ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

For citation:

Gharaibeh, G., Kharabsheh, B. (2023), "Geopolitical Risks, Returns, and Volatility in the MENA Financial Markets: Evidence from GARCH and EGARCH Models", *Montenegrin Journal of Economics*, Vol. 19, No. 3, pp. 21-36.

Geopolitical Risks, Returns, and Volatility in the MENA Financial Markets: Evidence from GARCH and EGARCH Models

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ARTICLE INFO

Received July 01, 2022
Revised from August 02, 2022
Accepted September 02, 2022
Available online July 15, 2023

JEL classification: G0, G02, G15

DOI: 10.14254/1800-5845/2023.19-3.2

Keywords:

Russia,
Ukraine,
War,
GARCH,
EGARCH.

ABSTRACT

This paper aims to examine the effect of geopolitical risks on the daily returns and volatilities of the MENA indices over the period 2016-2022. This study investigates the returns and volatilities in the MENA indices covering two important geopolitical events: the first period includes the repercussions of the Arab Spring and tensions in the Gulf region starting from 3 January, 2016 to 30 December, 2019, while the second period relates to the current geopolitical risks of the war between Russia and Ukraine from 24 February, 2022 to 15 June, 2022. Two models were employed in the analysis, GARCH and EGARCH. Based on the GARCH model, geopolitical risks have no negatively and statistically significant effect on the daily returns of stock markets in the MENA region, except for Iraqi, Omani and Egyptian indices. The results also reveal that the volatilities of the MENA indices is statistically significant during the full sample period and geopolitical risk resulted from the repercussions of the Arab Spring and tensions in the Gulf region. For the period of the Russian-Ukrainian war and based on the EGARCH model, Geopolitical risk has a negative and statistically significant effect on the daily volatility for Bahraini, Tunisian, Moroccan, Qatari and Dubai indices. The results provide strong evidence of leverage effect for the Kuwaiti and Moroccan indices. This paper provides an important insight for the government as decision makers and for investors as traders in the MENA region to realize the various risks.

INTRODUCTION

Recently, the impact of geopolitical risks (GPR) on the returns and volatilities of financial markets has drawn the interest of many policymakers, researchers, and market participants. The term geopolitical risks, according to Caldara and Iacoviello, (2022, p. 2) refers to "the risk associated with wars, terrorist acts, and tensions between states that affect the normal and peaceful course of international relations". Geopolitical tensions and threats have a significant effect on local and global economies, causing higher uncertainties and financial market instability (Campbell et. al., 2012). In a Gallup survey conducted in 2017, 75% of investors who participated in this survey were concerned about how global military and political conflicts will affect their investments. More importantly, those investors prioritized geopolitical threats over political and economic instability (Caldara and Iacoviello, 2022). In addition, GPR is documented in several studies as a key determinant of investment decisions for investors, firms as well as government (Jin Pyo, 2021).

The adverse effect of GPR on financial markets has become significantly higher nowadays, particularly because of the rapid growth of information technology where all the financial market transactions have become faster and easier, as well as the sensitivity of stock prices has also extremely increased (Yang et.al 2021). Negative GPR can impact the stock market in many different ways. Higher GPR increases uncertainty which results in delaying market players' decision-making, increasing the risk of investment. Moreover, higher tensions and shocks might adversely affect both the demand and supply channels causing higher costs for the companies (Bloom, 2009; Fernandez-Villaverde et. al 2015). However, despite the significance of the subject, the empirical evidence is quite scant and excessively ambiguous. Even the limited research papers conducted report inconsistent findings on how GPR might affect financial market returns and volatilities. For example, some papers demonstrate that GPR negatively affects financial markets (Jin Pyo, 2021; Fossung et.al, 2021; Caldara & Iacoviello, 2022). Others claim that the relationship depends on the levels of stock market development, volatility regimes, and macroeconomic factors (Hoque & Zaidi, 2020). While other conducted studies reveal no effects of geopolitical threats on financial markets (Apergis et al., 2018; Bouras et al., 2019). These mixed results serve as a motivation for the current study.

In the Middle East and North Africa (MENA) region, this topic might gain more importance. This region has experienced numerous geopolitical shocks including wars and political conflicts (such as the Gulf War (1990–1991), the Iraq War (2003–2011), the Arab Spring (2010–2012), the Syrian Civil War (which began in 2011), tensions in the Gulf region, especially between Saudi Arabia and Qatar (2016-2020), reaching to the current conflict between Russia and Ukraine, as a part of the world. This region also has witnessed several terrorist activities over the last decade. Thus studying the effect of GPR in such a region, that is rich in such negative shocks, might offer a clear picture of the effect of these events on the returns and volatilities of MENA markets. Further, the selection of the MENA markets, as a sample, might consider an important contribution for the current study.

First of all, most of prior studies consider one country in the analysis, while including cross-countries studies might enhance the credibility and generalizability of the findings. Second, when it comes to the MENA countries, usually they share similar economic structures, have rapid population growth, have underdeveloped financial markets, and have political systems that are frequently operate differently from those of developed countries (Elsayed and Helmi, 2021). These characteristics might lead to different findings that were reported from developed economies. Last but not least, with exception to Elsayed and Helmi, (2021), the lack of studies that tackle the GPR in such region is apparent in the literature and the need for more research is a priority. Even the study of Elsayed and Helmi (2021) does not include the effect of recent GPR i.e. the Russian- Ukrainian conflict, their study just stops at the year 2018. The current study, however, yields up-to-date, covering the period from 2016 to 2022.

The main objective of the current study is to inspect the effect of geopolitical risks on the daily returns and volatilities of the MENA indices. Initially, the analysis is done covering the full sample period i.e. from 3 January, 2016 to 15 June, 2022. Later, two main periods were created; the first period includes the repercussions of the Arab Spring and tensions in the Gulf region, especially between Saudi Arabia and Qatar covering from 3 January, 2016 to 30 December, 2019. The second period includes the current war between Russia and Ukraine covering the period of 24 February, 2022 to 15 June, 2022. Further, the impact of the Corona pandemic is also discussed as an additional third period to understand the effect of volatilities in the returns of the indicators during the study period.

The rest of the paper moves as follows. Section 2 presents the related literature review. Section 3 details data and methodology. The findings of the analysis are presented in section 4 and the last section offers the conclusion and discussion.

1. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Recently, the interest in studying the effect of geopolitical risks (GPR) on financial markets has increased. Geopolitical risks are viewed as important determinants of investors' investment decisions. It is documented that the increased levels of geopolitical tension results in several negative consequences such as a decrease in stock returns, lower economic activities, higher markets volatility, and redirection of capital to more stable environments (Berkman et al., 2011; Caldara & Iacoviello, 2022; Dogan et al., 2021; Elsayed and Helmi, 2021). The link between geopolitical risks and financial markets can be explained by several theoretical perspectives. The core theory is the efficient market hypothesis which assumes that assets' prices are a reflection of the available information in the market, thus the value of the company is quantified by its share price (Fama, 1970). Market participants, therefore, reevaluate market risk and immediately alter their investment decision upon the arrival of new information. Thus, when it comes to extreme positive or negative events, financial markets will respond quickly and adjust their prices, depending on their level of efficiency (Fama et al., 1969). In this regard, the event study theory assumes that the reaction of financial markets to a certain event can be easily detected by the change of share price around this event, simply by calculating abnormal and the cumulative abnormal return during the event window (Ball and Brown, 1968; Mackinlay, 1997).

From the psychological literature, the explanations of the effect of geopolitical risks on financial markets lie in the investors' behavior and sentiment. In this regard, these theories argue that investors in the financial markets tend to overreact to the news of geopolitical uncertainty. Thus, the presence of geopolitical risks stimulates strong emotional reactions for market participants such as anxiety or fear leading to irrational behavior that might result in assets' mispricing (De Bondt, 1989; Sunstein and Zeckhauser, 2011). The political literature also supports the link between geopolitical uncertainty and financial markets. These studies view certain events such as anti-government demonstrations, riots, and assassinations increase instability in the markets. Theoretically, Schwert (1989) in his model, supports and provides evidence that geopolitical risks lead to higher volatilities in the financial markets.

The empirical evidence on the association between geopolitical risks and financial markets is generally limited. However, the available evidence tackles this relationship from different angles. For example, part of the literature examines how GPR affects stocks' returns and volatilities. An important study by Pastor and Veronesi (2013) employs a policy uncertainty (PU) index and develops a general equilibrium model that tests how political uncertainty affects share prices in S&P 500 index from January 1985 through December 2010. The findings reveal that policy uncertainty calls for a higher risk premium, leading to higher stock volatility and correlation, particularly, in weaker economic settings. From the same setting, Chuliá et al. (2017) were the first who use the quantile impulse-response functions to evaluate how US policy and equity market uncertainties are related not only to the domestic stock returns but also to the mature and emerging financial markets. The study used long daily observations covering from Jan.1998 to March 2016. The study found that uncertainties have a negative effect on stock returns for both mature and emerging markets but more for emerging ones. However, weak negative evidence is documented for US Policy uncertainty on the returns of financial emerging markets.

From Korea, Jin Pyo (2020) investigates the relationship between geopolitical events on financial market behavior. The research shows that positive geopolitical events positively influence stock returns, and the opposite is also true. However, on the aggregate level, geopolitical tensions have no significant effect on either stock price index, industrial output, employment, or even gross trade volume indicating that these factors immune toward such geopolitical shocks. Hoque and Zaidi (2020) report a nonlinear effect of both global and country-specific geopolitical risk events on the returns of stock markets. The study employs a three-regime Markov-switching approach using data from five emerging economies namely, Brazil, India, Indonesia, South Africa, and Turkey. While the nonlinear relationship is clearly detected, the study reveals that global geopolitical tensions could have positive and negative impacts depending on several factors like volatility regimes, time lag, and the stock market. In the meanwhile, the country-specific political risks appear with a negative effect on all the stock markets' performance except the Indian stock market.

Another cross-country evidence is provided by Elsayed and Helmi (2021). Their study tests how geopolitical risks are related to returns and volatilities dynamics in the MENA region which includes countries from the Middle East and North Africa. The study employs the GPR index to cover different geopolitical tensions including wars, terrorism, and political uncertainty. The ADCC-GARCH model and a spillover approach show interesting results. The GPRs are not related to the return spillovers of financial markets for this region. Nevertheless, when the dynamic analysis is applied, the findings show that the total spillover index is highly responsive to the main political tensions in the region. Moreover, three countries namely, Saudi Arabia, Qatar, and the United Arab of Emirates are considered the core transmitters of return spillovers to the rest of the financial markets in this region.

A recent and important study is carried out by Caldara and Iacoviello (2022) covering 26 advanced economies over a very long period starting from 1900 to 2019. The study developed a GPR index that considers the timing and the severity of the negative geopolitical tensions. The VAR analysis reaches important and exciting findings. First, GPR negatively affects most of the macrocosmic variables i.e. lowering employment, export, and GDP for most economies. Second, as GPR increases a significant decrease in the stock prices is documented, this is noticed in 17 advanced economies according to the authors. The study concludes that GPR is a key driver of stock price movements in most financial markets, and more importantly, GPR spreads among markets because of a lack of confidence among investors in addition to the uncertainty regarding economic policy.

A separate strand of the literature examined sectoral analysis. For instance, Apergis et al. (2018) apply nonparametric causality tests to investigate if GPR can predict the movements and volatilities of stock returns in 24 global defense companies. The findings reveal that GPR can predict the volatility of 50% of these companies but not the movements of stock returns. From a different sector i.e. travel and leisure, Demiralay and Kilincarslan (2019) provide consistent evidence and report that GPR negatively affects stock index returns of major travel and leisure companies around the world, with the exception of the Asia & Pacific index. Consistent findings are reported for the Chinese tourism stock return by Jiang et al. (2020) and China's renewable energy stock market by Yang et al. (2021).

Recently, the current conflict between Russia and Ukraine also has been studied by Izzeldin et al. (2022). The study examines the reaction of the European and worldwide financial stock markets, in addition to certain commodities to the Russian invasion, and offers a comparison with previous pandemic and crisis. The findings reveal that financial markets react earlier to this military conflict compared with Covid-19 or even the global financial crisis. However, the negative duration is less compared with above mentioned two events. With regard to commodities, the study highlights that the most affected commodities are Wheat and nickel. Yousaf et al. (2022), consider how the conflict between Russia and Ukraine influences several financial markets from the G20 and the rest of the world. Using event study analysis, the military actions affect most of the sampled financial markets in a very negative way, particularly the Russian market. The study also indicates that the financial markets of Hungary, Russia, Poland, and Slovakia are among the first who were affected. Moving to a more comprehensive paper, Hossain and Al Masum (2022) employ daily observations from 39 financial markets. The study offers clear evidence of the negative effect of the Russian-Ukrainian conflict on the volatilities of the major financial markets. Moreover, this geopolitical risk also leads to a sharp decline in the major stock indices as well as the global currencies. Further, countries in the Euro-zone were the most negatively affected, compared with the rest of the world. Based on the above discussions we prose the following hypothesis:

H_1: Geopolitical risk has a statistically significant negative effect on the MENA equity markets.

H_{1a}: Geopolitical risk has a statistically significant negative effect on the daily returns for MENA equity markets.

H_{1b}: Geopolitical risk has a statistically significant effect on the daily volatility for MENA equity markets.

2. DATA AND METHODOLOGY

2.1 Data

To examine the impact of geopolitical risks on MENA indices, these main indices are determined based on the availability of daily data. These 13 indices represent most of the MENA countries, namely Saudi Arabia, Dubai, Abu Dhabi, Qatar, Kuwait, Bahrain, Iraq, Oman, Jordan, Palestine, Egypt, Tunisia and Morocco. The study data were downloaded from the https://www.investing.com/indices/website.

The time period of this study covers from 3 January, 2016 to 15 June, 2022. The entire time period is examined for the volatility of the MENA indices returns to form a general framework for the results of the study. To study the impact of geopolitical risks, two main periods are selected. The first time period of this study is investigated from 3 January, 2016 to 30 December, 2019 before the spread of the Corona pandemic is investigated, as a period that included the tension in the region following the Arab Spring revolutions and the tension in Gulf relations, especially between Saudi Arabia and Qatar. The second period is after the Corona pandemic, the beginning of the Russian-Ukrainian war that began in 24 February, 2022 until the time of this study. The volatility in the returns of the MENA indices during the Corona pandemic period is also discussed because it came during the study period. Table 1 provides a comprehensive statistical description of all MENA indices used in this study.

Table 1. Descriptive Statistics

MENA Countries	*Av. %*	*S.D. %*	*Max. %*	*Min. %*	*Skew.*	*Kurt.*	*Obs.*
Abu Dhabi	0.055	1.047	8.411	-8.063	-0.15	14.48	1612
Saudi Arabia	0.039	1.054	7.07	-8.32	-0.98	9.62	1611
Kuwait	0.031	1.122	6.34	-25.44	-8.96	183.27	1588
Egypt	0.030	1.275	6.70	-9.34	-0.39	5.95	1571
Bahrain	0.028	0.553	3.48	-5.82	-0.99	13.68	1585
Tunis	0.024	0.455	2.71	-4.10	-1.20	11.87	1612
Morocco	0.023	0.731	5.45	-8.82	-1.55	24.92	1607
Qatar	0.017	0.973	5.51	-9.70	-0.93	12.40	1604
Palestine	0.016	0.430	2.63	-3.67	-0.32	7.58	1553
Dubai	0.010	1.118	7.32	-8.29	-0.50	9.82	1612
Jordan	0.010	0.491	2.75	-4.48	-0.01	8.23	1563
Iraq	-0.011	0.907	4.039	-2.821	0.81	4.53	1376
Oman	-0.016	0.528	3.25	-5.57	-0.82	11.41	1590

Source: own

Table 1 presents the statistical description of mean returns, standard deviation, highest and lowest value, skewness, kurtosis, and number of observations for MENA indices from 3 January, 2016 to 15 June, 2022. The Abu Dhabi index achieves the highest average return among the MENA indices by about 0.055%, while the Oman index achieves the lowest negative average return of -0.016%. All MENA indicators indicate highly volatility, measured by standard deviation. The standard deviation clearly shows higher values than the average. The large difference between the minimum and maximum values confirms the large fluctuation in the MENA indices. It is clear that the MENA indicators are mostly around zero and skewed to the left, with the exception of the Kuwait indicator, which reports -8.96, while kurtosis indicates the presence of some extreme values. The last column displays the number of observation for each index.

2.2 Research Methods

The Generalized Autoregressive Conditional Heteroscedasticity (GARCH) is used in this study to find out the effect of geopolitical risks on the volatility of returns for the MENA indices. The ARCH group is very important in determining the effect of variability of returns (Chaudhary, Bakhshi, and Gupta, 2020). Therefore, it is used in this study. The use of the GARCH (1, 1) model enhances the knowledge of the effect of change in volatility over time (Engle, 1982). The natural logarithm of the MENA indices prices is calculated in order to arrive at the returns of these indices as follows:

$$R_i = \left(\frac{P_{it}}{P_{i,t-1}} \right) \text{...}(1)$$

Where:

R_i is return of MENA index *i*, P_{it} is the price of MENA index *i* at *t* day, P_{it-1} is the price of MENA index *i* at *t*-1 day.

2.2.1 Unit-Root Test

In time series analysis studies, the stationary of the data is checked using the unit root test. The two most commonly used tests in this field are Augmented Decker-Fuller (ADF) and Philips-Peron (PP). They are two tests that measure whether time series are stationary over time. The Augmented Decker-Fuller (ADF) is calculated based on the following:

$$\Delta y_t = \alpha_0 + \gamma_t y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \varepsilon_t \text{..}(2)$$

Where:

Δ is the first difference operator, y_t is time series, α_0 is the intercept, *p* is the optimum number of lags, ε_t indicates the residual errors, $\gamma = 0$ when series is not stationary and there is a unit root problem.

The Phillips-Peron (PP) is calculated based on the following:

$$\Delta y_t = (\rho - 1) y_{t-1} + \varepsilon_t \text{..}(3)$$

Δ is the first difference operator, y_t is time series, ε_t indicates the residual errors, this test makes a non-parametric correction to the *t*-test statistic.

2.2.2 ARCH Effect Test

Before applying the GARCH model, Engel (1982) referred to an important condition, which is the application of the heterogeneity test and the presence of the ARCH and GARCH effect. Thus, the Autoregressive Conditional Heteroscedasticity-Lagrange Multiplier test (ARCH-LM) is applied in this study as follows:

$$u_t^2 = \gamma_0 + \gamma_1 u_{t-1}^2 + \gamma_2 u_{t-2}^2 + \cdots + \gamma_q u_{t-q}^2 + \upsilon_t \text{....................................}(4)$$

Where:

u^2 is the square residual, q number of lags, γ_0 is the intercept, $\gamma_1, \gamma_2 \cdots \gamma_q$ are the unknown coefficients with q as order, and υ indicates a random term.

2.2.3 GARCH Model

The generalized ARCH model is usually used to overcome the large number of parameters used in the ARCH model. Bollerslev (1986) introduced the GARCH model and distinguished it from the ARCH model because it distinguishes between late volatility and current shocks. Thus, the GARCH (1, 1) or GARCH model provides a better understanding of market volatility than the ARCH model. It can be written in the following way:

$$u_t^2 = \omega + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^{p} \beta_i \lambda_{t-i}^2 \qquad (5)$$

Where:

u is the conditional variance, ω is the intercept term, p and q is number of lags in the conditional variance terms; α and β is coefficients for the terms ARCH and GARCH, ε_{t-i} is the residual squared lag (ARCH term) from the prior year, λ_{t-1} is the variation from the prior year (GARCH term).

When a large volatility appears in a time series after the stabilization period, this is called cluster volatility. To address cluster volatility, an ARCH and CARCH model was developed to handle correlations in error variance. An increase in ARCH coefficient α indicates an increase in the influence of recent information, while an increase in beta coefficient β indicates delayed information and an increase in the lag of the shock fade time. The sum of ARCH and CARCH $(\alpha + \beta)$ means that the time series are consistent and the higher their values, the longer the volatility continues over a longer period of time. In times of crisis, cluster fluctuations are present (Predescu & Stancu, 2011). Therefore, to address these cluster fluctuations during geopolitical risks, ARCH and CARCH is used to capture these cluster volatility.

The GARCH model is used first over the entire study period to examine the effect of volatilities in the returns of the MENA indices. Then the study sample was divided into two main periods, the first period being geopolitical risks before the Corona pandemic over the period of 3 January, 2016 to 30 December, 2019, which includes the repercussions of the Arab Spring and tensions in the Gulf region, especially between Saudi Arabia and Qatar. The second period after the Corona pandemic over the period of 24 February, 2022 to 15 June, 2022 relates to the current geopolitical risks of the war between Russia and Ukraine. Because the Corona pandemic is during the study period over the period of 30 December, 2019 to 24 February, 2022, the impact of the pandemic is also discussed as an additional third period to understand the effect of volatilities in the returns of the indicators during the study period.

2.2.4 EGARCH Model

The exponential general autoregressive conditional heteroskedastic (EGARCH is another form of the GARCH family. EGARCH was developed by Nelson (1991) to solve the GARCH weakness in processing financial time series. This model is used in the event that the sum of the coefficients of ARCH and GARCH is more than one, as it allows determining the asymmetric effects between the positive and negative asset returns. A model can be written as follows:

$$\log(\sigma_t^2) = \alpha_0 + \sum_{j=i}^{\rho} \beta_j (\sigma_{t-j}^2) + \sum_{j=1}^{q} \left(\alpha_i \left| \frac{e_{t-i}}{\sigma_{t-i}} \right| + \gamma \frac{e_{t-i}}{\sigma_{t-i}} \right) \qquad (6)$$

Where: α_j is coefficient ARCH, β_i is coefficient GARCH, and γ is coefficient leverage effect.

3. RESULTS

Test for Unit Root

Table 2 shows the results of the Augmented Dickey Feller and Phillips-Perron tests. The results indicate that the market indices for the entire MENA countries are stationary. The *p*-value of all results of the Augmented Dickey Feller and Phillips-Perron are lower than 5 precent. Therefore, the MENA market indices are integrated at the level zero.

Table 2. Unit Root Test

	Augmented Dickey-Fuller		*Phillips-Perron*	
MENA Countries	*t-Statistics*	*Prob.*	*t-Statistics*	*Prob.*
Abu Dhabi	-15.12478	0.0000	-38.45322	0.0000
Saudi Arabia	-35.30210	0.0000	-35.29851	0.0000
Kuwait	-35.10093	0.0000	-35.36604	0.0000
Egypt	-31.13252	0.0000	-31.07511	0.0000
Bahrain	-23.64363	0.0000	-36.70603	0.0000
Tunis	-30.96387	0.0000	-30.95635	0.0000
Morocco	-33.92009	0.0000	-34.07103	0.0000
Qatar	-36.79145	0.0000	-36.86748	0.0000
Palestine	-23.20143	0.0000	-36.11943	0.0000
Dubai	-35.28786	0.0000	-35.95576	0.0000
Jordan	-31.56861	0.0000	-32.07983	0.0000
Iraq	-35.27169	0.0000	-35.26236	0.0000
Oman	-30.10394	0.0000	-30.47071	0.0000

Source: own

Test for Heteroscedasticity and Autocorrelation Errors

Table 3 includes the results of heteroskedastisty error test in Panel A, while Panel B details the results of autocorrelation error test for all MENA market indices. The result in Panel A of Table 3 shows that all MENA market indices are statistically significant at the level of 5%, except for the Kuwaiti index. This means that the data of most MENA market indices have a problem of heterogeneity. On the other hand, the results in Panel B of Table 3 show that All MENA market indices are also statistically significant at the level of 5%, except for Abu Dhabi and Iraq indices. Therefore, using a linear autoregressive model is unacceptable because it violates the basic assumptions of the ordinary least square (OLS) model. To solve this problem, this study uses the generalized autoregressive conditionally heteroskedasticity GARCH (1, 1) model rather than OLS model.

Table 3. Heteroscedasticity and Autocorrelation Errors

Panel A: Heteroscedasticity ARCH test results		
MENA Countries	*Obs*R-squared*	*Prob. Chi-Square(1)*
Abu Dhabi	255.6263	0.0000
Saudi Arabia	278.2819	0.0000
Kuwait	2.130542	0.1444
Egypt	154.7802	0.0000
Bahrain	111.5021	0.0000
Tunis	476.6105	0.0000

Morocco	87.83543	0.0000
Qatar	29.11201	0.0000
Palestine	32.70554	0.0000
Dubai	254.5869	0.0000
Jordan	206.0066	0.0000
Iraq	124.3191	0.0000
Oman	59.36058	0.0000
Panel B: Autocorrelation errors test		
MENA Countries	*Obs*R-squared*	*Prob. Chi-Square(2)*
Abu Dhabi	5.355396	0.0687
Saudi Arabia	26.04015	0.0000
Kuwait	24.71889	0.0000
Egypt	88.96818	0.0000
Bahrain	41.76272	0.0000
Tunis	96.79415	0.0000
Morocco	42.62900	0.0000
Qatar	10.66398	0.0048
Palestine	44.58206	0.0000
Dubai	25.62613	0.0000
Jordan	79.17311	0.0000
Iraq	3.447161	0.1784
Oman	117.3435	0.0000

Source: own

Test for Autoregressive Conditional Heteroscedasticity

To address the problem of heterogeneity in errors and to check if the GARCH (1, 1) solve the problem, this study uses a measure of ARCH-LM test. Table 4 shows the results of the heterogeneous conditional autoregressive. The results show that the *p*-value for all MENA market indicators is less than 5%, and this confirms that the use of GARCH (1, 1) model solves the problem

Table 4. ARCH-LM Test

	Results of ARCH-LM test	
MENA Countries	*Obs*R-squared*	*Prob. Chi-Square(1)*
Abu Dhabi	0.154146	0.6948
Saudi Arabia	0.185512	0.6667
Kuwait	-	-
Egypt	0.109512	0.7407
Bahrain	0.085389	0.7701
Tunis	0.686400	0.4074
Morocco	0.019811	0.8881
Qatar	0.076931	0.7815
Palestine	0.143818	0.7045
Dubai	2.343938	0.1258
Jordan	2.746834	0.0974
Iraq		
Oman	8.895330	0.0686

Source: own

Test for GARCH (1, 1) Model

Table 5 displays the results of returns and volatilities of MENA market indices based on the auto-regressive conditional heterokedostic model GARCH (1, 1). This model is used in this paper to improve the linear and simple autoregressive model by solving the problem of heterogeneity of variance. Table 5 is divided into Panel A, B and C. Panel A in Table 5 shows the returns and volatilities of the MENA indices for the full sample period extending from 3 January, 2016 to 15 June, 2022. Panel B shows the returns and volatility of the MENA indices during the period of the Corona pandemic extending from 30 December, 2019 to 23 February, 2022, while the third period, which is Panel C shows the returns and volatilities of the MENA indices during the period of the geopolitical war between Russia and Ukraine extending from 24 February, 2022 to 15 June, 2022.

Table 5. GARCH Model results

MENA Countries	μ	ω	α *(ARCH effect)*	β *(GARCH effect)*	$\alpha+\beta$	*Log likelihood*
Panel A: GARCH (1,1) Full sample period from 3 January, 2016 – 15 June, 2022						
Abu Dhabi	0.000745*	0.0000062	0.144222*	0.771345*	0.915567	5399.004
Saudi Arabia	0.000750*	0.0000047	0.154338*	0.801624*	0.955962	5253.336
Kuwait	0.000139	0.0000444	0.314644*	0.429090*	0.743734	5016.471
Egypt	0.000455	0.0000121	0.149614*	0.773519*	0.923133	4794.264
Bahrain	0.000301*	0.0000043	0.185066*	0.665858*	0.850924	6173.038
Tunis	0.000163	0.0000024	0.295589*	0.592432*	0.888021	6549.941
Morocco	0.000475*	0.0000044	0.195160*	0.704879*	0.900039	5905.692
Qatar	0.000507**	0.0000056	0.150358*	0.795634*	0.945992	5277.852
Palestine	0.0000442	0.0000033	0.169368*	0.656408*	0.825776	6338.563
Dubai	0.000163	0.0000043	0.100925*	0.854676*	0.955601	5173.273
Jordan	0.0000126	0.0000019	0.183305*	0.732920*	0.916225	6314.503
Iraq	-0.000250	0.0000185	0.291282*	0.488359*	0.779641	4658.647
Oman	-0.000322*	0.0000026	0.188702*	0.720971*	0.909673	6223.148
Panel B: GARCH (1,1) Geopolitical risk during the period of 3 January, 2016 – 29 December, 2019						
Abu Dhabi	0.000242	0.000002*	0.052256*	0.912064*	0.964251	3419.398
Saudi Arabia	0.000412	0.000005*	0.159139*	0.785603*	0.944742	3296.861
Kuwait	0.000252	0.000049	-0.000376	0.568385	0.568009	3117.980
Egypt	0.000686	0.000028*	0.193487*	0.651737*	0.845224	3028.747
Bahrain	0.000191	0.000005*	0.219932*	0.542241*	0.762173	3932.827
Tunis	0.000137	0.000002*	0.281673*	0.602852*	0.884525	4112.291
Morocco	0.000212	0.000007	0.209566	0.581066	0.790632	3769.696
Qatar	0.000209	0.000007*	0.080604*	0.838382*	0.918986	3229.265
Palestine	-0.000031	0.000005*	0.120648*	0.564970*	0.685618	4068.475
Dubai	-0.000075	0.000004*	0.068693*	0.883992*	0.952685	3328.389
Jordan	-0.000100	0.000003*	0.184597*	0.626006*	0.810603	4147.319
Iraq	-0.000566**	0.000014*	0.228212*	0.568454*	0.796666	2975.847
Oman	-0.000495*	0.000003*	0.154206*	0.733164*	0.88737	3911.354
Panel C: GARCH (1,1) COVID-19 during the period of 30 December, 2019 – 23 February, 2022						
Abu Dhabi	0.001323*	0.000006*	0.190147*	0.742854*	0.933001	1819.317
Saudi Arabia	0.001268*	0.000004*	0.155347*	0.819446*	0.974793	1795.030
Kuwait	0.001014*	0.000004*	0.432603*	0.639460*	1.072063	1795.875
Egypt	0.000476	0.000008*	0.169777*	0.772678*	0.942455	1640.342
Bahrain	0.000812*	0.000005*	0.171290*	0.685871*	0.857161	2028.156
Tunis	0.000164	0.000002*	0.326920*	0.575186*	0.902106	2219.602
Morocco	0.000738*	0.000003*	0.162723*	0.786200*	0.948923	1965.091

Qatar	0.000806*	0.000003*	0.180903*	0.778925*	0.959828	1896.452
Palestine	0.000112	0.000004*	0.236578*	0.632143*	0.868721	1998.938
Dubai	0.000520	0.000004*	0.128943*	0.848945*	0.977888	1694.326
Jordan	0.000300	0.000002*	0.167345*	0.773235*	0.94058	1921.549
Iraq	0.000484	0.000026*	0.354147*	0.434588*	0.788735	1435.956
Oman	-0.000005	0.000003*	0.233416*	0.698590*	0.932006	2059.303
Panel D: GARCH (1,1) Geopolitics Risks during the period of 24 February, 2022 – 15 June, 2022						
Abu Dhabi	0.001545	0.0000037	0.093279	0.956951*	1.05023	175.3544
Saudi Arabia	0.002085*	0.0000033	0.006636	1.164184*	1.17082	179.3340
Kuwait	0.000298	0.0000071	0.403905*	0.770507*	1.174412	230.2135
Egypt	-0.003038*	0.0000006	0.120688	1.048908*	1.169596	214.1998
Bahrain	-0.001298	0.0000463	0.184522	0.346738	0.53126	249.9235
Tunis	0.000942*	0.0000060	0.112559	0.441270	0.553829	231.5320
Morocco	0.001360*	0.0000006	2.221068*	0.581658*	2.802726	208.2406
Qatar	-0.001111	0.0000056	0.061196	1.163068	1.224264	180.0939
Palestine	0.001219**	0.0000125	0.516669**	0.182210	0.698879	287.5629
Dubai	0.001060	0.0000048	0.183379	1.124874*	1.308253	169.0528
Jordan	0.000916	0.0000026	0.361805	0.800797*	1.162602	262.6095
Iraq	-0.000499	0.0000007	0.452357**	1.007401*	1.459758	260.6992
Oman	0.000152	0.0000001	0.063481	0.983005*	1.046486	268.5193

*(P<0.01), ** (P<0.05)

Source: own

Panel A in Table 5 shows that, the full sample period, the conditional mean (μ) coefficient of the stock market indices of Abu Dhabi, Saudi Arabia, Bahrain, Morocco, Qatar are positive and statistically significant, while Kuwait, Egypt, Tunis, Palestine, Jordan, Dubai and Iraq are positive but statistically insignificant. However, the conditional mean of Oman index is only negative and statistically significant.

Panel A in Table 5 displays that the long-term variance (ω) which is statistically significant at the level of most of the MENA stock exchanges. This means that the GARCH (1, 1) succeeded in modelling the fluctuations during the full sample period for all the MENA market indices. In addition, the α (ARCH effect) and β (GARCH effect) coefficients are statistically significant. This is evidence that most of the MENA market indices are influenced by recent information and old news. However, the GARCH effect coefficients are larger than ARCH effect coefficients, which mean that market participants take into account older news more than new information, as well as old news is taking a long time to fade and volatility continues. Panel (A) in Table 5 also shows that the sum of the ARCH and GARCH coefficients ($\alpha + \beta$) is close to one, Abu Dhabi (0.915567), Saudi Arabia (0.955962), Egypt (0.923133), Morocco (0.900039), Dubai (0.955601), Jordan (0.916225), and Oman (0.909673), which means a severe and slow endings of the volatility shock. For the Bahrain, Tunis, and Palestine, the sum of ARCH and GARCH coefficients ($\alpha + \beta$) are 0.850924, 0.888021, and 0.825776, respectively. This indicates that the continuation of the shock of the medium volatility. Finally, the indicators of the remaining countries are Iraq 0.779641 and Kuwait 0.743734. This means that that the shock of relatively low volatility continues.

Panel B in Table 5 shows that, Geopolitical risks arising from the repercussions of the Arab Spring and tensions in the Gulf region from January 3, 2016 to December 30, 2019, indicate that there is a difference in the mean returns of the MENA indices. The conditional mean (μ) coefficient of the stock market indices of Abu Dhabi, Saudi Arabia, Kuwait, Egypt, Bahrain, Tunisia, Morocco and Qatar are positive but statistically insignificant, while the indices of the Palestine, Dubai, Jordan, Iraq and Oman are negative and statistically insignificant, except of Iraqi and Omani indices, which are negative and statistically significant. Therefore, we reject the hypothesis that indicates geopolitical risks have a negative and statistically significant effect on the daily returns of stock markets in the MENA region; while accept it for Iraqi and Omani indices.

Panel B in Table 5 displays that the long-term variance (ω) is statistically significant at the level of most of the MENA stock exchanges, except of Kuwait and Morocco. This means that the GARCH (1, 1) succeeded in modelling the fluctuations during the repercussions of the Arab Spring and tensions in the Gulf region for most the MENA market indices, except of the Kuwait and Morocco index because they are not statistically significant. The increased levels of geopolitical tension lead higher markets volatility and this result is consistent with previous finding such as Schwert (1989), Berkman, Jacobsen, and Lee (2011), Caldara and Iacoviello (2022), Dogan et al. (2021) and Elsayed and Helmi (2021). In addition, the α (ARCH effect) and β (GARCH effect) coefficients are statistically significant. This is evidence that most MENA market indices are influenced by recent information and old news. However, the GARCH effect coefficients are larger than ARCH effect coefficients, which mean that market participants take into account older news that is larger than new information, as well as old news is taking a long time to fade and volatility continues. These findings confirm the investor behaviour theory that investors in financial markets tend to overreact to news of geopolitical uncertainty. Thus, the presence of geopolitical risks induces strong emotional reactions of market participants such as anxiety or fear leading to irrational behaviour that may lead to mispricing of assets (De Bondt 1989; Sunstein and Zeckhauser 2011).

Panel B in Table 5 also shows that the sum of ARCH and GARCH coefficients ($\alpha + \beta$) is close to one, Abu Dhabi (0.96425), Saudi Arabia (0.94474), Qatar (0.91898) and Dubai (0.95268), which means a severe and slow endings of the volatility shock. For the Oman, Tunis, Egypt and Jordan, the sum of ARCH and GARCH coefficients ($\alpha + \beta$) are 0.88737 0.88452, 0.84522, and 0.810603, respectively. This indicates the continuation of the shock of the medium volatility. Finally, the indicators of the remaining countries are Iraq 0.796666, Bahrain 0.790632, Palestine 0.762173, and Kuwait 0.568009. This means that that the shock of relatively low volatility continues. Therefore, we accept the hypothesis that Geopolitical risk has a statistically significant effect on the daily volatility for MENA equity markets, while reject it for Moroccan index. These results indicate that MENA indices fluctuate in geopolitical risks results and contradict with finding of Jin Pyo (2020) who find that geopolitical tensions in Korea have no significant effect on either stock price index, industrial output, employment, or even gross trade volume indicating that these factors immune toward such geopolitical shocks.

Panel C in Table 5 shows that, during the Corona pandemic period, the conditional mean (μ) coefficient of the stock market indices of Abu Dhabi, Saudi Arabia, Kuwait, Bahrain, Morocco and Qatar are positive and statistically significant. It is noted that all of these countries are from the Gulf countries, except of Morocco stock market and these Gulf countries can benefit from the high prices in the energy sector, which supported the returns of shares in these markets, especially when oil and gas prices rose during the year 2021. On the other hand, all other countries' markets in the MENA are positive, but they are not statistically significant, except for the Oman, which was negative.

Panel C in Table 5 shows that results of stock indices volatility are relatively similar to the results in panel A. The long-term variance (ω) is statistically significant for all the stock exchanges. This means that the GARCH (1, 1) succeeded in modelling the fluctuations during the COVID 19 periods for all the MENA market indices. Also, the (ARCH effect) and (GARCH effect) coefficients are all positive and statistically significant. In addition, this is evidence that most of the MENA market indices are affected by recent information and old news during the Corona pandemic period. In particular, the ARCH coefficients in Panel C are greater than ARCH coefficients in Panel A. This is evidence that recent news has a greater impact due to the influence of these markets by the news of the Corona pandemic. However, the GARCH effect coefficients are larger than the ARCH effect coefficients, which mean that market participants take into account old news that has more influence than new information, as well as old news that takes a long time to fade and volatility continues. Panel C in Table 5 also shows that the sum of the ARCH and GARCH coefficients is slightly less than one, except of Bahrain and Iraq. This means severe and slow endings of the volatility shock for all the MENA market indices. For the Bahrain and Iraq index, the shock of relatively low volatility continues.

Table 5 Panel D shows that the conditional mean (μ) of the MENA market indices during the period of the Geopolitical risks of the Russian-Ukrainian war is affected and its performance relatively declined. It is clear that the highest conditional mean among MENA countries is Saudi Arabia 0.002085, while the lowest conditional mean is Egypt -0.003038. In addition, there are 4 countries such as Saudi Arabia, Tunis, Morocco, and Palestine have positive and statistically significant conditional mean, while 4 countries Abu Dhabi, Kuwait, Dubai, Jordan and Oman have positive but statistically insignificant conditional mean. In contrast, the four remaining countries in the MENA (Egypt, Bahrain, Qatar and Iraq) have negative conditional mean, but they are not statistically significant, except for Egypt, which are statistically significant. Therefore, we reject the hypothesis that geopolitical risks have a negative and statistically significant effect on the daily returns of stock markets in the MENA region, while accept it for Egyptian index.

Table 5 in Panel D shows that the variance value reached the highest level in the index of Palestine, which is 0.0000125 and statistically significant at the level of 5%, while it is the lowest in the Omani market, which is 0.0000001, but it is not statistically significant. However, Panel D displays that the long-term variance (ω) is not statistically significant for all the stock exchanges. This means that the GARCH (1, 1) failed in modelling the fluctuations during the Russian-Ukrainian war periods for all the MENA market indices. Looking at the coefficient of ARCH, it reached the maximum level in the Morocco, Palestine, Iraq and Kuwait indices and they are statistically significant. This is evidence that recent information or the Russian-Ukrainian war have a significant impact on these markets. On the other hand, looking at the GARCH (1, 1) coefficient, all the coefficients of the MENA markets are statistically significant, except of four markets: Bahrain, Tunisia, Qatar and Palestine. This is evidence that most of the MENA markets are affected by long-term news. Table 5 in Panel C also shows that in most MENA markets, the sum of ARCH and GARCH coefficients ($\alpha + \beta$) is more than one. This is evidence of the continuity of oscillation shocks, which requires dealing with a special type of these models, which is the EGARCH model, where the shock leads to infinity.

Table 6. EGARCH Model Results

MENA Countries	*C =* μ	*C(2) =* ω	*C(3) =* α	*C(4) =* γ	*C(5) =* β	*Log likelihood*
EGARCH Geopolitical Risks during the period of 24 February, 2022 – 15 June, 2022						
Abu Dhabi	0.001434	-10.29856	0.171824	0.315523	-0.050983	170.3157
Saudi Arabia	0.001372	-3.659532	-0.046313	-0.215223	0.618843	170.8059
Kuwait	0.000435	-1.516729	-0.131719	**-0.451865***	0.830213*	235.7946
Egypt	-0.001857	-0.155307	-0.117783*	0.163698	0.975313*	212.9134
Bahrain	-0.001500	-10.93567*	1.204186*	0.480677*	-0.043395	252.8612
Tunis	0.000303	-7.403996*	-0.921219*	0.465674	0.305300	228.9873
Morocco	0.000725	-1.982999*	0.345119	**-0.448227***	0.837458*	205.6583
Qatar	-0.002429	-5.713638**	0.670125	0.334457	0.435470	175.3994
Palestine	0.001138	-17.05357	-0.231752	-0.142163	-0.629733	286.5394
Dubai	0.001059	-6.583610**	1.171907**	0.128161	0.401058	164.0513
Jordan	0.001062	-1.243138	0.359866	0.085519	0.904997	262.5612
Iraq	-0.000801	-3.587110	0.618892*	-0.104496	0.696652*	258.1241
Oman	0.000130	-7.351618	-0.304044	0.464465**	0.270019	264.1801

Source: own

Table 6 displays the results of EGARCH (1, 1) during the geopolitical risks over the period of 24 February, 2022 – 15 June, 2022. The result of Table 6 shows that the long-term variance (ω) is statistically significant for indices of Bahrain, Tunis, Morocco, Qatar, and Dubai, while is not statistically significant for others. Therefore, we accept the hypothesis that Geopolitical risk has a negative and statistically significant effect on the daily volatility for Bahraini, Tunisian, Moroccan, Qatari and Dubai indices, while reject it for remaining MEAN indices. This result supports the results documented by Izzeldin et.al (2022), Yousaf et.al (2022), Al Masum (2022). The results of this study are also in consistent with Elsayed and Helmi (2021) when they apply dynamic analysis in the MENA markets.

Table 6 also shows γ is the coefficient of the asymmetric term and it is negative and statistically significant for the Kuwaiti and Moroccan indices. This means that there is strong evidence of the effect of leverage. In other words, a negative news or shock has larger effect on the conditional variance compared to positive news or shock. The indicators of Saudi Arabia, Palestine and Iraq, γ is negative, but it is not statistically significant. Thus, the EGARCH (1, 1) specification failed to model the volatility of these indices due to the inability of the model to improve the probability. Therefore, the effect of financial leverage does not exist. For the Bahraini index, γ is positive and statistically significant at the 1% level, while for the Omani index it is positive and statistically significant at the 5% level. In other words, a positive news or shock has larger effect on the conditional variance compared to negative news or shock. For the rest of the indicators, namely Abu Dhabi, Egypt, Tunis, Qatar, Dubai, and Jordan, γ is positive but not statistically significant. Given β, it is relatively low in most indicators and sometimes negative. This suggests that shocks are less persistent, and resolve faster during a period of geopolitical risk.

CONCLUSION AND DISCUSSION

This study examines the volatility characteristics of MENA indices returns based on the GARCH and EGARH model. These models helped us understand the volatility of indices returns in the MENA countries and provide an important background for investors and decision makers. The current study provides several conclusions from the previous analysis: MENA indices are characterized by large volatility, especially during the geopolitical risks that proceeded the Corona pandemic period, and this indicates that these markets are interconnected and affected by each other. This paper also showed greater volatilities in the MENA indices during the Corona pandemic period, especially from recent news side. The GARCH model can be applied to the MENA indices because it reflects the volatility of returns with high accuracy, especially in the period of the overall study and in the period of geopolitical risks before the Corona pandemic, as well as during the Corona pandemic period. The results of the study also showed, based on the GARCH model, that the volatilities of returns in the MENA indices persist for long periods with a gradual decline over time.

For the geopolitical risk period of the Russian-Ukrainian war, the GARCH model failed to model the volatility of the MENA indices' returns. Therefore, the EGARCH model is used to address this problem. The study showed that the effect of financial leverage is noticeable in the Kuwaiti and Moroccan indices. We conclude based on the results of the asymmetric GARCH family models, that market news has mixed effects on the MENA indices. The weak leverage effect confirms that MENA indices are more sensitive to market information.

Based on the above results, this paper presents some suggestions for investors in MENA indices. Firstly, MENA markets are not immune to such geopolitical shocks. Therefore, the MENA markets need to strengthen and develop their risk administrative systems. MENA markets are inefficient emerging markets, especially compared to developed markets. They are greatly affected by globalization and the rapid transfer of risks across countries. The design of a risk management control system can effectively reduce the risks of financial volatilities and thus reduce its impact on the MENA indices. Secondly, enforcing the law and activating the role of supervision and control over the market, especially with regard to legal violations. The disclosure of information must be expedited because the MENA indices are greatly affected by the current information. In addition, some markets were affected by negative news, such as Kuwait and Morocco. Thus, this leads investors to sell more stocks, causing large fluctuations in these indices. Rapid disclosure of information, credibility and transparency mitigate information asymmetry among listed companies. Examining the volatility of returns on the MENA indices helps us understand the actual economic process and provides an important insight for the government as decision makers and for investors as traders to realize the various risks.

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