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Navigating Market Volatility: Analyzing the Influence of Oil Price Fluctuations on Stock Prices in the Saudi Arabian Mining Sector

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Abstract. This study utilizes panel data models to thoroughly examine the intricate relationship between oil price fluctuations and stock prices within the Saudi financial market across 15 distinct sectors. The research unveils a nuanced under-standing of the long-term negative impact between oil prices and Saudi stock prices. Employing robust causality and co-integration tests, the study establishes a durable equilibrium relationship with bidirectional influences between these variables. These findings carry actionable insights, providing valuable guidance for investors, policymakers, and financial market stakeholders to navigate the complexities of the Saudi Arabian market dynamics.

Keywords: Causality Test, Co-integration, Oil Prices, Panel Data Models, Saudi Financial Market, Stock Prices.

1. INTRODUCTION

Oil stands as a dominant force shaping global economic dynamics, maintaining its pivotal role amidst transformative changes in the energy landscape. Regardless of the diversification of energy sources, oil remains a critical international commodity, exerting substantial influence on the economies of both petroleum-dependent and non-petroleum nations, thereby impacting global capital markets. As the Saudi economy experiences significant growth, its influence over the performance of the Saudi stock market positions it as a key player in the global financial arena. This research seeks to forge connections between oil and stock prices, employing a conceptual framework that defines oil prices as the monetary value of oil, influenced by political, economic, and natural forces. Various types of oil prices, including announced, realized, benchmark, and cost-tax prices, are considered in the study. Similarly, stocks, representing ownership in a company, exhibit characteristics such as ownership certificates, profit, capital shares, and participation in general meetings, with values differing across nominal, book, and market values. The research delves into the impact of oil price changes on stock prices, exploring correlations between oil prices and stock market indicators. An increase in oil prices positively affects stock markets due to reduced input costs and increased consumer spending, while a decrease has the opposite effect. The relationship varies across sectors in the short and long term, emphasizing the dynamic nature of their interplay in the market. Adopting a descriptive approach, the study utilizes case study methods, panel time series, and parameter estimation techniques, supported by statistical software such as Excel and EViews 9.0 to facilitate a comprehensive analysis. The subsequent sections will delve into the existing literature, methodology, results, and a detailed analysis of the findings, providing a holistic understanding of the intricate relationship between oil prices and stock prices in the Saudi financial market.

2. LITERATURE REVIEW

The existing literature provides a multifaceted perspective on the intricate relationships among energy, financial markets, and environmental sustainability. Weng et al. (2021) underscores the significance of incorporating COVID-19-related news into decision-making processes for crude oil futures, highlighting its predictive value. Liu et al. (2023) contribute to the understanding of the complex interplay between crude oil price volatility and stock market returns across diverse countries. Urom et al. (2023) investigates the time-varying dynamic integration of oil price shocks and interest rates, identifying key factors influencing spillover effects. The study by Liu et al. (2023) explores the heterogeneous impacts of expected and unexpected oil price shocks on China's stock market, emphasizing the importance of financial skill training and efficient risk-alert mechanisms. Hussain and Rehman (2022) explore the volatility connectedness of Gulf Cooperation Council stock markets with S&P Global Oil Index returns, emphasizing the impact of global oil price volatility on net volatility spillovers. Rajput and Bhalla (2023) investigate the causality between income and expenditure of the Central Pollution Control Board in India, offering insights into the long-run relationship and direction of causation. Dinçer and Yüksel (2022) analyze the effectiveness of monetary policies in E7 economies, revealing a long-term relationship between central bank interest rates and inflation rates. Perone (2024) explores the relationship between renewable energy production and CO2 emissions in OECD countries, highlighting specific renewable sources' potential to reduce emissions. Balash and Faizliev (2024) delve into the evolution of external shock

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impacts on the volatility connectedness of Russian oil and gas companies stock prices. Antonakakis et al. (2018) investigate uncertainty spillovers among developed economies, employing a time-varying parameter vector autoregressive model. Luo et al. (2024) examine the risk spillover from international crude oil markets to China's financial markets, considering extreme events and the moderating effect of U.S. monetary policy. Mao, Wang, and Bibi (2024) investigate the interconnectedness of the COVID-19 pandemic, stock markets, and crude oil markets in China, the United States, and India, focusing on returns and volatility effects. Finally, Sun (2024) explores the impact of inclusive finance on oil production targets in Gulf countries, offering valuable policy implications for economic diversification and sustainability. These studies contribute to a comprehensive understanding of complex dynamics at the intersection of energy, finance, and environmental considerations. In this context, our study adds a unique dimension by focusing specifically on Gulf countries, providing insights into the role of inclusive finance as a catalyst for change in mitigating fiscal vulnerabilities and achieving balanced and sustainable development amid global oil market fluctuations.

3. METHODOLOGICAL APPROACH

The study delves into the intricate relationship between oil prices and stock prices within the Saudi financial market from January 2013 to December 2015. Monthly oil prices are sourced from the global financial market website Investing, while monthly stock prices of companies representing the diverse sectors of the Saudi financial market are acquired from the electronic platform Tadawul. The data set spans approximately 540 observations, providing a robust foundation for analysis. Focused on the Saudi financial market, which has evolved significantly since its establishment in the mid-thirties, the market's formalization began in the early eighties. The establishment of the Saudi Financial Market Company, known as "Tadawul," in 1984 marked a crucial milestone. Currently encompassing 15 sectors and 173 companies, the Saudi financial market offers a rich and diverse landscape for investigating the interplay between oil prices and stock prices, forming the crux of this comprehensive study. The sectors and companies are detailed in Table 1, illustrating the broad spectrum under consideration.

Table 1: Number of sectors and listed companies in each sector.

Sector	Listed Companies
Banking and Financial Services Sector	12
Petrochemical Industry Sector	14
Cement Sector	14
Retail Sector	16
Energy, Utilities, and Services Sector	2
Agriculture and Food Industries Sector	16
Communications and Information Technology	4
Insurance Sector	35
Multi-Investment Companies Sector	7
Industrial Investment Sector	15
Construction and Building Sector	17
Real Estate Development Sector	9
Transportation Sector	5
Media and Publishing Sector	3
Hotels and Tourism Sector	4

The dataset used in this study is sourced from reputable platforms, enhancing its reliability. Monthly oil prices are obtained from the globally recognized Investing website, known for its accuracy in financial market data. Investing aggregates information from reputable sources, ensuring the dependability of our oil price data. Additionally, monthly stock prices are acquired from Tadawul, the principal stock exchange in Saudi Arabia, valued for its transparency and efficiency in trading. Tadawul covers diverse sectors, providing a comprehensive view of the Saudi stock market dynamics. Rigorous data cleaning and preprocessing have been undertaken to maintain data accuracy, addressing outliers or inconsistencies. This meticulous approach ensures that our data set accurately reflects trends in both oil and stock prices. The inclusion of key sectors, such as Banking, Petrochemicals, Retail, and Energy, ensures a thorough analysis of the Saudi financial market's response to oil price fluctuations, enhancing the study's representativeness and relevance.

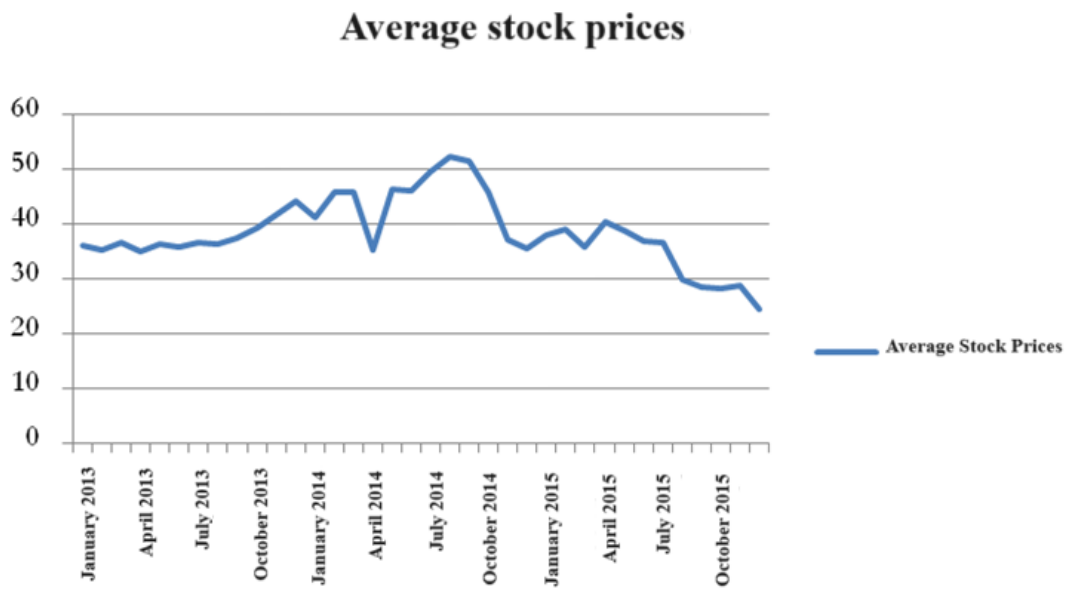

Figure 1: Graphical representation of the stock prices listed in the Saudi financial market for the period from January 2013 to December 2015.

Examining Figure 1 reveals the dynamic trajectory of oil prices from 2013 to 2015. Notably, there was a substantial surge in oil prices, peaking at $100 per barrel in 2013. However, a significant downturn occurred from September 2014 to January 2015, resulting in a notable 55% decline. These fluctuations indicate continuous oscillations and volatility in oil prices, a pattern that has endured over time. The observed volatility can be linked to supply and demand dynamics, influenced by policies enacted by oil-exporting countries, particularly those within OPEC (Organization of the Petroleum Exporting Countries).

In parallel, Figure 1 depicts the fluctuation and shocks in the prices of stocks in the Saudi financial market during the same period. Despite oil price fluctuations, stock prices remained relatively stable over the years studied. The temporal variations in monthly data from 2013 to 2015 can be attributed to crises and factors impacting the Saudi stock market's instability. This suggests a certain resilience or insulation of the Saudi financial market from the immediate and direct impacts of oil price dynamics, emphasizing the need for a nuanced understanding of the relationship between oil prices and stock prices in the Saudi context.

In the mathematical model used for this study, the relationship between oil prices and stock prices in the Saudi financial market is systematically explored. The model is expressed as:

$$Pc_{it}=B_0(i)+B_1.pp_{it}+\varepsilon_t$$

The subscript i represents different sectors (cross-sections), and t represents various periods.

Where:

$$i=1, 2,\ldots,15 \quad t=1,2,\ldots,36$$

Pc_{it}: Represents the closing prices of stocks for sector i at time t, serving as the dependent variable in our analysis.

$B_0(i)$: Denotes the intercept term specific to each sector i in the Saudi financial market, contributing to the baseline value of stock prices for that sector.

B_1: Represents the coefficient for the oil prices pp_{it}, indicating the magnitude and direction of the influence of oil prices on stock prices.

pp_{it}: Signifies the oil prices for sector i at time t, functioning as the independent variable reflecting the monetary value of oil.

ε_t: Represents the error term, accounting for unobserved factors or variations that might influence stock prices beyond the modeled variables.

This model allows for a detailed examination of the impact of oil price fluctuations on stock prices across different sectors and time frames within the Saudi financial market.

The graphical representation in Figure 2 showcases the relationship between oil prices pp_{it} and stock prices Pc_{it} in the Saudi financial market. Each point on the scatter plot corresponds to a pair of values for oil prices and stock prices at a specific period. This visual representation allows for a clear observation of the potential patterns or trends in how changes in oil prices may influence stock prices within the selected sectors.

In anticipation of potential correlations between oil prices and stock prices in the Saudi financial market, driven by the economic significance of oil in the region, our initial expectation was that fluctuations in oil prices might influence stock prices across various sectors. However, a detailed analysis of the scatter plot revealed no clear linear relationship between stock prices and oil prices. The scattered points in the plot lacked a distinct pattern, challenging the suitability of a linear model to describe the relationship. This observation prompts us to consider alternative models and emphasizes the need for further statistical analysis to validate and quantify any

underlying trends or associations within the data. While the assumption of a linear model was initially made based on the absence of a distinct curved pattern in the scatter plot, ongoing diagnostic tests, and considerations for model selection, including assessments of residuals for normality, homoscedasticity, and independence, will guide our approach. The linear model serves as a starting point in regression analysis due to its simplicity and straightforward interpretation, but our modeling approach may be refined based on the outcomes of these diagnostic checks as the study progresses.

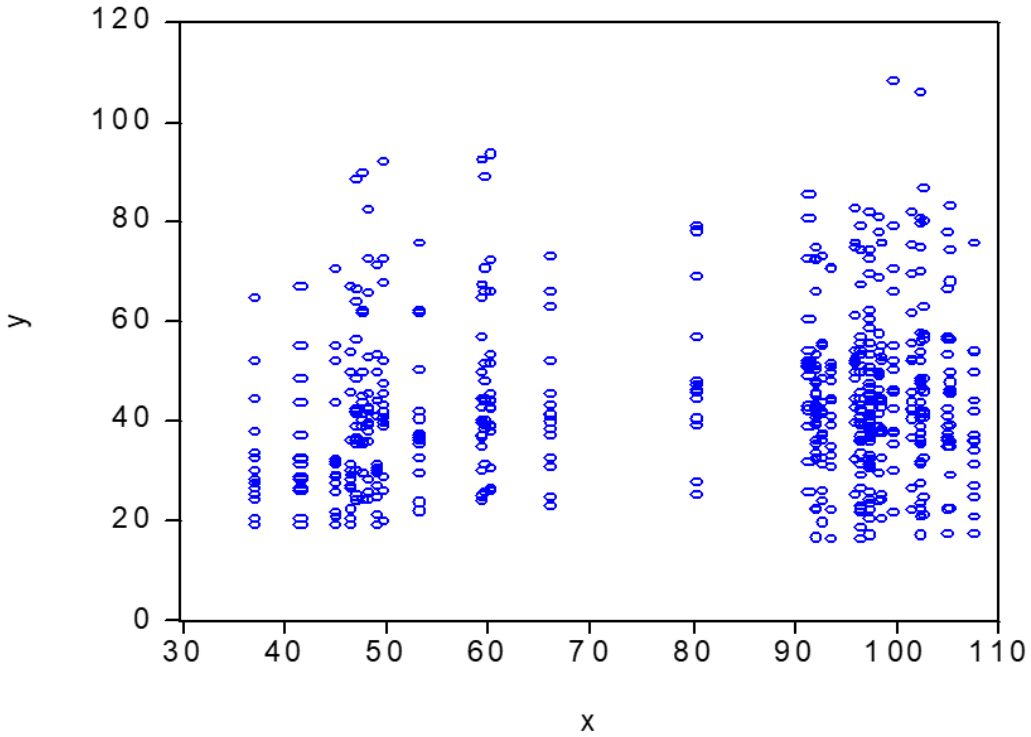

Figure 2: Correlation Between Oil Prices and Stock Prices in the Financial Market.

4. RESULTS

4.1. Results of Stationarity Tests

The stationarity tests, as summarized in Table 2, indicate that both oil prices (x) and stock prices (y) are not stationary at the significance level of α=0.05. However, after the first differencing, all probabilities for unit root tests become less than α=0.05, suggesting that the series x and y are integrated into order one, revealing a common integration between them.

Table 2: Stationarity tests results for Oil Prices (x) and stock prices (y).

Tests		**Summary**					
Prob*(0.05)		**LLC**	**Breitung**	**ADF**	**PP**	**IPS**	**Hadri**
Oil Prices	x	0.9561	0	0.0382	0.3835	0.0909	0
	D(x)	0	0	0	0	0	0
Stock Prices	y	1	1	1	1	1	0.1946
	D(y)	0	0	0	0	0	0.0477

4.2. Pedroni's Common Integration Test

Table 3 presents the results of Pedroni tests for common integration, revealing probabilities less than or equal to 0.05 for most tests. While two tests have probabilities greater than 0.05, suggesting no common integration, the majority indicate evidence for the presence of common integration among the variables.

Table 3: Results of the Common Integration Test.

Tests				**Weighted Tests**	
Partial Tests		**Statistical**	**Probability**	**Statistical**	**Probability**
	V. Stat.	-1.706998	0.9561	-2.007034	0.9776
	Rho	-15.91336	0.0000	-18.00581	0.0000
	PP	-15.42845	0.0000	-17.87887	0.0000
Within Sectors	ADF	-15.40440	0.0000	-17.75823	0.0000
	Rho	-16.02308	0.0000		
Between Sectors	PP	-22.61789	0.0000		
	ADF	-21.12132	0.0000		
	ADF	-21.12132	0		

4.3. Results of the Causality Test

The causality test, detailed in Table 4, indicates a p-value of 0.0018, less than α=0.05, supporting hypothesis H1 and implying a causal relationship between the variables. Conversely, a p-value of 8E-05 leads to the rejection of H1, indicating no causal relationship.

Table 4: Causality Test results.

Null Hypothesis	F-stat	Probability
D(X) does not cause D(Y)	6.38727	0.0018
D(Y) does not cause D(X)	9.60156	8E-05

4.4. Model Estimation Results

The model estimation results in Table 4 reveal a statistically significant model with a positive coefficient of 6.28799 for the independent variable, providing insights into the relationship between oil prices and stock prices in the Saudi financial market.

5. ANALYSIS OF THE RESULTS AND DISCUSSION

The stationarity results indicate non-stationarity at the level but stationarity at the first differences, supporting the need for considering integrated variables. The Pedroni test outcomes suggest evidence of common integration, emphasizing the long-term equilibrium relationship between oil prices and stock prices in the Saudi market.

The causality test results demonstrate a significant causal relationship, implying that fluctuations in oil prices impact the stock prices of various sectors in the Saudi financial market in the long term. This aligns with economic theory, highlighting the sensitivity of stock prices to oil price movements.

The DOLS model estimation results reinforce these findings, indicating a positive effect of oil prices on the stock prices of Saudi market sectors. The overall results contribute to a deeper understanding of the intricate relationship between oil prices and stock prices, offering valuable insights for investors, policymakers, and market stakeholders navigating the complexities of the Saudi financial market.

6. CONCLUSIONS

This study delves into the intricate relationship between oil price fluctuations and stock prices within the Saudi financial market, offering valuable insights into a critical concern given the pronounced impact of economic crises resulting from oil shocks. The study, grounded in theoretical underpinnings and robust methodologies, brings forth several key findings. Notably, standard models employed for static analysis reveal a significant positive impact of oil prices on the stock prices of various sectors within the Saudi market, underscoring the interconnectedness of these variables. The stationarity analysis demonstrates that while the time series of oil prices and stock prices of Saudi market sectors were non-stationary at their initial level, achieving stationarity in the first differences provides a nuanced understanding of their dynamics. Factors such as geopolitical returns, natural disasters, and oil crises impacting oil prices, coupled with economic conditions and organizational factors influencing stock prices, validate hypotheses and highlight the influence of supply and demand fundamentals. The study underscores the vulnerability of the Saudi economy to events affecting oil prices, emphasizing its high dependence on this commodity. The appropriate model selection, favoring the Fixed Effects model based on a comparison test between "Panel" models, considers the specificity of each sector. The cointegration test reveals a long-term equilibrium relationship between oil prices and the stock prices of the Saudi market, affirming the study's hypothesis with a model explanatory power of 0.90. Causality results indicate a reciprocal relationship between oil prices and the stock prices of the Saudi market. In conclusion, this study significantly enriches our understanding of the intricate dynamics between oil price fluctuations and stock prices in the Saudi financial market, providing valuable guidance for investors and policymakers to make informed decisions in a market intricately connected to global oil dynamics.

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Data Availability Statement:
The dataset used in this study is not publicly available due to restrictions related to proprietary information and confidentiality. The data comprises monthly oil prices obtained from the Investing website and monthly stock prices from the Tadawul electronic platform. Both sources are third-party platforms with terms of use that prohibit the public sharing of their datasets.

Conflicts of Interest: The authors declare that there are no conflicts of interest related to the research, the publication of this paper, or any financial interest that could potentially influence the results or interpretation of the study. The authors have no affiliations or financial involvement with any organization or entity that has a direct interest in the subject matter discussed in this paper.

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