International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2025, 15(4), 724-729.

Disentangling the Time-Frequency Nexus of Oil, Uncertainties, and Saudi Equities: A Wavelet Local Multiple Correlation Approach

Hela Ben Hamida[1], Chaker Aloui[2]*

[1]College of Business, Imam Mohammad Ibn Saud Islamic University (IMSIU), Kingdom of Saudi Arabia, [2]College of Business, Prince Sultan University, Kingdom of Saudi Arabia. *Email: caloui@psu.edu.sa

Received: 07 February 2025 **Accepted:** 29 May 2025 **DOI:** https://doi.org/10.32479/ijeep.19705

ABSTRACT

This paper examines the combined and separate effects of geopolitical risk, economic policy uncertainty, and oil prices on the stock market within a multivariate time-frequency framework, focusing on Saudi Arabia as an oil-rich country. We implement the wavelet local multiple correlation approach using monthly data from January 2000 to December 2024. Our results reveal that oil prices, geopolitical risk, and economic uncertainty are key drivers of Saudi market behavior. The joint and individual effects vary significantly across time scales and frequencies. Increasing uncertainty surrounding economic policies and rising geopolitical tensions in the region have intensified the impact of oil price movements on the Saudi market. These findings have several implications for portfolio managers, foreign investors, and policymakers. When analyzing and forecasting stock returns, portfolio managers should consider oil prices, geopolitical risk, and changes in economic policy uncertainty.

Keywords: Economic Uncertainty, Geopolitics, Oil Market, Wavelet Local Multiple Correlation, Saudi Arabia
JEL Classifications: G15, C58, Q40

1. INTRODUCTION

In the complex landscape of global finance, few markets are as influenced by economic policy dynamics and geopolitical risk as those of oil-rich economies. With its extensive oil reserves and critical position in global energy markets, Saudi Arabia exemplifies how these factors can impact domestic economic performance and the broader market landscape. In Saudi Arabia, oil exports account for around 70% of the country's government revenue (SAMA, 2024[1]), making its stock market intricately sensitive to global crude oil market volatility (e.g., Abdou et al., 2024; Arouri et al., 2025; Eissa et al., 2024; Lou et al., 2024, Ahmed et al., 2025 and Al-Fayoumi et al., 2025).

That said, exploring the combined and differential influences of economic policies, geopolitical uncertainties, and oil prices on the stock market in Saudi Arabia is crucial for market operators, foreign and local investors, regulators, and market analysts aiming to navigate this volatile terrain.

The last decade has highlighted the crucial importance of the oil-stock nexus. For instance, in January 2016, global oil prices had fallen to around $30 per barrel, recording an around 70% drop in 18 months. The Saudi market (Tadawul) has been severely impacted, dropping by around 15-20% in the first half of 2014, and the Saudi market index (TASI) reached its lowest level of 5,500 when oil prices fell to $26. However, geopolitical factors, such as tensions with Iran around the nuclear program, the army conflict in Yemen and subsequent attacks on oil refineries, the COVID-19 disease, the Russo-Ukrainian war, and the Israel-Palestinian

1 Sama.gov.sa/en-US/EconomicReports/DevelopmentReports/Key_Economic_Developments_Q3_2024_EN.pdf

conflict, have considerably amplified risks and uncertainties. Thus, given the geopolitical risks in the Middle East and the changing global energy dynamics, the time-varying interrelationships between geopolitical risk, economic policy shifts, oil market volatility, and the stock market remain complex and continue to intrigue practitioners and academia.

This research employs the wavelet local multiple correlation (WLMC) method to explore the joint effect of geopolitical risk, economic uncertainty, and oil price movements on the behaviour of the Saudi stock market. Unlike static correlation analysis, the WLMC explores the time-frequency variation of the relationships between all the selected variables. It allows for analyzing the combined and differential impact of GPR, EPU, and oil and stock markets in the multivariate time-frequency domain. It also identifies the most dominant drivers of the oil-stock time-frequency dependence structure. The WLMC offers new insights on how the oil-stock interdependencies are evolving and frequencies (i.e., investment horizons), and to what extent it is affected by the occurrence of local geopolitical tensions and economic uncertainty.

This study is particularly relevant in light of the Kingdom's Vision 2030. In 2016, Saudi Arabia embarked on massive economic policy reforms to steer the economy towards a more diversified and innovative economy. Saudi Arabia continues to build structural reforms to expand non-oil sectors. However, oil still has a heavy weight (78.1 % of the total exports in 2023: Q2), underscoring the continued importance of oil in the economy. Therefore, exploring how local economic policies, reform initiatives, and geopolitical risks shape this oil-stock nexus has become more crucial than ever for policymakers and investors.

This paper contributes to the extensive oil-stock literature[2] by providing new insights into the oil-stock-local risk factors in Saudi Arabia. The study will offer fresh empirical evidence of how regional geopolitical tensions and economic policy shits are interconnected to the Saudi local market in a multivariate time-frequency framework. As far as we know, this is the first study exploring joint and isolated risk factors in the stock market using the WLMC approach.

The structure of the paper is as follows: Section 2 reviews the prior empirical studies. Section 3 presents the data and methodology used. Section 4 discusses the findings, while Section 5 provides the conclusion and policy implications.

2. LITERATURE REVIEW

In this section, we examine previous studies that explore the effects of geopolitical risk, economic uncertainty, and oil price shocks on stock market behavior. Our focus is primarily on recent research within the context of Saudi Arabia and other Gulf Cooperation Council (GCC) economies. The literature review is summarized in the table below.

From the studies mentioned earlier, several key observations can be made. First, although various empirical studies employing both standard and non-standard methods have examined oil-rich countries, specifically Saudi Arabia, a heavily oil-dependent economy, there has yet to be a consensus regarding the effects of oil shocks and global uncertainties on the Saudi stock market. The results vary significantly when analyzing the short to medium-term and long-term effects. Second, while oil shocks, geopolitical tensions, and economic uncertainties concurrently impact the stock market, previous research has seldom investigated the distinct and combined effects of these three risk factors on market behavior. Third, the question of which factor—oil, economic uncertainty, or geopolitical risk—dominates the effects on the market remains largely unexplored.

This paper aims to address these gaps comprehensively. We introduce the wavelet local multiple correlation approach (WLMC), a novel method proposed by Polanco-Martínez (2018), to re-examine the impact of oil shocks, economic uncertainty, and geopolitics on the Saudi stock market within a time-frequency framework. The WLMC method is a powerful tool for analyzing the interconnectedness of multiple time series over different time scales and frequencies (investment horizons).

Several factors motivate the use of the WLMC method. It enables the detection of non-stationary and scale-dependent associations, revealing how one time series relates to various others over different time scales. Additionally, WLMC presents a straightforward and easily interpretable heat map that illustrates how correlations evolve over time and across frequency periods. Finally, the WLMC method allows for identifying potential drivers or influencers among the selected variables (risk factors), a concept that has not been fully explored in prior studies.

3. DATA AND METHODS

3.1. Data

We employ monthly data of the Saudi market index. Data were extracted from the Bloomberg database. The GPR index for Saudi Arabia measured the local geopolitical risk gathered from Caldara and Iacoviello (2022). The World Uncertainty Index (WUI) approximated the economic policy uncertainty, which the Federal Reserve Bank (https://fred.stlouisfed.org) recently designed for individual countries. We refer to the West Texas Intermediate (WTI) for oil prices. Data were extracted from the Energy Information Administration (EIA) website (https://www.iea.org/data-and-statistics). The time series covers the period from January 2000 to December 2024, yielding 300 observations. It is worth noting that the sample period is long and includes several extreme events such as the 2008 global financial crisis, the COVID-19 outbreak, the Russo-Ukraniamn conflict, the Saudi-Yemen conflict, the US-Iran tensions, the recent Israelo-Palestinian conflict, and other economic policy shits regarding the 2030 Saudi Vision.

3.2. Methods

3.2.1. The local multiple regression

The WLMC is based on the local regressions. Considering X as a (n) multivariate time series dimension observed at time $t = 1,\ldots,T$.

2 Journal readers can refer to Hammed (2024) for a literature review on the oil-GPR-EPU nexus. The paper is cited within the reference list.

Authors	Sample and method	Key findings
Aloui and Hamida (2019)	Saudi Arabia 2000-2017, Wavelets	• Geopolitics affect Saudi market in high frequencies while oil shocks are more pronounced over longer time hirizons.
Alqahtani and Klein (2021)	GCC countries 2007-2018	• GCC countries exhibit heterogenoues reactions to geopolitical risk. • They are more adversely affected by regional geopolitical tensions.
Aloui et al. (2023)	Multivariate GARCH model GCC countries 2013-2019	• Geopolitical risk affects the dependence between islamic stocks and bonds. • The geopolitical risk escalation increeases the GCC stock market correlations
Chen (2023)	1997-2021, G7 countries Wavelets.	• GPR and EPU effect on the oil-stock relationship is depending on the investment horizons
Saâdaoui et al. (2023)	Wavelet s- causality tests Saudi stock market	• GPR impact on the Saudi market intensifies during times of crisis. • Unidirectionnal causality from GPR to equity market.
Bokhtiar et al. (2023)	GARCH DCC Islamic and conventionnal markets	• Islamic stock markets are more sensitive to oil shocks rather than geopolitics. Stock market reactions are state-dependent.
Eissa and Refai (2024)	Six MENA 2002-2023 GARCH model	• Stock markets react asymmetrically to geopolitical risk and economic uncertainty.
Eissa et al. (2024)	MENA countries 2002-2023 Quintile regression	• Saudi market reacts negativel; y to GPR escalationPolitical risk in influencing all stock markets.
Chen et al. (2024)	1998-2025, US market TVP-VAR model	• EPU and GPR have positive impact on stock return connectedness in the short and nmid-terms. GPR has has a positivre impact on the long-run.
Tlili et al. (2024)	Saudi Arabia- 1993-2020. Wavelets coherence.	• Negative oil shocks have significant negative impact on stock market and Saudi financial development. • The adverse effect of geopolitical risk is evidenced onver the long-run.
Abdou et al. (2024)	Saudi Arabia Pre and post 2006 market collapse Machine Learning	• Oil shocks exert little influence on the stock market during the pre-2006 market collapse. • Oil effect intensifies during the post 2006 collapse.
Belanes et al. (2024)	Saudi Arabia 2000-2021 ARDL model	• The Saudi stock market is adversely affected by oil shocks over the short and long run horizons.
Al-Fayoumi et al. (2025)	GCC stocks 2022-2024 Time frequency	• Geopolitical risk is strenghthening GCC stock market volatility.
Arouri et al. (2025)	2008-2022, GCC countries, seemingly related regressions.	• The increases in CPU decorrelates GCC stock returns from oil price changes. • The decreases in CPU tend to strengthen the oil-stock connectedness.
Ahmed et al. (2025)	Global vector autoregression model	• 1% shock in GPR and oil price demande causes significant decrease in equity markets. • Asian markets are more sentive to oil shocks, while european ones are more vulnerable to GPR shocks.

$x_i \in X$, a local regression at a fixed $s \in \{t = 1,\ldots,T\}$ is employed for minimizing the weighted sum of squared errors (Fernández-Macho, 2018)

$$S_s = \sum_t \theta(t-s)\left[f_s\left(X_{-i,t}\right) - x_{i,t} \right]^2 \quad (1)$$

$\theta(x)$ designates a given moving average weight function depending on the time lag between X_t and X_s while $f_s\ (X_{-i})$ refers to a local function of $\{X/x_i\}$ around s. The local coefficients of determination is given by:

$$R_s^2 = 1 - \frac{RwSS_s}{TwSS_s}, (s) = 1,\ldots T \quad (2)$$

$RwSS_s$ and $TwSS_s$ correspond respectively to residual and total weighted sum of squares.

3.2.2. The WLMC

We consider $W_{jt} = (w_{1jt}, w_{2jt},\ldots,w_{njt})$ as the wavelet coefficients for scale λ_j, with $j = \{1,2,\ldots,J\}$ and J are the maximum of the wavelet transform decomposition using the maximum overlap discrete wavelet transform to the time series $x_i \in X$, i = $\{1,2,\ldots,n\}$. The WLMC ($\rho_{X,s}\ (\lambda_j)$), representing a given scale λ_j is computed as the square roots of the R_s^2 (Eq. 2) for that linear combination of variables w_{ij}, i= $\{1,2,\ldots,n\}$. Using Eq. (2), we get:

$$\hat{\rho}_{X;s}\left(\lambda_j\right) = \sqrt{R_{js}^2}\ ;\ j = \{1,2,\ldots,J\};\ s \in \{t = 1,\ldots,T\} \quad (3)$$

The R_s^2 in the regression of z_i on the other system' variables which is equivalent to the square correlation between the observed and the generated $\hat{z}_i$ from such regression. For, Fernández-Macho (2018), a consistent estimator of the WLMC is given by:

$$\hat{\rho}_{X;s}\left(\lambda_j\right) = Corr\left(\theta(t-s)^{\frac{1}{2}} w_{ij}, \theta(t-s)^{\frac{1}{2}} \hat{w}_{ij} \right), s \in \{t = 1,\ldots,T\} \quad (4)$$

Where, w_{ij} is selected based on that its multiple local regression on the regressors $\{w_{ij}, k \neq j\}$ maximizes the associated determination coefficients. $\hat{}_{ij}$ is the corresponding vector of of w_{ij} fitted values (Polanco-Martínez et al., 2020, p. 7).

4. EMPIRICAL RESULTS

Table 1 reports the descriptive statistics (Panel A) and the static Pearson correlations (Panel B). All the time series are volatile, exhibit substantial deviations from the normal distribution, and are not stationary. The use of the WLMC method is suitable since it is not affected by non-normality and non-linearity of the time series. Oil and EPU positively correlate with the stock, while the GPR-stock correlation is negative but statistically insignificant.

4.1. The Bivariate Case

The WLMC heat map (Figure 1) portrays the time scales and frequency periods (months) correlation between 2 time series (bivariate). The time scale is reported on the horizontal axis, while frequencies running from 1 to 64 months are shown on the vertical axis. The thick black line indicates the correlation values. The colored bar indicates the strength of the bivariate correlation, while the warmer (colder) color indicates a low (high) correlation. The while-colored intervals indicate an insignificant correlation. The red reflects a strong correlation, while the blue indicates a low correlation. When looking at the oil-stock heat map (Figure 1a), we note insignificant dependence over the whole sample period for the short-term (2-16 periods' frequencies). Most of the significant correlations are mainly localized in the 16-32 and 32-64 periods (long-run). The highest positive correlations (ranging between 0.5 and 1) were identified during 2016-2024 and are mainly localized in 32-64 frequency bands. The GPR-stock heat map (Figure 1b) reveals substantial time-frequency variations of the GPR-stock dependencies. Over the short term (2-16 periods) and extends to the whole sample period but turns out to be strongly negative (correlation ranging between −0.5 and −1) over the long run (16-32 periods) for the sub-periods 2000-2008 and up to 32-64 months for 2008-2024. The highest negative correlation corresponds to the 2018-2024 subperiod (up to 64 periods), which corresponds to the escalation of GPR inherent to the Saudi-Yemenite war, military attacks on the Saudi oil refineries, the ongoing Ukrainian conflict, and the recent military escalation in Gaza. The EPU-stock heat map (Figure 1b) shows a quite similar time-frequency varying pattern. The EPU is strongly correlated (corr >0.7) to stock returns over the long run (up to 64 periods). However, the EPU significantly correlates with the stock market over the mid-run (6 to 16-period frequencies). After 2016, the EPU turned out to be positively associated with the stock market, which may be explained by the announcement of the 2030 Saudi vision as a substantial shift in the Saudi economic policy.

4.2. The Tri-Variate Case

Here, we report the WLMC heat maps showing the impact of two independent variables (risk factors) on the stock market after isolating the effects of the third variable (Figure 2a-c). In addition, we plot the WLMC heat map for the three independent variables (Oil, GPR, and EPU) to explore their time-frequency connectedness (Figure 2d). We also plot the WLMC to identify the "dominant" independent variable or the one that optimizes the multiple correlation (Figure 2e). The visual inspection of Figure 2a, showing the combined correlation of GPR and EPU on the stock market, reveals that the GPR-EPU joint effect on the stock market is insignificant over the short term (0-6 periods frequency) over the whole sample period. Their impact was significant and positive (for 6-12 months). Up to 12 months frequency, the GPR-EPU combined correlation is positive as indicated by the enormous intervals of dark red color that are predominantly localized up to 32 periods frequency. While substantially varying across time and frequencies, geopolitical and economic uncertainties are correlated with the Saudi market. Figure 2b displays the Oil-EPU-stock dependencies. The heat-map configuration is quite similar to Figure 2a. The Oil-EPU effect on stock is positive and relatively weak over short and mid-runs (2-32 periods) and turns out to be positive and strong up to 32 32-period frequency. The oil-GPR-stock heat map (Figure 2c) shows that the GPR-Oil effect on the stock returns is strong and positive. Weak positive dependencies are localized on high frequencies (2-8 months frequencies) covering the entire sample period. High and strong correlations are observed for up to 8 months. Figure 2d shows that the three independent variables are positively and significantly interrelated throughout the sample period and all frequencies. The WLMC heat map in Figure 2e allows us to identify the dominant indicator in the trivariate oil, GPR, and EPU. Oil is the dominant indicator, followed by GPR and EPU.

4.3. The Four-Variate Case

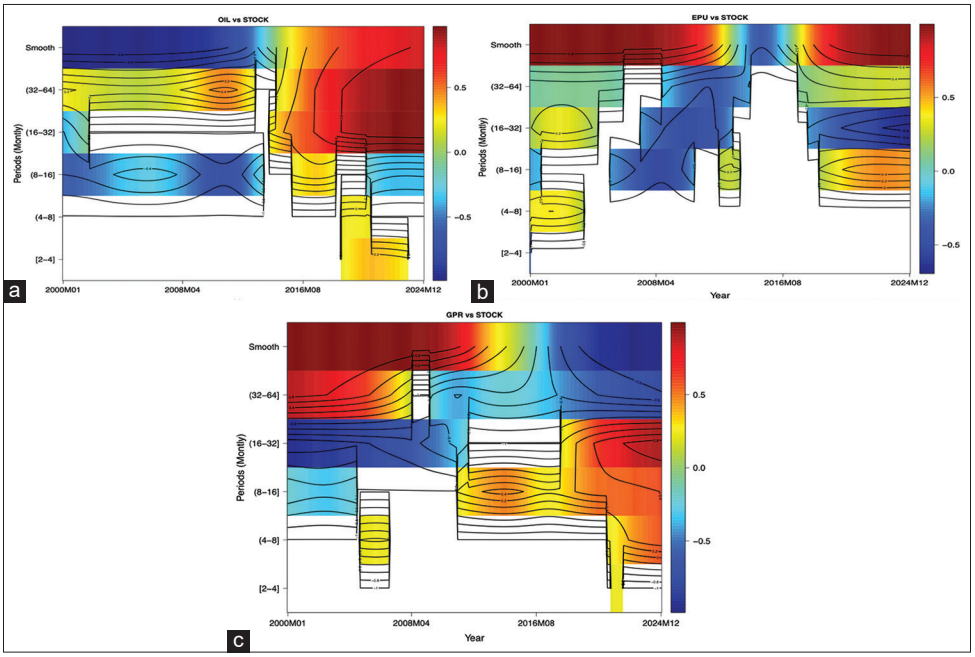
We plot the WLMC four-variate (Figure 3) by choosing the stock market as a dependent variable. Our main goal is to explore further how the combined effect of these risk factors affects the stock

Table 1: Descriptive statistics and Pearson statistic correlations

Statistics	GPR	EPU	OIL	STOCK
Panel A: Descriptive statistics				
Mean	0.00311	0.00328	0.00359	0.06711
SD	0.10914	0.63334	0.05461	0.00671
Skewness	1.689***(0.000)	2.487*** (0.000)	−0.135 (−0.331)	0.163 (−0.242)
Ex.Kurtosis	4.092***(0.000)	4.416*** (0.000)	−0.971*** (0.000)	−0.077 (−0.929)
JB	351.965*** (0.000)	552.985*** (0.000)	12.699*** (0.002)	1.397 (0.497)
ERS	−3.517 (0.0001)	−1.122 (−0.263)	−2.878 (−0.004)	−1.555 (−0.121)
Panel B: Pearson static correlations				
Pearson	GPR	EPU	OIL	STOCK
GPR	1.000***	0.089	−0.096	−0.019
EPU	0.089	1.000***	0.202***	0.241***
OIL	−0.096	0.202***	1.000***	0.298***
STOCK	−0.019	0.241***	0.298***	1.000***

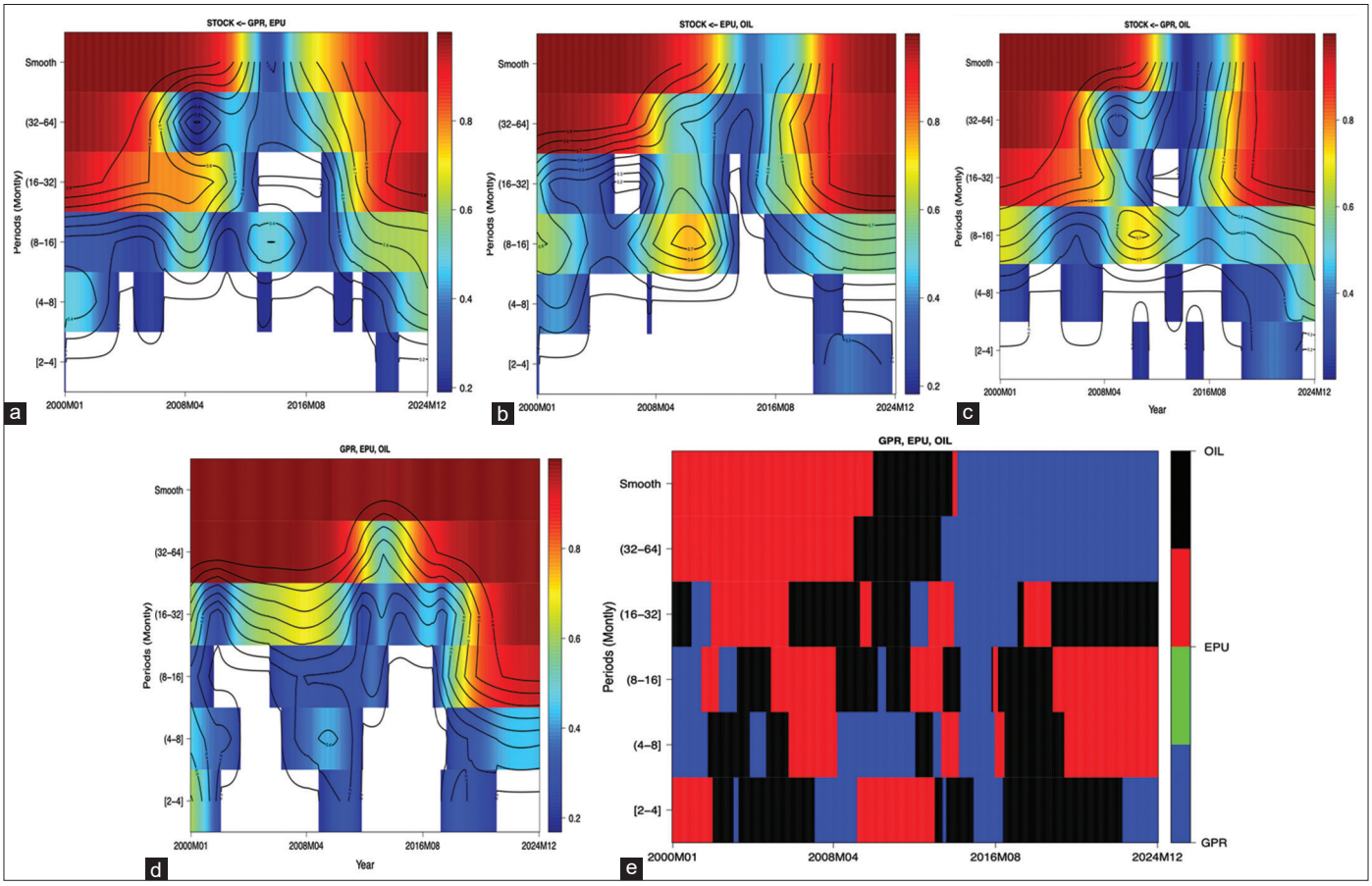
JB refers to the Jarque Bera normality test. ERS is Elliott-Rothenberg-Stock test for an autoregressive unit root. Tests are implemented to logarithmic changes of each variable.
SD: Standard deviation

Figure 1: The bivariate wavelet local multiple correlation. (a) Oil versus stock. (b) EPU versus stock(c) GPR versus stock



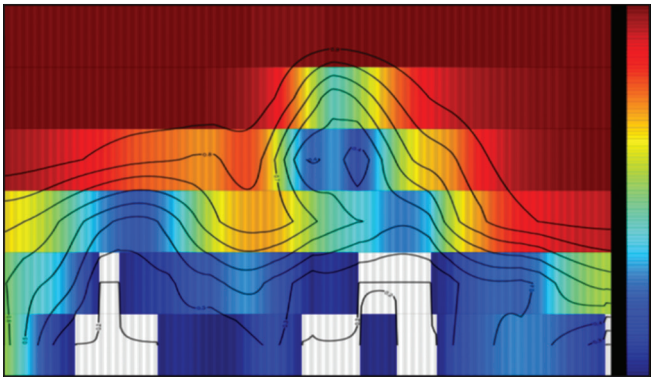
The white-coloured intervals (periods) indicate that the correlation is insignificant at the 5% level. The wavelet filter is set as (wf) = "la8"

Figure 2: The tri-variate wavelet local multiple correlation heat maps. (a) GPR, EPU versus stock. (b) EPU, Oil versus stock. (c) GPR, Oil versus stock. (d) GPR, EPU, Oil. (e) Dominant independent variable



market over time and frequency periods. As we can see, GPR EPU strongly correlates with stock over almost the whole sample period. Although positively correlated, the strength of the combined effect on the stock market varies substantially over the frequency scales. A closer look at the heat map shows relatively weak and positive dependencies over the short run (from 2 to 8 periods frequency).

Figure 3: GPR-Oil-EPU versus stock



Still, the strength of the correlation tends to increase substantially for lower frequency bands. The correlation is higher than 0.8 for up to 32 periods of frequency.

5. CONCLUSION AND POLICY IMPLICATIONS

This study investigates the joint and differential dependence of oil, geopolitical risk, and economic policy uncertainty on the Saudi stock market in the time-frequency domain. Our results unveil that: (1) oil, geopolitical risk, and economic uncertainty are key drivers of the Saudi market behavior; (2) The joint and isolated effect of these risk factors are substantially varying over time scales and frequencies; (3) The rise of uncertainty surrounding economic policies and the escalations of the geopolitics in the region are strengthening the impact of oil price movements on the Saudi market.

These outcomes offer several implications for portfolio managers, foreign investors, and policymakers. When analyzing and forecasting stock returns, portfolio managers should account for oil, geopolitical risk, and economic policy shifts. Foreign investors will better understand how the Saudi stock market responds during tremendous economic and geopolitical conditions. Policymakers can set regulatory rules to ensure higher financial stability. These results would be extended in several ways, such as expanding the sample to other oil-rich countries and considering other global and regional risk factors. Using different methods, including quintile wavelets, quintile ARDL models, and other data frequencies, may be helpful to check robustness and better understand stock market drivers' intricacy.

6. FUNDING STATEMENT

This work was supported and funded by the Deanship of Scientific Research at Imam Mohammad Ibn Saud Islamic University (IMSIU) (grant number IMSIU-DDRSP2503).

REFERENCES

Abdou, H.A., Elamer, A.A., Abedin, M.Z., Ibrahim, B.A. (2024), The impact of oil and global markets on Saudi stock market predictability: A machine learning approach. Energy Economics, 132, 107416.

Ahmed, F., Sohag, K., Islam, M., Hassan, M.K. (2025), Navigating turbulence: How do geopolitical risks and oil price shocks shape global equity markets? A GVAR approach. Borsa Istanbul Review, 25(3), 449-467.

Al-Fayoumi, N., Bouri, E., Abuzayed, B. (2025), Geopolitical risk and the volatility of GCC stock markets around the war on Gaza strip. Defence and Peace Economics, 36(4), 1-22.

Aloui, C., Al-Kayed, L., Asadov, A., Danila, N. (2023), Geopolitical risk and stock-bond interplay: A comparative study of islamic and conventional assets in the GCC. Defence and Peace Economics, 35(6), 740-759.

Aloui, C., Hamida H. (2019), Oil-stock nexus in an oil-rich country: Does gorepolitical risk matter in terms on ınvestment horizons. Defence and Peace Economics, 32(4), 468-488.

Alqahtani, A., Klein, T. (2021), Oil price changes, uncertainty, and geopolitical risks: On the resilience of GCC countries to global tensions. Energy, 236, 121541.

Arouri, M., Gomes, M., Pijourlet, G. (2025), Does climate policy uncertainty shape the response of stock markets to oil price changes? Evidence from GCC stock markets. Journal of Environmental Management, 375, 124229.

Belanes, A., Ben Maatoug A., Triki, M.B., (2024), The dynamic impact of oil shocks on the Saudi stock market: new evidence through dynamic simulated ARDL approach, Journal of Risk Finance, 25(1), 115-129.

Bokhtiar, H.M., Hassan, M.K., Alhomaidi, A. (2023), How do sectoral Islamic equity markets react to geopolitical risk, economic policy uncertainty, and oil price shocks? The Journal of Economic Asymmetries, 28, e00333.

Caldara, D., Iacoviello, M. (2022), Measuring geopolitical risk. American Economic Review, 112(4), 1194-1225.

Chen, X., (2022), Are the shocks of EPU, VIX and GPR indexes on the oil-stock nexus alike? A time frequency analysis. Applied Economics, 55(48), 5537-5652.

Chen, X.Y., Yao, L., Wang, S., Huang, (2024), How EPU, VIX, and GPR interact with the dynamic connectedness among commodity and financial markets: Evidence from wavelet analysis. The North American Journal of Economics and Finance, 74, 102217.

Eissa, M.A., Al Refai, H. (2024), Context-dependent responses to geopolitical risk in Middle Eastern and African stock markets: An asymmetric volatility spillover study. International Review of Economics and Finance, 94, 103402.

Eissa, M.A., Refai, H., Chortareas, G. (2024), Heterogeneous impacts of geopolitical risk factors on stock markets in the Middle East: A quantile regression analysis across four emerging economies. The Journal of Economic Asymmetries, 30, 4949.

Fernández-Macho, J. (2018), Time-localized wavelet multiple regression and correlation. Physica A: Statistical Mechanics and its Applications, 492, 1226-1238.

Hammed, Y.S. (2024), Global economic policy uncertainties and international oil price volatility under alternative market conditions. Energy Research Letters, 5, 121664.

Lou, Q., Iqbal, N., Alraey, Y. (2024), Sensitivity to changes in oil prices, tax returns and the cross-section of stock returns: The present situation for net-oil exporting economies. Heliyon, 10(13), e33119.

Polanco-Martínez, J.M, Fernández-Macho J, Medina-Elizalde M. (2020), Dynamic wavelet correlation analysis for multivariate climate time series. Science Reports, 10(1), 21277.

Saâdaoui, F., Jabeur, S.B., Goodell, J. (2023), Geopolitical risk and the Saudi stock market: Evidence from a new wavelet packet multiresolution cross-causality. Finance Research Letters, 53, 10365.

Tlili, H., Tissaoui, K., Kahouli, B. (2024), How volatility in the oil market and uncertainty shocks affect Saudi economy: A frequency approach. Humanities Social Sciences, Communications, 11, 1482.