

OPEC Announcements and their Effects on Oil Price in Condition of US Crude Oil Commercial Stocks

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Abstract

We examined the influence of OPEC announcements on oil prices, considering the status of US commercial crude oil stocks by analyzing announcements from official conferences and ministerial meetings related to major international crude oil over twenty years (2000–2021). Our research included assessing statements made during official conferences and ministerial meetings concerning significant global crude oil. We employed event study methodology to analyze the variations in the scale and significance of market reactions to decisions regarding oil production quotas made by OPEC/OPEC+, taking into account the capacity of US oil storage in stock tanks. Despite initial expectations regarding the effects of production cuts or increases in oil prices, the trends sometimes exhibit unconventional reactions. Based on an analysis of 85 meeting announcements of OPEC/OPEC+ during this period, it was observed that the short-term evaluation of cut and increase decisions fell below market expectations in terms of balancing oil supply and demand. Additionally, considering the high volatility of oil prices in the estimation window before these decisions, it can be concluded that certain categories discussed in this study do not have a significant influence on oil prices.

Key Words: *OPEC Meetings, OPEC+ Meetings, Event Study, Announcement Effect, Oil Price, US crude oil commercial stocks.*

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1- Introduction

Energy, particularly oil, is a crucial driving force for the economy. The price of oil has a significant impact on macroeconomic indicators, which are highly sensitive to global political and economic news and are shaped by the fundamental concepts of supply and demand in the market. The Organization of the Petroleum Exporting Countries (OPEC) is known as one of the most important economic coalitions, responsible for supplying over 30% of the world's crude oil production. OPEC monitors the oil market's supply-demand status and tries to balance the market as a sweep producer by using its ability to produce oil as much as required. Therefore, OPEC, and recently OPEC+ after 2016, play an essential role in determining the oil price when they make decisions in meetings and announce and apply their resolutions. Therefore it is crucial for policymakers, market participants, and analysts to comprehend the significance of these decisions on both oil prices and the wider economy.

Investigating how OPEC meetings affect oil prices and the decisions made in different circumstances, such as the status of US Crude Oil Commercial Stocks, has been considered a crucial event for financial markets. OPEC meetings typically take place twice a year, with extraordinary sessions held as needed. Decisions relating to production reductions, production increases, or maintenance of existing production quotas for member countries have distinct effects on the market. Therefore, investigating these impacts can help governments and private enterprises involved in oil production and consumption manage energy supplies and primary resources effectively.

To investigate the effects of OPEC meeting news, the study employs the Event Study or Announcement Effect method. This method is commonly utilized to assess how news disseminates in financial markets, such as the disclosure of company information or the announcement of annual profits, and their subsequent impact on share prices and the overall market. The research methodology combines qualitative and quantitative data. OPEC decisions are analyzed using a historical approach, with the decisions categorized as qualitative data.

It is essential to grasp the behavior of oil prices and the factors that impact them before and after OPEC meetings due to the sensitivity of the financial markets. Despite policymakers acknowledging the impact of US oil stocks on oil prices, no research has been conducted on the relationship between US stock and OPEC announcements yet. Previous studies that have examined the consequences of OPEC meeting decisions are all related to ten years before the consensus of OPEC and OPEC Plus. Therefore, this article is of significant importance as it uses the Event Study or Announcement Effect method to examine the effects of OPEC meetings news. This technique is utilized to assess how news influences financial markets. for instance, it evaluates the effect of the disclosure of company information or the announcement of their annual profit on share prices and the market. The research method used is a combination of qualitative and quantitative data.

The decisions made by OPEC are analyzed through a historical period, and these decisions are classified as qualitative data. Additionally, information on the daily oil prices and the status of oil stocks in the United States are collected and analyzed for the period before and after the OPEC meetings that called Estimation Window. During this period the upper and lower bounds of oil stocks levels are determined and visualized as a moving band over time. Subsequently, the

circumstances surrounding oil prices are extracted and analyzed relative to this band. The analysis of oil prices occurs within the Event window, covering a few days before and after the meetings and categorized based on price levels and the classification of decision types. Ultimately, cumulative changes are identified and subjected to significance testing using the T-test.

This research is divided into five sections. The second section involves a detailed literature review on the topic, Which includes previous studies that have analyzed how prices are influenced by OPEC meetings. The third section elaborates on the research methodology, providing detailed explanations. The fourth section delves into the data analysis process. Lastly, the data and conclusions will be discussed.

2- A Review of Literature

The Event Study or Announcement Effect method, commonly employed to investigate the impact of economic news, has previously been utilized to assess the effects of corporate financial information release, such as annual earnings per share (EPS) or dividends per share (DPS), on share prices. [Brown and Warner \(1980\)](#) conducted a study on the Event Study method, examining three approaches for measuring abnormal returns. Several studies have applied these methods to analyze the impact of OPEC meeting news.

[Draper \(1984\)](#) examined the effects of ordinary and extraordinary OPEC meetings on future heating oil prices, specifically focusing on ordinary meetings held between 1978 and 1980. The study found that average weekly price changes were positive before ordinary meetings and negative afterward, indicating significant changes.

[Daves and Krinsky \(1992\)](#) conducted a study examining the impact of OPEC meetings on the future prices of oil and heating oil between 1979 and 1990. In their research, They have classified news related to OPEC meetings where members reached a consensus and established production quotas, resulting in a rise in oil prices, as "good news". Likewise, news about meetings where members failed to reach an agreement, resulting in a decrease in oil prices, was categorized as "bad news". Regarding the "good news" category, the market exhibited a partial reaction before the meeting day, which extended until one day after that. However, not all reactions were immediately observed, as another part of the market's response to OPEC decisions occurred between the first and twentieth day after the meeting. In the case of "bad news," the market's reaction after the meeting and prior to the first day was characterized by a significant decline in prices. However, after the first day, the changes in oil and heating oil prices were not deemed significant.

[Horan \(2004\)](#) investigated the influence of OPEC meetings on the price of future oil options during the period from 1989 to 2001, encompassing 20 days before and 20 days after each OPEC meeting. The study concluded that meetings of the market monitoring committee and subcommittees, which are responsible for assessing supply and demand, market equilibrium, and proposing decisions during OPEC meetings, have a more pronounced impact on the market. Prices during these meetings exhibit higher volatility.

[Guidi et al. \(2006\)](#) conducted a study on the impact of OPEC meetings on financial markets from 1986 to 2004. The researchers categorized the OPEC meetings into two qualitative periods: high-level conflicts and non-conflict. They also examined the consequences of decisions to increase or decrease oil production in the American and British stocks markets. The high-level conflict period included events such as the Iran-Iraq war, Iraq's attack on Kuwait, and the American invasion of Iraq. Interestingly, during the conflict period and decisions to reduce oil production, the American stocks market displayed a positive and upward trend, whereas the British stocks market reacted negatively.

[Shiva won \(2008\)](#) examined the impact of OPEC meetings on the prices of 15 distinct types of oil (including light/heavy, sour/sweet, and OPEC/non-OPEC basket) within the period spanning from 1982 to 2008. The decisions made by OPEC were categorized into three types: reduction, increase, and unchanged. One of the key findings of this study revealed a lack of significant differentiation in the effects on prices among the different oil types, namely light/heavy, sour/sweet, and OPEC/non-OPEC basket. Consequently, it was inferred that OPEC decisions exhibit varying effects on oil prices, contingent upon different market circumstances and price ranges.

[Xiaowen's \(2008\)](#) examined the effects of OPEC meetings from 1982 to 2008 and applied the Event Study approach, identifying variations in market reactions to OPEC decisions across different price ranges. By identifying differentiation in market reactions, the study provided valuable insights into the factors influencing oil prices and the effectiveness of OPEC's decision-making processes.

The reviewed studies were deemed outdated as they did not account for changes occurring after the 2008 financial crisis, the rise of shale oil, and the establishment of non-OPEC entities. Additionally, these studies lacked a comprehensive analysis of the conditions surrounding OPEC meetings and the impact of fundamental variables, such as crude oil stock levels, on oil prices.

Following the increase in shale oil production and the lack of cooperation among major oil-exporting countries, Saudi Arabia raised concerns that reducing its production alone would expose its export market to other parties. Consequently, the country opted to maintain its production levels, leading to an unprecedented decline in oil prices.

Subsequently, recognizing the vulnerability of their oil revenues, nations reliant on these incomes became convinced of the necessity for cooperation between OPEC and non-OPEC countries in managing crude oil supply. Consequently, meetings were convened to address this issue. The inaugural OPEC+ meeting took place on December 10, 2016. Typically, these meetings were held following OPEC meetings to facilitate coordination between OPEC and non-OPEC countries. However, in response to the COVID-19 pandemic, independent OPEC+ meetings have been regularly convened to address the restoration of oil production, separate from OPEC meetings.

In this study, the impact of OPEC meetings from 2002 to 2021 was examined. The Estimation Window was employed to assess prevailing market conditions and their influence on decision-making during both OPEC and non-OPEC meetings. The fundamental variables considered in the oil market analysis included oil prices and the status of U.S. crude oil stocks.

3- Research Methodology

In this research, the effects of OPEC and non-OPEC meetings on oil prices were examined, by using Event Study as the research methodology. The level of U.S. crude oil stocks, a fundamental variable in the oil market, was used to categorize the meetings. The analysis covered OPEC and non-OPEC meetings from the 119th OPEC meeting in 2002 to the 23rd OPEC+ meeting at the end of 2021.

Between 2002 and 2021, a total of 85 meetings were held, including 62 OPEC meetings and 23 OPEC+ meetings. Among the OPEC meetings, 38 meeting were ordinary while 24 meeting were extraordinary. The outcomes of these meetings were categorized into three types: production increases, production decreases, and the decision to maintain existing production quotas called no change.

Table 1: the OPEC and non-OPEC meetings categories and their number.

Type of Meetings	Number of Meetings	Ordinary/ Extra-Ordinary	Number of Ordinary / Extra-Ordinary Meetings	Type of Decision	Number of Every Decision
OPEC	62	ordinary	38	Decrease	4
				Increase	2
				no change	32
		extra-ordinary	24	Decrease	6
				Increase	5
				no change	13
OPEC & non-OPEC	23	Decrease	4		
		Increase	5		
		no change	14		
Total	85	Decrease	14		
		Increase	12		
		no change	59		

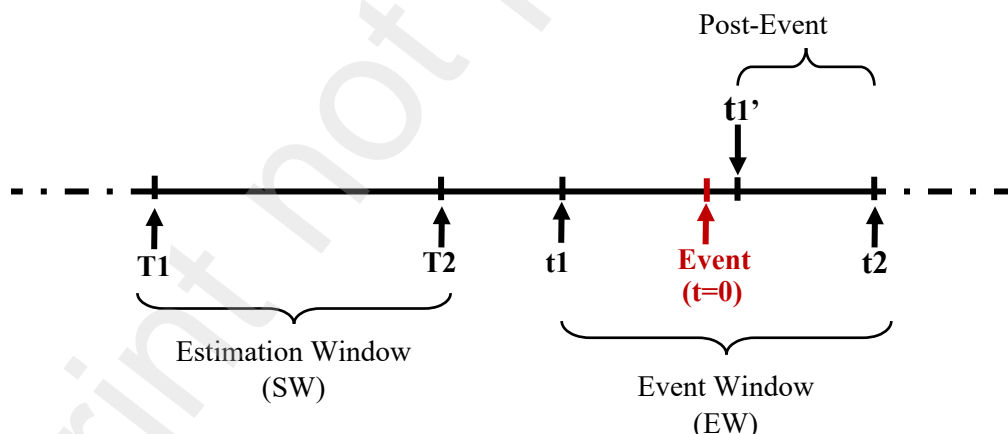
Source: Statements of OPEC and non-OPEC meetings since 2002 are presented on the meeting's website.

Table 1, out of the total 85 meetings, 14 meetings resulted in a decrease in oil production, 12 meetings led to an increase, while 59 meetings saw no change in production levels. It is important to note that for the purpose of conducting a detailed and accurate study, eight OPEC meetings that were immediately followed by OPEC+ meetings have been excluded from the Event Study. Thus out of 77 meetings, 12 OPEC meetings led to a decline in production, 12 meetings led to an increase, and 53 meetings resulted in no change in the production level due to consensus or a lack of agreement.

The impact of these decisions on oil prices will be examined by considering the decision-making circumstances and the state of U.S. crude oil stocks. The level of U.S. crude oil stocks is taken into account to assess the conditions that influence the decision-making meetings regarding oil production. Subsequently, the decision-making meetings are categorized into nine groups based on the decisions made and the meeting conditions, which are further divided into three categories: relatively high, relatively low, and within.

The Event Study return, also known as abnormal return, is a quantitative method used to assess the impact of news. This approach involves calculating the Cumulative Average Abnormal Return (CAAR) by taking the difference between the actual return and the estimated or expected return $\epsilon_t = R_t - E(R_t)$. The return is measured within a predetermined interval before and after the news release, known as the Event Window, to evaluate the news' impact. The Estimation Window, as illustrated in *Error! Reference source not found.*, is an interval used to analyze the price condition, timing of the news release, and index status prior to the event. Within this window, the maximum and minimum values of the index preceding the news release are considered representative of the pre-event state, while eliminating other factors that may impact the variable. Consequently, the index state is categorized into three modes: above, within, and below the defined range. In the Event Study method, a T-test is utilized to examine changes in the index and determine the significance of the cumulative average return. Therefore, it is essential to assess the standard deviation of the index within the Estimation Window.

schematic of the Event Study method and how to choose the Estimation Window and Event Window



3-1 Statistical Research Methodology

The initial stage involves classifying the meetings based on the conditions that govern them and the Estimation Window of U.S. crude oil stocks levels. These categories are determined as relatively high, relatively low, and within the Estimation Window range. Once the categories are established, daily abnormal returns must be calculated using formula (1) for both the Event

Window and Estimation Window data. This calculation enables the assessment and monitoring of the trend in oil price fluctuations within each category. In this context, the expected rate of return is assumed to be zero.

$$R_{m,t}\beta_i - \alpha_i - R_{i,t} = (R_i) - ER_{i,t} = AR_{i,t} \quad (1)$$

In other Event Study research, the Cumulative Abnormal Return (CAR) is commonly utilized. As per formula (2), the CAR is calculated by summing the daily abnormal returns starting from the first day of the Event Window for each meeting.

$$\sum_{t=T_1}^{T_2} AR_{i,t} = (T_1, T_2)CAR \quad (2)$$

To calculate the Cumulative Average Abnormal Return (CAAR) of each category, the cumulative abnormal return of each session is calculated and averaged according to the number of meetings in each category. After calculating the mean daily abnormal return of each meeting by formula (3), the variance of each session's data should be calculated from the same category to check the significance of changes in daily abnormal return. According to the formula (4), the variance of the estimation window of each category is also calculated.

$$\sum_{i=1}^N AR_{i,t} \frac{1}{N} = ARR \quad (3)$$

$$\sum_{i=1}^N \sigma^2(AR_{t,i}) \frac{1}{N^2} = (AR_N)VAR \quad (4)$$

$$\frac{AR_t}{\sqrt{Var(AR_N)}} = (AR_N)SAR \quad (5)$$

To assess the significance of changes in the cumulative abnormal return, formulas (4) and (5) are applied. After calculating the mean cumulative abnormal return of each meeting using formula (6), the variance of the Estimation Window is multiplied by the Event Window of the same category. This multiplication is necessary to examine the significance of changes in the cumulative abnormal return.

$$\sum_{i=1}^N CAAR(T_1, T_2) \frac{1}{N} = T_2 \cdot T_1 CAAR(\quad (6)$$

VAR

$$)R_N Var(A(T_1 - T_2 + 1)) = (CAAR_i(T_1.T_2)) \quad (7)$$

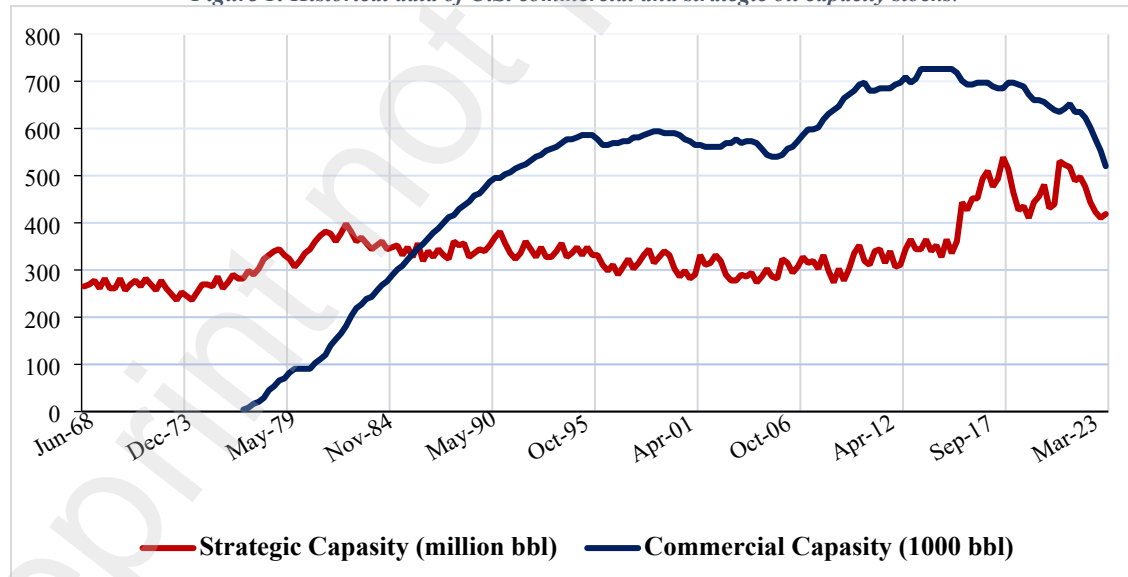
$$\frac{CAR_i(T_1.T_2)}{\sqrt{Var(CAR_i(T_1.T_2))}} = R_t SCA \quad (8)$$

3-2 Research Methodology Using Condition of U.S. Crude Oil Stocks

The level of U.S. crude oil stock is a crucial factor discussed in the concluding announcement of OPEC meetings, as it influences the decisions made by OPEC member countries. Since there is no readily available data on global crude oil stocks, this study employs the methodology proposed by Killian and Murphy (2014). This method utilizes an alternative variable, namely U.S. crude oil stocks, to estimate global crude oil stocks. In this particular study, U.S. crude oil stocks within the range of 2.23-2.59 is considered representative of the global oil stocks.

The U.S. crude oil stocks is further categorized into commercial stocks and strategic stocks, which also include petroleum products in addition to crude oil. Currently, the United States has stock capacity of approximately 800 million barrels.

Figure 1: Historical data of U.S. commercial and strategic oil capacity stocks.

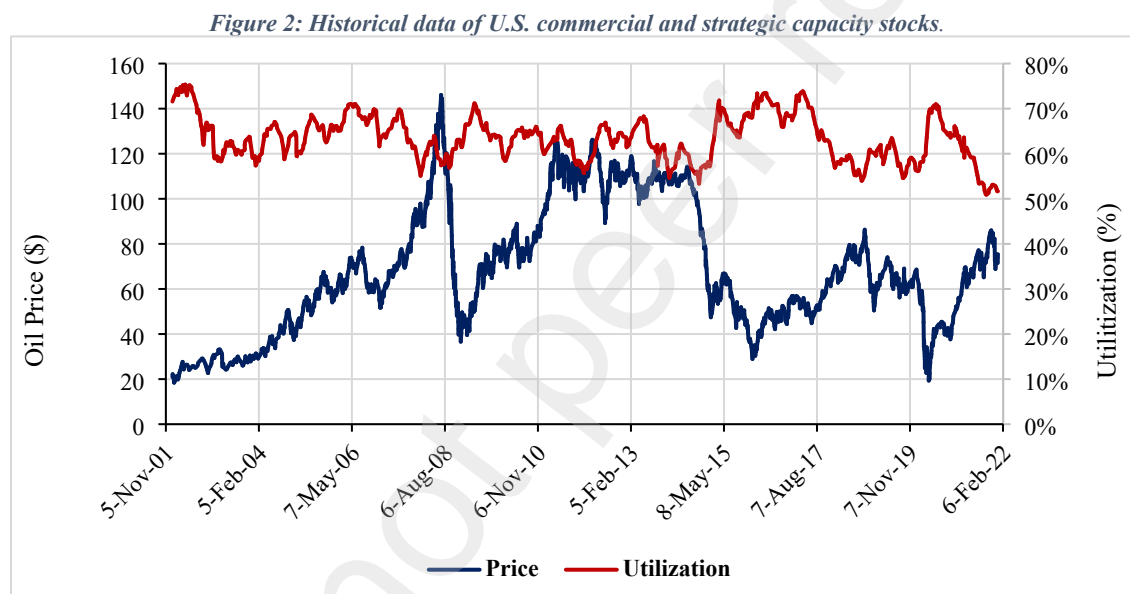


Source: www.eia.com

In this study, the market condition on the day of OPEC meetings is analyzed by measuring the percentage of storage capacity in relation to the working capacity of U.S. commercial stocks. It is observed that the prevailing trend of increasing commercial stocks is primarily attributable to capacity growth. Therefore, this measurement helps to assess the storage condition accurately.

Considering the storage tanks' spare capacity and the levels of supply and stored crude oil, it is important to account for the conditions when they are high compared to the previous chronological trend. In doing so, not only is the general increasing trend accounted for, but also the appropriate consideration is given to the factors governing the spare capacity of the storage tanks.

Figure 2, illustrates the calculation of the oil stock utilization percentage, which is derived from the ratio of the stock level to the storage capacity. This percentage is then presented alongside the stock level of the Estimation Window. As discussed in the literature review section, Xiaowen (2008) concluded that there is no significant difference when investigating the effects of OPEC meetings on oil prices based on factors such as light/heavy oil, sour/sweet oil, and OPEC/non-OPEC basket. Therefore, in this article, only the daily Brent Oil futures price is considered as a reference.



Source: www.eia.com

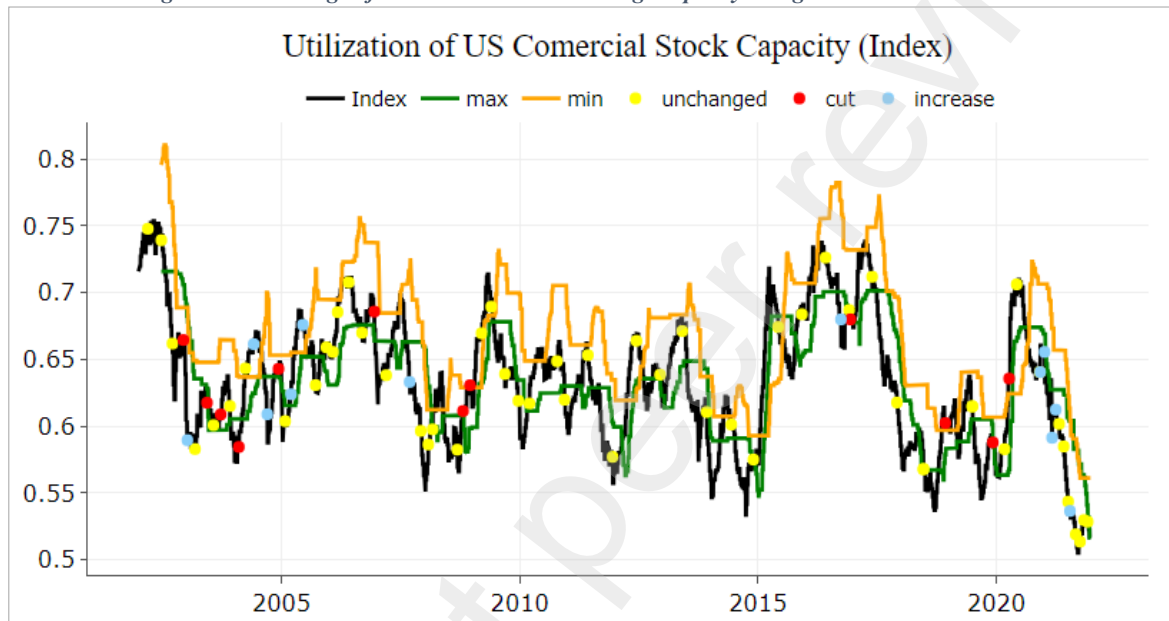
To conduct the Event Study and explore the impact of OPEC meetings on oil prices, two periods, namely the Event Window and the Estimation Window, need to be defined. The Estimation Window encompasses a duration of 10 days before and 10 days after the OPEC meeting. The period before the meeting is chosen to capture any news releases preceding the official announcement. On the other hand, the period after the meeting is selected to thoroughly observe the effects of the session on oil prices, as these impacts may take a few days to materialize completely.

Various intervals were selected and analyzed to assess the impact of altering the Event Window and Estimation Window periods. Initially, in order to classify the meetings, a specific day or interval had to be chosen as the determining factor that influenced the decision of the participating members. Consequently, the oil price on the day of the meeting, the average price over the 5 days leading up to the meeting, the average price over the 10 days leading up to the meeting, and the average price over the 5 days from the 10th to the 6th day before the meeting

were taken into consideration. Subsequently, the Estimation Window was determined by considering various periods ranging from 10 days to 30, 50, 70, and 125 days prior to the meeting.

Figure 3 presents the rate of U.S. commercial stocks as a key variable indicating the state of the oil market. The maximum and minimum stock levels are utilized to establish a range within the Estimation Window, which may vary in width based on the duration of the estimation period. As previously mentioned, the average stock level estimated on the day of the meeting is categorized as either above, below, or within this range.

Figure 3: Percentage of U.S. commercial oil storage capacity along the Estimation Window.



4- Data analysis

Analyzing OPEC meetings and decisions spanning from 2002 to 2021, the data pertaining to the aforementioned variables was gathered and can be presented and analyzed in the following manner.

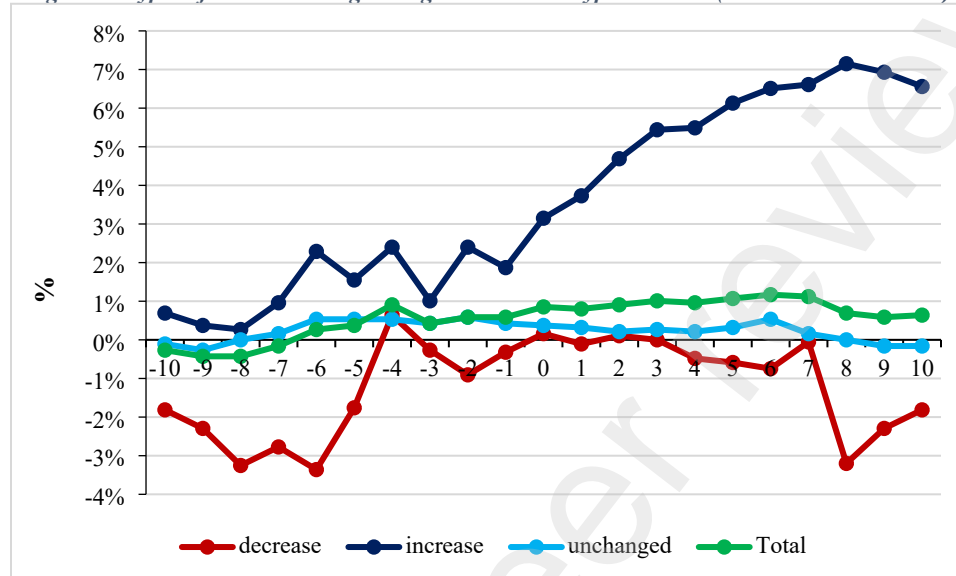
4-1 Effect of OPEC Meetings on Oil Prices Based on Type of Decisions

In general, if we categorize oil prices around all OPEC meetings solely based on the decisions made, the results obtained, as depicted in Figure 4, indicate that, on average, the decision to decrease production coincided with low oil prices. The decision was typically reached approximately six days prior to the meeting, anticipating the production reduction. However, in the days following the meeting, despite the initial excitement, the market remained concerned about the excess supply compared to demand and perceived the production decline as insufficient, resulting in a decline in oil prices.

Regarding the decision to increase production, given the high oil prices and the supply shortage relative to demand, the market, in anticipation of a production surge, considered the increase to be insufficient in addressing the supply shortage starting from one day before the meetings and the release of the decision report, leading to an increase in oil prices.

On average, the decision to maintain the production level did not cause a significant shift in prices. Analyzing all the meetings reveals that, on average, OPEC meetings do not have a significant impact on oil prices. However, each meeting experiences a unique price fluctuation process based on prevailing conditions, which necessitates proper classification and analysis.

Figure 4: Types of OPEC meetings along with decision-type divisions (the research estimates).



4-2 The Impact of Different Estimation Windows on Categories of the OPEC Meetings, Using the Variable of U.S. Crude Oil Stocks

Initially, we examined the categorization of OPEC meetings based on the impact of the Estimation Window duration. Table 2 provides an overview of four intervals (-10 to -30), (-10 to -50), (-10 to -70), and (-10 to -125) that were analyzed. *Error! Reference source not found.* below illustrates that while variations in the Estimation Window did not have a substantial effect on the shift in meeting categories, resulting in no price change, the interval (-10 to -70) displayed a more comprehensible trend.

Table 2: Division of meetings in distinct categories according to the length of the Estimation Window.

Decision	Level of U.S. Crude Oil Stocks Compared to Estimation Days	-30- -10	-50- -10	-70- -10	-125- -10
Decrease (A)	Higher (1)	6	6	6	2
	Lower (2)	0	0	0	0
	Within (3)	6	6	6	10
Increase (B)	Higher (1)	1	1	0	0
	Lower (2)	5	5	4	2
	Within (3)	6	6	8	10
Unchanged (C)	Higher (1)	10	8	5	4
	Lower (2)	15	8	6	4

	Within (3)	28	37	42	42
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4-3 The Impact of OPEC Meetings on Oil Prices, Using the Variable of U.S. Crude Oil Stocks

4-3.1 Decision to Decrease Production

Given the obtained results, as presented in *Table 3*, using the oil price variable, the data of OPEC meeting decisions have been divided into three categories, relatively higher than, relatively lower than, and within its level in Estimation Window range.

Table 3: Division of meetings with the reduction decision of production given the condition of U.S. crude oil stocks.

Decision	Level of U.S. Stocks Oil Compared to Estimation Days	Sessions (-10 to -70)
Decrease (A)	Higher (1)	6
	Lower (2)	0
	Within (3)	6

4-3.1.1 Relatively High Level of U.S. Crude Oil Stocks

Six OPEC meetings, leading to the decision to reduce production, were conducted when the U.S. crude oil stocks exceeded the levels of the preceding 70-day interval. **Error! Reference source not found.** demonstrates that the meetings falling within this category correspond to the years 2003, 2004, 2008, 2018, 2019, and 2020. During these meetings, the decision to decrease production ranged from 500 thousand to 10 million barrels per day.

Figure 5: Meetings leading to decrease in production in relatively high level of U.S crude oil stocks.

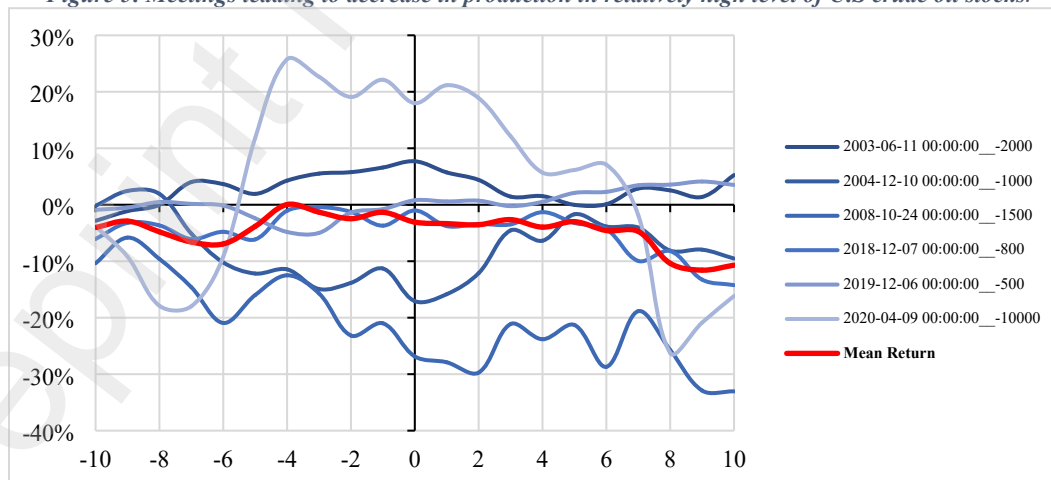
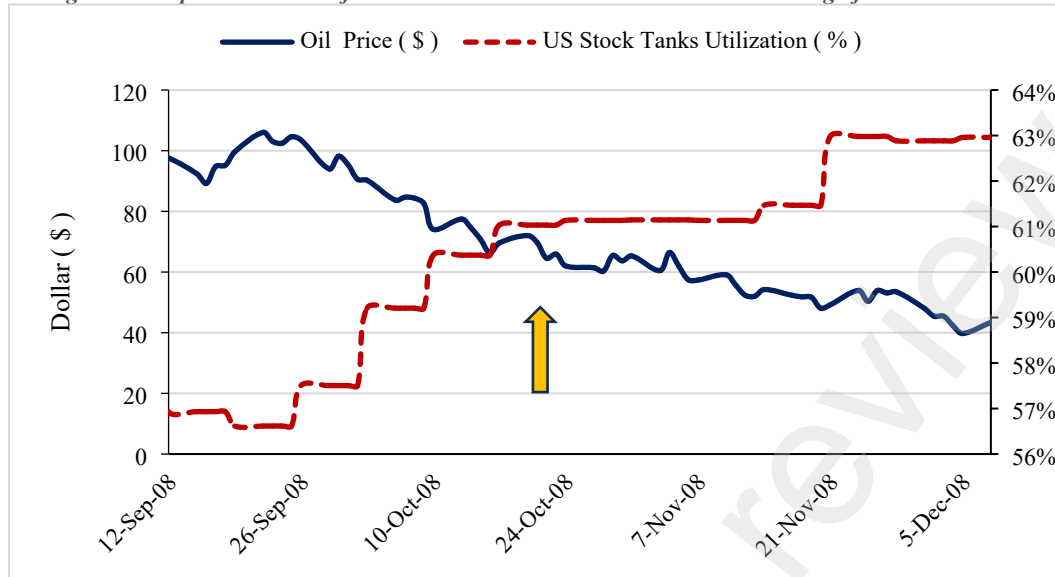


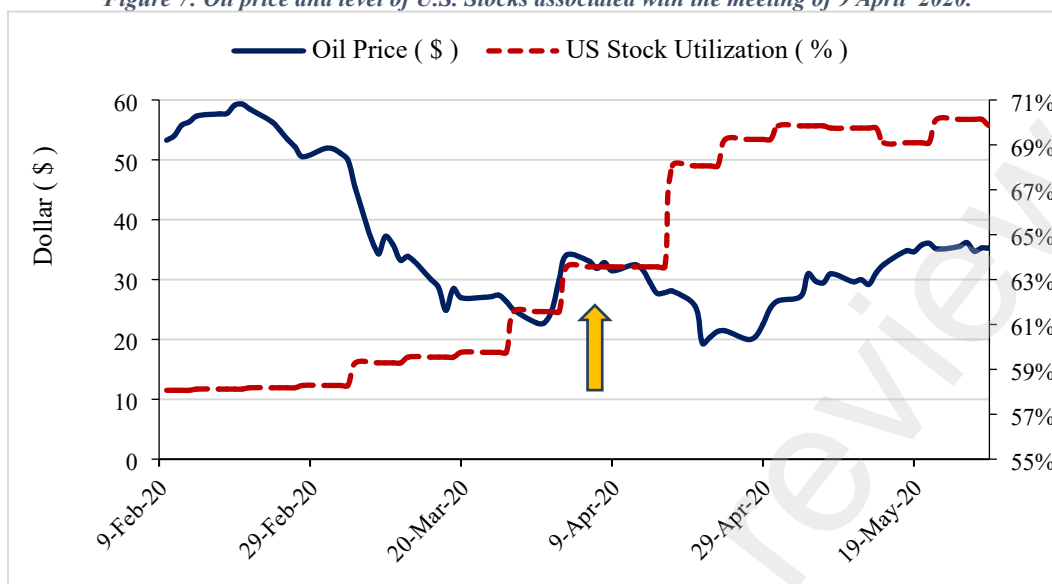
Figure 6: Oil price and level of U.S. crude oil stocks associated with the meeting of 24 October 2008.



One of the most crucial decisions made during the OPEC extraordinary meetings was the agreement to decrease oil production by 1.5 million barrels per day in response to the 2008 financial crisis. The meeting took place amidst a significant decline in oil prices, falling from approximately 100 dollars to 60 dollars within a month (a 40% decrease), and a 60 percent increase in the utilization level of U.S. oil stocks capacity. However, despite the decision to reduce oil production by 1.5 million barrels, the price continued to decrease due to the sustained growth in the utilization of stock capacity during the analyzed period. Consequently, the market recognized that the announced reduction was insufficient to address the increasing supply relative to demand. As a result, the oil price began to decline once again. According to *Figure 6*, within 1.5 months after the meeting, the price dropped from 60 dollars to 40 dollars.

Another significant decision within the category of OPEC+ meetings took place on April 9, 2020, during the peak of the coronavirus outbreak. The decision involved cutting oil production by 10 million barrels. Despite the surplus oil supply, the increase in storage levels contributed to a rise in oil prices. As depicted in *Figure 7*, the impact of OPEC's decision on the market was observed approximately 10 days later. As strategic stocks reached an unprecedented level of 70%, a relative stability was established in ground stock occupation. Consequently, the oil price initially remained stable. With the anticipation of an improved situation regarding the coronavirus outbreak and the hope for the development of a vaccine, the oil price gradually began to increase.

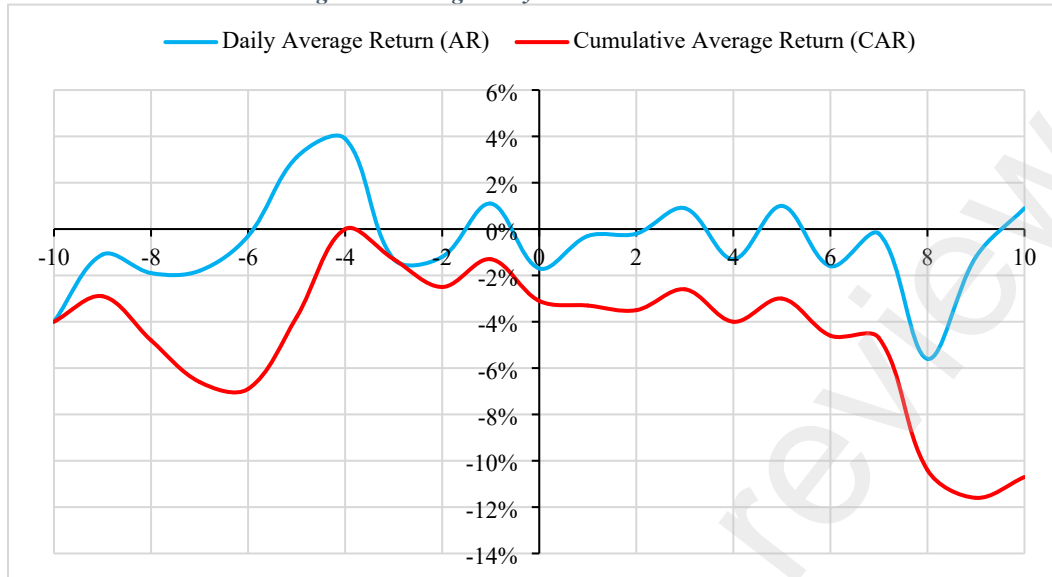
Figure 7: Oil price and level of U.S. Stocks associated with the meeting of 9 April 2020.



Another significant decision within the category of OPEC+ meetings took place on April 9, 2020, during the peak of the coronavirus outbreak. The decision involved cutting oil production by 10 million barrels. Despite the surplus oil supply, the increase in storage levels caused an upward trend in oil prices. According to *Figure 7*, OPEC's decision had an impact on the market approximately 10 days later. As strategic stocks reached an unprecedented level of 70%, relative stability was established in ground stock occupation. Consequently, the oil price initially remained stable. With the anticipation of an improved situation regarding the coronavirus outbreak and hopes for the production of a vaccine, the oil price slowly began to rise.

Based on the average data from six meetings in this category, as shown in *Figure 8*, when the level of U.S. oil stocks exceeded the levels of the previous 70-day interval, the market anticipated that OPEC would decide to decrease production. Consequently, initially, there was an average price increase of 8%. However, after the decision was made, the market perceived either the approved decline as insufficient or the price increase before the meeting as an overreaction. As a result, the price returned to its previous level or even dropped below the minimum cost before the meeting, as indicated in *Table 6*. Contrary to expectations, these changes, observed 8 days after the meeting, resulted in a price decline with a 95% level of confidence.

Figure 8: Average Daily and Cumulative Return.



4-3.1.2 Relatively Low Level of U.S. Crude Oil Stocks

There are no meetings in this category that have been identified.

4-3.1.3 Relatively Within Level of U.S. Crude Oil Stocks

Based on *Figure 9*, a total of 36 OPEC meetings were held in the years 2002, 2003, 2004, 2006, 2008, and 2016. During these meetings, when the level of United States crude oil commercial stocks remained within its recent 70-day interval, a decision was made to decrease production. The reduction varied from 500 thousand to 4.2 million barrels per day.

One notable meeting took place on October 24, 2008, during the financial crisis. In this meeting, OPEC members decided to decrease oil production by 1.5 million barrels per day. As shown in *Figure 10*, the oil price exhibited a persistent downward trend, while the overall level of oil stocks continued to increase.

On December 17, 2008, with the oil price still declining, OPEC once again decided to reduce production to 4.2 million barrels per day to prevent further price deterioration, despite the growing level of U.S. crude oil stocks (which falls within the category of the last 70-day interval). Despite the rising storage levels, the price remained relatively stable around \$40, representing a 60% reduction from previous levels.

Figure 9: Meetings leading to decrease in production in relatively within level of U.S crude oil stocks.

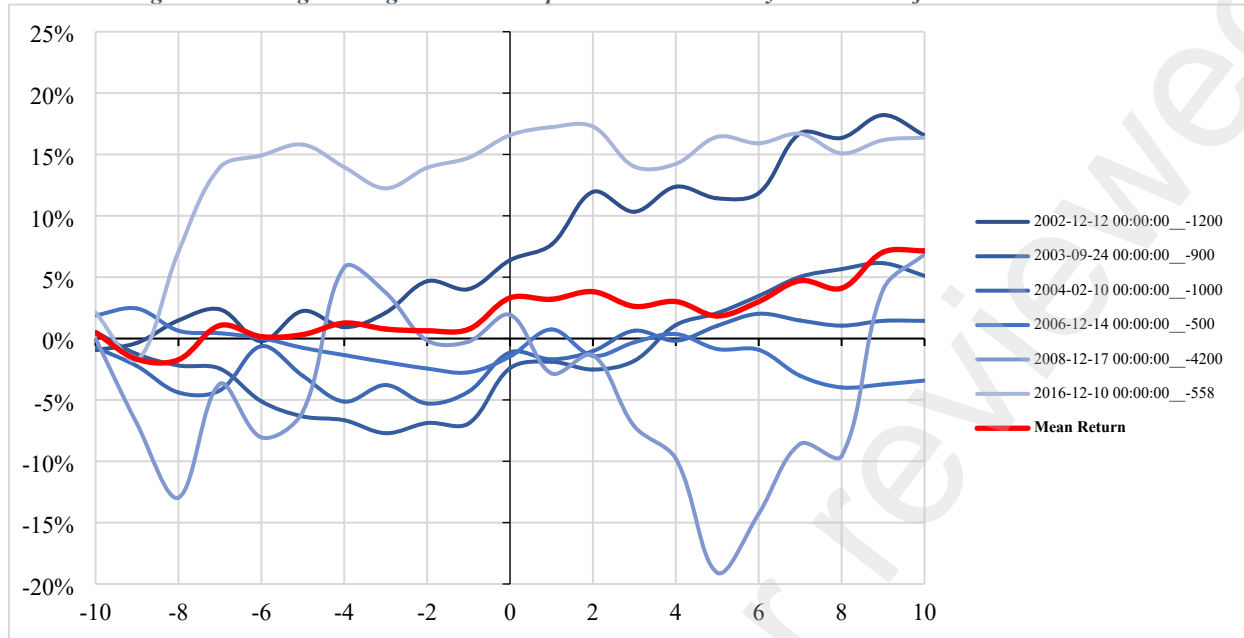
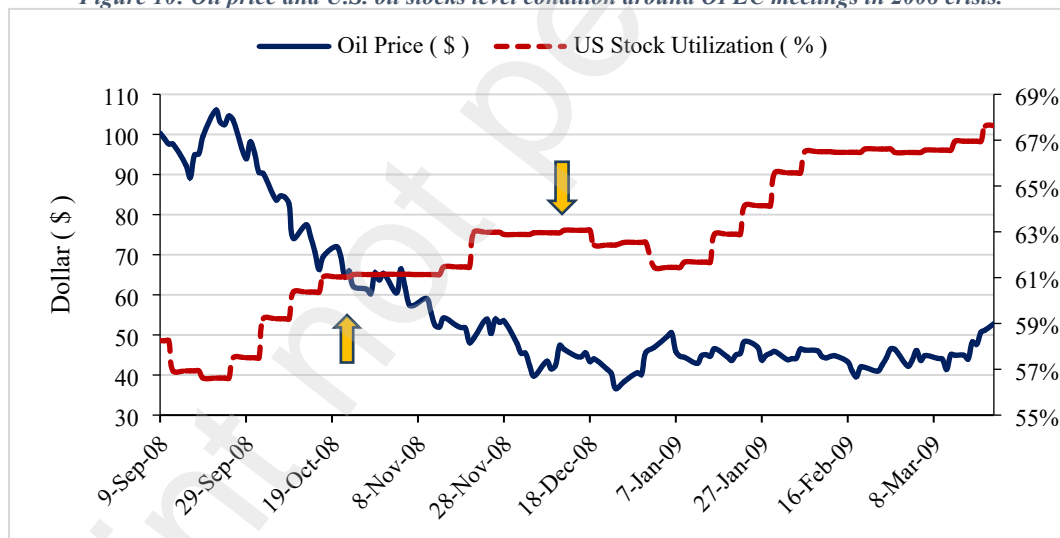


Figure 10: Oil price and U.S. oil stocks level condition around OPEC meetings in 2008 crisis.



Another significant meeting took place on 10 December 2016. To provide a more comprehensive analysis, considering the level of oil stocks within the last 70-day interval, the longer-term trend, and the surplus supply in the oil market prior to the ten-day interval under review, it can be argued that the announcement of the deal between Saudi Arabia and Russia to decrease oil production and the formation of OPEC+ had a substantial impact on the oil price. The price experienced a significant increase following the news release and continued to rise as the meeting approached.

Taking into account Figure 11, and analyzing the average ongoing trend of the oil price when the level of oil stocks fell within the last 70-day interval, it can be inferred that following the decision to decrease production, the oil price witnessed a modest increase of 7%. However, it should be noted that this increase was not particularly significant, especially considering the high

volatility of the price leading up to the meeting where the decision to decrease production was made.

Figure 11: Oil price and U.S. oil stocks level condition around the time of OPEC+ formation.

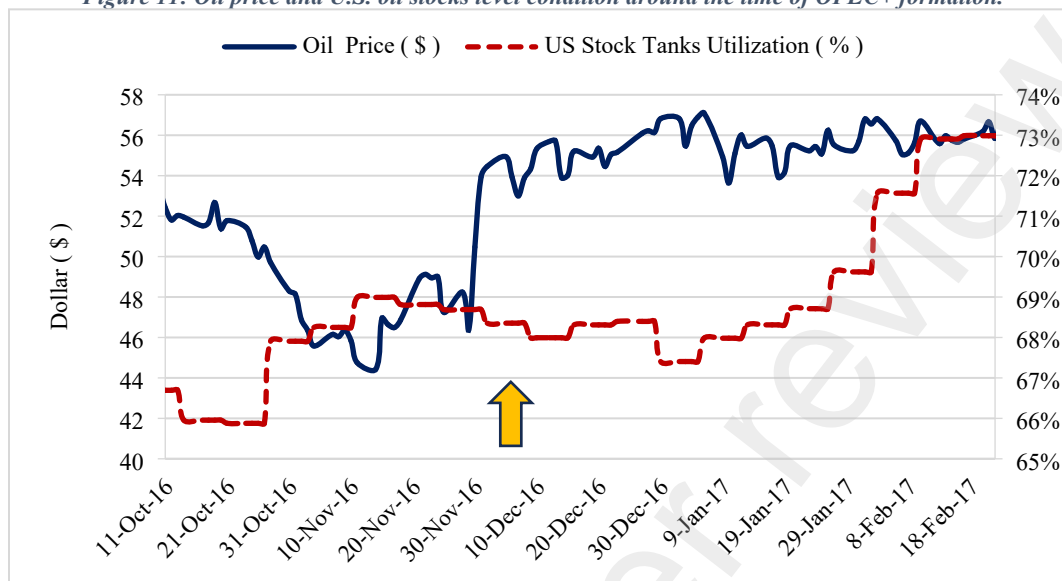


Figure 12: Average Daily and Cumulative Return.

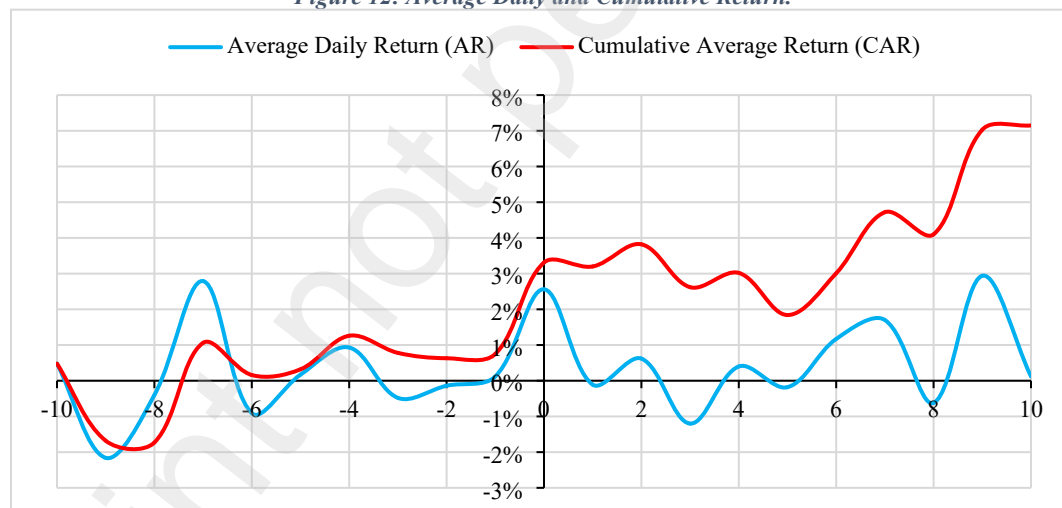


Figure 12 illustrate that analyzing the average trend of the oil price when the U.S. crude oil stocks level remains relatively within the estimated range of the last 70 days, it can be inferred that after the decision to reduce production, the oil price experienced an increase. Specifically, the price rose by a total of 7%. However, it is worth noting that considering the significant price volatility prior to the production cut meeting, as indicated in Table 6, this percentage of price increase was not considered significant.

4-3.2 Decision to Increase Production

According to the obtained results, the data of OPEC meetings decisions can be categorized into three groups: relatively high, relatively low, and within, based on the variable of the U.S. crude oil commercial stocks level. The results are summarized in *Table 4*.

Table 4: Division of meetings with the Increase decision of production given the condition of U.S crude oil stocks.

Decision	Level of U.S. Stocks Oil Compared to Estimation Days	Sessions
Increase (B)	Higher (1)	0
	Lower (2)	4
	Within (3)	8

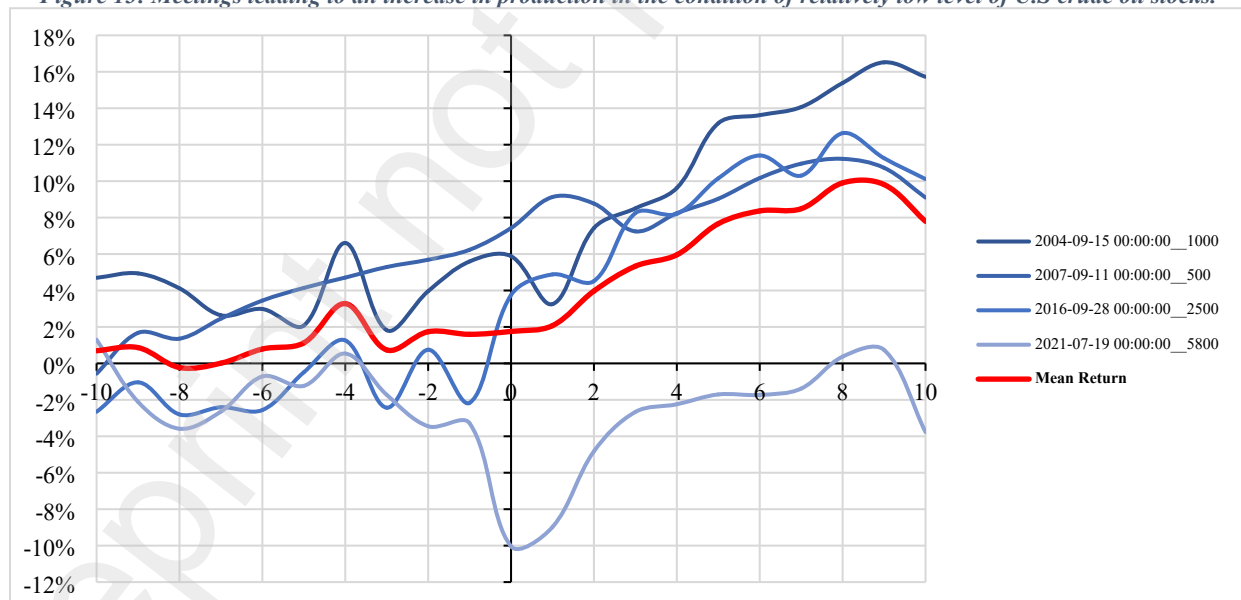
4-3.2.1 Relatively High Level of U.S. Crude Oil Stocks

There are no meetings in this category that have been identified.

4-3.2.2 Relatively Low Level of U.S. Crude Oil Stocks

A series of OPEC and OPEC+ meetings took place, culminating in the decision to decrease production, during periods when the level of U.S. crude oil stocks was relatively low. These meetings, as depicted in *Figure 13*, occurred in 2004, 2007, 2016, and 2021. The production cuts ranged from 500 thousand to 5.8 million barrels per day.

Figure 13: Meetings leading to an increase in production in the condition of relatively low level of U.S crude oil stocks.



As highlighted earlier, one of the pivotal meetings was held after the improvement in the epidemic situation, during which a decision was made to increase production by 5.8 million barrels per day. *Figure 14* indicates a declining level of stocks, while the market remained apprehensive about the future of the Coronavirus and the OPEC's decision to raise production beyond the market's demands prior to the meeting. However, OPEC presented a monthly documented program that entailed gradually restoring production to pre-pandemic levels, specifically 400 thousand

barrels per day, over a span of 15 months. The market interpreted this resolution as an indication of potential future supply shortages. Consequently, following the meeting, the oil price rebounded, compensating for the previous decline.

Figure 14: OPEC+ critical meeting to increase oil production to 5.8 million barrels per day.

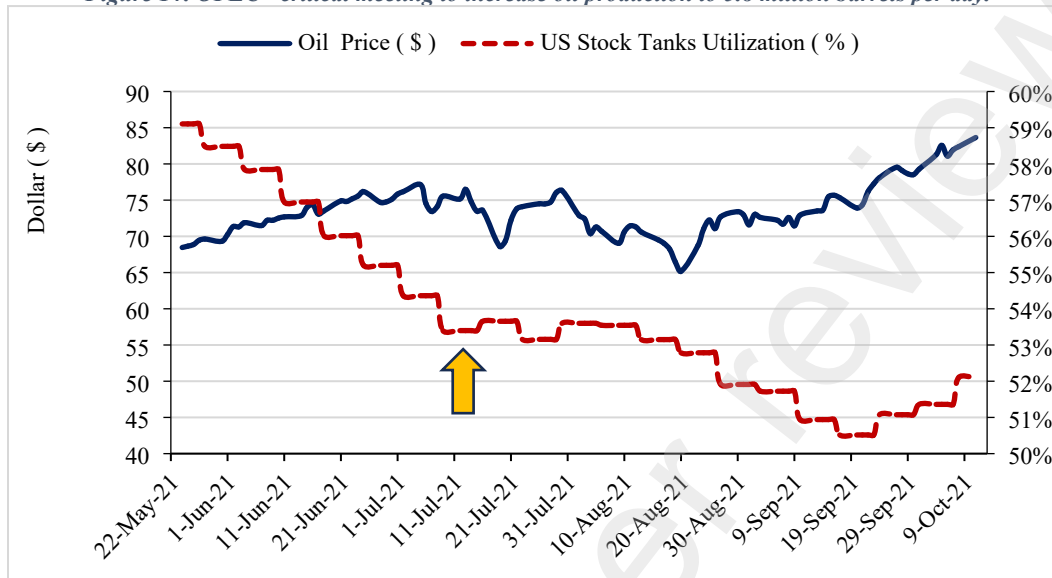
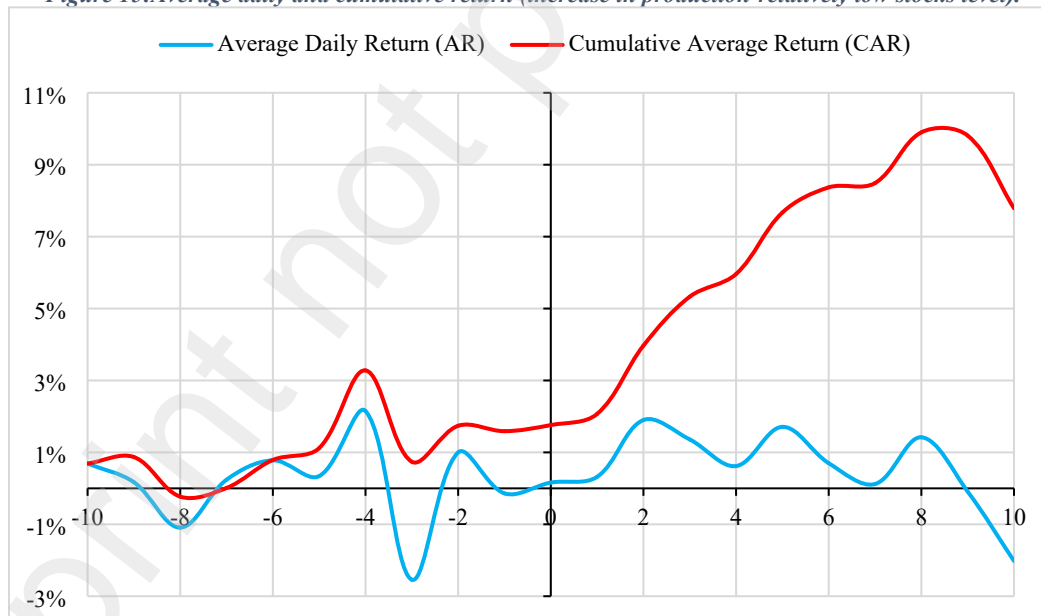


Figure 15: Average daily and cumulative return (increase in production-relatively low stocks level).



Based on Figure 15, it can be observed that OPEC's decision to increase production was lower than the market's estimated level, aiming to establish a balance in the supply. Referring to Table 6, the price witnessed a significant growth of approximately 10% with a statistical significance of 95% following the meeting.

4-3.2.3 Relatively Within Level of U.S. Crude Oil Stocks

A total of eight OPEC meetings, leading to the decision to reduce production, took place within the last 70-day period. The corresponding years for these meetings, as depicted in *Figure 16*, are 2003, 2004, 2005, 2020, and 2021. The recorded increase in production during these meetings ranged from 150,000 to 2.5 million barrels per day.

Figure 16: Meetings leading to a decrease in production in stocks level conditions within the Estimation Window.

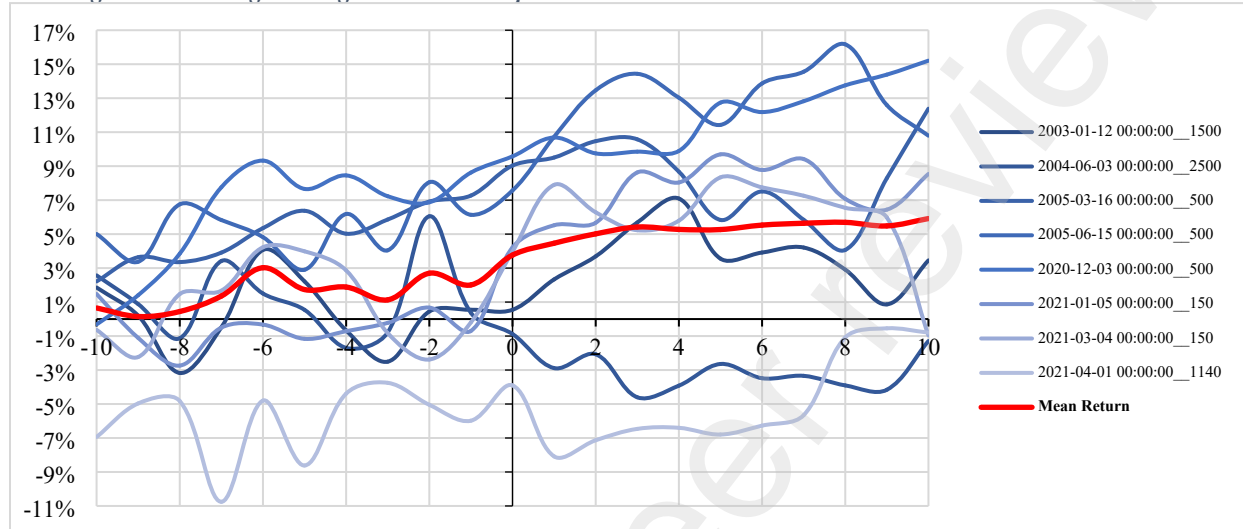
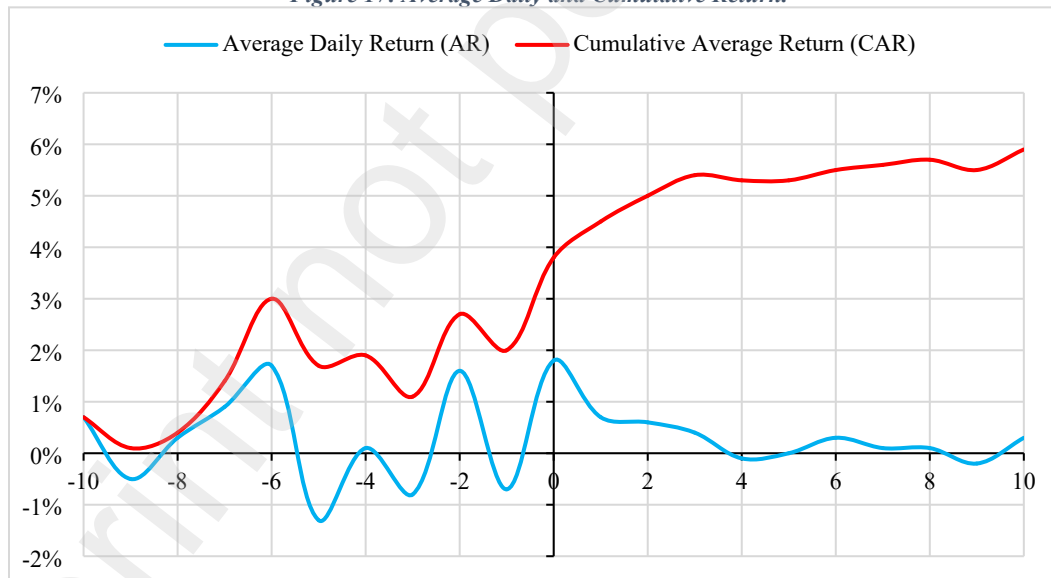


Figure 17: Average Daily and Cumulative Return.



Based on the analysis presented in *Figure 17*, it can be observed that during the last 70-day period within the estimated window range, when the level of U.S. crude oil stocks was relatively stable, OPEC's decision to increase production indicates the market's anticipation of a potential surge in future demand and price. Referring to *Table 6*, with a statistical significance level of 90%, the market forecasts a rise in future demand, which is expected to result in an increase in price.

4-3.3 Decision Not To Change the Production

The analysis of OPEC decisions can be categorized based on the United States' level of crude oil stocks into three groups: relatively high, relatively low, and within the Estimation Window. The outcomes of this examination are depicted in *Table 5*.

Table 5: Division of meetings in the category of the decision not to change the production.

Decision	Level of U.S. Stocks Oil Compared to Estimation Days	Sessions
Unchange (C)	Higher (1)	5
	Lower (2)	6
	Within (3)	42

4-3.3.1 Relatively High Level of U.S. Crude Oil Stocks

Five OPEC meetings, ultimately resulting in no change, were held due to the decision not to alter the production level or a lack of consensus among the members. These meetings took place during periods when the level of U.S. crude oil stocks was relatively high. *Figure 18* depicts the meetings associated with the years 2004, 2006, 2011, 2015, and 2020.

Figure 18: Meetings leading not to change in production in condition of relatively within the level of U.S. crude oil stocks.

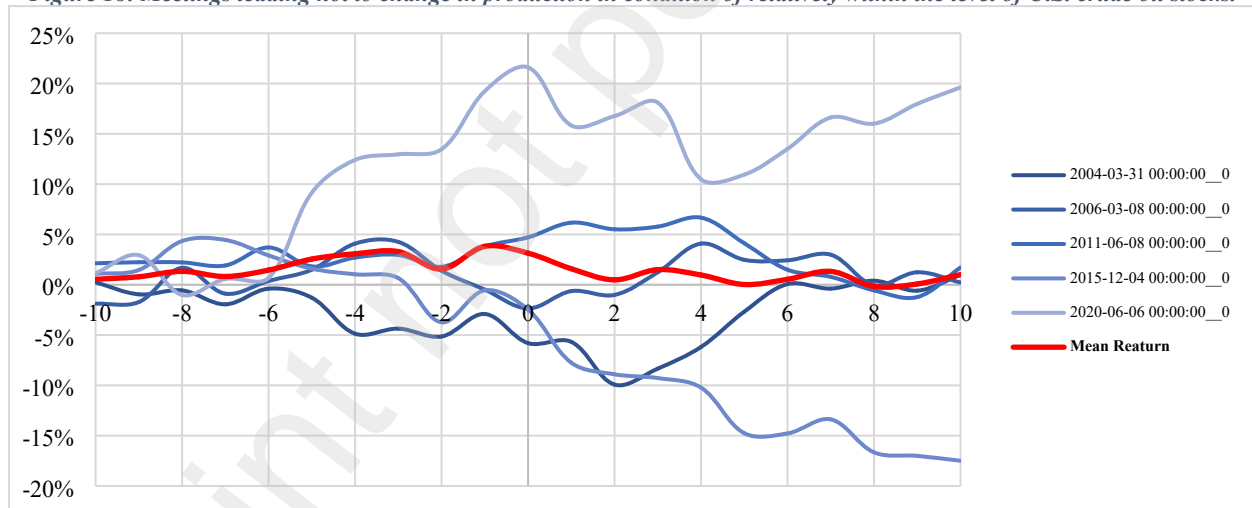
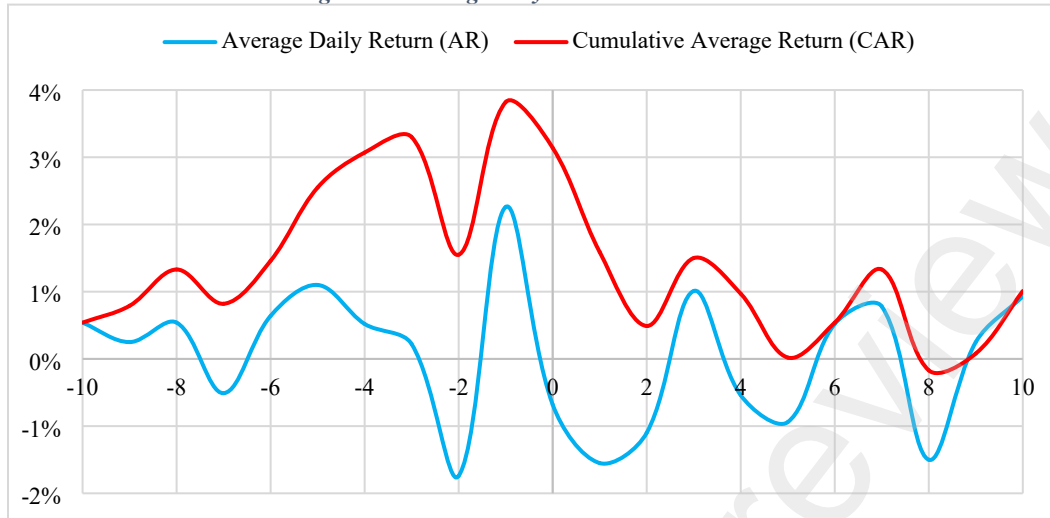


Figure 19: Average daily and cumulative return.

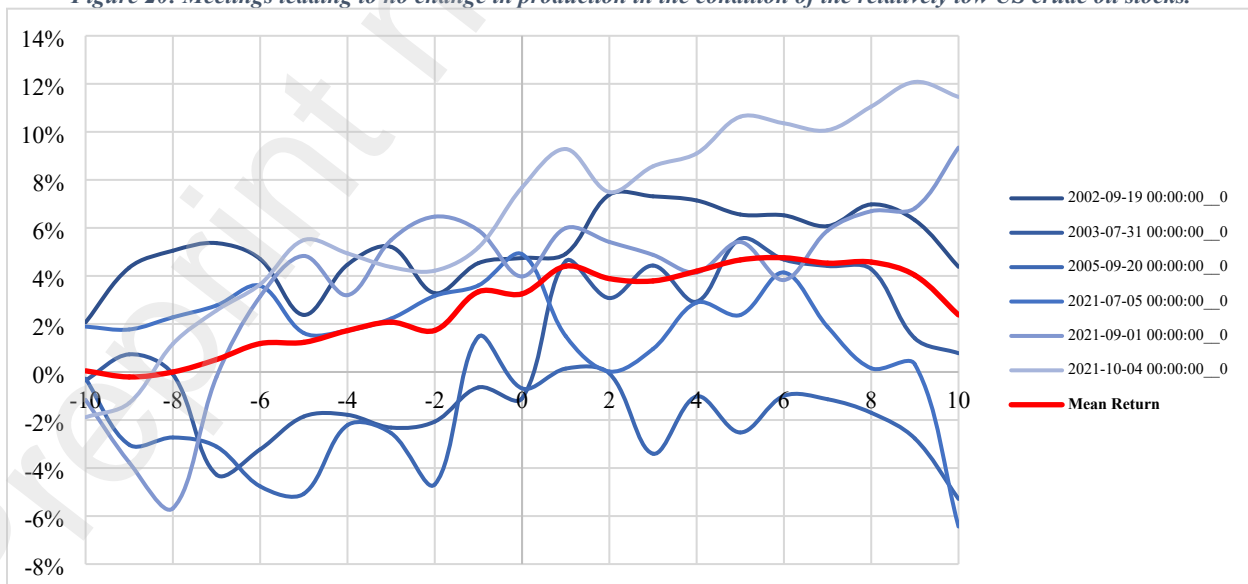


According to the data presented in *Figure 19*, which represents the average of five meetings in this category, it can be observed that when the level of stocks exceeded the recent 70-day interval mentioned in *Table 6*, there was no significant and analyzable price change during the OPEC meetings, on average.

4-3.3.2 Relatively Low Level of U.S. Crude Oil Stocks

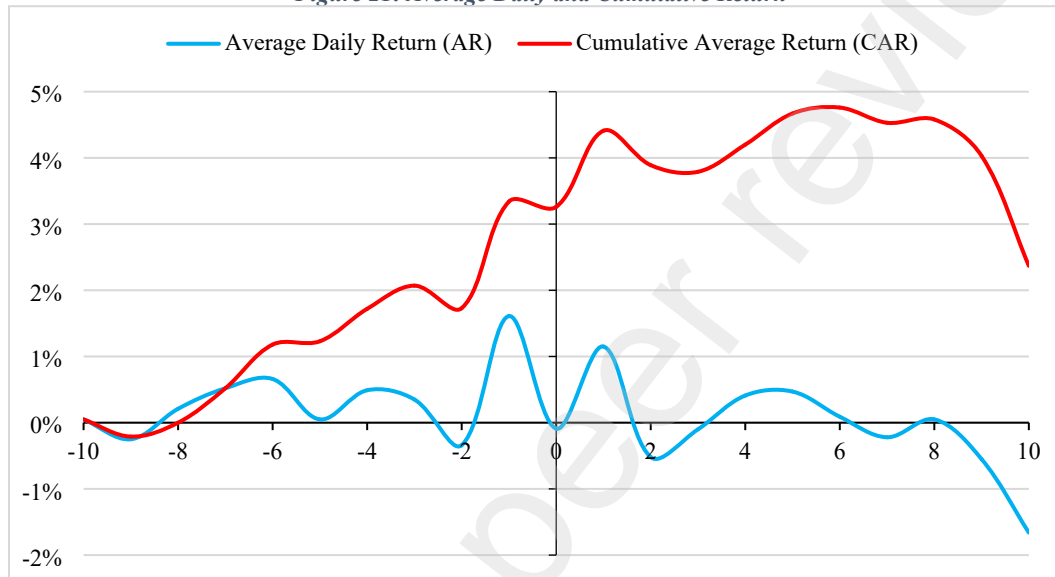
Six OPEC meetings resulted in a decision not to change the production level or a lack of consensus among the members, leading to no change. These meetings took place during periods of relatively low U.S. crude oil stocks. *Figure 20* illustrates the meetings associated with the years 2002, 2003, 2005, and 2021.

Figure 20: Meetings leading to no change in production in the condition of the relatively low US crude oil stocks.



Referring to *Figure 21*, based on the average data from six meetings in this category, when the stock level was below the recent 70-day interval, the market anticipated an increase in the production level. However, upon the news release of no change in the production level prior to the meeting, as indicated in *Table 6*, the oil price witnessed a 5% expansion. Examining the daily returns, a statistically significant reaction at a 95% confidence level was observed only on the day preceding the meeting, with no other notable changes.

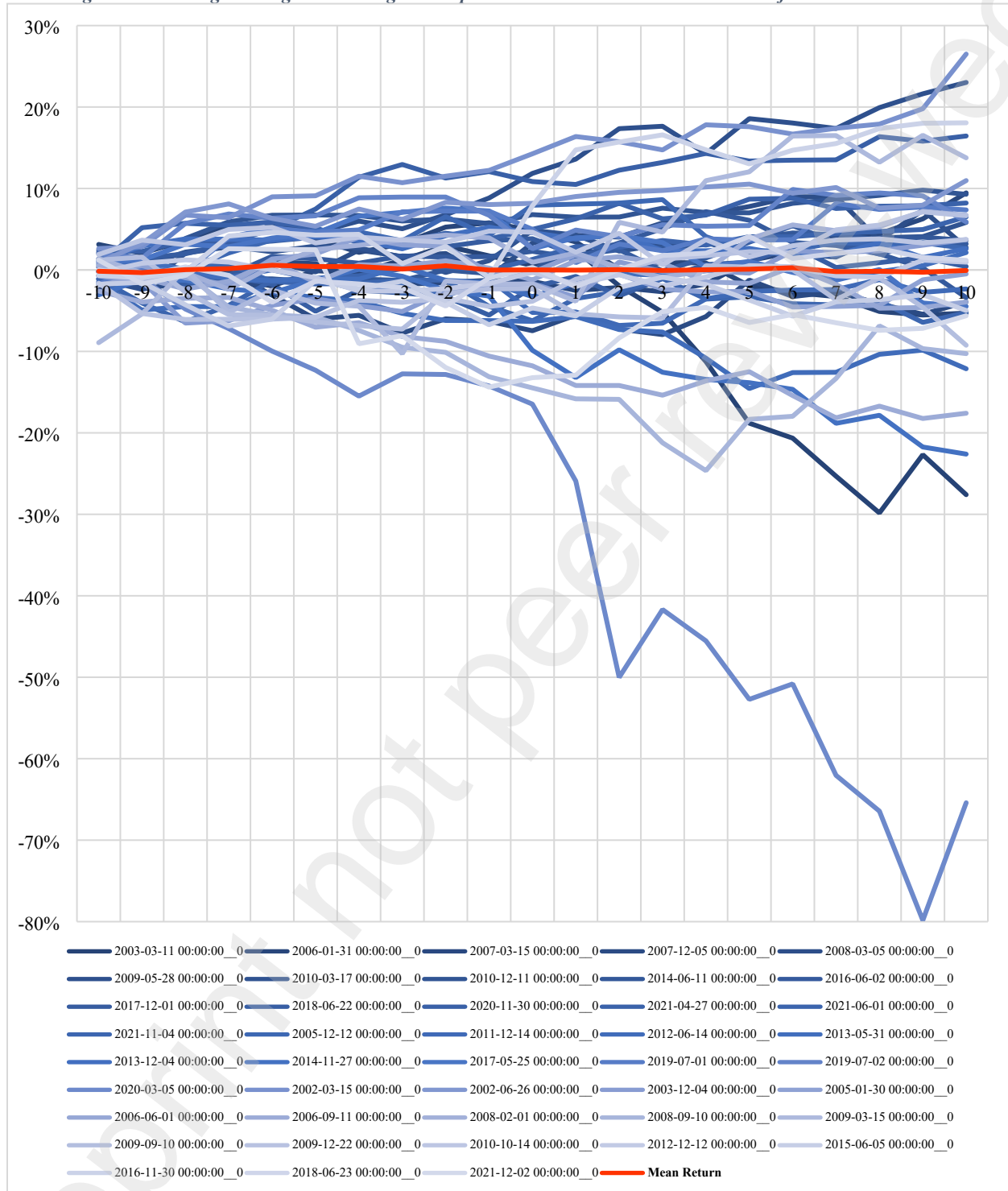
Figure 21: Average Daily and Cumulative Return



4-3.3.3 Relatively Within Level of U.S. Crude Oil Stocks

A total of forty-two OPEC meetings were conducted, resulting in a decision not to alter the production level or a lack of consensus among the member countries regarding a change. These meetings took place when the level of United States commercial stocks of crude oil fell within the recent 70-day interval. *Figure 22* illustrates that over half of the OPEC meetings fall into this category.

Figure 22: Meetings leading not to change in the production level related to within level of U.S crude oil stocks.



One of the meetings exhibiting different behavior within this category took place on March 5, 2020. Despite being held within the interval of U.S. crude oil stocks level, which was also within the Estimation Window prior to the pandemic outbreak, significant changes occurred. As previously mentioned, the oil price experienced a substantial decline following the decision not to change production levels and the ensuing price war, leading to an increase in oil stocks. As

depicted in *Figure 23*, the rise in stocks resulted in a drop in oil prices from \$60 to \$20, due to a lack of consensus regarding production reduction.

Figure 23: The critical meeting with no consensus to reduce the production level at the advent of the Coronavirus epidemic.

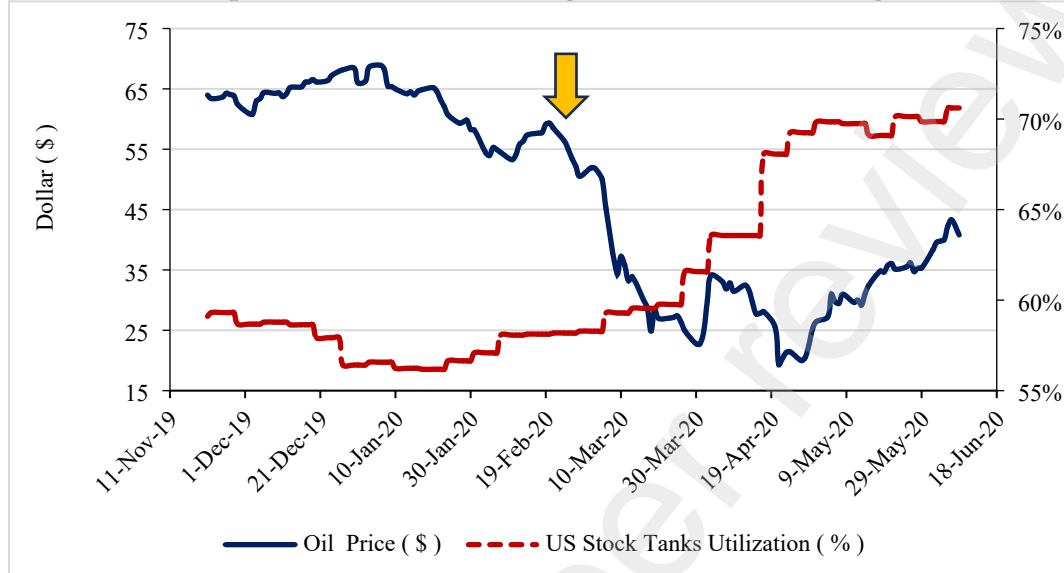
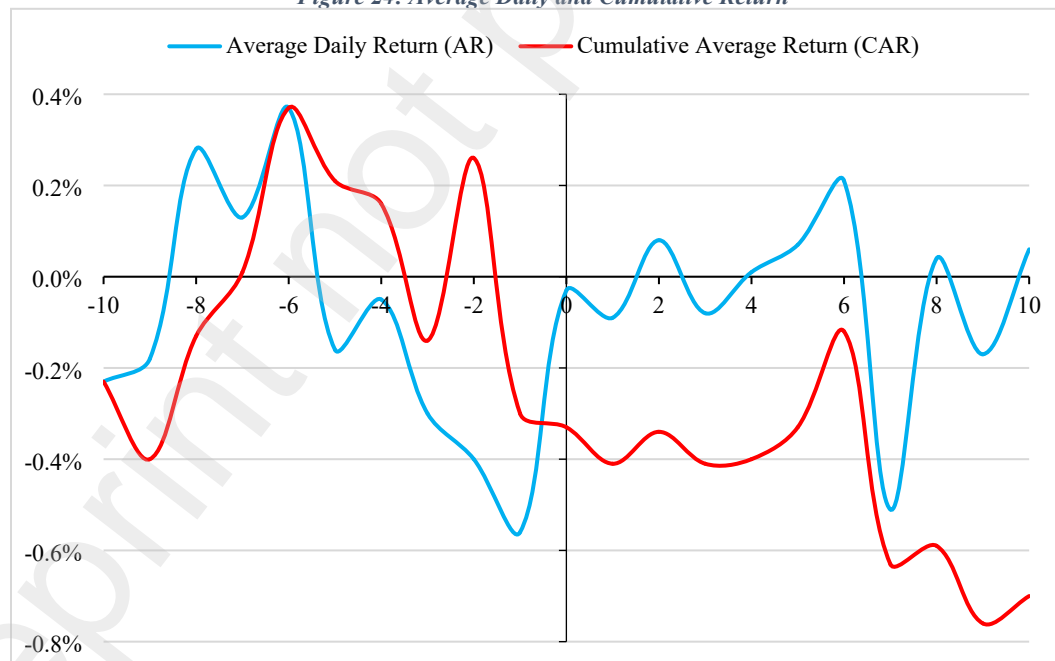


Figure 24: Average Daily and Cumulative Return



According to *Figure 24*, utilizing the average data from 42 OPEC meetings falling into this category, it can be observed that when the U.S. crude oil stocks level remained within the range of the previous 70 days, the absence of production level changes did not result in significant fluctuations in oil prices (*Table 6*).

5- Conclusion and Policy Implications

- ✓ **OPEC's decision to decrease production:** When the level of U.S. oil stocks exceeded the recent 70-day interval, there was market anticipation that OPEC would reduce production. Consequently, there was an initial average price increase of 7%. However, after the decision was made, the market either perceived the approved reduction as insufficient or interpreted the pre-session price surge as an overreaction. As a result, prices returned to their previous level and even dropped below the pre-meeting minimum price with a 95% confidence level. When the stock level was low, no decision was made to reduce production. However, when the stock level fell within the Estimated Window, there was an overall 7% increase in oil prices following the decision to reduce production. Nevertheless, this increase was not significant due to the high price volatility observed prior to the meeting that ultimately led to a production decrease
- ✓ **OPEC's decision to increase productions:** When the level of oil stocks was relatively low, below the market's estimate, in order to achieve a supply balance, there was a significant price growth of approximately 10% with a 95% confidence level. Conversely, in instances where the stock level exceeded the Estimated Window, no meeting resulted in an increase in production. However, the decisions made during OPEC sessions held under normal storage conditions provided the market with an analysis indicating a potential expansion in future demand. This analysis anticipated a future price increase with a 90% confidence level.
- ✓ **OPEC's decision not to change productions:** When the level of oil stocks exceeded the 70-day interval, OPEC meetings did not result in any significant and analyzable changes in oil prices. However, when the stock level was relatively low, the market anticipated an increase in production. Prior to the meeting, there was a 5% increase in oil prices following the announcement of no change in production. However, this reaction was statistically significant (95%) only on the day before the meeting, and no other notable changes were observed. Under normal conditions, without considering storage levels, the absence of a change in production level had no significant impact on the oil price.

Table 6: Significance Test of Cumulative Average Return (CAR) with OPEC/OPEC+ Meetings Classification and Condition of U.S. Crude Oil Stocks

Event Window	Decrease Production(A)			Increase Production(B)			No change Production(C)		
	High	Low	Within	High	Low	Within	High	Low	Within
-10	-0.040 ***		0.0048		0.0069	0.007	0.0054	0.0005	-0.0023
-9	-0.029		-0.0168		0.0087	0.001	0.0079	-	-0.0040
-8	-0.048 **		-0.0173		-	0.004	0.0133	0.00	-0.0013
-7	-0.066 ***		0.0106		0.0001	0.014	0.0082	0.0052	0.0001
-6	-0.069 **		0.0016		0.0079	0.03 *	0.0146	0.0118	0.0037
-5	-0.038		0.0032		0.0112	0.017	0.0255	0.0123	0.0021
-4	0.000		0.0126		0.0328	0.019	0.0307 *	0.0172	0.0016
-3	-0.013		0.0078		0.0074	0.011	0.0330 *	0.0207	-0.0014
-2	-0.025		0.0063		0.0174	0.027	0.0155	0.0173	0.0026
-1	-0.013		0.0075		0.0159	0.02	0.0382 **	0.0334	-0.0030
0	-0.031		0.0331		0.0176	0.038	0.0314 *	0.0326	-0.0033
1	-0.033		0.0320		0.0207	0.045 *	0.0159	0.0441 *	-0.0041
2	-0.035		0.0382		0.0397	0.050 *	0.0049	0.0389	-0.0034
3	-0.026		0.0262		0.0533	0.054 **	0.0150	0.0379	-0.0041
4	-0.040		0.0302		0.0596	0.053 *	0.0097	0.0420	-0.0040
5	-0.030		0.0184		0.0767 **	0.053 *	0.0002	0.0467	-0.0033
6	-0.046		0.0301		0.0837 **	0.055 *	0.0054	0.0476	-0.0012
7	-0.047		0.0472		0.0849 **	0.056 *	0.0133	0.0453	-0.0063
8	-0.104 *		0.0410		0.0990 **	0.057 *	-0.0017	0.0458	-0.0059
9	-0.016 **		0.0703		0.0981 **	0.055 *	0.0008	0.0403	-0.0076
10	-0.107 *		0.0715		0.0779 *	0.059 *	0.0101	0.0237	-0.0070

Confidence Probability:

* 90% , ** 95% , *** 99%

6- References

- Yergin, D. (2020). *The new map: Energy, climate, and the clash of nations*. Penguin Uk
- Brown, S. J., & Warner, J. B. (1980). Measuring security price performance. *Journal of financial economics*, 8(3), 205-258
- Draper, D. W. (1984). The Behavior of Event-Related Returns on Oil Futures Contracts. *Journal of Futures Markets*, 4(2).
- Deaves, R., & Krinsky, I. (1992). The behavior of oil futures returns around OPEC conferences. *Journal of Futures Markets*, 12(5), 563-574.
- Horan, S. M., Peterson, J. H., & Mahar, J. (2004). Implied volatility of oil futures options surrounding OPEC meetings. *The Energy Journal*, 25(3), 103-125.
- Guidi, M. G., Russell, A., & Tarbert, H. (2006). The effect of OPEC policy decisions on oil and stock prices. *OPEC review*, 30(1), 1-18.
- Lin, S. X., & Tamvakis, M. (2010). OPEC announcements and their effects on crude oil prices. *Energy Policy*, 38(2), 1010-1016.
- Spencer, S., & Bredin, D. (2019). Agreement matters: OPEC announcement effects on WTI term structure. *Energy Economics*, 80, 589-609.
- Organization of the Petroleum Exporting Countries. (2021). **World Oil Outlook 2045**. OPEC.
- International Energy Agency. (2022). *World Energy Outlook 2022*.
- British Petroleum. (2021). *Statistical Review of World Energy 2021*. BP.
- U.S. Energy Information Administration. (2022). *Annual Energy Outlook 2022 (AEO2022)*.