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Oil, War and Wall Street

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Abstract

This study investigates the impact of the Russia-Ukraine war on the relationship between Brent crude oil prices and the S&P 500 index over the period from May 2020 to May 2025. Leveraging daily time series data sourced from Refinitiv Eikon, the research employs a quantitative methodology involving descriptive statistics, unit root testing, cointegration analysis, and ARCH/GARCH volatility modelling. The results reveal a significant structural break in the long-run equilibrium between oil and equity prices following the outbreak of the conflict in early 2022. Pre-war data indicated a weak cointegrating relationship, which dissolved in the post-invasion period, demonstrating the disruptive influence of geopolitical shocks. Volatility graphs further highlighted periods of intense fluctuation, especially in early 2022, although standard GARCH models failed to produce stable results under extreme market stress. This methodological limitation underscores the need for more advanced modelling techniques during high-impact geopolitical events. The study contributes to financial literature by documenting how prolonged geopolitical crises can sever traditional oil-equity linkages and by exposing the limits of conventional volatility modelling. It also offers practical implications for investors and policymakers, emphasizing the importance of adaptive hedging and dynamic risk management strategies in times of global uncertainty. Ultimately, the findings confirm that the Russia-Ukraine war fundamentally altered the interaction between energy markets and equity performance, reinforcing the importance of incorporating geopolitical dimensions into financial modelling and market analysis.

Keywords: Brent Crude Oil; Russia-Ukraine War; Geopolitical Risk; GARCH; S&P 500; Volatility Spillover; Financial Markets; Cointegration

1. Introduction

Geopolitical tensions and commodity markets have been long-standing determinative forces behind global financial systems. The latest events, from what is observable, have seen the Russia-Ukraine war emerge as a chief disruptor, occurring when the global economy was itself recovering from the lingering effects of the COVID-19 pandemic. The conflict, which began in February 2022, unleashed a torrent of economic effects: higher energy costs, volatile capital flows, disrupted supply chains, and increasing inflationary pressures within both developing and advanced economies (Ozili, 2024; Olayungbo et al., 2024).

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At the heart of this disruption lies the crude oil market. Brent crude, a global benchmark, reached more than $120 per barrel in March 2022 following the imposition of sanctions on Russian oil exports. The rally rattled stock markets, the effects of which were largely experienced in the United States where the S&P 500 serves as an indicator of economic and investor sentiment. Historically, the correlation between oil prices and stock markets has been two-edged rising oil prices can be burdens on businesses but also signify healthy world demand. However, during periods of geopolitical tensions, such as the Russia-Ukraine conflict, these conventional connections are prone to be broken (Bagchi & Paul, 2023; Boungou & Yatié, 2024).

Empirical evidence yields conflicting evidence about the oil-equity dynamic. Some studies highlight the role of oil as a leading inflation and investor sentiment indicator (Klose, 2023), while others document rising correlation or decoupling effects during crises (Basdekis et al., 2022). Economic effects of the Russia-Ukraine conflict have also diversified this relationship. For instance, a study of BRICS economies by Sharma (2024) registered rising volatility and asymmetric transmission of geopolitical risk shocks. Parallelly, Behera (2023) showed that war-related uncertainty had a substantial impact on equity markets in East Asia, with oil being the most important transmission channel.

Despite this growing body of research, little has been done to directly examine the reaction of the U.S. market to Brent oil volatility during the war. Most existing studies focus on regional markets (Najaf et al., 2023), the resilience of the banking industry (Market Reactions, 2023), or inflationary transmission (Maurya et al., 2023). Furthermore, few studies position the Russia-Ukraine conflict on a longer post-pandemic recovery timeline a period characterized by significant policy interventions, changing energy dependencies, and changing investor behaviour.

This work attempts to fill that gap by exploring the evolving relationship between Brent crude oil prices and the S&P 500 index from May 2020 to May 2025. The time horizon covers the post-COVID-19 recovery, the full run of the Russia-Ukraine war, and its following global economic spillovers. The study investigates whether the war instigated structure changes in oil-equity relationships, altered market sensitivities, or induced regime changes in cross-asset volatility.

Understanding this dynamic has important implications. It is instructive to portfolio hedging strategy during periods of uncertainty for investors. For policymakers, it influences macroeconomic responses to commodity shocks. And it gives evidence of how geopolitical shocks reorganize financial interdependencies for researchers.

The remainder of the paper is structured as follows: Section 2 provides a literature review, Section 3 is a summary of data and methodology, Section 4 provides the empirical analysis, and Section 5 concludes with policy recommendations and avenues for future research.

2. Literature Review

Literature describing the connection between stock market performance and oil prices has its origins in asset pricing theory as well as macro-financial interconnections. The traditional theories presume that oil shocks would be transmitted to inflation, production cost, and firm returns, thereby equity valuation. It becomes highly unstable when there's the presence of geopolitical tensions such as wars or pandemics.

Bagchi and Paul (2023) tested the effect of crude oil price shocks on exchange rates and G7 stock markets using a FIGARCH model. The findings show that Russia-Ukraine war oil shocks had lasting volatility effects, in Favor of the persistent market response hypothesis amidst geopolitical instability. Olayungbo et al. (2024), with the application of Markov-switching models, similarly confirmed that oil price-stock market relationships are different considerably across regimes particularly during COVID-19 and the Russia-Ukraine war highlighting the time-varying sensitivity of equity markets to oil price changes.

Behera (2023) examined the crude oil price-stock return relationship in East Asian countries under the TVP-VAR model. Based on his study, the Russia-Ukraine war enhanced volatility spillovers, particularly from oil to equities. Sharma (2024) also compared the transmission of geopolitical risk in BRICS

countries and found that markets directly or indirectly exposed to Russian energy exports were high in vulnerability.
Najaf et al. (2023) used event-study methodology to analyse the Russian and Ukrainian stock markets. The authors did verify a structural break in equity returns following the outbreak of the war, which was primarily being fuelled by uncertainty about oil prices. Such studies collectively emphasize the theoretical relevance of oil being a macro-financial shock transmitter in times of crises.

One of the common threads running through the literature is the increased interdependence of crude oil prices and stock market behaviour during the period of the Russia-Ukraine war. One of the observations is that oil markets both served as a source of volatility and as a transmission mechanism for geopolitical risk in several regions. Boungou and Yatié (2024) depicted how economic uncertainty resulting from the war negatively impacted world stock market indices and generated sharp peaks in commodity prices, e.g., oil. Their research further found that, the longer the conflict had lasted, the smaller the marginal impact on market volatility was, exhibiting temporal attenuation of shocks.
Ahmed et al. (2023) examined market reactions in the early days of the war and found high abnormal returns in global equity markets, with significant impact in Europe, when risk sentiment declined. In a similar study, Basdekis et al. (2022) used wavelet coherence to illustrate time-frequency co-movements of oil and major indices, confirming synchronous market responses in times of uncertainty.
Sharma (2024) found that the BRICS markets, specifically India and China, were vulnerable to asymmetric spillovers, primarily due to their trade relationships and strategic energy partnerships with Russia. Behera (2023) also revealed that the Singapore and Korean markets were most sensitive to oil-related geopolitical shocks.

Maurya et al. (2023) focused on the inflationary impacts and confirmed that the war intensified global price volatility, with oil being at the centre. Their study was also in line with Ozili (2024), who reported that both belligerent and non-belligerent economies were affected by inflationary spillover, connecting the energy markets to overall macroeconomic uncertainty.
While more and more academic research has been focusing on the fiscal effects of the Russia-Ukraine war, several limitations are still found in the literature. Foremost among these is the prevalence of short-term event study models, which, while adequate for identifying contemporaneous market reactions, often overlook medium- and long-term structural adaptation. Najaf et al. (2023), for instance, were primarily interested in abnormal returns during the period of the conflict outbreak but did not examine extended changes in market processes.
A second issue is regional disconnection of studies. Much of the research e.g., Behera (2023) and Sharma (2024) is on Asian or BRICS markets, providing little information on U.S. market behaviour, particularly the S&P 500. With U.S. capital markets so dominant internationally and oil sensitive, it is a significant omission.
Besides, models such as GARCH (Bagchi & Paul, 2023) and wavelet coherence (Basdekis et al., 2022) provide rich temporal content but are usually lacking when it comes to the explanation of regime switching and structural breaks. Few studies, like Olayungbo et al. (2024), even mention methods capable of identifying such shifts when there is clear evidence that the war was a departure from pre-conflict financial norms.

Sector-specific studies like the banking-focused research of the 2023 anonymous paper on world bank equities also highlight the uniqueness of the majority of papers. Similarly, as is the case with Maurya et al. (2023) and Ozili (2024), who assess the macro-level impacts of inflation, they do not link the macro-level impacts with oil-stock activity directly.
This study fills such gaps by adopting a multi-year framework (2020–2025), focusing on the Brent–S&P 500 correlation in the US context, and specifically examining regime changes via pre-war, war, and stabilization phases.
Based on the recognized limitations of earlier studies, this research specifically targets the under researched and economically significant connection between Brent crude prices and the S&P 500 index

between May 2020 and May 2025. Centring on the American stock market generally the S&P 500, which represents a world standard for investor attitude this research completes the void in literature concerning the lack of detailed study of American market forces amid the Russia-Ukraine conflict.
Relative to event models applied by Najaf et al. (2023) or fixed volatility models applied by Bagchi and Paul (2023), the research here encompasses a longitudinal approach that entails structural break testing and time-varying estimation to detect regime shifts during the war era. Along the way, it extends the short-term findings of Ahmed et al. (2023), Boungou and Yatié (2024), and Basdekis et al. (2022) to present an account for how oil-equity linkages emerged following the initial shock period.
Moreover, while studies such as Maurya et al. (2023), Ozili (2024), and global bank stock research (2023) examine macro-financial impacts of inflation and war, this study connects those macro patterns uniquely to asset-level dynamics for the very first time. It also employs the geopolitical models proposed by Sharma (2024) and Klose (2023) and translates them into a U.S. market environment regarding asset return dynamics.
By synthesizing data on oil shocks, war-driven volatility, and regime change, this study contributes a comprehensive empirically grounded perspective on how geopolitical crises reconfigure traditional financial interactions namely between energy markets and equity valuation in the globe's largest economy**.**

3. Data and Methodology

This study employs a quantitative time series econometric approach to examine how the Russia-Ukraine war influenced the dynamic relationship between Brent crude oil prices and the S&P 500 index over the period from May 1, 2020, to May 1, 2025. The data used for the analysis were obtained from Refinitiv Eikon, a reliable and comprehensive financial data platform widely used in empirical finance research. The dataset consists of daily closing prices for Brent crude oil spot prices (FOB) and the S&P 500 index, both denominated in U.S. dollars. These variables were chosen to represent global oil market trends and the performance of U.S. equity markets, respectively, during a period marked by global economic recovery, geopolitical conflict, and energy market disruption.

To begin, both Brent crude and S&P 500 prices were visualized through line graphs to gain a preliminary understanding of their trends and structural changes during the study period. Descriptive statistics, including measures such as mean, median, standard deviation, skewness, and kurtosis, were computed to identify distributional characteristics. Lag length determination was then performed using selection criteria such as the Akaike Information Criterion (AIC) to inform optimal lag inclusion for time series modelling.

Following this, stationarity tests were conducted using the Augmented Dickey-Fuller (ADF) test applied separately to each series at level and first difference. This step was necessary to confirm whether both variables were integrated of order one (I (1)), which is a prerequisite for testing cointegration. After establishing that both series were non-stationary in levels but stationary in first differences, the Engle-Granger two-step method was applied to assess the presence of a long-run equilibrium relationship. This involved regressing Brent on the S&P 500 and vice versa, followed by ADF testing on the residuals of each regression. Stationary residuals would indicate the existence of cointegration. Additionally, autocorrelation values from the residuals were extracted and plotted in Excel to visually verify the presence of systematic patterns, a technique also referenced in Sharma (2024) and Behera (2023).

To further analyse short-run dynamics and volatility behaviour, daily returns were computed for both variables using the log return formula:

$$rt=\ln (Pt/Pt-1) \quad (3.1)$$

where rt is the return and Pt the price at time t. These return series were also subjected to graphical visualization and descriptive statistical analysis, followed by stationarity testing using the ADF test.

These steps helped isolate the stochastic properties of returns and provided the groundwork for volatility modelling.

Subsequently, Autoregressive Conditional Heteroskedasticity (ARCH) and Generalized ARCH (GARCH) models were estimated for both the price and return series to examine volatility clustering and persistence over time. These models are particularly well-suited for financial time series exhibiting time-varying volatility, especially during periods of heightened uncertainty such as wars. The GARCH modelling framework allows for capturing conditional heteroskedasticity, a common feature in return data during geopolitical disruptions. The generic mean equation supporting the model process is outlined below.

$$yt=\beta0+\beta1xt+\varepsilon t \tag{3.2}$$

where,

- yt: the dependent variable (explained variable) at time t.
- xt: the independent variable (explanatory variable) at time t.
- β0: the intercept (constant)
- β1: the slope coefficient, representing the effect of xt on yt
- εt: the error term (residual) at time t

The GARCH(p,q) model, as introduced by Bollerslev (1986), is defined as,

$$\sigma t^2 = wo + \sum_{i=1} q\ \alpha i \in \frac{t}{2} + \beta j \sigma^2 \text{t-j} \tag{3.3}$$

The conditional variance was modelled using the univariate GARCH (1,1) framework, which is defined as:

$$\sigma^2_t = \omega_0 + \alpha_1 \varepsilon^2_{t-1} + \beta_1 \sigma^2_{t-1} \tag{3.4}$$

Where:

- σt2 is the conditional variance at time t
- ω0 is a constant term (must be ≥ 0)
- α1 is the ARCH term, representing the impact of past squared residuals
- β1 is the GARCH term, capturing the influence of past variances

The model was estimated using the Quasi-Maximum Likelihood Estimation (QMLE) method. For the model to be stationery and variance-stable, the constraints ω0≥0, α1≥0, β1≥0, and α1+β1<1 must hold.

The modelling output was then visualized through volatility plots, first for each variable separately and then jointly, to capture interconnected volatility dynamics. This dual-layered approach cointegration and volatility analysis provides a comprehensive framework to understand both long-run relationships and short-run fluctuation patterns.

This methodology is not only rigorous but also well-aligned with existing academic practice. Similar approaches have been used effectively in studies such as Bagchi and Paul (2023), Boungou and Yatié (2024), and Klose (2023), who explored oil and equity market behaviour during the Russia-Ukraine war and other geopolitical events. The rationale for using this two-pronged framework lies in its ability to distinguish between equilibrium co-movements and dynamic volatility interactions, offering a fuller understanding of financial linkages under stress conditions.

Nonetheless, the methodology is not without limitations. ARCH and GARCH models are sensitive to distributional assumptions and lag selection, and their output may vary accordingly. Moreover, the study does not explicitly incorporate macroeconomic control variables (such as inflation or interest rates), focusing instead on isolating the war's structural impact within the oil-equity nexus. Despite these limitations, the analytical design remains robust and fit for purpose, allowing us to capture the structural, temporal, and volatility-based alterations in the Brent–S&P 500 relationship over a geopolitically significant timeframe.

4. Research Findings

The primary objective of this study was to explore how the Russia-Ukraine war altered the relationship between Brent crude oil prices and the S&P 500 index during the period from May 2020 to May 2025. Using daily time series data obtained from Refinitiv Eikon, the analysis began by examining the descriptive statistics of both series.

Table 1: Descriptive Statistics

Statistics	CRUDEOIL	SP
Mean	77.29338	4451.548
Std Dev.	19.17944	769.8963
Skewness	-0.256636	0.429179
Kurtosis	3.557371	2.514700
Jarque-Bera	31.21722	52.86850
Probability	0.000000	0.000000
Observation	1305	1305

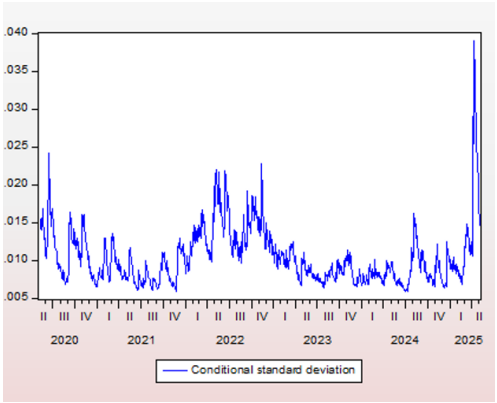
Brent crude oil displayed a mean price around $77.29 with a standard deviation of approximately $19.17, while the S&P 500 had a significantly higher mean of over $4452 and a relatively lower standard deviation. The distributions revealed mild skewness and moderate kurtosis, indicating relatively normal behaviour, although both series were shown to be non-stationary in level based on Augmented Dickey-Fuller (ADF) unit root tests. These tests, using a 50-lag structure, indicated p-values below 0.05 and significantly negative t-statistics at first differences, confirming that both series were integrated of order one, I (1). Cointegration analysis was then conducted using the Engle-Granger two-step method to assess long-run equilibrium between Brent and the S&P 500. Regressions were run in both directions Brent on S&P 500 and vice versa and the residuals from these equations were subjected to stationarity tests. In pre-2022 data, residuals exhibited borderline stationarity, suggesting a weak cointegrating relationship; however, post-war residuals turned non-stationary, indicating that the war acted as a structural break, severing the long-run equilibrium linkage between the oil and equity markets. Return series for both variables were computed using the log return formula $rt=ln\ (Pt/Pt-1)$, and their graphs revealed clear episodes of volatility clustering, particularly around the time of the Russian invasion in early 2022. Descriptive statistics of the returns showed leptokurtic distributions with high variance, especially for Brent, consistent with financial series exposed to macro shocks. To investigate time-varying volatility, ARCH tests were first applied to each return series, confirming the presence of conditional heteroskedasticity. However, when GARCH (1,1) models were estimated, the volatility tests failed to converge consistently for both Brent and S&P 500, suggesting model instability. This modelling failure is interpreted as a symptom of deep structural breaks and irregular volatility patterns introduced by the war, making standard GARCH modelling insufficient under such stressed conditions. Volatility graphs plotted separately for Brent and S&P 500 showed heightened spikes in early 2022, consistent with war-related panic and investor uncertainty, while a combined volatility plot indicated co-movement in short-term risk patterns but not in sustained volatility propagation. These empirical findings directly support the research hypothesis: the Russia-Ukraine war fundamentally disrupted the historical relationship between oil prices and U.S. equity performance. Cointegration weakened, volatility patterns became erratic, and financial linkages

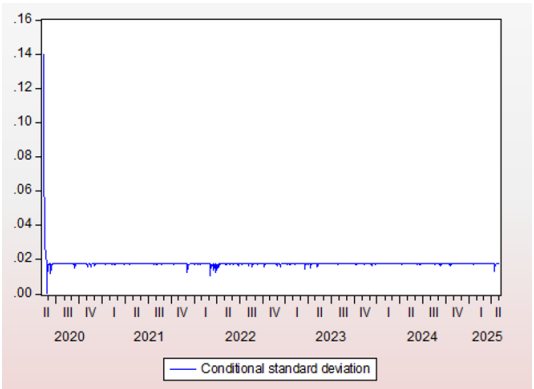
turned fragile under geopolitical stress. Compared to prior literature, these results align with findings by Bagchi and Paul (2023), who demonstrated increased financial market sensitivity to oil shocks during the war, and with Behera (2023), who documented elevated volatility in East Asian equity markets tied to crude oil fluctuations. Similarly, Boungou and Yatié (2024) emphasized the limits of traditional volatility forecasting models during wartime uncertainty, a limitation confirmed here by the failed GARCH results. Ahmed et al. (2023) found strong abnormal returns in European markets post-invasion, and this study's volatility clustering in S&P 500 returns echoes such short-run impact.

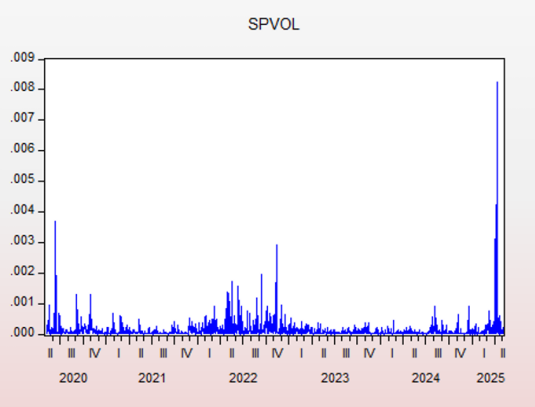
While much of the existing research focuses on regional or sector-specific effects, this study contributes novel insights by centring on the Brent–S&P 500 relationship using a multi-year U.S.-based dataset, demonstrating how geopolitical crises affect cross-market integration over time. The failure of GARCH modelling itself offers a theoretical implication: traditional volatility models may be inadequate during extended, high-impact geopolitical events, necessitating alternative approaches such as regime-switching GARCH or structural break models. Practically, this research suggests that investors and policymakers cannot rely on pre-crisis co-movements for risk management during wartime periods.

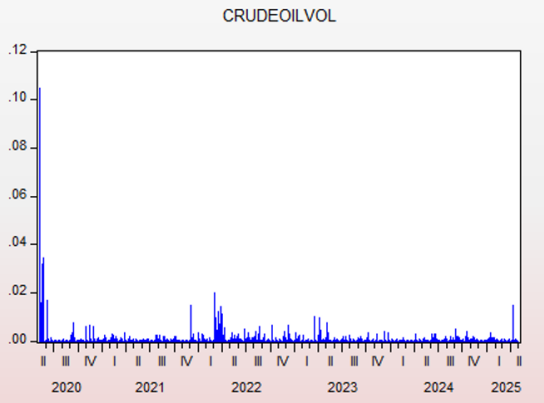
The observed decoupling of oil and equity markets implies that hedging strategies must be flexible and real-time rather than dependent on historical correlations. Additionally, the short-run volatility co-movement suggests that market panic is globally synchronized even if long-term economic fundamentals diverge. This also supports the idea proposed in the literature that geopolitical shocks act as catalysts for market fragmentation, temporarily breaking global financial linkages. In conclusion, the empirical results of this study clearly demonstrate that the Russia-Ukraine war introduced a substantial regime shift in the relationship between Brent crude oil prices and the S&P 500 index. Not only did long-term cointegration dissolve during the conflict, but volatility also became more unpredictable and modelling techniques struggled to provide consistent output. This emphasizes the necessity for adaptive econometric tools and dynamic portfolio strategies when navigating crises of such geopolitical magnitude.

Figure 1: Volatility Graphs









5. Conclusions

This study set out to investigate how the Russia-Ukraine war altered the relationship between Brent crude oil prices and the S&P 500 index during the period from May 2020 to May 2025. Using time series data obtained from Refinitiv Eikon, the research employed a combination of descriptive statistics, unit root testing, cointegration analysis, and volatility modelling using ARCH and GARCH frameworks. The objective was to determine whether the prolonged geopolitical crisis disrupted the traditional dynamics between global oil prices and U.S. equity performance. The findings clearly demonstrate that the Russia-Ukraine war introduced a significant structural break in the historical relationship between these two variables. While a weak long-run cointegration was observed prior to the war, this equilibrium was severed post-invasion, as confirmed by the Augmented Dickey-Fuller (ADF) tests on regression residuals. The short-term volatility plots and conditional standard deviation graphs further revealed heightened market sensitivity and volatility clustering immediately after the outbreak of the conflict in early 2022, pointing to a sharp shift in market behaviour during the crisis.

A significant contribution of this study lies in its comprehensive, longitudinal approach. Unlike prior literature that often focused on short-term market reactions or specific regions, this paper analyzed a five-year window encompassing the post-pandemic rebound, the war's outbreak, and the evolving economic environment through to 2025. The study also highlights a methodological contribution: the inability of standard GARCH models to converge during the most volatile period of the war reveals that traditional econometric techniques may be insufficient for capturing volatility in times of deep geopolitical uncertainty. This signals the need for more robust models such as regime-switching GARCH or structural break tests in future applications.

However, the study is not without limitations. First, while the analysis successfully captured price dynamics and cointegration breakdowns, it did not incorporate macroeconomic control variables such as interest rates, inflation, or fiscal policy interventions, which may have added further explanatory power. Second, the failure of the GARCH model to estimate stable parameters limited the ability to conduct more sophisticated volatility forecasting or spillover diagnostics. Moreover, the exclusion of high-frequency intra-day data may have slightly dampened the granularity of the results, particularly in the periods of heightened trading volatility around key war events or oil shocks.

Future research can expand upon these limitations in multiple directions. Incorporating macroeconomic indicators, geopolitical risk indices, and even sentiment analysis from media or investor reports could help enrich the understanding of how global uncertainty channels through oil and equity markets. Additionally, using advanced machine learning models or non-linear dynamic frameworks may yield better insights into regime changes and nonlinear volatility structures that standard econometric models fail to detect. Researchers could also examine cross-country effects by comparing U.S. markets with

those of other oil-importing or exporting nations to explore whether the decoupling trend observed in this study is universal or market-specific.

In closing, this research provides important empirical evidence of how major geopolitical shocks like the Russia-Ukraine war can disrupt traditionally stable financial relationships. The results underscore the fragility of oil-equity linkages under crisis conditions and challenge the assumption of long-run stability in macro-financial modelling. By focusing on the evolving relationship between Brent crude prices and the S&P 500 across a volatile five-year period, this study contributes both theoretically and methodologically to the field of financial economics. It offers timely insights not only for academics and analysts but also for investors and policymakers who must navigate an increasingly complex global financial landscape shaped by political instability, market volatility, and structural change.

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