An empirical study of the impact of Opec announcements on stock returns of selected sector indexes of the Stockholm stock market

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Abstract

This study presents an observation of the impact of Opec announcements on the behavior of sector indexes returns of the Stockholm stock market. It looks at the effects of the announcements on the stock returns of three sectors indices of the Stockholm stock market: Energy, Telecommunications and Financial using the general market index return (OMX Stockholm 30) as the explanatory variable. The time period analyzed is limited to the years of 2005 to 2007 when markets worldwide were taken by euphoria and panic caused by the anticipation of the upcoming financial crisis given that it has been well proved that such events do cause a substantial effect on stock prices.

In order to estimate the reaction of the sector index returns over Opec announcements, the author uses the event studies and constructs an extended version of the CAPM model by introducing dummy variables for each day of the set of announcements over the event window. It is used stationary time series data and the returns on the three sector indices were subdivided in an event window of 5 days around the announcement dates in continuous intervals of 3 years according to the Stockholm stock market trading days. As to improve the results obtained with the CAPM model, the author uses the Cumulative Abnormal Returns (CAR) which adds all the coefficients of the dummy variables which are the returns in excess of what is expected.

The empirical findings for the event study reveal that none of the dummy variable coefficients were significant which indicate that none of the sector indexes is sensitive to the announcements. For the CAR results, the Telecommunication was the only sector that responded to news. Most likely because the general market index OMXST30 has proved to create extra returns around these dates. That is probably the reason that the three sector indexes could not produce significant additional response.

Table of Contents

Abbreviations

ADF	Augumented Dickey Fuller
OPEC	Organization of Petroleum
GICS	Global Industrial Classification Standard
OMXST 30	Nordic Exchange Stockholm (Stockholm General Index)
CAPM	Capital Asset Pricing Model
SML	Security Market Line
CAR	Cumulative Abnormal Returns
GDP	Gross Domestic Product
CMAR	Cumulative Mean Abnormal Return
MTBE	Additive to ethanol
DCF	Discounted Cash Flow
ROIC	Return on Invested Capital
OECD	Organization for Economic Co-operation and development

Acknowledgments

1. Introduction

''It has been widely accepted that oil price fluctuations have a strong influence in financial markets (Opec Review, 2006)''.

There have been rumors amongst economic experts that affirm that the constant increases in oil prices is one of the reasons for the financial crisis the world have been experiencing for the past years.

From the last two decades oil prices have been rising at a rapid pace due to external factors such as wars and natural disasters.

The event of wars or conflicts that affect oil producer countries (considering only Opec member countries), have shown to have major influence on Opec production decisions. The Organization immediately responds by announcing new production quotas that will determine oil prices. According to EIA 2006, what determines the magnitude and strength of the impact of oil price increases in the economy is the state of the economy associated with macroeconomic policies adopted at the time a new event happens. The overall effect is that economies either stagnate or enter into a recession and take a downturn until they are resettled.

While governments apply new policies to control and regulate the effects of harmful oil price fluctuations, firms cut back on productivity levels and consumers reduce their spending patterns. As a consequence, the rhythm of the economy slows down and no longer operates at maximum capacity. The result for the firms is a possible reduction in productivity levels which might affect profits about the firm's future performance which might affect expect stock returns immediately shown in share prices. Recent finance researches suggest that oil price increases adversely affect firms share prices (Opec, 2006). There should be changes in stock price movements which can be either small or large changes according to market efficiency. When there is some instability on the behavior of the stock prices, investors can find opportunities to exploit these variations and get abnormal returns. Therefore, the earlier[1] the oil price changes are detected the greater the possibilities of gaining extra returns or preventing losses of short-term invested capital.

So that with the purpose of measuring the impact of Opec announcements on the stock returns, the author uses the event study methodology starting with a multiple regression based on the CAPM model and the Dummy variable approach. Next, the author uses the Cumulative Abnormal Returns (CAR) which is an instrument well accepted in finance research in order to provide investors with a closer estimate of how much excess returns investors would receive after a prearranged period of time given the news impact.

The topic is appealing to explore because it is current and of high interest amongst investors as oil prices are very volatile and that creates possibilities of extra gain. Therefore, the author felt that exploring this topic more closely would be enriching for obtaining deeper knowledge for his future professional life.[1] . The time span of this research is restricted to the years preceding the recent financial crisis when the warning signs of the upcoming crisis started to appear.

1.1 Purpose

The purpose of this study is to analyze the impact of Opec announcements on stock returns of selected sector indexes of the Stockholm stock market throughout the period of 2005 to 2007.

1.2 Limitations

The scope of this research is limited to observing the returns of three sector index returns of Energy, Telecommunications and Financial sectors of companies listed in the Stockholm stock market using the general market index return OMX Stockholm 30 according to Opec announcements between 2005-2007. This period of time was chosen because of the turbulence in the markets worldwide when facing the uncertainty in the preceding years of the financial crisis 2008.

The data is gathered from credible institutions (namely: Nasdaq OMX Nordics Stockholm, Sweden Energy Institute, Riksbank and Opec). The sector returns are organized according to Opec announcements taking into consideration the increases, decreases and no change in oil production throughout the 5 days event window.

1.3 Outline

Chapter 1: introduces the paper and presents the purpose and brief explanation of the limitations of this study. The first chapter intends to provide the reader with an anticipation of what this paper is about.
Chapter 2: presents the data used and an illustration of the implemented regression models. Also, gives an explanation of the methodology used with the hypothesis, detailed explanation of the models and financial instruments used to prepare the data and to estimate the stock returns in relation to the news.
Chapter 3: presents a discussion of relevant information to provide a broad view of how oil prices affect the stock market, the author discusses the interaction between the economy and the stock market and firm's performance. As well as background information about Opec policy decisions which are relevant to support the argument and a review of the historical events that contributed to Opec's production

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[1] Here, the author mentions exclusively the possibility to catch/prevent losing the extra returns more efficiently than its competitors and not considering the ''leakage problem'' yet.

decisions throughout the years of 2005 to 2007, followed by a summary of previous research studies involving similar topics.

Chapter 4: presents comprehensive discussion of diverse economic theories that are fundaments for this analysis and to help drawing the conclusions.

Chapter 5: provides an outlook of the swedish economy situation during the period observed as well as a brief description of the economic and financial aspects that are relevant for this study. Following, there's a discussion of the financial indicators used in this analysis.

Chapter 6: presents all the regression results which are illustrated on tables and graphs for better visualization and comparison of the outcomes.

Chapter 7: the author concludes the study by discussing the empirical findings and bringing all the information into perspective of the economic and financial context of the period analyzed.

2. Method

This thesis is based on event studies which is the most common method applied in finance research in order to capture the impact of specific events that may affect stock returns. A brief description of each method used in the regression is provided bellow.

Since this study is based on time series data it is necessary to check if we can rely on the nature of the data or its usefulness in order to obtain final accurate results. So, in preparation to estimate the regressions, the author uses a technical procedure called Unit Root.

Once approved, the time series data is ready to be used for the estimation of the main regression model which is an extension of the CAPM model that includes dummy variables to capture the excess stock returns around the dates of the announcements so that it is possible to state and quantify the amount of expected return produced on the given period of time by assigning proxies to describe the qualities to each day of the event.

As to improve the results obtained with the CAPM model, the author uses the Cumulative Abnormal Returns (CAR) which adds all the coefficients of the dummy variables which are the returns in excess of what is expected.

2.1 Unit Root test

Time series data is heavily used in finance researches since it makes it possible for investors to somewhat forecast financial indicators. For that purpose, it is necessary that the series is stochastic or stationary so that the mean and covariance remain the same independent of time. The Unit Root test is commonly used

to identify whether the time series presents (small or large) instability patterns which are structural breaks that could be present in financial data, like stock prices.

If breaks (or shocks) are found in the time series data and are not considered what will happen is the phenomenon of spurious or nonsense regression. It means that the regression result will present a false idea that there is a statistical relation between the dependent variable and the independent variable(s) while there's no relation. The outcome is that the regression results could lead to misleading conclusions. The distinction between stationarity and nonstationarity stochastic process (or time series) is very important in showing the trend (the slow long-run evolution of the time series in consideration observed) (Gujarati, 2009).

In order to know about the trend and check if the series is predictable or not (more specifically if the time series is a function of time or not), there are three possibilities which are presented below:

$$\Delta Y_t = \delta Y_{t-1} + u_t \qquad\qquad \text{Pure random walk} \quad (1)$$

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + u_t \qquad\qquad \text{Random walk with drift} \quad (2)$$

$$\Delta Y_t = \beta_1 + \beta_{2t} + \delta Y_{t-1} + u_t \qquad\qquad \text{Deterministic trend} \quad (3)$$

2.1.1 ADF test

Amongst the three types of unit root tests, the ADF (Augumented Dickey Fuller) is a technical procedure that verifies wether the time series data is stationary or not. The test is well used in finance research in order to prepare the data for long-term forecasting (a common example is stock returns). It is conducted by expanding the three equations presented in the previous section, by adding the lagged values of the dependent variable ΔY_t. The general ADF test is estimated by the following model:

$$\Delta Y_t = \beta_1 + \beta_{2t} + \delta Y_{t-1} + \Sigma \alpha_i \Delta Y_{t-1} + \varepsilon_t \qquad\qquad (4)$$

Where the error term (ε_t) is a white noise error which indicates that the variables are independent, uncorrelated and identically distributed and where $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$, etc. The number of lagged difference terms to include is often determined empirically and the idea is to include enough terms so that the error term is serially uncorrelated, so that it is possible to obtain an unbiased estimate of δ, the coefficient of lagged Y_{t-1} (Basic Econometrics, 2009). In this case the error terms are the factors that may influence the prices of stocks and the fact that the error terms are not correlated means that the stock price of today is not affected by the price of yesterday.

In this study, the author starts by using only one lagged variable of the dependent variable (which corresponds to the random walk with drift), to see if the results are already significant and the hypothesis of non-stationarity can be rejected. So that a more specific model of ADF test is used:

$$Y_t = \beta_1 + \delta Y_{t-1} + \varepsilon_t \qquad\qquad\qquad (5)$$

where:

Y_t is the natural logarithm of the sector index return[2] and its lag
Y_{t-1} is the lag of the difference of the sector index return
β_t is the expected price in time ''t''
δ is the drift parameter
εt is the white noise error term

i.   Hypothesis

Here, it is tested for the hypothesis of non-stationary variables (using the natural logarithms of all the variables used in the main model).

Null hypothesis: $H_0: \delta = 0,$ (i.e, there is a unit root or the time series is nonstationary)
Alternative hypothesis: $H_1: \delta < 0,$ (i.e, the time series is stationary)

Once the results are obtained, one must check the drift parameter (δ) which is going to show if the time series have a tendency to return to a constant mean.

If I reject the null hypothesis than the time series is stationary which economically means that even though the stock return values drift apart from the average rate of return values, they tend to converge to initial values which are the average rate of returns of the security without the event.

If the findings show that the series is stationary, than it is possible to make long-term forecast and the data is approved to be used on the estimation of the stock returns that are attributed to a specific event (news). Since the purpose here is to test the usefulness of the time series data, the four financial variables (Energy, telecommunications, financial sector index returns and the general index return (OMXST 30)) are tested using the ADF model (5) presented above.

2.2 Event Study Methodology

When an unusual event occurs that disrupts stock market stability, there should be positive or negative abnormal returns attributable to the event.

In order to capture the impact that these events have on stock price movements, financial researchers use a technique called event studies. It consists in finding the impact that caused instability on the market (for

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[2] Initially, the author estimate stock returns and uses the natural logarithm of the sector indexes ($\ln Y_t$) and its lag ($\ln Y_{t-1}$) which is based on the conventional formula: (closing price of today- closing price of yesterday/ (closing price of today)).

example, oil price shocks that were caused by wars or natural catastrophes) on the stock market (or selected sectors of the market, etc). Event studies are very largely used in finance research in order to help investors make the most profitable investment decisions.

This method is based on the observation of stock price returns according to particular events that occurred and that have the power to impact the internal cost of firms. Stock prices should be sensitive to sudden changes in macroeconomic variables and new information that can cause changes in input costs.

The occurrence of unanticipated changes in the market generates risk to companies' which will cause uncertainty to firm's future performance in the market. That will affect firm's value, consequently stock returns are affected. This is called event risk and event studies are the approach used to measure the dimensions of the impact of these events in the stocks of the company (Bodie, 2009).

2.2.1 Empirical framework

The intention of this study is to observe the impact of Opec announcements on stock returns over a specific period of time. As explained on the previous section, the occurrence of unanticipated events that affect firms' asset value increase risk, therefore stock prices move abnormally.
It is possible to observe how stock returns respond to news impact by using event study approaches such as the Fama-French three factor model and the well-known CAPM (Capital Asset Pricing Model). Furthermore, it is common practice to use the Dummy Variable approach to observe the stock return movements on the days of the event window (the days before the announcement, at the announcement date and after the announcement date).
Therefore, the main regression model adopted in this study is built upon the CAPM model and the Dummy Variable approach which are presented in the following sections.

iii. CAPM

The CAPM (Capital Asset Pricing Model) is'' the best available model to explain rates of return on risky assets''. More clearly explained, the CAPM model provides a benchmark rate of return that evaluates possible investments and a proxy that makes an educated guess of the returns on assets that have not yet been traded on the market (Bodie, 2009).
The model is based on the relationship of beta (β_i) and alpha (α_i). Beta expresses the connection between investment's risk and the market's risk according to the market conditions and alpha is a constant benchmark that shows the normal expected return.

The relationship between beta and alpha is also represented in terms of expected returns on security index $(E(r_i))$ and expected market returns $(E(r_m))$ by the following model[3] which assumes that the market is efficient:

$$E(r_i) = \alpha_i + r_f + \beta_i [E(r_m) - r_f] \quad\quad\quad (6)$$

Where:

r_i is the expected rate of return on security *i* or the index

r_f is the risk-free rate[4]

β_i is a measure of the systematic risk and a measure that shows how close the security's rate of return moves with the market

α_i represents market efficiency

Moreover, the risk premium form of CAPM is:

$$E(r_i) - r_f = \beta_i (Er_m - r_f) \quad\quad\quad (7)$$

where the first part of the equation shows the expected risk premium and the second part of the equation $(\beta_i (Er_m - r_f))$ shows the compensation or excess return that investors obtain for taking extra risk (β_i) with the security.

This relationship between the expected returns on security index $(E(r_i))$ and expected market returns $(E(r_m))$ is graphically represented by the Security Market Line (SML)[5] and it is illustrated on Figure I:

Figure I
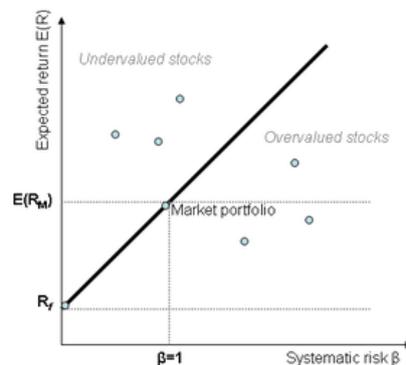
Source: www.wikipedia.com

From the illustration above, one can observe that when beta is equal to $1 (\beta=1)$, the security rate of return moves together with the expected return of the market $(E\ (r_m))$ which means that the security is correctly valued $(\alpha=0)$. Assets that are priced above the SML are undervalued because of higher amount of risk $(\beta>1)$ and therefore they yield to higher returns. That is one of the assumptions of the CAPM model which embraces that investors are rewarded with a higher expected return for taking higher risk. While the assets that are priced under the line are overvalued and lead to lower rates of return. Even though the stock return values drift apart from the average rate of return values, they tend to converge to initial values which are the average rate of returns of the security without the event.

Beta (β_i) is the systematic or nondiversifiable risk which is risk that cannot be diversified (external risk that cannot be avoided such as natural catastrophes, wars and economical recession that affects several markets across the world) and it also measures to which extent the security's rate of return moves with the market. If beta is positive $(\beta>1)$ it means that the security's rate of return moves with the market following closely the general market return index, while if beta is negative $(\beta<1)$ it suggests a defensive security (Gujarati, 2009).

According to the CAPM theory, alpha should be zero for all assets because the model assumes that the market is efficient and the stocks should be fairly priced. It means that in the absence of security analysis, one should take security alpha (α) as zero thus there's no shortage or excess on security's expected returns. If alpha is different than zero the security is mispriced.

Assuming that the market efficient $(\alpha_i=0)$, the CAPM model is presented in a more simplified version:

$$E\ (r_i)_{=}r_{f+}\beta_i\ [E\ (r_m)-r_f] \tag{8}$$

iv.   The Dummy variable approach

The Dummy variable approach consists in incorporating dummy variables into regression models in order to classify data into mutually exclusive categories that takes the value of 1 and 0 indicating the presence or absence of a quality or attribute that have some influence on the dependent variable.

In this study, the author includes dummy variables into the main regression model in order to observe the rate or return on the stock indexes for each of the days of the event window which consists of two days ex ante the announcement day, at the announcement day and ex post the announcement day. The criteria is that for each day of the event window it is assigned a dummy variable which takes the value of 1 for the assigned day and 0 for the remaining days. For each dummy variable there is a coefficient which is called the differential intercept coefficient because they tell by now how much the value of the category that receives the value of 1 differs from the intercept coefficient of the benchmark category (Gujarati, pg.281).

The Dummy variable approach is represented by the following model:

$$Y_i = \beta_1 D_{1i} + \beta_2 D_{2i} + \beta_3 D_{3i} + u_i \qquad (9)$$

where:

Y_i is the dependent variable that is influenced by the categories assigned to the dummy variables corresponding to the event window
β_{2i} and β_{3i} are the differential intercept coefficients of the dummy variables that show the value of the dependent variable in the presence or absence of the attribute
D_1, D_2 and D_3 are dummy variables that take the value of 1 in the presence of the event and 0, otherwise

It is common that the dummy variables present the situation of perfect collinearity or multicollinearity which is called dummy variable trap. For that reason, the number of dummy variables introduced must be one less than the categories of the variables introduced (m-1). Then, the dummy variable approach removes the dummy variable trap problem. In this study, the author uses the dummy variable model without intercept because the main regression model which is based on CAPM already explains a benchmark for comparison, the variable alpha.

2.3 Main Regression Model

As explained previously, the CAPM Model is vastly used in finance as a tool to describe and quantify the amount of expected return on a security at a given period of time. In addition to that, it is common practice to introduce dummy variables as proxies to assign qualities to each event piece of the sample. In this study, the author relies on the usefulness of the CAPM model and the dummy variable approach, in order to efficiently estimate the impact of Opec announcements on the sector indexes rate of return. For each dummy variable introduced, there's one drift parameter'' γ'' that tells how much of the expected returns can be explained by Opec announcements which are represented in an event window that ranges from two days before the announcement to two days after the announcement. The main regression model is presented below:

$$R^t_{si} = \alpha_i + \beta r^i_t + \gamma_{t-2} D_1 + \gamma_{t-1} D_2 + \gamma_{t=0} D_3 + \gamma_{t+1} D_4 + \gamma_{t+2} D_5 + \varepsilon_t \qquad (10)$$

where:

R^t_{si} is the return on sector index
α_i is a benchmark for comparison of the sector index returns without the expectation of the event (the risk-free interest rate)
β is the volatility of the market index in time ''t''
r^i_t is the return on the general market index

γ is the drift parameter or the coefficient of the dummy variable on the event window (range from $t = -2$, $t = -1$; $t = 0$; $t = +1$ to $t = +2$) which gives the information about the abnormal returns associated with the Opec announcements

t is the event window

D_1 to D_5 are the dummy variables[6]   D: {1, for event day
                                                        {0, remaining days

ii. Hypothesis

In order to draw conclusions that can be supported by statistical proof of the news impact on the stock market, it is tested here the hypothesis wether Opec announcements have no impact in the sector index returns or not. Since the event window corresponds to five days, a null and an alternative hypothesis were formulated for each day:

a. D_1: two days before the announcement

$H_0: \gamma_{t-2} = 0$ $H_1: \gamma_{t-2} \neq 0$

b. D_2: one days before the announcement

$H_0: \gamma_{t-1} = 0$ $H_1: \gamma_{t-1} \neq 0$

c. D_3: at the announcement date

$H_0: \gamma_{t=0} = 0$ $H_1: \gamma_{t=0} \neq 0$

d. D_4: one day after the announcement

$H_0: \gamma_{t+1} = 0$ $H_1: \gamma_{t+1} \neq 0$

e. D_5: two days after the announcement

$H_0: \gamma_{t+2} = 0$ $H_1: \gamma_{t+2} \neq 0$

After the regression results are obtained, one must observe the coefficient '' γ '' for each of the hypothesis' propositions presented above. If the null hypothesis is rejected, that means that the rate of returns on the respective sector index are affected by Opec announcements. The best result here is

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[6] Observe that the data regarding to Opecs' announcements will be separated into production cut (which indicates oil prices increases), production increase (which indicates oil price decrease) and no change in production (which indicate no significant change in oil price). The latter two decisions are given less significance because they tend to stabilize oil prices and the stock markets are not significantly affected by it.

obtained if the null hypothesis is rejected because that means that there are abnormal returns over the expected and they are proportionally distributed on the sector indexes throughout the event window.

2.3.1 Cumulative Abnormal Returns Model

The stock returns obtained in excess of the expected returns estimated after the CAPM model, are called abnormal returns. Estimating the abnormal returns over a time period is commonly used in finance research to provide investors with a close estimate of how much excess returns investors would receive after a prearranged period of time.

The Cumulative Abnormal Returns (CAR) method is in accordance with the Efficient Market Hypothesis. Under the Efficient Market Hypothesis, the market supposedly reflect all the information on the stock prices and it creates trends which allow traders to capture profit opportunities (or losses) between one price to another around the days were the market is unpredictably responding to new information. After that, the expected rates of return on stocks tend to go back to normal because the stocks are fairly priced again.

If the market is efficient, stock price movement should follow the Security Market Line and even if new information influence the stock price behavior for some days, the prices should adjust and go back to normal again after the market has adapted to the news. Previous finance researchers[7] have proved that the extra returns that are possibly obtained before the announcement date and at the announcement date tend to slowly go back to normal the days after the announcement date until the stock returns no longer increase or decrease.

Estimating the cumulative abnormal returns is the very essential part of an event study because it shows a close estimate of the total firm-specific stock movement over the time period of interest. By knowing how sensitive to the news release the stock prices really are will enable investors to make a coherent decision according to the targeted companys' ability to overcome or absorb new information. In this study, the author uses the cumulative abnormal returns as an indicator of the impact of Opec announcements' on the general market index and the sector index returns after the estimation of the stock market returns by CAPM.

The procedure used to estimate CAR is very simple. Once obtained the expected returns on the sector indexes from the CAPM model, it is used a linear restriction model that enables the estimation of the abnormal returns for each of the chosen sector indexes (Energy, Telecommunications and Financial).

In this study the CAR model looks like this:

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[7] Massimo Guidolin M.; and Eliana La Ferrara, *The economic effects of violent conflict: Evidence from asset market reactions*, Journal of Peace Research, 2010

$$AR^t_{si} = \alpha + Er^i_t(\Sigma^t_{si}) + \varepsilon_t \qquad\qquad (11)$$

where:

$\Sigma^t_{si} = \gamma_{t-2} + \gamma_{t-1} + \gamma_{t=0} + \gamma_{t+1} + \gamma_{t+2}$; is the sum of all expected returns for the event window of each sector index

$$\{ \quad \Sigma^t_{si/energy} = \gamma_{t-2} + \gamma_{t-1} + \gamma_{t=0} + \gamma_{t+1} + \gamma_{t+2}$$

$$\{ \quad \Sigma^t_{si/telecom} = \gamma_{t-2} + \gamma_{t-1} + \gamma_{t=0} + \gamma_{t+1} + \gamma_{t+2}$$

$$\{ \quad \Sigma^t_{si/finance} = \gamma_{t-2} + \gamma_{t-1} + \gamma_{t=0} + \gamma_{t+1} + \gamma_{t+2}$$

AR^t_{si} are the abnormal returns on the sector index
α is the benchmark for comparison of the sector index returns under normal market conditions
Er^i_t shows the expected returns on general market index

By estimating CAR, it is reduced the eventual problems from ''leakage of information'' which happen when corporate insiders and favored analysts obtain information before it is disclosed to the general public.

i. Hypothesis

In order to draw conclusions that can be supported by statistical proof of the news impact on the three sector index returns, it is tested here the following hypothesis':

a. *Energy sector*

Null hypothesis: $\quad H_0$: $\gamma_{t-2} + \gamma_{t-1} + \gamma_{t=0} + \gamma_{t+1} + \gamma_{t+2} = 0$; $\quad \Sigma^t_{si} = 0$

Alternative hypothesis: H_1: $\gamma_{t-2} + \gamma_{t-1} + \gamma_{t=0} + \gamma_{t+1} + \gamma_{t+2} \neq 0$; $\quad \Sigma^t_{si} \neq 0$

b. *Telecommunication service sector*

Null hypothesis: $\quad H_0$: $\gamma_{t-2} + \gamma_{t-1} + \gamma_{t=0} + \gamma_{t+1} + \gamma_{t+2} = 0$; $\quad \Sigma^t_{si} = 0$

Alternative hypothesis: H_1: $\gamma_{t-2} + \gamma_{t-1} + \gamma_{t=0} + \gamma_{t+1} + \gamma_{t+2} \neq 0$; $\quad \Sigma^t_{si} \neq 0$

c. *Financial sector*

Null hypothesis: $\quad H_0$: $\gamma_{t-2} + \gamma_{t-1} + \gamma_{t=0} + \gamma_{t+1} + \gamma_{t+2} = 0$; $\quad \Sigma^t_{si} = 0$

Alternative hypothesis: H_1: $\gamma_{t-2} + \gamma_{t-1} + \gamma_{t=0} + \gamma_{t+1} + \gamma_{t+2} \neq 0$; $\quad \Sigma^t_{si} \neq 0$

If the null hypothesis Ho is rejected, that means that the sum of expected returns (Σ_t^i) on each of the sector indexes observed respond to Opec announcements.

3 Background

In order to give some comprehension of how oil prices affect the stock market, the author discusses the interaction between the economy and the stock market and firm's performance.

First, there's a short discussion of oil price movements and the economy. After that, it is presented an overall view of the relation between Opec decisions (announcements) and the stock market activity with a description of aspects of Opec that are relevant to this discussion. Then, it is presented a review of the historical events that contributed to Opec's production decisions (price of oil) throughout the years of 2005 to 2007, followed by a summary of previous research studies involving similar topics.

3.1 Oil prices, firms and the stock market

Looking through an overall perspective, the entire economy of a nation is at some degree dependent on the price of oil. As oil prices are negatively correlated to economic activities, oil price fluctuations will impact macroeconomic factors (namely GDP and interest rates). Once the economy is affected, it becomes riskier (higher level of uncertainty) for energy consumer industries to keep producing at the same levels (and maintain the same expected profit margins).

In the case of higher oil prices, it represents higher costs to production which reduce earnings. For most industries, oil is the major input for companies' production so that oil price movements influence companies productivity at some degree.

Therefore, industries of various sectors should expect changes in revenues according to increases in firm's cost of productions. For firms' that are especially dependent on petroleum for production, rises in oil prices directly affect their profits and that brings down their value in the market.

What happens is that producers will try to pass on the extra costs to consumers in the form of higher prices for goods and services. Consumers will have to spend more of their income to buy the same amount of goods (or choose to reduce consumption if they can). If the cost increases cannot be passed on to consumers, economic inputs such as labor and capital stock may be reallocated. The uncertainty can cause workers layoffs and the idling of plants, reducing economic output in the short term (EIA, 2006). According to previous studies[8], there is a strong relation between oil prices and asset values. Asset returns are influenced by interest rates, inflation rates and oil price shocks since these factors affect firm's conditions.

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[8] Hamilton, 1983 (*Oil and the Macroeconomy since World War II. Journal of Political Economy)* was the pioneer economist to prove the relation between oil price fluctuations and stock market activity. There are several subsequent studies in the same subject that complement his work.

If the economy is doing well, businesses have growing possibilities or at least they keep a considerable margin of expected returns. If the economy is entering into a recession period, it will negatively influence businesses performance. In addition to a downturn in national economic activity, lower prospects of future economic performance (uncertainty about future expected returns) will reduce stock market activity.

Financial markets are pressured as a consequence of lower expected returns from stakeholders which have invested capital that is now compromised in paying extra debts (higher interest rates, higher input costs all these associated with lower cash flow).

In view of these aspects, it becomes clear that it is essential for investors to examine the status of the economy before they make an investment decision.

3.2 OPEC Policy Decisions and the stock market

OPEC (Organization of the Petroleum Exporting Countries) was created in September 14, 1960, as an agreement between 5 countries that were producers and exporters of crude oil in order to establish regulations to neutralize oil price instabilities. Throughout time, OPEC has become a permanent international organization, assuming control of the largest share of global oil production, currently consisting of 12 producing and exporting countries, spread across three continents (America, Asia and Africa). Opec's member countries together are responsible for over 42 percent of worldwide production and Opec's crude oil exports corresponds to 58 percent.

In order to stabilize prices and assure general market equilibrium, OPEC has established a Quota System[9]. The Quota System identifies yearly production quotas for the member countries and it requires that they work at maximum potential in order to at least for 30 days a year accomplish the assigned quota (www.opec.org).

''The OPEC Statute requires OPEC to pursue stability and harmony in the petroleum market for the benefit of both oil producers and consumers. If demand grows, or some oil producers are producing less oil, OPEC can increase its oil production in order to prevent a sudden rise in prices. OPEC might also reduce its oil production in response to market conditions (Organization of the Petroleum Exporting Countries, 2009).''

It is important to consider OPEC's decision announcements when looking at the behavior of the stock market in relation to oil prices movements. As oil price increases, not only the economy but businesses of all kinds should be affected to some degree and firm's asset returns are compromised as well.

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[9] (Daniels, Radebaugh and Sullivan,2004,p.225-6)

Previous studies[10] have revealed that risk in crude oil markets increase when Opecs meetings approach. These meetings are usually held 3 to 4 times a year where Opec announces general and individual quotas for its members.

It has been observed that just with the rumor around Opec's meetings, oil prices start to fluctuate and the consequence is directly felt in financial markets worldwide at some degree. According to Opec Review 2009, the announcements that lead to increases/no alterations in oil production were observed to help stabilize oil prices and the financial market responds positively with increases in expected returns (market performance suffers no major impacts, in the latter case). Meanwhile, the production cut decisions have been observed to produce a significant reaction to the market (especially after announcement period) and returns are expected to decrease.

Previous researches[11] reveal that Opec production decisions have shown to create strong effects on volatility of stocks in the US and UK markets. Also, when taking into consideration the occurrence of conflicts (or wars), it has been observed that when Opec decides to decrease production, volatility in these markets is higher on non-conflict days than on conflict days and they assume that it could be the result of the decision itself. Researchers[12] think it might be that the announcement of the reduction in oil supply coincides with the cessation of the conflict where the continuous disruption of oil supply is no longer a threat. Therefore, uncertainty in the stock markets is lowered.

Also, how sensitive the stock market is to changes in oil supply depends on how the market anticipates Opec decisions[13]. For example, it has been observed that the US stock market is highly volatile because it efficiently anticipates Opecs decisions. High volatility (higher risk, higher uncertainty over expected stock market activity) in stock markets, precede declined market activity while low volatility indicate high market activity and good prospects of returns for investors.

It has been observed that oil spot markets take about five days after the decision for the oil spot prices to fully incorporate the new information (the release of Opec new production decision). The UK and US stock markets have shown to obtain abnormal returns up to 2 days after Opecs' decision (t=1 , 2) then from the third day (t=3), no more abnormal returns are gained. Therefore, it is important to notice that just the rumor of the announcement might already have some significance in the movement of stock prices and not only the news itself (that will cause the oil price to increase or decrease). Another aspect observed

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[10] Guidi and Tarbert, Opec Review, 2006.
[11] OPEC Review, 2006.
[12] Guidolin M.;Ferrara E.; ''*The economic effects of violent conflict: Evidence from asset market reactions'',* Peace Research, 2011.

[13] OPEC meets twice a year on prescheduled dates for 'ordinary' conferences but they also call for 'extraordinary' conferences with short notice. Each official press release is considered an event. Having compiled a list of events, the author classifies each OPEC announcement in terms of a production cut, hike and no change in production levels.

by Opecs reviewers is that Opec decision to reduce output leads to a drop in cumulative median abnormal returns (CMAR)[14] in the stock prices. Economically, the market reacts to new information over the entire period: t=-X (days before), t=0 (announcement day), and t= +X (days after).

Also, it seems that markets' reaction to Opecs' decisions is asymmetric regarding increases and decreases in supply. Increases in oil supply have less effect (statistic significancy) on markets than decreases in oil supply. The more efficient the market is, the less impact it will suffer from Opecs decisions.

In conclusion, investors must evaluate the economy situation before making an investment and the more precise he measures, the higher chances to capture the new situation faster than its competitors and obtain abnormal returns or keep from losing them.

3.2 History of Oil Price Shocks

In order to provide an overall view of how Opecs announcements affect the stock market, it is helpful to look at historical events that may have some impact on Opec quota.

In 1991, Iraq invades Kuwait and this event caused a small oil price shock which lasted for about 9 months. Even though it was considered a small shock compared to previous ones, this event led to the recession in the early 90's which brought major effects for many economies on the same level as the previous shocks.

In 1999 to 2000, OPEC's Restraint caused a small oil price shock (not compared to the ones in 1973 and 1978 but that kept increasing persistently. In addition to the events of four catastrophic hurricanes in the Gulf of Mexico (major oil production platform), followed by the US invasion into Iraq (2003). This resulted in a loss of oil production in Iraq.

Between the years of 2002 and 2005 Opec's exports grew rapidly following even higher demand for oil from expanding markets (US and Asia) initially caused increases in oil prices which kept rising and that contributed to a reduction in oil demand later on. Non-Opec suppliers also developed in oil productivity and were able to supply the extra demand mutually with Opec producers which kept prices stable.

In the years following the US-Iraq war (2003), Opec decides to review their Quota System in order to increase efficiency and establish prices to a certain level that would benefit both producers and consumers in addition to guarantee adequate capital returns to those investing in the petroleum industry (Sandrea, R.2003).

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[14] The CMAR captures the total firm-specific stock movement for an entire period when the market might be responding to new information (Bodie, 2009).

In the same year (2003), Venezuela had some problems that also led to a loss in production and that country was never able to return to its production levels again.

Both Iraq and Venezuela forfeited their possibility to produce at maximum capacity. This loss combined with OPEC's decision to increase production in order to meet growing international demand, caused OPEC's producers the inability to cover demand in the case of an interruption of supply. As a consequence of this sudden shortage of production, there were successive increases in oil prices throughout 2004 and 2005 which added a significant risk premium to crude oil prices.

Meanwhile, the asian economy was growing in a very rapid pace and demand for oil and its products started to increase accordingly so that they became a potential consumer. Also, the US economy was improving and demand for oil started to rise. As a result, OPEC announced a higher production quota.

The event of four catastrophic hurricanes in the US caused refinery problems and they were forced to cut back production in a large amount, in addition to problems associated with the conversion from MTBE as an additive to ethanol have contributed to higher prices in 2005.

Hurricane Katrina deactivated oil refineries in the US which made oil production to fall and as a consequence, gasoline prices reached a high record.

At the end of 2005, crude oil prices had increased to the point that worldwide oil demand was forced down and the level of uncertainty in major financial markets was elevated as they feared future oil price heights.

According to Opec Bulletin 2005, OPEC's ministerial conference held three extraordinary meetings (in addition to the two regular annual meetings) to discuss about the rising price of oil. These meetings increased the Organization's production ceiling with OPEC's total crude oil exports rising in order to ensure the market remained well supplied for that year.

As a consequence of constant increases in oil prices, world demand for oil was reduced in 2006 (OpecReview, 2006). Around this time, there were some isolated and smaller events and natural disasters that contributed to worldwide rises in oil prices and that originated global recession: the north korean missile tests (which caused instability in the Asian stock markets because investors feared that the tests could originate a conflict between the Southeast and East Asian areas).

The rapid expansion of the global economy over the years 2002–2007 led to an oil demand rush and a corresponding rise in OPECs production to satisfy the ever growing demand (Opec World Oil Report, 2010).

From the end of 2005 to 2007, Opecs oil exports gradually declined because of the continued growth in oil prices and flat supplies from Non-OPEC producers (Opec Bulletin, 2005). Until spare capacity became an issue, inventory levels provided an excellent tool for short-term price forecasts.

Although not well publicized OPEC has for several years depended on a policy that amounts to world inventory management and that has supported increases in oil prices worldwide (EIA, WTRG Economics, 2005-2007).

Below is an illustration of the oil price movements according to historical events (between 2001 and 2007).

Figure II
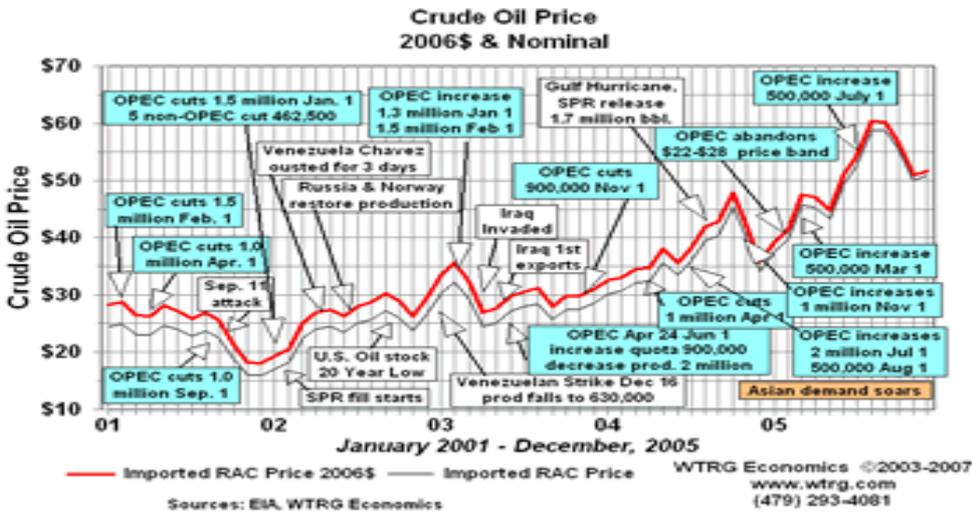
When looking at these events it is observed that it is either when an economy collapses or in the event of a natural catastrophe or war that oil prices increase and that is usually followed by a slowdown in the global economy and turmoil in the industrial world.

Just the likelihood of war or major economical crisis influence oil prices and therefore equity prices. It creates an atmosphere of uncertainty which elevates risk in the financial markets (besides the fact that oil prices might be rapidly increasing as a result of the expectancy of war, also contributing for higher risk). As a consequence, financial markets bear the impact especially in the sectors where oil is a major input. That is why it is essential for investors to make an assessment of the actual economic situation in order to evaluate short and long- term market performance and thus exploit the possibilities of higher returns.

3.3 Previous Studies

There have been previous researches at professional and academic levels with similar topic. Below are listed some of this literature:

- The authors Guidi and Tarbert (Opec Review, 2006) analyzed the effects of Opec policy decisions on the US and UK stock markets during conflict and non-conflict periods between 1986-2004. They have concluded that risk in crude oil markets increase when Opecs meetings

approach and that volatility in these markets is higher on non-conflict days than on conflict days and they assume that it could be the result of the decision itself.

- Hamilton, 1983 (Oil and the Macroeconomy since World War II. Journal of Political Economy) was the pioneer economist to prove the relation between oil price fluctuations and stock market activity. There are several subsequent studies in the same subject that complement his work.

- Guidolin and Ferrara (Journal of Peace research, 2010) observed the economic effects of violent conflict on asset market between 1974-2004 applying the event study methodology. Their results suggest that, on average, national stock markets are more likely to display positive than negative reactions to conflict onset.

- Gogineni, S. (The Eastern Finance Association, 2010) observed the impact of daily oil price changes on the stock returns of many types of industries and found that in addition to the stock returns of industries that depend heavily on oil, stock returns of some industries that use little oil also are sensitive to oil prices.

4 Theory

The following economic theories are presented to support the analysis of the results and to help drawing conclusions about the subject discussed in this study.

4.1 Theory of Value Creation

The theory of valuation was chosen because of its importance in explaining the relationship between value creation within the company (according to the amount of capital invested) and its economic profit in determining the company's position in the financial market.

By creating value, the company strengthens its financial profile. As a result, its performance is improved which raises shareholder's earnings and the expectancy of higher returns which gives the investors a positive expectancy of higher returns.

When the value of things change overtime, the value creation within a company (according to cash flow) of company's production is affected.

Koller (2005)[15] on his book: "Measuring and Managing the value of companies" arguments that the two key value drivers for cash flow and value creation are:

Growth: which is the rate at which the company can grow its revenues and generate profit;

ROIC (Return on Invested Capital): it's a measure that tells the company's ability in generating returns by efficiently investing capital. It's obtained by subtracting capital invested minus cost of capital. If

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[15]Tim Koller, Marc Goedhart, Favid Wessels, (2005) "Measuring and Managing the value of companies" (4th Edition), McKinsey & Company, ch.3 and 4.

there's growth that means that the return exceeded the cost of capital. The higher the capital invested at returns above the cost of capital, the higher value created, the higher the potential earnings prospects, thus stock prices will increase as the expected cash flow to the stock holder has increased.

According to Koller 2005[16], there are many methods used in finance, to measure companies' value and the most common one is the Discounted Cash Flow (DCF). This method explains how the difference between cash flow and cost of capital determines future profit margin (long-term improvements maximize profit). As the company gains higher profits, it improves growth prospects and that will attract investors. Assuming that the market is efficient, the creation of value will immediately be captured by the stock market if the form of higher stock prices.

The behavior of the stock market is determined by:

Market Valuation Levels: or market-value-to-capital, this level is determined by the company's absolute level of long-term performance and growth (expected revenues and earnings growth and return on invested capital-ROIC) (Koller 2005).

Total Return to Shareholders: is measured by changes in the market valuation of a company over some specific time period and is driven by changes in investors' expectations for long-term future returns on capital and growth (Koller, 2005).

Increases in the price of basic material for production will directly affect a company's production costs and the company's economic profit (ROIC minus Cost of Capital) bringing down companies' revenues. The value of the company will be affected and so will the company's share prices.

Companies that use oil as base material for production might suffer losses from increases in oil prices and their stock prices should immediately reflect that information on the market. Increasing oil prices imply increasing costs and declining profit margins, that will keep happening until the company adjusts to a new level of cost of production. Since this instability affects the real stock prices, the company is undervalued in the market. After the company's financial statement becomes stable, there should be growth potential again and good expectations of future performance which should attract investors again.

4.2 Stock Valuation

By definition, stock prices are the market value of shareholders' equity divided by the number of outstanding shares, which are stocks currently held by investors, including restricted shares owned by the company's insider and by the public, (Bodie, 2009). The stock price reflects the growth that investors expect of the company in the future.

There are basically two methods to value stocks and they give investors an overall idea about what the stock is really worth in comparison to its price in the market.

The fundamental valuation is used to justify stock prices and it is based on the cash flow of the company. The cash flow generates value for the company by accounting expenses and returns to the company's financial statement. This valuation shows long-term projections for the stock prices.

The most used methodology used in this type of valuation is the P/E Ratio and it's measured as a ratio between the market price and earnings per share and it serves as a useful indicator of the company's growth prospects.

The other type of valuation method is the Supply and Demand and it's based on the investors' willingness to buy and sell stocks which motivates the prices of the stocks to go up or down. This method drives short-term stock market trends.

4.3 Efficient Market Hypothesis

The Efficient Market Hypothesis is based on the premises that stock prices reflect all the available information about the company's actual and future economic performance (Bodie, 2009).

Market efficiency may differ according to market's size. A small market is usually less efficient, thus speculation opportunities may be higher due to undisclosed or delayed assimilation of new information.

In a large market, competition is higher and the degree of efficiency is also higher. That is because investors spend more resources and time searching and analyzing new information which could translate into higher investment returns.

The movement of stock prices going up and down creates trends which allow traders to capture profit opportunities (or losses) between one price to another. According to the theory, the four major factors that form market trends are:

- **Governments**: through Fiscal and Monetary Policies the government can impact the demand side of the economy and achieve desired growth level. The government applies fiscal policy by using different tools (government's spending and taxations) in order to control income (which will affect consumption) and to achieve desired level of economic growth. By using monetary policy, governments control money supply within the country and that will affect interest rates. Increases in the money supply lower short-term interest rates, encouraging investments and consumption demand (Bodie, 2009). Meanwhile, shortage of money supply increases interest rates reducing investments because it costs more to borrow money; then, saving is encouraged instead.

In advanced economies, financial markets are improved by consistent regulatory policies and that benefits businesses by giving them easier access to credit and mortgages (IMF, 2007)[17]. It creates more demand in the consumer side and companies can count on more available resources to increase productivity which will elevate companies' revenues and consequently move stock markets up towards higher expected returns;

- **International Trade**: financial markets are stimulated by the flow of funds generated with trade between countries. If a country is an exporter, it's economy strengthens with the volume of money that comes into the country whether it is goods or services because more money will be available that can be reinvested and generate more money within the country;

- **Speculation and Expectation**: these two are elements of the financial markets that are determined by what people (that includes investors, consumers and politicians) anticipate about the future of the economy according to the economy's actual situation. How they react today in the market is considered to be an important determinant of future performance of the market in the sense that consumers and investors will feel more comfortable in consuming and investing if they anticipate positive income levels and higher returns (respectively);

- **Supply and Demand:** are important determinants of prices on the economy because when supply is reduced, prices will raise and vice-versa and if supply is somewhat stable, demand increases or decreases will fluctuate higher or lower. As observed earlier, these price fluctuations are what create trends (the movement of stocks).

4.4 Liquidity

Liquidity is a concept used in finance, rather than a theory and it measures how fast an asset can be bought or sold in the market with no alterations in its price (Bodie, 2009). The volume and the pace of trading activity of assets' of a company gives investors an initial and simple outlook of how liquid the shares of the company are according to its fair market value.

Part of liquidity is the cost of engaging in a transaction, the price impact (which is the adverse moment in price one would encounter when attempting to execute a larger trade and finally the immediacy or the speed in which the asset can be sold without reverting to fire-sale prices (Bodie, 2007).

There's one important factor to mention and it's the liquidity risk which makes the investors uncertain about the guaranteed expected rates of return. The cost of trading a security (both ways) and the ability to sell it at a fair price should vary according to market overall conditions. Therefore, when facing uncertainty (liquidity risk situations), investors demand extra compensation for taking risks.

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[17] IMF, 3rd International Derivatives and Financial Market Conference 2007, *Economic Growth and Financial Market Development: A Strengthening Integration.*

According to Amihud and Mendelson[18] liquidity is increasingly viewed as an important determinant of prices and expected returns. The longer the assets' historical level of high liquidity, the more attractive the company will be in the market.

Measuring liquidity is very valuable because investors can make assessments of the risk of a security and the company's financial strength then they'll be able to judge and make a decision where it is better to invest their money.

4.5 The Fisher Irving Theorem or the Theory of Interest

Fisher (1930) assumed that all capital of the firm is already used in the production process so that a stock of capital, K, did not exist but all capital is in reality investment. It's used to understand current and future stock price movements.[19]

Fisher introduces his theory by easily explaining interest which he calls ''an index of a community's preference for a dollar of present (income) over a dollar of future income''. He suggests that the result from the interaction of the two forces is the time preference that people have for capital now, and the investment opportunity principle (that the income invested now will yield greater income in the future) (Encyclopedia of Economics, 1867-1947).

Fisher explains that the rate of interest is a premium gained in exchanging present and future goods according to the consumer's desirability for them over the preferred time to obtain such goods. He observes that the price of goods sacrificed now in relation to the relative price of goods available at a future date is what defines interest rates (Fisher, 1930, The Theory of Interest).

The preferred time is called Time Preference and it refers, according to Fisher, to the urge of present goods over future goods or future over present goods or no preference. In terms of capital invested, time is a factor that decides the expected return on invested money. What is going to decide the amount of return is the investors urgency to obtain his investment back in addition to his opinion of the future possibilities of obtaining a premium (reward) for waiting for the money to ''grow''(and that is according to the expected rate of interest).

According to Fisher's theory, investors' decisions depend on the appropriate time to invest and the opportunities of obtaining extra premium.

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[18] Yakov Amihud and Haim Mendelson, *''Asset Pricing and the Bid-Ask Spread,''* Journal of financial Economics 17 (1986).
[19] Even though the interest rate was not used as a variable, the author decides to include this theory because it gives an idea about how investors think.

4.6 Capital Market Theory

The CAPM model (Capital asset pricing model) is a well-known security pricing model amongst finance analysts. It is based on the concept that investors should be rewarded by the time the money is invested and the risk associated with it.

It consists of two types of risk, the systematic risk (also known as the beta-risk which is risk that cannot be diversified, and it is caused by external factors that cannot be avoided) and the risk-free rate (that is the expected return of the market, that can be reduced by diversifying with a portfolio of different assets).

In order to measure risk, analysts use the beta variable which is a standard finance risk indicator that measures the covariance between fluctuations in an asset's value and fluctuations in the value of a widely diversified asset portfolio.

A number of researchers, using different data and different estimation procedures, find that the estimated Beta for oil (and natural gas) is negative, which implies a strong negative covariance risk with a widely diversified asset portfolio (IEA, 2003).

5 Economic and Financial data

In order to provide a more comprehensible view of the swedish economy situation, it will be presented here, a brief description of its economy and financial aspects that are relevant for this study. Following, there's a discussion of the financial indicators used in this analysis.

5.1 Economic Data

Sweden is highly classified in respect to the low levels of corruption and high levels of trust, controlled low inflation levels which cooperates to the well functioning of the economy.
According to the OECD Report, 2009, the Swedish economy is an open market whose economic model is focused on national economical growth by diminution of monopoly power and barriers to competition. It was observed that the continuous opening of the swedish economy to globalization has increased the volume of imports and exports which enhances economic activity.
Also, there have been strong efforts from the Swedish government in order to lower oil dependency by substituting petroleum for renewable energy to supply domestic industry. Currently, almost half of the swedish energy comes from renewable energy (OECD, 2009).
The Swedish economy have been made progress in the privatization process which have created a positive impact in the financial markets since it stimulates competition and thus, increasing efficiency. As a consequence, companies implement internal changes that can increase shareholders value by constant increases in profits (Antoncic and Hisrich, 2003; Zahra *et al.*, 2000). The aim is to even more reduce

public ownership which still accounts for one-quarter of market capitalization in the Stockholm Stock Exchange.

The OECD have reported that between 2005 and mid-2007 the Swedish economy have expanded quickly followed by a fall caused by the preceding effects of the financial markets worldwide. Already in 2007, the swedish economy started to feel the impact of the financial crisis. Oil prices increased which forced a slow down on GDP growth. Higher interest rates made borrowing more costly and the cost of production increased leading to a decrease in productivity which cooled down economic activity.

Riksbank, the central bank of Sweden, uses the regulatory system repo rate 1[20] in order to promote the financial system's stability and effectiveness. According to statistics, the Swedish financial market is a source of risk capital for both the financial and the non-financial sector (SCB, 2007).

The financial market activity in Sweden started with the Stock Exchange of Stockholm which was established in 1863 and it was taken over in 1998 by OMX. As of today, the leading stock exchange market of the Nordics is the OMX Nordic Exchange which has 161 exchange members and it lists more than eight hundred companies. Out of these, the 30 largest companies are traded in the OMX Stockholm 30.

5.2 Financial Data

The financial indicators used in this study are the general index (OMX Stockholm 30) and the stock returns of 3 of the sector indexes listed on OMX Nasdaq Nordics: Energy, Telecommunication Services and Financials. The index returns are collected from the OMX Nasdaq Nordics website, from the first trading day of 2005 to the last trading day of 2007. The financial data is correlated to Opec's decision dates in order to examine the relationship between the sector indexes returns and Opec announcements.

A full list of the sample data is provided in the appendix where I have arranged the financial data considering Nasdaq's yearly trading calendar.

5.2.1   General Market Index

> i.   **OMX Stockholm 30:** is a weighted listing of major companies traded on the Stockholm Stock Exchange in Sweden. The Stockholm General Index (OMX 30) was established to provide an easily accessible measure of the performance of the stock exchange by including the major companies, but weighting them against their importance and market capitalization. The OMX Stockholm 30 is the leading share index of Stockholm

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[20] The rate of return that can be earned by simultaneously selling a bond futures or forward contract and then buying an actual bond of equal amount in the cash market using borrowed money (www.riksbank.se).

Exchange. It is a market weighted price index that consists of the 30 most traded stocks on the OMX Nordic Exchange Stockholm. The shares traded in the index are known to have high liquidity. The limited number of constituents guarantees that all the underlying shares of the index have excellent liquidity, which results in an index that is highly suitable as underlying for derivative products. The composition of the OMXS30 index is revised twice a year (www.nasdaqomxnordic.com).

5.2.2 Sector Index

A sector index measures the performance of a group of companies according to their specialization and whose stocks are listed on a general or specialist stock exchange. Here is a short description of each sector chosen for analysis, according to GICS (Global Industrial Classification Standard).

ii. OMXEnergy_PI

This sector includes upstream oil companies whose businesses are dominated by either of the following activities: the construction or provision of oil rigs, drilling equipment and other energy related service and equipment, including seismic data collection. Companies engaged in the exploration, production, marketing refining and or transportation of oil and gas products, coal and other consumable fuels. Amongst the companies grouped in this sector are large companies which   develop and exploit gas and oil reserves with the purpose of commercializing its resources (www.nasdaqomx.com).

iii. OMX Telecommunications Serv._ PI

The telecommunications sector offers communication services primarily through a fixed line, cellular, wireless etc. Included in this group is one of Europe's leading telecom operators_ Tele2_ which provides services for private households as well as for companies in several countries.

iv. OMX Financials_PI

The financial sector contains companies involved in innumerous activities such as banking, mortgage finance and investment banking. Their purpose is to provide financial services to private and corporate costumers according to their requirements.

5.3 Opec Announcements Data

The data about Opec announcements was collected from Opec's website and separated according to the results of the decisions on oil production (quantity reduced _assume significant increase in oil prices; quantity unchanged_ assume no significant price change; quantity increased _assume decrease in oil prices). During the time period considered in this study, 14 announcements have been made, of which 9 resulted in no change in production, 3 in a production increase and 2 in production cut.

6   Empirical Results

Below are presented the empirical findings of the Unit Root test, the main regression model and the Cumulative Abnormal returns followed by detailed explanation after each result.

6.1 ADF test Results

In order to make long-term forecast possible, it is necessary to check if the series is stationary or not. The time series data must be stationary so that the mean and covariance remain the same independent of time. The ADF (Augumented Dickey Fuller) is a technical procedure usually used in finance research in order to prepare the time series data for estimation of financial variables. The ADF model used to test for stationarity is described below:

$Y_t = \beta_1 + \delta Y_{t-1} + \varepsilon_t$

Table I presents the results of the ADF test. The dependent variable (Y_t) is the returns on the sector indexes observed and the independent variable (Y_{t-1}) was the sector index returns lagged one time and its coefficient '' δ '' (the slope coefficient) shows how far away the series data (stock returns) shift apart from the mean.

Table I

Table I presents the results of the ADF test on each of the financial variables (the returns on the three sector indexes: Energy, Telecommunications and Financials and the returns on the general market index OMXST30).

*corresponds to significance level at 95%.

Difference Sector Index Return	Beta	Slope coefficient	R^2
OMXS Energy_PI	-0,140	-1,032	0,517
t-value	(-1,863)	(-28,308*)	
OMXS Financials_ PI	-0,063	-1,067	0,533
t-value	(-1,596)	(-28,353*)	
OMXS Tel. Serv_PI	-0,082	-1,035	0,520
t-value	(-1,596)	(-28,353*)	
OMX ST 30_General index	-0,059	-1,081	0,540
t-value	(-1,455)	(-29,692*)	

Dependent variable: the natural log difference on the sector index returns and the general market index.

After obtaining the results for the ADF test, it is observed that for all the four variables tested, the slope coefficient is significant which means that even though the time series data (the sector index returns) drifts away from the mean for a while, it diverges back to mean. Therefore, the author rejects the null hypothesis and the time series data is stationary and it is approved to make estimation of long-term forecast of the sector index returns analyzed. That means that the time series is stationary and it is useful to be used in the estimation of the main regression.

6.2 Main Regression results

In this study, the author relies on the usefulness of the CAPM model and the dummy variable approach to construct a model that efficiently estimates the impact of Opec announcements on the returns of the sector indexes: Energy, Telecommunication Services and Financials. The model used is the following:

$$R^t_{si} = \alpha_i + \beta r^i_t + \gamma_{t-2} D_1 + \gamma_{t-1} D_2 + \gamma_{t=0} D_3 + \gamma_{t+1} D_4 + \gamma_{t+2} D_5 + \varepsilon_t$$

Table II presents the outcome of the main regression. For each dummy variable introduced, there's one drift parameter'' γ'' that tells how much of the expected returns can be explained by Opec announcements (on the event window which range from two days before the announcement to two days after the announcement). The regression results are presented below:

Table II

Table II presents the outcome of the regression of each sector index returns on the general market index returns and the returns of the sectors general index returns correspondent to each day of the event window. The data observed corresponds to the period between 2005.01.03 to 2007.12.28. *corresponds to significance level at 95%.

Sector Index	constant	$r^{OMXST30}$	γ^D_{t-2}	γ^D_{t-1}	$\gamma^D_{t=0}$	γ^D_{t+1}	γ^D_{t+2}	R^2
OMXS Energy_PI	-0,091	1,094	0,598	-0,518	0,405	0,155	0,052	0,344
t-value	-1,426	19,667*	1,321	-1,143	0,893	0,341	0,114	
OMXS Financials_ PI	-0,007	0,955	0,045	-0,039	0,030	-0,029	-0,006	0,855
t-value	-0,389	65,864*	0,384	-0,329	0,256	-,245	-0,054	
OMXS Tel. Serv_PI	-0,010	0,803	-0,240	-0,525	-0,183	-0,178	-0,250	0,397
t-value	-0,240	21,980*	-0,808	-1,764	-0,615	-0,598	-0,839	

Dependent variable: Sector index retuns.

From the table above, it can be observed that the three sector indexes are not sensitive to the announcements because the dummy variable coefficients are not statistically significant for none of the days of the event window. Meanwhile, the results show that the general market index responds to the Opec announcements (considering the whole event window).

Before explaining the results of the sector index returns on the general market index, the author finds it necessary to bring up one of the assumptions of the CAPM model. According to that, the closer beta is to 1 the closer it follows the Security Market Line (SML) which means that the security rate of return moves together with the expected return of the market because the security is correctly valued ($\alpha=0$) and there's no extra compensation for investors to pursue that security for the reason that the risk is very low. The energy sector seems to follow very closely the stock returns on the general market index as a response to the news because OMXST30 beta coefficient is very close to 1. There seems to be no statistically significance on the general market index (OMXST30) response on the returns of the three sector indexes. From the illustration above, one can observe that when beta is equal to 1($\beta=1$), the security rate of return moves together with the expected return of the market (E (r_m)) which means that the security is correctly valued ($\alpha=0$). Assets that are priced above the SML are undervalued because of higher amount of risk ($\beta>1$) and therefore they yield to higher returns. That is l which embraces that investors are rewarded with a higher expected return for taking higher risk. While the assets that are priced under the line are overvalued and lead to lower rates of return. Even though the stock return values drift apart from the average rate of return values, they tend to converge to initial values which are the average rate of returns of the security without the event.

Meanwhile, there seems to be no statistically significant impact of Opec announcements (considering the whole event window) on the returns of the three sector indexes observed. It means that during the days around the event window the general market index produces abnormal returns but the sector indexes seem not to produce further returns.

However The market responds for each dummy variable introduced, there's one drift parameter'' γ'' that tells how much of the expected returns can be explained by Opec announcements which are represented in an event window that ranges from two days before the announcement to two days after the announcement.

After the regression results are obtained, one must observe the coefficient '' γ'' for each of the hypothesis' propositions presented above. If the null hypothesis is rejected, that means that the expected returns on the respective sector index are affected by Opec announcements. The best result here is obtained if the null hypothesis is rejected because that means that there are cumulative abnormal returns and they are proportionally distributed on the sector indexes throughout the event window.

6.3 Cumulative Abnormal Returns (CAR) test results

In order to enhance the results obtained by the CAPM model, the author estimates the Cumulative Abnormal returns which add all the coefficients of the dummy variables.

The following model was used on the estimation of CAR:

$$AR^t_{si} = \alpha + Er^i_t (\Sigma^t_{si}) + \varepsilon_t$$

Table III presents the results of the Cumulative Abnormal return throughout the days of the event window and it shows a close estimate of the stock movement of the observed sector indexes and the general market index after the estimation of the additional stock returns on the main regression.

Table III

Table III presents the results of the linear testing restrictions (CAR test) using the full sample data (sector index returns between 2005.01.03 to 2007.12.28). The values correspond to the Cumulative Abnormal returns that fall between the confidence interval whose limits are set to be the Lower and Upper bound at the 95% confidence interval. *corresponds to significance level at 95%.

Sector Index	Upper Bound	Lower Bound	p-value
Energy Ret.	2.756	-1.373	0.511
Telecom. Ret.	-0-019	-2.733	0.047*
Financial Ret.	0.540	-0.537	0.996
OMXST30	0.928	-1.788	0.534

Dependent variable: Abnormal returns for each sector index and the general index, respectively.

Before discussing the results of table III it is essential to clarify what Lower and Upper bound means. The concept of lower and upper bounds are originated from the confidence interval which measures the probability values that fall between two sets of values with a percentage probability (usually 95% or 99%). These two terms are used by the statistic software SPSS to describe the lower and upper confidence limits of a confidence interval estimation and are calculated using the formula sample mean: +/- margin of error. In this study, the set of values correspond to the additional returns that each sector index and the general market index could produce over the returns produced by the general market index as results of the news impact on the Stockholm stock market as well as the general index abnormal returns.

The CAR test results represented on table III, show that only the Telecommunication sector results should be taken into consideration because the results for the other two sectors and the general index in Stockholm were not significant. For the Telecommunication sector, the full range of values (which are the set of values that correspond to the abnormal returns) between the lower and upper bound are negative at the 95% confidence level. It means that the cumulative abnormal returns fall on the zone where the values are negative. The null hypothesis is rejected for the telecommunication sector which means that the sum of abnormal returns (Σ^i_t) observed respond to Opec announcements (even though it is a negative response). For the Energy and Telecommunication sectors the results are not statistically significant

probably because the general market index absorbs the Cumulative Abnormal Returns for the 5 day event window.

The figure presented below is a complement of table III. It illustrates the Cumulative Abnormal return movements produced throughout the 5 days event window which correspond to the days around Opec announcements.

Figure III

The figure below presents a perspective of the Cumulative abnormal returns for the three sector indexes according to event window of five days around Opec announcement (t = 0)
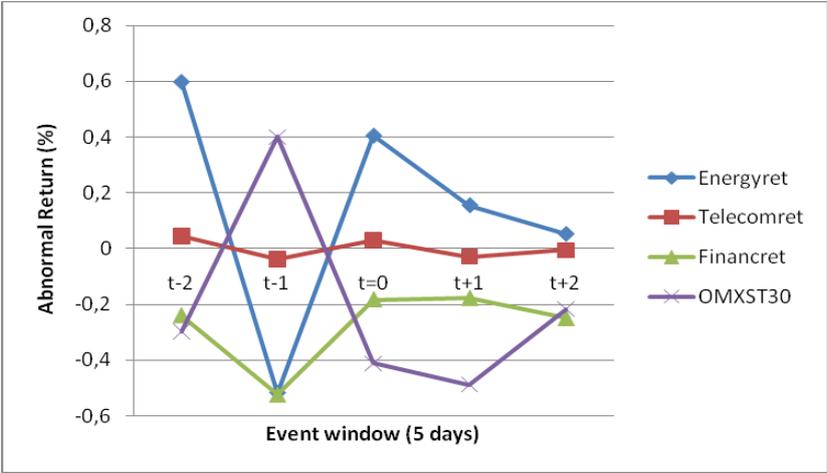

Fig. III Abnormal returns of the three sector indices on OMXST30 and five dummy variables and Abnormal returns of the OMXST30 on the dummy variables (only) according to the event window

On figure III, it is possible to visualize the results obtained on table III. The graph shows the excess returns as a function of time. More precisely, the X axis represents the time corresponding to the event window (which are the 5 days around Opec announcements, ranging from t = -2, t = -1; t = 0; t = +1 to t = +2, and the Y axis corresponds to the abnormal returns of the three sector indexes (Energy, Telecommunications and Financial) obtained in excess of the expected returns produced by the general market index. The set of values that fall under the time line 0 are negative (the cumulative additional returns are negative if they are situated on this region) and the set of values that fall above the time line 0 are positive (the cumulative additional returns are positive if they are situated on this region).

The blue line represents the movements of CAR for the Energy sector and the green line represents the Financial sector. The red line represents the movements of the CAR for the Telecommunications sector and here it is possible to visualize that the sum of the cumulative excess returns for this sector between the lower and upper bounds fall under the X axis, on the negative region. The purple line is the movements for the CAR of the general market index.

7   Conclusion

The purpose of this thesis was to analyze the impact of Opec announcements on stock returns of selected sector indexes of the Stockholm stock market. The time period analyzed is limited to the years of 2005 to 2007 when markets worldwide were taken by euphoria and panic caused by the anticipation of the upcoming financial crisis given that it has been well proved that such events do cause a substantial effect on stock prices.

The author sets up an extended CAPM that includes dummy variables to capture the excess stock returns around the dates of the announcements so that it is possible to state and quantify the amount of expected return produced on the given period of time by assigning proxies to describe the qualities to each day of the event.) in order to enhance the results obtained by the CAPM model, the author estimates CAR which adds all the coefficients of the dummy variables that are the returns in excess of what is expected.

On the calculations, the general market index returns together with the stock returns over the days around the announcements were used as factors of the sectors indices returns. The explanatory variable was the stock general index in Stockholm (OMXST30), and the three sector indices observed (Energy, Telecommunications and Financials) were the dependent variables.

This framework of analysis allowed detecting how the three sector index returns and the general market index responded to Opec announcements. The event study shows that none of the dummy variable coefficients was significant (individually) which indicates that none of the sector indexes is sensitive to the announcements. However, this should not be interpreted as the announcements have no impact on the Swedish stock market since the general index in Stockholm was the explanatory variable on the main regression model and it has proved to create additional returns around these dates. So that the three sector indexes could not produce significant additional response.

The author contemplates one reason why the results were not substantial on the sectors index returns and that may be that other control variables (macroeconomic factors) such as interest rate and exchange rate were not taken into consideration. That could be a suggestion for further research to observe the stock return movements over a period of time considering the days around Opec announcement dates in addition to the general market index and some macroeconomic variables that may also have impact on stock returns. In addition to that, the author makes the inference that during the years observed, the decisions of Opec might not have significantly damaged the performance of companies listed in the specific sector indexes of the Stockholm stock market.

The empirical results obtained in this study, demonstrate that only the Telecommunication sector had statistical significant results for the Cumulative Abnormal returns given Opec announcements under the

years previous to the financial crisis (2005 to 2007). The Energy and Financial sectors have not showed statistical significant results for CAR.

Therefore, author concludes that it is a proof of the Stockholm stock market efficiency because the general market index OMXST30 incorporates the impact of Opec announcements and is able to produce additional returns as a consequence of such events. The overall conclusion is that the Swedish economy as whole is sensitive to the OPEC announcements, since the telecommunication is the sector that should be insensitive to oil.

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Appendix

OPEC Announcements

Below are the dates of announcements and the number of days since the last announcement.
For the decision, 0 :quantity unchanged (assume no significant price change); + :quantity increased (assume no significant price change); _ :quantity reduced (assume significant increase in oil prices).

Date Weekday	Price	Decision	Dummy variables
2005-01-31 Monday 33	48.25	0	0
2005-03-16 Wednesday 31	56.50	+	0
2005-06-15 Wednesday 63	55.53	+	0
2005-10-10 Monday 81	60.71	0	0
2005-12-12 Monday 43	61.36	0	0
2006-01-31 Tuesday 33	67.86	0	0
2006-03-08 Wednesday 25	60.06	0	0
2006-06-01 Thursday 59	70.11	0	0
2006-09-11 Monday 69	65.42	0	0
2006-10-20 Friday 29	57.35	_	1
2006-12-14 Thursday 37	62.48	_	1
2007-03-15 Thursday 61	57.52	0	0
2007-09-11 Tuesday 124	78.16	+	0
2007-12-05 Wednesday 60	87.45	0	0

Source: www.opec.com
There were 14 announcements in the time period considered (2005 through 2007).
Observe that the data regarding to Opecs' announcements will be separated into production cut (which indicates oil prices increases), production increase (which indicates oil price decrease) and no change in production (which indicate no significant change in oil price). The latter two decisions are given less significancy because they tend to stabilize oil prices and the stock markets are not significantly affected by it.)