



MASTERARBEIT | MASTER'S THESIS

Titel | Title

The Impact of International Sanctions and Oil Embargo against
Russia on the International Oil Price

verfasst von | submitted by
Vladislav Diachkov BA

angestrebter akademischer Grad | in partial fulfilment of the requirements for the degree of
Master of Science (MSc)

Wien | Vienna, 2024

Studienkennzahl lt. Studienblatt | Degree
programme code as it appears on the
student record sheet:

UA 066 914

Studienrichtung lt. Studienblatt | Degree
programme as it appears on the student
record sheet:

Masterstudium Internationale Betriebswirtschaft

Betreut von | Supervisor:

Univ.-Prof. i.R. Dipl.-Ing. Dr. Robert Kunst

Abstract

This paper investigates the impact of international sanctions and oil embargo against Russia on the global oil market. It examines the political application of economic sanctions and embargoes, with a focus on their repercussions in the oil sector. The research is centered around the macroeconomic effects of these measures, emphasizing their influence on Russian and European economies. By analyzing time series data from 2010 to 2023, the study employs advanced econometric techniques to establish the correlation between political actions and fluctuations in global oil prices.

The intention is to enrich academic discourse in energy economics and aid in policy formulation, shedding light on the intricate dynamics between political decisions and energy markets. The outcomes of this investigation are expected to carry significant ramifications for international energy strategies and global diplomacy. They underscore the essential role of geopolitical developments in shaping the oil industry. This paper seeks to offer a thorough understanding of the intricate relationship between international politics and the energy sector, thereby contributing valuable insights for policymakers, scholars and stakeholders within the energy market. However, the complexity of these interactions cannot be overstated, because they impact not only economic results but also political stability. Although the findings appear promising, they simultaneously expose challenges that need to be addressed.

Keywords: International Sanctions, Oil Embargo, Global Oil Price, Energy Markets

Abstrakt

Diese Arbeit untersucht die Auswirkungen internationaler Sanktionen und eines Ölembargos gegen Russland auf den globalen Ölmarkt. Sie beleuchtet die politische Anwendung von wirtschaftlichen Sanktionen und Embargos, mit einem Schwerpunkt auf deren Folgen für den Ölsektor. Die Forschung konzentriert sich auf die makroökonomischen Effekte dieser Maßnahmen und betont deren Einfluss auf die russische und europäische Wirtschaft. Durch die Analyse von Zeitreihendaten aus den Jahren 2010 bis 2023 wendet die Studie fortschrittliche ökonometrische Methoden an, um die Korrelation zwischen politischen Maßnahmen und Schwankungen der globalen Ölpreise zu untersuchen.

Ziel ist es, den akademischen Diskurs in der Energiewirtschaft zu bereichern und zur politischen Entscheidungsfindung beizutragen, indem die komplexen Wechselwirkungen zwischen politischen Entscheidungen und Energiemärkten aufgezeigt werden. Die Ergebnisse dieser Untersuchung könnten bedeutende Implikationen für internationale Energiestrategien und die globale Diplomatie haben. Sie unterstreichen die zentrale Rolle geopolitischer Entwicklungen bei der Gestaltung der Ölindustrie.

Diese Arbeit strebt an, ein umfassendes Verständnis der vielschichtigen Beziehung zwischen internationaler Politik und dem Energiesektor zu bieten und damit wertvolle Erkenntnisse für politische Entscheidungsträger, Wissenschaftler und Akteure im Energiemarkt zu liefern. Allerdings kann die Komplexität dieser Interaktionen nicht genug betont werden, da sie nicht nur wirtschaftliche Ergebnisse, sondern auch die politische Stabilität beeinflussen. Obwohl die Ergebnisse vielversprechend erscheinen, decken sie gleichzeitig Herausforderungen auf, die noch adressiert werden müssen.

Preface

The research topic of the influence of sanctions on the oil market, particularly sanctions against Russia, has fascinated me for a long time. I have observed oil price movements since a young age and researched this topic during my earlier studies. Therefore, it was especially interesting for me to delve deeper into this subject and gain a better understanding of the underlying processes.

I am grateful to Prof. i.R. Dipl.-Ing. Dr. Robert Kunst, who shared my interest in this topic and provided valuable advice and suggestions during the writing process. His expertise and constructive feedback were invaluable in shaping this work.

Furthermore, I would like to express my heartfelt thanks to my friends and family, who were always there for me and offered their support, especially during times when my focus on this thesis required significant time and attention.

Table of Contents

ABSTRACT	1
PREFACE.....	4
LIST OF ABBREVIATION.....	8
LIST OF FIGURES	9
LIST OF TABELS	10
1.INTRODUCTION	12
1.1 PROBLEM STATEMENT	12
1.2 RESEARCH QUESTIONS, OBJECTIVES AND DELIMITATION OF THE SUBJECT OF INVESTIGATION	13
2. THEORETICAL FOUNDATIONS AND THEMATIC BACKGROUND	16
2.1 OIL AS A POLITICAL POWER	16
2.2 THE UKRAINIAN CONFLICT	18
2.3 OIL IN RUSSIAN ECONOMIC SECTOR.....	19
2.3.1 The Pervasive Influence of Oil on Russia's Economic Landscape.....	19
2.3.2 Main Players in the Russian Oil Sector.....	22
2.3.3 Economic Sanctions and the Russian Oil Sector	25
2.3.4 The Dependence of the Russian Economy on Oil Prices and the Ruble Exchange Rate	26
2.3.5 The Oil Price Volatility-Ruble Exchange Rate Connection.....	28
2.3.6 The Impact on Russia's Economic Stability	28
2.3.7 The Ongoing Conflict in Ukraine and Oil Prices.....	29
2.4 MAIN OIL SUPPLIERS ON INTERNATIONAL MARKET	29
3. SANCTIONS AND THEIR INFLUENCE ON THE OIL PRICE.	32
3.1 SANCTIONS AGAINST RUSSIA	32
3.1.1 Price Cap for Russian Oil and Gas	34
3.1.2 US Sanctions Against Energy Sectors	35
3.1.3 Disconnection of Russian Banks from SWIFT	36
3.1.4 Ban on Oil Imports from Russia	38
3.2 DYNAMICS OF THE GLOBAL OIL MARKET, WITH A SPECIFIC FOCUS ON THE PIVOTAL ROLE OF RUSSIAN OIL AND SANCTIONS	39
4. METHODOLOGY	41
4.1 DATA COLLECTION AND ANALYSIS.....	41
4.2 STATIONARITY ANALYSIS, AUGMENTED DICKEY-FULLER (ADF) AND PHILLIPS-PERRON (PP) TESTS.....	43
4.3 VECTOR ERROR CORRECTION MODEL (VECM) / GRANGER CAUSALITY ANALYSIS	44
4.4 EVENT STUDY ANALYSIS	44
5. RESULTS	46
5.1 GRAPHICAL ANALYSIS OF OIL PRICE TRENDS AND SANCTION IMPACTS.....	46
5.1.1 Initial Data Assessment.....	46
5.2 DESCRIPTIVE STATISTICS	49
5.3 DISTRIBUTION ANALYSIS	50
5.4 IMPACT OF SANCTIONS.....	52
5.5 Investigating and Addressing Non-Stationarity in Oil Prices.....	53

5.5.1 Initial Assessment of Stationarity	53
5.5.2 Addressing Non-Stationarity with Differencing	54
5.5.3 Verifying Stationarity with the ADF Test.....	54
5.5.4 Interpretation of the Results	55
5.6 COINTEGRATION TEST AND VECTOR ERROR CORRECTION MODEL (VECM) ANALYSIS	57
5.6.1 VECM Analysis Interpretation	57
5.6.2 Long-Term Equilibrium Relationships	57
5.6.3 Short-Term Dynamics	58
5.6.4 Speed of Adjustment	60
5.6.6 Actual vs. Fitted Values Analysis	64
5.7 EVENT STUDY ANALYSIS	66
5.7.1 Approach Explanation	66
5.7.2 Results.....	67
5.7.3 Comparative Discussion Across Oil Types	67
5.7.4 Conclusion.....	68
6 CONCLUSION	69
REFERENCES.....	72
APPENDIX 1.....	83
APPENDIX 2.....	86
APPENDIX 3.....	91

List of Abbreviation

ADF - Augmented Dickey-Fuller

AR - Abnormal Returns

CAR - Cumulative Abnormal Returns

FOB - Free on Board

PP - Phillips-Perron

SWIFT - Society for Worldwide Interbank Financial Telecommunication

VECM - Vector Error Correction Model

WTI - West Texas Intermediate

List of Figures

Figure 1: Contribution of Oil Exports to Russia's Overall Revenue (Source: Russian Ministry of Finance).....	21
Figure 2: Brent Oil Price (USD/barrel) and RUB/USD Exchange Rates	26
Figure 3: Cushing. OK WTI Spot Price FOB (Dollars per Barrel); Europe Brent Spot Price FOB (Dollars per Barrel); Crude Oil. Dubai (Dollars per Barrel; and Urals Oil Price (Dollars per Barrel); Separate illustration of 4 oil types	47
Figure 4: Cushing. OK WTI Spot Price FOB (Dollars per Barrel); Europe Brent Spot Price FOB (Dollars per Barrel); Crude Oil. Dubai (Dollars per Barrel; and Urals Oil Price (Dollars per Barrel).....	48
Figure 5: Visual Representation of Oil Price Distribution	51
Figure 6: Representation of all four types of oil price data before and after differencing	56
Figure 7: Actual vs. Fitted Values Analysis.....	65

List of Tabels

<i>Table 1: Descriptive Statistics</i>	49
<i>Table 2: ADF statistic (non-stationary) for Cushing, OK WTI Spot Price FOB (Dollars per Barrel); Europe Brent Spot Price FOB (Dollars per Barrel); Crude Oil, Dubai (Dollars per Barrel); and Urals Oil Price (Dollars per Barrel)</i>	53
<i>Table 3: ADF statistic for Cushing, OK WTI Spot Price FOB (Dollars per Barrel); Europe Brent Spot Price FOB (Dollars per Barrel); Crude Oil, Dubai (Dollars per Barrel); and Urals Oil Price (Dollars per Barrel)</i>	55
<i>Table 4: Johansen Cointegration Test Results</i>	58
<i>Table 5: Significant Short-Term Coefficients in VECM</i>	58
<i>Table 6: VECM Alpha Coefficients (Adjustment Speeds)</i>	60
<i>Table 7: Exogenous Variables Coefficients</i>	62

1.Introduction

1.1 Problem Statement

“An absolute isolation . . . that brings a nation to its senses just as suffocation removes from the individual all inclinations to fight. . . Apply this economic, peaceful, silent, deadly remedy and there will be no need for force. It is a terrible remedy. It does not cost a life outside of the nation boycotted, but it brings a pressure upon that nation which, in my judgment, no modern nation could resist.”

-Woodrow Wilson.1923-

Oil, frequently characterized as the lifeblood of the global economy, has transcended its role as a mere commodity to emerge as a powerful instrument of political power both on an internal level, as articulated by Bell & Wolford (2015) and on a multinational scale (Mulder, 2022). Throughout history, numerous instances attest to the ability of oil to influence geopolitical dynamics and shape the course of international relations. The strategic significance of oil is a recurrent theme in academic literature and has been emphasized by various authors and journals including International Journal of Energy Economics and The Oil and Gas Journal. It is evident that oil's significance extends far beyond its economic utility, as it has been wielded as a formidable political tool in numerous conflicts worldwide.

This master's thesis delves into the intricate relationship between oil and geopolitics, with a specific focus on the ongoing conflict in Ukraine and its profound economic repercussions on the oil sector. The conflict in Ukraine is a compelling case study that highlights the multifaceted nature of oil's role in contemporary global politics; however, this relationship is far from straightforward. Although oil is frequently perceived simply as a resource, it is, in fact, deeply intertwined with national interests and power dynamics, because it influences decisions across the globe.

1.2 Research questions, objectives and delimitation of the subject of investigation

This part of the master's thesis serves as a roadmap for the study, directing readers through the primary focus and goals of the project. The principal goal of the master thesis is to determine the oil price fluctuation and to identify if there is any dependency and correlations between the implementation of sanctions and the oil price fluctuation among various types as within the Russian sector so in the broader market.

The author formulates several research questions that will be examined throughout the study. Thus, it is crucial to determine them in this section. These questions are designed to explore the impact of international sanctions and oil embargoes on Russia, specifically in relation to the global oil market, and the possibility to influence the target country solely. The questions include:

R1: *What effect do international sanctions and the oil embargo on Russia have on the price of oil globally?*

Through this research question, the author aims to investigate the impact of international sanctions and the oil embargo specifically imposed on Russia on the global oil price. Russia holds a significant market share in the global oil industry as it has been stated by IEA (2023), therefore, understanding how sanctions impact oil prices globally is essential. The focus is on tracking fluctuations in oil prices and examining the dependency of these fluctuations on the imposed sanctions. The research involves analyses of historical data, economic models, and geopolitical factors to provide insights into the relationship between sanctions against Russia and the international oil market.

R2: *How has the relationship between the international sanctions and oil embargo against Russia and the global oil price been impacted by the global oil market and other factors?*

By posing this research question, the author broadens the scope to explore the complex interactions between international sanctions, the oil embargo on Russia, and various factors influencing the global oil market. It seeks to understand how dynamics within the global oil market, as well as other external factors, shape the relationship between imposed sanctions, the oil embargo, and the global oil price. This could involve examining the roles of geopolitical events, economic indicators, and market behaviors in influencing this relationship over time. This implies that the cause of certain decisions regarding sanctions implementation was correlated with market trends or political events. Moreover, in this section, it is necessary to examine the nature of the sanctions and the goal in economic sense.

R3: *What potential effects could these actions have on the world's energy situation, especially in light of how they affect ties between Russia and the rest of the world?*

Through this research question, the author delves into the broader implications of the international sanctions and oil embargo on Russia by exploring their potential effects on the world's energy situation. The focus is on understanding how these actions may impact global energy dynamics, considering not only the economic aspects but also the diplomatic and geopolitical consequences. This paper involves analyzing the long-term effects on energy security, regional relationships, and potential shifts in global energy policies as a result of strained ties between Russia and the rest of the world. It could also explore alternative strategies adopted by different countries in response to the changing geopolitical situation.

In summary, these research questions collectively aim to offer a thorough understanding of the complex relationship between international sanctions, the oil embargo imposed on Russia and their repercussions on the global oil market and energy landscape.

The objective of this study is to carry out a detailed analysis of the effects of international sanctions and the oil embargo against Russia on global oil prices. By examining the interaction between political measures and energy markets, this project aims to contribute to the academic literature and inform policy-making in the field of energy economics. The findings provide valuable insights into the relationship between geopolitical actions and market responses, offering potential implications for the global energy situation. Ultimately, this study seeks to facilitate the development of informed energy policies and strategies, thereby enhancing global energy security and stability.

Therefore, the objectives of the research are briefly outlined, and they include:

- Investigate the **impact of international sanctions and the oil embargo on Russia** on the global oil price, focusing on the fluctuation of prices and the dependency on imposed sanctions.
- Examine the complex interactions between international sanctions, the oil embargo on Russia, and various **factors influencing the global oil market**, including geopolitical events, economic indicators, and market behaviors.
- Analyze the potential **broader effects of these actions** on the world's energy situation, considering both economic and diplomatic aspects.

2. Theoretical foundations and thematic background

2.1 Oil as a Political Power

Commodities have always played a significant role in the geopolitical sphere, influencing relationships and policies among nations. Similar to oil, coal and other energy resources are pivotal in shaping economic and political landscapes. Europe's energy strategy, for instance, involves a mix of dependencies on various commodities, each with its own possible geopolitical connotations. This reliance on a diverse array of energy sources emphasizes the delicate balance of power in international relations. Specifically, oil's prominence in the energy sector highlights its status as a strategic asset, often utilized by nations to pursue geopolitical achievements. Control over oil resources and supply routes has historically impacted international relationships, economic stability, and military strategies, cementing oil's role as a potent political tool. The use of oil to negotiate, exert influence, or apply pressure demonstrates its capacity to shape foreign policies and global power structures, making the politics of oil a key factor in understanding the evolving dynamics of international relations and global power shifts (Mitchell, 2013).

The strategic deployment of oil as a geopolitical tool has been a recurrent phenomenon, manifesting its profound influence on global affairs and various conflicts. In the 1970s, during the Arab-Israeli war, the oil embargo launched by OPEC against nations perceived as supporting Israel marked a watershed moment. As Yergin (2006) states this deliberate withholding of oil resources demonstrated the potential of oil as a powerful and formidable political weapon, culminating in the 1973 oil crisis. The crisis not only highlighted the vulnerability of nations heavily that were

reliant on oil imports but also revealed the considerable political and economic consequences that could arise from manipulating the flow of oil.

A further illustration of geopolitical maneuvers is the Iran-Iraq War (1980-1988), Both nations, Iran and Iraq, found themselves embroiled in a prolonged conflict, targeting each other's oil infrastructure in an effort to disrupt oil exports. This intentional disruption had far-reaching consequences, causing disruptions in the global oil market and highlighting the dual role of oil as both a target and a tool of economic coercion (Klare, 2004). The competition for dominance over oil resources became deeply interwoven with the larger dynamics of conflict, emphasizing the pivotal role of oil in shaping geopolitical strategies.

The Gulf War in 1990-1991 added another layer to the narrative, emphasizing the critical importance of oil security. Iraq's invasion of Kuwait posed a direct threat to regional oil supplies, prompting the swift formation of an international coalition. This coalition, in addition to addressing broader geopolitical concerns, had safeguarding oil resources as a key objective, further highlighting the geopolitical significance of oil (Painter, 2018).

In a contemporary context, Venezuela's use of oil as a diplomatic tool serves as another example. As a major oil producer, Venezuela has leveraged its oil exports to cultivate political alliances, especially in the Caribbean and Central America, by offering discounted oil rates. This example demonstrates how oil can be employed not only as an economic pressure but also as a means of exerting influence in regional geopolitics (Colgan, 2014).

In the geopolitical landscape, the interdependence between European countries and Russia, particularly in the energy sector, is profound. However, recent trends of non-

cooperation with Russia in energy sector have emerged, serving as an important self-identification tool in European countries (Tichy & Dubsky, 2024). With approximately 44% of the EU's natural gas imports coming from Russia as of 2020, Europe's energy security is directly linked to Russian supplies. This reliance, mirrored by Russia's dependence on energy exports for its economic stability, creates a significant political dimension. Such interdependence not only exposes vulnerabilities and challenges in diversifying energy sources but also presents opportunities for political power. The ability to leverage energy supplies as a tool for political influence underscores the strategic importance of this relationship in the broader geopolitical arena (Christen & Felbermayr, 2022).

2.2 The Ukrainian Conflict

The backdrop to the conflict is essential to comprehending its complexities. In 2014, Russia annexed Crimea, a move vehemently condemned by the majority of Western countries. In response to this act of aggression, a series of punitive measures, including economic sanctions, were implemented against Russia by the international community. These sanctions targeted various sectors of the Russian economy, including economic sanctions and sanctions targeted energy sector (EU, 2022).

A significant turning point in the Ukraine conflict occurred in February 2022, when Russia deployed military forces into Ukraine and subsequently annexed four additional regions. This escalation led to an even more pronounced international response, resulting in a surge of both political and economic sanctions against Russia (De Young, 2022). It is within this context that the present study seeks to shed light on the oil sector's central role in the ongoing conflict and its aftermath.

The Russian economy relies heavily on key commodities, prominently including natural gas and oil, making these sectors critical to the nation's stability and its ability

to pursue its strategic interests (OECD, 2021). To counter Russian military actions in Ukraine and exert pressure on the Russian government, various economic sanctions were imposed. Among these sanctions, the oil embargo and price ceiling measures were implemented to curtail Russian profits from oil sales. This deliberate targeting of Russia's oil sector as a punitive measure is a testament to the recognition of oil's pivotal role in the geopolitical arena. (GIGA, 2023)

This master's thesis analyzes the intricate interplay between oil, geopolitics, and the ongoing conflict in Ukraine. Through an examination of the conflict's background, the sanctions imposed, and their specific impact on the oil sector, this study seeks to contribute to understanding of the broader dynamics of energy resources in contemporary international politics. In doing so, it aims to provide valuable insights into the complexities of managing global conflicts intertwined with vital economic interests, particularly those associated with oil.

2.3 Oil in Russian economic sector

2.3.1 The Pervasive Influence of Oil on Russia's Economic Landscape

The economic centrality of oil to Russia, extending beyond fiscal considerations, permeating the very basement of the nation's financial well-being and geopolitical influence. As one of the foremost global oil producers and exporters, Russia's reliance on the revenue generated by its oil sector is essential. The revenues derived from oil exports constitute a substantial proportion of the country's budget and trade balance, underscoring the critical role that oil plays in shaping Russia's economic landscape.

The petroleum sector in Russia plays a pivotal role in the country's economy and global energy supply. This sector is responsible for a significant portion of Russia's

state income, constituting 40% of it as of 2018, and is a major employer, with over 1.1 million people engaged in this industry. Gazprom, a leading entity in this sector, employs more than 400,000 individuals, highlighting its economic significance. The sector's substantial influence extends to shaping labor markets and Russia's position in the global energy landscape. Additionally, the Kremlin's control over major producers like Gazprom and Rosneft, along with its influence on operational conditions and privileges for these companies, signifies the state's involvement in this sector. This control and influence play a critical role in the overall dynamics of the Russian oil industry, domestically and internationally (Rubino, 2020).

Historically, Russia's dependence on oil revenue has been a stabilizing force in maintaining domestic equilibrium. The vast financial inflows from oil exports have served as a cornerstone for sustaining the country's economic stability, allowing for robust state expenditures and investments. Yergin (2006) provides insights into the historical significance of oil as a driver of economic stability and power dynamics. This historical perspective is crucial in understanding the long-term patterns and implications of Russia's reliance on oil revenues.

Furthermore, oil revenues have played a pivotal role in advancing Russia's foreign policy objectives. The financial leverage garnered from oil exports has empowered the Russian government to assert itself on the global stage, influencing international affairs in alignment with its strategic interests. Gonzales's (2012) exploration of energy politics provides insights into the intricate connections between energy resources and geopolitical influence. This geopolitical dimension adds another layer of complexity to the intersection of oil revenue and national stability.

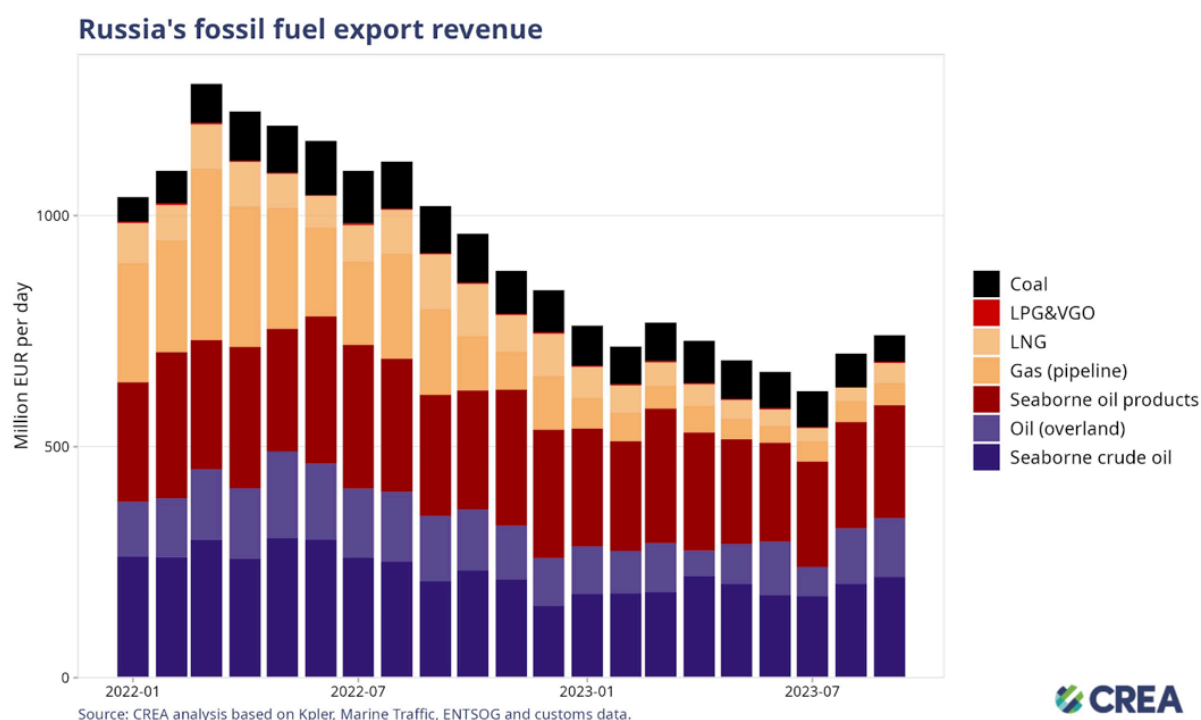


Figure 1: Contribution of Oil Exports to Russia's Overall Revenue (Source: Russian Ministry of Finance)

To visualize the significance of oil revenue in Russia's economic landscape, **Figure 1** provides a graphical representation of the contribution of oil exports to the country's overall revenue. The data, sourced from the Russian Ministry of Finance, highlights the persistent and substantial share of revenue attributed to oil exports over the years.

The economic bedrock formed by oil revenue is not merely a financial consideration for Russia but a linchpin for national stability and geopolitical influence. The historical patterns and contemporary dynamics outlined in this section provide a foundation for understanding the intricate relationship between Russia's oil sector, its economic resilience, and its role in shaping global power dynamics.

2.3.2 Main Players in the Russian Oil Sector

The Russian oil sector, a foundation of the nation's economic stability and global energy prominence, is characterized by the dominance of key players, both state-owned and privately held. These entities not only shape the industry's landscape but also significantly contribute to Russia's standing as a formidable force in the global energy arena. The exploration, production, and export activities of these major players are integral to the nation's economic resilience, energy security, and strategic foreign policy endeavors. The following section presents the main players in the Russian oil industry.

The first big player, Rosneft, stands as the preeminent and largest state-owned oil company in Russia, exerting considerable influence over the nation's oil industry. Boasting an expansive network of production assets, refineries, and export capabilities, Rosneft operates on both domestic and international fronts. Its far-reaching impact positions it as a key player in the global oil landscape, contributing significantly to Russia's energy dominance (Skawka, 2008).

Established in the 1990s, Rosneft evolved through strategic acquisitions, notably Yuganskneftegaz and YUKOS, significantly increasing its production capacity. By 2018, Rosneft had not only expanded domestically but also established a global presence, reflecting its strategic adaptability in the face of challenges like oil price volatility. Its role in shaping Russian foreign energy policy and strategic international partnerships further cemented its position as a dominant player in the global oil market. Rosneft's growth and influence are underpinned by impressive production figures and expansive operations. The company's strategic alliances have enabled access to new technologies and markets, demonstrating its adaptability and

foresight in the global oil economy. These efforts have positioned Rosneft not just as a national leader in the Russian oil industry, but also as a significant player on the world stage, showcasing its resilience and strategic prowess in navigating the complex dynamics of the global energy sector (Overland & Poussenkova, 2023).

Another big player as a subsidiary of the state-owned energy giant Gazprom, Gazprom-Neft holds a prominent position in the Russian oil sector. Renowned for its robust exploration and production activities, substantial refining capacity, and expanding international footprint, Gazprom-Neft plays a pivotal role in enhancing Russia's oil production and export capabilities (O'Neill, 2016).

Lukoil, a major privately owned oil company in Russia, commands a significant presence in the exploration, production, refining, and marketing of oil and natural gas. With operations extending beyond Russia's borders and involvement in diverse international projects, Lukoil's influence contributes significantly to its global standing (Vagaboy, 2018). Lukoil's establishment post, 1991 symbolizes a pivotal shift in Russia's oil sector, transitioning from state-dominated to a more privatized industry. The company's strategic approach involved acquiring smaller firms and expanding into global markets, particularly in the Middle East, Africa, and Central Asia. By the early 2000s, this strategy positioned LUKOIL as one of the key hydrocarbon producers on the global stage, showcasing effective management in the volatile post-Soviet economy.

Complementing its expansion strategy, Lukoil also embraced environmental sustainability. The company's investments in ecological protection and energy efficiency initiatives reflect a commitment to responsible corporate conduct within the oil industry. This dual focus on growth and sustainability demonstrates Lukoil's

adaptability and forward-thinking approach in the evolving energy sector (Gustafson & Victor, 2023).

Surgutneftegaz is a major player in the Russian oil industry, known for its extensive exploration, production, and refining operations. ranking consistently among the top crude oil producers (Maugrei, 2006). Similarly, Tatneft, based in Tatarstan, plays a significant role in regional energy production. with a focus on oil field development and refining (Maganov, 2019).

The key players in the Russian oil sector, ranging from global giants to regional firms, contribute significantly to its diversity and complexity. State-owned companies like Rosneft and Gazprom Neft exert influence that goes beyond mere economic factors, playing a crucial role in shaping both Russia's energy policies and its international relations.

The significance of these companies extends beyond their economic roles, as they are often used as tools in Russia's foreign policy and geopolitical strategies. These major players are not only influential in economic spheres but also in defining Russia's geopolitical presence (Gidadhubli, 2003). A deeper understanding of their strategic motivations and interactions is essential for grasping the intricate role of Russia's oil sector in the conflict with Ukraine, as well as its broader impact on the global energy landscape. This thesis aims to explore these connections and their wider implications with careful analysis.

2.3.3 Economic Sanctions and the Russian Oil Sector

As a response to Russia's annexation of Crimea in 2014 and the subsequent military actions in Ukraine, western countries, led by the United States and the European Union, imposed a range of economic sanctions on Russia. These sanctions, often referred to as "targeted sanctions," were designed to exert economic pressure on Russia and, in particular, disrupt its oil sector and influence economy (Korhonen, 2019).

The sanctions encompassed several measures, including restrictions on technology and equipment exports for oil exploration and production, limitations on Russian oil companies' access to Western financial markets, and restrictions on trade in oil-related goods and services. These measures aimed to curtail Russia's ability to maintain and expand its oil production and exports and to resist Russia's military actions in Ukraine (Shkodinsky et al., 2022). Moreover, the imposition of an oil embargo and price ceiling added another layer of complexity to the situation. These measures aimed to reduce Russia's profits from oil sales by limiting both the quantity of oil that could be exported and the price at which it could be sold (Baker, 2022).

As a result of these sanctions and limitations, Russia's oil sector has faced numerous challenges, including reduced access to financing for exploration and production activities, technological constraints, and difficulties in marketing its oil abroad. These factors have placed significant pressure on Russia's economy and underscored the vulnerability of a nation heavily reliant on oil exports in a geopolitically unstable world (Welt et al., 2022).

This thesis analyzes the multifaceted impact of these sanctions and measures on the Russian oil economic sector and, in turn, assess their implications for the ongoing

conflict in Ukraine. Furthermore, it aims to contribute to the broader discourse on the interplay between oil, geopolitics, and economic stability within the context of the contemporary global political landscape.

2.3.4 The Dependence of the Russian Economy on Oil Prices and the Ruble Exchange Rate

The Russian economy has long been intricately linked to global oil prices, with fluctuations in oil prices exerting a profound impact on the country's economic stability and the value of the Russian ruble. The relationship between oil prices and the ruble exchange rate is emblematic of Russia's dependence on the energy sector, with oil exports playing a central role in the nation's economic well-being. This section will delve into the dynamics of this dependence and the evident correlation between oil price volatility and the value of the Russian ruble (Bilan et al., 2018).



Figure 2: Brent Oil Price (USD/barrel) and RUB/USD Exchange Rates

Figure 2 depicts a comparative time series analysis of Brent crude oil prices juxtaposed with the RUB/USD exchange rate over a 12-year period from July 2005 to July 2017. The vertical axis represents two distinct monetary values: the price of Brent oil, indicated by the red line, and the RUB/USD exchange rate, represented by

the black line. The Brent oil prices are measured on the left vertical axis, with values ranging from approximately 60 to over 240 potentially, reflecting the price per barrel in USD. Meanwhile, the RUB/USD exchange rate, plotted against the right vertical axis, oscillates between 30 to 60, likely denoting the number of Russian Rubles equivalent to one US Dollar (Bilan et al., 2018).

The horizontal axis uniformly chronicles the progression of time in months and years. The graph demonstrates marked volatility in both datasets, with several notable peaks and troughs that suggest a degree of correlation between the two variables. A pronounced peak in the price of Brent oil can be observed, which aligns temporally with a significant ascent in the RUB/USD exchange rate, indicating an interdependence where the Ruble's strength against the Dollar appears contingent on the robustness of oil prices (Bilan et al., 2018). This relationship is crucial as it underscores the sensitivity of the Russian economy to fluctuations in global oil prices, a dependency that has far-reaching implications for economic stability and geopolitical shifts.

The temporal alignment of the Brent oil price spikes and Ruble valuation against the Dollar provides a visual representation of the economic phenomenon where resource-driven economies may experience currency appreciation concurrent with rising commodity prices. This graph serves as a critical visual aid in understanding the macroeconomic dynamics at play, forming a basis for the ensuing analysis on the impact of commodity price fluctuations on exchange rates within resource-dependent economies (Bilan et al., 2018).

Albulescu (2022) conducts an in-depth analysis of how oil prices impact Russian banks. He employs econometric models to analyze data from 17 Russian banks between 2008 and 2016, revealing a significant relationship between oil price changes

and bank stability. The results highlight both immediate and long-term effects, emphasizing the sensitivity of the Russian banking sector to global oil market fluctuations (Albulescu, 2022).

2.3.5 The Oil Price Volatility-Ruble Exchange Rate Connection

The Russian economy's dependence on oil exports is evident through a straightforward mechanism. When global oil prices are high, Russia experiences an influx of revenue from oil exports, which, in turn, bolsters the country's foreign exchange reserves and supports the value of the Russian ruble. Conversely, when oil prices plummet, Russia faces economic challenges as its main source of income diminishes, leading to a devaluation of the ruble (Aganin & Peresetsky, 2018).

This interdependence is most evident when examining the correlation between oil price volatility and fluctuations in the ruble exchange rate. Historically, when oil prices experience sharp declines, the value of the Russian ruble tends to depreciate substantially against major currencies, such as the US dollar and the euro. Conversely, when oil prices surge, the ruble tends to strengthen (Aganin & Peresetsky, 2018).

2.3.6 The Impact on Russia's Economic Stability

The dependence of the Russian economy on oil prices is a double-edged sword. High oil prices can lead to economic growth, increased government revenues, and a strong ruble. However, this dependence also makes the economy vulnerable to the volatility of global oil markets. Sharp drops in oil prices can lead to budgetary deficits, economic instability, and depreciation of the ruble. The Russian government often has to tap into its foreign exchange reserves to stabilize the ruble during such downturns (Balashova & Serletis, 2020).

2.3.7 The Ongoing Conflict in Ukraine and Oil Prices

The ongoing conflict in Ukraine has added an extra component of complexity to this economic dependency. The imposition of economic sanctions and the restrictions placed on Russia's oil sector by Western countries, as a response to Russia's actions in Ukraine, have the potential to exacerbate the economic consequences of oil price volatility. Reduced access to international financial markets and technological limitations can further impact Russia's economic stability during oil price fluctuations. (EU Commission, 2024)

This thesis explores the intricacies of Russia's economic dependence on oil prices and the ruble exchange rate, particularly in the context of the ongoing conflict in Ukraine. It analyzes the impact of sanctions and restrictions on Russia's oil sector, shedding light on the ways in which geopolitical factors can exacerbate economic vulnerabilities. By doing so, it provides a comprehensive understanding of the economic dimensions of the conflict and its implications.

2.4 Main Oil Suppliers on International Market

In the global arena of oil production and distribution, several key players wield significant influence, shaping the dynamics of the international oil market. Among these players, Saudi Arabia stands as a towering figure, boasting the largest proven reserves of crude oil on the planet. Its strategic position as a leading oil exporter grants it considerable sway over market prices and production levels, allowing it to impact global oil supply with its policy decisions. Its interactions with other major oil-producing nations, particularly within the Organization of the Petroleum Exporting Countries (OPEC) and non-OPEC alliances, play a crucial role in shaping oil prices and market stability.

Moreover, the United States has emerged as an active player in recent years, propelled by the shale revolution that unlocked vast reserves of previously inaccessible oil and gas. Rapid advancements in hydraulic fracturing and horizontal drilling techniques have transformed the United States into one of the world's top oil producers, rivaling traditional powerhouses like Saudi Arabia and Russia. Its flexibility in adjusting production levels in response to market conditions adds another layer of complexity to global oil dynamics. (Brown & Yucel, 2013)

The author has chosen to focus on four distinct types of oil:

Brent Crude, West Texas Intermediate (WTI), Dubai Crude, and Urals Oil.

Brent Crude, originating from the North Sea, serves as a major benchmark for oil prices worldwide. It is widely traded and its price is used as a reference for around two-thirds of the world's internationally traded crude oil supplies. Brent Crude's significance is underscored by its widespread use in oil futures trading and its influence on global pricing structures (Soriano & Torró, 2022).

West Texas Intermediate (WTI), primarily produced in the United States, is another key benchmark known for its high quality and serves as the primary oil grade for North American pricing (Miller et al., 2010).

Dubai Crude, originating from the United Arab Emirates, plays a crucial role in pricing oil in the Asian markets, particularly as a reference for pricing Middle Eastern oil exports to Asia (Yang et al., 2018).

Urals Oil, a mix of heavy and light crudes from Russia, serves as a benchmark for pricing Russian exports and has significant influence in the European market. Each of these types of oil has unique properties and serves specific regional markets, reflecting the diverse and complex nature of the global oil industry (Solovieva et al., 2021).

Beyond these major players, other nations contribute significantly to the international oil market. Countries in the Middle East, such as Iraq, Iran, and the United Arab Emirates, possess substantial reserves and play pivotal roles in global oil supply. Meanwhile, nations like Canada, Brazil, and Venezuela contribute to the market with their diverse oil resources, each facing unique challenges and opportunities in the competitive landscape of the oil industry (IEA. 2024).

The international oil market is shaped by a diverse array of players, each wielding influence through their production capacities, geopolitical strategies, and market interactions. Understanding the dynamics of these main players is crucial for navigating the complexities of the global oil market and anticipating its future trajectories.

3. Sanctions and their Influence on the Oil Price.

3.1 Sanctions against Russia

In response to Russian actions in Ukraine, European states have implemented a series of sanctions aimed at curtailing the revenue Russia generates from its commodities, particularly gas, oil and metals. These sanctions are intended to exert economic pressure by reducing the volume of direct purchases. However, the effectiveness of these measures is subject to ongoing debate, as there are reports of Russian entities circumventing the sanctions through what is colloquially termed as “black fleet” operations. These involve the use of vessels that do not broadcast their location or that may be reflagged under different nationalities to disguise their origins and continue trading under the radar of international scrutiny (Roth, 2023).

The "black fleet" can be part of a larger set of tactics employed by Russian companies to evade sanctions, which might include indirect sales through third countries, mixing Russian oil with other sources to obfuscate its origin, or utilizing complex ownership structures to mask the true beneficiaries of the trade. These tactics complicate the enforcement of sanctions and challenge the international community's ability to monitor and restrict the flow of Russian commodities effectively (Roth, 2023).

Hofer (2018) reveals that these sanctions, especially implemented by the United States, fall into a legal grey area. They are not traditional acts of self-defense but rather economic measures aimed at influencing Russian policy. This nuanced understanding of sanctions under international law highlights the complexities European states face in both implementing and enforcing these sanctions against Russia. The tactics employed by Russian entities, like "black fleet" operations, further blur the

lines of legal and illegal actions under international law, complicating the task of sanction enforcement.

As a result of these evasion strategies, many European states have found it challenging to completely disengage from Russian energy supplies. The dependency on Russian gas and oil is deep-rooted due to the infrastructure that has been in place for decades, as well as the lack of immediately viable alternative sources at comparable scales and costs. Consequently, as Eurostat (2023) states, while some European states have significantly reduced their intake of Russian commodities, others continue to obtain them, albeit at reduced levels or through indirect means.

The situation is further complicated by the global nature of commodity markets. When European buyers withdraw, it creates opportunities for other nations to step in and purchase Russian commodities at discounted prices, which can mitigate the financial impact of European sanctions on Russia. Moreover, the rise in global energy prices can offset the reduction in volumes sold, which means that the financial impact on Russia, while significant, may not be as substantial as the initial volumes suggest (Katinas,2024).

Hofer's insights into the legal nature of these sanctions illuminate the complexities and challenges faced by European states in navigating the delicate balance between legal obligations and political realities. This understanding is crucial for developing effective strategies in sanction implementation and enforcement (Hofer, 2018).

Therefore, while the ban on the purchase of Russian commodities by European states is a clear stance against Russian actions, the effectiveness of this measure is nuanced and varies widely. The full impact of the sanctions remains uncertain and is

influenced by the dynamic interplay of evasion tactics, commodity markets, and the geopolitics.

3.1.1 Price Cap for Russian Oil and Gas

Continuing the discussion on European sanctions against Russia, a notable strategy under consideration is the implementation of a price cap on Russian commodities, especially gas and oil. This approach, as discussed by Johnson et al. (2023), involves setting a maximum limit on the price that buyers can pay for Russian energy exports, aimed at reducing Russia's revenue while minimizing disruptions to the global energy market.

The concept of a price cap presents both economic and diplomatic challenges. Economically, it seeks to limit Russia's profits from its energy sector, a major source of revenue, without causing a drastic shortage in the global supply. The effectiveness of this strategy largely depends on the cooperation and compliance of global players in the energy market, including both the traditional allies of the Western countries and the parties that might seek to exploit the situation for their own gain. As Wickenden et al. (2024) states, the import of oil from Russia increased in the Czech Republic in 2023 and returned to pre-conflict levels in 2024. The earlier decrease, however, was caused by the interruption of the Druzhba pipeline. This trend can also be observed in other European states, further confirming the challenges associated with implementing sanctions.

From a diplomatic standpoint, the implementation of a price cap requires extensive international collaboration. It necessitates agreement among a diverse group of countries on the cap level, ensuring it is sufficiently low to impact Russian revenues but not so low as to incentivize Russia to cut off supply entirely. Moreover, enforcing

this cap would be complex, given the need to monitor and prevent circumvention through indirect sales, reflagging of ships, and other evasion tactics similar to those seen with the "black fleet" operations (Johnson et al.,2023).

Further complicating the issue is the response from Russia. Moscow could retaliate by reducing or cutting off energy supplies to specific countries or globally, leading to increased energy prices and potential shortages. This possibility poses a significant risk, particularly for European countries that are heavily reliant on Russian energy. Russia demonstrated this in February 2023. As Zaniewicz (2023) argues, the formal reason given was an issue with payment for transit; however, the actual reason was a response to European sanction policies.

The introduction of a price cap on Russian commodities thus requires careful consideration of its potential economic impacts, enforcement challenges, and geopolitical ramifications. While it presents a novel approach to exerting economic pressure, its success hinges on the intricate balance of international cooperation, market dynamics, and strategic geopolitical maneuvering (Duehren et al., 2023)

3.1.2 US Sanctions Against Energy Sectors

The United States has implemented a series of sanctions targeting Russia's energy sector as part of a broader strategy to weaken Russia's economic base and limit its capacity to finance its military activities. These sanctions encompass restrictions on new investments in Russia's energy projects, bans on the export of certain technologies crucial for oil exploration and production, and measures targeting key Russian energy companies and their executives (U.S. Department Treasury, 2022)

As stated by U.S. Department of State (2023), the impact of these sanctions is multifaceted. Economically, measures aim at stifling the growth and modernization of Russia's energy sector, which is vital for the country's revenue. By restricting access to advanced technologies and international investment, the US seeks to undermine the efficiency and competitiveness of Russian energy production, particularly in challenging environments like the Arctic and deep-water fields.

These measures aim at ensuring their effectiveness and at preventing Russia from circumventing them through alternative markets and partnerships. This includes working with European and Asian countries that have significant energy trade relations with Russia, persuading them to adopt similar restrictions or limit their engagement with sanctioned entities.

However, these sanctions also pose risks. To offset the losses from Western markets, Russia might deepen its energy ties with non-Western countries, such as China and India. This reorientation could alter global energy dynamics, creating new alliances and shifting trade patterns (Verma, 2024).

3.1.3 Disconnection of Russian Banks from SWIFT

One of the most impactful sanctions imposed on Russia is the disconnection of several major Russian banks from the SWIFT international payment system. SWIFT, the Society for Worldwide Interbank Financial Telecommunication, is a global network used by banks to securely transmit information and instructions through a standardized system of codes (SWIFT, 2024). Removing Russian banks from this system aims to disrupt their ability to conduct international transactions. Thereby crippling financial operations and isolating the Russian economy from global markets (European Commission, 2022).

Economically, the exclusion from SWIFT severely limits Russia's ability to engage in international trade and finance. It hampers the ability of Russian companies to receive payments for exports, pay for imports, and access foreign capital. This can lead to significant cash flow issues, a decrease in international trade, and an overall contraction of the economy (European Commission. 2022).

Diplomatically, implementing such a measure requires substantial coordination among SWIFT's member countries and the broader international community. It is essential to mitigate the impact on global markets, particularly in Europe, which has significant financial and trade links with Russia. Ensuring that humanitarian and essential transactions can still proceed, such as food and medicine purchases, is also a critical concern (European Commission. 2023).

The effectiveness of this sanction is high, but it also carries risks. Russia may retaliate by disrupting its supply of critical commodities, such as energy, to the global market, causing price spikes and shortages. Additionally, it could accelerate the development of alternative financial networks, reducing the long-term influence of SWIFT (European Commission, 2023).

Disconnecting Russian banks from SWIFT represents a powerful economic sanction with the potential to significantly impair Russia's financial system. Its success hinges on comprehensive international support and careful management of the broader economic repercussions.

3.1.4 Ban on Oil Imports from Russia

In response to Russia's aggressive actions, several countries have imposed bans on the import of Russian oil. This measure is designed to cut off a significant source of revenue for the Russian government, which relies heavily on energy exports to fund its operations, including its military endeavors (The White House. 2022).

The ban on Russian oil imports aims to reduce Russia's income from one of its most lucrative export commodities. This sanction pressures Russia to find alternative buyers, often at discounted rates, reducing its overall revenue. For the countries imposing the ban, this move necessitates the diversification of energy sources, seeking alternative suppliers to fill the gap left by the absence of Russian oil (The White House, 2022).

From a diplomatic perspective, as with previously presented sanctions, achieving a broad consensus on such bans requires extensive negotiation and collaboration among importing nations. This is particularly challenging given the varying degrees of dependency on Russian oil across different countries. Ensuring that the ban does not lead to severe energy shortages or excessively high prices is a delicate balance to strike (Chachko & Heath, 2022).

As discussed by Reed (2023), the response from Russia to such bans can include reducing or halting oil supplies to countries participating in the sanctions, increasing global energy market volatility. The ban on Russian oil imports is a significant step in exerting economic pressure on Russia. Its success depends on international solidarity, the ability to mitigate adverse effects on the global energy market, and the robustness of enforcement mechanisms to prevent circumvention of the ban.

3.2 Dynamics of the Global Oil Market, with a Specific Focus on the Pivotal Role of Russian Oil and Sanctions

The impact of international sanctions and the oil embargo on Russia has been significant but varied in terms of its effect on global oil prices and Russia's oil export revenues (European Central Bank, 2023).

Initially, the sanctions led to a notable drop in Russia's seaborne exports of crude oil. However, over time, Russia managed to redirect its oil exports from sanctioning countries to non-sanctioning countries, mainly to India, China, and Turkey. This shift helped Russia maintain its export volumes of seaborne crude oil, averting a more significant impact on global oil supply. As a result, global oil prices showed limited volatility despite the introduction of the EU crude oil embargo and the crude oil price cap. The sanctions initially led to a decrease in international oil prices, but this was countered by increased exports in other countries like Kazakhstan and Turkey (CEPR, 2023).

Despite this, the sanctions have significantly impacted Russia's oil export revenues. Over the first year of the sanctions, Russia's export earnings from oil were expected to be cut by 14%, resulting in a significant loss. The sanctions mainly worked by lowering Russian oil prices compared to global prices. However, the effectiveness of the sanctions diminished over time due to insufficient monitoring and enforcement of the oil price cap policy. This allowed Russia to sell its oil above the set cap level and capitalize on loopholes, such as the "refining loophole," which enables oil products produced from Russian crude oil to enter countries imposing sanctions (St. Louis Federal Reserve, 2023)

The Centre for Research on Energy and Clean Air noted that the price cap had an impact but failed to live up to its potential. The price difference on Russian oil and

benchmark global oil has declined steadily since early 2023. The sanctions' declining effect is attributed to the failure of G7 and EU governments to enforce and strengthen the price cap, enabling Russia to sell its oil above the price cap level and increase export volumes to new buyers not imposing sanctions (CREA, 2023).

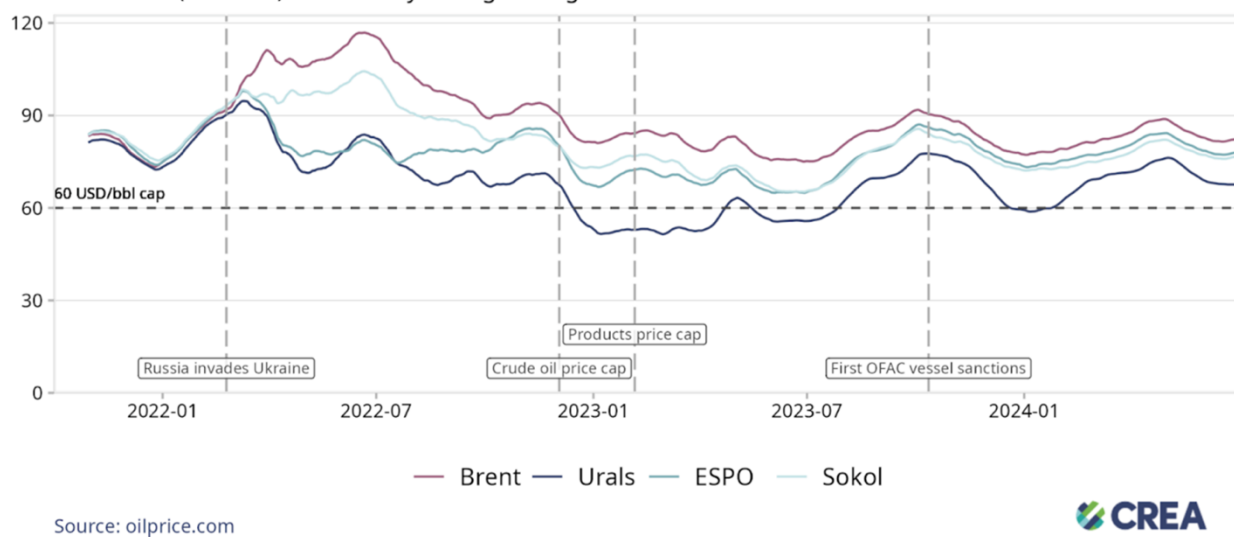


Figure 3: *Russian and Brent Oil Price over Time*

As shown in Figure 3, after the introduction of the price cap on Russian oil, a decline in the prices of both Russian oil types and Brent is evident. The most significant changes are observed with Urals; however, after several months, this oil was traded above the price cap and remained above this threshold, suggesting a breach of the sanction by most buyers. This highlights once again the complexity of implementing sanctions and how challenging it can be to coordinate among different countries in the open market to agree on a price cap rule.

4. Methodology

4.1 Data Collection and Analysis

The study utilizes time series data spanning from 2010 to 2023, incorporating variables such as the global oil price, international sanctions, and oil embargo specifically targeting Russia. This study employs data from reputable sources including the GIGA Sanctions Data Set, IEA Statistics, OPEC Statistics, and World Bank Commodity. To identify temporal patterns and trends associated with international sanctions and oil embargoes against Russia, this paper employs various econometric approaches

For this study investigating the influence of sanctions against Russia on international oil prices from 2010 to 2023, careful consideration was given by author to the selection of appropriate time intervals for the analysis. The choice of time intervals is crucial as it determines the level of granularity and the ability to capture both short-term fluctuations and longer-term trends in the relationship between sanctions and oil prices.

Monthly data intervals were used predominantly in this study due to their ability to strike a balance between granularity and statistical power. By aggregating data on a monthly basis, the analysis captures the inherent volatility of oil prices while mitigating the noise associated with daily fluctuations. Moreover, monthly intervals allow for a comprehensive examination of the immediate and short-term effects of sanctions announcements or implementations on oil prices, thus providing insights into market dynamics and investor sentiment.

Furthermore, to enhance the granularity of the analysis and capture the specific impacts of sanctions-related events, event windows were defined for the monthly data framework. These event windows correspond to significant events such as the announcement or implementation of new sanctions measures against Russia. By delineating specific time periods around these events, the study evaluates the immediate market reactions and any subsequent adjustments in oil prices, thereby providing a nuanced understanding of the temporal dynamics of the sanctions - oil price relationships.

To comprehensively evaluate the influence of sanctions on the international oil market, similar analyses were conducted on major players in the global oil industry. Time series data for key oil-producing and oil-consuming countries, such as the United States, Saudi Arabia, Europe were collected and analyzed using the same econometric techniques applied to the Russian case. This extension provides a comparative assessment of the impact of sanctions across different regions and economies.

Overall, the selection of monthly data intervals supplemented by event windows reflects a comprehensive approach to analyzing the influence of sanctions against Russia on international oil prices. By employing multiple time intervals, the study uncovers both short-term fluctuations and longer-term trends, thereby contributing to a deeper understanding of the complex interplay between geopolitical events and oil market dynamics.

4.2 Stationarity Analysis, Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests

Two well-known statistical tests – the Phillips-Perron (PP) test and the Augmented Dickey-Fuller (ADF) – are used to carefully evaluate the dataset's stationarity. The purpose of these tests is to compare the alternative hypothesis of stationarity with the null hypothesis, which holds that a unit root exists in the time series and indicates non-stationarity.

The addition of the series' lags to the regression model is how the **Augmented Dickey-Fuller (ADF)** test expands upon the original Dickey-Fuller test. By taking higher-order autocorrelation into account, this augmentation strengthens the test's resistance to different types of serial dependency in the data. The ADF test reduces the possibility of incorrectly accepting the null hypothesis of a unit root by addressing serial correlation in the error terms through the inclusion of lagged differences. The existence of a unit root is then ascertained by comparing the test statistic obtained from the ADF test to critical values (Fuller, 1976).

Conversely, the ADF test requires the explicit specification of lag order, but the **Phillips-Perron (PP)** test provides an alternate method by directly addressing serial correlation and heteroskedasticity within the test statistics. In order to account for any serial correlation and time-dependent heteroskedasticity in the error terms, the PP test adjusts the Dickey-Fuller test statistics (Phillips & Perron, 1988). This flexibility was considered as a primary advantage. However, subsequent researches conducted by Schwert (1989) and later one by Perron and Campbell (1991) have shown that the PP test does not consistently outperform the ADF test, particularly in the presence of moving average (MA) processes. Nevertheless, it is important to

interpret results from both tests cautiously, ensuring that implementation is aligned with the characteristics of the dataset.

4.3 Vector Error Correction Model (VECM) / Granger Causality Analysis

If the Johansen cointegration test confirms the presence of cointegration among the time series variables namely - international sanctions, oil embargoes targeting Russia, and global oil prices it indicates a long-run equilibrium relationship among these variables (Johansen, 1991). To model and adjust for deviations from this equilibrium, a Vector Error Correction Model (VECM) is employed. The VECM integrates both short-term dynamics and long-term relationships, allowing for the correction of any disequilibrium through error correction terms (Engle & Granger, 1987).

Additionally, Granger causality tests are conducted to investigate potential dynamic influences between the variables. Specifically, these tests assess whether past values of international sanctions and oil embargoes can predict future changes in global oil prices beyond the information contained in their own historical data (Granger, 1969). Establishing such causality is crucial for understanding the impact of geopolitical actions on oil markets and for informing policy decisions.

4.4 Event Study Analysis

In case significant events impact global oil market be, such as international sanctions or other noteworthy geopolitical shifts detected, an event study investigation is carried out to analyze the influence of these events on oil prices. According to McKinlay (1997), the event study approach entails identifying an event window centered on the event date and comparing the anomalous returns of oil prices during this time to a normal return model based on historical data. This paper offers insights into the

short-term market reactions by separating out the impact of particular events on oil prices (Brown & Warner, 1985; Fama et al.1969).

Prior studies have utilized event study methodologies to evaluate the effects of global sanctions and geopolitical threats on the oil markets. For example, Kilian and Park (2009) looked at the relationship between oil price shocks and the U.S. stock market, while Zhang and Yao (2013) looked into how geopolitical concerns affect oil price fluctuations. Furthermore, Hamilton (2009) examined the origins and effects of large-scale oil shocks. He argues that the event study methodology is effective at capturing the market's instantaneous reaction to major geopolitical and economic events.

With the use of this methodology, the analysis seeks to give policymakers, investors, and other stakeholders in the energy industry a clear knowledge of the ways in which particular geopolitical developments and sanctions impact oil prices.

5. Results

5.1 Graphical Analysis of Oil Price Trends and Sanction Impacts

After investigation, four datasets were selected to analyse the global oil market dynamics. These datasets include Cushing, OK WTI Spot Price FOB (Dollars per Barrel), representing the primary indicator of the American oil market; Europe Brent Spot Price FOB (Dollars per Barrel), the main indicator for the European oil market; Crude Oil, Dubai (Dollars per Barrel), a major benchmark for oil in the Arab Emirates; and Urals Oil Price (Dollars per Barrel), an important Russian oil benchmark.

The datasets comprised of monthly oil price data from January 2010 to December 2023, resulting in 168 observations for each oil type. This extensive period allows for a robust analysis of market trends and external influences. To understand the connection, between oil prices and geopolitical events, four key sanctions were considered: U.S. sanctions against the energy sector, the price cap on Russian oil, the disconnection of Russian banks from SWIFT, and the ban on imports of Russian oil. These sanctions were chosen due to the assumption of a major impact on global oil markets, as it has been mentioned previously, in the part “Sanctions and their Influence on the Oil Price”

5.1.1 Initial Data Assessment

The initial analysis involved a graphical representation of the data, providing a visual insight into how these sanctions may correlate with fluctuations in oil prices. The visual analysis serves as a preliminary step in understanding the dependencies and interactions within the oil market. Further statistical and econometric analyses conducted to quantify the effects of these sanctions on oil prices, controlling for other relevant factors such as event-based analyses and cointegration of oil types.

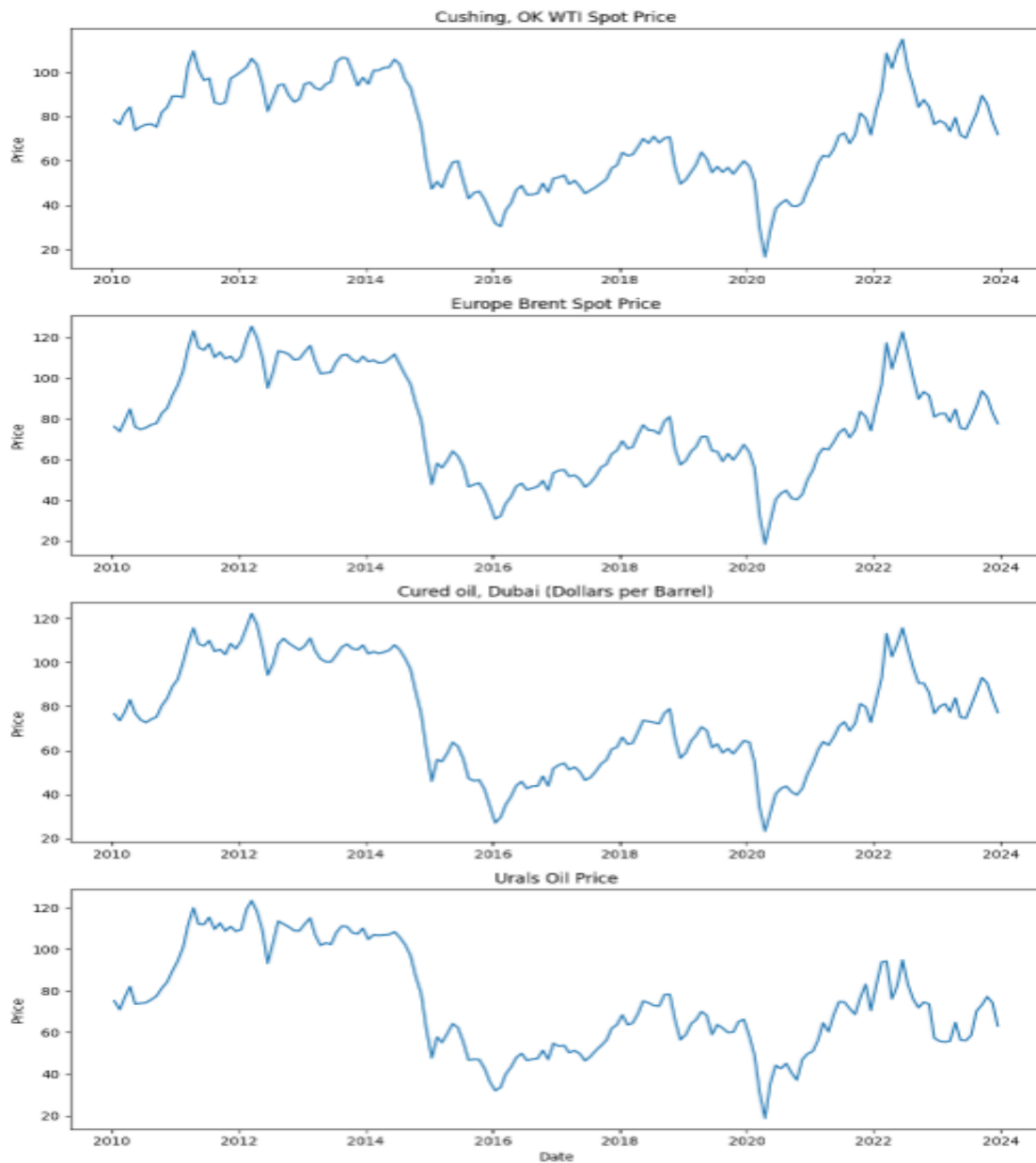


Figure 4: Cushing, OK WTI Spot Price FOB (Dollars per Barrel); Europe Brent Spot Price FOB (Dollars per Barrel); Crude Oil, Dubai (Dollars per Barrel); and Urals Oil Price (Dollars per Barrel); Separate illustration of 4 oil types

The graphical representation of the data reveals several notable features across the four types of oil, starting from 2010. Initially, there is a noticeable increase in oil prices, which remained relatively stable until 2014. Following this period, a significant decrease in prices is observed around 2020, followed by a subsequent sharp increase. All four types of oil prices demonstrate similar movements, suggesting that

they may be influenced by common market behaviour or factors affecting the global oil market.

Upon further examination of the graph, particularly after 2022, a slight deviation in the price of Russian Urals oil compared to the other types of oil becomes apparent. This deviation may be attributed to the imposition of sanctions, such as the price cap on Russian oil exports, which likely impacted its market price. Despite this divergence, the overall pattern remains consistent across all four types of oil for most of the observed period.

The observed simultaneous movements in the prices of these oil types indicate potential interdependencies or shared influences driving their market prices. To explore these dynamics further, author proceeds with a detailed analysis of summary statistics, distributional characteristics, and movements of the oil prices. Additionally, the author will examine the specific impacts of the various sanctions on these prices to better understand the underlying market mechanisms, if there are any.

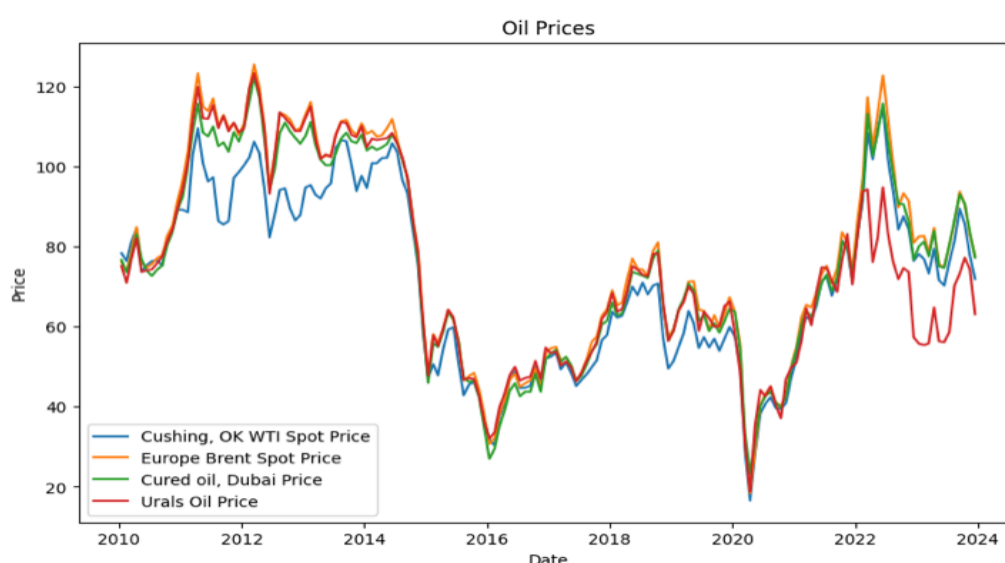


Figure 5: Cushing, OK WTI Spot Price FOB (Dollars per Barrel); Europe Brent Spot Price FOB (Dollars per Barrel); Crude Oil, Dubai (Dollars per Barrel); and Urals Oil Price (Dollars per Barrel)

5.2 Descriptive Statistics

The descriptive statistics provide an initial glimpse into the dataset, capturing the central tendency and variability of the oil prices over the study period.

Cushing. OK WTI Spot Price FOB (Dollars per Barrel)		Sanction 1; US sanctions against energy sectors	
count	168	count	168
mean	71.7015	mean	0.6667
min	16.5500	min	0.0000
25%	51.9925	25%	0.0000
50%	71.8050	50%	1.0000
75%	90.0275	75%	1.0000
max	114.8400	max	1.0000
std	22.0061	std	0.4728
Europe Brent Spot Price FOB (Dollars per Barrel)		Sanction 2; Price Cap of Russian oil	
count	168	count	168
mean	77.9528	mean	0.0953
min	18.3800	min	0.0000
25%	57.4725	25%	0.0000
50%	75.5250	50%	0.0000
75%	103.1200	75%	0.0000
max	125.4500	max	1.0000
std	25.5566	std	0.2944
Cured oil, Dubai (Dollars per Barrel)		Sanction 3; Diconnection of Russian Banks from SWIFT	
count	168	count	168
mean	75.9224	mean	0.1310
min	23.2700	min	0.0000
25%	56.1450	25%	0.0000
50%	74.0835	50%	0.0000
75%	101.7085	75%	0.0000
max	122.2759	max	1.0000
std	24.5008	std	0.3384
Urals Oil Price (Dollars per Barrel)		Sanction 4; Ban on imports from Russia of oil	
count	168	count	168
mean	74.3827	mean	0.0774
min	18.7800	min	0.0000
25%	55.6875	25%	0.0000
50%	70.7500	50%	0.0000
75%	97.9900	75%	0.0000
max	123.3100	max	1.0000
std	24.4770	std	0.2680

Table 1: Descriptive Statistics

The descriptive statistics provide an initial glimpse into the dataset, capturing the central tendency and variability of the oil prices over the study period.

The mean price by Cushing, OK WTI Spot Price FOB is \$71.70 per barrel, with a price range spanning from \$16.55 to \$114.84. The standard deviation of \$22.01 indicates significant variability, reflecting fluctuations in market conditions and external factors affecting WTI spot prices.

Whenever, the average of Europe Brent Spot Price FOB price is higher at \$77.95 per barrel, with prices ranging from \$18.38 to \$125.45. A higher standard deviation of \$25.56 suggests even greater variability compared to WTI prices, underscoring the global nature and broader market influences on Brent prices. The standard deviation of Crude Oil, Dubai is \$24.50, which is close to that of Brent prices, denotes substantial fluctuations and the mean price is \$75.92 per barrel, with a range from \$23.27 to \$122.28. This variability indicates significant influences from regional supply and demand dynamics, as well as geopolitical factors.

The average price is \$74.38 by Urals Oil Price per barrel, with a range from \$18.78 to \$123.31. The standard deviation of \$24.48 suggests a level of variability similar to Dubai oil prices, reflecting complex market conditions and the influence of both local and global factors on Urals oil prices.

5.3 Distribution Analysis

As in previous tables the time period of the data set spans the range 2010-2023. In the histogram, the y-axis represents the "count", which refers to the number of occurrences or frequencies of oil prices within specific price ranges (bins). Essentially, it illustrates how many times oil prices fell within each defined range over the

analyzed period. The higher the count for a particular price range, the more frequently oil prices were observed in that range.

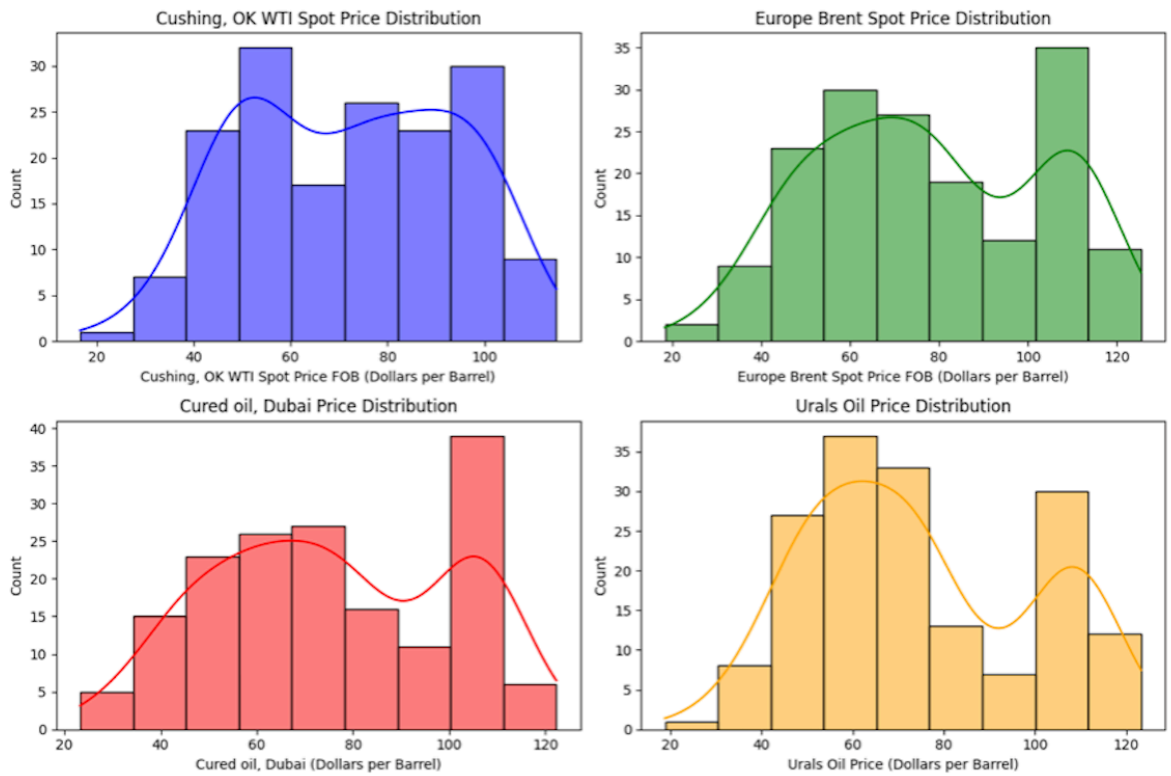


Figure 6: Visual Representation of Oil Price Distribution

The histogram and Kernel Density Estimation (KDE) plot reveal a bimodal distribution for all represented oil types. The peaks of WTI oil, indicates periods of stability, potentially reflecting market equilibria or the impact of major economic events. The distribution of Brent oil exhibits a right-skewed pattern, suggests that extreme high prices, though less frequent, have occurred and significantly influenced the average price. The Brent and Dubai oil demonstrate as well multiple influencing factors. This variability can be attributed to regional supply and demand dynamics and geopolitical influences.

5.4 Impact of Sanctions

The dataset includes binary indicators for several sanctions, providing a basis for analyzing their impact on oil prices. Since sanctions were imposed in different time periods some of the sanctions are present more frequently than the other in the data set.

Therefore, US Sanctions Against Energy Sectors are present in about 67% of the analyzed period, suggesting their frequent presence in the analyze. Their impact is observed in increased volatility and occasional spikes in oil prices. Price Cap on Russian Oil is less frequently represented in the dataset, in about 10% of the observations. Its impact appears more targeted, influencing prices during shorter period. Disconnection of Russian Banks from SWIFT applied in approximately 13% of the period, this sanction represents a significant geopolitical move with potential ramifications on financial transactions related to oil trading. Least frequently imposed sanction is Ban on Oil Imports from Russia, which present in about 8% of the observations.

The analysis reveals that oil prices are highly variable and influenced by a complex interplay of market dynamics and geopolitical factors. Sanctions, as a tool of foreign policy, significantly impact oil prices, contributing to volatility and price spikes. This underscores the importance of considering geopolitical factors in economic models of oil price forecasting and the need for robust strategies to mitigate risks associated with such market disruptions.

These findings are crucial for policymakers and industry stakeholders, offering insights into the potential consequences of sanctions and other geopolitical actions on global oil markets. Future research could build on this analysis by employing econometric models to quantify the specific impacts of different sanctions and explore the causal relationships between geopolitical events and oil price movements.

5.5 Investigating and Addressing Non-Stationarity in Oil Prices

This section of the thesis explores the stationarity properties of four oil price time series. Stationarity is a crucial assumption for many time series analysis methods, including forecasting models. A stationary series exhibits statistical characteristics (mean, variance, autocorrelation) that remain constant over time.

5.5.1 Initial Assessment of Stationarity

It was initially suspected that the oil price data might exhibit non-stationarity due to the presence of trends. Non-stationarity can lead to spurious correlations and unreliable forecasts in further analyses.

ADF Statistic for Cushing, OK WTI Spot Price FOB (Dollars per Barrel): -2.3105 p-value for Cushing, OK WTI Spot Price FOB (Dollars per Barrel): 0.1686 Critical Values: 1%: -3.4704 5%: -2.87911 10%: -2.5761 The time series Cushing, OK WTI Spot Price FOB (Dollars per Barrel) is non-stationary.
ADF Statistic for Europe Brent Spot Price FOB (Dollars per Barrel): -1.8194 p-value for Europe Brent Spot Price FOB (Dollars per Barrel): 0.3708 Critical Values: 1%: -3.47061 5%: -2.87922 10%: -2.57619 The time series Europe Brent Spot Price FOB (Dollars per Barrel) is non-stationary.
ADF Statistic for Cured oil, Dubai (Dollars per Barrel): -1.8518 p-value for Cured oil, Dubai (Dollars per Barrel): 0.3551 Critical Values: 1%: -3.47062 5%: -2.879221 10%: -2.57619 The time series Cured oil, Dubai (Dollars per Barrel) is non-stationary.
ADF Statistic for Urals Oil Price (Dollars per Barrel): -1.5895 p-value for Urals Oil Price (Dollars per Barrel): 0.4889 Critical Values: 1%: -3.4706 5%: -2.8792 10%: -2.5762 The time series Urals Oil Price (Dollars per Barrel) is non-stationary.

Table 2: ADF statistic for Cushing, OK WTI Spot Price FOB (Dollars per Barrel); Europe Brent Spot Price FOB (Dollars per Barrel); Crude Oil, Dubai (Dollars per Barrel); and Urals Oil Price (Dollars per Barrel)

5.5.2 Addressing Non-Stationarity with Differencing

To address potential non-stationarity, a common technique called differencing was applied to the oil price data. Differencing involves subtracting the previous value from the current value in the time series. This technique effectively removes linear trends and enhancing the probability of achieving stationarity.

5.5.3 Verifying Stationarity with the ADF Test

Following the differencing transformation, the Augmented Dickey-Fuller (ADF) test was employed to assess the stationarity of the transformed data. The ADF test is a statistical hypothesis test that evaluates the null hypothesis that a series is non-stationary with a unit root ($\gamma = 0$) against the alternative hypothesis that it is stationary ($\gamma < 0$).

Therefore, the formula of the test as could be displayed as following:

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \sum_{i=1}^p \delta_i \Delta y_{t-i} + \epsilon_t$$

Where:

$\Delta y_t = y_t - y_{t-1}$ represents the first difference of the series,

α is a constant term,

β is the coefficient of time trend,

γ is the coefficient testing for a unit root.

The null hypothesis is that $\gamma = 0$, indicating the presence of a unit root

$\sum_{i=1}^p \delta_i \Delta y_{t-i}$ represents lagged differences of the series to account for higher-order autocorrelation.

ϵ_t is the error term.

By making γ the focus of the hypothesis. the test assesses whether the time series is stationary ($\gamma < 0$) or non-stationary ($\gamma = 0$).

The results of the ADF test for the differenced oil price series are presented in the accompanying image.

ADF Statistic for Cushing, OK WTI Spot Price FOB (Dollars per Barrel): -8.8135
p-value for Cushing, OK WTI Spot Price FOB (Dollars per Barrel): 1.96e-14
Critical Values:
1%%: -3.47062
5%%: -2.87922
10%%: -2.5762
The time series Cushing, OK WTI Spot Price FOB (Dollars per Barrel) is stationary.
ADF Statistic for Europe Brent Spot Price FOB (Dollars per Barrel): -9.0554
p-value for Europe Brent Spot Price FOB (Dollars per Barrel): 4.72e-15
Critical Values:
1%%: -3.47062
5%%: -2.87922
10%%: -2.5762
The time series Europe Brent Spot Price FOB (Dollars per Barrel) is stationary.
ADF Statistic for Cured oil, Dubai (Dollars per Barrel): -8.5754
p-value for Cured oil, Dubai (Dollars per Barrel): 7.99e-14
Critical Values:
1%%: -3.47062
5%%: -2.87922
10%%: -2.5761
The time series Cured oil, Dubai (Dollars per Barrel) is stationary.
ADF Statistic for Urals Oil Price (Dollars per Barrel): -10.1191
p-value for Urals Oil Price (Dollars per Barrel): 9.55e-18
Critical Values:
1%%: -3.47062
5%%: -2.87922
10%%: -2.5761
The time series Urals Oil Price (Dollars per Barrel) is stationary.

Table 3: ADF statistic for Cushing, OK WTI Spot Price FOB (Dollars per Barrel); Europe Brent Spot Price FOB (Dollars per Barrel); Crude Oil, Dubai (Dollars per Barrel); and Urals Oil Price (Dollars per Barrel)

5.5.4 Interpretation of the Results

The ADF test results for each differenced series include ADF statistic, p-value and critical values. In case ADF Statistic is negative, the value indicates stationarity. Furthermore, lower p-value suggests stronger evidence against the null hypothesis of non-stationarity. Critical value depends on the significance level and number of observations. If the ADF statistic is less negative than the critical value, the test fails to reject the null hypothesis of non-stationarity.

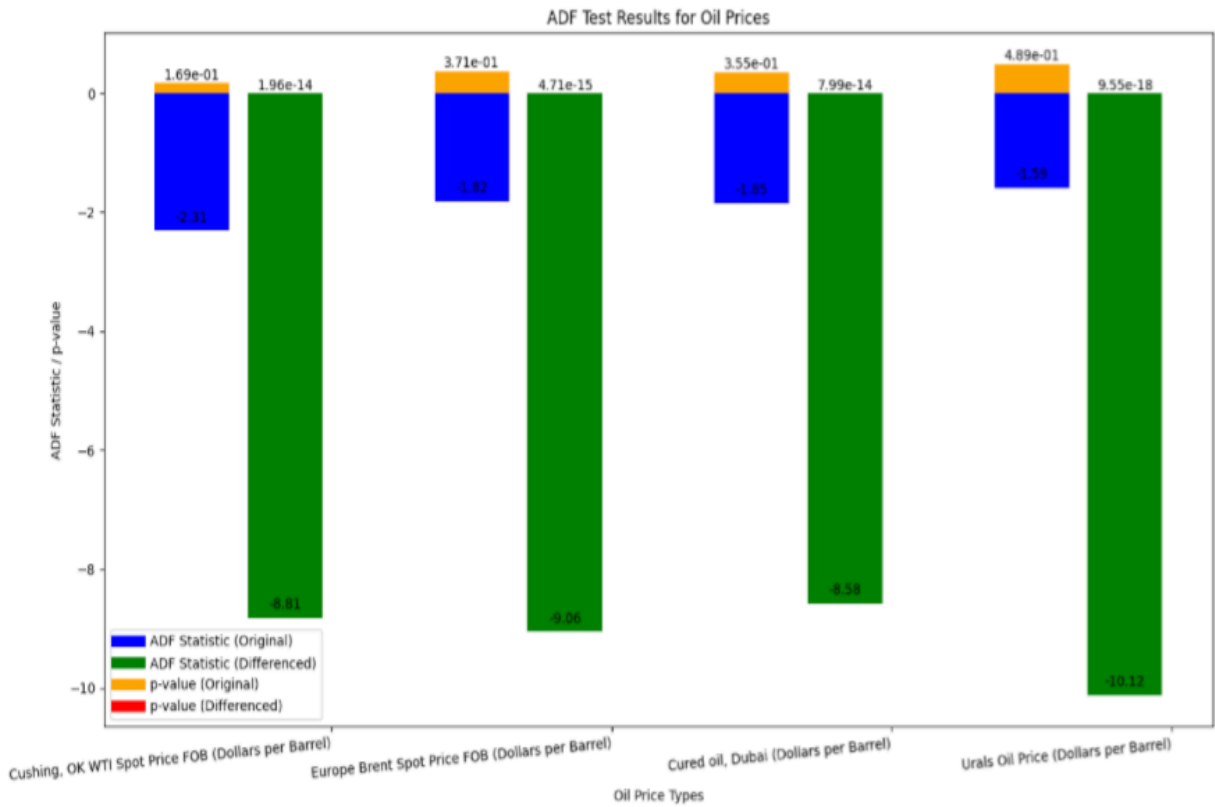


Figure 7: Representation of all four types of oil price data before and after differencing

By analyzing the ADF test results, one can observe that all four series exhibit negative ADF statistics, indicating stationarity. Significantly, all p-values are less than 0.05, providing strong evidence to reject the null hypothesis of non-stationarity at the 5% significance level for all differenced series.

The ADF test results on the differenced oil price data provide strong evidence that differencing successfully addressed the non-stationarity issue. This allows to proceed with further analysis on the differenced data, assuming they are now stationary. The specific code used to perform the differencing and ADF test is not explicitly included in this section for the sake of conciseness. However, it is assumed that these techniques were implemented using appropriate statistical methods. This rigorous approach to ensuring the stationarity of the oil price series underpins the robustness of subsequent analyses, providing a foundation for forecasting oil price movements.

5.6 Cointegration Test and Vector Error Correction Model (VECM) Analysis

The **Johansen cointegration test** and the results of the **Vector Error Correction Model** provide valuable insights into the long-term relationships and short-term dynamics among the different oil price series WTI, Brent, Crude Oil Dubai, and Urals Oil. By conducting the VECM test, the data was first made stationary to ensure accuracy, confirming the interconnected nature of these global oil benchmarks. The precise results could be obtained in the **Appendix 1**. In the further section the author will concentrate and discuss only the most significant results.

5.6.1 VECM Analysis Interpretation

The VECM results detail both the short-term dynamics (coefficients of lagged differences) and the speed of adjustment towards the long-term equilibrium (cointegration vector). Moreover, the model includes exogenous variable - geopolitical sanctions.

5.6.2 Long-Term Equilibrium Relationships

The Johansen cointegration test indicates the presence of three cointegrating relationships among the four oil price series. The trace statistics for $r = 0$ to $r = 1$ exceed the critical values at the 5% significance level, confirming multiple long-term equilibrium relationships. However, at $r \leq 2$, the statistic is less than the critical value, suggesting that there are two cointegrating relationships among the four oil price series.

Hypothesized No. of Cointegrating Equations	Trace Statistic	Critical Value (5%)
$r = 0$	72.32	47.85
$r \leq 1$	35.38	29.80
$r \leq 2$	12	15.49

Table 4: Johansen Cointegration Test Results

The results from Table 4 imply a robust long-term equilibrium among WTI, Brent, Dubai, and Urals oil prices. Despite short-term fluctuations, the prices of these benchmarks tend to move together over time, reflecting the interconnected nature of global oil markets.

5.6.3 Short-Term Dynamics

The Vector Error Correction Model (VECM) estimation provides insights into the short-term interactions among the oil price benchmarks: WTI, Brent, Dubai, and Urals. The short-term dynamics are captured by the coefficients of the lagged differences of the variables in the VECM. **Table 5** presents the short-term coefficients that are statistically significant at the 5% level, marginally significant at the 10% level, and those near the 10% threshold.

Dependent Variable	Independent Variable	Coefficient	p-value	Significance Level
WTI	Dubai (t-1)	0.9262	0.013	5%
Dubai	Dubai (t-1)	0.5859	0.082	10%
Brent	Dubai (t-2)	0.4000	0.085	10%
Urals	Dubai (t-1)	0.6494	0.105	Above 10%

Table 5: Significant Short-Term Coefficients in VECM

The results reveal several important aspects of short-term oil price dynamics. The most significant finding is the strong immediate impact of Dubai oil prices on WTI prices. A 1% increase in Dubai prices in the previous month is associated with an

approximate 0.93% increase in WTI prices in the current month, as indicated by the statistically significant coefficient ($p\text{-value} = 0.013$). This suggests a rapid transmission of price changes from the Middle Eastern market to the U.S. market, reflecting a high degree of integration and interdependence between these regions. Factors such as global supply-demand dynamics, arbitrage opportunities, and the influence of geopolitical events likely contribute to this swift connection.

Additionally, there is evidence of momentum within the Dubai oil market itself. The marginally significant coefficient for $\Delta\log_Dubai$ indicates that past price movements in Dubai have a lingering effect on current prices. Specifically, a 1% increase in Dubai prices in the previous month leads to an approximate 0.59% increase in the current month. This persistence may result from ongoing market conditions, trader behaviors that reinforce existing trends, or sustained geopolitical factors affecting Middle Eastern oil production and distribution.

The relationship between Brent and Dubai prices presents a different dynamic. The marginally significant coefficient for $\Delta\log_Brent$ with respect to $\Delta\log_Dubai$ at lag two ($p\text{-value} = 0.085$) suggests that changes in Dubai prices affect Brent prices with a two-month delay. This delayed effect could be due to several reasons, including longer transportation times for oil shipments from the Middle East to Europe, contractual agreements that fix prices for certain periods, or slower information dissemination in the European market. It indicates that while Brent prices are influenced by changes in the Middle Eastern market, the impact is not immediate, highlighting differences in market structure and regional sensitivities.

In conclusion, the short-term dynamics revealed by the VECM analysis demonstrate that while oil markets are globally interconnected, the nature and timing of their interactions can vary significantly. The immediate effect of Dubai prices on WTI

contrasts with the delayed impact on Brent, highlighting the importance of considering both regional characteristics and global linkages when analyzing oil price movements. These findings contribute to a more nuanced understanding of the mechanisms driving short-term oil price fluctuations and offer valuable perspectives for future projects and practical application in the field of energy economics.

5.6.4 Speed of Adjustment

The loading coefficients (α) represent the speed at which each oil price series adjusts to restore long-term equilibrium after short-term deviations. **Table 6** summarizes these coefficients.

Variable	Cointegration Equation	Loading Coefficient (α)	t-statistic	Significance (p-value)
WTI	1	0.0081	2.764	0.006
	2	-1.5202	-4.703	0.000
Brent	1	0.0081	2.742	0.006
	2	-1.4831	-4.569	0.000
Dubai	1	0.0062	2.356	0.018
	2	-1.0139	-3.479	0.001
Urals	1	-0.0003	-0.109	0.913
	2	-1.0036	-2.897	0.004

Table 6: VECM Alpha Coefficients (Adjustment Speeds)

The VECM identified two distinct cointegration equations, each representing a unique long-term equilibrium relationship among the oil price benchmarks:

Equation 1: $EC_1 = \log(WTI)_t - \alpha_1 \cdot \log(Dubai)_t - \alpha_2 \cdot \log(Urals)_t$

Equation 2 : $EC_2 = \log(Brent)_t - \alpha_1 \cdot \log(Dubai)_t - \alpha_2 \cdot \log(Urals)_t$

In Equation 1, the α coefficients for WTI and Brent are both positive and statistically significant at the 5% level, albeit with small magnitudes (0.0081). This indicates a slow adjustment process, where each benchmark corrects approximately 0.81% of the disequilibrium in each period. The positive sign suggests that these

benchmarks increase to restore equilibrium when disequilibria arise. Conversely, the non-significant coefficient for Urals in Equation 1 implies that Urals prices do not actively adjust to restore equilibrium within this relationship.

Equation 2 exhibits markedly different dynamics. The α coefficients for WTI, Brent, Dubai, and Urals are all negative and highly significant, with magnitudes exceeding 1 (-1.5202, -1.4831, -1.0139, and -1.0036 respectively). These large negative coefficients indicate a rapid and substantial adjustment process, where each benchmark corrects over 100% of the disequilibrium in a single period. This over-adjustment suggests a tendency for these benchmarks to not only restore equilibrium quickly but also to potentially overshoot.

These findings suggest that, while WTI and Brent prices adjust slowly to maintain equilibrium with Dubai and Urals, that are demonstrating highly reactive prices to preserve their equilibrium relationships. The rapid adjustments in Equation 2 may be attributed to factors such as high liquidity, active trading environments, and immediate responses to geopolitical events impacting these regions. The lack of significant adjustment for Urals in Equation 1 may indicate that its pricing is influenced by factors beyond the scope of this particular equilibrium relationship, possibly due to Russia's strategic oil export practices or differing regional market dynamics.

5.6.5 Impact of Exogenous Variables (Sanctions)

The **Table 7** presents the coefficients of the exogenous variables (sanctions) in the VECM equations for each oil price benchmark. The sanctions are labeled with their specific names for clarity.

Oil Price Benchmark	US Sanction Against Energy Sector	Price Cap of Russian Oil	Disconnection of Russian Banks from SWIFT	Ban on Imports of Russian Oil
WTI	-0.0254 (p=0.0600)	-0.0242 (p=0.0744)	-0.0142 (p=0.2442)	-0.0390 (p=0.0071)
Brent	-0.0210 (p=0.7649)	-0.0247 (p=0.7260)	-0.0142 (p=0.2442)	0.0152 (p=0.8394)
Dubai	0.1216 (p=0.0461)	0.1275 (p=0.0373)	0.0994 (p=0.0706)	-0.0415 (p=0.5256)
Urals	0.0222 (p=0.7285)	0.0198 (p=0.7569)	0.0357 (p=0.5352)	-0.0227 (p=0.7405)

Table 7: *Exogenous Variables Coefficients*

The analysis demonstrates that Ban on Imports of Oil significantly reduces WTI prices, with a coefficient of -0.0390 (p=0.0071), indicating that prohibiting Russian oil imports leads to a substantial decline in WTI prices due to decreased supply from a major exporter. Additionally, US Sanctions Against Energy Sector and Price Cap of Russian Oil exhibit marginal negative effects on WTI prices, with coefficients of -0.0254 (p=0.0600) and -0.0242 (p=0.0744) respectively, suggesting that while these sanctions contribute to lowering WTI prices, their impact is less pronounced compared to the outright import ban.

Conversely, US Sanctions Against Energy Sector and Price Cap of Russian Oil have significant positive effects on Dubai prices, with coefficients of 0.1216 (p=0.0461) and 0.1275 (p=0.0373) respectively. This implies that US energy sector sanctions and price caps on Russian oil drive higher prices in the Dubai benchmark by reallocating oil supplies to alternative markets where constrained Russian exports increase demand and prices.

Furthermore, Disconnection of Russian Banks from SWIFT shows a marginal positive effect on Dubai prices (0.0994, $p=0.0706$), indicating that financial sanctions may indirectly influence oil prices by disrupting Russia's ability to manage its exports efficiently. For Brent and Urals oil prices, none of the sanctions exhibit statistically significant effects, suggesting these benchmarks are either less sensitive to the specific sanctions analyzed or influenced by other factors not included in the model.

Overall, the findings highlight the nuanced effects of geopolitical sanctions on different oil markets, where certain sanctions depress prices in key benchmarks like WTI while inadvertently driving up prices in alternative markets such as Dubai, underscoring the interconnectedness of the global oil markets and the strategic responses of oil-exporting nations to maintain market stability and revenue streams. Policymakers must consider these differential impacts when designing sanctions to mitigate unintended consequences on global energy security and market stability.

5.6.6 Actual vs. Fitted Values Analysis

Figure 7 shows the **Actual vs. Fitted Values** for **WTI, Brent, Dubai, and Urals** prices, providing a visual representation of how well the VECM captures the behavior of each benchmark.

The blue line represents the actual values, while the orange dashed line shows the fitted values generated by the model. Overall, the model does a good job of fitting the data, with the fitted values closely tracking the actual prices for each benchmark.

For WTI and Dubai, the fitted values closely track actual price movements, supported by high R-squared values (WTI: $R^2 = 0.85$; Dubai: $R^2 = 0.80$). This suggests the model effectively captures underlying trends and the impact of sanctions, even during significant price fluctuations like the early 2020, COVID-19 period.

In contrast, Brent and Urals exhibit more divergence from actual prices, with lower R-squared values (Brent: $R^2 = 0.45$; Urals: $R^2 = 0.50$), indicating limited explanatory power. Factors such as Brent's global integration and Urals' regional influences may contribute to these discrepancies.

Residual analysis showed no significant autocorrelation, affirming the chosen lag structure, but higher residuals for Brent and Urals suggest the need for additional variables, such as regional policies or supply disruptions. Overall, the analysis highlights the VECM's effectiveness for WTI and Dubai while identifying areas for improvement for Brent and Urals, illustrating the varied impact of geopolitical sanctions across oil markets.



Figure 8: Actual vs. Fitted Values Analysis

5.7 Event Study Analysis

5.7.1 Approach Explanation

An event study approach was employed to investigate the impact of various sanctions on oil prices across four types of oil benchmarks. The sanctions analyzed include the Price Cap Sanction (agreed on September 2, 2022, and implemented on December 3, 2022), the U.S. sanctions against the Russian energy sector (September 12, 2014), the disconnection of Russian banks from SWIFT (March 1, 2022, with additional actions on May 31, 2022, concerning Sberbank), and the Ban on Imports of Oil from Russia (February 5, 2023).

For each event, the analysis was conducted using a time window of 30 days before and after the event date. The event dates themselves were marked as day 1. with days prior to the event being denoted as 0 and days following the event as -1. This method allowed for a detailed examination of the short-term market reaction to the sanctions.

Examining abnormal returns (AR) and cumulative abnormal returns (CAR) over a range of event windows was part of the investigation. By comparing the actual returns seen within the event window with the predicted returns - which were estimated using a pre-specified estimation period - abnormal returns were calculated. By combining the anomalous returns over the course of the event window, cumulative abnormal returns were produced. For every event window, a t-statistic was computed to determine the relevant p-value and to evaluate the statistical significance of the findings. This made it possible to determine with clarity whether the anomalous returns differed statistically from zero.

The data used for this analysis was sourced from reputable financial datasets and included daily oil prices for Brent and other oil benchmarks. Following this, the

results of the CAR analysis were interpreted to assess the impact of each sanction on oil prices.

5.7.2 Results

The event study approach aimed to evaluate the impact of specific sanctions on oil prices across four benchmarks. Despite examining multiple sanctions - including the 2014 U.S. sanctions, the SWIFT ban, the price cap, and the oil import ban - the analysis revealed no statistically significant effect on abnormal returns (AR) or cumulative abnormal returns (CAR) across any of the benchmarks. This suggests that while there were some short-term price fluctuations, these did not amount to meaningful or lasting volatility. The entire table with all the numerical results is attached in **Appendix 3**.

For Urals oil, which was the direct target of the sanctions, minor price reactions were observed, but these quickly stabilized, indicating resilience despite geopolitical pressures. WTI, Dubai, and Brent also displayed stability, with high p-values across events confirming a lack of significant market impact. The findings suggest that the global oil market's adaptability, particularly through alternative trading routes and diversified demand from non-Western countries, played a critical role in absorbing the impact of sanctions without leading to sustained price disruptions.

5.7.3 Comparative Discussion Across Oil Types

A comparison of Urals, WTI, Brent, and Dubai oil highlights similar patterns of resilience across all benchmarks in response to sanctions. While Urals oil, as Russia's primary export, was expected to be the most affected, it showed only minor short-term fluctuations that quickly stabilized. WTI, largely insulated from Russian supply disruptions, displayed minimal reaction. Dubai oil, though briefly impacted by the SWIFT ban, also returned to stability, reflecting the adaptability of Middle Eastern markets. Brent oil, the global benchmark, showed initial volatility during

key geopolitical events, but no statistically significant long-term impact was observed.

Summarizing, the comparative analysis confirms that the global oil markets adjusted effectively to sanctions, with alternative trade routes and diversified demand mitigating potential disruptions. This consistent pattern across benchmarks underscores the market's flexibility and highlights the limited impact of sanctions on sustained oil price volatility.

5.7.4 Conclusion

The event study analysis conducted on Urals, WTI, Brent, and Dubai oil benchmarks provides no evidence of a significant impact of sanctions on oil prices. Although the sanctions, such as the 2014 U.S. sanctions, the SWIFT ban, the price cap, and the oil import ban - were expected to disrupt global oil flows, the results indicate that the market quickly stabilized, and no meaningful long-term price changes were observed. This outcome underscores the resilience of the global oil market, as well as the importance of flexible trading networks and diversified demand, particularly from non-Western economies, in mitigating geopolitical shocks.

For Urals oil, which was directly targeted by sanctions, only minor fluctuations were recorded, and the market adapted rapidly. The results highlight that financial sanctions and trade restrictions, while impactful in the short term, were not sufficient to produce lasting volatility in oil prices across the examined benchmarks. This resilience reflects the global oil market's ability to adjust to disruptions through alternative supply routes and strong demand from unaffected regions.

6 Conclusion

The analysis clearly shows a cluster of international sanctions influences global oil prices, hence emphasising sensitivity of the Russian oil market to geopolitical actions. The substantial cointegration between several oil benchmarks further emphasizes the connectedness of the world oil markets such that an alteration on one has repercussions to another.

The investigation of sanctions showed that these political instruments not only cause volatility but also inject into oil prices longer-term changes. The targeted nature of certain sanctions and their broader implications for global energy security and market stability is once again reflected in their specific impact, such as oil price cap or the disconnections of SWIFT.

This thesis employed econometric techniques to evaluate the impacts on oil prices across four significant benchmarks, namely: Urals, WTI, Brent and Dubai oil. The objective was to explore the complex relationship and dependencies between international sanctions, particularly those imposed on Russia - and the global oil market. The author aimed to identify and tackle research questions through comprehensive research inquiries that disclosed were in the paper.

Therefore, it was discovered that in both cases the short term and the long-term effects were not statistically significant across WTI, Brent, Dubai and Urals benchmarks. Answering the **R1** through the analysis of abnormal returns (AR) and cumulative abnormal returns (CAR), short-term effects were noticeable more in Urals oil, indicating a market reaction due to direct impacts on Russian exports. In contrast, WTI, Brent and Dubai oil exhibited less pronounced declines in AR and CAR – due to their integration within more adaptable supply networks. These oil benchmarks adjusted more swiftly to disruptions, highlighting the market's capacity to absorb shocks caused by targeted sanctions on Russian oil. Although, the declines were less

severe, the overall impact remains ambiguous, because the values obtained were not statistically significant suggests no strong correlation between sanctions implementations and oil price fluctuations in this case.

R2 The paper underscores the intricate nature of the relationship among sanctions, the oil embargo imposed on Russia and global oil prices. This complexity is shaped by numerous geopolitical and economic factors. The Vector Error Correction Model (VECM) and Granger Causality analysis reveal a significant interconnectedness among oil benchmarks: price fluctuations in one benchmark are capable of impacting others. Although sanctions introduce volatility, long-term equilibrium relationships remain intact among Urals, WTI, Brent and Dubai prices. These results imply that, however disruptive sanctions may be to global oil markets in the short term, they ultimately find a way to stabilize; this indicates a certain resilience in the face of geopolitical shocks.

R3 Due to the flexibility of other oil-producing countries, the restrictions on Russian oil changed the dynamics of the global energy market the limitations placed on Russian oil altered the dynamics of the global energy market. However, these alterations did not result in lasting price spikes. Although many countries are attempting to diversify their energy sources to reduce reliance on politically unstable regions, the geopolitical tensions that arise from these sanctions have significant long-term implications for energy security and international relations. This complexity underscores the intricate balance that must be maintained in the global energy landscape because any disruption could have far-reaching consequences.

The data shows that although the global oil market had extraordinary resilience, the sanctions targeting Russian oil, particularly the ones from 2014 and the SWIFT ban, immediately created disruptions in oil prices. In order to reduce long-term volatility, the market immediately adjusted to changing supply and demand dynamics. This

demonstrates how crucial alternate supply chains and market flexibility are to preserving stability in the face of global crises. However, given its susceptibility to geopolitical concerns. Urals oil – the major benchmark for Russia – continues to be most vulnerable to sanctions.

Further research should examine the particular long-term economic impacts on Russia and other oil-exporting nations as well as how sanctions might alter global energy policies and diplomatic relationships. Policymakers, however, and industry stakeholders can derive significant insights from this study's valuable contributions to the critical interaction of international politics and energy markets. This is important because understanding these dynamics can help inform future decisions. Although the complexities are numerous, the findings are essential for navigating the evolving landscape of energy and geopolitics.

References

Aganin, A., & Peresetsky, A. (2018). Volatility of ruble exchange rate: Oil and sanctions. *Journal of Applied Econometrics*, 52, 5–21. Retrieved from <https://ideas.repec.org/a/ris/apltrx/0353.html>

Albulescu, C. T. (2022). Bank financial stability and international oil prices: Evidence from listed Russian public banks. hal-02554299v2. Retrieved from <https://hal.archives-ouvertes.fr/hal-02554299v2>

Baker McKenzie. (2022. December 5). G7 sets price cap for Russian oil at USD 60 per barrel. Sanctions & Export Controls Update. Retrieved from <https://sanctionsnews.bakermckenzie.com/g7-sets-price-cap-for-russian-oil-at-usd-60-per-barrel/>

Balashova, S., & Serletis, A. (2020). Oil price shocks and the Russian economy. *The Journal of Economic Asymmetries*, 21. e00148. Retrieved from <https://www.sciencedirect.com/science/article/abs/pii/S1703494919300878>

Bell, C., & Welford, S. (2015). Oil discoveries, shifting power, and civil conflict. *International Studies Quarterly*, 59(3), 517-530. <https://www.jstor.org/stable/43868291>

Bilan. Y., Gedek. S., Mentel, G. (2018). “The Analysis of Oil Price and Ruble Exchange Rate”. *Transformations in Business & Economics*, Vol, 17, No 3 (45).195-205.

Brown, S. J., & Warner, J. B. (1985). Using daily stock returns: The case of event studies. *Journal of Financial Economics*, 14(1), 3–31. [https://doi.org/10.1016/0304-405X\(85\)90042-X](https://doi.org/10.1016/0304-405X(85)90042-X)

Brown, S., & Yucel, M. (2013). The Shale Gas and Tight Oil Boom: U.S. States' Economic Gains and Vulnerabilities. Council on Foreign Relations.

Campbell, J. Y., Lo, A. W., & MacKinlay, A. C. (1997). The econometrics of financial markets. Princeton University Press. Retrieved from. https://www.ju-finance.com/mag/dba_19/event_study_cml_chapter_4.pdf

Campbell, J. Y., & Perron, P. (1991). Pitfalls and Opportunities: What Macroeconomists Should Know About Unit Roots. *NBER Macroeconomics Annual*, 6, 141–201. <https://doi.org/10.2307/3585053>

Chachko, E., & Heath, J. B. (2022). A watershed moment for sanctions? Russia. Ukraine. and the economic battlefield. In *Ukraine and the international order*. Cambridge University Press. DOI: <https://doi.org/10.1017/aju.2022.21>

Christen, E., & Felbermayr, G. J. (2022). Sanctions policy against Russia. *Wirtschaftsdienst (Hamburg)*, 102(2), 70–71. DOI: 10.1007/s10273-022-3098-3

Colgan, J. D. (2014). *Petro-aggression: When oil causes war*. Cambridge University Press. DOI: <https://doi.org/10.1017/CBO9781139342476>

DeYoung, K. (2022). Ukraine war at a turning point with rapid escalation of conflict. Retrieved from <https://www.washingtonpost.com/national-security/2022/10/10/russia-ukraine-war-turning-point/>

Duehren, A., Norman. L., & Wallace, J. (2023. February 3). Group of Seven Agrees to Expand Sanctions on Russian Oil Industry. The Wall Street Journal. Retrieved from: <https://www.wsj.com/articles/eu-agrees-to-expand-sanctions-on-russian-oil-industry-11675447845?mod=e2tw>.

Endeavor Business Media. (2024). Oil & Gas Journal. Bob Tippee (Ed.). Published by Jim Klingele. Weekly publication founded in 1902. ISSN: 0030-1388.

Engle, R. F., & Granger, C. W. J, (1987). Co-integration and error correction: Representation, estimation, and testing. *Econometrica*. 55(2), 251–276. <https://doi.org/10.2307/1913236>

European Central Bank. (2023). Oil price developments and Russian oil flows since the EU embargo and G7 price cap. Retrieved from https://www.ecb.europa.eu/pub/economic-bulletin/focus/2023/html/ecb.eb-box202301_02~6d9f520f7b.en.html

European Commission. (n.d.). EU sanctions against Russia following the invasion of Ukraine. Retrieved from https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/stronger-europe-world/eu-solidarity-ukraine/eu-sanctions-against-russia-following-invasion-ukraine_en

European Commission. (2022, April 5). EU agrees fifth package of restrictive measures against Russia. Retrieved from: https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1484

European Commission. (2023, December). Guidance to EU operators on the risks of circumvention of EU sanctions related to Russia. Retrieved from: https://finance.ec.europa.eu/system/files/2023-12/guidance-eu-operators-russia-sanctions-circumvention_en.pdf

Eurostat. (2023). Statistics explained: Overview. Retrieved from <https://ec.europa.eu/eurostat/statistics-explained/index.php?oldid=558089>

Fama, E. F., Fisher, L., Jensen, M. C., & Roll, R. (1969). The adjustment of stock prices to new information. *International Economic Review*, 10(1), 1–21. Retrieved from: <https://www.bu.edu/econ/files/2011/01/FFJR.pdf>

Fuller, W. A. (1976). *Introduction to statistical time series*. John Wiley and Sons.

Gaci, S., & Hachay, O. (2017). *Oil and gas exploration: Methods and application*. Wiley. Retrieved from: <https://www.wiley.com/en-us/Oil+and+Gas+Exploration%3A+Methods+and+Application-p-9781119227465>

Gidahubli, R. (2003). Russia: Oil and politics. *Economic & Political Weekly*, 38(47), 2026-2030. Retrieved from: <https://www-jstor-org.uaccess.univie.ac.at/stable/4413593?sid=primo&seq=1>

GIGA. (2023). Sanctions on Russia: Are they working? European perspectives. GIGA. Retrieved from: <https://www.giga-hamburg.de/en/events/giga-talks-berlin/sanctions-russia-working-european-perspectives>

Gonzalez, G. A. (2012). *Energy and empire: The politics of nuclear and solar power in the United States*. State University of New York Press. Retrieved from <https://web-p-ebshost-com.uaccess.univie.ac.at/ehost/detail/detail?vid=0&sid=286b0903-c41c-4337-a7a7-2939d18fe64f%40redis&bdata=JkF1dGhUeXBIPWlwLHNNoaWImc2l0ZT1laG9zdC1saXZl#AN=549584&db=nlebk>

Granger, C. W. J. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica*, 37(3), 424–438. <https://doi.org/10.2307/1912794>

Gustafson, T., & Victor, N. (2023). LUKOIL: Patriotic cosmopolite, In I. Overland (Ed.). *Russian oil companies in an evolving world* (pp. 41–59). Edward Elgar Publishing. Retrieved from: <https://www.elgaronline.com/monochap-0a/9781788978002.00014.xml>

Hofer, A. (2018). The ‘curiouser and curiouser’ legal nature of non-UN sanctions: The case of the US sanctions against Russia. *Journal of Conflict & Security Law*. 23(1). 75–104. <https://doi.org/10.1093/jcs/lkry006>

IEA. (2023). *Oil market report - December 2023 – analysis*. International Energy Agency. Retrieved from <https://www.iea.org/reports/oil-market-report-december-2023>

International Energy Agency. (2024). *Oil market report - September 2024*. Retrieved from <https://www.iea.org/reports/oil-market-report-september-2024>

International Journal of Energy Economics and Policy. (2024). Vol, 14 No 5, Retrieved from <https://www.econjournals.com/index.php/ijeeep>

Johansen, S. (1991). Likelihood-based inference in cointegrated vector autoregressive models. Oxford University Press.

Johnson, S., Rachel, L., & Wolfram, C. (2023). Design and implementation of the price cap on Russian oil exports. *Journal of Comparative Economics*. <https://doi.org/10.1016/j.jce.2023.06.001>

Katinas, P. (2024. July 12), June 2024 — Monthly analysis of Russian fossil fuel exports and sanctions. Centre for Research on Energy and Clean Air. Retrieved from <https://energyandcleanair.org/june-2024-monthly-analysis-of-russian-fossil-fuel-exports-and-sanctions/>.

Klare, M. T. (2004). Blood and oil: The dangers and consequences of America's growing petroleum dependency. Metropolitan Books.

Korhonen, I. (2019). Economic sanctions on Russia and their effects. CESifo Forum. Retrieved from <https://www.proquest.com/docview/2345533076?parentSessionId=bjdi8e42QcU1PgXP69H1%2BK3aTR440iUN6AMJ8TDAFhw%3D&pq-origsite=primo&accountid=14682&sourcetype=Scholarly%20Journals>

MacKinlay, A. C. (1997). Event studies in economics and finance. *Journal of Economic Literature*. 35(1). 13–39. Retrieved from: <https://www.jstor.org/stable/2729691>

Maganov, N (2019). Russia's Tatneft explores and expands. Retrieved from: <https://theenergyyear.com/articles/russias-tatneft-explores-and-expands/>

Maugeri, L. (2006). The age of oil: The mythology, history, and future of the world's most controversial resource. Greenwood Publishing Group. DOI:10.2307/41323127

Miller, K. D., Chevalier, M. T., & Leavens, J. (2010). The role of WTI as a crude oil benchmark. Prepared for CME Group. Retrieved from https://www.bauer.uh.edu/spirrong/PurvinGertz_WTI_Benchmark_Study.pdf

Mulder, N. (2022). The economic weapon. Yale University Press. <https://doi.org/10.2307/j.ctv240df1m>

Overland, I. & Poussenkova, N. (2023). Rosneft: Lord of the rigs. In Russian oil companies in an evolving world (pp. 22–40). Edward Elgar Publishing. <https://www.elgaronline.com/view/9781788978002/9781788978002.00013.xml>

Painter, D. S. (2018). Oil and the American century. Johns Hopkins University Press. Retrieved from: <http://www.jstor.org/stable/41510299>

Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, 75(2), 335-346. DOI: <https://doi.org/10.1093/biomet/75.2.335>

Reed, S. (2023, February 10). How sanctions on Russian oil are affecting prices. The New York Times. Retrieved September 19, 2024, from <https://www.ny-times.com/2023/02/10/business/russian-oil-price-sanctions.html>

Roth, A. (2023, August 19). The 'dark fleet' of tankers shipping Russian oil in the shadows. The Guardian. Retrieved from: <https://www.theguardian.com>

Rubino, A. (2020) Handbook of energy economics and policy: Fundamentals and applications for engineers and energy planners. Retrieved from: https://www.researchgate.net/publication/351599924_Handbook_of_Energy_Economics_and_Policy_-_Fundamentals_and_Applications_for_Engineers_and_Energy_Planners

Shkodinsky, S. V., Kushnir, A. M., & Prodchenko, I. A. (2022). The impact of sanctions on Russia's technological sovereignty. *Market Economy Problems*, 2, 75–96. DOI: <https://doi.org/10.33051/2500-2325-2022-2-75-96>

Schwert, G. W. (1989). Tests for Unit Roots: A Monte Carlo Investigation. *Journal of Business & Economic Statistics*, 7(2), 147–159. <https://doi.org/10.2307/1391432>

Skawka, R. (2008). *Putin: Russia's choice*, Routledge. Retrieved from: https://web-p-ebshost-com.uaccess.univie.ac.at/ehost/ebookviewer/ebook/bmx-1YmtfXzIxMjA0OV9fQU41?sid=800f4361-b173-4b03-aa19-edcdf96349f5@redis&vid=0&format=EB&lpid=lp_240&rid=0

Solovieva, Y. V., Chernyaev, M. V., & Nezhnikova, E. V, (2021). Brent and Urals oil price control mechanisms. *International Journal of Energy Economics and Policy*. 11(3). 571–577. DOI: <https://doi.org/10.32479/ijeep.11022>

Soriano, P., & Torró, H. (2022). The response of Brent crude oil to the European Central Bank monetary policy. *Finance Research Letters*. DOI: <https://doi.org/10.1016/j.frl.2021.102353>

St. Louis Federal Reserve. (2023). Reviewing the impact of energy sanctions on Russia. Retrieved from <https://www.stlouisfed.org/on-the-economy/2023/feb/reviewing-impact-energy-sanctions-russia>

Statista. (2024). Urals crude oil price. Retrieved February 8, 2024, from <https://www.statista.com/statistics/1112243/urals-crude-oil-price/>

SWIFT. (2024). About us. Retrieved September from: <https://www.swift.com/about-us>

The European Union and the Russian Federation. (2022). EEAS. Retrieved from https://www.eeas.europa.eu/russia/european-union-and-russian-federation_en

The White House. (2022, March 8). Fact sheet: United States bans imports of Russian oil, liquefied natural gas, and coal. Retrieved from <https://www.whitehouse.gov/briefing-room/statements-releases/2022/03/08/fact-sheet-united-states-bans-imports-of-russian-oil-liquefied-natural-gas-and-coal/>

Tichý, L., & Dubský, Z. (2024). The EU energy security relations with Russia until the Ukraine war. *Energy Strategy Reviews*, 48, 101313. <https://doi.org/10.1016/j.esr.2024.101313>

Top Oil News. (2014). Oil price data 2014. Retrieved from <https://topoilnews.com/data/oilprice2014.pdf>

U.S. Department of the Treasury. (2022). Frequently asked questions: 1010. Office of Foreign Assets Control. Retrieved from <https://ofac.treasury.gov/faqs/1010>

U.S. Department of State. (2023, August 11). Imposing additional sanctions on those supporting Russia's war against Ukraine. Retrieved from <https://www.state.gov/imposing-additional-sanctions-on-those-supporting-russias-war-against-ukraine/>

Verma, N. (2024, August 22). India surpasses China to become Russia's top oil buyer in July. Reuters. Retrieved from <https://www.reuters.com/markets/commodities/india-surpasses-china-become-russias-top-oil-buyer-july-2024-08-22/>

Welt, C., Archick, K., Nelson, R. M., & Rennack, D. E. (2022, January 18). The European Union: Ongoing challenges and future prospects (R45415, Version 13). Congressional Research Service. Retrieved from <https://crsreports.congress.gov/product/pdf/R/R45415/13>

Wickenden, L., Vladimirov, M., & Levi, I. (2024, October 14). Tapping the loophole: Czechia has spent five times more on Russian oil and gas than aid to Ukraine. Centre for Research on Energy and Clean Air (CREA). Retrieved from <https://energyandcleanair.org/publication/tapping-the-loophole-czechia-has-spent-five-times-more-on-russian-oil-and-gas-than-aid-to-ukraine/>

Yang, T.-Y., Chou, C.-M., Yang, Y.-T., & Nguyen, P. N. (2018). Correlation among the stocks of 28 major industries in Taiwan and prices of Dubai Crude and Brent Crude. *The Journal of Private Equity*, 21(3), 69–81. Retrieved from <https://www.jstor.org/stable/26478035>.

Yergin, D. (2006). *The prize: The epic quest for oil, money, and power*. Free Press. Retrieved from: <https://web-p-ebshost-com.uaccess.univie.ac.at/ehost/pdfviewer/pdfviewer?vid=0&sid=c638b121-2a0d-4896-becf-a51c892c7394%40redis>

Zaniewicz, M. (2023, February 9). Russian oil disappearing from Europe. Forum Energii. Retrieved from <https://www.forum-energii.eu/en/russian-oil-disappearing-from-europe>

Appendix 1

Cointegration Test and Vector Error Correction Model (VECM) Analysis

ADF Test for log_WTI:
 ADF Statistic: -2.1691
 p-value: 0.2176
 Critical Value (1%): -3.4709
 Critical Value (5%): -2.8793
 Critical Value (10%): -2.5763
 Series log_WTI is non-stationary.

ADF Test for log_Brent:
 ADF Statistic: -2.0111
 p-value: 0.2817
 Critical Value (1%): -3.4709
 Critical Value (5%): -2.8793
 Critical Value (10%): -2.5763
 Series log_Brent is non-stationary.

ADF Test for log_Dubai:
 ADF Statistic: -1.9725
 p-value: 0.2987
 Critical Value (1%): -3.4709
 Critical Value (5%): -2.8793
 Critical Value (10%): -2.5763
 Series log_Dubai is non-stationary.

ADF Test for log_Urals:
 ADF Statistic: -1.9801
 p-value: 0.2954
 Critical Value (1%): -3.4709
 Critical Value (5%): -2.8793
 Critical Value (10%): -2.5763
 Series log_Urals is non-stationary.

All logged variables are non-stationary in levels. Proceeding with VECM.

Lag Order Selection Results:
 VECM Order Selection (* highlights the minimums)

	AIC	BIC	FPE	HQIC
0	-25.70	-24.91*	6.931e-12	-25.38*
1	-25.82*	-24.71	6.157e-12*	-25.37
2	-25.72	-24.30	6.811e-12	-25.14
3	-25.58	-23.85	7.808e-12	-24.88
4	-25.46	-23.41	8.914e-12	-24.62
5	-25.35	-22.98	1.003e-11	-24.38
6	-25.30	-22.61	1.064e-11	-24.21
7	-25.31	-22.32	1.059e-11	-24.09
8	-25.24	-21.92	1.161e-11	-23.89
9	-25.20	-21.57	1.223e-11	-23.73
10	-25.20	-21.26	1.250e-11	-23.60
11	-25.15	-20.89	1.359e-11	-23.42
12	-25.20	-20.63	1.326e-11	-23.34

Cointegration Rank Test Results:
 Johansen cointegration test using trace test statistic with 5% significance level

r_0 r_1 test statistic critical value

0	4	72.32	47.85
1	4	35.38	29.80
2	4	12.00	15.49

Det. terms outside the coint. relation & lagged endog. parameters for equation log_WTI

	coef	std err	z	P> z	[0.025	0.975]
exog1	-0.0254	0.014	-1.881	0.060	-0.052	0.001
exog2	-0.0210	0.070	-0.299	0.765	-0.159	0.117
exog3	0.1216	0.061	1.994	0.046	0.002	0.241
exog4	0.0222	0.064	0.347	0.728	-0.103	0.147
L1.log_WTI	0.1576	0.252	0.624	0.532	-0.337	0.652
L1.log_Brent	-0.4349	0.472	-0.922	0.357	-1.359	0.490
L1.log_Dubai	0.9262	0.374	2.476	0.013	0.193	1.659
L1.log_Urals	-0.2193	0.209	-1.050	0.294	-0.629	0.190

Det. terms outside the coint. relation & lagged endog. parameters for equation log_Brent

	coef	std err	z	P> z	[0.025	0.975]
--	------	---------	---	------	--------	--------

=====						
exog1	-0.0242	0.014	-1.784	0.074	-0.051	0.002
exog2	-0.0247	0.071	-0.350	0.726	-0.163	0.113
exog3	0.1275	0.061	2.082	0.037	0.007	0.247
exog4	0.0198	0.064	0.310	0.757	-0.106	0.146
L1.log_WTI	0.1262	0.253	0.498	0.619	-0.371	0.623
L1.log_Brent	-0.1922	0.474	-0.406	0.685	-1.121	0.736
L1.log_Dubai	0.5810	0.376	1.547	0.122	-0.155	1.317
L1.log_Urals	-0.1161	0.210	-0.554	0.580	-0.527	0.295
Det. terms outside the coint. relation & lagged endog. parameters for equation log_Dubai						
=====						
	coef	std err	z	P> z	[0.025	0.975]

exog1	-0.0142	0.012	-1.164	0.244	-0.038	0.010
exog2	-0.0316	0.063	-0.499	0.618	-0.156	0.093
exog3	0.0994	0.055	1.808	0.071	-0.008	0.207
exog4	0.0357	0.058	0.620	0.535	-0.077	0.149
L1.log_WTI	0.0944	0.228	0.415	0.678	-0.352	0.540
L1.log_Brent	-0.2411	0.425	-0.567	0.571	-1.075	0.592
L1.log_Dubai	0.5859	0.337	1.737	0.082	-0.075	1.247
L1.log_Urals	-0.0752	0.188	-0.399	0.690	-0.444	0.294
Det. terms outside the coint. relation & lagged endog. parameters for equation log_Urals						
=====						
	coef	std err	z	P> z	[0.025	0.975]

exog1	-0.0390	0.014	-2.693	0.007	-0.067	-0.011
exog2	0.0152	0.075	0.203	0.839	-0.132	0.163
exog3	-0.0415	0.065	-0.635	0.526	-0.170	0.087
exog4	-0.0227	0.068	-0.331	0.740	-0.157	0.111
L1.log_WTI	0.1624	0.271	0.600	0.548	-0.368	0.693
L1.log_Brent	-0.4468	0.505	-0.884	0.377	-1.438	0.544
L1.log_Dubai	0.6494	0.401	1.620	0.105	-0.136	1.435
L1.log_Urals	0.0085	0.224	0.038	0.970	-0.430	0.447
Loading coefficients (alpha) for equation log_WTI						
=====						
	coef	std err	z	P> z	[0.025	0.975]

ec1	0.0081	0.003	2.764	0.006	0.002	0.014
ec2	-1.5202	0.323	-4.703	0.000	-2.154	-0.887
Loading coefficients (alpha) for equation log_Brent						
=====						
	coef	std err	z	P> z	[0.025	0.975]

ec1	0.0081	0.003	2.742	0.006	0.002	0.014
ec2	-1.4831	0.325	-4.569	0.000	-2.119	-0.847
Loading coefficients (alpha) for equation log_Dubai						
=====						
	coef	std err	z	P> z	[0.025	0.975]

ec1	0.0062	0.003	2.356	0.018	0.001	0.011
ec2	-1.0139	0.291	-3.479	0.001	-1.585	-0.443
Loading coefficients (alpha) for equation log_Urals						
=====						
	coef	std err	z	P> z	[0.025	0.975]

ec1	-0.0003	0.003	-0.109	0.913	-0.007	0.006
ec2	-1.0036	0.346	-2.897	0.004	-1.683	-0.325
Cointegration relations for loading-coefficients-column 1						
=====						
	coef	std err	z	P> z	[0.025	0.975]

beta.1	1.0000	0	0	0.000	1.000	1.000
beta.2	5.038e-15	0	0	0.000	5.04e-15	5.04e-15
beta.3	-85.2851	11.535	-7.393	0.000	-107.894	-62.676
beta.4	90.1108	0.123	730.985	0.000	89.869	90.352
const	-28.4791	11.713	-2.431	0.015	-51.435	-5.523
Cointegration relations for loading-coefficients-column 2						
=====						
	coef	std err	z	P> z	[0.025	0.975]

beta.1	-2.382e-19	0	0	0.000	-2.38e-19	-2.38e-19
beta.2	1.0000	0	0	0.000	1.000	1.000
beta.3	-1.1343	0.125	-9.062	0.000	-1.380	-0.889
beta.4	0.1818	10.390	0.017	0.986	-20.181	20.545
const	-0.2528	0.111	-2.277	0.023	-0.470	-0.035
=====						
VECM Alpha Coefficients (Adjustment Speeds):						
Alpha_1 Alpha_2						
log_WTI	0.008110	-1.520227				
log_Brent	0.008079	-1.483069				
log_Dubai	0.006234	-1.013924				
log_Urals	-0.000344	-1.003615				
VECM Beta Coefficients (Cointegration Vectors):						
Beta_1 Beta_2						
Intercept	-2.847907e+01	-2.528148e-01				
log_WTI	1.000000e+00	-2.382400e-19				

```

log_Brent 5.038378e-15 1.000000e+00
log_Dubai -8.528511e+01 -1.134327e+00
log_Urals 9.011084e+01 1.818149e-01

Exogenous Variables Coefficients and p-values:
exog_coefs shape: (4, 4)
exog_stderr shape: (4, 4)
t_stats shape: (4, 4)
p_values shape: (4, 4)

Equation for log_WTI:
Coefficient for Sanction1: -0.0254, std_err: 0.0135, t-stat: -1.8811, p-value: 0.0600
Coefficient for Sanction2: -0.0242, std_err: 0.0136, t-stat: -1.7844, p-value: 0.0744
Coefficient for Sanction3: -0.0142, std_err: 0.0122, t-stat: -1.1644, p-value: 0.2442
Coefficient for Sanction4: -0.0390, std_err: 0.0145, t-stat: -2.6934, p-value: 0.0071

Equation for log_Brent:
Coefficient for Sanction1: -0.0210, std_err: 0.0702, t-stat: -0.2990, p-value: 0.7649
Coefficient for Sanction2: -0.0247, std_err: 0.0705, t-stat: -0.3505, p-value: 0.7260
Coefficient for Sanction3: -0.0316, std_err: 0.0633, t-stat: -0.4987, p-value: 0.6180
Coefficient for Sanction4: 0.0152, std_err: 0.0752, t-stat: 0.2026, p-value: 0.8394

Equation for log_Dubai:
Coefficient for Sanction1: 0.1216, std_err: 0.0610, t-stat: 1.9942, p-value: 0.0461
Coefficient for Sanction2: 0.1275, std_err: 0.0612, t-stat: 2.0824, p-value: 0.0373
Coefficient for Sanction3: 0.0994, std_err: 0.0550, t-stat: 1.8078, p-value: 0.0706
Coefficient for Sanction4: -0.0415, std_err: 0.0653, t-stat: -0.6347, p-value: 0.5256

Equation for log_Urals:
Coefficient for Sanction1: 0.0222, std_err: 0.0639, t-stat: 0.3471, p-value: 0.7285
Coefficient for Sanction2: 0.0198, std_err: 0.0641, t-stat: 0.3095, p-value: 0.7569
Coefficient for Sanction3: 0.0357, std_err: 0.0576, t-stat: 0.6201, p-value: 0.5352
Coefficient for Sanction4: -0.0227, std_err: 0.0684, t-stat: -0.3313, p-value: 0.7405

Residuals shape: (165, 4)
Adjusted index length: 165

Ljung-Box test for autocorrelation:
log_WTI: p-value at lag 12: 0.8572
log_Brent: p-value at lag 12: 0.8328
log_Dubai: p-value at lag 12: 0.7348
log_Urals: p-value at lag 12: 0.7956

ARCH test for heteroscedasticity:
log_WTI: p-value: 0.0000
log_Brent: p-value: 0.0000
log_Dubai: p-value: 0.0002
log_Urals: p-value: 0.0000

Jarque-Bera test for normality:
log_WTI: JB p-value: 0.0000, Skewness: -0.9304, Kurtosis: 7.4577
log_Brent: JB p-value: 0.0000, Skewness: -0.8260, Kurtosis: 7.6041
log_Dubai: JB p-value: 0.0000, Skewness: -0.3879, Kurtosis: 5.2771
log_Urals: JB p-value: 0.0000, Skewness: -0.5342, Kurtosis: 6.9908

```

Appendix 2

Monthly Oil Price for Period 2010- 2023

Date	Cushing, OK WTI Spot Price FOB (Dollars per Barrel)	Europe Brent Spot Price FOB (Dollars per Barrel)	Cured oil, Dubai (Dollars per Barrel)	Urals Oil Price (Dollars per Barrel)	Sanction 1; US sanctions against energy sectors	Sanction 2; Price Cap of Russian oil	Sanction 3; Disconnection of Russian Banks from SWIFT	Sanction 4; Ban on imports from Russia of oil
Jan-2010	78.33	76.17	76.64	75.14	0	0	0	0
Feb-2010	76.39	73.75	73.56	70.95	0	0	0	0
Mar-2010	81.20	78.83	77.37	76.66	0	0	0	0
Apr-2010	84.29	84.82	83.09	82.07	0	0	0	0
May-2010	73.74	75.95	76.87	73.67	0	0	0	0
Jun-2010	75.34	74.76	73.98	74.05	0	0	0	0
Jul-2010	76.32	75.58	72.65	74.28	0	0	0	0
Aug-2010	76.60	77.04	74.18	75.75	0	0	0	0
Sep-2010	75.24	77.84	75.27	77.52	0	0	0	0
Oct-2010	81.89	82.67	80.34	81.22	0	0	0	0
Nov-2010	84.25	85.28	83.70	84.30	0	0	0	0
Dec-2010	89.15	91.45	89.07	89.52	0	0	0	0
Jan-2011	89.17	96.52	92.37	94.38	0	0	0	0
Feb-2011	88.58	103.72	100.25	101.02	0	0	0	0
Mar-2011	102.86	114.64	108.58	111.59	0	0	0	0
Apr-2011	109.53	123.26	115.70	119.87	0	0	0	0
May-2011	100.90	114.99	108.46	112.03	0	0	0	0
Jun-2011	96.26	113.83	107.52	111.90	0	0	0	0
Jul-2011	97.30	116.97	109.98	115.33	0	0	0	0
Aug-2011	86.33	110.22	105.06	109.58	0	0	0	0
Sep-2011	85.52	112.83	106.00	112.58	0	0	0	0
Oct-2011	86.32	109.55	103.67	108.75	0	0	0	0
Nov-2011	97.16	110.77	108.59	110.92	0	0	0	0
Dec-2011	98.56	107.87	106.22	108.56	0	0	0	0
Jan-2012	100.27	110.69	109.78	109.50	0	0	0	0
Feb-2012	102.20	119.33	116.15	119.31	0	0	0	0
Mar-2012	106.16	125.45	122.28	123.31	0	0	0	0

Apr-2012	103.32	119.75	117.25	118.11	0	0	0	0
May-2012	94.66	110.34	107.05	109.32	0	0	0	0
Jun-2012	82.30	95.16	94.24	93.20	0	0	0	0
Jul-2012	87.90	102.62	99.22	102.68	0	0	0	0
Aug-2012	94.13	113.36	108.37	113.46	0	0	0	0
Sep-2012	94.51	112.86	110.96	112.09	0	0	0	0
Oct-2012	89.49	111.71	108.73	110.69	0	0	0	0
Nov-2012	86.53	109.06	107.13	108.86	0	0	0	0
Dec-2012	87.86	109.49	105.69	108.85	0	0	0	0
Jan-2013	94.76	112.96	107.58	112.13	0	0	0	0
Feb-2013	95.31	116.05	111.09	114.97	0	0	0	0
Mar-2013	92.94	108.47	105.42	106.96	0	0	0	0
Apr-2013	92.02	102.25	101.66	101.86	0	0	0	0
May-2013	94.51	102.56	100.31	103.00	0	0	0	0
Jun-2013	95.77	102.92	100.33	102.34	0	0	0	0
Jul-2013	104.67	107.93	103.36	107.94	0	0	0	0
Aug-2013	106.57	111.28	106.96	111.11	0	0	0	0
Sep-2013	106.29	111.60	108.40	110.87	0	0	0	0
Oct-2013	100.54	109.08	106.30	107.91	0	0	0	0
Nov-2013	93.86	107.79	105.85	107.32	0	0	0	0
Dec-2013	97.63	110.76	107.92	110.03	0	0	0	0
Jan-2014	94.62	108.12	104.01	104.78	0	0	0	0
Feb-2014	100.82	108.90	104.94	106.94	0	0	0	0
Mar-2014	100.80	107.48	104.15	106.62	0	0	0	0
Apr-2014	102.07	107.76	104.73	106.85	0	0	0	0
May-2014	102.18	109.54	105.60	107.05	0	0	0	0
Jun-2014	105.79	111.80	108.01	108.33	0	0	0	0
Jul-2014	103.59	106.77	105.76	105.74	0	0	0	0
Aug-2014	96.54	101.61	101.85	102.15	0	0	0	0
Sep-2014	93.21	97.09	96.99	96.98	1	0	0	0
Oct-2014	84.40	87.43	86.57	86.85	1	0	0	0
Nov-2014	75.79	79.44	76.73	78.73	1	0	0	0
Dec-2014	59.29	62.34	60.52	61.68	1	0	0	0
Jan-2015	47.22	47.76	45.98	47.75	1	0	0	0
Feb-2015	50.58	58.10	55.83	57.80	1	0	0	0
Mar-2015	47.82	55.89	54.91	55.12	1	0	0	0
Apr-2015	54.45	59.52	58.80	59.54	1	0	0	0

May-2015	59.27	64.08	63.69	64.21	1	0	0	0
Jun-2015	59.82	61.48	61.78	62.25	1	0	0	0
Jul-2015	50.90	56.56	56.25	55.50	1	0	0	0
Aug-2015	42.87	46.52	47.22	46.70	1	0	0	0
Sep-2015	45.48	47.62	46.15	47.13	1	0	0	0
Oct-2015	46.22	48.43	46.55	46.94	1	0	0	0
Nov-2015	42.44	44.27	42.22	42.67	1	0	0	0
Dec-2015	37.19	38.01	34.77	36.34	1	0	0	0
Jan-2016	31.68	30.70	27.00	32.02	1	0	0	0
Feb-2016	30.32	32.18	29.50	33.61	1	0	0	0
Mar-2016	37.55	38.21	35.18	39.88	1	0	0	0
Apr-2016	40.75	41.58	39.04	43.33	1	0	0	0
May-2016	46.71	46.74	43.95	47.85	1	0	0	0
Jun-2016	48.76	48.25	45.83	49.93	1	0	0	0
Jul-2016	44.65	44.95	42.62	46.52	1	0	0	0
Aug-2016	44.72	45.84	43.74	47.17	1	0	0	0
Sep-2016	45.18	46.57	43.74	47.45	1	0	0	0
Oct-2016	49.78	49.52	48.26	51.39	1	0	0	0
Nov-2016	45.66	44.73	43.77	47.00	1	0	0	0
Dec-2016	51.97	53.31	51.78	54.72	1	0	0	0
Jan-2017	52.50	54.58	53.37	53.35	1	0	0	0
Feb-2017	53.47	54.87	54.17	53.75	1	0	0	0
Mar-2017	49.33	51.59	51.16	50.29	1	0	0	0
Apr-2017	51.06	52.31	52.45	51.28	1	0	0	0
May-2017	48.48	50.33	50.31	49.81	1	0	0	0
Jun-2017	45.18	46.37	46.44	46.37	1	0	0	0
Jul-2017	46.63	48.48	47.63	48.39	1	0	0	0
Aug-2017	48.04	51.70	50.43	51.27	1	0	0	0
Sep-2017	49.82	56.15	53.86	53.65	1	0	0	0
Oct-2017	51.58	57.51	55.58	56.18	1	0	0	0
Nov-2017	56.64	62.71	60.58	61.95	1	0	0	0
Dec-2017	57.88	64.37	61.41	63.66	1	0	0	0
Jan-2018	63.70	69.08	66.02	68.40	1	0	0	0
Feb-2018	62.23	65.32	62.79	63.72	1	0	0	0
Mar-2018	62.73	66.02	63.29	64.42	1	0	0	0
Apr-2018	66.25	72.11	68.43	68.98	1	0	0	0

May-2018	69.98	76.98	73.66	75.08	1	0	0	0
Jun-2018	67.87	74.41	73.22	74.25	1	0	0	0
Jul-2018	70.98	74.25	72.72	72.93	1	0	0	0
Aug-2018	68.06	72.53	72.13	72.60	1	0	0	0
Sep-2018	70.23	78.89	77.02	78.15	1	0	0	0
Oct-2018	70.75	81.03	78.96	78.28	1	0	0	0
Nov-2018	56.96	64.75	65.11	65.71	1	0	0	0
Dec-2018	49.52	57.36	56.47	56.47	1	0	0	0
Jan-2019	51.38	59.41	58.96	58.92	1	0	0	0
Feb-2019	54.95	63.96	64.32	64.16	1	0	0	0
Mar-2019	58.15	66.14	66.80	66.05	1	0	0	0
Apr-2019	63.86	71.23	70.66	70.03	1	0	0	0
May-2019	60.83	71.32	69.13	68.19	1	0	0	0
Jun-2019	54.66	64.22	61.30	58.98	1	0	0	0
Jul-2019	57.35	63.92	62.91	63.73	1	0	0	0
Aug-2019	54.81	59.04	58.92	62.09	1	0	0	0
Sep-2019	56.95	62.83	60.84	59.94	1	0	0	0
Oct-2019	53.96	59.71	58.47	60.15	1	0	0	0
Nov-2019	57.03	63.21	61.41	65.15	1	0	0	0
Dec-2019	59.88	67.31	64.41	66.27	1	0	0	0
Jan-2020	57.52	63.65	63.76	58.37	1	0	0	0
Feb-2020	50.54	55.66	54.51	48.86	1	0	0	0
Mar-2020	29.21	32.01	33.75	31.03	1	0	0	0
Apr-2020	16.55	18.38	23.27	18.78	1	0	0	0
May-2020	28.56	29.38	31.56	35.46	1	0	0	0
Jun-2020	38.31	40.27	40.14	44.16	1	0	0	0
Jul-2020	40.71	43.24	42.64	42.62	1	0	0	0
Aug-2020	42.34	44.74	43.71	45.10	1	0	0	0
Sep-2020	39.63	40.91	41.10	40.49	1	0	0	0
Oct-2020	39.40	40.19	39.70	37.12	1	0	0	0
Nov-2020	40.94	42.69	42.58	46.92	1	0	0	0
Dec-2020	47.02	49.99	49.26	49.68	1	0	0	0
Jan-2021	52.00	54.77	54.16	50.97	1	0	0	0
Feb-2021	59.04	62.28	60.37	56.45	1	0	0	0
Mar-2021	62.33	65.41	63.95	64.55	1	0	0	0
Apr-2021	61.72	64.81	62.37	60.35	1	0	0	0

May-2021	65.17	68.53	65.98	68.44	1	0	0	0
Jun-2021	71.38	73.16	70.96	74.76	1	0	0	0
Jul-2021	72.49	75.17	73.00	74.66	1	0	0	0
Aug-2021	67.73	70.75	68.85	71.43	1	0	0	0
Sep-2021	71.65	74.49	72.24	68.68	1	0	0	0
Oct-2021	81.48	83.54	81.22	76.67	1	0	0	0
Nov-2021	79.15	81.05	79.80	83.10	1	0	0	0
Dec-2021	71.71	74.17	72.76	70.55	1	0	0	0
Jan-2022	83.22	86.51	83.11	82.78	1	0	0	0
Feb-2022	91.64	97.13	93.13	93.78	1	0	0	0
Mar-2022	108.50	117.25	113.11	94.25	1	0	1	0
Apr-2022	101.78	104.58	102.68	76.12	1	0	1	0
May-2022	109.55	113.34	108.32	82.29	1	0	1	0
Jun-2022	114.84	122.71	115.73	94.77	1	0	1	0
Jul-2022	101.62	111.93	106.48	83.21	1	0	1	0
Aug-2022	93.67	100.45	97.75	76.06	1	0	1	0
Sep-2022	84.26	89.76	90.63	71.88	1	1	1	0
Oct-2022	87.55	93.33	90.59	74.61	1	1	1	0
Nov-2022	84.37	91.42	86.28	73.65	1	1	1	0
Dec-2022	76.44	80.92	76.78	57.33	1	1	1	1
Jan-2023	78.12	82.50	80.03	55.75	1	1	1	1
Feb-2023	76.83	82.59	81.21	55.39	1	1	1	1
Mar-2023	73.28	78.43	77.52	55.81	1	1	1	1
Apr-2023	79.45	84.64	83.83	64.76	1	1	1	1
May-2023	71.58	75.47	75.08	56.32	1	1	1	1
Jun-2023	70.25	74.84	74.67	56.10	1	1	1	1
Jul-2023	76.07	80.11	80.46	58.61	1	1	1	1
Aug-2023	81.39	86.15	86.61	70.23	1	1	1	1
Sep-2023	89.43	93.72	93.08	73.26	1	1	1	1
Oct-2023	85.64	90.60	90.62	77.18	1	1	1	1
Nov-2023	77.69	82.94	83.45	74.28	1	1	1	1
Dec-2023	71.90	77.63	77.22	63.09	1	1	1	1

Appendix 3

WTI. Ban Ban on Imports from Russia of Oil; Event Based

T-statistic: 0.03588217483551276					
P-value: 0.9715641437068033					
Abnormal Returns:		Cumulative Abnormal Returns:			
Date	Abnormal Return	Date	CAR	Price	Event
0 2023-06-03	NaN	0 2023-06-03	NaN	80.39	0
1 2023-03-03	-0.007423	1 2023-03-03	-7.423419e-03	79.62	0
2 2023-02-03	-0.017564	2 2023-02-03	-2.498720e-02	78.05	0
3 2023-01-03	-0.003995	3 2023-01-03	-2.898221e-02	77.57	0
4 2023-02-28	-0.006740	4 2023-02-28	-3.572252e-02	76.88	0
5 2023-02-27	-0.014885	5 2023-02-27	-5.060717e-02	75.57	0
6 2023-02-24	0.010359	6 2023-02-24	-4.024797e-02	76.19	0
7 2023-02-23	-0.010051	7 2023-02-23	-5.029941e-02	75.26	0
8 2023-02-22	-0.015251	8 2023-02-22	-6.555085e-02	73.95	0
9 2023-02-21	0.033663	9 2023-02-21	-3.188819e-02	76.28	0
10 2023-02-17	0.002548	10 2023-02-17	-2.934001e-02	76.31	0
11 2023-02-16	0.030198	11 2023-02-16	8.583802e-04	78.45	0
12 2023-02-15	0.003685	12 2023-02-15	4.542904e-03	78.57	0
13 2023-02-14	0.008646	13 2023-02-14	1.318882e-02	79.08	0
14 2023-02-13	0.015559	14 2023-02-13	2.874785e-02	80.14	0
15 2023-10-02	-0.002836	15 2023-10-02	2.591147e-02	79.74	0
16 2023-09-02	-0.019164	16 2023-09-02	6.747072e-03	78.04	0
17 2023-08-02	0.007665	17 2023-08-02	1.441195e-02	78.47	0
18 2023-07-02	-0.014412	18 2023-07-02	1.040834e-17	77.17	0
19 2023-06-02	-0.037498	19 2023-06-02	-3.749783e-02	74.11	1
20 2023-03-02	-0.007425	20 2023-03-02	-4.492329e-02	73.4	-1
21 2023-02-02	0.035806	21 2023-02-02	-9.117182e-03	75.87	-1
22 2023-01-02	0.008350	22 2023-01-02	-7.674883e-04	76.34	-1
23 2023-01-31	0.036344	23 2023-01-31	3.557655e-02	78.95	-1
24 2023-01-30	-0.010258	24 2023-01-30	2.531852e-02	77.97	-1
25 2023-01-27	0.024728	25 2023-01-27	5.004619e-02	79.73	-1
26 2023-01-26	0.013568	26 2023-01-26	6.361460e-02	80.64	-1
27 2023-01-25	-0.008510	27 2023-01-25	5.510480e-02	79.78	-1

28 2023-01-24	0.003158	28 2023-01-24	5.826245e-02	79.86	-1
29 2023-01-23	0.024193	29 2023-01-23	8.245590e-02	81.62	-1
30 2023-01-20	-0.002133	30 2023-01-20	8.032262e-02	81.27	-1
31 2023-01-19	-0.009658	31 2023-01-19	7.066503e-02	80.31	-1
32 2023-01-18	-0.007557	32 2023-01-18	6.310755e-02	79.53	-1
33 2023-01-17	0.011208	33 2023-01-17	7.431563e-02	80.25	-1
34 2023-01-13	-0.002206	34 2023-01-13	7.210914e-02	79.9	-1
35 2023-12-01	-0.017620	35 2023-12-01	5.448931e-02	78.32	-1
36 2023-11-01	-0.008826	36 2023-11-01	4.566361e-02	77.46	-1
37 2023-10-01	-0.028183	37 2023-10-01	1.748026e-02	75.11	-1
38 2023-09-01	-0.003437	38 2023-09-01	1.404334e-02	74.69	-1
39 2023-06-01	-0.010163	39 2023-06-01	3.880651e-03	73.77	-1

WTI. U.S. sanctions against Russian energy sectors; Event Based

T-statistic: -0.45263058049378624					
P-value: 0.6530387402362055					
Abnormal Returns:		Cumulative Abnormal Returns:			
Date	Abnormal Return	Date	CAR	Price	Event
0 2014-10-13	NaN	0 2014-10-13	NaN	85.73	0
1 2014-10-10	-0.002471	1 2014-10-10	-2.471107e-03	85.87	0
2 2014-09-10	-0.005385	2 2014-09-10	-7.856255e-03	85.76	0
3 2014-08-10	0.013736	3 2014-08-10	5.880089e-03	87.29	0
4 2014-07-10	0.014226	4 2014-07-10	2.010565e-02	88.89	0
5 2014-06-10	0.012096	5 2014-06-10	3.220131e-02	90.33	0
6 2014-03-10	-0.010414	6 2014-03-10	2.178697e-02	89.76	0
7 2014-02-10	0.009933	7 2014-02-10	3.172026e-02	91.02	0
8 2014-01-10	-0.007180	8 2014-01-10	2.453988e-02	90.74	0
9 2014-09-30	0.000635	9 2014-09-30	2.517455e-02	91.17	0
10 2014-09-29	0.032750	10 2014-09-29	5.792464e-02	94.53	0
11 2014-09-26	0.006686	11 2014-09-26	6.461072e-02	95.55	0
12 2014-09-25	-0.024617	12 2014-09-25	3.999376e-02	93.59	0
13 2014-09-24	-0.003997	13 2014-09-24	3.599647e-02	93.6	0
14 2014-09-23	-0.026006	14 2014-09-23	9.990615e-03	91.55	0
15 2014-09-22	-0.005087	15 2014-09-22	4.903404e-03	91.46	0
16 2014-09-19	0.006502	16 2014-09-19	1.140499e-02	92.43	0
17 2014-09-18	0.002820	17 2014-09-18	1.422501e-02	93.07	0
18 2014-09-17	0.009434	18 2014-09-17	2.365907e-02	94.33	0
19 2014-09-16	0.002044	19 2014-09-16	2.570355e-02	94.91	0
20 2014-09-15	-0.025704	20 2014-09-15	-6.938894e-18	92.86	0
21 2014-12-09	-0.011427	21 2014-12-09	-1.142699e-02	92.18	1
22 2014-11-09	0.003598	22 2014-11-09	-7.828813e-03	92.89	-1
23 2014-10-09	-0.016807	23 2014-10-09	-2.463615e-02	91.71	-1
24 2014-09-09	0.007018	24 2014-09-09	-1.761828e-02	92.73	-1
25 2014-08-09	-0.005075	25 2014-08-09	-2.269298e-02	92.64	-1
26 2014-05-09	0.003236	26 2014-05-09	-1.945688e-02	93.32	-1
27 2014-04-09	0.008648	27 2014-04-09	-1.080920e-02	94.51	-1
28 2014-03-09	0.006371	28 2014-03-09	-4.438257e-03	95.5	-1
29 2014-02-09	-0.031120	29 2014-02-09	-3.555811e-02	92.92	-1

30 2014-08-29	0.049060	30 2014-08-29 1.350177e-02	97.86	-1
31 2014-08-28	-0.018615	31 2014-08-28 -5.112901e-03	96.44	-1
32 2014-08-27	-0.010533	32 2014-08-27 -1.564591e-02	95.82	-1
33 2014-08-26	-0.004522	33 2014-08-26 -2.016750e-02	95.78	-1
34 2014-08-25	-0.008176	34 2014-08-25 -2.834347e-02	95.39	-1
35 2014-08-22	-0.022764	35 2014-08-22 -5.110785e-02	93.61	-1
36 2014-08-21	-0.000258	36 2014-08-21 -5.136625e-02	93.97	-1
37 2014-08-20	0.021755	37 2014-08-20 -2.961107e-02	96.4	-1
38 2014-08-19	-0.025370	38 2014-08-19 -5.498078e-02	94.35	-1
39 2014-08-18	0.018047	39 2014-08-18 -3.693335e-02	96.44	-1
40 2014-08-15	0.004813	40 2014-08-15 -3.212003e-02	97.3	-1
41 2014-08-14	-0.022193	41 2014-08-14 -5.431256e-02	95.54	-1
42 2014-08-13	0.017144	42 2014-08-13 -3.716906e-02	97.57	-1
43 2014-12-08	-0.006256	43 2014-12-08 -4.342550e-02	97.36	-1
44 2014-11-08	0.003394	44 2014-11-08 -4.003170e-02	98.09	-1
45 2014-08-08	-0.008998	45 2014-08-08 -4.902930e-02	97.61	-1

WTI. Price Cap; Event Based

T-statistic: 0.29878914068341295					
P-value: 0.7665743519714658					
Abnormal Returns:		Cumulative Abnormal Returns:			
Date	Abnormal Return	Date	CAR	Price	Event
0 2022-03-10	NaN	0 2022-03-10	NaN	84.05	0
1 2022-09-30	-0.051741	1 2022-09-30	-5.174050e-02	79.91	0
2 2022-09-29	0.020917	2 2022-09-29	-3.082329e-02	81.78	0
3 2022-09-28	0.007665	3 2022-09-28	-2.315821e-02	82.61	0
4 2022-09-27	-0.047273	4 2022-09-27	-7.043109e-02	78.91	0
5 2022-09-26	-0.024535	5 2022-09-26	-9.496563e-02	77.17	0
6 2022-09-23	0.022137	6 2022-09-23	-7.282878e-02	79.07	0
7 2022-09-22	0.060119	7 2022-09-22	-1.271013e-02	84.02	0
8 2022-09-21	-0.010101	8 2022-09-21	-2.281147e-02	83.38	0
9 2022-09-20	0.013227	9 2022-09-20	-9.584377e-03	84.69	0
10 2022-09-19	0.014755	10 2022-09-19	5.170858e-03	86.15	0
11 2022-09-16	-0.009217	11 2022-09-16	-4.045693e-03	85.57	0
12 2022-09-15	-0.000731	12 2022-09-15	-4.776851e-03	85.72	0
13 2022-09-14	0.034380	13 2022-09-14	2.960325e-02	88.88	0
14 2022-09-13	-0.014185	14 2022-09-13	1.541797e-02	87.84	0
15 2022-12-09	0.001387	15 2022-12-09	1.680454e-02	88.18	0
16 2022-09-09	-0.012804	16 2022-09-09	4.000627e-03	87.27	0
17 2022-08-09	-0.039496	17 2022-08-09	-3.549505e-02	84.04	0
18 2022-07-09	-0.020809	18 2022-07-09	-5.630377e-02	82.5	0
19 2022-06-09	0.056304	19 2022-06-09	6.938894e-18	87.35	0
20 2022-02-09	-0.003171	20 2022-02-09	-3.171000e-03	87.29	1
21 2022-01-09	-0.004775	21 2022-01-09	-7.946322e-03	87.09	-1
22 2022-08-31	0.031963	22 2022-08-31	2.401669e-02	90.09	-1
23 2022-08-30	0.019605	23 2022-08-30	4.362161e-02	92.08	-1
24 2022-08-29	0.055292	24 2022-08-29	9.891335e-02	97.4	-1
25 2022-08-26	-0.041190	25 2022-08-26	5.772287e-02	93.63	-1
26 2022-08-25	-0.005688	26 2022-08-25	5.203466e-02	93.33	-1
27 2022-08-24	0.020981	27 2022-08-24	7.301568e-02	95.52	-1
28 2022-08-23	0.007357	28 2022-08-23	8.037244e-02	96.46	-1
29 2022-08-22	-0.034000	29 2022-08-22	4.637268e-02	93.42	-1

30 2022-08-19	-0.001093	30 2022-08-19 4.528013e-02	93.55	-1
31 2022-08-18	-0.006225	31 2022-08-18 3.905471e-02	93.2	-1
32 2022-08-17	-0.027699	32 2022-08-17 1.135601e-02	90.85	-1
33 2022-08-16	-0.020316	33 2022-08-16 -8.959690e-03	89.23	-1
34 2022-08-15	0.031249	34 2022-08-15 2.228925e-02	92.24	-1
35 2022-12-08	0.025920	35 2022-12-08 4.820931e-02	94.86	-1
36 2022-11-08	0.020286	36 2022-11-08 6.849560e-02	97.02	-1
37 2022-10-08	-0.026603	37 2022-10-08 4.189275e-02	94.68	-1
38 2022-09-08	-0.018327	38 2022-09-08 2.356580e-02	93.18	-1
39 2022-08-08	0.001165	39 2022-08-08 2.473054e-02	93.52	-1
40 2022-05-08	-0.021197	40 2022-05-08 3.533861e-03	91.77	-1
41 2022-04-08	-0.007715	41 2022-04-08 -4.180715e-03	91.29	-1
42 2022-03-08	0.018986	42 2022-03-08 1.480522e-02	93.25	-1
43 2022-02-08	0.039232	43 2022-02-08 5.403693e-02	97.14	-1

WTI. Disconnection of Russian Banks from SWIFT; Event Based

T-statistic: -1.1856001251758423					
P-value: 0.24244482665550462					
Abnormal Returns:		Cumulative Abnormal Returns:			
Date	Abnormal Return	Date	CAR	Price	Event
0 2022-01-04	NaN	0 2022-01-04	NaN	99.32	0
1 2022-03-31	0.005835	1 2022-03-31	5.835376e-03	100.53	0
2 2022-03-30	0.066069	2 2022-03-30	7.190410e-02	107.81	0
3 2022-03-29	-0.039369	3 2022-03-29	3.253558e-02	104.25	0
4 2022-03-28	0.025307	4 2022-03-28	5.784279e-02	107.55	0
5 2022-03-25	0.074080	5 2022-03-25	1.319230e-01	116.2	0
6 2022-03-24	-0.023559	6 2022-03-24	1.083639e-01	114.2	0
7 2022-03-23	-0.000305	7 2022-03-23	1.080584e-01	114.89	0
8 2022-03-22	-0.039945	8 2022-03-22	6.811360e-02	111.03	0
9 2022-03-21	0.003650	9 2022-03-21	7.176343e-02	112.14	0
10 2022-03-18	-0.072782	10 2022-03-18	-1.018852e-03	104.69	0
11 2022-03-17	-0.022777	11 2022-03-17	-2.379578e-02	102.97	0
12 2022-03-16	-0.085205	12 2022-03-16	-1.090012e-01	94.85	0
13 2022-03-15	0.010205	13 2022-03-15	-9.879618e-02	96.42	0
14 2022-03-14	0.064177	14 2022-03-14	-3.461886e-02	103.22	0
15 2022-11-03	0.052653	15 2022-11-03	1.803386e-02	109.31	0
16 2022-10-03	-0.037269	16 2022-10-03	-1.923484e-02	105.93	0
17 2022-09-03	0.020840	17 2022-09-03	1.605461e-03	108.81	0
18 2022-08-03	0.129945	18 2022-08-03	1.315506e-01	123.64	0
19 2022-07-03	-0.041773	19 2022-07-03	8.977772e-02	119.26	0
20 2022-04-03	-0.035611	20 2022-04-03	5.416646e-02	115.77	0
21 2022-03-03	-0.076141	21 2022-03-03	-2.197457e-02	107.69	0
22 2022-02-03	0.021975	22 2022-02-03	-2.775558e-17	110.74	0
23 2022-01-03	-0.070281	23 2022-01-03	-7.028101e-02	103.66	1
24 2022-02-28	-0.078989	24 2022-02-28	-1.492698e-01	96.13	-1
25 2022-02-25	-0.052639	25 2022-02-25	-2.019087e-01	91.68	-1
26 2022-02-24	0.005542	26 2022-02-24	-1.963670e-01	92.77	-1
27 2022-02-23	-0.013138	27 2022-02-23	-2.095055e-01	92.14	-1
28 2022-02-22	-0.006673	28 2022-02-22	-2.161786e-01	92.11	-1
29 2022-02-18	-0.015576	29 2022-02-18	-2.317541e-01	91.26	-1
30 2022-02-17	-0.000649	30 2022-02-17	-2.324036e-01	91.78	-1

31 2022-02-16	0.015989	31 2022-02-16 -2.164150e-01	93.83	-1
32 2022-02-15	-0.025105	32 2022-02-15 -2.415198e-01	92.07	-1
33 2022-02-14	0.031124	33 2022-02-14 -2.103958e-01	95.52	-1
34 2022-11-02	-0.031682	34 2022-11-02 -2.420783e-01	93.1	-1
35 2022-10-02	-0.041471	35 2022-10-02 -2.835493e-01	89.83	-1
36 2022-09-02	-0.009242	36 2022-09-02 -2.927911e-01	89.57	-1
37 2022-08-02	-0.009139	37 2022-08-02 -3.019297e-01	89.32	-1
38 2022-07-02	0.015260	38 2022-07-02 -2.866694e-01	91.25	-1
39 2022-04-02	0.004831	39 2022-04-02 -2.818388e-01	92.27	-1
40 2022-03-02	-0.029107	40 2022-03-02 -3.109456e-01	90.17	-1
41 2022-02-02	-0.028639	41 2022-02-02 -3.395843e-01	88.16	-1
42 2022-01-02	-0.005667	42 2022-01-02 -3.452512e-01	88.22	-1
43 2022-01-31	0.004308	43 2022-01-31 -3.409435e-01	89.16	-1

Urals. Ban on Imports from Russia of Oil; Event Based

T-statistic: 0.5270644942255581					
P-value: 0.6009892292904517					
Abnormal Returns:		Cumulative Abnormal Returns:			
Date	Abnormal Return	Date	CAR	Price	Event
0 2023-03-06	NaN	0 2023-03-06	NaN	62.63	0
1 2023-03-03	-0.001270	1 2023-03-03	-1.269958e-03	62.16	0
2 2023-03-02	-0.007279	2 2023-03-02	-8.549039e-03	61.32	0
3 2023-03-01	-0.017086	3 2023-03-01	-2.563489e-02	59.89	0
4 2023-02-28	0.012579	4 2023-02-28	-1.305550e-02	60.27	0
5 2023-02-27	-0.093815	5 2023-02-27	-1.068708e-01	54.24	0
6 2023-02-24	0.017296	6 2023-02-24	-8.957446e-02	54.84	0
7 2023-02-23	0.001129	7 2023-02-23	-8.844579e-02	54.56	0
8 2023-02-22	-0.018142	8 2023-02-22	-1.065882e-01	53.23	0
9 2023-02-21	0.042680	9 2023-02-21	-6.390814e-02	55.17	0
10 2023-02-20	0.008410	10 2023-02-20	-5.549862e-02	55.29	0
11 2023-02-17	-0.000638	11 2023-02-17	-5.613704e-02	54.91	0
12 2023-02-16	0.046300	12 2023-02-16	-9.837042e-03	57.11	0
13 2023-02-15	-0.011451	13 2023-02-15	-2.128778e-02	56.1	0
14 2023-02-14	0.034220	14 2023-02-14	1.293239e-02	57.67	0
15 2023-02-13	0.020453	15 2023-02-13	3.338566e-02	58.49	0
16 2023-02-10	0.005209	16 2023-02-10	3.859427e-02	58.43	0
17 2023-02-09	-0.034840	17 2023-02-09	3.753915e-03	56.03	0
18 2023-02-08	0.007305	18 2023-02-08	1.105920e-02	56.09	0
19 2023-02-07	-0.011059	19 2023-02-07	2.775558e-17	55.12	0
20 2023-02-06	-0.039121	20 2023-02-06	-3.912116e-02	52.62	1
21 2023-02-03	0.025239	21 2023-02-03	-1.388254e-02	53.62	-1
22 2023-02-02	0.005115	22 2023-02-02	-8.767095e-03	53.56	-1
23 2023-02-01	0.055152	23 2023-02-01	4.638444e-02	56.18	-1
24 2023-01-31	0.003920	24 2023-01-31	5.030488e-02	56.05	-1
25 2023-01-30	0.034067	25 2023-01-30	8.437161e-02	57.61	-1
26 2023-01-27	0.021162	26 2023-01-27	1.055340e-01	58.47	-1
27 2023-01-26	0.022482	27 2023-01-26	1.280161e-01	59.42	-1
28 2023-01-25	-0.011941	28 2023-01-25	1.160748e-01	58.34	-1
29 2023-01-24	0.014291	29 2023-01-24	1.303655e-01	58.81	-1
30 2023-01-23	0.048234	30 2023-01-23	1.785996e-01	61.28	-1

31	2023-01-20	-0.026892	31	2023-01-20	1.517074e-01	59.25	-1
32	2023-01-19	-0.023808	32	2023-01-19	1.278996e-01	57.47	-1
33	2023-01-18	0.031465	33	2023-01-18	1.593646e-01	58.92	-1
34	2023-01-17	-0.028728	34	2023-01-17	1.306364e-01	56.86	-1
35	2023-01-16	-0.015925	35	2023-01-16	1.147111e-01	55.6	-1
36	2023-01-13	0.016127	36	2023-01-13	1.308376e-01	56.15	-1
37	2023-01-12	0.001426	37	2023-01-12	1.322635e-01	55.88	-1
38	2023-01-11	-0.037610	38	2023-01-11	9.465399e-02	53.43	-1
39	2023-01-10	-0.038123	39	2023-01-10	5.653132e-02	51.06	-1
40	2023-01-09	0.033653	40	2023-01-09	9.018447e-02	52.46	-1
41	2023-01-06	0.008331	41	2023-01-06	9.851574e-02	52.57	-1
42	2023-01-05	0.000718	42	2023-01-05	9.923372e-02	52.28	-1

Urals. US sanctions against Russian energy sectors; Event Based

Event: Sheet1				
T-statistic: -0.8363618138492274				
P-value: 0.4076847838391977				
Abnormal Returns:		Cumulative Abnormal Returns:		
Date	Abnormal Return	Date	CAR	Price
0 2014-08-12	NaN	0 2014-08-12	NaN	102.6
1 2014-08-13	0.010156	1 2014-08-13	1.015565e-02	103.39
2 2014-08-14	-0.025690	2 2014-08-14	-1.553435e-02	100.48
3 2014-08-15	0.012508	3 2014-08-15	-3.026752e-03	101.49
4 2014-08-18	-0.012028	4 2014-08-18	-1.505509e-02	100.02
5 2014-08-19	0.001156	5 2014-08-19	-1.389898e-02	99.89
6 2014-08-20	0.008863	6 2014-08-20	-5.036083e-03	100.53
7 2014-08-21	0.004644	7 2014-08-21	-3.918322e-04	100.75
8 2014-08-22	-0.003102	8 2014-08-22	-3.494296e-03	100.19
9 2014-08-25	0.004252	9 2014-08-25	7.581396e-04	100.37
10 2014-08-26	-0.001031	10 2014-08-26	-2.731091e-04	100.02
11 2014-08-27	0.004455	11 2014-08-27	4.182340e-03	100.22
12 2014-08-28	0.002256	12 2014-08-28	6.438628e-03	100.2
13 2014-08-29	0.011238	13 2014-08-29	1.767691e-02	101.08
14 2014-09-02	-0.010900	14 2014-09-02	6.777003e-03	99.73
15 2014-09-03	0.021608	15 2014-09-03	2.838456e-02	101.64
16 2014-09-04	-0.002168	16 2014-09-04	2.621625e-02	101.17
17 2014-09-05	-0.008318	17 2014-09-05	1.789815e-02	100.08
18 2014-09-08	-0.003639	18 2014-09-08	1.425888e-02	99.47
19 2014-09-09	-0.008502	19 2014-09-09	5.756648e-03	98.38
20 2014-09-10	-0.008624	20 2014-09-10	-2.866991e-03	97.29
21 2014-09-11	0.002867	21 2014-09-11	-1.301043e-17	97.33
22 2014-09-12	-0.012545	22 2014-09-12	-1.254466e-02	95.87
23 2014-09-15	0.003812	23 2014-09-15	-8.732813e-03	96
24 2014-09-16	0.013289	24 2014-09-16	4.556370e-03	97.04
25 2014-09-17	0.001941	25 2014-09-17	6.496967e-03	96.99
26 2014-09-18	-0.009710	26 2014-09-18	-3.213387e-03	95.81
27 2014-09-19	0.009136	27 2014-09-19	5.922350e-03	96.45
28 2014-09-22	-0.011645	28 2014-09-22	-5.722372e-03	95.09
29 2014-09-23	-0.000278	29 2014-09-23	-6.000774e-03	94.83
30 2014-09-24	0.006041	30 2014-09-24	4.043803e-05	95.17

31 2014-09-25	0.001405	31 2014-09-25 1.445536e-03	95.07	-1
32 2014-09-26	0.001614	32 2014-09-26 3.059900e-03	94.99	-1
33 2014-09-29	0.005298	33 2014-09-29 8.358153e-03	95.26	-1
34 2014-09-30	-0.021479	34 2014-09-30 -1.312049e-02	92.98	-1
35 2014-10-01	0.003209	35 2014-10-01 -9.911794e-03	93.05	-1
36 2014-10-02	-0.002273	36 2014-10-02 -1.218459e-02	92.61	-1
37 2014-10-03	-0.014065	37 2014-10-03 -2.624963e-02	91.08	-1
38 2014-10-06	0.013325	38 2014-10-06 -1.292422e-02	92.07	-1
39 2014-10-07	-0.009492	39 2014-10-07 -2.241580e-02	90.97	-1
40 2014-10-08	-0.000732	40 2014-10-08 -2.314781e-02	90.68	-1
41 2014-10-09	-0.021033	41 2014-10-09 -4.418116e-02	88.55	-1
42 2014-10-10	0.004037	42 2014-10-10 -4.014428e-02	88.69	-1
43 2014-10-13	-0.016712	43 2014-10-13 -5.685632e-02	86.99	-1

Urals. Price Cap; Event based

T-statistic: -0.593264780988458				
P-value: 0.5561854742359567				
Abnormal Returns:		Cumulative Abnormal Returns:		
Date	Abnormal Return	Date	CAR	Price Event
0 2023-10-02	NaN	0 2023-10-02	NaN	77.18 0
1 2023-09-29	0.063358	1 2023-09-29	6.335788e-02	82.02 0
2 2023-09-28	0.016619	2 2023-09-28	7.997693e-02	83.33 0
3 2023-09-27	0.002807	3 2023-09-27	8.278436e-02	83.51 0
4 2023-09-26	-0.063297	4 2023-09-26	1.948726e-02	78.17 0
5 2023-09-25	-0.005237	5 2023-09-25	1.424998e-02	77.71 0
6 2023-09-22	0.009398	6 2023-09-22	2.364780e-02	78.39 0
7 2023-09-21	0.003199	7 2023-09-21	2.684648e-02	78.59 0
8 2023-09-20	0.029913	8 2023-09-20	5.675963e-02	80.89 0
9 2023-09-19	0.000647	9 2023-09-19	5.740697e-02	80.89 0
10 2023-09-18	-0.007512	10 2023-09-18	4.989508e-02	80.23 0
11 2023-09-15	-0.011194	11 2023-09-15	3.870145e-02	79.28 0
12 2023-09-14	-0.006921	12 2023-09-14	3.178068e-02	78.68 0
13 2023-09-13	-0.018544	13 2023-09-13	1.323635e-02	77.17 0
14 2023-09-12	0.007904	14 2023-09-12	2.114040e-02	77.73 0
15 2023-09-11	-0.024182	15 2023-09-11	-3.041806e-03	75.8 0
16 2023-09-08	0.003814	16 2023-09-08	7.717573e-04	76.04 0
17 2023-09-07	-0.004482	17 2023-09-07	-3.709786e-03	75.65 0
18 2023-09-06	-0.004244	18 2023-09-06	-7.953394e-03	75.28 0
19 2023-09-05	0.007953	19 2023-09-05	1.040834e-17	75.83 0
20 2023-09-04	-0.019529	20 2023-09-04	-1.952937e-02	74.3 1
21 2023-09-01	-0.013350	21 2023-09-01	-3.287935e-02	73.26 -1
22 2023-08-31	-0.028564	22 2023-08-31	-6.144304e-02	71.12 -1
23 2023-08-30	-0.016788	23 2023-08-30	-7.823102e-02	69.88 -1
24 2023-08-29	-0.000497	24 2023-08-29	-7.872851e-02	69.8 -1
25 2023-08-28	-0.009381	25 2023-08-28	-8.810982e-02	69.1 -1
26 2023-08-25	0.000647	26 2023-08-25	-8.746249e-02	69.1 -1
27 2023-08-24	-0.017298	27 2023-08-24	-1.047602e-01	67.86 -1
28 2023-08-23	0.002416	28 2023-08-23	-1.023445e-01	67.98 -1
29 2023-08-22	0.013887	29 2023-08-22	-8.845795e-02	68.88 -1

30 2023-08-21	0.018940	30 2023-08-21 -6.951793e-02	70.14	-1
31 2023-08-18	-0.007907	31 2023-08-18 -7.742491e-02	69.54	-1
32 2023-08-17	0.019342	32 2023-08-17 -5.808330e-02	70.84	-1
33 2023-08-16	0.001918	33 2023-08-16 -5.616549e-02	70.93	-1
34 2023-08-15	0.003608	34 2023-08-15 -5.255749e-02	71.14	-1
35 2023-08-14	0.021592	35 2023-08-14 -3.096554e-02	72.63	-1
36 2023-08-11	0.008220	36 2023-08-11 -2.274557e-02	73.18	-1
37 2023-08-10	0.000101	37 2023-08-10 -2.264483e-02	73.14	-1
38 2023-08-09	0.008714	38 2023-08-09 -1.393078e-02	73.73	-1
39 2023-08-08	-0.025529	39 2023-08-08 -3.946003e-02	71.8	-1
40 2023-08-07	-0.004784	40 2023-08-07 -4.424445e-02	71.41	-1
41 2023-08-04	0.009750	41 2023-08-04 -3.449474e-02	72.06	-1
42 2023-08-03	-0.016699	42 2023-08-03 -5.119406e-02	70.81	-1
43 2023-08-02	-0.024349	43 2023-08-02 -7.554320e-02	69.04	-1

Urals. Disconnection of Russian Banks from SWIFT; Event Based

Event: Sheet1				
T-statistic: -1.1852525489465358				
P-value: 0.24258069225107085				
Abnormal Returns:		Cumulative Abnormal Returns:		
Date	Abnormal Return	Date	CAR	Price
0 2022-04-01	NaN	0 2022-04-01	NaN	81.83
1 2022-03-31	0.001541	1 2022-03-31	1.541145e-03	82.91
2 2022-03-30	0.079285	2 2022-03-30	8.082618e-02	90.45
3 2022-03-29	-0.050684	3 2022-03-29	3.014215e-02	86.92
4 2022-03-28	0.026539	4 2022-03-28	5.668124e-02	90.24
5 2022-03-25	0.072230	5 2022-03-25	1.289117e-01	97.81
6 2022-03-24	0.009609	6 2022-03-24	1.385205e-01	99.89
7 2022-03-23	0.007564	7 2022-03-23	1.460847e-01	101.81
8 2022-03-22	-0.073537	8 2022-03-22	7.254775e-02	95.51
9 2022-03-21	-0.013856	9 2022-03-21	5.869208e-02	95.3
10 2022-03-18	-0.083640	10 2022-03-18	-2.494808e-02	88.44
11 2022-03-17	-0.019233	11 2022-03-17	-4.418079e-02	87.77
12 2022-03-16	-0.091411	12 2022-03-16	-1.355916e-01	80.77
13 2022-03-15	0.004810	13 2022-03-15	-1.307821e-01	82.1
14 2022-03-14	0.024031	14 2022-03-14	-1.067508e-01	85.03
15 2022-03-11	0.067139	15 2022-03-11	-3.961207e-02	91.73
16 2022-03-10	0.010146	16 2022-03-10	-2.946590e-02	93.73
17 2022-03-09	0.075295	17 2022-03-09	4.582904e-02	101.88
18 2022-03-08	0.077958	18 2022-03-08	1.237873e-01	111.01
19 2022-03-07	-0.063724	19 2022-03-07	6.006299e-02	105.23
20 2022-03-04	-0.113624	20 2022-03-04	-5.356107e-02	94.5
21 2022-03-03	0.033528	21 2022-03-03	-2.003284e-02	98.77
22 2022-03-02	0.020033	22 2022-03-02	-1.040834e-17	101.9
23 2022-03-01	-0.047084	23 2022-03-01	-4.708384e-02	98.29
24 2022-02-28	-0.052455	24 2022-02-28	-9.953843e-02	94.28
25 2022-02-25	-0.037431	25 2022-02-25	-1.369697e-01	91.85
26 2022-02-24	0.022529	26 2022-02-24	-1.144404e-01	94.99
27 2022-02-23	-0.011657	27 2022-02-23	-1.260974e-01	94.99
28 2022-02-22	-0.017552	28 2022-02-22	-1.436497e-01	94.43
29 2022-02-21	0.000204	29 2022-02-21	-1.434460e-01	95.55
30 2022-02-18	-0.040647	30 2022-02-18	-1.840930e-01	92.78

31 2022-02-17	-0.021357	31 2022-02-17 -2.054503e-01	91.88	-1
32 2022-02-16	0.031334	32 2022-02-16 -1.741164e-01	95.83	-1
33 2022-02-15	-0.014683	33 2022-02-15 -1.887996e-01	95.54	-1
34 2022-02-14	0.009800	34 2022-02-14 -1.789995e-01	97.59	-1
35 2022-02-11	-0.051415	35 2022-02-11 -2.304146e-01	93.71	-1
36 2022-02-10	0.005737	36 2022-02-10 -2.246775e-01	95.34	-1
37 2022-02-09	-0.020363	37 2022-02-09 -2.450401e-01	94.51	-1
38 2022-02-08	-0.011022	38 2022-02-08 -2.560622e-01	94.57	-1
39 2022-02-07	0.012981	39 2022-02-07 -2.430813e-01	96.9	-1
40 2022-02-04	-0.018262	40 2022-02-04 -2.613430e-01	96.26	-1
41 2022-02-03	-0.067755	41 2022-02-03 -3.290981e-01	90.86	-1
42 2022-02-02	-0.024974	42 2022-02-02 -3.540722e-01	89.65	-1
43 2022-02-01	-0.002510	43 2022-02-01 -3.565825e-01	90.47	-1

Dubai. Price Cap; Event Based

Event: Sheet1				
T-statistic: -0.058026304610736525				
P-value: 0.9540028759861873				
Abnormal Returns:				
Date Abnormal Return		Cumulative Abnormal Returns:		
0	2022-03-10	NaN	Date CAR	Price Event
1	2022-09-30	0.029637	0 2022-03-10	NaN 88.03 0
2	2022-09-29	-0.004179	1 2022-09-30	2.963712e-02 90.91 0
3	2022-09-28	-0.002088	2 2022-09-29	2.545814e-02 90.81 0
4	2022-09-27	-0.005059	3 2022-09-28	2.337023e-02 90.90 0
5	2022-09-26	-0.005504	4 2022-09-27	1.831103e-02 90.72 0
6	2022-09-23	0.002667	5 2022-09-26	1.280700e-02 90.50 0
7	2022-09-22	0.009665	6 2022-09-23	1.547386e-02 91.02 0
8	2022-09-21	-0.007093	7 2022-09-22	2.513932e-02 92.18 0
9	2022-09-20	-0.002099	8 2022-09-21	1.804643e-02 91.81 0
10	2022-09-19	0.003015	9 2022-09-20	1.594773e-02 91.90 0
11	2022-09-16	-0.005242	10 2022-09-19	1.896231e-02 92.46 0
12	2022-09-15	-0.006114	11 2022-09-16	1.372022e-02 92.26 0
13	2022-09-14	0.011816	12 2022-09-15	7.606323e-03 91.98 0
14	2022-09-13	-0.012077	13 2022-09-14	1.942187e-02 93.35 0
15	2022-12-09	0.006109	14 2022-09-13	7.344483e-03 92.51 0
16	2022-09-09	-0.009292	15 2022-12-09	1.345368e-02 93.36 0
17	2022-08-09	-0.031210	16 2022-09-09	4.162179e-03 92.78 0
18	2022-07-09	-0.012062	17 2022-08-09	-2.704788e-02 90.17 0
19	2022-06-09	0.039110	18 2022-07-09	-3.910990e-02 89.36 0
20	2022-02-09	-0.008770	19 2022-06-09	-6.938894e-18 93.13 0
21	2022-01-09	-0.008695	20 2022-02-09	-8.769964e-03 92.60 1
22	2022-08-31	0.046009	21 2022-01-09	-1.746451e-02 92.08 -1
23	2022-08-30	-0.004011	22 2022-08-31	2.854425e-02 96.60 -1
24	2022-08-29	0.000755	23 2022-08-30	2.453357e-02 96.51 -1
25	2022-08-26	-0.006692	24 2022-08-29	2.528838e-02 96.88 -1
26	2022-08-25	-0.006187	25 2022-08-26	1.859667e-02 96.53 -1
27	2022-08-24	-0.000689	26 2022-08-25	1.240983e-02 96.23 -1
28	2022-08-23	-0.003597	27 2022-08-24	1.172094e-02 96.46 -1
29	2022-08-22	-0.013659	28 2022-08-23	8.123600e-03 96.41 -1
30	2022-08-19	-0.003079	29 2022-08-22	-5.535210e-03 95.39 -1

31 2022-08-18	-0.005280	30 2022-08-19 -8.614204e-03	95.39	-1
32 2022-08-17	-0.015056	31 2022-08-18 -1.389469e-02	95.18	-1
33 2022-08-16	-0.009247	32 2022-08-17 -2.895099e-02	94.04	-1
34 2022-08-15	0.013078	33 2022-08-16 -3.819757e-02	93.46	-1
35 2022-12-08	0.012821	34 2022-08-15 -2.511992e-02	94.97	-1
36 2022-11-08	0.014541	35 2022-12-08 -1.229916e-02	96.48	-1
37 2022-10-08	-0.016422	36 2022-11-08 2.242080e-03	98.18	-1
38 2022-09-08	-0.012370	37 2022-10-08 -1.417975e-02	96.87	-1
39 2022-08-08	-0.002350	38 2022-09-08 -2.654955e-02	95.97	-1
40 2022-05-08	-0.020051	39 2022-08-08 -2.889915e-02	96.04	-1
41 2022-04-08	-0.006574	40 2022-05-08 -4.895024e-02	94.41	-1
42 2022-03-08	0.017010	41 2022-04-08 -5.552463e-02	94.08	-1
43 2022-02-08	0.032661	42 2022-03-08 -3.851434e-02	95.97	-1
		43 2022-02-08 -5.852995e-03	99.40	-1

Dubai. U.S. sanctions against Russian energy sectors; Event Based

Event: Sheet1				
T-statistic: -1.2926688690493853				
P-value: 0.20206736864536512				
Abnormal Return		Cumulative Abnormal Returns:		
Date	Abnormal Return	Date	CAR	Price
0 2014-10-14	NaN	0 2014-10-14	NaN	87.16
1 2014-10-13	0.019587	1 2014-10-13	0.019587	89.32
2 2014-10-10	-0.001500	2 2014-10-10	0.018087	89.65
3 2014-09-10	-0.008318	3 2014-09-10	0.009769	89.37
4 2014-08-10	0.006554	4 2014-08-10	0.016323	90.42
5 2014-07-10	0.002436	5 2014-07-10	0.018759	91.11
6 2014-06-10	0.010171	6 2014-06-10	0.028930	92.51
7 2014-03-10	-0.017626	7 2014-03-10	0.011305	91.36
8 2014-02-10	0.004000	8 2014-02-10	0.015304	92.20
9 2014-01-10	0.003265	9 2014-01-10	0.018569	92.98
10 2014-09-30	0.032340	10 2014-09-30	0.050909	96.47
11 2014-09-29	-0.004987	11 2014-09-29	0.045922	96.49
12 2014-09-26	-0.005091	12 2014-09-26	0.040831	96.50
13 2014-09-25	-0.004780	13 2014-09-25	0.036050	96.54
14 2014-09-24	-0.005402	14 2014-09-24	0.030648	96.52
15 2014-09-23	-0.005609	15 2014-09-23	0.025039	96.48
16 2014-09-22	-0.004988	16 2014-09-22	0.020052	96.50
17 2014-09-19	-0.000739	17 2014-09-19	0.019313	96.93
18 2014-09-18	-0.007671	18 2014-09-18	0.011642	96.69
19 2014-09-17	0.000390	19 2014-09-17	0.012032	97.23
20 2014-09-16	-0.004063	20 2014-09-16	0.007969	97.34
21 2014-09-15	-0.007969	21 2014-09-15	0.000000	97.07
22 2014-12-09	-0.005813	22 2014-12-09	-0.005813	97.01
23 2014-11-09	-0.001587	23 2014-11-09	-0.007400	97.36
24 2014-10-09	-0.006633	24 2014-10-09	-0.014033	97.22
25 2014-09-09	0.002725	25 2014-09-09	-0.011307	97.99
26 2014-08-09	-0.000603	26 2014-08-09	-0.011910	98.44
27 2014-05-09	-0.001436	27 2014-05-09	-0.013346	98.81
28 2014-04-09	0.004217	28 2014-04-09	-0.009129	99.74
29 2014-03-09	0.006736	29 2014-03-09	-0.002393	100.93
30 2014-02-09	-0.027487	30 2014-02-09	-0.029880	98.68

31 2014-08-29	0.025713	31 2014-08-29 -0.004167	101.73	-1
32 2014-08-28	-0.004900	32 2014-08-28 -0.009067	101.76	-1
33 2014-08-27	-0.004900	33 2014-08-27 -0.013967	101.79	-1
34 2014-08-26	-0.006374	34 2014-08-26 -0.020340	101.67	-1
35 2014-08-25	-0.005293	35 2014-08-25 -0.025634	101.66	-1
36 2014-08-22	-0.006080	36 2014-08-22 -0.031714	101.57	-1
37 2014-08-21	-0.003127	37 2014-08-21 -0.034841	101.78	-1
38 2014-08-20	-0.005490	38 2014-08-20 -0.040331	101.75	-1
39 2014-08-19	-0.006767	39 2014-08-19 -0.047098	101.59	-1
40 2014-08-18	-0.004998	40 2014-08-18 -0.052096	101.61	-1
41 2014-08-15	0.002974	41 2014-08-15 -0.049122	102.44	-1
42 2014-08-14	-0.011638	42 2014-08-14 -0.060760	101.78	-1
43 2014-08-13	0.012490	43 2014-08-13 -0.048269	103.58	-1
44 2014-12-08	-0.012436	44 2014-12-08 -0.060705	102.83	-1
45 2014-11-08	0.001807	45 2014-11-08 -0.058898	103.55	-1
46 2014-08-08	-0.004615	46 2014-08-08 -0.063513	103.61	-1
47 2014-07-08	-0.002203	47 2014-07-08 -0.065716	103.92	-1
48 2014-06-08	-0.013470	48 2014-06-08 -0.079186	103.06	-1
49 2014-05-08	-0.005001	49 2014-05-08 -0.084187	103.08	-1
50 2014-04-08	0.006156	50 2014-04-08 -0.078032	104.25	-1
51 2014-01-08	-0.012965	51 2014-01-08 -0.090996	103.44	-1

Dubai. Ban on Imports from Russia of Oil; Event Based

Event: Sheet1				
T-statistic: -0.4432746188930072				
P-value: 0.660016452966743				
Abnormal Returns:		Cumulative Abnormal Returns:		
Date	Abnormal Return	Date	CAR	Price Event
0 2023-06-03	NaN	0 2023-06-03	NaN	84.40 0
1 2023-03-03	0.001063	1 2023-03-03	1.062809e-03	84.31 0
2 2023-02-03	-0.012697	2 2023-02-03	-1.163427e-02	83.06 0
3 2023-01-03	-0.006419	3 2023-01-03	-1.805314e-02	82.35 0
4 2023-02-28	-0.001150	4 2023-02-28	-1.920267e-02	82.08 0
5 2023-02-27	0.001764	5 2023-02-27	-1.743901e-02	82.05 0
6 2023-02-24	0.002982	6 2023-02-24	-1.445671e-02	82.12 0
7 2023-02-23	0.000424	7 2023-02-23	-1.403237e-02	81.98 0
8 2023-02-22	-0.001408	8 2023-02-22	-1.544066e-02	81.69 0
9 2023-02-21	0.008005	9 2023-02-21	-7.435629e-03	82.17 0
10 2023-02-17	0.000912	10 2023-02-17	-6.523458e-03	82.07 0
11 2023-02-16	0.011390	11 2023-02-16	4.866090e-03	82.83 0
12 2023-02-15	0.003578	12 2023-02-15	8.444000e-03	82.95 0
13 2023-02-14	0.003335	13 2023-02-14	1.177871e-02	83.05 0
14 2023-02-13	0.007788	14 2023-02-13	1.956711e-02	83.52 0
15 2023-10-02	-0.002301	15 2023-10-02	1.726619e-02	83.15 0
16 2023-09-02	-0.013385	16 2023-09-02	3.881220e-03	81.86 0
17 2023-08-02	0.005916	17 2023-08-02	9.797334e-03	82.17 0
18 2023-07-02	-0.009797	18 2023-07-02	1.040834e-17	81.19 0
19 2023-06-02	-0.025214	19 2023-06-02	-2.521411e-02	78.97 1
20 2023-03-02	-0.008888	20 2023-03-02	-3.410179e-02	78.10 -1
21 2023-02-02	0.027353	21 2023-02-02	-6.748559e-03	80.07 -1
22 2023-01-02	0.005251	22 2023-01-02	-1.497130e-03	80.32 -1
23 2023-01-31	0.002876	23 2023-01-31	1.379042e-03	80.38 -1
24 2023-01-30	0.002627	24 2023-01-30	4.005838e-03	80.42 -1
25 2023-01-27	0.004119	25 2023-01-27	8.124553e-03	80.58 -1
26 2023-01-26	0.004115	26 2023-01-26	1.223932e-02	80.74 -1
27 2023-01-25	0.000024	27 2023-01-25	1.226295e-02	80.57 -1
28 2023-01-24	0.002502	28 2023-01-24	1.476446e-02	80.60 -1
29 2023-01-23	0.007960	29 2023-01-23	2.272489e-02	81.07 -1
30 2023-01-20	0.001266	30 2023-01-20	2.399060e-02	81.00 -1

31 2023-01-19	-0.004167	31 2023-01-19 1.982346e-02	80.49	-1
32 2023-01-18	-0.001598	32 2023-01-18 1.822545e-02	80.19	-1
33 2023-01-17	0.007990	33 2023-01-17 2.621569e-02	80.66	-1
34 2023-01-13	-0.005805	34 2023-01-13 2.041031e-02	80.02	-1
35 2023-12-01	-0.005744	35 2023-12-01 1.466644e-02	79.39	-1
36 2023-11-01	-0.006814	36 2023-11-01 7.852405e-03	78.68	-1
37 2023-10-01	-0.018461	37 2023-10-01 -1.060817e-02	77.06	-1
38 2023-09-01	-0.006046	38 2023-09-01 -1.665445e-02	76.43	-1
39 2023-06-01	-0.011347	39 2023-06-01 -2.800168e-02	75.40	-1
40 2023-05-01	0.002925	40 2023-05-01 -2.507676e-02	75.46	-1

Dubai. Disconnection of Russian Banks from SWIFT; Event Based

Event: Sheet1				
T-statistic: -1.343445984823157				
P-value: 0.18651650364725697				
Abnormal Returns:		Cumulative Abnormal Returns:		
Date	Abnormal Return	Date	CAR	Price
0 2022-01-04	NaN	0 2022-01-04	NaN	101.85
1 2022-03-31	0.084805	1 2022-03-31	8.480542e-02	110.89
2 2022-03-30	-0.003953	2 2022-03-30	8.085286e-02	110.89
3 2022-03-29	-0.007019	3 2022-03-29	7.383420e-02	110.55
4 2022-03-28	-0.001329	4 2022-03-28	7.250489e-02	110.84
5 2022-03-25	0.007415	5 2022-03-25	7.992006e-02	112.10
6 2022-03-24	-0.006450	6 2022-03-24	7.346973e-02	111.82
7 2022-03-23	0.002934	7 2022-03-23	7.640324e-02	112.59
8 2022-03-22	-0.014255	8 2022-03-22	6.214781e-02	111.43
9 2022-03-21	-0.001260	9 2022-03-21	6.088753e-02	111.73
10 2022-03-18	-0.028476	10 2022-03-18	3.241156e-02	108.99
11 2022-03-17	-0.005879	11 2022-03-17	2.653222e-02	108.78
12 2022-03-16	-0.039713	12 2022-03-16	-1.318059e-02	104.89
13 2022-03-15	0.004342	13 2022-03-15	-8.838744e-03	105.76
14 2022-03-14	0.028385	14 2022-03-14	1.954606e-02	109.18
15 2022-11-03	0.027280	15 2022-11-03	4.682633e-02	112.59
16 2022-10-03	-0.025180	16 2022-10-03	2.164631e-02	110.20
17 2022-09-03	0.002037	17 2022-09-03	2.368286e-02	110.86
18 2022-08-03	0.101315	18 2022-08-03	1.249982e-01	122.53
19 2022-07-03	-0.039454	19 2022-07-03	8.554414e-02	118.18
20 2022-04-03	-0.031284	20 2022-04-03	5.426039e-02	114.95
21 2022-03-03	-0.076767	21 2022-03-03	-2.250644e-02	106.58
22 2022-02-03	0.022506	22 2022-02-03	1.387779e-17	109.40
23 2022-01-03	-0.071594	23 2022-01-03	-7.159424e-02	102.00
24 2022-02-28	-0.098658	24 2022-02-28	-1.702527e-01	92.34
25 2022-02-25	-0.008393	25 2022-02-25	-1.786454e-01	91.93
26 2022-02-24	-0.002430	26 2022-02-24	-1.810750e-01	92.07
27 2022-02-23	-0.007971	27 2022-02-23	-1.890463e-01	91.70
28 2022-02-22	-0.002426	28 2022-02-22	-1.914721e-01	91.84
29 2022-02-18	-0.014188	29 2022-02-18	-2.056599e-01	90.90
30 2022-02-17	-0.006483	30 2022-02-17	-2.121427e-01	90.67

31 2022-02-16	0.005863	31 2022-02-16 -2.062794e-01	91.56	-1
32 2022-02-15	-0.011598	32 2022-02-15 -2.178772e-01	90.86	-1
33 2022-02-14	0.015308	33 2022-02-14 -2.025694e-01	92.61	-1
34 2022-11-02	-0.012807	34 2022-11-02 -2.153763e-01	91.79	-1
35 2022-10-02	-0.024325	35 2022-10-02 -2.397014e-01	89.92	-1
36 2022-09-02	-0.004397	36 2022-09-02 -2.440988e-01	89.88	-1
37 2022-08-02	-0.010628	37 2022-08-02 -2.547270e-01	89.28	-1
38 2022-07-02	0.012625	38 2022-07-02 -2.421025e-01	90.76	-1
39 2022-04-02	-0.000647	39 2022-04-02 -2.427496e-01	91.06	-1
40 2022-03-02	-0.024818	40 2022-03-02 -2.675675e-01	89.16	-1
41 2022-02-02	-0.019543	41 2022-02-02 -2.871100e-01	87.77	-1
42 2022-01-02	-0.007940	42 2022-01-02 -2.950503e-01	87.42	-1

Brent. Price Cap for Russian Oil. Event Based

Event: Sheet1				
T-statistic: 0.36581151778977705				
P-value: 0.7163418292432469				
Abnormal Returns:		Cumulative Abnormal Returns:		
Date	Abnormal Return	Date	CAR	Price
0 2022-03-10	NaN	0 2022-03-10	NaN	90.68
1 2022-09-30	-0.022089	1 2022-09-30	-2.208893e-02	88.9
2 2022-09-29	0.003277	2 2022-09-29	-1.881162e-02	89.41
3 2022-09-28	-0.000894	3 2022-09-28	-1.970527e-02	89.55
4 2022-09-27	-0.042437	4 2022-09-27	-6.214240e-02	85.97
5 2022-09-26	-0.042241	5 2022-09-26	-1.043832e-01	82.55
6 2022-09-23	0.018619	6 2022-09-23	-8.576453e-02	84.29
7 2022-09-22	0.070028	7 2022-09-22	-1.573615e-02	90.4
8 2022-09-21	-0.008433	8 2022-09-21	-2.416907e-02	89.86
9 2022-09-20	-0.005130	9 2022-09-20	-2.929936e-02	89.62
10 2022-09-16	-0.004580	10 2022-09-16	-3.387890e-02	89.43
11 2022-09-15	-0.004137	11 2022-09-15	-3.801565e-02	89.28
12 2022-09-14	0.037303	12 2022-09-14	-7.125781e-04	92.83
13 2022-09-13	-0.010970	13 2022-09-13	-1.168223e-02	92.04
14 2022-12-09	0.012860	14 2022-12-09	1.177731e-03	93.45
15 2022-09-09	-0.021400	15 2022-09-09	-2.022235e-02	91.68
16 2022-08-09	-0.042708	16 2022-08-09	-6.293051e-02	87.99
17 2022-07-09	-0.015643	17 2022-07-09	-7.857329e-02	86.83
18 2022-06-09	0.050518	18 2022-06-09	-2.805568e-02	91.43
19 2022-05-09	0.028056	19 2022-05-09	2.428613e-17	94.22
20 2022-02-09	-0.014453	20 2022-02-09	-1.445268e-02	93.09
21 2022-01-09	-0.011590	21 2022-01-09	-2.604309e-02	92.24
22 2022-08-31	0.044266	22 2022-08-31	1.822337e-02	96.55
23 2022-08-30	0.026437	23 2022-08-30	4.466085e-02	99.34
24 2022-08-26	0.015559	24 2022-08-26	6.022030e-02	101.13
25 2022-08-25	-0.025400	25 2022-08-25	3.482006e-02	98.81
26 2022-08-24	0.008268	26 2022-08-24	4.308825e-02	99.87
27 2022-08-23	-0.006264	27 2022-08-23	3.682384e-02	99.49
28 2022-08-22	-0.046987	28 2022-08-22	-1.016272e-02	95.06
29 2022-08-19	0.012163	29 2022-08-19	2.000158e-03	96.45
30 2022-08-18	-0.003496	30 2022-08-18	-1.496117e-03	96.35

31 2022-08-17	0.006570	31 2022-08-17 5.073994e-03	97.22	-1
32 2022-08-16	-0.021591	32 2022-08-16 -1.651734e-02	95.36	-1
33 2022-08-15	0.027847	33 2022-08-15 1.132940e-02	98.25	-1
34 2022-12-08	0.053011	34 2022-12-08 6.434067e-02	103.7	-1
35 2022-11-08	0.031195	35 2022-11-08 9.553597e-02	107.19	-1
36 2022-10-08	-0.022331	36 2022-10-08 7.320525e-02	105.06	-1
37 2022-09-08	-0.014357	37 2022-09-08 5.884782e-02	103.81	-1
38 2022-08-08	-0.005831	38 2022-08-08 5.301680e-02	103.46	-1
39 2022-05-08	-0.032906	39 2022-05-08 2.011078e-02	100.31	-1
40 2022-04-08	-0.025588	40 2022-04-08 -5.476987e-03	97.99	-1
41 2022-03-08	0.036626	41 2022-03-08 3.114917e-02	101.82	-1
42 2022-02-08	0.043602	42 2022-02-08 7.475137e-02	106.51	-1
43 2022-01-08	-0.006403	43 2022-01-08 6.834861e-02	106.09	-1

Brent. US sanctions against Russian energy sectors; Event Based

T-statistic: -1.3115760364733442					
P-value: 0.19662326161510327					
Abnormal Returns:		Cumulative Abnormal Returns:			
Date	Abnormal Return	Date	CAR	Price	Event
0 2014-03-10	NaN	0 2014-03-10	NaN	90.8	0
1 2014-02-10	0.000547	1 2014-02-10	5.473931e-04	91.29	0
2 2014-01-10	0.031080	2 2014-01-10	3.162777e-02	94.57	0
3 2014-09-30	-0.003792	3 2014-09-30	2.783610e-02	94.67	0
4 2014-09-29	0.006031	4 2014-09-29	3.386692e-02	95.7	0
5 2014-09-26	-0.011328	5 2014-09-26	2.253926e-02	95.08	0
6 2014-09-25	-0.003587	6 2014-09-25	1.895227e-02	95.2	0
7 2014-09-24	-0.011887	7 2014-09-24	7.065370e-03	94.53	0
8 2014-09-23	-0.001252	8 2014-09-23	5.813029e-03	94.87	0
9 2014-09-22	0.000421	9 2014-09-22	6.234316e-03	95.37	0
10 2014-09-19	0.009621	10 2014-09-19	1.585519e-02	96.75	0
11 2014-09-18	-0.004126	11 2014-09-18	1.172962e-02	96.82	0
12 2014-09-17	0.004240	12 2014-09-17	1.596957e-02	97.7	0
13 2014-09-16	-0.008022	13 2014-09-16	7.947512e-03	97.39	0
14 2014-09-15	-0.014706	14 2014-09-15	-6.758846e-03	96.43	0
15 2014-12-09	-0.006094	15 2014-12-09	-1.285235e-02	96.31	0
16 2014-11-09	-0.003707	16 2014-11-09	-1.655929e-02	96.42	0
17 2014-10-09	-0.006508	17 2014-10-09	-2.306778e-02	96.26	0
18 2014-09-09	0.014058	18 2014-09-09	-9.009738e-03	98.08	0
19 2014-08-09	0.009935	19 2014-08-09	9.250297e-04	99.53	0
20 2014-05-09	-0.005050	20 2014-05-09	-4.124997e-03	99.51	0
21 2014-04-09	0.012235	21 2014-04-09	8.109630e-03	101.21	0
22 2014-03-09	-0.008110	22 2014-03-09	-1.387779e-17	100.88	0
23 2014-02-09	-0.011491	23 2014-02-09	-1.149064e-02	100.21	1
24 2014-08-29	0.004232	24 2014-08-29	-7.258790e-03	101.12	-1
25 2014-08-28	-0.008904	25 2014-08-28	-1.616246e-02	100.71	-1
26 2014-08-27	-0.007927	26 2014-08-27	-2.408969e-02	100.4	-1
27 2014-08-26	-0.003853	27 2014-08-26	-2.794276e-02	100.5	-1
28 2014-08-25	-0.004949	28 2014-08-25	-3.289134e-02	100.49	-1
29 2014-08-22	-0.008830	29 2014-08-22	-4.172092e-02	100.09	-1
30 2014-08-21	-0.002951	30 2014-08-21	-4.467171e-02	100.28	-1

31 2014-08-20	-0.008439	31 2014-08-20 -5.311074e-02	99.92	-1
32 2014-08-19	-0.006651	32 2014-08-19 -5.976126e-02	99.74	-1
33 2014-08-18	-0.008559	33 2014-08-18 -6.831999e-02	99.37	-1
34 2014-08-15	0.012863	34 2014-08-15 -5.545749e-02	101.13	-1
35 2014-08-14	-0.004651	35 2014-08-14 -6.010881e-02	101.15	-1
36 2014-08-13	0.006224	36 2014-08-13 -5.388523e-02	102.27	-1
37 2014-12-08	-0.010618	37 2014-12-08 -6.450335e-02	101.68	-1
38 2014-11-08	0.012755	38 2014-11-08 -5.174819e-02	103.47	-1
39 2014-08-08	-0.005912	39 2014-08-08 -5.766038e-02	103.36	-1
40 2014-07-08	0.001536	40 2014-07-08 -5.612401e-02	104.02	-1
41 2014-06-08	-0.003407	41 2014-06-08 -5.953107e-02	104.17	-1
42 2014-05-08	-0.017809	42 2014-05-08 -7.733973e-02	102.82	-1
43 2014-04-08	0.003029	43 2014-04-08 -7.431097e-02	103.63	-1
44 2014-01-08	-0.006586	44 2014-01-08 -8.089700e-02	103.45	-1

Brent. Ban on Imports from Russia of Oi

T-statistic: -0.3189910841453952							
P-value: 0.7513528121277995							
Abnormal Returns:		Cumulative Abnormal Returns:					
Date	Abnormal Return	Date	CAR	Price	Event		
0	2023-06-03	NaN	0	2023-06-03	NaN	85.86	0
1	2023-03-03	0.000305	1	2023-03-03	0.000305	85.74	0
2	2023-02-03	-0.016842	2	2023-02-03	-0.016537	84.15	0
3	2023-01-03	-0.003883	3	2023-01-03	-0.020420	83.68	0
4	2023-02-28	-0.003914	4	2023-02-28	-0.024334	83.21	0
5	2023-02-27	-0.021972	5	2023-02-27	-0.046306	81.24	0
6	2023-02-24	0.014873	6	2023-02-24	-0.031433	82.31	0
7	2023-02-23	-0.001092	7	2023-02-23	-0.032525	82.08	0
8	2023-02-22	-0.029121	8	2023-02-22	-0.061646	79.55	0
9	2023-02-21	0.034261	9	2023-02-21	-0.027385	82.14	0
10	2023-02-20	0.009616	10	2023-02-20	-0.017769	82.79	0
11	2023-02-17	-0.008202	11	2023-02-17	-0.025971	81.97	0
12	2023-02-16	0.024516	12	2023-02-16	-0.001455	83.84	0
13	2023-02-15	0.004923	13	2023-02-15	0.003468	84.11	0
14	2023-02-14	0.011808	14	2023-02-14	0.015276	84.96	0
15	2023-02-13	0.013708	15	2023-02-13	0.028984	85.98	0
16	2023-10-02	-0.004345	16	2023-10-02	0.024639	85.46	0
17	2023-09-02	-0.021700	17	2023-09-02	0.002939	83.46	0
18	2023-08-02	0.010210	18	2023-08-02	0.013148	84.17	0
19	2023-07-02	-0.013148	19	2023-07-02	0.000000	82.92	0
20	2023-06-02	-0.027723	20	2023-06-02	-0.027723	80.48	1
21	2023-03-02	-0.018551	21	2023-03-02	-0.046274	78.85	-1
22	2023-02-02	0.023516	22	2023-02-02	-0.022758	80.57	-1
23	2023-01-02	0.014611	23	2023-01-02	-0.008148	81.61	-1
24	2023-01-31	0.023881	24	2023-01-31	0.015734	83.42	-1
25	2023-01-30	0.019444	25	2023-01-30	0.035178	84.9	-1
26	2023-01-27	0.007121	26	2023-01-27	0.042298	85.36	-1
27	2023-01-26	0.012598	27	2023-01-26	0.054896	86.29	-1
28	2023-01-25	-0.012320	28	2023-01-25	0.042576	85.08	-1
29	2023-01-24	0.003701	29	2023-01-24	0.046277	85.25	-1
30	2023-01-23	0.028565	30	2023-01-23	0.074841	87.54	-1

31 2023-01-20	-0.004923	31 2023-01-20 0.069918	86.96	-1
32 2023-01-19	-0.019917	32 2023-01-19 0.050002	85.08	-1
33 2023-01-18	-0.013577	33 2023-01-18 0.036425	83.78	-1
34 2023-01-17	0.008864	34 2023-01-17 0.045289	84.38	-1
35 2023-01-16	-0.018800	35 2023-01-16 0.026489	82.65	-1
36 2023-01-13	0.011140	36 2023-01-13 0.037629	83.43	-1
37 2023-12-01	-0.008366	37 2023-12-01 0.029263	82.59	-1
38 2023-11-01	-0.016217	38 2023-11-01 0.013046	81.11	-1
39 2023-10-01	-0.031709	39 2023-10-01 -0.018663	78.4	-1
40 2023-09-01	-0.009777	40 2023-09-01 -0.028440	77.5	-1
41 2023-06-01	-0.012362	41 2023-06-01 -0.040802	76.41	-1
42 2023-05-01	0.005890	42 2023-05-01 -0.034912	76.73	-1

Brent. Disconnection of Russian Banks from SWIFT; Event based

T-statistic: -1.3937965194621456				
P-value: 0.1707104985055535				
Abnormal Returns:		Cumulative Abnormal Returns:		
Date	Abnormal Return	Date	CAR	Price
0 2022-01-04	NaN	0 2022-01-04	NaN	106.13
1 2022-03-31	0.004361	1 2022-03-31	4.361375e-03	107.29
2 2022-03-30	0.070792	2 2022-03-30	7.515318e-02	115.59
3 2022-03-29	-0.030792	3 2022-03-29	4.436102e-02	112.79
4 2022-03-28	0.008592	4 2022-03-28	5.295332e-02	114.5
5 2022-03-25	0.064785	5 2022-03-25	1.177384e-01	122.67
6 2022-03-24	0.004110	6 2022-03-24	1.218489e-01	123.98
7 2022-03-23	0.021984	7 2022-03-23	1.438332e-01	127.52
8 2022-03-22	-0.053542	8 2022-03-22	9.029159e-02	121.53
9 2022-03-21	-0.000315	9 2022-03-21	8.997657e-02	122.29
10 2022-03-18	-0.071742	10 2022-03-18	1.823501e-02	114.32
11 2022-03-17	-0.013741	11 2022-03-17	4.493543e-03	113.5
12 2022-03-16	-0.084895	12 2022-03-16	-8.040106e-02	104.61
13 2022-03-15	-0.001502	13 2022-03-15	-8.190324e-02	105.14
14 2022-03-14	0.043365	14 2022-03-14	-3.853844e-02	110.39
15 2022-11-03	0.063365	15 2022-11-03	2.482682e-02	118.11
16 2022-10-03	-0.036795	16 2022-10-03	-1.196786e-02	114.54
17 2022-09-03	0.011242	17 2022-09-03	-7.261060e-04	116.58
18 2022-08-03	0.135823	18 2022-08-03	1.350968e-01	133.18
19 2022-07-03	-0.037805	19 2022-07-03	9.729223e-02	129.02
20 2022-04-03	-0.046562	20 2022-04-03	5.072981e-02	123.86
21 2022-03-03	-0.075194	21 2022-03-03	-2.446467e-02	115.36
22 2022-02-03	0.024465	22 2022-02-03	-4.163336e-17	118.94
23 2022-01-03	-0.073913	23 2022-01-03	-7.391350e-02	110.93
24 2022-02-28	-0.077334	24 2022-02-28	-1.512475e-01	103.08
25 2022-02-25	-0.050418	25 2022-02-25	-2.016655e-01	98.56
26 2022-02-24	0.021130	26 2022-02-24	-1.805353e-01	101.29
27 2022-02-23	-0.026314	27 2022-02-23	-2.068492e-01	99.29
28 2022-02-22	-0.012209	28 2022-02-22	-2.190578e-01	98.73
29 2022-02-21	-0.004340	29 2022-02-21	-2.233981e-01	98.95
30 2022-02-18	-0.034563	30 2022-02-18	-2.579607e-01	96.18

31 2022-02-17	-0.015926	31 2022-02-17 -2.738868e-01	95.28	-1
32 2022-02-16	0.016101	32 2022-02-16 -2.577854e-01	97.44	-1
33 2022-02-15	0.003591	33 2022-02-15 -2.541939e-01	98.43	-1
34 2022-02-14	0.026247	34 2022-02-14 -2.279473e-01	101.66	-1
35 2022-11-02	-0.047489	35 2022-11-02 -2.754366e-01	97.5	-1
36 2022-10-02	-0.018158	36 2022-10-02 -2.935950e-01	96.37	-1
37 2022-09-02	-0.021303	37 2022-09-02 -3.148985e-01	94.95	-1
38 2022-08-02	0.005227	38 2022-08-02 -3.096714e-01	96.07	-1
39 2022-07-02	0.006026	39 2022-07-02 -3.036451e-01	97.28	-1
40 2022-04-02	-0.010886	40 2022-04-02 -3.145311e-01	96.86	-1
41 2022-03-02	-0.046523	41 2022-03-02 -3.610543e-01	92.99	-1
42 2022-02-02	-0.023345	42 2022-02-02 -3.843989e-01	91.43	-1
43 2022-01-02	-0.019584	43 2022-01-02 -4.039829e-01	90.24	-1