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Effect of covid-19 pandemic and Russia-Ukraine crisis on the oil market volatility

أثر جائحة كوفيد 19 و الأزمة الروسية الأوكرانية على تقلبات أسعار النفط

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Abstract:

This paper analyzes the effect of the covid-19 and the Russian war on the oil market, the paper gives an overview on the oil market and the fluctuations of its prices emphasizing the impact of the health and geopolitical crises; the study uses the GARCH(1,1) model to measure the volatility of the oil prices and show their reaction to the crises. The results indicate the existence of very high volatility in the return series over the period 01/ 1998 to 09/2022; the conditional standard deviation graph shows the highest levels during the crises periods and confirms the reaction of the oil market to the geopolitical, economic and health crises especially during the last two years and after the covid-19 pandemic.

Keywords:covid-19, Russian war, oil market, volatility.

JELClassificationCodes:I19, Q3, C58

ملخص:

يهدف هذاالبحث لدراسة تأثير كوفيد -19 والحرب الروسية- الأوكرانية على سوق النفط ، ويقدم البحث لمحة عامة عن سوق النفط وتقلبات أسعاره مع التأكيد على تأثير الأزمات الصحية والجيوسياسية. تستخدم الدراسة نموذج $GARCH\ 1,1$ لقياس تقلب أسعار النفط وإظهار رد فعلهم على الأزمات. تشير النتائج إلى وجود درجة عالية من التقلب في سلسلة المرتجعات خلال الفترة من 1998/01 إلى 2022/09. يوضح الرسم البياني للانحراف المعياري المشروط مستويات عالية اثناء فترات الأزمات هذا ما يؤكد رد فعل سوق النفط على الأزمات الجيوسياسية والاقتصادية والصحية خاصة خلال العامين الماضيين وبعد جائحة كوفيد -19.

كلمات مفتاحية: كوفيد -19، الحرب الروسية، سوق النفط، التقلبات.

تصنيفاتJEL : I19, Q3, C58

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INTRODUCTION:

Since the 1970s, oil prices have experienced complex fluctuations. These fluctuations are mostly related to historical events such as the first and second Gulf War, and the global financial crisis of 2008. The last decade was marked by a collapse of the oil market in 2014/2015 followed a few years later by the pandemic that caused an unprecedented fall in prices. Recently, on Monday, April 21, 2020, the price of U.S. crude oil turned negative for the first time in history, forcing producers to pay buyers to take the barrels that they could not store due to the oversupply of oil. This situation is a direct result of failed negotiations between Russia and the Organization of the Petroleum Exporting Countries (OPEC) to reduce daily barrel production and the drop in oil demand due to the COVID-19 outbreak. Energy consumption in general, and oil demand in particular, have decreased as offices shut and industrial activity slowed sharply with government travel and work restrictions to slow the spread of the corona-virus.

After weeks of tensions, in the beginning of 2022, Russian President Vladimir Putin ordered Russian troops to invade Ukraine. Brent futures, already trending higher before the crisis, hit $105/b on February 24 before retreating and closing at $99/b on the day as all the signals were indicating that the sanctions imposed on Russia would not target its crude oil and natural gas sales. But as sanctions on Russia intensified and as financial institutions started to refuse financing Russia-related transactions, including opening letters of credit or clearing payments and as some companies became reluctant to purchase Russian crude, Brent on March 2 (the time of writing) was trading above $110 for the first time since 2014.

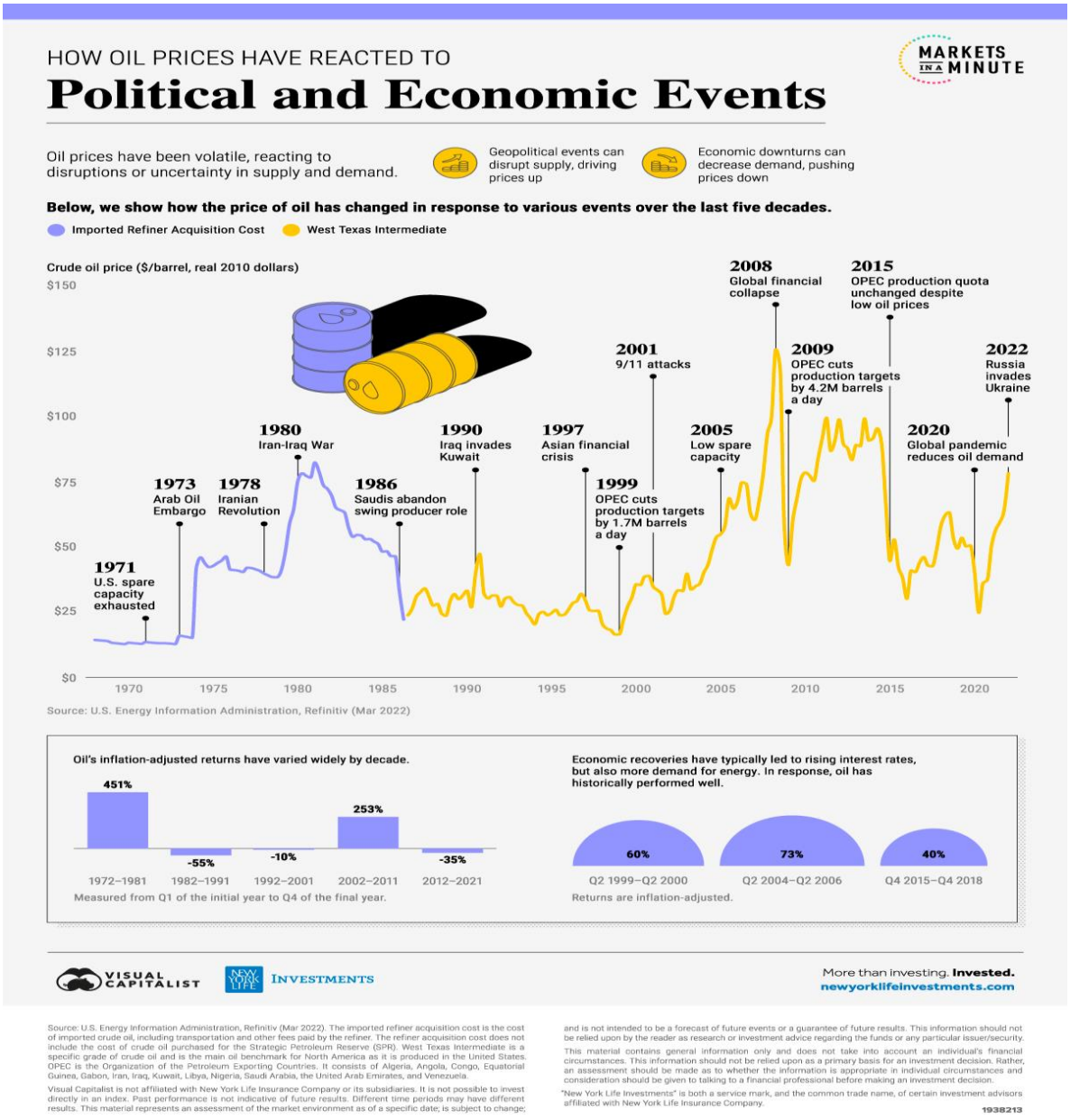
In that context, our paper analyzes the effect of the covid-19 and the Russian war on the oil market, and gives answer to the following question:

How was the reaction of the oil market to the covid-19 and Russian war crises?

To answer this problematic, we divided the paper into three sections; the first talking about the oil market and the fluctuations of its prices; the second summarizes the methodology of the study in which we used the GARCH(1,1) model to analyze the volatility of the oil prices and show the reaction to the crises; finally, the third one shows the empirical results.

1- Overview on the oil market:

Figure1: changes in the oil market



Source: US Energy information, 2022

The behavior of oil prices has received special attention in the current economic studies especially after the two shocks of 1970s and 1980s. Since the mid 1980s, the price of oil remained very volatile as shown in the figure. Several reasons have caused this wide variability in oil markets: geopolitical, speculation and supply and demand shocks. This uncertainty in the price of oil, which is technically termed as volatility, represents a challenge for both importers and exporters of this commodity.

These fluctuations are mostly related to historical events such as the first and second Gulf War, and the global financial crisis of 2008. The last decade was marked by a collapse of the oil market in 2014/2015 followed a few years later by the pandemic that caused an unprecedented fall in prices. Recently, on Monday, April 21, 2020, the price of U.S. crude oil

turned negative for the first time in history, forcing producers to pay buyers to take the barrels that they could not store due to the oversupply of oil. This situation is a direct result of failed negotiations between Russia and the Organization of the Petroleum Exporting Countries (OPEC) to reduce daily barrel production and the drop in oil demand due to the COVID-19 outbreak. Energy consumption in general, and oil demand in particular, have decreased as offices shut and industrial activity slowed sharply with government travel and work restrictions to slow the spread of the coronavirus. Recently, the Russian- Ukranian War is affecting the oil market to a positive trend.

Both crude oil and petroleum product prices can be affected by events that have the potential to disrupt the flow of oil and products to market, including geopolitical and weather related developments. These types of events may lead to actual disruptions or create uncertainty about future supply or demand, which can lead to higher volatility in prices. The volatility of oil prices is inherently tied to the low responsiveness or "inelasticity" of both supply and demand to price changes in the short run. Both, oil production capacity and the equipment that use petroleum products as their main source of energy are relatively fixed in the near-term. It takes years to develop new supply sources or vary production, and it is very hard for consumers to switch to other fuels or increase fuel efficiency in the near- term when prices rise. Under such conditions, a large price change can be necessary to re-balance physical supply and demand following a shock to the system. (Energy Information Administration 2015).

1-1 Oil price reaction to the covid-19 pandemic:

In 2020, the Covid-19 pandemic affected the global economy, trading companies, and other sectors such as agriculture, the oil industry, etc. However, crude oil price fluctuations significantly impact listed companies' output, costs, and profits, resulting in stock price fluctuations (Gao et al. 2021), (Lee et al. 2019) and (Ding et al. 2020). Mean-while, the achievements of the registered businesses may result in economic shifts. Furthermore, changes in the global economy can disrupt the steadiness of international crude oil supply and demand, resulting in crude oil price variations (Guan and Li 2020).

Coronavirus affects the oil market in two ways. First, travel restrictions due to containment efforts limit the use of jet fuel, and supply chains slow and industrial activity declines as companies send workers home—meaningless oil and oil-based products are being used and produced. This has very direct effects on oil consumption and informs near-term calculations of real oil demand. Second, the stock market reaction to the effect of the coronavirus on the global economy builds a projection of global oil demand over the long-term. As broader market sentiment about the health of the global economy declines, so do projections about the future oil demand curve, prompting flight away from oil and energy stocks and further drawing down prices.

The response in oil prices has been significant. Brent prices hit a twelve-month low last week, with the near-term outlook looking grim and the forecast looking increasingly dark for the balance of the year. During that period the forward curve, a marker of expected per-barrel value over the rest of the year, has flattened in the past week, signaling that oil traders see no value in holding or selling off their stocks. At week’s end, Brent was trading at slightly over $50 per barrel with West Texas Intermediate (WTI) prices hanging on at $45.26.

Importantly, following nearly a year of market preoccupation with a global oil supply glut, current market sentiment toward projected demand declines is so significant that events that would have otherwise been huge supply-side market movers have gone largely unnoticed. A near-complete removal of Libyan oil from the market (reportedly beyond 800,000 bpd) and an escalation of sanctions against Venezuelan production still constitute larger near-term risks to supply, yet, due to the scale of an increasingly realistic worst case coronavirus scenario on the global economy, both have passed without much attention.

Oil prices bounced back slightly on February 2, with both Brent and WTI rising by around two dollars on the back of a broader rebound throughout the stock market. However, this bump should be contextualized by volatility due to the uncertain economic forecast, expectations for interest rate cuts in the United States and Canada, and anticipation surrounding a possible production cut by OPEC+ as it meets over the next few days.

As the oil market continues to react to an abysmal economic forecast, there are several key items to look out for.

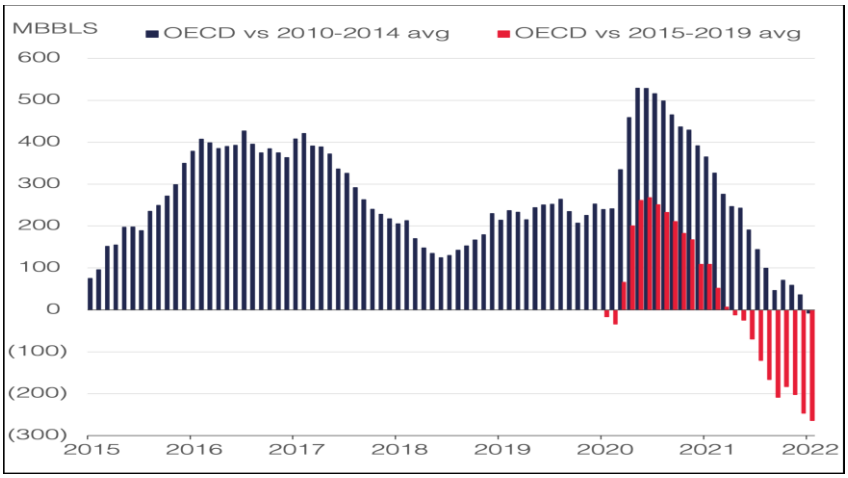
1-2 Russia–Ukraine War and US Oil Prices:

Russia's invasion of Ukraine on the 24 February 2022 has seen an intricate development in crude oil prices, since the oil market experienced structural changes.

After weeks of tensions, Russian President Vladimir Putin ordered Russian troops to invade Ukraine. Brent futures, already trending higher before the crisis, hit $105/b on February 24 before retreating and closing at $99/b on the day as all the signals were indicating that the sanctions imposed on Russia would not target its crude oil and natural gas sales. But as sanctions on Russia intensified and as financial institutions started to refuse financing Russia-related transactions, including opening letters of credit or clearing payments and as some companies became reluctant to purchase Russian crude, Brent on March 2 (the time of writing) was trading above $110 for the first time since 2014. (B.Fattouh and al.; 2022, P2)

The rise in oil prices over the last few months reflects tighter market fundamentals with the recovery in oil demand surprising on the upside, OPEC+ returning fewer barrels than planned in their current agreement and OECD crude and products stocks continuing to fall (Figure 2). The upward pressure on oil prices also reflects heightened concerns about the size of spare production capacity in a deteriorating geopolitical environment and amid a higher probability of output disruptions. The Russia-Ukraine crisis adds a new layer of geopolitical uncertainty on top of a wide range of uncertainties surrounding the oil market and spillovers from other energy markets, particularly the gas market where high gas prices have created additional pressure on oil demand due to gas-to-oil substitution.

Figure2: OECD commercial stocks



Source : International Energy information

1-3- Empirical literature :

Although that the covid 19 issue is recent, many studies dealt with it impact on the oil market; in this context, we will show here a set of such studies:

Gharib, Meftah, Serret and Jabbeur (2021) provided an analysis of crude oil, diesel, and gasoline prices for the period from November 1, 2019 to December 31, 2020. They applied Log Periodic Power-Law Singularity (LPPLS) and Discrete Scale LPPLS bubble indicators to explore the dynamic bubbles of oil prices and predict their crash times. The results indicate that West Texas Light crude oil and North Sea Brent crude oil experienced a statistically significant negative financial bubble during the COVID-19 outbreak.

Bourghal, Jawwadi and Rozin (2021) explored the dynamics of oil volatility. Using the VAR model, the authors showed that oil price volatility reacted substantially to the Covid 19 pandemic-induced oil shocks. In particular, they documented the impact of uncertainty caused by the shocks and investor anxiety on oil price volatility. They showed that greater uncertainty leads to more oil price volatility. Our findings remained unchanged even after controlling for modeling robustness.

Khalfaoui, Jabbeur, Al Qadassi and Solarin (2022) examined the time-varying causal effect of the novel COVID-19 pandemic in the major oil-importing and oil-exporting countries on the oil price changes, stock market volatilities and the economic uncertainty using the wavelet coherence and network analysis. During the period of the pandemic, we explore such relationship by resorting to the wavelet coherence and gaussian graphical model (GGM) frameworks. Their findings also provided evidence that the COVID-19 pandemic and oil price changes in oil-importing countries mirror those in oil-exporting countries and vice versa. Further, the COVID-19 pandemic has a profound immediate time–frequency effect on the US, Japanese, South Korean, Indian, and Canadian economic uncertainties.

Regarding the effect of the Russia-Ukraine war on the oil market, some studies dealt with the issue empirically while others dealt with it analytically:

Basdekis, christopolus, katsampoxakis and nastas (2022) tried to examine the existence of interdependencies between specific stock market indices, exchange rates and crude oil for the period January 2021 to July 2022 with daily data. In the period they have chosen, the post-vaccination phase against COVID-19, as well as the war in Ukraine, is covered. The variables selected for this study are RTSI, Eurostoxx, S&P 500, EUR/USD and RUB/USD exchange rates and crude oil prices. The findings of the study reveal the existence of strong correlations between all variables, during different time periods and for different frequencies during the period under review. Of particular interest is the finding that shows that during the crisis period, the RTSI significantly affects both the European and American stock markets, while also determining the evolution of the Russian currency.

Fang and shao (December 2022) constructed a new index to measure the intensity of the Russia-Ukraine conflict and use it to examine to what extent and through which channels does this conflict affect the volatility risk of commodity markets. Their results suggest that the intensification of the Russia-Ukraine conflict significantly increases the volatility of agricultural, metal, and **energy markets**. The authors argued that the conflict affects these markets through both economic and financial channels. Regarding economic channels, after the escalation of conflict, the higher the global market share of a commodity exported by Russia,

2- Data and methodology :

Our aim in this study is to model the trend of oil price over the period January 1998 to September 2022 and pursue its reaction during the health and geopolitical crises. Because of the high volatility of this time series we will apply GARCH model.

2-1 An overview of the model :

Homoscedasticity, one of the least squares (OLS) assumptions which means that the expected value of all error terms when squared is the same at any given point. In some cross sectional and financial time series, this assumption is violated and the problem of heteroscedasticity is present.

Instead of concerning this phenomenon as a problem to be corrected, Robert Engle (1982) suggested a model in which this problem is a variance to be modelled.

The model suggested by Engle is: ARCH (Autoregressive conditional heteroscedasticity) model ,is used to model and forecast variance of the error terms.

An ARCH model is defined as follow (Engle 1982) :

$Yt/Yt\text{-}1 \sim N(xt\ b, ht)$

$ht=h(et\text{-}1 , et\text{-}2 ,\ldots\ldots,et\text{-}p , a)$

$et = Yt - xt\ b$

Where :

Yt-1 : a set of information available at (t-1)

b : a vector of unknown parameters

ht :the conditional variance of the error term

et : error term

a : an unknown parameters

P : the order of the ARCH process.

In order to simplify, the model can be defined :

$s^2 = ao+Saie^2t-i$: i=1,,,,,,p

Where :ht = s^2.

In 1986, Bollerslev developed a generalized ARCH (GARCH) model which can be defined in the equation below:

$s^2 = ao + Saie^2t-i + Sbj\ s^2t-j$: i=1,,,,,p j=1,,,,,q

This equation means that the conditional variance depends not only on the squared lagged error terms but also on the variance itself.

The orders p and q can be identified by applying Box and Jenkins techniques to the AC and PAC.

ARCH and GARCH models are right if :

" i , j : ao>0 , $bj^3 0$, $ai^3 0$

2-2 Methodology :

In order to achieve the objective of our paper, we will follow the steps below:

1_ Testing the stationarity of the oil price series using Augmented Dickey Fuller and Philip Perron tests, and providing some descriptive statistics concerning the series.

2_ Testing the heteroscedasticity from the ARCH_LM test by estimating the regression of the residuals :

$$\varepsilon^2 t = \alpha o + \alpha_1 \varepsilon^2_{t-1}$$

In the context of the null hypothesis of homoscedasticity, LM statistic follows a Chi Squared distribution $X^2(p)$:

If : LM> X^2 *: we reject the nul hypothesis H0 , and the series has an ARCH effect*

If : LM < X^2 : we accept the nul hypothesis and the ARCH effect doesn't occur in the series (the variance of the residual terms is constant)

3_ Parameters estimation of GARCH (1,1) model : we estimate the parameters of the mean and the variance regressions :

$R_t = \mu + \varepsilon_t$

$\sigma^2 = \alpha_0 + \alpha_1 \varepsilon^2_{t-1} + \beta_1\ \sigma^2_{t-1}$

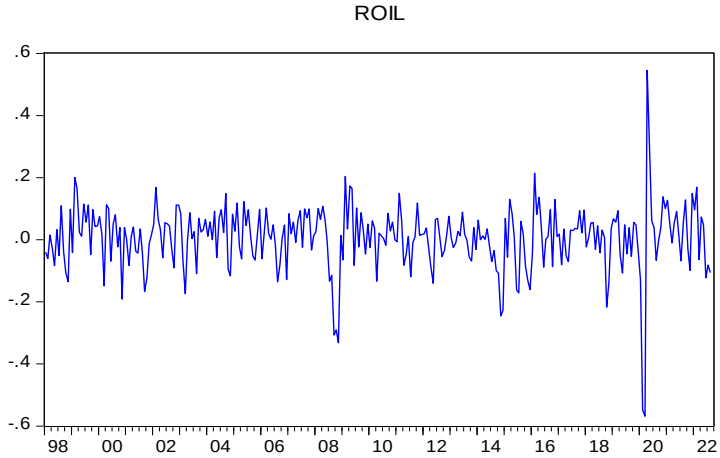
4_ Modelling the volatility of the oil price series by plotting the standard deviation of the error terms.

2-3 Data :

In our study we are going to use the oil price (oil) monthly data, the data cover 297 observations from January 1998 to September 2022 ,these data are brought from the International energy information.

We use the series of oil returns (roil) from the equation: roilt=(oil(t)-oil(t-1))/oil(t-1)

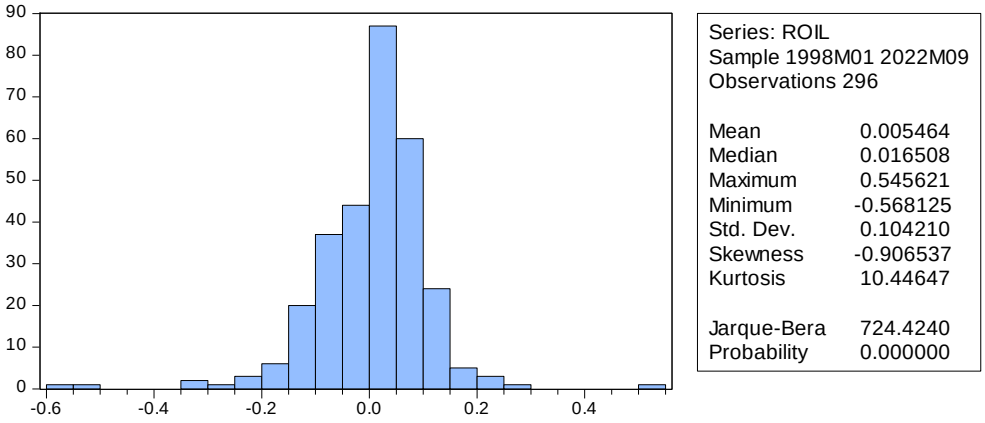
Figure 3: oil returns



Source: author's calculations using Eviews 9 program

From the histogram and descriptive statistics of the oil return series, we observe that the mean and the median are positive with 0.0054% and 0.01% respectively. The negative skewness (-0,906) and a kurtosis superior to 3 (10.44) indicates that the return series is asymmetric and highly leptokurtic to the normal. The Jack Bera test and its probability equals to 0 reject the hypothesis of the normal distribution which confirms that the return series is not normally distributed.

Figure4: historgram and descriptive statistics



Source: author's calculations using Eviews program

Augmented Dickey Fuller and Philip Perron tests reject the hypothesis of the existence of unit root in the series, that means the oil return series is stationary. The table below presents the t-statistics and probabilities of the ADF and PP test at the level and with intercept, the values are approximately the same for both tests which confirms the stationarity of the oil returns series.(table1)

Table1 :stationarity tests (ADF and PP)

	t-Statistic	**Prob.***
Augmented Dickey-Fuller test statistic	-13.12	0.000
Phillips-Perron test statistic	-12.68	0.000

Source: author's calculations using Eviews program

The ARCH-LM test shows clearly the existence of an ARCH effect in the residuals then the model GARCH(1,1) is adequate to model the volatility of the oil market. Results for ARCH-LM test are presented in table2.

Table2: ARCH-LM test for residuals of oil returns series

Heteroskedasticity Test: ARCH				
F-statistic	280.6177	Prob. F(1,293)		0.0000
Obs*R-squared	144.3160	Prob. Chi-Square(1)		0.0000
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Date: 01/24/23 Time: 15:29				
Sample (adjusted): 1998M02 2022M08				
Included observations: 295 afteradjustments				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	0.003287	0.001463	2.247570	0.0253
RESID^2(-1)	0.699354	0.041748	16.75165	0.0000
R-squared	0.489207	Meandependent var		0.010853
Adjusted R-squared	0.487464	S.D. dependent var		0.033374
S.E. of regression	0.023893	Akaike info criterion		-4.623724
Sumsquaredresid	0.167263	Schwarz criterion		-4.598728
Log likelihood	683.9993	Hannan-Quinn criter.		-4.613715
F-statistic	280.6177	Durbin-Watson stat		1.644208

Source: author's calculations using Eviews program

3- Results and discussion:

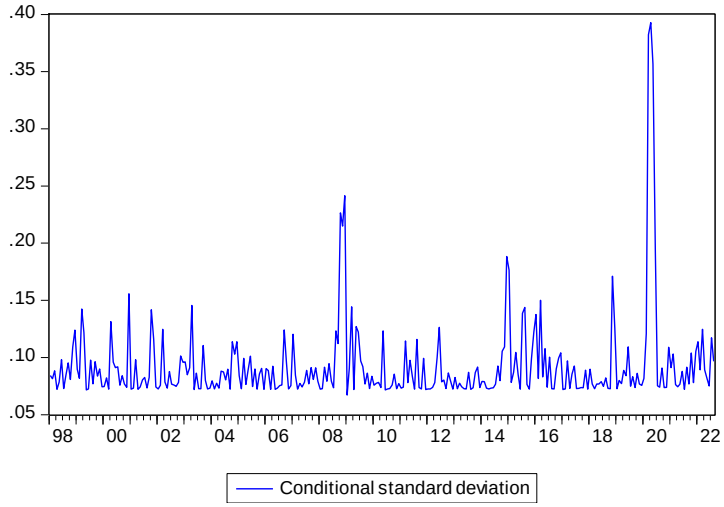
Our GARCH (1,1) estimation over the period (01/1998 to 09/2022) using Eviews 9 computational package gives us the following mean and conditional variance equations:

roilt=0.0162 +εt

σ_t^2 =0.0053+0.44ε_(t-1)^2- 0.013σ_(t-1)^2

The results summary exhibits high significance of the existence of GARCH effects, z-statistics are significant and a DW superior to 2.

The high value of β1 means that the volatility of oil returns is persistent during the period of the study. The conditional standard deviation plot confirms the high volatility of the oil markets, further, it shows the highest spikes during the crises periods; from 2008 to 2009, the global financial crisis period, and the most important spikes is over the year 2020 in which the world faced the covid-19 pandemic and the biginning of the Russin-Ukranian war.



Conclusion:

Our paper analyzed the trend of the price of oil during 1998-2022 and showed the effect of the covid-19 pandemic and the Russian- Ukranian war on the oil market.

Coronavirus affects the oil market in two ways. First, travel restrictions due to containment efforts limit the use of jet fuel, and supply chains slow and industrial activity declines as companies send workers home—meaningless oil and oil-based products are being used and produced.

Russia's invasion of Ukraine on the 24 February 2022 has seen an intricate development in crude oil prices, since the oil market experienced structural changes.

Using the univariateGARCH(1.1) econometric model, we modelled the volatility of the oil return series. Our results indicated the existence of very high volatility in the return series over the period 01/ 1998 to 09/2022; the conditional standard deviation graph confirms the reaction of the oil market to the geopolitical, economic and health crises especially during the last two years and after the covid-19 pandemic.

Bibliography

1. Basdekis, christopolus, katsampoxakis and nastas (2022), The Impact of the Ukrainian War on Stock and Energy Markets: A Wavelet Coherence Analysis, Energies 2022, 15, 8174. https://doi.org/10.3390/ en15218174.
2. Bollerslev, Tim. A Conditionally Heteroskedastic Time Series Model for Speculative Prices and Rates of Return, The Review of Economics and Statistics, Vol. 69, No. 3 (Aug., 1987), pp. 542-547.
3. Bourghal, Jawwadi and Rozin (2021), Oil price volatility in the context of Covid-19, International economics review, Volume 167, October 2021, Pages 39-49. https://www.sciencedirect.com/science/article/abs/pii/S2110701721000226
4. ChaimaGharib and al, impact of covid-19 pandemic on crude oil prices: evidence from econophysics approach, Resource policy 74 (2021).
5. Fang and Shao (2022), The Russia-Ukraine conflict and volatility risk of commodity markets, Finance Research Letters, Volume 50, December 2022, 103264. https://www.sciencedirect.com/science/article/abs/pii/S154461232200455X
6. Fattouh and al., Russia-Ukraine crisis implication for the oil market, the oxford institute for the energy studies, March 2022.
7. International energy Administration www.iea.org
8. Khalfaoui, Jabbeur, Al Qadassi and Solarin (2022), Dynamic causality interplay from COVID-19 pandemic to oil price, stock market, and economic policy uncertainty: evidence from oil-importing and oil-exporting countries, *Annals of Operations Research* volume 313, pages 105–143 (2022).
9. LEE CHEE NIAN, APPLICATION OF ARIMA AND GARCH MODELS IN FORECASTING CRUDE OIL PRICES.university of Malysia
10. Li, Y., Chevallier, J., Wei, Y., Li, J., 2020. Identifying price bubbles in the US, European and Asian natural gas market: evidence from a GSADF test approach. Energy Econ. 87, 104740. https://doi.org/10.1016/j.eneco.2020.104740.
11. Ozili, P.K., Arun, T., 2020. Spillover of COVID-19: Impact on the Global Economy. Available SSRN 3562570.
12. Robert Engle, GARCH 101: The Use ofARCH/GARCH Models in Applied Econometrics, Journal of Economic Perspectives—Volume 15, Number 4—Fall 2001—Pages 157–168.
13. Robert F. Engle, Estimates of the Variance of U. S. Inflation Based upon the ARCH Model, Journal of Money, Credit and Banking, Vol. 15, No. 3 (Aug., 1983), pp. 286-301.
14. Shu, M., Song, R., Zhu, W., 2021. The 'COVID' crash of the 2020 U.S. Stock market. N. Am. J. Econ. Finance 58, 101497. https://doi.org/10.1016/j.najef.2021.101497
15. Wei-Chong Choo See-Nie Lee Sze-NieUng, Macroeconomics Uncertainty and Performance of GARCH Models in Forecasting Japan Stock Market Volatility. Centre for Promoting Ideas, USA.