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Examining the Relationship between Oil Prices and Stock Returns: Evidence from OECD Countries

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ABSTRACT

This study uses data from the OECD countries to investigate the relationship between stock returns and oil prices. The study uses daily closing values for analysis and covers the years 2000-2022. Oil prices are taken as the independent variable and stock returns as the dependent variable using the panel data analysis. The analysis includes intermediary factors as GDP and inflation. The research begins with a unit root test, followed by a panel co-integration test. Finally, the panel causality test and panel regression results are interpreted. This study primarily aims to explore the effect of oil price volatility on stock returns. Results show a statistically significant positive association between stock returns and oil prices. These findings highlight the importance of oil prices as a determinant of stock returns in the financial markets and provide investors, financial institutions and policymakers valuable insights.

Keywords: Oil Prices, Stock Returns, Volatility, Panel Data, OECD Countries
JEL Classifications: L94, C12, E30

1. INTRODUCTION

In today's global economy, fluctuations in oil prices have significant implications across various dimensions. Economic growth, inflation, trade balance, and financial markets are highly sensitive to changes in oil prices. These fluctuations can deeply impact markets worldwide, presenting significant challenges and opportunities for investors, financial institutions, and policymakers.

Examining the relationship between oil prices and stock returns plays a crucial role in economic decision-making processes. Stock markets are influenced by various factors such as economic growth, company performance, and global market conditions. Therefore, understanding the impact of changes in oil prices on stock returns is a matter of considerable concern for investors. Understanding this relationship can assist in the development of effective risk management strategies and optimization of portfolios.

Findings from academic research and practical applications provide various perspectives on how oil prices affect stock markets. However, fully comprehending this relationship requires further study and analysis. In this context, the use of robust methods such as panel data analysis allows for comprehensive analysis on large samples, leading to more reliable results.

The primary aim of this study is to delve deeper into the relationship between oil prices and stock returns. Comprehensive datasets obtained from OECD countries will be utilized, and various econometric techniques will be applied. The results of the analysis will provide valuable insights to investors, financial institutions, and policymakers, enabling them to better understand the role of oil prices in financial markets and make more informed decisions.

The structure of the study is as follows: Firstly, a literature review will be conducted to summarize existing knowledge on the relationship between stock returns and oil prices. Then, the data sources and analysis methods will be explained, including definitions of the variables used in the analysis. Unit root tests will be used to analyze the stationarity of the series, and if necessary, panel cointegration tests will be conducted. Subsequently, panel regression analysis and panel causality tests will be performed, and the results will be interpreted.This study aims to contribute to the understanding of financial markets and the development of risk management strategies. Investors can make more informed decisions by comprehending the impact of oil price fluctuations on stock returns.

This study contributes significantly to the existing literature by focusing on the relationship between stock returns and oil prices in OECD countries. The scope of the investigation is narrowed down to this specific group, providing targeted and contextual analysis, enhancing methodological rigor by employing advanced econometric techniques, and presenting empirical evidence of meaningful long-term relationships. Additionally, by emphasizing the driving forces behind oil prices, it sheds light on the mechanisms underlying this relationship and suggests potential significant implications for investors and policymakers. Through these comprehensive approaches, the study helps us gain a better understanding of the interaction between stock market performance and oil prices in OECD countries.

2. LITERATURE REVIEW

Studies that have already been published in the existing literature investigate the relationship between stock market returns and oil prices, concentrating on how oil prices affect stock markets in different countries and areas. Numerous research additionally examined the impact of oil prices on economic growth and exchange rates using different methodologies and data sources to analyze this association. According to the studies, there is a complicated association between stock market returns and oil prices, depending on various factors including the type of data used and the country's net oil exports or imports. Studies show that stock market volatility is affected by oil price volatility, and stock market performance measures oil price moves and fluctuations forecasts.

Studies examining the relationship between oil prices and stock returns generally use the following methods:

Linear Relationship Research: In this method, it is investigated whether changes in oil prices have a linear effect on stock returns.

Most of the studies using this method in the literature suggest that oil prices can directly affect stock prices and returns. This effect is considered to be that increases in oil prices can reduce or increase stock returns, affecting company costs and profitability.

Variance Approach: This approach examines the impact of oil price volatility on the variance in stock returns. It is accepted that the volatility of oil prices has an impact on the volatility of stock returns. It is suggested that uncertainty and volatility in oil prices may increase the risk perception of market participants, which in turn may increase the variance in stock returns.

Time Series Analysis: Time series analysis measures how the relationship between oil prices and stock returns changes over time. In this type of analysis, it is examined whether the effect of oil prices on stock returns changes over time. For example, there may be a strong relationship between oil prices and stock returns in certain periods, while in other periods this relationship may weaken or reverse.

Section Analysis: In this type of analysis, sections that are thought to affect the relationship are taken into account instead of the time dimension. It analyzes how exposure to oil prices will affect stock returns of companies in different industries. In other words, these analyzes investigate the sensitivity of companies in different industries to oil prices and the effect of this sensitivity on stock returns. For example, companies in the energy sector are expected to have greater exposure to oil prices, while companies in industries less affected by oil consumption may have a different impact on stock returns.

Chen et al. (1986) examined the effects of economic forces on the stock market. Their study aimed to understand how economic forces influence changes in the stock markets. The analysis utilized a long time series spanning from 1926 to 1982. The results indicated that economic forces affect stock prices and are associated with market fluctuations.

Sadorsky (1999) analyzed the connection between stock and oil prices in seven industrialized countries. The author applied a multivariate GARCH model and indicated that unexpected changes in oil prices significantly impacted the returns of the stock market. The influence was stronger for Canada compared to the United States.

Ling and McAleer (2003) aimed to investigate the oil returns effect on returns of stock market in various countries. They utilized a multivariate GARCH model as their methodology. They found that oil returns significantly impacted stock market returns for most countries, except for Mexico.

The effect of oil price risk on emerging markets was analyzed by Basher and Sadorsky (2006). The analysis utilized monthly data from 1990 to 2003, revealing an adverse impact of oil price risk on up-and-coming markets.

In their research, Narayan and Narayan (2006) examined the effect of oil prices on the stock prices of Vietnam. The objective was to analyze how oil prices influence the stock market of Vietnam. Daily data from 1996 to 2005 were utilized, and the findings indicated that Vietnam's stock prices display a positive impact from oil prices.

Using a multivariate VAR approach, Soytaş and Sari (2006) explored the association between Turkey's stock markets, oil prices, and exchange rates. They analyzed the correlation among stock markets, oil prices, and exchange rates. Monthly data from 1990 to 2004 were employed. The authors indicated the influence of oil prices on exchange rates and stock prices, and there are mutual connections between these assets.

Park and Ratti (2008) established a relationship between stock returns and oil prices, specifically showing that an escalation in oil prices negatively affects stock returns. They employed a VAR (Vector Autoregression) model to examine this relationship.

Lee and Chang (2008) studied the correlation between the consumption of energy and stock market performance in OECD countries. Their objective was to analyze the impact of energy consumption on the stock market. The analysis utilized data on an annual basis from 1980 to 2004. They indicated a long-term association between energy consumption and stock market performance, suggesting the influences of increasing energy consumption on stock prices.

Apergis and Miller (2009) investigated the link between stock and oil prices at a sectoral level. They utilized a multivariate GARCH model with sectoral indices. They revealed an association between stock and oil price changes across different sectors.

Kilian and Park (2009) demonstrated that fluctuations in the U.S. stock market made by oil prices impact stock returns. They emphasized that oil prices significantly impact the stock market. Kilian and Park utilized a VAR model to analyze the oil prices' influence on the U.S. stock market.

Chen et al. (2010) analyzed the effects of sudden fluctuations in oil prices on China's stock market via a VAR model. Their findings indicated that shocks in oil prices could notably influence the Chinese stock market, albeit with varying magnitudes across different sectors. Consistent with the findings of Yang and Yin (2017), their research also underscores the significant impact of oil price shocks on industry-specific stock returns.

Aloui and Mabrouk (2010) focused on examining the influence of unexpected spikes in crude oil prices on the Gulf Cooperation Council (GCC) countries' stock markets. Their goal was to understand how abrupt fluctuations in crude oil prices affect the stock market's behavior. This study employed daily data from 1998 to 2008. They revealed that sudden changes in prices of crude oil cause changes in stock markets and have negative effects.

Lizardo and Mollick (2010) explored the oil price fluctuations' impact on the U.S. dollar's exchange rates. They aimed to analyze the connection between oil prices and exchange rates via monthly data from 1973 to 2006. The research demonstrated that oil price variations influence the value of the U.S. dollar in foreign exchange, with an increase in the price of oil resulting in a decrease in exchange rates.

The interplay among exchange rates, oil prices, and precious metal prices was analyzed by Sari et al. (2010). The analysis covered the period from 1989 to 2009 using monthly data. The findings revealed that precious metal prices are impacted by oil prices and indirectly impact exchange rates.

The non-linear correlation between stock indices and oil prices was examined by Wang and Wu (2012). Their objective was to demonstrate that a non-linear model can represent the association between stock indices and the price of oil. The study utilized data collected on a daily basis from 2002 to 2011. They revealed a complex connection between stock indices and the price of oil, which could be effectively captured using a non-linear model.

Narayan and Sharma (2011) discovered a negative association between stock returns and oil prices, indicating an association between oil price rise and stock returns decrease. They examined this relationship across 17 different countries using panel data analysis methods.

Chen and Tsang (2011) showed a short-term connection between stock returns and oil prices. However, they did not observe a prolonged correlation and noted no direct impact of oil prices on stock returns. They employed a time series analysis method to examine the impact of oil prices on the Chinese stock market.

Filis et al. (2011) examined the stock markets influenced by oil prices in Greece, Spain, and Portugal and found the relationship to be strongest in Greece.

Kaufmann and Ullman (2012) found a negative connection between stock returns and oil prices. Their study utilized the co-integration analysis and Granger causality test to examine this relationship.

Arouri et al. (2012) used a multivariate GARCH model to analyze stock market returns and oil prices interplay in Gulf Cooperation Council (GCC) countries. The results showed that oil prices significantly affect stock market returns in the GCC countries, with varying magnitudes across different sectors.

Oral and Orbay (2012) examined the oil price variations' impact on industry portfolios in Turkey using data from the Istanbul Stock Exchange. They demonstrated that oil price variations significantly affect the returns of certain industry portfolios.

Aloui et al. (2013) identified an association between stock returns and oil prices, demonstrating that fluctuations in stock returns could be traced through the oil prices' significant role. They employed statistical methods such as correlation analysis, covariance analysis, and exogeneity tests to examine the relationship.

Hammoudeh et al. (2013) assessed the association between stock returns and oil prices in North Africa and the Middle East. They found the relationship to be stronger in nations that rely on oil imports.

Aboura and Chevallier (2014) used a VAR model to investigate the linkages between the stock markets of the BRICS countries and crude oil prices. They indicated the significant impact of the oil prices on the stock markets of several countries, such as Brazil, Russia, India, and South Africa, but not China.

Chen and Chen (2015) identified a non-linear connection between stock returns and oil prices in China.

Yin et al. (2016) identified a complex linkage between oil prices and stock returns. Their study revealed that declines in oil prices generally have a negative impact on stock returns, while increases in oil prices can positively affect stock returns. They applied the ARDL (Autoregressive Distributed Lag) model to analyze the stock returns and oil prices correlation.

Adebiyi et al. (2017) examined the impact of the volatility of the oil price on the returns of the stock market in Nigeria using a multivariate GARCH model. An association, which was significantly negative, between stock market returns and oil price volatility was discovered by them.

The correlation between stock market returns and oil prices in the Gulf Cooperation Council (GCC) countries during the financial crisis was examined by Dhaoui et al. (2018). They utilized a regime-switching model and found that the association between oil price volatility and GCC stock market performance depends on the regime.

Khraief and Boutahar (2018) analyzed the stock market performance influenced by oil prices in the G7 countries using dynamic panel data analysis. The findings indicated that in the G7 countries, a significant negative relationship exists between oil prices and stock market performance.

Celik and Gupta (2019) studied the integration between oil prices and stock markets compared to gold prices in the United States, Japan, and the United Kingdom. The findings revealed that, compared to gold prices, stock markets indicated higher integration with oil prices.

Using a time-varying copula model, Cui et al., (2019) investigated the connection between crude oil and stock markets in the U.S. and China. They indicated that the correlation between stock markets and crude oil varies over time and across countries.

Aladejebi and Omitogun (2020) examined the stock market returns influenced by oil prices in African countries that import and export oil using panel data analysis. The results indicated a significant influence of oil prices on the stock market returns in both types of countries.

Cevik et al. (2021) investigate the relationship between crude oil prices and stock market performance in Saudi Arabia, emphasizing the role of second-moment effects as represented by volatility spillovers. Weekly data spanning 2001-2018 is utilized alongside time-varying causality tests and considerations for structural breaks, allowing for a nuanced analysis of this dynamic. Through the application of an APARCH process, the authors capture leverage effects within the volatility of returns. Empirical findings suggest a bidirectional causal relationship between stock and oil performance series. While no significant spillover effects are detected from the stock market to the oil market, substantial spillover effects are identified emanating from crude oil price changes and impacting stock market returns. Additionally, evidence supports the presence of risk spillovers between crude oil prices and the stock market.

Kang et al. (2021), analyzes the influence of economic policy uncertainty, oil price fluctuations, and jet fuel price volatility on the stock returns of U.S. airlines, incorporating both industry and individual company data. A structural vector-autoregressive model is employed, encompassing variables known to impact airline returns. The findings confirm that increases in oil prices, economic uncertainty, and jet fuel price volatility significantly impede real stock returns for airlines at both industry and firm levels. Moreover, the study reveals that hedging future fuel purchases statistically benefits smaller airlines. These results offer valuable insights for policymakers, airline industry managers, and commodity investors regarding risk management strategies and policymaking approaches.

Ma et al. (2021), explores the ability of oil returns to predict stock market returns, employing a series of economic constraints. The research demonstrates that oil returns hold a stronger and more consistent predictive power than their asymmetric counterparts, both in unconstrained and three constrained approaches. Furthermore, a novel constraint based on the three-sigma rule yields the highest forecast accuracy. Additionally, incorporating oil returns into 14 macroeconomic predictors outperforms univariate macro models in terms of average forecasting performance. Finally, the study reveals that the predictive ability of oil returns varies according to economic phases linked to the business cycle, geopolitical risks, and financial crises. The authors attribute the predictability of oil returns to two channels: the discount rate channel and the sentiment channel.

Zhang et al., (2021), investigates the impact of the COVID-19 pandemic on the relationship between oil prices and stock market return predictability using daily Japanese stock market data from 2020 to 2021. It contributes to the field by examining whether the pandemic altered this association. The authors employ an empirical model controlling for various factors like seasonality, return-related variables, heteroskedasticity, and endogeneity. The findings reveal an 89.5% decrease in the influence of oil prices on stock returns attributed to COVID-19. This suggests that during the pandemic's economic disruption and financial market instability, the link between oil prices and stock returns weakened. This could have implications for trading strategies reliant on oil price predictions.

Dawar et al. (2021), their study deviates from previous research by examining the dependence between crude oil and renewable energy stock prices under diverse market conditions, utilizing a quantile-based regression approach to capture a more comprehensive picture. Weekly data from the WTI oil market and three clean energy stock indices are analyzed. The employed quantile regressions reveal strong evidence for a declining dependence of clean energy stock returns on crude oil returns across various market quantiles. Notably, lagged effects of oil returns on clean energy stocks are found to be generally significant, indicating differing reactions to new oil price information depending on market conditions. Further investigation for asymmetric effects reveals a pronounced impact of negative oil returns during bearish periods, while positive oil returns show no significant influence on clean energy stocks during bullish episodes. This suggests that renewable energy stocks are becoming increasingly decoupled from oil price fluctuations, particularly during negative market conditions.

3. RELATIONSHIP BETWEEN OIL PRICES AND STOCK RETURNS

3.1. Dataset and Methodology

This study examines the impact of oil prices (PETL) on stock returns in OECD countries. This study examined the 36 member countries of the OECD, as shown in Table 1, between the years 2000 and 2022, and the data frequencies were determined annually. Table 1 displays the countries under examination.

The variables of the study and the data sources are shown in Table 2.

Mediator variable was used in the model to analyze the research in an appropriate econometric model and to obtain correct results. Mediator variables were determined as Gross domestic product and inflation, and the accuracy and validity of these variables will be determined by the Sargan Test. The hypothesis of the research is shown in Table 3. In order to establish the classical assumptions of the model, the logarithm of the data used in the study was used.

In this study, EVIEWS 10 and EXCEL 2019 programs were used to apply the model and perform analysis methods. The Panel Generalized Method of Moments (GMM) model was applied to test the instrument of analysis under variable conditions and with cross-sectional data. The GMM model is an estimation method used with many statistical methods. GMM is used to make predictions, especially in non-parametric and non-linear models.

Table 4 shows the descriptive statistics of the study's data.

In parametric analysis methods, it is necessary for the dependent variable and the residual term of the model to follow a normal distribution. As indicated in Table 4, the probability value and Jarque-Bera test statistic demonstrate that the data for the LNHSG variable exhibits a normal distribution. Hence, parametric analysis methods can be employed with this data. Additionally, since there are 606 observations for the variables, the assumption of normality for the residual term in the GMM model to be used will not be violated.

4. TEST RESULTS

4.1. Unit Root Test

Assessing the stationarity of a series variable is done via unit root tests, usually assumed in the null hypothesis, indicating the non-stationarity of the series. In contrast, the alternative hypothesis can assume stationarity, trend stationarity, or explosive root based on the specific test employed. If the probability values obtained from the test results are lower than 0.05, the null hypothesis is rejected. The ADF and P.P. unit root tests were used in this study.

Table 1: OECD countries included in the sample

1	England	13	Lithuania	25	Türkiye
2	Ireland	14	Luxembourg	26	U.S.
3	Spain	15	Hungary	27	Germany
4	Israel	16	Mexico	28	Austria
5	Sweden	17	Norway	29	Belgium
6	Netherlands	18	Poland	30	Denmark
7	Italy	19	Portugal		
8	Japan	20	Slovakia		
9	Iceland	21	Slovenia		
10	Canada	22	France		
11	New Zealand	23	Republic of Korea (South Korea)		
12	Greece	24	Estonia		

Table 2: Variables and Sources of Data

Variables			Source
Independent Variables	**Brent Oil Price**	**PETL**	
Dependent Variables	Return of Stock Exchange	HSG	data.oecd.org
Intermediary Variable	Gross Domestic Products	GDP	data.oecd.org
Intermediary Variable	Inflation	INF	data.oecd.org

Table 3: Hypotheses of the Study

H_0	Brent Oil Price does not affect stock as an independent variable.
H_1	Brent Oil Price affects stock as an independent variable.

Table 4: Descriptive Statistics

	LNHSG	LNPETL
Mean	4.528.551	4.120.240
Median	4.562.905	4.178.750
Maximum	5.332.989	4.683.219
Minimum	3.847.595	3.248.240
Std.Dev.	0.308436	0.414067
Skewness	0.006905	-0.489906
Kurtosis	2.734.351	2.400.927
Jargue-Bera	1.786.692	3.330.270
Probability	0.409284	0.000000
Observations	606	606

The implicit assumption of the unit root testing approach is that the time series to be tested can be constructed as follows:

$y_t = D_t + Z_t + \varepsilon_t$

D_t: A deterministic component, such as a seasonal component, a trend, or other factors
z_t: Random fluctuations, which make up the stochastic component.
ε_t: Standard Error Term

In order to ascertain whether the stochastic component of a time series contains a unit root or is stationary, the unit root test is employed. When time series that are not stationary are used to build models, various issues arise, including the spurious regression problem and the influence of autoregressive structures. These problems can lead to the misinterpretation of a non-existent relationship between variables, falsely assuming its existence and evaluating it accordingly. The ADF and P.P. unit root tests results are shown in Table 5.

In Table 5, the unit root tests results for the series are shown. It can be observed that the LNHSG and LNINF variable series have probability values below 0.05 at the normal level, showing the stationary state of these series in their original form. On the other hand, the LNPETL and LNGDP variable series exhibit non-stationarity, and the null hypothesis is accepted in both the ADF and P.P. tests. Since stationary series are preferred for modeling purposes, the first difference of these series was utilized in the tests. The first difference of the LNPETL and LNGDP variable series rejects the null hypothesis in both the ADF and P.P. tests, indicating their stationarity.

4.2. Co-integration Test

Co-integration tests are utilized to identify long-term relationships among stationary series. This study employed the Pedroni Panel Co-integration test, which is based on the Engle-Granger approach. The objective was to investigate the long-term relationship between the first differenced stationary variable LNPETL and the stationary variable LNHSG at normal levels.

The Engle and Granger co-integration test (1987) examines the a simulated regression residuals involving I(1) variables. The residuals should exhibit I(0) properties if the variables are co-integrated, indicating stationarity. Conversely, the residuals will possess I(1) characteristics if the variables are not co-integrated. Kao (1999) and Pedroni (1999, 2004) expand the Engle-Granger framework to include panel data tests. Pedroni proposes various co-integration tests that account for trend coefficients and heterogeneous intercepts in different cross-sections.

$$y_{it}=\alpha_i+\delta_i t+\beta_{1i}x_{1i,t}+\beta_{2i}x_{2i,t}+\ldots\beta_{Mi}x_{Mi,t}+e_{i,t}$$

The equation in this study is assumed to be first-order integrated. The Pedroni Panel Co-integration test comprises seven different panel tests, and the test results overall interpretation is typically according to how many tests reject the null hypothesis. If the rejection of the null hypothesis occurs in four out of the seven Pedroni tests, it indicates that the Pedroni test rejects the null hypothesis. Table 6 displays the outcomes of the Pedroni Panel Co-integration test.

As Table 6 shows, 5 of 7 tests reject the null hypothesis. Therefore, a long-term relationship between LNPETL and LNHSG variables can be accepted.

4.3. GMM Model Estimation

The GMM model (Dynamic Panel data model) analysis employed the 2-stage Arellano-Bond method for estimation. In this analysis, relationships were examined up to two lags. The Sargan test, which produces J-statistics and p-values, was done to determine the validity of the model's intermediary variables. The Sargan test results are calculated within the GMM model estimation. The GMM model 2-stage Arellano-Bond test results are presented in Table 7.

According to the GMM model estimations, if the probability values of the first and second lags of the LNHSG variable are below 0.05, it shows the null hypothesis rejection. Thus, both the first and second lags of the LNHSG variable have an impact on the LNHSG variable at time zero. Notably, the effect was positive 1 year ago, while it was determined to be negative 2 years ago. Among these effects, the coefficient of the 1st-year lag is larger, indicating a stronger effect compared to the 2nd-year lag.

Furthermore, the probability value of the LNPETL variable rejects the null hypothesis, suggesting that the LNPETL variable positively affects the LNHSG variable. This implies that a rise in Brent oil prices positively impacts the stock index returns in 30 OECD countries, leading to an increase in returns.

The intermediary variables' validity is assessed via the Sargan test, which is presented through J-statistics and probability values. The Sargan test's null hypothesis assumes the invalidation of intermediary variables used in the model. However, the probability value obtained from the estimated

Table 5: Unit Root Test Results

Panel unit root test: Summary				
Automatic lag length selection based on SIC				
Series: LNHSG				
Method	**Statistic**	**Prob.**	**Cross-sections**	**Obs**
ADF-Fisher Chi - square	144.265	0.0000	30	534
PP-Fisher Chi - square	110.573	0.0001	30	565
Series: D (LNPETL)				
Method	**Statistic**	**Prob.**	**Cross-sections**	**Obs**
ADF-Fisher Chi - square	346.364	0.0000	30	630
PP-Fisher Chi - square	346.816	0.0000	30	630
Series: D (GDP)				
Method	**Statistic**	**Prob.**	**Cross-sections**	**Obs**
ADF-Fisher Chi - square	269.063	0.0000	30	619
PP-Fisher Chi - square	362.132	0.0000	30	630
Series: D (INF)				
Method	**Statistic**	**Prob.**	**Cross-sections**	**Obs**
ADF-Fisher Chi - square	145.082	0.0000	30	550
PP-Fisher Chi - square	133.698	0.0000	30	568

Table 6: Co-integration Test Results

Pedroni Residual Cointegration Test				
Series: LNHSG LN PETL				
Included observations: 690				
Cross-sections included: 30				
Null Hypothesis: No cointegration				
Alternative hypothesis: common AR coefs. (within-dimensions)				
			Weighted	
	Statistic	**Prob.**	**Statistic**	**Prob.**
Panel v-Statistics	1,417964	0,0781	0,252209	0,4004
Panel rho-Statistics	-0.618130	0,2682	-1.138.055	0,1275
Panel PP-Statistics	-3.738.062	0,0001	-5.607.111	0,0000
Panel ADF-Statistics	-7.298.703	0,0000	-8.760.640	0,0000
Alternative hypothesis: individual AR coefs. (within-dimensions)				
Panel v-Statistics	**Statistic**	**Prob.**		
Group rho-Statistic	1,314126	0,9056		
Group PP-Statistic	-5.181.796	0,0000		
Group ADF-Statistic	-1.015.607	0,0000		

Table 7: GMM Model Estimation

Dependent Variable: LNHSG				
Method: Panel Generalized Method of Moments				
Transformation: First Differences				
Sample (adjusted): 2003-2022				
Cross-sections included: 30				
Total Panel (unbalanced) observations: 443				
White period instrument weighting matrix				
White period standard errors& covariance (d.f. Corrected)				
Instrument specification: @DYN (LNHSG,-2) D (LNGDP) LN 8INF)				
Variable	**Coefficient**	**Std.Error**	**t-Statistic**	**Prob.**
LNHSG(-1)	0.778953	0.002963	2.629.195	0.0000
LNHSG(-2)	-0.149128	0.004268	-3.494.313	0.0000
D (LNPETL)	0.175404	0.007287	2.407.068	0.0000
Effects Specification				
Cross-section fixed (first differences)				
J-statistic	2.189.016	Instrument rank		31
Prob (J-Statistic)	0.786351			

Table 8: Arellano-Bond Serial Correlation Test

Arellano-Bond Serial Correlation Test				
Test Order	**m-Statistic**	**rho**	**SE (rho)**	**Prob.**
AR (1)	-0.025094	-3.101.950	123.611.450	0.9800
AR (2)	-0.016285	-2.417.970	148.475.679	0.9870

Sargan test rejects the null hypothesis, indicating that the LNINF and LNGDP values are indeed valid as intermediary variables in the model.

4.4. Arellano-Bond Serial Correlation Test

(Arellano and Bond, 1991; Majeed et al., 2023) proposed using the first and second-order serial correlation statistics to test for serial correlation in panel equations estimated using GMM, which are computed in this study. The Arellano-Bond test examines the correlation of residuals in the prediction process. The coefficients' standard covariance matrix is used by default for the calculation. The Arellano-Bond serial correlation test assesses whether the error terms in GMM estimation exhibit quadratic serial correlation. This test's null hypothesis assumes the serial correlation in the model. The test outcome is presented in Table 8.

Arellano-bond test results show that the AR(2) p-value is higher than 0.05, and the null hypothesis is rejected. Therefore, the error terms in the GMM estimation do not have a second-order serial correlation.

4.5. Pairwise Granger Causality Test

The Granger causality test applied in this study is grounded in the extensive work on time series analysis and causality tests by Toda and Yamamoto (1994), demonstrating that our methodology is based on a robust theoretical foundation. The pairwise Granger causality test's null hypothesis is that one variable causes the value changes of the other variable.

Pairwise Granger causality test econometric equation is as follows:

Model for LNPETL to causally affect LNHSG:

Table 9: Pairwise Granger Causality Test Results

Pairwise Granger Causality Tests			
Lags: 2			
Nul Hypothesis:	**Obs**	**F-Statistic**	**Prob.**
LNPETL does not Granger cause LNHSG	526	27.3972	5.E-12
LNHSG does not Granger cause LNPETL		8.45154	0.0002

$$LNHSG\_t=\alpha+\beta 1*LNHSG\_(t-1)+\beta 2*LNPETL\_(t-1)+\varepsilon\_t$$

Model for LNHSG to causally affect LNPETL:

$$LNPETL\_t=\alpha+\beta 1*LNHSG\_(t-1)+\beta 2*LNPETL\_(t-1)+\varepsilon\_t$$

Here:
LNHSG_t is the value of LNHSG at time t,
LNHSG_(t-1), LNHSG value of the previous time,
LNPETL_t is the value of LNPETL at time t,
LNPETL_(t-1), LNPETL value of previous time,
α is a constant coefficient (bias term),
Coefficients of $\beta 1$ and $\beta 2$, LNHSG_(t-1) and LNPETL_(t-1) variables,
ε_t, error term.

The model structure used for the Granger causality test is represented by these equations. In the test, the $\beta 2$ coefficient quantifies the impact of LNHSG on LNPETL, while the $\beta 1$ coefficient measures the effect of LNPETL on LNHSG. The test results assess the statistical significance of these coefficients and determine whether a causal association between the variables exists. Table 9 shows the results of the Pairwise Granger causality Test.

As shown in Table 9, the probability values from the causality test reject the null hypothesis. This indicates a significant causal association between the variables. The first test result suggests that changes in the LNHSG variable can be attributed to the influence of LNPETL. Similarly, the second test, also with a significant probability value, rejects the null hypothesis, indicating that the LNHSG variable causes changes in the LNPETL variable.

Based on the outcomes in the table, the conclusion can be drawn that a one-way causality relationship exists between the series. Specifically, it is observed that LNPETL has a causal effect on LNHSG, whereas it is determined that LNHSG does not have a causal effect on LNPETL. This implies that the causality is unidirectional, meaning that LNPETL can impact LNHSG, but LNHSG does not have a significant impact on LNPETL.

5. DISCUSSION AND CONCLUSION

Financial markets are dynamic ecosystems influenced by a multitude of factors, including economic indicators, geopolitical events, and commodity prices. Among these, the relationship between stock returns and oil prices has garnered significant attention due to its implications for investors and policymakers alike. As global markets become increasingly interconnected, understanding the intricate dynamics between these variables is paramount for making informed investment decisions and formulating effective economic policies.

Investors are increasingly seeking the most suitable financial market and investment tools to achieve higher returns, thanks to the ease of fund transfers between markets. It is evident from an overview of global financial markets that positive or negative news in one market can significantly impact other markets.

The present study investigates the interplay between stock returns and Brent oil prices, focusing on the stock indices of OECD countries as the dependent variable. The data's stationarity is tested using ADF and P.P. unit root tests, which reveal being stationary as the first difference between the LNPETL and LNGDP variables.

To explore the long-term effects, the Pedroni test is employed, revealing significant "Long-term associations among the LNHSG and LNPETL variables. This study aims to determine these effects by incorporating the effects of the 2-year dependent variable, along with oil price effects, using the GMM model with an intermediary variable. Additionally, the Sargan test verifies the mediator variables' validity in the model. The GMM model results demonstrate a positive influence of Brent oil prices on the stock returns of OECD countries.

The rise of Brent oil prices is attributed to rising demand, driven by economic growth and income increases. It is observed that the growth of economies consistently relates to the growth of financial markets, highlighting a positive relationship.

This study shares both similarities and differences with previous research in the existing literature. It is important to note that variations in methodology, sample selection, and other factors can lead to diverse findings. For instance, our study differs from Narayan and Sharma's (2011) research, which identified a negative link between stock returns and the price of oil, while aligning with Aloui et al. 's (2013) and Kaufmann and Ullman's (2012) studies, identifying a correlation between stock returns and the price of oil, with oil prices positively impacting stock returns. Similar to the observations made by Al-Fayoumi and Al-Khazali (2014) regarding Kuwait's stock market, our study finds that oil price shocks have distinct effects on stock market behaviors. Similarly, studies such as Sadorsky (1999) and Park and Ratti (2008), Apergis and Miller (2009) and Khraief and Boutahar (2018) found that there is a negative relationship between oil prices and stock returns, unlike our study.

This study takes a step towards understanding the complex interactions in financial markets by examining the relationship of OECD countries' stock indices with Brent oil prices. Our findings show that Brent oil prices have a positive impact on stock returns of OECD countries, which is attributed to rising demand triggered by economic growth and income increases. However, it is important to highlight the complexity of this relationship. The different results obtained compared to previous studies may be due to differences in methodology, sample selection and the influence of other factors. In this context, future studies need to conduct further research to understand this relationship more comprehensively, taking into account different methodologies and variables. In addition, a more in-depth analysis of this relationship, taking into account the impact of other factors in financial markets (for example, interest rates, exchange rates, political uncertainty, etc.), will both contribute to the academic literature and provide valuable information for those operating in financial markets.

5.1. Implications

The findings of this study hold significant implications for various stakeholders, including investors, policymakers, and financial institutions. Firstly, investors can utilize the insights provided by this research to make more informed investment decisions. Understanding the positive association between stock returns and oil prices in OECD countries allows investors to adjust their portfolios accordingly, taking into account the impact of oil price fluctuations on stock market performance. Moreover, financial institutions can use these findings to develop more effective risk management strategies, considering the influence of oil prices on financial markets. Policymakers can also benefit from this study by gaining a deeper understanding of the dynamics between oil prices and stock returns, which can inform policy decisions related to economic stability and financial regulation.

5.2. Limitations

Despite the contributions of this study, it is essential to acknowledge certain limitations that may impact the interpretation and generalization of the findings. Firstly, the analysis focuses solely on OECD countries, which may limit the generalizability of the results to other regions or countries with different economic characteristics. Additionally, the study period spans from 2000 to 2022, which may not capture more recent developments or structural changes in the relationship between oil prices and stock returns. Moreover, while advanced econometric techniques were employed, the study relies on secondary data sources, which may be subject to measurement error or data limitations. Finally, the study does not consider potential nonlinear relationships or dynamic effects between oil prices and stock returns, which could be explored in future research.

5.3. Further Directions

To address the limitations outlined above and build upon the findings of this study, several avenues for future research can be explored. Firstly, extending the analysis to include non-OECD countries and emerging markets would provide a more comprehensive understanding of the global dynamics between oil prices and stock returns. Additionally, conducting a more extensive analysis of the impact of oil price volatility on stock market performance could yield valuable insights for investors and policymakers. Furthermore, incorporating more recent data and exploring the effects of structural changes in the oil market, such as shifts towards renewable energy sources, would enhance the relevance and timeliness of the research findings. Finally, future studies could explore potential nonlinear relationships and dynamic effects using more sophisticated econometric models, allowing for a more nuanced understanding of the complex interplay between oil prices and stock returns.

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