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The Oil Price-Stock Market Volatility Connection: Evidence from G20 Economies

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Abstract

This research investigates how oil price fluctuations affect stock market performance across G20 countries, utilizing the BEKK and DCC-GARCH models to model dynamic linkages and volatility cross-contagion between the two markets. An analysis is conducted from January 2004 to January 2021, examining the impact of oil price volatility on stock market performance and also contemplating the reverse relationship. We perform a research study in the context of the COVID-19 pandemic. The BEKK model enables us to estimate fluctuating conditional correlations over time, whereas the DCC-GARCH model offers a deeper understanding of the progressing dynamics that govern the relationships among variables. Our data analysis shows sizable reciprocal causation; the impact of oil price fluctuations on stock market performance is noticeable across the G20 economies. Volatility in the stock market is shown to be influenced by shifts in oil prices, thereby presenting their complex connection. Grasping these dynamics is crucial for both investors and policymakers in an unstable market environment and times of worldwide uncertainty. The study sheds novel insights into how monetary shock transfers happen, providing significant contributions to understanding market interdependence and the influence of commodities on market conditions.

Keywords: Bivariate GARCH, Dynamic relationship, G20 countries, Oil prices, Shocks transmission, Stock market returns.

1. Introduction

The link between oil prices and stock market returns is of great interest in both academic research and policy circles as well as among investors, especially on the G20 countries. Since these are all major players in the global economy, and they have large oil producers and consumers and also developed financial markets. However, oil prices have far-reaching consequences on global economic growth, inflation and corporate profitability that weigh heavily on stock market performance. For one, shocks are transmitted between international oil prices and stock market returns. Oil price volatility will have sector-specific effects, especially for industries that are high users of energy-inputs influencing valuations differently. Second, the same geopolitical events and global economic trends that to some extent define these relationships induce simultaneous movements in oil prices and stock markets, whilst enhancing concerns of causality as well as directionality.

The hypothetical dependency can function as both a positive and contrasting force. Given the economies of shipping and receiving countries are enormously dependent on the price of oil, the price fluctuations of crude are responsible to influence the economies of these countries substantially as well as the changes in its price tend to have a great impact on them. The volatility in crude oil and alternative energy resources may immediately influence investment returns on the stock market. The interrelation between stock market values and oil prices has garnered substantial focus in fresh years.

So, the IEA estimated that oil will account for 30% of universal energy supply by 2030. Investors especially portfolio managers experience disruption expected to the unpredictability of oil prices triggering risk and uncertainty in their investments. Research findings show oil prices straightforwardly affect stock markets by adapting forthcoming cash inflows, or influence stock markets obliquely via impacts on interest rates set assessing these cash inflows. Research has extensively studied how a high oil price causes stock market performance to decline by minimizing the possible growth of fiscal activities expected to loftier input costs, lessened business revenues, and increased comprehensive price inflation. The supplementary uncertainty, linked to loftier unrefined oil prices communicating high risk premiums, also lowers share prices.

However, Changes to stock markets are transmitted through some diverse channels. Stock prices are influenced by oil prices both debiting to the cost of capital and upcoming cash flow expectations. Greater corporate cash flow is reduced debiting to ascending production costs caused by taller crude oil prices, which also inferior share prices. Dissecting the correlation between crude oil and time-honored stock markets offers significant

insights for investors. A precarious international crude oil market may result in delayed investment decisions, as uncertainty in the oil market can have a extensive impact on both the stock markets and the total economy.

Uncertainty in the oil market's problems and risks are indeed transmitted to the authentic economy, with a ripple effect also hitting the capital market and affecting stock returns worldwide, including both established and developing countries. The G20's activities as a significant governing and fiscal grouping have a considerable effect on world energy markets and the universal economy in overall. The intense dependence of the G20 economies on energy exports and imports renders them vulnerable to oil prices and their volatility, with possible ramifications for the G20 region and its financial markets, particularly its stock market returns. The market fluctuations stemming from pronounced rises and falls in oil prices in current years underscore the value of examining the causal relationships between stock market performances and oil price volatility.

Indeed, mainly extensive oil consumers aren't just limited to the US, china, japan, and india; rather, so are nations like canada, russia, and brazil that are also remarkable producers. World energy markets are chiefly dominated by them. Since the G20 countries are highly affected by events like global crises and the coronavirus, differentiating the effect of oil shocks on their stock market returns should be simpler. The global situation has substantially worsened, and the demand worldwide is now more perilous than before. The crisis has had a detrimental impact not exclusively on human health but also altered the way people live and produce. An economic blockade and a stock market crash have caused by all countries' measures taken to limit the spread of the epidemic resulting in a global economic downturn and a collapse of the energy market. Given the substantial fluctuation in oil prices in modern years, research should focus on the effects of these price variations on stock market performance.

Our research seeks to uncover any possible link between fluctuations in the oil and financial markets, precisely by assessing how disturbances and turbulence are passed from the oil market to the stock market. The study's findings will provide investors with precious insights into leading the complexities of global financial markets, permitting them to make knowledgeable decisions involving possible fluctuations in oil prices. Further research may provide greater efficacious and functional solutions for performing policies that help minimize the unfavorable effects of fickle oil prices on monetary outcomes. This research further contributes to succeeding scholarship on the interactions of commodity markets and investigates the separate characteristics of the G20 economies in relation to the global context.

The objective of our study is to uncover correlations between volatility in oil prices and fluctuations in the financial sector, with a focus on comprehending how oil market shocks affect the general stock market performance. This research delves into the relationship between stock market performance and oil prices, with a focus on the manner in which fluctuations in both oil-exporting and oil-importing nations. Changes in oil price volatility are associated with variations in the level of stock market volatility which do fluctuate over time. Both definitely and adversely, the connection's influence can be observed at diverse instances, pivoting together or pivoting apart on average, and pulsating at divergent times. The price movement of oil differs in correlation with stock market fluctuations between oil-exporting nations and oil-importing nations in terms of extent. Oil prices on WTI and stock market returns data from 16 countries of G20.

The results of this research will provide investors with substantial information to make judicious choices about market fluctuations engaging global financial investments in response to shifts in the price of oil. Future studies may contribute to the development of more effective and usable policy strategies to counter the negative effects of price fluctuations in oil on economic results. The research also contributes to current literature by exploring the dynamics between commodity markets and discovering individual traits of G20 economies within a broader global framework.

2. Review of Literature

Many studies have looked at how changes in oil prices affect stock markets. One study by Park and Ratti (2008) found that changes in oil prices caused changes in stock prices in 13 European countries. Another study by Kilian and Park (2009) found that the US stock market was affected by both changes in oil supply and demand, with demand changes having a bigger impact.

Many studies have looked at how changes in the price of oil affect stock markets around the world. Wen et al. (2012) found that during the 2008 financial crisis, big swings in the price of oil affected both the US and Chinese stock markets. Ghorbel and Boujelbene (2013) showed that oil price swings also affected stock markets in many countries, including those in the Middle East, Brazil, Russia, India, and China. Also, Büyükşahin and Robe (2014) suggested that future studies should consider how economic crises affect the relationship between oil prices and stock prices.

Guesmi and Fattoum (2014) found that big changes in the global economy affected the relationship between oil prices and stock prices in both countries that import and export oil. This relationship was stronger during the financial crisis

The MENA countries studied by Bouri (2015) included Lebanon, Jordan, Tunisia, and Morocco from 2003 to 2013. Prior to the financial crisis, data indicates that there is restricted interdependence in the transfer of volatility between the oil and stock markets in Middle Eastern and Northern Afro countries. During the post-monetary crisis period, links to monetary growth can be seen in sure countries.

Du and He (2015) investigate the risk cross effects between oil and stock markets running data from September 2004 through September 2012 regularly. Research indicates that before the financial crisis, the stock market had a positive effect on the oil market, while the oil market had a negative influence on the stock market. Across the post-monetary crisis timeframe, instances of mutual risk transmission have been observed.

A number of researchers, embracing Khalfaoui (2015), collaborated on a study. A restricted number of studies have precisely analyzed the g7 nations. Researchers utilize a multivariate GARCH approach in combination with wavelet analysis to examine the correlation between West Texas Intermediate (WTI) oil prices and substantial stock markets of the Group of Seven (G7) economies. The research reveals a significant transfer of risk between the

oil market and the stock market, where heightened oil market fluctuations mainly cause heightened stock market uncertainty.

The study reveals that diverse chronological correlations relating to oil trade do not vary between countries that import and countries that export oil. Maghyereh and his team. Oil-exporting countries used during the period of 2008-2015 are Algeria, Iraq, and Libya.Research findings indicate that fluctuations in oil prices serve as the main channel by which volatility affects stock market fluctuations, and the data fails to distinguish between oleaginous-importing and oleaginous-exporting countries. Possessing comprehensive knowledge of conventional stock markets can be key in helping investors make knowledgeable decisions across distinct scenarios. Research after the commodities liberalization has indicated a direct correlation between unprocessed oil markets and diverse worldwide equity markets. The justification for placing the DCC-GARCH model to the relationship between oil prices and equities is not completely warranted, as it adopts a multivariate approach that implies mutually beneficial effects on volatility between the oil market and the stock market. When bringing into account worldwide patterns, generalizations are regularly essential to make out the difference between countries reliant on oil exports versus oil imports in terms of the relationship between oil prices and equities markets

Several studies have examined the relationship between oil prices and stock markets in different regions. Roberto and his colleagues (2017) looked at six Latin American countries (Argentina, Brazil, Chile, Colombia, Mexico, and Peru) from 2000 to 2015. They found that higher oil prices generally led to higher stock returns, regardless of whether the country was a major oil exporter or importer.

Horobet and his team (2019) studied the connection between the European Union's financial sector and the oil market from 2010 to 2018. Their research showed that stocks in the financial sector are affected by oil price changes over long periods.The Middle East is a significant oil-producing region. Studies have explored the link between oil and stock markets in this area, particularly in the Gulf Cooperation Council (GCC) countries. Ammar and Mahmoud (2020) analyzed the Dubai market from 2010 to 2018 and found that oil market volatility influences the volatility of energy stocks.

Lin et al. (2019) showed that changes in the price of oil directly affected the Chinese and European stock markets during times when the markets were acting unusually. These studies all show that big changes in the price of oil can have a big impact on stock markets, especially during times of economic trouble.

Abdulrahaman (2020) investigated the long-term relationship between oil and stock markets in Saudi Arabia, a major oil exporter, using data from 2000 to 2017. Their research confirmed a strong connection between the two markets.

3. Methodology

The process of volatility can't be straightforwardly remarked or measured. Market anxiety usually revolves around one crucial factor. The tool is also used to assess the shock transmission between diverse markets. The frequency of shocks and volatility between oil markets and stock markets in selected G20 countries such as Japan, Mexico, Russia, and so on, and a few alternative G20 countries, were evaluated through two GARCH family models. This choice aims at acquiring accurate and relevant outcomes which have been steadily supported by sundry anteceding investigations.

The BEKK-GARCH model's reputation is one of an elaborate model that is appropriate for the study of two-way effects. The DCC-GARCH model has earned a reputation for designing better outcomes. Different investigations in new times have employed it, thereby authenticating its uniqueness (Tsuji, 2018; Fills et al, 2011). Based on specifications of dependent volatility, several single-variable models basic the DCC model can incorporate the Glosten - Jagannathan - Runkle (GJR) unbalanced model as well as the exponential GARCH (EGARCH) model with the unbalanced leverage effect of Nelson (1991). It is also potential to modify the BEKK and DCC models in order to incorporate considerations of asymmetry, leverage effects and alternative ordinarily observed variance and correlation features of monetary returns into the structures.

The BEKK model

The multivariate GARCH models, known as the BEKK class, were introduced by Engle and Kroner (1995). Bauwens et al (2006) suggest a general formulation that accounts for some factor structures (see particularly, e.g. The year they published their work). We consider within this paper the easiest BEKK formulation with all model orders set to:

$$\Sigma t=CCj+A\varepsilon t-1\ \varepsilon tj-1Aj+B\Sigma t-1Bj$$

Where A and B are two (N*N) matrices of constant parameters and C' is a (N*N) matrix of symmetric parameter. The fully parameterized model comprises 2.5 N^2 + 0.5 N parameters.

The DCC model

Engle (2002) introduced the DCC model as a broader adaptation of Bollerslev's (1990) consistent conditional correlation (CCC) model. The intention here is to model the conditional variances and the conditional correlations individually. The covariance matrix is broken down consequently to the subsequent formula.

$$\sum t = D_t\ R_t\ D_t$$

$$D_t = diag\ (\sigma_1, t, \sigma_2, t, \ldots\ldots \sigma_k, t)$$

$$R_t = Q_t^{1/2}\ Q_t\ Q_t^{1/2}\ ;\ Q_t = dg(Q_t)$$

Where Q_t includes the conditional variances characterized by a series of univariate GARCH equations (see Baba and al. (1990); Engle (2002)). The dynamic correlation matrix, R_t, does not come directly from a dynamic equation, but is derived by normalizing a different matrix, Q_t, which has a dynamic structure. The configuration of Q_t defines the complexity and feasibility of the model in large cross-sectional dimensions.

Proposals for Q_t specifications have been put forth. The subsequent analysis focuses solely on the most uncomplicated model and applies merely to the BEKK specifications of equations (1) through (4). Hadamard DCC, which is also referred to as the DCC model, was first introduced by Engle in 2002

$$Q_t = S + A * D_{t-1}\ \varepsilon_{t-1}\ \varepsilon_{t-j}\ D_{t-1} - \sum S + B * (Q_{t-1} - S)$$

With A and B as symmetrical parameter matrices and S as the long-term covariance matrix.

4. Data and Descriptive Statistics

4.1. Data Availability Statement

We analyzed data from the former month for the two series in question: the oil prices and the stock market returns of G20, comprised of 16 countries such as Australia, Brazil, Canada, China, France, Germany, India, Italy, Japan, Mexico, Russia, South Africa, South Korea, the United Kingdom, Turkey, and the United States. The years from 2004 to 2020 have been classified into five distinct intervals. From 2004 to 2007, a period of stability preceded the Subprime crisis. The Subprime crisis happened between 2008 and 2009. Between 2010 and 2014, the transition from the Subprime crisis to the debt crisis, which culminated in the 2014 Oil crisis, took place. The years 2015 to 2019 were marked by comprehensive universal financial stability. The COVID health crisis defined the period from 2021.

These data were collected from the data stream data base (a global platform of Financial and macroeconomic Data) and the international database The Global economy.

4.2. Descriptive Statistics

Table 1. Descriptive statistics.

	WTI	**SIAUS**	**SIBR**	**SICA**	**SICH**	**SIFR**	**SIGER**	**SIIND**
Mean	0.006813	0.003753	0.009067	0.003964	0.005761	0.003105	0.004792	0.011041
Median	0.014827	0.008181	0.011651	0.010836	0.000921	0.009164	0.013215	0.018394
Maximum	0.728814	0.103200	0.200413	0.109348	0.213908	0.106783	0.139292	0.220859
Minimum	-0.447122	-0.222921	-0.280195	-0.221203	-0.195488	-0.245601	-0.245390	-0.240469
Std. Dev.	0.110172	0.036991	0.060911	0.036843	0.066295	0.043721	0.047034	0.054451
Skewness	0.681695	-1.609310	-0.806945	-2.240944	0.401592	-1.563778	-1.502868	-0.629307
Kurtosis	13.53196	10.36139	6.290208	14.85418	4.268968	9.276804	8.854649	7.130637
Jarque-Bera	944.5410	540.6032	112.4771	1345.099	18.88885	411.8815	362.7326	156.1625
Probability	0.000000	0.000000	0.000000	0.000000	0.000079	0.000000	0.000000	0.000000
Sum	1.369365	0.754279	1.822367	0.796774	1.157987	0.624119	0.963130	2.219212
Sum Sq. Dev.	2.427590	0.273667	0.742023	0.271480	0.879015	0.382308	0.442434	0.592981
Observations	201	201	201	201	201	201	201	201
	SIITA	SIJAP	SIMEX	SIRUS	SISAF	SISKOR	SITUR	SIUKING	SIUSA
Mean	0.00076	0.00331	0.00801	0.01048	0.00885	0.00609	0.01117	0.002044	0.004216
Median	0.00584	0.00640	0.01104	0.01576	0.01500	0.00973	0.01511	0.005745	0.010500
Maximum	0.18303	0.10371	0.13378	0.18220	0.07437	0.15923	0.18698	0.088798	0.126605
Minimum	-0.26430	-0.21957	-0.19152	-0.38059	-0.19895	-0.17549	-0.22643	-0.214878	-0.224787
Std. Dev.	0.05173	0.04781	0.04408	0.06527	0.03866	0.04406	0.06350	0.036727	0.039460
Skewness	-0.98230	-0.80481	-0.72613	-1.32672	-1.56614	-0.78610	-0.31197	-1.777610	-2.044221
Kurtosis	7.52766	5.14891	5.21863	9.32853	8.69577	5.72779	4.06934	11.16674	13.05484
Jarque-Bera	204.010	60.3731	58.8885	394.387	353.869	83.0188	12.8372	664.4323	986.7019
Probability	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00163	0.000000	0.000000
Sum	0.15346	0.66525	1.61052	2.10651	1.77998	1.22549	2.24573	0.410784	0.847391
Sum Sq. Dev.	0.53529	0.45731	0.38862	0.85205	0.29898	0.38841	0.80657	0.269774	0.311418
Observations	201	201	201	201	201	201	201	201	201

Descriptive statistics are presented for daily returns based on oil indices and stock indices on the table. The pre-pandemic and pandemic era is divided into the pre-recession period, the crisis period, the post-recession period, the crisis period and the pre-recession period. Data on level, risk, standard deviation, evolution over time, and the lowest and peak statistics in the field of descriptive statistics provide an idea. Subsequent consecutive crises that have impacted the oil and stock markets, a majority of indices are displaying unfavorable lowest values. Series studied permit normality to be tested by the "Skewness" and "Kurtosis" coefficients as well as the Jarque-Bera test statistic. The degree of distribution's flatness is measured by the "Kurtosis" coefficient. The normal distribution follows as distribution when it equals three. A value of coefficient fewer than 3 for kurtosis indicates a distribution is more flattering than a normal distribution, while a value more significant than 3 suggests a leptokurtic distribution.

The Skewness coefficient measures the degree of distribution asymmetry. The distribution skews to the left when this coefficient is adverse, and it skews to the right when it is affirmative. At zero, the distribution being balanced suggests it follows a normal distribution. The null hypothesis of the Jarque-Bera test for the normality of the distribution is the normality itself of data. An estimated value of the k-squared statistic that is larger than the listed value of the test statistic leads to the rejection of this hypothesis.

5. Empirical Findings

5.1. Stationarity Test: Augmented Dickey-Fuller (ADF)

To understand how data changes over time, we first need to make sure it's behaving in a predictable way. This is called checking for "stationarity." We use a special test called The ADF test which helps us figure out if our data is stable or not, even if it looks like it's changing a lot. This test helps us get a clearer picture of whether our data is reliable for studying changes.
Over time.

Table 2. Stationarity test : Augmented Dickey-Fuller (ADF).

	SIAUS	**SIBR**	**SICA**	**SICH**	**SIFR**	**SIGER**	**SIIND**	**SIITA**
ADF test in level	-11.31345 0.0000***	-10.05088 0.0000***	-11.21867 0.0000***	-9.221951 0.0000***	-11.46416 0.0000***	-11.54625 0.0000***	-10.23061 0.0000***	-11.81599 0.0000***
ADF test first difference	-11.83443- 0.0000***	-11.73217 0.0000***	-12.57950- 0.0000***	-15.51194 0.0000***	-9.692905 0.0000***	-9.796026 0.0000***	-12.88532 0.0000***	-12.51546 0.0000***
	SIJAP	SIMEX	SIRUS	SISAF	SISKOR	SITUR	SIUKING	SIUSA
ADF test in level	-11.14152 0.0000***	-11.47700 0.0000***	-9.894833 0.0000***	-11.99281 0.0000***	-10.92912 0.0000***	-10.89029 0.0000***	-12.49528 0.0000***	-11.14580 0.0000***
ADF test first difference	-13.55871 0.0000***	-14.42846 0.0000***	-15.15411 0.0000***	-9.895130 0.0000***	-9.688681 0.0000***	-13.05923 0.0000***	-13.03901 0.0000***	-14.29963 0.0000***

5.2. Vector Auto Regression (Var) Test

Vector Autoregression (VAR) is a powerful tool for understanding how different economic factors, like inflation, unemployment, and interest rates, affect each other over time. It's like a system of equations that shows how these factors are connected. For example, if inflation goes up, VAR can help us see how that might affect unemployment and interest rates. It doesn't assume one factor causes another, but instead looks at how they all influence each other. This makes VAR a flexible tool for understanding the complex relationships in the economy.

Table 3. Vector Auto Regression (VAR) Test.

	SIAUS	**SIBR**	**SICA**	**SICH**	**SIFR**	**SIGER**	**SIIND**	**SIITA**
Lag (1)	(0.682820) 2.98678***	(0.494898) 3.51950***	(1.194674) 5.21337***	(0.183159) 1.44766	(0.635556) 3.46356***	(0.618769) 3.67097***	(0.441845) 2.92883***	(0.478478) 3.09398***
Lag (2)	(-0.519184) -2.24309**	(-0.206186) -1.44985	(-0.388098) -1.59487	(-0.09351) -0.74253	(-0.485421) - 2.60233***	(-0.3781) -2.19122**	(-0.371497) -2.4711***	(-0.348812) -2.22377**
	SIJAP	SIMEX	SIRUS	SISAF	SISKOR	SITUR	SIUKING	SIUSA
Lag (1)	(0.386582) 2.28087**	(0.47173) 2.5147***	(0.441596) 3.38716***	(1.003438) 4.91113***	(0.823615) 4.53435***	(0.328258) 2.59288***	(0.805366) 3.7126***	(0.904141) 4.34468***
Lag (2)	(-0.217494) -1.2714	(-0.364704) -1.92433*	(-0.096434) -0.71955	(-0.190675) -0.87921	(-0.292946) -1.55113	(-0.189414) -1.47995	(-0.434526) -1.93969*	(-0.472278) -2.21189**

Note(s): ***, **, * statistical significance at 1%, 5 and 10% levels, respectively

The analysis of the VAR model shows that a one-period delay in oil prices has a positive and significant impact on stock market returns for most countries, including Australia, Brazil, Canada, France, Germany, India, Italy, Japan, Mexico, Russia, South Africa, South Korea, Turkey, the United Kingdom, and the United States, except for China. This finding is consistent with previous research by Roberto et al. (2017).

However, when the oil price is delayed by two periods, the impact on stock market returns becomes negative and significant for a smaller group of countries, including Australia, Germany, India, Italy, and the United States. For the other countries, the impact is negative but not statistically significant. This finding aligns with previous studies by Filis et al. (2011) and Khan et al. (2019). It's important to note that the results for the first lag (one-period delay) are generally more relevant than those for the second lag (two-period delay). This is because the immediate consequences of oil price shocks are fully reflected in the first lag, while these effects are diminished in the second lag.

5.3. Analysis of the Correlation Between Crude Price and G20 Stock Market Indexes

The BEKK model, proposed by Baba, Engle, Kraft, and Kroner (1995), is known as the highest exhaustive and highest convoluted model of the models considered for this study in terms of computation. Results in Chart 8 illustrate the effects of incorporating oil price shocks on the performance of the various stock indices in our selected dual-variable BEKK-GARCH model. The period has been categorized into five unique sub-periods. The first interval spans from January 1, 2004, to June 30, 2007, while the following interval spans from July 1, 2007, to December 31, 2009, followed by another interval encompassing from January 1, 2010, to December 31, 2014, then another interval from January 1, 2015, to December 31, 2019, and the ultimate interval occurs from January , 2020, to January, 2021. This paper examined the volatility transmission between the oil and stock markets of 16 G20 countries divided into oil exporting and comprising nations over five unique sub-periods.

The transmission is quantified in two phases through $\alpha_{2,1}$and variance is represented by$\beta_{2,1}$. Three diverse significance levels are studied: one percent, five percent, and several percent. ARCH coefficients measure the postponed shocks impact while GARCH explains how volatility affects the equation. The assessed results of BEKK-GARCH analysis show that both ARCH and GARCH effects are substantial in the oil and stock markets.

5.3.1. Analysis of Results for Importing Countries

Table 4. Analysis of results for importing countries.

Period 1 : 2004-2007 before the subprime crises								
Countries	**Australia**	**Brasil**	**Canada**	**China**	**France**	**Germany**	**India**	**Italy**
$\alpha_{1,2}$	(0.169597216) 0.01518284**	(0.05877782) 0.61825417	(0.116275985) 0.17805003	(-0.06208051) 0.49479682	(0.03767483) 0.65624020	(-0.09130473) 0.41291163	(0.141097745) 0.21186811	(0.114155928) 0.22540396
$\alpha_{2,1}$	(1.654782729) 0.00968508***	(-0.36805293) 0.06716381*	(0.390316497) 0.62253815	(-0.97635438) 0.0006742***	(-0.2300705) 0.74310132	(-0.2394867) 0.64728079	(-0.282727397) 0.32347168	(-0.514984745) 0.38707364
$\beta_{1,2}$	(0.202658597) 0.00841906***	(-0.1804604) 0.0000031***	(0.054327556) 0.43950938	(-0.59129083) 0.0000439***	(-0.00103684) 0.98838929	(-0.04101038) 0.41504148	(-0.091468981) 0.45663033	(-0.164737136) 0.14092334
$\beta_{2,1}$	(2.463787408) 0.00081607***	(0.26959268) 0.0014616***	(-1.076989534) 0.1912885	(-0.58214004) 0.0094340***	(-1.64296696) 0.0072258***	(-1.03020196) 0.04714491**	(0.219497394) 0.39915079	(0.154874933) 0.91892794
Period 2 : 2008-2009 the subprime crises								
Countries	Australia	Brasil	Canada	China	France	Germany	India	Italy
$\alpha_{1,2}$	(-0.088484494) 0.23127608	(-0.04852523) 0.56726119	(0.03981804) 0.55905529	(0.16391328) 0.0095533***	(-0.21192893) 0.04594817**	(-2.47572676) 0.0000000***	(-0.9028) 0.00000000***	(-8.2139e-03) 0.00000001***
$\alpha_{2,1}$	(-1.019532424) 0.00008945***	(-1.07727442) 0.0001345***	(1.678801628) 0.00118638***	(-0.47705689) 0.30095772	(0.43774818) 0.04168180**	(0.92545761) 0.0000000***	(0.1327) 0.00000000***	(0.2469) 0.00000000***
$\beta_{1,2}$	(-0.16821894) 0.19645864	(-0.11805167) 0.45999088	(-0.206672244) 0.00072169***	(0.201490849) 0.21488241	(-0.38726908) 0.0000000***	(-0.01461998) 0.06138959*	(0.4002) 0.00000000***	(0.2402) 0.00000000***
$\beta_{2,1}$	(-0.646021254) 0.02412485**	(-0.44903077) 0.08148306*	(1.087060641) 0.04658286**	(1.01273258) 0.07657895*	(0.6721346) 0.0000000***	(0.00513251) 0.1270042	(0.1955) 0.00000000***	(0.2035) 0.00000309***
Period 3 : 2010 -2014 after the subprime crises and on the Sovereign debt crisis								
Countries	Australia	Brasil	Canada	China	France	Germany	India	Italy
$\alpha_{1,2}$	(0.132698966) 0.07887568*	(-0.48163288) 0.0002231***	(0.023698546) 0.72654426	(-0.10363660) 0.33341714	(0.23725172) 0.03931942**	(0.34502674) 0.0021888***	(-0.252033511) 0.00406265***	(0.417888805) 0.00023534***
$\alpha_{2,1}$	(0.109813916) 0.76098620	(0.58939818) 0.0059907***	(1.177612153) 0.00032657***	(0.77049669) 0.01041155**	(1.87535075) 0.0071684***	(2.31959778) 0.0000000***	(0.732344154) 0.00091239***	(0.082522089) 0.77651123
$\beta_{1,2}$	(0.246884312) 0.00094687***	(0.28028483) 0.17080017	(0.276047027) 0.00066263***	(-0.14903503) 0.52190468	(0.03564804) 0.77842593	(-0.00986098) 0.91148162	(-0.148293055) 0.03431159**	(0.345025627) 0.00426592***
$\beta_{2,1}$	(-1.317857651) 0.00000000***	(-0.90497577) 0.0019739***	(-0.513797813) 0.07081295*	(-0.22580676) 0.65567468	(0.67706337) 0.0000343***	(0.57412898) 0.0000004***	(0.331816235) 0.03092979**	(-0.814393585) 0.00010788***

Period 4 : 2015-2019 befor COVID-19								
Countries	Australia	Brasil	Canada	China	France	Germany	India	Italy
$\alpha_{1,2}$	(-0.208841593) 0.00000006***	(-0.00994103) 0.91445574	(-0.157164953) 0.01063880**	(-0.1761913) 0.04758599**	(-0.17555448) 0.0005954***	(-0.2085324) 0.0004671***	(0.012373638) 0.79718606	(-0.286751766) 0.04930797**
$\alpha_{2,1}$	(2.119996952) 0.00000139***	(0.69774481) 0.0015485***	(1.771425028) 0.00010945***	(-0.66997731) 0.01138941**	(1.74552908) 0.0000027***	(1.45438818) 0.0000213***	(-0.101279972) 0.82270552	(1.300753303) 0.00000324***
$\beta_{1,2}$	(-0.006792305) 0.80154871	(-0.35277126) 0.0000001***	(0.188201227) 0.00007816***	(-0.19042913) 0.04964350**	(0.3553212) 0.0000069***	(-0.22824673) 0.0021967***	(-0.138685438) 0.02300313**	(0.028248952) 0.85308336
$\beta_{2,1}$	(0.175208863) 0.66110155	(0.64265948) 0.0000206***	(-0.515641162) 0.62058348	(0.57775992) 0.0005418***	(-1.83542528) 0.0000001***	(1.23724630) 0.07175053*	(2.465201662) 0.00000000***	(-0.757196580) 0.48959280
Period 5 : 2020 -2021 the COVID-19								
countries	Australia	Brasil	Canada	China	France	Germany	India	Italy
$\alpha_{1,2}$	(-0.477091562) 0.00000000***	(0.049127390) 0.12419103	(-0.462383259) 0.00000000***	(-0.03684975) 0.29608677	(-0.38278084) 0.0000000***	(0.02626215) 0.0000000***	(-0.085750679) 0.00000000***	(-0.255296741) 0.00000000***
$\alpha_{2,1}$	(4.332756787) 0.00000000***	(0.62702503) 0.0005431***	(6.990584107) 0.00000000***	(3.56421437) 0.0000000***	(5.80258697) 0.0000000***	(3.0944353) 0.0000000***	(3.848406714) 0.00000000***	(6.736233798) 0.00000000***
$\beta_{1,2}$	(-0.012216566) 0.30846432	(0.01063818) 0.56761257	(-0.009020603) 0.00000000***	(-0.00046059) 0.96708326	(-0.01053482) 0.0000000***	(0.11371150) 0.0000000***	(0.047138925) 0.00000000***	(-0.023758603) 0.00000000***
$\beta_{2,1}$	(0.053369942) 0.00015037***	(0.06946938) 0.32793668	(0.077423311) 0.00000000***	(1.32254806) 0.0000000***	(0.0472128) 0.0000000***	(0.5113333) 0.0000000***	(0.559194167) 0.00000000***	(0.626585326) 0.00000000***

Note(s): ***, **, * statistical significance at 1%, 5 and 10% levels, respectively.

This study examined how changes in oil prices affected stock market returns in various oil-importing countries. During a period of rising oil prices, the study found that oil prices had a significant impact on stock market performance.

The analysis, using a statistical model called BEKK-GARCH, showed that before the 2008 financial crisis, oil price changes influenced both the average return and the volatility of stock markets in Australia, Brazil, China, and Italy. This means that oil price fluctuations affected both the overall direction and the riskiness of stock markets in these countries.

However, in France and Germany, oil price changes only affected the volatility of the stock market, not the average return. This suggests that while oil price fluctuations increased risk in these countries, they didn't necessarily lead to higher or lower overall stock market returns.

Overall, the study found that the impact of oil price changes on stock markets varied across different oil-importing countries, with some experiencing both positive and negative effects. Crude oil is a very important commodity that has a big impact on the economy. When oil prices go up, it costs more to produce goods and services, as well as to transport things and heat homes. This can lead to higher prices for consumers, which can make them buy less. When people buy less, it can hurt businesses, make people less confident about the economy, and have a negative impact on the overall economy.

There are a few reasons why oil prices can affect the stock market. One reason is that the value of a company's stock is based on how much money it is expected to make in the future. If oil prices go up, it can cost companies more to operate, which could reduce their profits. This could lead to lower stock prices. However, higher oil prices could also mean that companies that produce oil will make more money, which could lead to higher stock prices. Studies have shown that there is a connection between oil prices and stock market prices. This means that changes in oil prices can affect the stock market. This is similar to what researchers Malik and Ewing (2009) and Arouri and Nguyen (2010) found in their studies.

Our study found no evidence of transmission from oil markets to stock markets in most of the countries we examined. This aligns with previous research by Cong et al. (2008) and Jammazi and Alouli (2010). However, during the second period of our study, which coincided with the global financial crisis, we observed a significant impact on oil markets. The price of crude oil surged from $96 in January 2008 to $144 in July, likely due to the subprime crisis and its effect on oil supply. This sharp increase affected industries heavily reliant on fuel.The combination of the global economic crisis and efforts by major oil-consuming countries to reduce their dependence on oil led to a dramatic drop in oil prices, reaching as low as $32 per barrel. Our analysis revealed that this period saw a transmission of effects from oil markets to stock markets in all G20 oil-importing countries, both in terms of average price and volatility. Interestingly, the transmission was negative for Australia, Brazil, and China, while it was positive for the other countries.

During a period when oil prices rose to their highest point in July 2008, the impact on stock markets was expected to be positive. This was because the price increase was driven by strong global demand for oil. However, things changed after mid-2008 when the global financial crisis hit. The crisis made financial markets around the world more connected, and the relationship between oil prices and stock markets in oil-importing countries became stronger. As the crisis deepened, both the stock market and the oil market experienced a downturn, leading to a negative impact on stock markets.

The price of oil rose to $80 per barrel in the early 2000s. This was partly due to oil-producing countries cutting back on production to deal with economic problems. The global economy improved in 2010, which also helped push oil prices higher.

However, things changed after mid-2008. The financial crisis that year made the world's financial markets more connected. This led to a stronger relationship between oil prices and stock market prices. The crisis caused stock markets to decline and also led to a sharp drop in oil prices.

Research shows that changes in oil prices can affect stock markets, especially in countries that import a lot of oil. This is similar to a study by Nazlioglu and al. (2015). They found that oil price changes affected financial markets before the 2008 crisis. After the crisis, they found that financial market problems could also affect oil prices. In 2015, the price of oil plummeted to $50 per barrel due to a surplus of oil, mainly from increased production in the United States. Even though OPEC countries kept their production levels the same, the price fell even further, reaching below $30 per barrel. However, a few months later, the price started to rise slightly after some oil-producing countries decided to cut back on production. This period saw a significant impact on both the oil and stock markets. The volatility in the oil market directly affected the stock markets of many oil-importing countries.The global oil price experienced a dramatic decline in mid-2014. The price of Brent crude oil dropped from $114 per barrel in June 2014 to $28 per barrel in February 2016, a decrease of over 70%. This sharp drop was caused by a combination of factors: so, the rapid growth of North American shale oil production, fueled by technological advancements, led to a surplus of oil in the market and the Slow economic growth in many countries resulted in a decrease in the demand for crude oil.

In essence, the combination of too much oil and not enough demand drove down the global oil price.The year 2020 saw a major global crisis with the emergence of the COVID-19 virus. This pandemic caused a worldwide slowdown, with economies shrinking rapidly. The price of oil plummeted to a very low level, falling below $20 per barrel. This was particularly concerning for countries that rely heavily on oil revenue. Studies have shown a strong connection between oil prices and stock market performance, especially for countries that import oil, like those in the G20.

5.3.2. Results Analysis for Exporting Countries

Table 5. Analysis of results for exporting countries.

Period 1: 2004-2007 before the subprime crises								
Countries	**Japan**	**Mexico**	**Russia**	**South Africa**	**South korea**	**Turkey**	**United Kingdom**	**United States**
$\alpha_{1,2}$	(-0.078614113) 0.04683363**	(0.118139173) 0.11838453	(0.090898471) 0.60764701	(0.024565310) 0.62296385	(-0.015471428) 0.86654871	(0.298644868) 0.04347037**	(0.093390965) 0.28751143	(0.068722648) 0.16479182
$\alpha_{2,1}$	(0.629441175) 0.04228121**	(-2.046654616) 0.00000000***	(-0.570704965) 0.05499495*	(-0.299380340) 0.52687744	(0.989177744) 0.00065098***	(0.081494083) 0.75291683	(0.482239577) 0.44731582	(1.631732194) 0.00498912***
$\beta_{1,2}$	(0.050338795) 0.00675580***	(0.012776838) 0.85571849	(0.560832485) 0.12375177	(0.296423264) 0.00000000***	(0.095708620) 0.23417511	(-0.198037412) 0.04473297**	(-0.002182587) 0.98441788	(0.043389611) 0.02811906**
$\beta_{2,1}$	(0.045329318) 0.81567868	(0.000022833) 0.66588500	(-0.793421135) 0.00011313***	(-1.524642491) 0.00000215***	(-0.083462599) 0.68882748	(0.360575869) 0.05075932*	(1.421263015) 0.10750330	(-0.243810237) 0.34272385
Period 2 : 2008-2009 the subprime crises								
Countries	Japan	Mexico	Russia	South Africa	South korea	Turkey	United Kingdom	United States
$\alpha_{1,2}$	(0.736870) 0.00000000***	(1.905891351) 0.00000000***	(-0.4828) 0.02175166**	(-0.255682150) 0.44298475	(2.872868155) 0.00000000***	(1.704645662) 0.00000000***	(0.733566370) 0.00956585***	(0.990075141) 0.00000000***
$\alpha_{2,1}$	(-1.178209) 0.00000000***	(-3.870827938) 0.00000000***	(0.7983) 0.00000000***	(0.226935724) 0.39406317	(-2.185993924) 0.00000000***	(-1.249361306) 0.00000000***	(0.000427886) 0.88273101	(-0.685673638) 0.00000000***
$\beta_{1,2}$	(-0.275630) 0.03295570**	(0.071544855) 0.00000000***	0.4162 0.00000000***	(0.687851839) 0.00000000***	(0.184002179) 0.00000000***	(-0.036585403) 0.00000000***	(0.000238667) 0.99863318	(-0.059910751) 0.26308020
$\beta_{2,1}$	(-0.000030) 0.00000000***	(0.051779347) 0.00000000***	(0.4036) 0.00000000***	(0.047515482) 0.00000000***	(-0.051367532) 0.00000000***	(-0.111789730) 0.00000000***	(-0.000152489) 0.87345512	(0.002644439) 0.05328588/
Period 3 : 2010 -2014 after the subprime crises and on the Sovereign debt crisis								
Countries	Japan	Mexico	Russisa	South Africa	South korea	Turkey	United Kingdom	United States
$\alpha_{1,2}$	(0.235484924) 0.00415880**	(0.129175514) 0.31332353	(0.085619930) 0.53628264	(0.269305965) 0.00000008***	(0.274816236) 0.00304131***	(-0.305297434) 0.01145705**	(-0.024634476) 0.57389825	(0.010687475) 0.88090202
$\alpha_{2,1}$	(0.741362220) 0.00259140***	(0.946708199) 0.00082963***	(-1.056231161) 0.00086158***	(2.148355505) 0.00001024***	(1.523403063) 0.00000002***	(0.778437494) 0.00002074***	(0.897276963) 0.00015000***	(1.397380759) 0.00000475***
$\beta_{1,2}$	(-0.037826041) 0.67119522	(-0.335788406) 0.00067670***	(-0.624162719) 0.00473837***	(-0.101695146) 0.08499822*	(0.018345071) 0.88795741	(-0.138625772) 0.47739579	(0.411457872) 0.00000000***	(0.115832802) 0.15014561
$\beta_{2,1}$	(-0.317796756) 0.14723725	(0.780934117) 0.00551131***	(0.350511635) 0.38615008	(-0.670527977) 0.01879517**	(-0.655047913) 0.08504442*	(-0.373070609) 0.34907580	(-1.920249931) 0.00000000***	(0.443486676) 0.00673259***

Period 4 : 2015-2019 befor COVID-19								
Countries	**Japan**	**Mexico**	**Russia**	**South Africa**	**South korea**	**Turkey**	**United Kingdom**	**United States**
$\alpha_{1,2}$	(-0.333458450) 0.00000002***	(0.091482568) 0.03534234**	(-0.130495291) 0.01709291**	(0.052813212) 0.54296427	(-0.144886642) 0.01331436**	(0.204168958) 0.01163456**	(-0.090327266) 0.01633754**	(-0.184766909) 0.00029484***
$\alpha_{2,1}$	(1.260740101) 0.00010189***	(-1.067431292) 0.01639655**	(0.191924464) 0.61075365	(-1.839373478) 0.00010838***	(-1.252690998) 0.00082615***	(-0.585282064) 0.04533999**	(-0.122378159) 0.87175971	(2.162645372) 0.00054887***
$\beta_{1,2}$	(-0.119562008) 0.10412902	(0.009211532) 0.61907059	(-0.032591921) 0.81322184	(0.150708089) 0.06148021*	(0.111312674) 0.28305473	(0.494753180) 0.00000000***	(-0.182813531) 0.00015196***	(-0.056742643) 0.28453314
$\beta_{2,1}$	(0.645365505) 0.12287292	(-0.395127970) 0.02962722**	(1.533809029) 0.06161001*	(-1.131276466) 0.04189184**	(1.491161958) 0.00848143***	(1.287563812) 0.00249113***	(2.550829986) 0.00000140***	(2.585720915) 0.00000100***
Period 5 : 2020 -2021 the COVID-19								
Countries	Japan	Mexico	Russia	South Africa	South korea	Turkey	United Kingdom	United States
$\alpha_{1,2}$	(-0.223829) 0.00000000***	(0.045375397) 0.14050291	(-0.452885299) 0.00000000***	(-0.428430313) 0.00000000***	(-0.144246) 0.00000000***	(-0.323017340) 0.00000000***	(-0.264343875) 0.00000000***	(-0.022242536) 0.00000000***
$\alpha_{2,1}$	(2.400173) 0.00000000***	(0.838961721) 0.00056712***	(2.550117657) 0.00000000***	(5.114567261) 0.00000000***	(3.894208) 0.00000000***	(3.780508237) 0.00000000***	6.522721173) 0.00000000***	(4.657193488) 0.00000000***
$\beta_{1,2}$	(-0.006642) 0.00000000***	(-0.187096122) 0.00022621***	(-0.075075329) 0.00000000***	(-0.055198048) 0.00000000***	(-0.003750) 0.00000000***	(0.022203886) 0.00024299***	(0.012380458) 0.25204329	(0.041809063) 0.00000019***
$\beta_{2,1}$	(0.529698) 0.00000000***	(0.344380352) 0.36964152	(0.423503370) 0.00000000***	(0.626387100) 0.00000000***	(0.894262) 0.00000000***	(-0.000035945) 0.98698921	(1.397264296) 0.00001365***	(0.866032057) 0.00000000***

Note(s): ***, **, * statistical significance at 1%, 5 and 10% levels, respectively.

During the subprime mortgage crisis, oil prices and stock markets in oil-exporting countries like Japan, Mexico, Russia, South Korea, the United States, Turkey, and South Africa were closely linked. This means that changes in one market often caused changes in the other. The strength of the country's economy influenced how this connection worked. Sometimes, a rise in oil prices led to a drop in stock prices, and vice versa. However, the overall impact was similar across these countries during this period.

Several factors contributed to this close relationship. The housing boom in the early 2000s created a positive atmosphere for global markets, including both oil and stocks. This led to higher prices in both areas. Additionally, events like the 9/11 attacks and the Iraq War caused uncertainty in all economies, leading to similar movements in stock markets and a stronger connection to oil prices. Finally, China's rapid economic growth and its impact on global trade created a sense of optimism in stock markets worldwide, regardless of the country's origin. During the subprime mortgage crisis, oil prices and stock markets generally moved in opposite directions for most oil-exporting countries. The only exception was the United Kingdom.

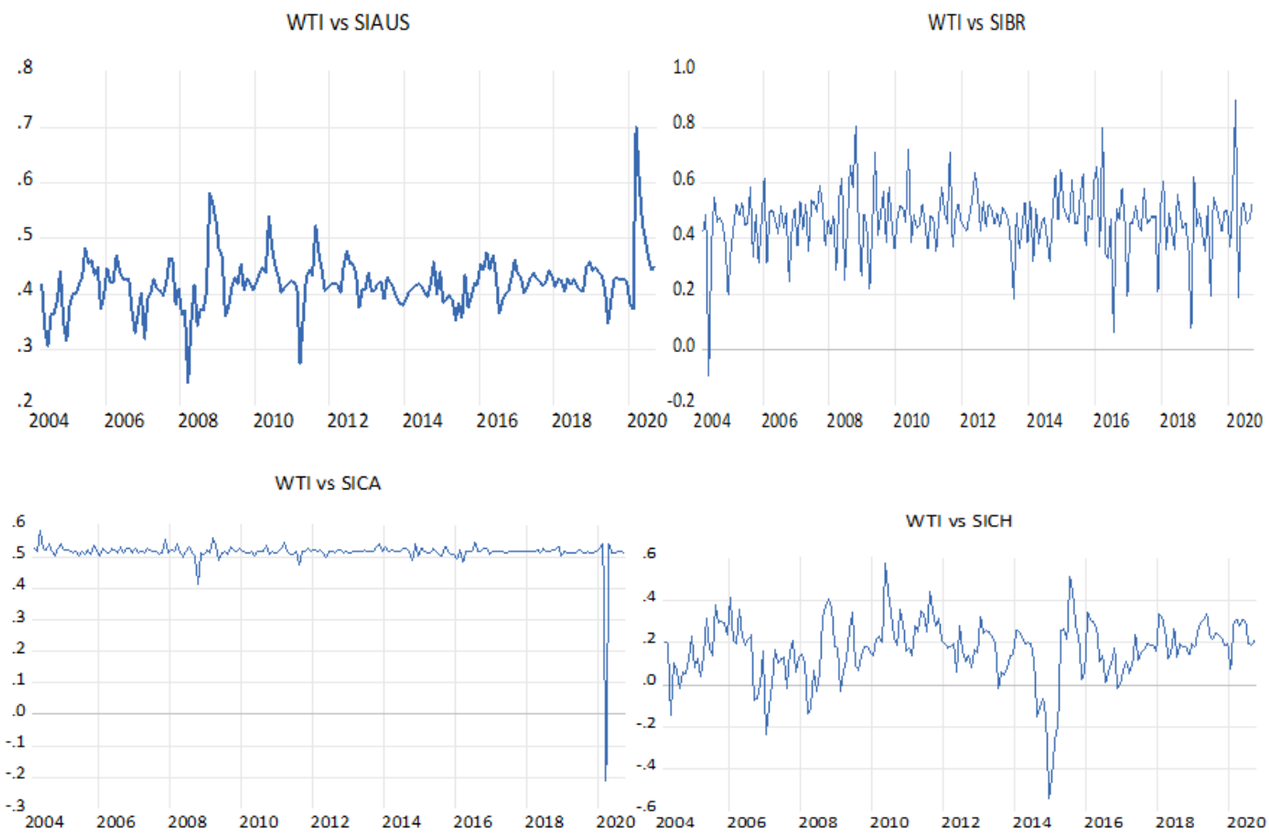
The global financial crisis of 2008-2009 had a similar impact on all stock markets, causing them to move together. During this period, oil prices and stock markets generally moved in opposite directions, with both average prices and price fluctuations being negatively affected. The crisis was triggered by the widespread issuance of risky US mortgage loans, which led to a global financial shock. This shock can be seen as an oil price shock, as it reduced global demand for oil.

After the subprime crisis, the sovereign debt crisis in Europe further impacted oil and stock markets. This crisis affected many European countries and led to a significant connection between oil prices and stock markets for most countries.

This study looked at how oil price changes affect stock market volatility, both before and during the COVID-19 pandemic. The results show that oil price volatility and stock market volatility are strongly connected, and this connection is even stronger during the pandemic. This means that changes in oil prices have a bigger impact on stock markets during the pandemic.

The study found that the relationship between oil price volatility and stock market volatility is stronger during the pandemic than before. This suggests that the COVID-19 outbreak has made the global financial markets more interconnected and vulnerable to shocks. Other studies have also found that the pandemic has increased the risk of financial contagion, meaning that problems in one market can quickly spread to others.This research aligns with previous studies that found a connection between oil market changes and emerging stock markets.

Overall, our findings show that oil price volatility directly impacts stock market returns in many countries. The influence usually flows from oil to stocks, not the other way around. However, there are differences between countries, likely due to the varying economic situations of emerging markets. It's important to remember that this research was conducted during a period of significant financial instability. This means that the impact of oil on stock markets might have been stronger than usual due to the general uncertainty and volatility in the global economy.



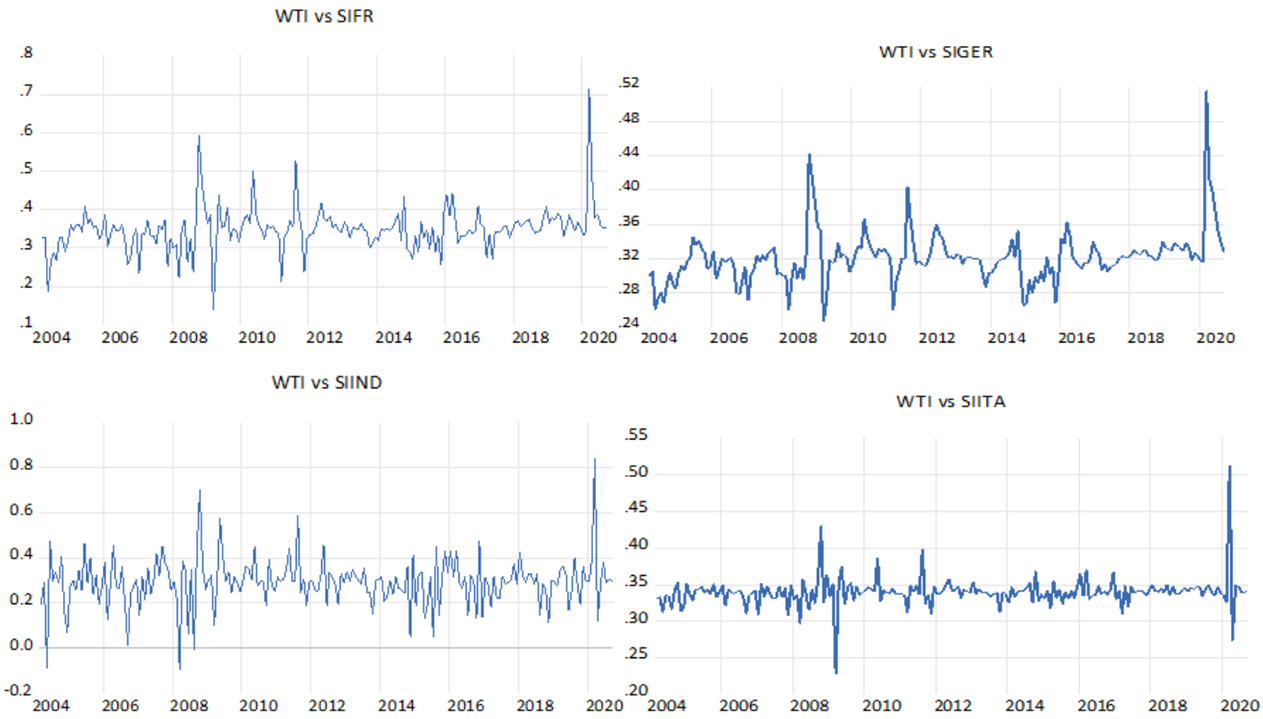
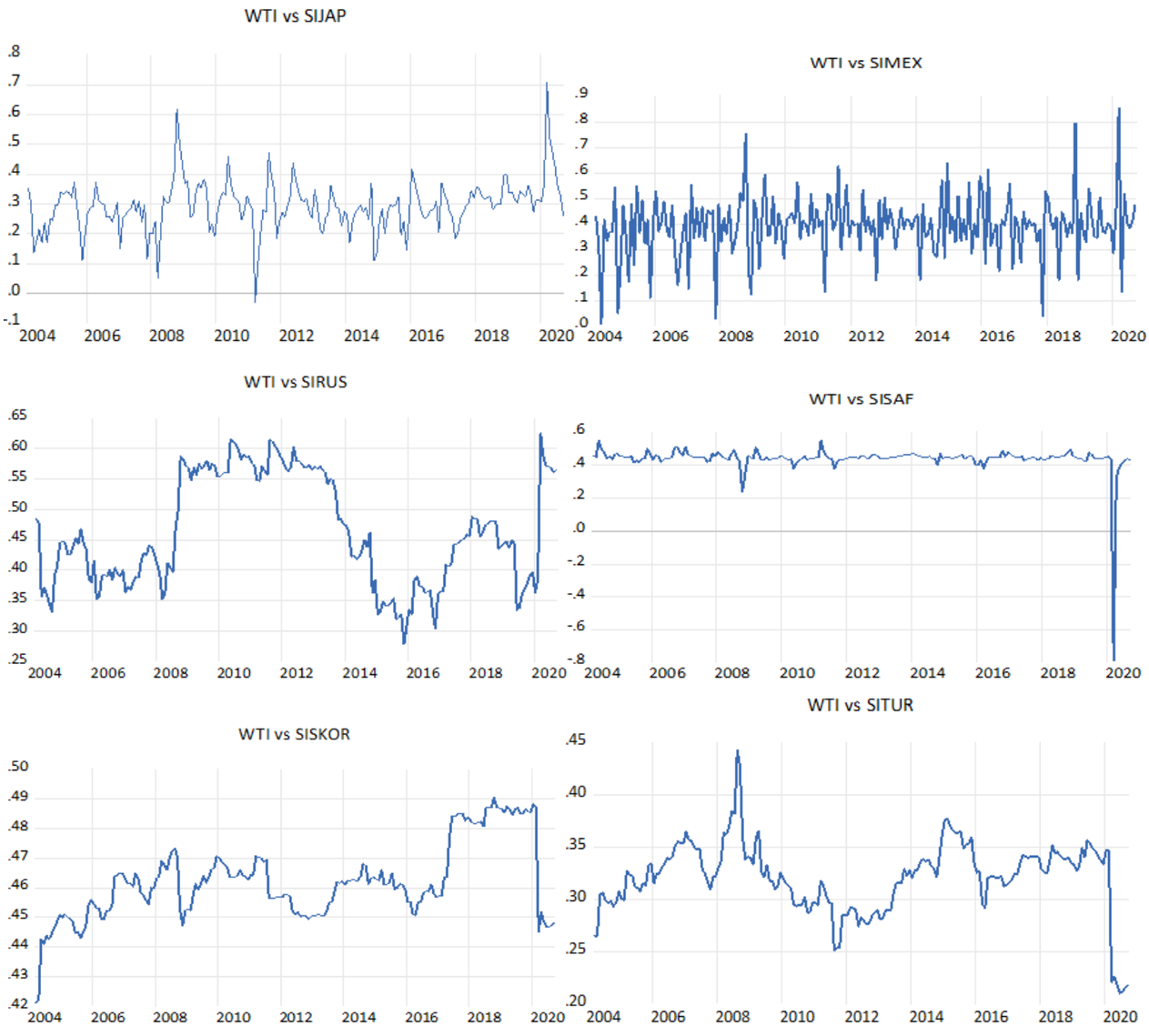


Figure 1. Dynamic Conditional Correlation between Oil Price and Stock Returns of Importing Countries.



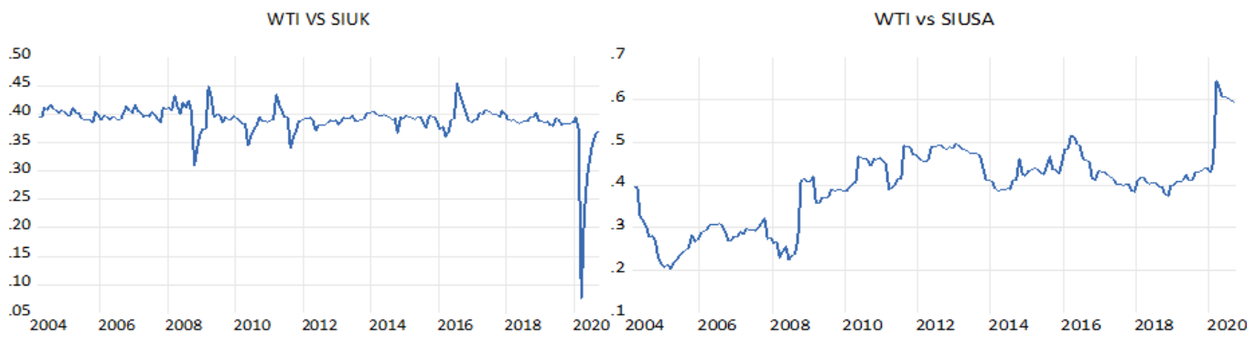


Figure 2. Dynamic Conditional Correlation between oil price and stock market returns for oil exporting countries.

We studied how the oil price (WIT oil index) and stock markets in G20 countries moved together between 2004 and 2021. This period included several major crises, like the 2008 financial crisis, the European debt crisis, and the COVID-19 pandemic. We looked at 16 G20 countries with available data, focusing on 8 oil-exporting and 8 oil-importing countries. We used a statistical model called DCC-GARCH (1,1) to understand how the relationship between oil prices and stock markets changed over time. This model is helpful because it allows the volatility (how much prices change) and the correlation (how much they move together) to vary over time.

Our results clearly show the impact of the major crises on both oil-exporting and oil-importing countries. We can see how these events affected the relationship between oil prices and stock markets. The 2008-2009 financial crisis was a major event that shook the world. It started with problems in the housing market in 2006, where many people couldn't pay their mortgages. This spread throughout the financial system, causing a global crisis. One big effect was a drop in the prices of oil and natural gas. Oil went from $133.88 a barrel to $39.09, and natural gas went from $12.69 to $4.52. Looking at the period when the housing crisis was at its worst 2007, we see some interesting things. For countries that import oil, lower oil prices were good news. This is because they could buy oil cheaper, which helped their businesses and stock markets.

On the other hand, countries that export oil were hurt by the lower prices. They made less money from selling oil, which negatively affected their stock markets. Market movements are interconnected, and their relationships change over time. During crises, like the 2010 European sovereign debt crisis, markets tend to move more closely together. This was also seen in the 1980s Latin American debt crisis, which had a lasting negative impact on the region. The current situation in Europe is concerning because it shares similarities with past crises. One major worry is that countries that rely heavily on exports could face a high risk of default if oil prices fall. This is because lower oil prices often lead to higher interest rates, which can make it harder for these countries to manage their finances.

During the European sovereign debt crisis (2010-2016), the gap between interest rates on government bonds in different European countries widened significantly. This happened at the same time as major events in the Middle East and a sharp drop in oil prices (almost 75%) between 2014 and 2015. After accounting for economic factors, our research shows that the widening of these interest rate gaps was strongly linked to increased demand for safe assets due to the instability in the Middle East and North Africa (MENA) region.

The oil price crash also caused a decline in global demand, which had a negative impact on interest rate gaps, especially in countries on the edge of the Eurozone (EMU periphery). This is likely because these countries are more sensitive to disruptions in the oil market.

Finally, our findings suggest that changes in the supply of goods and services had little impact on interest rate gaps during this period, except for some positive correlations in Belgium and France. The Arab Spring had a significant impact on oil prices. It caused people to buy more oil than usual, which is called a "precautionary demand shock," because they were worried about future supply disruptions. At the same time, actual problems with oil production in the region also led to supply shocks. Interestingly, only Belgium and France saw their bond prices change in response to these supply shocks. This is likely because they have strong trade relationships with oil-producing countries in the Arab world. For example, France imported a huge amount of oil from North Africa and the Middle East in 2015.When oil prices dropped between 2014 and 2015, it was mainly due to a combination of factors: people buying less oil (aggregate demand shock) and problems with oil production (supply shock). During this time, bond prices didn't change much in response to the precautionary demand shock. However, they did move in the way we expected when oil prices fell due to lower demand. The fact that bond prices didn't react much to supply shocks during this period suggests that these shocks weren't very important for financial markets.

This study examined the relationship between crude oil prices and stock market prices before and during the COVID-19 pandemic. Using a technique called cross wavelet transform, the researchers found that oil prices and stock prices move together, especially in the short-term (high-frequency). This means that when oil prices go up, stock prices tend to go up as well, and vice versa. However, the study also found that this relationship was weaker in the long-term (low-frequency) during the pandemic. This suggests that the short-term connection between oil and stock markets became more important during the crisis.

Another study by Salisu et al. (2020) found that oil prices influenced stock prices before the pandemic, but after the pandemic, the relationship became two-way. This means that both oil and stock prices affected each other. The study also noted that oil prices were more volatile than stock prices both before and during the pandemic. However, all stock markets showed positive returns, even during the crisis, and these returns were actually higher during the pandemic.

6. Conclusion

Oil prices have been very unpredictable lately, going up and down quickly. This is more extreme than we've seen since the oil crisis of 1979. These big changes in oil prices have a big impact on the economies and financial markets of countries that buy and sell oil.

The oil industry is very important and affects many markets, especially the financial market. The financial market also affects the oil market, so they are connected. This chapter looks at how the financial markets of countries that export and import oil, as well as the financial markets of the G20 countries (which include the biggest oil producers and consumers), are all connected. The goal is to understand how much the price of oil can make stock markets in some G20 countries more likely to have problems.

the study found that both oil and stock prices had unusual patterns, with more extreme values than expected (asymmetry and leptokurtosis). This research investigated how changes in oil prices affect stock markets in 16 G20 countries. We used two different models, BEKK-GARCH and DCC-GARCH, to analyze this relationship. To get a clearer picture, we divided the study period into five smaller periods and separated the countries into oil exporters and importers. This helped us understand how oil price volatility impacts the economies of major oil producers and consumers differently.

Our analysis revealed that the relationship between oil prices and stock returns is dynamic and changes over time. We observed that the correlation between stock returns tends to increase during periods of crisis.

Furthermore, we found strong evidence of a direct transmission of volatility between oil and stock markets in many of the countries studied. Generally, shocks and volatility tend to flow from oil markets to stock markets more often than the other way around. However, there are differences between countries, which is expected given the diverse nature of their economies.

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