
Rubis	France
Rural Electrification Corporation	India
Rushydro	Russia
RWE	Germany
RWE Preference	Germany
Saeta Yield	Spain
Saibu Gas	Japan
Satluj Jal Vidyut Nigam	India
Scana	USA
Selected Energy	Cyprus
Sembcorp Salalah Power	Oman
Sempra Energy	USA

Seo PRVB	Luxembourg
Severn Trent	UK
Sharqiyah Desalination	Oman
Shikoku Electric Power	Japan
Shizuokagas	Japan
SIIC Environment Holdings	Singapore
SMN Power Holding	Oman
Snam	Italy
Societe Electrique de Lour	Luxembourg
Sohar Power	Oman
Southern	USA
Southern Hydropower	Vietnam
Southwest Gas	USA
Spark Infrastructure Group	Australia
SSE	UK
Suez	France
Tallinna Vesi	Estonia
Taqa Morocco	Morocco
Tata Power	India
Tauron Polska Energia	Poland
Tenaga Nasional	Malaysia
Terna Energy	Greece
Terna Rete Elettrica NAZ	Italy
Thac BA Hydropower	Vietnam
Thac Mo Hydro Power	Vietnam
Thessaloniki Water Supply	Greece
Toho Gas	Japan
Tohoku Electric Power	Japan
Tokai Holdings	Japan
Tokyo Electric Power Company Holdings	Japan
Tokyo Gas	Japan
Torrent Power	India
Transalta	Canada
Transalta Renewables	Canada
TRNSNR CEI Transp Denga Electrica En Alta TNSN	Argentina
Trustpower	New Zealand
TSMS Alianca Energia Eletrica Units	Brazil
UGI	USA
Ultrapar Participoes On	Brazil
Uniper Securities	Germany
Unipro	Russia
United Utilities Group	UK
Vector	New Zealand
Vectren	USA
Veolia Environnement	France
Verbund	Austria
Vinh Son-Song Hinh Hydropower	Vietnam
WEC Energy Group	USA
Westar Energy	USA
WGL Holdings	USA
Xcel Energy	USA
YTL	Malaysia
YTL Power International	Malaysia

Appendix A3 Basic Materials index composition

Full Name	Market
Abou Kir Fertilizers	Egypt
Acacia Mining	UK
Acerias Paz del Rio	Colombia
Acerinox 'R'	Spain
Acron	Russia
Adaro Energy	Indonesia
Adeka	Japan
African Rainbow Minerals	South Africa
Agnico Eagle Mines	Canada
Agrium	Canada
Ahlstrom	Finland
Aichi Steel	Japan
Air Liquide	France
Air Products and Chemicals	USA
Air Water	Japan
Akzo Nobel	Netherlands
Al Fajar Al Alamia	Oman
Al Jazeera Steel Products	Oman
Alamos Gold	Canada
Albemarle	USA
Aluminum Company of America	USA
Alcomet	Bulgaria
Alkout Industrial Projects	Kuwait
Allgemeine Gold und Silberscheideanstalt	Germany
Alpek de Convertible	Mexico
Alro Slatina	Romania
Alrosa	Russia
Alrosa-Nyurba	Russia
Altri SGPS	Portugal
Aluar	Argentina
Aluminium	Romania

Full Name	Market
Alumina	Australia
Aluminium Bahrain	Bahrain
Aluminium du Maroc	Morocco
Amag Austria Metall	Austria
Anglo American	UK
Anglo American Platinum	South Africa
Anglogold Ashanti	South Africa
Antofagasta	UK
Aperam	Netherlands
Arcelormittal	Netherlands
Arcelormittal Hunedoara	Romania
Arkema	France
Asahi Holdings	Japan
Asahi Kasei	Japan
Asanko Gold	Canada
Ashland Global Holdings	USA
Assore	South Africa
Aurubis	Germany
Avery Dennison	USA
Axalta Coating Systems	USA
B2GOLD	Canada
Banpu	Thailand
Barrick Gold	Canada
BASF	Germany
Batu Kawan	Malaysia
Bayan Resources	Indonesia
Bayer	Germany
Bayer Cropscience	India
BHP Billiton	Australia
BHP Billiton	UK
Billerud Korsnas	Sweden
Bio On	Italy

Bluescope Steel	Australia
Bogdanka	Poland
Boliden	Sweden
Borregaard	Norway
Boubyan Petrochemicals	Kuwait
Braskem On	Brazil
Braskem PN Series 'A'	Brazil
Brenntag	Germany
Brookfield Infrastructure Partners Units	USA
Buenaventura 'V'	Peru
Cabot	USA
Cameco	Canada
Canfor	Canada
Cap	Nigeria
Carbochim Cluj Napoca	Romania
Cascades	Canada
Castrol India	India
Celanese 'A'	USA
Celulosa	Argentina
Centamin	UK
Centerra Gold	Canada
Cerro Verde	Peru
CF Industries Holdings	USA
Chandra Asri Petrochemical	Indonesia
Chemtrade Logistics Income Fund	Canada
China Coal Energy 'H'	China
China Gold International Resources	Canada
China Hongqiao Group	Hong Kong
China Shenhua Energy Company 'H'	China
China Steel	Taiwan
Ciech	Poland
Cinkarna Redne	Slovenia
Clariant	Switzerland
Coal India	India
Companhia Siderurgica Nacional On	Brazil
Compania Minera Milpo	Peru
Compania Minera Poderosa	Peru
Conroy Gold and Natural Resources (ESM)	Ireland
Consol Energy	USA
Corimon 'A'	Venezuela
Corinth Pipe Works	Greece
Corporacion Aceros Arequipa	Peru
Covestro	Germany
Crete Plastics	Greece
Croda International	UK
Cydsa	Mexico
D&L Industries	Philippines
Dai Thien Loc	Vietnam
Daicel	Japan
Daido Steel	Japan
Daio Paper	Japan
Dawood HRC Chemicals Corporation	Pakistan
Denka	Japan
Detour Gold	Canada
Dic	Japan
Dmci Holdings	Philippines
Dolkam Suja	Slovakia
Dominion Diamond	Canada
Dong Phu Rubber	Vietnam
Dottikon ES Holding	Switzerland
Dow Chemical	USA
Dowa Holdings	Japan
DSM Koninklijke	Netherlands
E I du Pont de Nemours	USA
Earth Chemical	Japan
Eastman Chemical	USA
Ecolab	USA
Egypt Aluminium	Egypt
Egypt Iron and Steel	Egypt
Egyptian Chemical IND	Egypt
Eisen-und Huttenwerke	Germany
El EZZ Aldekhela Steel Alexandria	Egypt
Eldorado Gold	Canada
Elementis	UK
Empre Siderurgica del Peru 'A'	Peru
Empresas CMPC	Chile
EMS-Chemie 'N'	Switzerland
Ence Energia y Celulosa	Spain
Endeavour Mining	Canada
Engro	Pakistan
Engro Fertilizers	Pakistan
Eramet	France
Ercros	Spain
Eregli Demir Celik	Turkey
Evolution Mining	Australia
Evonik Industries	Germany
Evraz	UK
Exxaro Resources	South Africa
EZZ Steel	Egypt
F Ramada Investimentos	Portugal
Fatima Fertilizer	Pakistan
Fauji Fertilizer	Pakistan
Fauji Fertilizer Bin Qasim	Pakistan
Ferrexpo	UK
Fibria Celulose On	Brazil
First Majestic Silver	Canada
First Quantum Minerals	Canada
FMC	USA
Formosa Chemicals and Fibre	Taiwan
Formosa Plastics	Taiwan
Fortescue Metals Group	Australia
Fortuna Silver Mines	Canada
Fosfatos del Pacifico	Peru
Fosun International	Hong Kong
Franco-Nevada	Canada
Freeport-Mcmoran	USA
Fresnillo	UK
Frutarom	Israel
Fuchs Petrolub	Germany
Fuchs Petrolub Preference	Germany
Gerdau On	Brazil
Gerdau PN	Brazil
Givaudan 'N'	Switzerland
Glencore	UK
Gold Fields	South Africa
Goldcorp	Canada
Great Western Mining (ESM) Corporation	Ireland
Grecemar	France
Grigiskes	Lithuania
Grupa Azoty	Poland
Grupa Kety	Poland
Grupo Kuo 'A'	Mexico
Grupo Kuo 'B'	Mexico
Grupo Mexico 'B'	Mexico
Grupo Quimico	Venezuela
Grupo Simec	Mexico
Grupo Zuliano	Venezuela
Guyana Goldfields	Canada

H&R	Germany
Hanwha Chemical	South Korea
Hap Seng Consolidated	Malaysia
Harmony Gold Mining	South Africa
Hexpol 'B'	Sweden
Hindalco Industries	India
Hindustan Zinc	India
Hitachi Chemical	Japan
Hitachi Metals	Japan
Hoa Sen Group	Vietnam
Hochschild Mining	UK
Hokuetsu Kishu Paper	Japan
Holland Colours	Netherlands
Holmen 'B'	Sweden
Hudbay Minerals	Canada
Huntsman	USA
Hyundai Steel	South Korea
Iamgold	Canada
Iberpapel Gestion	Spain
ICI Pakistan	Pakistan
ICL	Israel
IF Pro Populo Konk	Slovakia
Iluka Resources	Australia
Imcd Group	Netherlands
Imerys	France
Impala Platinum	South Africa
Inabata and Company	Japan
Inapa	Portugal
Incitec Pivot	Australia
Independence Group	Australia
Indorama Ventures	Thailand
Industrielle Penoles	Mexico
Industrias CH	Mexico
Inner Mongolia Yitai Coal 'B'	China
International Paper	USA
International Flavors and Fragrances	USA
IRPC	Thailand
Israel Corporation Limited	Israel
Ivanhoe Mines	Canada
J S R	Japan
Jacquet Metal SCE	France
JFE Holdings	Japan
Johnson Matthey	UK
Jordan Phosphate Mines	Jordan
JSP	Japan
JSW	Poland
JSW Steel	India
Jubilant Life Sciences	India
K + S	Germany
Kaneka	Japan
Kansai Paint	Japan
Kanto Denka Kogyo	Japan
Kaz Minerals	UK
Kazanorgsintez	Russia
Kemira	Finland
Kenmare Resources	Ireland
KGHM	Poland
Kingboard Chemical Holdings	Hong Kong
Kinross Gold	Canada
Kirkland Lake Gold	Canada
Kloeckner and Company	Germany
Klondex Mines	Canada
Kobe Steel	Japan
Korea Zinc	South Korea
Koza Altin Isletmeleri	Turkey
Kumba Iron Ore	South Africa
Kuraray	Japan
Kureha	Japan
Kyoei Steel	Japan
Lanxess	Germany
Lee and Man Paper Manufacturing	Hong Kong
Lenzing	Austria
LG Chem	South Korea
Linde	Germany
Lingotes Especiales	Spain
Lonmin	UK
Lotte Chemical	South Korea
Lucara Diamond	Canada
Lundin Mining	Canada
Lyondellbasell Industries Class A	USA
MAG Silver	Canada
Magnitogorsk Iron and Steel Works	Russia
Managem	Morocco
Manpa	Venezuela
Maruichi Steel Tube	Japan
Melamin Redne	Slovenia
Methanex	Canada
Metsa Board 'B'	Finland
Mexichem de Convertible	Mexico
Minera Frisco	Mexico
Mineral Resources	Australia
Mineros	Colombia
Miniere Touissit	Morocco
Minsur 'I'	Peru
Miquel y Costas	Spain
Mitsubishi Chemical Holdings	Japan
Mitsubishi Gas Chemical	Japan
Mitsui Chemicals	Japan
Mitsui Mining and Smelting	Japan
MMC Norilsk Nickel	Russia
Mondi	South Africa
Mondi	UK
Mosaic	USA
Mountain Province Diamonds	Canada
Munksjo	Finland
Mytilineos Holdings	Greece
Nacl Explosivos	Chile
Nagase	Japan
Nam Kim Steel	Vietnam
Nan Ya Plastics	Taiwan
National Aluminium	India
Navigator Comp	Portugal
Neochim	Bulgaria
Nevsun Resources	Canada
New Gold	Canada
New Hope Corporation	Australia
Newcrest Mining	Australia
Newmarket	USA
Newmont Mining	USA
Nickel Asia	Philippines
Nihon Parkerizing	Japan
Nine Dragons Paper Holdings	Hong Kong
Nippon Kayaku	Japan
Nippon Light Metal Holdings	Japan
Nippon Paint Holdings	Japan
Nippon Paper Industries	Japan
Nippon Shokubai	Japan
Nippon Soda	Japan
Nippon Steel and Sumikin Bussan	Japan
Nippon Steel and Sumitomo Metal	Japan

Nippon Synthetic Chemical Industry	Japan
Nissan Chemical Industries	Japan
Nisshin Steel	Japan
Nitto Denko	Japan
Nizhnekamskneftekhim	Russia
NMDC	India
NOF	Japan
Norsk Hydro	Norway
Northam Platinum	South Africa
Northern Star	Australia
Novagold Resources	Canada
Novolipetsk Steel	Russia
Nucor	USA
Nufarm	Australia
Nyrstar	Belgium
Oceanagold	Canada
OCI	Netherlands
Oji Holdings	Japan
Okamoto Industries	Japan
Okaya	Japan
Olin	USA
Oman Chlorine	Oman
Orica	Australia
Ormonde Mining (ESM)	Ireland
Osaka Steel	Japan
Osisko Gold Royalties	Canada
Outokumpu 'A'	Finland
Ovoca Gold (ESM)	Ireland
Oz Minerals	Australia
Pacific Metals	Japan
Pan American Silver	Canada
Papeles y Cartones de Europa	Spain
Petkim Petrokimya Holding	Turkey
Petra Diamonds	UK
Petrokemija	Croatia
Petronas Chemicals Group	Malaysia
Petropavlovsk	UK
Petrovietnam CA MAU Fertilizer	Vietnam
Petrovietnam Fertilizer and Chemical	Vietnam
Phosagro	Russia
Phuoc Hoa Rubber	Vietnam
PI Industries	India
Pidilite Industries	India
Plastika Nitra	Slovakia
Plastiques du Value de Loire	France
Polymetal International	UK
Polyus	Russia
Pomina Steel	Vietnam
Posco	South Korea
Potash Corporation of Saskatchewan	Canada
PPG Industries	USA
Praxair	USA
Press Metal	Malaysia
Pretium Resources	Canada
Pulawy	Poland
Quimica del Pacifico	Peru
Qurain Petrochemical Industries	Kuwait
Randgold Resources	UK
Recticel	Belgium
Regis Resources	Australia
Reliance Steel and Aluminum	USA
Resolute Mining	Australia
Rio Tinto	Australia
Rio Tinto	UK
Robertet	France
Royal Gold	USA
RPM International	USA
Russel Metals	Canada
Sakata INX	Japan
Salzgitter	Germany
Sanyo Chemical Industries	Japan
Sanyo Special Steel	Japan
Sappi	South Africa
Sasol	South Africa
Sava	Slovenia
SC Vrancart	Romania
Societe Metallurgique d'Imiter	Morocco
Schmolz + Bickenbach	Switzerland
Scotts Miracle-Gro	USA
Sudwestdeutsche Salzwerke	Germany
Semafo	Canada
Semapa	Portugal
Semirara Mining and Power	Philippines
Sensient Technologies	USA
Severstal	Russia
Shikoku Chemicals	Japan
Shin-Etsu Chemical	Japan
Shin-Etsu Polymer	Japan
Shougang Hierro	Peru
Showa Denko KK	Japan
Sibanye Gold	South Africa
Siderar 'A'	Argentina
Siderurgica Venezolana	Venezuela
Sidi Kerir Petrochemicals	Egypt
Silver Standard Resources	Canada
Silver Wheaton	Canada
Simona	Germany
Sims Metal Management	Australia
Sociedad Minera El Brocal SAA	Peru
Sociedad Quimica y Minera de Chile A Preference	Chile
Sociedad Quimica y Minera de Chile B Preference	Chile
Soda Sanayi	Turkey
Sol	Italy
Solvac	Belgium
Solvay	Belgium
Solvay Indupa	Argentina
Sonasid	Morocco
SOUTH32	Australia
Southern Copper	USA
Southern Peru 'I'	Peru
SRF	India
Ssab 'B'	Sweden
Saint Barbara	Australia
Stalprodukt	Poland
Steel Authority of India	India
Steel Dynamics	USA
Stora Enso 'A'	Finland
Stora Enso 'R'	Finland
Sumitomo Bakelite	Japan
Sumitomo Chemical	Japan
Sumitomo Metal Mining	Japan
Suzano Bahia Sul Papel Celulose A PN	Brazil
Svilosa	Bulgaria
Symrise	Germany
Syngenta	Switzerland
Synthomer	UK
Synthos	Poland
T Hasegawa	Japan

Tahoe Resources	Canada
Taiyo Holdings	Japan
Taiyo Nippon Sanso	Japan
Takasago International	Japan
Tambang Batubara Bukit Asam	Indonesia
Tata Chemicals	India
Tata Steel	India
Teck Resources 'B'	Canada
Teijin	Japan
Tenaris	Luxembourg
Tessenderlo	Belgium
The Arab Potash	Jordan
Thrace Plastics	Greece
Tmac Resources	Canada
TMK OAO	Russia
Toagosei	Japan
Tokai Carbon	Japan
Tokushu Tokai Paper	Japan
Tokuyama	Japan
Tokyo Steel Manufacturing	Japan
Toray Industries	Japan
Torex Gold Resources	Canada
Tosoh	Japan
Toyo Ink SC Holdings	Japan
Tubacex	Spain
Tubos Reunidos	Spain
Turquoise Hill Resources	Canada
Uacj	Japan
UBE Industries	Japan
Umicore	Belgium
United Company Rusal	Hong Kong
United Paper Industries	Bahrain
UPL	India
UPM-Kymmene	Finland
Uralkali	Russia
Usinas Siderurgicas de Minas Gerais On	Brazil
Vale Indonesia	Indonesia
Vale On	Brazil
Vale PN	Brazil
Valvoline	USA
Vedanta	India
Vedanta Resources	UK
Victrex	UK
Vietnam Fumigation	Vietnam
Voestalpine	Austria
Volcan Compania Minera 'A'	Peru
Volcan Compania Minera B Preference	Peru
Vsmpo	Russia
W R Grace	USA
Wacker Chemie	Germany
Washington H Soul Pattinson and Company	Australia
West Fraser Timber	Canada
Westlake Chemical	USA
Whitehaven Coal	Australia
Yamana Gold	Canada
Yamato Kogyo	Japan
Yara International	Norway
Yodogawa Steel Works	Japan
Zeon	Japan

Appendix A4 Industrials index composition

Full Name	Market
3M	USA
3M India	India
A P Moller - Maersk 'A'	Denmark
A P Moller - Maersk 'B'	Denmark
AA	UK
AAC Technologies Holdings	Hong Kong
Aalberts Industries	Netherlands
ABB India	India
ABB Limited N	Switzerland
Abertis Infraestructuras	Spain
Aboitiz Equity Ventures	Philippines
ACC	India
Accenture Class A	USA
Access Engineering	Sri Lanka
Acciona	Spain
Acico Industries	Kuwait
ACS Actividades Construccion y Servicios	Spain
Acuity Brands	USA
Adani Ports and Special Economic Zone	India
ADC Croatia International Club	Croatia
Adecco 'R'	Switzerland
Adelaide Brighton	Australia
ADP	France
Aecom	USA
Aena Shares	Spain
Aeon Delight	Japan
Aercap Holdings N V	USA
Aerop Gugl Marco	Italy
Aerostar Bacau	Romania
AF Gruppen 'A'	Norway
Afaq Energy	Jordan
AFG Arbonia-Forster	Switzerland
AGCO	USA
AGFA-Gevaert	Belgium
Aggreko	UK
Agilent Technologies	USA
Agility Public Warehousing	Kuwait
Agrometal	Argentina
Agta Record	France
AIA Engineering	India
Aica Kogyo	Japan
Aichi	Japan
Aida Engineering	Japan
Airbus Group	France
Airports of Thailand	Thailand
Akcansa Cimento Sanayi VE Ticaret	Turkey
Akka Technologies	France
AKR Corporindo	Indonesia
Aktieselskabet Schouw and Company	Denmark
Al Anwar Ceramic Tile	Oman
Alba	Germany
Alexandria Cement	Egypt
Alfa 'A'	Mexico
Alfa Laval	Sweden
Allami Nyomda	Hungary
Allegion	USA

Allgemeine Baugesellschaft 'A' Porr	Austria
Alliance Data Systems	USA
Alliance Global Group	Philippines
Allison Transmission Holdings	USA
Alps Electric	Japan
ALS	Australia
Alstom	France
Amada Holdings	Japan
Amadeus Fire	Germany
Amadeus IT Group	Spain
Amano	Japan
Amara Raja Batteries	India
Ambuja Cements	India
Amcor	Australia
Ametek	USA
AMG Advanced Metallurgical Group	Netherlands
Amphenol 'A'	USA
Andritz	Austria
Anhui Conch Cement 'H'	China
Ansaldo States	Italy
Applus Servicios Technologicos	Spain
Aptargroup	USA
Arabian Cement	Egypt
Arabtec Holding	Dubai
Aramex	Dubai
Arcadis	Netherlands
Arkan Building Materials	Abu Dhabi
Arrow Electronics	USA
Asahi Glass	Japan
Ashaka Cement	Nigeria
Ashok Leyland	India
Ashtead Group	UK
Asia Cement	Taiwan
Asian Paints	India
Askul	Japan
Aslan Cimento Anonim Sirketi	Turkey
Assa Abloy 'B'	Sweden
Assystem	France
Astaldi	Italy
Astm	Italy
At&S Austria Technology and (Vienna Stock Exchange) Systemtech	Austria
Atkins (WS)	UK
Atlantia	Italy
Atlantska Plovidba	Croatia
Atlas Copco 'A'	Sweden
Atlas Copco 'B'	Sweden
Auckland International Airport	New Zealand
Aurizon Holdings	Australia
Automatic Data Processing	USA
Autopistas del Sol	Argentina
Aviation Latecoere	France
Aviation Lease and Finance	Kuwait
Avnet	USA
Avon Rubber	UK
Ayala	Philippines
Azbil	Japan
Azkoyen	Spain
B/E Aerospace	USA
Babcock International	UK
BAE Systems	UK
Bahrain Ship Repairing and Engineering Company	Bahrain
Balfour Beatty	UK
Ball	USA
BAM Groep Koninklijke	Netherlands
Barco New	Belgium
Barloworld	South Africa
Bastogi	Italy
Batenburg Techniek	Netherlands
BBA Aviation	UK
Becamex Infrastructure Development	Vietnam
Beijing Enterprises Holdings	Hong Kong
Bekaert (D)	Belgium
Belimo Holding	Switzerland
BELLSYSTEM24 Holdings	Japan
Bemis	USA
Benefit One	Japan
Benefit Systems	Poland
Berendsen	UK
Berger Paints India	India
Berli Jucker	Thailand
Berry Plastics Group	USA
Bertrandt	Germany
Bestway Cement	Pakistan
Beta Glass	Nigeria
Bharat Electronics	India
Bharat Forge	India
Bharat Heavy Electricals	India
Bidvest Group	South Africa
Biesse	Italy
Bilfinger Berger	Germany
Binh Duong Mineral and Construction	Vietnam
Binh Minh Plastics	Vietnam
Bintulu Port Holdings	Malaysia
Blue Dart Express	India
Blue Solutions	France
Bobst Group 'R'	Switzerland
BOC Aviation	Hong Kong
Bodycote	UK
Boeing	USA
Boldt	Argentina
Bollore	France
Bombardier 'B'	Canada
Boot (Henry)	UK
Booz Allen Hamilton Holding	USA
Boral	Australia
Borealis Exploration	Czech Republic
Boskalis Westminster	Netherlands
Bossard 'B'	Switzerland
Bouygues	France
Bpost	Belgium
Braas Monier Building Gross Serv	Germany
Brambles	Australia
Brickworks	Australia
Broadridge Financial Solutions	USA
Brunel International	Netherlands
Bucher Industries	Switzerland
Budimex	Poland
Bunka Shutter	Japan
Bunzl	UK
Burckhardt Compression Holding	Switzerland
Bureau Veritas International	France
Burkhalter N	Switzerland
Buzzi Unicem	Italy
Buzzi Unicem RSP	Italy
BWT	Austria
BWX Technologies	USA
CAE	Canada
Cahya Mata Sarawak	Malaysia

Caltagirone	Italy	Cleanaway Waste Management	Australia
Canadian National Railway	Canada	CNH Industrial	Italy
Canadian Pacific Railway	Canada	Cobham	UK
Capita	UK	Cofide Gruppo de Benedet	Italy
Caputo	Argentina	Cognex	USA
Cargoport Logistics 'B'	Venezuela	Colas	France
Cargoport Logistics 'C'	Venezuela	Colfax	USA
Cargoport Logistics 'D'	Venezuela	Colorado	Morocco
Cargotec 'B'	Finland	Combined Group Contracting Company	Kuwait
Carillion	UK	Comelf Bistrita	Romania
Carlisle Companies	USA	Comet Holdings 'R'	Switzerland
Carton de Colombia	Colombia	Companhia Cocs Rodoviarias On	Brazil
Catcher Technology	Taiwan	Computershare	Australia
Caterpillar	USA	Comsys Holdings	Japan
Caverion Corporation	Finland	Conconcreto	Colombia
CCL Industries 'B'	Canada	Conduril Engenharia Limited Data	Portugal
CCT Correios de Portugal	Portugal	Connect Group	UK
Celestica Sub Voting Shares	Canada	Const y Auxiliar de Ferr	Spain
Cembre	Italy	Construcciones El Condor	Colombia
Cementir Holding	Italy	Container Corporation of India	India
Cementos Argos	Colombia	Conzzeta Holding 'A'	Switzerland
Cementos Argos Preference	Colombia	Corelogic	USA
Cementos Molins	Spain	Corporacion de Ferias y Expocisiones	Colombia
Cementos Pacasmayo SAA	Peru	Corporation Moctezuma	Mexico
Cementos Portland Valderrivas	Spain	Corticeira Amorim	Portugal
Cemex CPO	Mexico	Cosco Shipping Ports	Hong Kong
Cemex Latam Holding (BOG)	Colombia	Costain Group	UK
Cemex Venezuela 1	Venezuela	Costar Group	USA
Cemex Venezuela 2	Venezuela	Cotec Construction Joint Stock	Vietnam
Cemmac	Slovakia	CPL Resources (ESM)	Ireland
Central Glass	Japan	Cramo	Finland
Century Textiles and Industries	India	Crane	USA
Ceram Carabobo	Venezuela	CRH	UK
Cerved Information Solutions	Italy	Crompton Greaves Consumer Electric	India
Cetis Redne	Slovenia	Crown Holdings	USA
CFAO	France	CRRC 'H'	China
CFE	Belgium	Csepel Holding	Hungary
CH Robinson Worldwide	USA	CSR	Australia
Charles Taylor	UK	CSX	USA
Chemolak	Slovakia	CTS Eventim	Germany
Chemring Group	UK	Cummins	USA
China Communications Construction 'H'	China	Cuong Thuan Idico Development Investment	Vietnam
China Everbright International	Hong Kong	Curtiss Wright	USA
China Merchants Port Holdings	Hong Kong	CWT	Singapore
China Railway Construction 'H'	China	Cyprus Cement	Cyprus
China Railway Group 'H'	China	Cyprus Trading	Cyprus
China Railway Signal and Communication 'H'	China	Daelim Industrial	South Korea
China Resources Beer (Holdings) Company	Hong Kong	Daetwyler 'I'	Switzerland
China State Construction International Holdings	Hong Kong	Daewoo Engineering and Construction	South Korea
Chiyoda	Japan	Daifuku	Japan
Chudenko	Japan	Daihen	Japan
Ciment du Maroc	Morocco	Daikin Industries	Japan
Cimentos de Portugal SGPS	Portugal	Daiseki	Japan
Cimic Group	Australia	Dalekovod D D	Croatia
Cintas	USA	Dalmia Bharat	India
CIR Compagnie Industriali Riun	Italy	d'Amico International Shipping	Luxembourg
Citic	Hong Kong	Dampskibsselskabet Norden	Denmark
CJ Korea Express	South Korea	Danaher	USA
CK Hutchison Holdings	Hong Kong	Dangote Cement	Nigeria
CKD	Japan	Danieli	Italy
Clarkson	UK	Danieli and C RSP	Italy
		Dassault Aviation	France
		Datalogic	Italy

DCC	UK	Enefi Energy	Hungary
De La Rue	UK	Enercare	Canada
Deceuninck ECH	Belgium	En-Japan	Japan
Deere	USA	Enka Insaat VE Sanayi	Turkey
Delta Electronics	Taiwan	Enplas	Japan
Delta Electronics	Thailand	Envases Vzlano	Venezuela
Deluxe	USA	Equiniti Group	UK
Derichebourg	France	Essentra PLC	UK
Deutsche Post	Germany	Eurazeo	France
Deutz	Germany	Eurokai GMBH and Company KGaA	Germany
Development Investment Construction	Vietnam	Euronav	Belgium
Dexerials	Japan	Euronet Worldwide	USA
DFDS	Denmark	Evpu AS	Slovakia
DG Khan Cement Company	Pakistan	EVS Broadcast Equipment	Belgium
DH	Canada	Exel Industries	France
Dialight	UK	Exmar	Belgium
Dimco	Cyprus	Exova Group	UK
Dinhvu Port Investment and Development	Vietnam	Expeditor International of Washington	USA
Dip	Japan	Experian	UK
Diploma	UK	Expolanka Holdings	Sri Lanka
Disco	Japan	Facc AG	Austria
DKSH Holding	Switzerland	Faiveley Transport	France
DMG Mori	Germany	Famur	Poland
DMG Mori	Japan	Fanuc	Japan
Dominguez	Venezuela	Fastenal	USA
Donaldson Company	USA	Fauji Cement Company	Pakistan
Dorma Kaba Hold	Switzerland	Fedex	USA
Doshisha	Japan	Feintool	Switzerland
Dover	USA	Fenner	UK
Downer EDI	Australia	Ferreyros SAA	Peru
DPA Group	Netherlands	Ferrovial	Spain
Dry Cell and Storage Battery	Vietnam	Ferrum Ceramica y Metalurgia 'B'	Argentina
DSV 'B'	Denmark	FHL H KRKD MRBL Granite	Greece
Duerkopp Adler	Germany	Fidelity National Information Services	USA
Duerr	Germany	Fiera Milano	Italy
Duluxgroup	Australia	Figeac Aero	France
Duratex On	Brazil	Fincantieri	Italy
Duro Dakovic Holding	Croatia	Fingerprint Cards 'B'	Sweden
Duro Felguera	Spain	Finning International	Canada
E2V Technologies	UK	First Data Class A	USA
Eagle Industry	Japan	Fiserv	USA
Eagle Materials	USA	Fisher (James) and Sons	UK
Eaton	USA	Fleetcor Technologies	USA
Ebara	Japan	Fletcher Building	New Zealand
Ecod Infu E Logistica On	Brazil	Flex	USA
Edag Engineering Group	Germany	Flir Systems	USA
Edenred	France	Floridienne	Belgium
Eicher Motors	India	Flowserve	USA
Eiffage	France	Flsmidth and Company 'B'	Denmark
El En	Italy	Flughafen Wien	Austria
Elbit Systems	Israel	Flughafen Zurich	Switzerland
Electrocomponents	UK	Fluidra	Spain
Electromagnetica	Romania	Fluor	USA
Electroputere Craiova	Romania	FN de Cementos	Venezuela
Element Fleet Management	Canada	FN de Vidrios	Venezuela
Elementia	Mexico	Fomento Construccion y Contratas	Spain
Elis	France	Forbo 'R'	Switzerland
Ellaktor	Greece	Forterra	UK
Elswedy Electric	Egypt	Fortive	USA
Embraer On	Brazil	Fortune Brands Home and Security	USA
Emcor Group	USA	Foxconn Technology	Taiwan
Emerson Electric	USA	FP	Japan
Emka	Bulgaria	Fraport	Germany
Enav	Italy	Freightways	New Zealand
		Frontline	Norway

Fuji Electric	Japan
Fuji Machine Manufacturing	Japan
Fuji Seal International	Japan
Fujikura	Japan
Fujitec	Japan
Fukushima Industries	Japan
Fukuyama Transporting	Japan
Funai Soken Holdings	Japan
Furukawa	Japan
Furukawa Electric	Japan
Futaba	Japan
G4S	UK
Gamuda	Malaysia
Gap Vassilopoulos	Cyprus
GE T&D India	India
GEA Group	Germany
Geberit 'R'	Switzerland
GEK Terna Holding Real Estate Construction	Greece
Gemadept	Vietnam
General de Alquiler de Maquinaria	Spain
General Dynamics	USA
General Electric	USA
Genesee and Wyoming 'A'	USA
Genpact	USA
Geocomplex	Slovakia
Georg Fischer 'R'	Switzerland
GL Events	France
Global Dominion Access	Spain
Global Payments	USA
Glory	Japan
GMO Payment Gateway	Japan
GPO Conces Oeste	Argentina
Graco	USA
Grafton Group Units	UK
Grana y Montero	Peru
Grand Harbour Marina	Malta
Graphic Packaging Holding	USA
Grasim Industries	India
Grenke N	Germany
Groupe Crit	France
Groupe Eurotunnel	France
Groupe Guillin	France
Grupo Aeroportuario del Centro Norte 'B'	Mexico
Grupo Aeroportuario del Pacifico	Mexico
Grupo Aeroportuario del Sureste 'B'	Mexico
Grupo Carso Series A1	Mexico
Grupo Cementos	Mexico
Grupo Lamosa	Mexico
Grupo Rotoplas	Mexico
Grupo Saltillo	Mexico
GTT	France
Gujarat Pipavav Port	India
Gulf Cable and Electrical Industries	Kuwait
Gulf Warehousing	Qatar
H&K	France
Haitian International Holdings	Hong Kong
Halma	UK
Hamamatsu Photonics	Japan
Hamburger Hafen und Logistik	Germany
Hanwa	Japan
Hanwha	South Korea
Hanwha Techwin	South Korea
Hapag Lloyd	Germany
Harju Elekter	Estonia
Harmonic Drive Systems	Japan
Haseko	Japan
HATIEN1 Cement	Vietnam
Haulotte Group	France
Havell's India	India
Hayleys	Sri Lanka
Hays	UK
Hazama Ando	Japan
HD Supply Holdings	USA
HeidelbergCement	Germany
Heidelberger Druckmaschinen	Germany
Heijmans	Netherlands
Hella KGaA Hueck	Germany
Hexcel	USA
Hi-LEX	Japan
Hill and Smith	UK
Hino Motors	Japan
Hirata	Japan
Hirose Electric	Japan
Hitachi	Japan
Hitachi Construction Machinery	Japan
Hitachi Koki	Japan
Hitachi Transport System	Japan
Hitachi Zosen	Japan
Hoa Binh Construction and Real Estate Corporation	Vietnam
Hoa Phat Group	Vietnam
Hochiminh City Infrastructure Investment	Vietnam
Hochtief	Germany
Hoegh Long Holdings	Norway
Hogg Robinson Group	UK
Holcim Philippines	Philippines
Holcim Slovensko	Slovakia
Homag Group	Germany
Homeserve	UK
Hon Hai Precision Industry	Taiwan
Honeywell International	USA
Horiba	Japan
Hoshizaki	Japan
Howden Joinery Group	UK
Hoya	Japan
Hubbell	USA
Huhtamaki	Finland
Human Soft Holding	Kuwait
Hunt JB Transport Services	USA
Huntington Ingalls Industries	USA
Hutchison Port Holdings Trust	Singapore
Hydratec Industries	Netherlands
Hydraulic Elements and Systems	Bulgaria
Hyosung	South Korea
Hyundai Development	South Korea
Hyundai Engineering and Construction	South Korea
Hyundai Glovis	South Korea
Hyundai Heavy Industries	South Korea
Ibiden	Japan
Ibstock	UK
ID Logistics Group	France
Idex	USA
IHI	Japan
IJM	Malaysia
Illinois Tool Works	USA
IMA Industria Macchine	Italy
IMI	UK

Impact Developer and Contractor	Romania
Impd DSRRL Economico de Amlat de Convertible	Mexico
Imperial	South Africa
Implenia 'R'	Switzerland
Impregilo	Italy
Inaba Denkisangyo	Japan
Indocement Tunggal Prakarsa	Indonesia
Indus Holding	Germany
Industries Qatar	Qatar
Indutrade	Sweden
Inficon	Switzerland
Infomart	Japan
Infratil	New Zealand
Ingersoll-Rand	USA
Inles Ribnica Redne	Slovenia
Intereuropa	Slovenia
International Container Terminal Services	Philippines
Interpump Group	Italy
Interroll	Switzerland
Interserve	UK
Intertape Polymer Group	Canada
Intertek Group	UK
Inversiones Argos	Colombia
Inversiones Argos Preference	Colombia
INZ Stavby Kosice	Slovakia
IPG Photonics	USA
Iproeb Bistrita	Romania
IRB Infrastructure Developers	India
Iriso Electronics	Japan
Iseki and Company	Japan
ISS AS	Denmark
Isuzu Motors	Japan
Italmobiliare	Italy
Itochu	Japan
ITT	USA
Jabil Circuit	USA
Jack Henry and Associates	USA
Jacobs Engineering	USA
Jamco	Japan
James Hardie Industries Chess/Crest Depository Interest	Australia
Japan Airport Terminal	Japan
Japan Avions Electronics Industry	Japan
Japan Display	Japan
Japan Material	Japan
Japan Steel Works	Japan
Jardine Matheson Holdings	Singapore
Jardine Strategic Holdings	Singapore
Jasa Marga	Indonesia
Jenoptik	Germany
Jensen-Group	Belgium
Jet ALU	Morocco
JGC	Japan
John Keells Holdings	Sri Lanka
Johnson Controls International	USA
Juan Minetti	Argentina
Julius Berger Nigeria	Nigeria
Jungheinrich Preference	Germany
Kajaria Ceramics	India
Kajima	Japan
Kamigumi	Japan
Kanamoto	Japan
Kandenko	Japan
Kanematsu	Japan
Kansai Nerolac Paints	India
Kansas City Southern	USA
KAP Industrial	South Africa
Kapsch Trafficcom	Austria
Kardex 'B'	Switzerland
Kartonpack	Hungary
Kawasaki Heavy Industry	Japan
Kawasaki Kisen Kaisha	Japan
KCC	South Korea
KCE Electronics	Thailand
Keller	UK
Kendrion	Netherlands
Kepco Plant Service and Engineering	South Korea
Keppel Telecommunications and Transportation	Singapore
Keyence	Japan
Keysight Technologies	USA
Kier Group	UK
Kinden	Japan
Kingspan Group	Ireland
Kintetsu World Express	Japan
Kion Group	Germany
Kirby	USA
Kitz	Japan
Klabin On	Brazil
Klabin PN	Brazil
Klaipedos Nafta	Lithuania
Koenig and Bauer	Germany
Kohat Cement	Pakistan
Komatsu	Japan
Komax	Switzerland
Komori	Japan
Koncar Distributivni Specijalni Transformatori	Croatia
Koncar Elektroindustrija	Croatia
Kone 'B'	Finland
Konecranes	Finland
Kongsberg Gruppen	Norway
Konoike Transport	Japan
Korado Bulgaria	Bulgaria
Korea Aerospace Industries	South Korea
Krones	Germany
Kruk	Poland
KSB	Germany
KSB Preference	Germany
Kubota	Japan
Kuehne + Nagel International	Switzerland
Kuka	Germany
Kumagai Gumi	Japan
Kurita Water Industry	Japan
Kuroda Electric	Japan
Kuwait Cement	Kuwait
Kyocera	Japan
Kyowa Exeo	Japan
Kyudenko	Japan
L3 Communications Holdings	USA
Lafarge Cement Wapco Nigeria	Nigeria
Lafarge Malaysia	Malaysia
Lafargeholcim	Switzerland
Lafargeholcim Maroc	Morocco
Larsen and Toubro	India
Lassila and Tikanoja	Finland
Lavendon Group	UK
Legrand	France

LEM 'R'	Switzerland
Lennox International	USA
Leonardo-Financial	Italy
Leoni	Germany
LG	South Korea
Lifco B	Sweden
Lincoln Electric Holdings	USA
Link Administration Holdings	Australia
Linkedin Class A	USA
Lintec	Japan
Lisgrafica	Portugal
Lisi	France
Lite-On Technology	Taiwan
Litho Formas Portuguesa Limited Data	Portugal
Lixil Group	Japan
Lockheed Martin	USA
Logista Hold	Spain
Logwin	Germany
Loomis 'B'	Sweden
Looser Holding	Switzerland
Low and Bonar	UK
LSR Group	Russia
Lu Gia Mechanical Electric	Vietnam
Lucky Cement	Pakistan
Luka Koper	Slovenia
Luka Ploce	Croatia
Luka Rijeka DD Rijeka	Croatia
Luve	Italy
M + S Hydraulic	Bulgaria
Mabuchi Motor	Japan
Macdonald Dettwiler and Associates	Canada
Machinery Group	Switzerland
Macquarie Atlas Roads	Australia
Macquarie Infrastructure	USA
Maeda	Japan
Maeda Road Construction	Japan
Mahindra and Mahindra	India
Mainfreight	New Zealand
Makino Milling Machine	Japan
Malaysia Airports Holdings	Malaysia
Malta International Airport	Malta
Malta Properties Company	Malta
Maltapost	Malta
Man	Germany
Man Preference	Germany
Manitou	France
Mannai Corporation	Qatar
Manpowergroup	USA
Manutan International	France
Maple Leaf Cement Factory	Pakistan
Marshalls	UK
Martifer	Portugal
Martin Marietta Materials	USA
Marubeni	Japan
Maschinenfabrik Berthold Hermle Preference	Germany
Masco	USA
Masterplast	Hungary
Max	Japan
Maximus	USA
Mayr-Melnhof Karton	Austria
MDU Resources Group	USA
Mears Group	UK
Mecanica Ceahlau	Romania
Medion	Germany
Meggitt	UK
Meidensha	Japan
Meitec	Japan
Menzies (John)	UK
Merko Ehitus	Estonia
Mersen (ex LCL)	France
Metawater	Japan
Metka Industrial Construction	Greece
Metso	Finland
Mettler Toledo International	USA
Minebea	Japan
Mirait Holdings	Japan
Misc Berhad	Malaysia
Misr Beni Suef Cement	Egypt
Misr Cement (Qena)	Egypt
Misumi Group	Japan
Mitani	Japan
Mitani Sekisan	Japan
Mitie Group	UK
Mitsubishi	Japan
Mitsubishi Electric	Japan
Mitsubishi Heavy Industries	Japan
Mitsubishi Logistics	Japan
Mitsubishi Materials	Japan
Mitsubishi Nichiyu Forklift	Japan
Mitsuboshi Belting	Japan
Mitsui	Japan
Mitsui Engineering and Shipbuilding	Japan
Mitsui OSK Lines	Japan
Miura	Japan
Monotaro	Japan
Morgan Advanced Material	UK
Morgan Sindall Group	UK
Morita Holdings	Japan
Mota Engil SGPS	Portugal
MTU Aero Engines Holding	Germany
Mullen Group	Canada
Murata Manufacturing	Japan
Music Industrial Direct 'A'	USA
My EG Services	Malaysia
Nabtesco	Japan
Nachi Fujikoshi	Japan
Nafais Holding	Kuwait
Nass Corporation BSC	Bahrain
National Central Cooling	Dubai
National Industries	Kuwait
National Instruments	USA
NBCC (India)	India
NCC 'B'	Sweden
Nedap	Netherlands
Nemesis Constructions	Cyprus
Nets	Denmark
New Flyer Industries	Canada
Neways Electric International	Netherlands
Nexans	France
NGK Insulators	Japan
Nibe Industrier 'B'	Sweden
Nice	Italy
Nichias	Japan
Nichicon	Japan
Nichiha	Japan
Nichiigakkan	Japan
Nidec	Japan
Nikkon Holdings	Japan
Nippo	Japan

Nippon Densetsu Kogyo	Japan	Oxford Instruments	UK
Nippon Electric Glass	Japan	Paccar	USA
Nippon Express	Japan	Pack	Japan
Nippon Sheet Glass	Japan	Packages	Pakistan
Nippon Signal	Japan	Packaging Corporation of America	USA
Nippon Yusen KK	Japan	Pact Group Holdings	Australia
Nishimatsu Construction	Japan	Pagegroup	UK
Nishio Rent All	Japan	Palfinger	Austria
Nissha Printing	Japan	Pan Group	Vietnam
Nissin Electric	Japan	Panalpina Welttransport	Switzerland
Nitta	Japan	Panaria Group Industrie Ceramiche	Italy
Nitto Boseki	Japan	Panevezio Statybos Trestas	Lithuania
Nitto Kogyo	Japan	Parker-Hannifin	USA
NKT	Denmark	Paychex	USA
Noble Group	Singapore	Paypal Holdings	USA
Nohmi Bosai	Japan	Paypoint	UK
Noibai Cargo Terminal Services	Vietnam	Paysafe Group	UK
Nomura	Japan	Peab 'B'	Sweden
Norbord	Canada	Pentair	USA
Nordecon	Estonia	Penta-Ocean Construction	Japan
Nordson	USA	Per Aarsleff Holding B	Denmark
Norfolk Southern	USA	Perkinelmer	USA
Noritz	Japan	Petrovietnam Transportation Corporation	Vietnam
Northern Cement	Jordan	Pfeiffer Vacuum Technology	Germany
Northgate	UK	Pfleiderer Group	Poland
Northrop Grumman	USA	Philips Electronics Koninklijke	Netherlands
Novisource	Netherlands	Philips Lighting	Netherlands
Novorossiysk Commercial Sea Port	Russia	Phoenix Mecano 'B'	Switzerland
NPK OVK	Russia	Picanol	Belgium
NTN	Japan	Piraeus Port Authority CR	Greece
NUI NHO Stone	Vietnam	PKC Group	Finland
NWS Holdings	Hong Kong	PKP Cargo	Poland
Obara Group	Japan	Placoplatre Limited Data	France
Obayashi	Japan	Polypipe Group	UK
Obrascon Huarte Lain	Spain	Ponsse	Finland
OC Oerlikon	Switzerland	Port of Tauranga	New Zealand
Ocean Yield	Norway	Portland Cement	Kuwait
Odessos Shiprepair Yard	Bulgaria	Porvair	UK
Odet (Finc de l')	France	Posco Daewoo	South Korea
Oeneo	France	Postnl	Netherlands
OHL Mexico	Mexico	PP (Persero)	Indonesia
Oiles	Japan	Prazske Sluzby	Czech Republic
Okuma	Japan	Prima Industrie	Italy
Okumura	Japan	Prodplast Bucarest	Romania
Old Dominion Freight Lines	USA	Promotora y Oprd Infraestructura	Mexico
Oman Cables Industry	Oman	Promotora y Oprd Infraestructura 'L'	Mexico
Oman Cement	Oman	Prosegur Compania Securidad	Spain
Oman Investment and Finance	Oman	Prysmian	Italy
Omron	Japan	Pushpay	New Zealand
Onex	Canada	Qatar Gas Transport Nakilat	Qatar
Oranjewoud 'A'	Netherlands	Qatar Industrial Manufacturing	Qatar
Orbital ATK	USA	Qatar National Cement	Qatar
Organizacion Cultiba	Mexico	Qatar Navigation	Qatar
Organizacion de Ingenieria Internacional	Colombia	Qatari Investors	Qatar
Ormester	Hungary	Qinetiq Group	UK
Orora	Australia	Quanta Services	USA
OSG	Japan	Qube Holdings	Australia
Oshkosh	USA	Quebecor 'A'	Canada
Osterreichische Post	Austria	Quebecor 'B'	Canada
Osterreichische STRR Holding	Austria	Quinenco	Chile
Otokar Otomotiv VE Savunma	Turkey	Raba Automotive Group	Hungary
Outotec	Finland	Raito Kogyo	Japan
Outsourcing	Japan	Ramirent	Finland
Owens Corning	USA	Randstad Holding	Netherlands

RAS Al Khaimah Ceramics	Abu Dhabi
Rational	Germany
Raysut Cement	Oman
Raytheon 'B'	USA
Recruit Holdings	Japan
Reece	Australia
Refrigeration Electrical Engineering Corporation	Vietnam
Regus	UK
Reliance Worldwide	Australia
Remgro	South Africa
Rengo	Japan
Renishaw	UK
Rentokil Initial	UK
Republic Services 'A'	USA
Resilux	Belgium
Retrasib	Romania
Rexel	France
RHI	Austria
Ricardo	UK
Richelieu Hardware	Canada
Rieter Holding 'R'	Switzerland
Rigolleau 'B'	Argentina
Ritchie Brothers Auctioneers	Canada
Robert Half International	USA
Robert Walters	UK
Rockwell Automation	USA
Rockwell Collins	USA
Rockwool 'A'	Denmark
Rockwool 'B'	Denmark
Rolls-Royce Holdings	UK
Romcab	Romania
Roper Technologies	USA
Rosenbauer International	Austria
Rotork	UK
Royal Ceramic Lanka	Sri Lanka
Royal Imtech	Netherlands
Royal Mail	UK
RPC Group	UK
RPS Group	UK
Rumo Logistica OPD Multimodal	Brazil
Ryder System	USA
S-1	South Korea
Saab 'B'	Sweden
Sacom Development and Investment	Vietnam
Sacyr	Spain
Saes Getters	Italy
Safran	France
Saint Gobain	France
Saint Ives	UK
Sakai Moving Service	Japan
Salalah Port Services	Oman
Samsung C&T	South Korea
Samsung Electro Mechanics	South Korea
Samsung Heavy Industries	South Korea
Samsung SDI	South Korea
Sandvik	Sweden
Sanki Engineering	Japan
Sankyu	Japan
Sanne Group	UK
Santierul Naval Orsova	Romania
Sanwa Holdings	Japan
Sartorius	Germany
Sartorius Preference	Germany
Sats	Singapore

Save-Aeroporto di Venezia Marco Polo	Italy
SC Transilvania	Romania
Schindler 'P'	Switzerland
Schindler 'R'	Switzerland
Schneider Electric Securities	France
Schuler Neue Shares	Germany
Schweiter Technologies	Switzerland
SDC Investimentos	Portugal
Sealed Air	USA
Secom	Japan
Securitas 'B'	Sweden
Seek	Australia
Seino Holdings	Japan
Sekisui Jushi	Japan
Semen Gresik	Indonesia
Semperit	Austria
Senior	UK
Senko	Japan
Sensata Technologies Holding	USA
Serco Group	UK
Servizi Italia	Italy
SES Tlmace	Slovakia
SFS Group	Switzerland
SGL Carbon	Germany
SGS 'N'	Switzerland
Shanghai Industrial Holdings	Hong Kong
Shanks Group	UK
Shenzhen International Holdings	Hong Kong
Sherwin-Williams	USA
Shibuya Kogyo	Japan
Shikun and Binui	Israel
Shima Seiki Manufacturing	Japan
Shimadzu	Japan
Shimizu	Japan
Shinmaywa Industries	Japan
Shinnihon	Japan
SHO-Bond Holdings	Japan
Shopify Subordinate Voting Shares 'A'	Canada
Shree Cement	India
SIA Engineering	Singapore
Siam Cement	Thailand
Siam City Cement	Thailand
Siam Global House	Thailand
Sias	Italy
Siemens	Germany
Siemens	India
SIG	UK
Sigdo Koppers	Chile
Siix	Japan
Sika 'B'	Switzerland
Sime Darby	Malaysia
Sinai Cement	Egypt
Singapore Post	Singapore
Singapore Technologies Engineering	Singapore
SK Kaken	Japan
Skanska 'B'	Sweden
SKF 'B'	Sweden
SLM Solution Group	Germany
SMC	Japan
Smith (ao)	USA
Smith (DS)	UK
Smiths Group	UK
SMS	Japan
Smurfit Kappa Group	Ireland

SNC-Lavalin Group	Canada
Sohgo Securities	Japan
Sojitz	Japan
Solar 'B'	Denmark
Somfy	France
Sonae Industria SGPS	Portugal
Sonda Urban and Industrial Zone Investment and Development	Vietnam
Sonoco Products	USA
South Logistics	Vietnam
South Valley Cement	Egypt
Spectris	UK
Speedy	Bulgaria
Speedy Hire	UK
Spie	France
Spirax-Sarco Engineering	UK
Spirit Aerosystems Class A	USA
Stabilus	Germany
Stantec	Canada
Star Micronics	Japan
Stara Planina	Bulgaria
Stef	France
Stella Jones	Canada
Stericycle	USA
Sthree	UK
STO Preference	Germany
Stobart Group Ordinary	UK
Stolt-Nielsen	Norway
Stomil Sanok	Poland
Strabag	Germany
Strabag Securities	Austria
Sues Canal Company for Technology Settling	Egypt
Suez Cement	Egypt
Sulzer 'R'	Switzerland
Sumitomo	Japan
Sumitomo Heavy Industries	Japan
Sumitomo Mitsui Construction	Japan
Sumitomo Osaka Cement	Japan
Sumitomo Warehouse	Japan
Sunny Optical Technology (Group)	Hong Kong
Super Group	South Africa
Superdong Fast Ferry Kien Giang	Vietnam
Supreme Industries	India
Sweco 'B'	Sweden
Swire Pacific 'A'	Hong Kong
Swire Pacific 'B'	Hong Kong
Sydney Airport	Australia
Tablemac	Colombia
Tadano	Japan
Taiheiyo Cement	Japan
Taikisha	Japan
Taisei	Japan
Taiwan Cement	Taiwan
Taiwan High Speed Rail	Taiwan
Taiyo Yuden	Japan
Takamatsu Construction Group	Japan
Takasago Thermal Engineering	Japan
Takeuchi Manufacturing	Japan
Takuma	Japan
Talgo	Spain
Tankerska Next Generation	Croatia
Tarkett	France
Tata Motors	India
Tata Motors 'A'	India
Tav Havalimanlari	Turkey
TDK	Japan
TE Connectivity	USA
Teixeira Duarte	Portugal
Teledyne Technologies	USA
Teleperformance	France
Temp Holdings	Japan
Tessi	France
Textron	USA
TFF Group	France
Thales	France
The Jordan Cement Factories	Jordan
The Ramco Cements	India
Thermador Groupe	France
Thermax	India
Thessaloniki Port Authority	Greece
THK	Japan
Thong Nhat Production and Investment	Vietnam
ThyssenKrupp	Germany
Tikkurila	Finland
Tisak Trgovacko	Croatia
Titan Cement CR	Greece
Titan Cement Preference	Greece
TKC	Japan
TKH Group	Netherlands
Toda	Japan
Tokyo Cement	Sri Lanka
Tokyu Construction	Japan
Toma	Czech Republic
Tomra Systems	Norway
Toppan Forms	Japan
Toppan Printing	Japan
Torm A	UK
Toro	USA
Toromont Industries	Canada
Toscana Aeroporti	Italy
Toshiba	Japan
Toshiba Machine	Japan
Toshiba Plant Systems and Services	Japan
Toshiba Tec	Japan
Total System Services	USA
Totetsu Kogyo	Japan
Toto	Japan
Toyo Engineering	Japan
Toyo Seikan Group Holdings	Japan
Toyota Tsusho	Japan
Trace Group Hold	Bulgaria
Trakya Cam Sanayi	Turkey
Trancom	Japan
Transcontinental 'A' Sub Voting	Canada
Transdigm Group	USA
Transforce	Canada
Transforwarding Warehousing	Vietnam
Transunion	USA
Transurban Group	Australia
Travis Perkins	UK
Trelleborg 'B'	Sweden
Trevi Financial Industriale	Italy
Trimble	USA
Trinity Industries	USA
Trusco Nakayama	Japan
Tsubaki Nakashima	Japan
Tsubakimoto Chain	Japan
TT Electronics	UK

Tube Investments of India	India	Wabtec	USA
Turk Traktor VE Ziraat Makineleri	Turkey	Wacker Neuson	Germany
Tyman	UK	Waha Capital	Abu Dhabi
Ultra Electronics Holdings	UK	Wartsila	Finland
Ultratech Cement	India	Washtec	Germany
Ulvac	Japan	Waskita Karya Persero	Indonesia
Uni Select	Canada	Waste Connections	Canada
Union Andina de Cementos	Peru	Waste Management	USA
Union Pacific	USA	Watsco	USA
Union Tool	Japan	WEG On	Brazil
Unior Kovaska	Slovenia	Weir Group	UK
United Aircraft Corporation	Russia	Westports Holdings	Malaysia
United Engineers	Singapore	Westrock	USA
United Kingdom Mail Group	UK	Westshore Terminals Investment	Canada
United Parcel Service 'B'	USA	WEX	USA
United Rentals	USA	Wienerberger	Austria
United Technologies	USA	Wincanton	UK
United Tractors	Indonesia	Winpak	Canada
Uponor	Finland	Wirecard	Germany
USG	USA	Wolseley	UK
Ushio	Japan	Woodward	USA
Uzin UTZ	Germany	World Fuel Services	USA
V Technology	Japan	Worldline	France
Vaisala 'A'	Finland	Worldpay Group	UK
Vallibel One	Sri Lanka	W-Scope	Japan
Vallourec	France	WSP Global	Canada
Valmet	Finland	WW Grainger	USA
Valspar	USA	Xaar	UK
Vantiv Class A	USA	Xerox	USA
Vassilico Cement Works	Cyprus	XP Power (Depository Interest)	Singapore
VAT Group	Switzerland	XPO Logistics	USA
Veidekke	Norway	XPO Logistics	France
Venture	Singapore	Xylem	USA
Verallia Deutschland	Germany	Yamato Holdings	Japan
Verenigde NED Company	Netherlands	Yamazen	Japan
Verisk Analytics Class A	USA	Yangzijiang Shipbuilding (Holdings)	Singapore
Vesuvius	UK	Yaskawa Electric	Japan
Vicat	France	Yinson Holdings	Malaysia
Vidrala	Spain	YIT	Finland
Vietnam Container Shipping	Vietnam	Yokogawa Electric	Japan
Vietnam Electric Cable	Vietnam	Yoma Strategic	Singapore
Vinci	France	Yuasa Trading	Japan
Viohalco	Belgium	Yumeshin Holdings	Japan
Vitro	Mexico	Zardoya Otis	Spain
Voltas	India	Zebra Technologies 'A'	USA
Volution Group	UK	Zehnder Group	Switzerland
Volvo 'A'	Sweden	Zhuzhou CRRC Times Electric 'H'	China
Volvo 'B'	Sweden	Zignago Vetro	Italy
Vopak	Netherlands	Zodiac Aerospace	France
Vossloh	Germany	ZTS Sabinov	Slovakia
Voting	Germany	ZTS VVU	Slovakia
VP	UK	Zumtobel	Austria
Vulcan Materials	USA		

Appendix A5 Technology index composition

Full Name	Market	Full Name	Market
4IG Nyilvanosan	Hungary	Advanced Micro Devices	USA
6PM Holdings	Malta	Advanced Semiconductor Engineering	Taiwan
Acacia Communications	USA	Advantech	Taiwan
Aconex	Australia	Advantest	Japan
Adobe Systems	USA	AI Holdings	Japan
Adva Optical Networking	Germany	Aixtron	Germany

Akamai Technologies	USA
Alcatel-Lucent	France
Alibaba Health Information Technology	Hong Kong
All for One Steeb	Germany
Alphabet 'A'	USA
Alphabet 'C'	USA
Also Holding	Switzerland
Alten	France
Altia Consultores	Spain
Altium	Australia
Altran Technologies	France
Amdocs	USA
Amper	Spain
Analog Devices	USA
Anritsu	Japan
Ansys	USA
Apple	USA
Applied Materials	USA
Arista Networks	USA
Arris International	USA
Ascom 'R'	Switzerland
Aselsan Elektronik Sanayi VE Ticaret	Turkey
ASM International	Netherlands
ASM Pacific Technology	Hong Kong
ASML Holding	Netherlands
Aspen Technology	USA
Asseco Poland	Poland
Asustek Computer	Taiwan
Atea	Norway
Athenahealth	USA
Atos	France
AU Optronics	Taiwan
Aubay	France
Austriamicrosystems	Switzerland
Ausy	France
Autodesk	USA
Aveva Group	UK
Axis	Sweden
Axway Software	France
B Communications	Israel
Basware	Finland
Be Semiconductor	Netherlands
Bechtle	Germany
Blackberry	Canada
Broadcom	USA
Brocade Communications Systems	USA
Brother Industries	Japan
CA	USA
Cadence Design Systems	USA
Cancom	Germany
Canon	Japan
Canon Electronics	Japan
Canon Marketing Japan	Japan
Cap Gemini	France
Capcom	Japan
Cavium	USA
CDK Global	USA
CDW	USA
Cegedim	France
Cegid Group	France
Cerner	USA
CGI Group 'A'	Canada
Check Point Software Technologies	USA
Cirrus Logic	USA
Cisco Systems	USA
Citrix Systems	USA
Cognizant Technology Solutions 'A'	USA
Commscope Holding Company	USA
Compal Electronics	Taiwan
Compta	Portugal
Compugroup Medical	Germany
Computacenter	UK
Computer Sciences	USA
Constellation Software	Canada
Corning	USA
Csra	USA
Ctac NM	Netherlands
Cyberagent	Japan
Cypress Semiconductor	USA
Dalenys	Belgium
Dassault Systemes	France
Datalab Tehnologije	Slovenia
Datalex	Ireland
Descartes Systems Group	Canada
Devoteam	France
Dialog Semiconductor	Germany
Digital Garage	Japan
Digital Telecommunications Ifcf	Thailand
Disway	Morocco
Docdata	Netherlands
DST Systems	USA
DTS	Japan
E-Tranzact International	Nigeria
Econocom Group	Belgium
Ei Towers	Italy
Eizo	Japan
Elang Mahkota Teknologi	Indonesia
Elecom	Japan
Ellie Mae	USA
Elmos Semiconductor	Germany
Enghouse Systems	Canada
EOH	South Africa
Epam Systems	USA
Ericsson 'A'	Sweden
Ericsson 'B'	Sweden
Esprinet	Italy
Est Media	Hungary
Evertz Technologies	Canada
F-Secure	Finland
F5 Networks	USA
Facebook Class A	USA
Fair Isaac	USA
FDM Group	UK
Fidessa Group	UK
Finisar	USA
Fortinet	USA
Fuji Soft	Japan
Fujifilm Holdings	Japan
Fujitsu	Japan
Fukui Computer Holdings	Japan
Garmin	USA
Gartner 'A'	USA
Gemalto	Netherlands
GFI Informatique	France
GFT Technologies	Germany
Glintt Global Intelligent Technologies SGPS	Portugal
Global Digital Services	Cyprus
GMO Internet	Japan
Grupo Ezentis	Spain

Guidewire Software	USA	Logitech 'R'	Switzerland
Harris	USA	Loqus Holdings	Malta
HCL Technologies	India	Macnica Fuji Electronics Holdings	Japan
Hermes Microvision	Taiwan	Manhattan Associates	USA
Hewlett Packard Enterprise	USA	Marvell Technology Group	USA
Hexagon 'B'	Sweden	Maxim Integrated Products	USA
Hightech Payement Systems	Morocco	Mediatek	Taiwan
Hitachi High - Technologies	Japan	Medidata Solutions	USA
Hitachi Kokusai Electric	Japan	Melco Holdings	Japan
HP	USA	Melexis	Belgium
HTC	Taiwan	Micro Focus International	UK
Huber + Suhner 'R'	Switzerland	Micro-Star International	Taiwan
IAC / Interactivecorp	USA	Microchip Technology	USA
ICT Group	Netherlands	Micron Technology	USA
Iliad	France	Micronics Japan	Japan
Imagination Technologies	UK	Microsemi	USA
Inari Amertron	Malaysia	Microsoft	USA
Indra Sistemas	Spain	Miroku Jyoho Service	Japan
Infineon Technologies	Germany	Mitsubishi Research Institute	Japan
Information Services International	Japan	Mixi	Japan
Infosys	India	Mobile World Investment	Vietnam
Ingenico Group	France	Mobileye	USA
Ingram Micro 'A'	USA	Monolithic Power Systems	USA
Innolux	Taiwan	Motorola Solutions	USA
Inotera Memories	Taiwan	Mphasis	India
Intel	USA	Muehlbauer Holding	Germany
International Business Machines	USA	Myob Group	Australia
Internet Initiative Japan	Japan	Nanya Technology	Taiwan
Intouch Holdings	Thailand	Naver	South Korea
Intuit	USA	NCC Group	UK
Inventec	Taiwan	NCR	USA
Inverko	Netherlands	NEC	Japan
Invl Technology	Lithuania	NEC Networks and System Integration	Japan
Iress	Australia	Nedsense Enterprises	Netherlands
Isra Vision	Germany	Nemetschek	Germany
Itochu Techno-Solutions	Japan	Neopost	France
J2 Global	USA	Net One Systems	Japan
Jasmine Broadband Internet		Netapp	USA
Infrastructure Fund	Thailand	Netsuite	USA
Juniper Networks	USA	Neurones	France
Justsystems	Japan	New Sources Energy	Netherlands
Kainos Group	UK	Nextdc	Australia
Kakao	South Korea	Nexus	Germany
Kanematsu Electronics	Japan	Nice	Israel
Key Soft	Hungary	Nihon Unisys	Japan
Kinaxis	Canada	Nnit	Denmark
Kingsoft	Hong Kong	Nokia	Finland
KLA Tencor	USA	Nomura Research Institute	Japan
Koei Tecmo Holdings	Japan	Nordic Semiconductor	Norway
Konica Minolta	Japan	Novabase	Portugal
KPS	Germany	Novatek Microelectronics	Taiwan
KTM Industries	Austria	NS Solutions	Japan
Kudelski 'B'	Switzerland	NSD	Japan
Laird	UK	NTT Data	Japan
Lam Research	USA	Nuance Communications	USA
Lavide Holding	Netherlands	Nuflare Technology	Japan
Lectra	France	Nvidia	USA
Legend Holdings 'H'	China	NXP Semiconductors	USA
Leidos Holdings	USA	Obic	Japan
Lenovo Group	Hong Kong	Obic Business Consultants	Japan
LG Display	South Korea	OHB	Germany
Line	Japan	OKI Electric Industry	Japan
Linear Technology	USA	Oman Fibre Optic	Oman
Linedata Services	France	On Semiconductor	USA
Logicom	Cyprus	Open Text (Toronto)	Canada

Opera Software	Norway	Soitec	France
Oracle	USA	Solucom	France
Oracle Financial Services Software	India	Sonda	Chile
Oracle Japan	Japan	Sophos Group	UK
Ordina	Netherlands	Sopra Steria Group	France
Orion Health Group	New Zealand	Spirent Communications	UK
Otsuka	Japan	Splunk	USA
OTT One	Hungary	Square Enix Holdings	Japan
Palo Alto Networks	USA	SS&C Technologies Holdings	USA
Parrot	France	Stmicroelectronics (Paris-SBF)	France
Pegatron	Taiwan	Sumco	Japan
Pharmagest Interactive	France	Symantec	USA
Pitney-Bowes	USA	Synnex	USA
Plaisio Computers	Greece	Synopsys	USA
Powertech Technology	Taiwan	Syntel	USA
PTC	USA	Systena	Japan
Qorvo	USA	T-Gaia	Japan
QSC	Germany	Taiwan Semiconductor Manufacturing	Taiwan
Qualcomm	USA	Tata Consultancy Services	India
Quanta Computer	Taiwan	Technology Mahindra	India
Quest Holdings CR	Greece	Technology One	Australia
Rackspace Hosting	USA	Technopro Holdings	Japan
Radiall	France	Tecnocom Telecomunicaciones y Energia	Spain
Realdolmen	Belgium	Tele Columbus	Germany
Red Hat	USA	Temenos Group	Switzerland
Reditus	Portugal	Tencent Holdings	Hong Kong
Renesas Electronics	Japan	Teradata	USA
Reply	Italy	Teradyne	USA
RIB Software	Germany	Tesla Liptovksy	Slovakia
Ricoh	Japan	Texas Instruments	USA
Riso Kagaku	Japan	Tie Kinetix	Netherlands
Rohm	Japan	Tieto OYJ	Finland
Roodmicrotec	Netherlands	TIS	Japan
RS2 Software	Malta	Tiscali	Italy
Ryosan	Japan	Tokyo Electron	Japan
Sage Group	UK	Tokyo Ohka Kogyo	Japan
Salesforce Com	USA	Tokyo Seimitsu	Japan
Samsung SDS	South Korea	Tom Tom	Netherlands
SAP	Germany	Totvs On	Brazil
Sato Holdings	Japan	Tower	Israel
SCOUT24	Germany	Tower Bersama Infrastructure	Indonesia
Screen Holdings	Japan	Trans Cosmos	Japan
SCSK	Japan	Travelsky Technology 'H'	China
SDL	UK	Trend Micro	Japan
Seagate Technology	USA	Twitter	USA
Secunet Security Networks	Germany	Tyler Technologies	USA
Seiko Epson	Japan	U-Blox Holding	Switzerland
Semiconductor Manufacturing International	Hong Kong	Ubiquiti Networks	USA
Servelec Group	UK	Ultimate Software Group	USA
Servicenow	USA	United Internet	Germany
Sesa	Italy	United Micro Electronics	Taiwan
Shinko Electric Industries	Japan	Vakrangee	India
SII	France	Valtech	France
Siliconware Precision Industries	Taiwan	Vanguard International Semiconductor	Taiwan
Siltronic	Germany	Veeva Systems Class A	USA
Silverlake Axis	Singapore	Verisign	USA
Simcorp	Denmark	Viasat	USA
Sina	USA	Vista Group International	New Zealand
Sirma Group Holding	Bulgaria	Vmware	USA
SK Holdings	South Korea	Western Digital	USA
SK Hynix	South Korea	Whitestone Group	Israel
Skyworks Solutions	USA	Wincor Nixdorf	Germany
Softcat	UK	Wipro	India
Software	Germany	Wisetech Global	Australia

Wistron	Taiwan
Workday Class A	USA
World Wide Web Ibercom	Spain
WPG Holdings	Taiwan
Xero	New Zealand
Xilinx	USA
Xing	Germany
Yahoo	USA
Yahoo Japan	Japan
Yandex	USA
Zetes Industries	Belgium
Zigexn	Japan