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Navigating Uncertainty: The Role of Gold, Silver, Oil, Cryptocurrency, and ESG indices in the MENA Region

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Thesis

Navigating Uncertainty: The Role of Gold, Silver, Oil, Cryptocurrency, and ESG indices in the MENA Region

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Abstract:

This study examines the effectiveness of various financial instruments as hedges and safe havens during different market conditions in the MENA region. It compares traditional safe-haven investments (gold, silver, and oil) and non-traditional safe-havens (cryptocurrencies and ESG stocks) to determine which investments function better as hedges and safe havens during different market conditions. The data covers eight years, starting in 2015 and ending in early 2023. DCC GARCH is utilized to examine time variation in conditional correlations. This study finds that Gold, Silver, and cryptocurrency can be considered strong hedges to the MENA market on average and weak safe havens during times of uncertainty. Oil can only be considered a weak hedge on average and presents stable correlations with the MENA index during specific periods. The ESG index does not provide evidence for being a good hedge or safe-haven.

Keywords: Safe-Havens, Hedges, Gold, Silver, Oil, cryptocurrencies, ESG, Sustainability, MENA region

I. Introduction:

Investors in the Middle East and North Africa (MENA) region face unique challenges and opportunities in the financial market. The region is characterized by economic, political, and social instability, making it imperative for investors to protect their wealth during times of crisis. The interest in investment protection in times of market uncertainty is not new, and research in this area has been plenty over the years. However, research on safe-haven assets has become more popular following the 2008 financial crisis (Robiyanto et al., 2017). Investors became increasingly concerned with preserving what they could do with their wealth and surviving such a crisis with limited losses. During market turmoil, they sought uncorrelated or negatively correlated traditional assets (Baur & Lucey, 2010). Safe-haven assets continue to be a hot topic for research in recent years with the pandemic and widespread global unrest. Historically, risk-averse investors flee to safety during times of stress, relocating their investments to various traditional assets they deem safe.

Investors consider these assets safe because they tend to maintain their value, perform better than other assets, or even appreciate volatile market environments. This phenomenon is called Flight-to-quality and Flight-to-liquidity, A phenomenon that occurs during times of market stress or uncertainty when investors become more risk-averse and seek to protect their investments. (Baur & Lucey, 2010; Papadamou et al., 2021). Investors seek one of two things in times of turmoil; Quality, which is associated with safe, low default-risk investments, or Liquidity, where investors seek to sell low-liquidity assets to buy ones they deem more easily liquidated. Those two investor behaviors are at the core of determining which assets will be safe havens when markets face uncertainty, so we can safely say that Safe-havens are not universal. They could differ from one market to another or from one crisis period to the next, and fund managers must do their due

diligence to identify them. One of the most prominent assets investors flee to is Gold, which investors often view as a hedge against inflation and U.S. dollar purchasing power depreciation. Conversely, investors have also started viewing Oil and other industrial commodities as hedges against inflation, and their prices rose alongside inflation.

The Researcher has recently witnessed international investors moving toward unconventional Safe-havens such as Cryptocurrencies and ESG (Environmental, Social, and Governance)indices. Due to decentralized and limited supply, the crypto market became a subject of interest in many studies to figure out if it can be a safe haven in uncertain periods and managed to garner favorable results in many studies (Dyhrberg, 2016; Bouri et al., 2017; Bouri et al., 2018). Furthermore, with the recent rise of interest in ESG issues, investors are becoming more concerned with aligning their investments with their values as it provides them with a sense of comfort and security. Additionally, some recent studies, such as Albuquerque et al. (2020) and Broadstock et al. (2021), provided evidence that ESG investing could lower downside risk for investors and be resilient during volatile market periods.

With this growing popularity of alternative assets, it is essential to understand the relationship between various asset classes and their potential as safe havens for investors in the MENA region. The purpose of this paper is to study the Correlation between the MENA region index and two commonly recognized traditional safe-haven assets: Gold and Silver, WTI Crude Oil indices, as well as two exotic haven assets: Cryptocurrency and ESG indices, during several periods of market downturn and different types of market crises.

The study will examine data from 2015 until early 2023, a period marked by significant events such as The Global Oil Price Collapse, The China Slowdown, the rise of Cryptocurrency, The

Emerging Market Turmoil, The US-China Trade War, the growing awareness of environmental, social, and governance (ESG) issues, the Covid19 Pandemic, and the Russia-Ukraine War, among others. This study will review existing research on the topic and analyze relevant data to achieve its objectives. This study's results will be presented clearly and concisely, making it accessible to a broad audience. Moreover, the goal is for this study to be a valuable resource for investors, financial analysts, and policymakers in the MENA region, providing them with insights and recommendations on how best to navigate the financial market during times of crisis. The remainder of the paper is organized as follows. Section 2 presents a review of the chosen literature. Section 3 highlights the data used. Section 4 describes the methodology. The empirical findings are presented in Sections 5 and 6. And Section 7 provides the conclusions and policy implications.

II. Literature review

During financial stress, various asset classes move together even when, in normal circumstances, they are not fundamentally correlated (Dornbusch et al., 2000). Such uncertainties in asset movements motivate the search for assets that do not follow the same trend during crisis periods. These assets are commonly known as safe-haven assets and are defined as assets that will not follow the movement of other assets in the market and maintain their value in times of turmoil.

Hedges and Safe-Havens are two sides of the same coin. Both are financial instruments used by investors to protect themselves, and both are assets that are uncorrelated or negatively correlated with another asset or portfolio. The only distinction between hedges and safe havens is when they exhibit these characteristics. Hedges exhibit these characteristics on average, while safe havens exhibit them during market stress (Baur & Lucey, 2010).

2.1 Gold

Precious metals are historically known to perform well under adverse market circumstances. This assumption can be attributed to many factors, such as supply, demand, and investor behavior. These factors lead to price increases during times of crisis, making them great candidates for safe havens. Gold, in particular, has always been considered a safe asset by investors and has been the object of focus for many studies, especially following the 2008 Global financial crisis. Subsequently, many studies analyzed Gold's hedging and safe-haven capabilities. For instance, Baur and Lucey (2010) studied whether Gold is a Safe-haven and a hedge for U.S., U.K., and German Stock and Bond markets. A least-squares regression model was used on sample data of gold prices, stock, and bond returns from 1995 until 2005, which found that Gold can be a hedge in both U.S. and UK Stock markets but not in German ones. While at the same time, it is a hedge in the German Bond market but not in the U.S. and U.K. bond markets; nevertheless, they concluded that Gold is a safe-haven asset in the U.S., U.K. and German stock and bond markets.

Coudert & Raymond (2011) observed German, UK, U.S., and G7 markets during crisis periods between 1978 and 2009. Their findings were that Gold was a safe haven for stock indices and a hedge in most cases. Ciner et al.,(2013) also yielded corroborating results by showcasing that Gold can be a Safe-haven against the exchange rate in the U.S. and U.K.

In another study by Dar & Maitra (2017), they decided to test the nexus between Gold and stock returns in three significant Gold consuming countries, China, The U.S., and India, from 1999 to 2013 using a range of methodologies. Their findings concluded that Gold could serve only as a weak hedge in the U.S. and India as it is not significantly correlated with stock returns and does not reduce risk or increase returns. The results were also similar for the safe-haven position. Gold

did not prove to be significantly correlated with stock returns during high market volatility and did not shield from shocks. The results for the Chinese market were slightly different, as Gold showed a significant positive correlation with returns. However, the Correlation was still deemed too weak. They concluded that Gold could serve as an ineffective hedge and a safe haven in Chinese stock markets.

Chkili (2016) studied the relationship between BRICS countries and Gold, and found that it can serve as a safe haven against extreme movements. A more recent study (Akhtaruzzaman et al., 2020) tested Gold's safe-haven properties during the COVID-19 pandemic crisis phases. They concluded that Gold remained a safe haven during the first phase of COVID-19 between Dec 2019–Mar 2020 but lost its status during the second phase between Mar 2020 − April 2020. Similar results were presented by (Salisu et al., 2021) where they found that during COVID-19 Gold presents better safe haven properties than US stocks as well as other precious metals such as Silver, Palladium and Platinum. (Chemkha et al., 2021) found evidence that supports the effectiveness of Bitcoin and Gold as hedging assets and state that during COVID-19 gold was a weak safe haven while Bitcoin was not due to its high variability.

These results demonstrate that although Gold is commonly associated with safe-haven properties, it is not guaranteed to be valid for all countries and markets. The results, in that regard, seem to vary from one country to the other and one market to the other.

2.2 Crude Oil

In addition to Gold, previous literature sought to test other commodities to see if they would exhibit hedging and Safe-Haven characteristics. One such commodity usually discussed alongside Gold is Oil, as it is very prominent and highly influential on macroeconomic factors such as interest

rates and inflation. Park and Ratti (2008) show that Oil's effect on macroeconomic factors depends on whether regular demand and supply movements or economic shocks cause downturns or upturns in Oil prices. They suggested that the relationship varies with time. On the other hand, Filis et al. (2011) and Ciner et al. (2013) found that Oil does not serve as a safe- haven for stock markets in Canada, Mexico, Brazil, the USA, Germany, and The Netherlands. However, Oil could still serve as a safe-haven during different periods of turmoil. Conversely, Elie et al. (2019) study provided a similar outcome to Park and Ratti (2008) and showcased that Oil alongside Gold can be considered a safe-haven against clean energy indices.

2.3 Cryptocurrencies

Since their inception with Bitcoin, cryptocurrencies have continued to be an object of marvel in financial markets with their high volatility and unpredictable behaviors. In recent years, they have elicited much interest from researchers. Furthermore, with the current pandemic, many studies were concerned with whether the cryptocurrency market can be a new safe-haven for investors. (Klein et al., 2018) found results that suggest that Bitcoin cannot serve as a safe-haven and cannot hedge against risk. Similarly, (Conlon & McGee, 2020) show that bitcoin does not act as a safe-haven during the COVID-19 health crisis.

On the other hand, Urquhart & Zhang(2019) tested Bitcoin's hedge and safe-haven capabilities against currencies, Oil, and stocks and found that Bitcoin can serve as a safe-haven for the Oil market during extreme down movements but is a weak safe-haven asset against currencies and stocks. Bouri et al.(2020) considered Bitcoin a better hedge than conventional stocks when there is heightened trade policy uncertainty since investor interest in cryptocurrencies drives growth in the crypto market, particularly during times of uncertainty when trust in institutions is low.

Conversely, Mokni et al.(2022) examined the role of the top five cryptocurrencies as a hedge and safe haven against Economic Policy Uncertainty (EPU) during and before the COVID-19 pandemic. They found that before COVID-19, cryptocurrencies exhibited weak safe-haven characteristics but failed to maintain their status during the health crisis.

2.4 ESG stocks

ESG indices are a type of stock market index that aims to reflect the performance of companies that positively impact the environment and society and have robust governance practices. The indices typically include companies that score well on metrics related to environmental sustainability, social responsibility, and ethical business practices. Investors can use ESG indices as a benchmark to track leaders' performance in these areas and gain exposure to companies well-positioned to benefit from the growing focus on sustainability and social responsibility. ESG investing is becoming increasingly popular as more investors seek to align their investments with their values, and companies increasingly recognize the importance of sustainability and social responsibility. According to a poll conducted by the global bank HSBC in 2020, 41 percent of regional investors wanted to implement an ESG investing policy (HSBC,2020); these findings were also corroborated by a 2022 PwC analysis where the top three sustainability goals for Middle Eastern businesses were found to be diversity and equality, climate change, and safety (PwC,2022). The increasing popularity of ESG stocks has sparked an ongoing debate about the financial benefits of ESG investing and its implications for long-term performance and risk management (e.g., Renneboog et al., 2008; Nofsinger & Varma, 2014; Auer & Schuhmacher, 2016; Lins et al., 2017). Piserà & Chiappini (2022) investigate the hedging and safe haven properties of the ESG index during COVID-19 in China. They found that during the outbreak of the COVID-19 crisis, ESG indices are the most effective indices to hedge the Shanghai Stock

Exchange position. A study by Mousa, Saleem, and Sági (2022) examined how standard, and ESG indices in the Arab region responded to volatility during the COVID-19 crisis. The study found results suggesting that ESG investments play an essential role as safer investments during times of crisis. Furthermore, their findings indicate that the ESG index is a safe haven for investment since it was less affected by the COVID-19 crisis than the standard index. In summary, ESG stocks could provide investors with a promising approach to risk management.

The research gap pertains to the markets that need to be studied and the duration of the research. Notably, the paper will be the first to analyze the MENA region comprehensively and examine the performance of cryptocurrency and ESG stocks' Safe-haven capabilities for the MENA region. The paper will look at a large sample of data and endeavor to provide MENA investors with valuable information to help them guard themselves against market downturns and help them capitalize on any opportunities during these downturns. Additionally, we will provide investors with information to support their day-to-day hedging activities in regular market periods.

III. Data

The data for this study includes the daily closing prices of The Dow Jones MENA Index; a stock market index that tracks the performance of publicly traded companies in the Middle East and North Africa region. S&P Dow Jones Indices, a subsidiary of S&P Global, maintain the index. The Dow Jones MENA Index includes companies from Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, and the United Arab Emirates. The index provides a comprehensive and representative benchmark for the performance of the stock markets in the Middle East and North Africa region. The index is calculated based on the total return

methodology, which considers price changes and dividends. The index provider regularly reviews to accurately reflect the regional stock markets' performance.

Additionally, to test for hedging and safe-haven capabilities, we use the daily closing prices for the Philadelphia gold and silver index, the West Texas Intermediate (WTI) crude index, the CCI30 Cryptocurrency index, and the S&P/Hawkamah ESG Pan Arab Index; a stock market index that tracks the performance of companies in the Middle East and North Africa (MENA) region based on Environmental, Social, and Governance (ESG) criteria. The index measures the performance of companies demonstrating a commitment to ESG principles and practices. S&P Dow Jones Indices maintain the index in partnership with the Institute of Corporate Governance in the Arab World (Hawkamah). The index provider uses a proprietary methodology that considers various ESG factors, including environmental impact, labor practices, human rights, and governance practices. The Data will cover a period from January 1st, 2015, until February 20th, 2023, to test for hedging capabilities on average for around eight years. 2015 was chosen as a starting point to allow for the least amount of data gaps as all the indices from which the data was obtained were established. Additionally, to test for safe-haven capabilities, we look at various periods of economic and financial unrest between 2015 and early 2023 to see how the relationship between the MENA market and the potential safe havens changes from one crisis to the other.

Daily data was explicitly chosen because, as Baur and Lucey (2010) and Ciner et al. (2013) demonstrated, investors tend to seek safe-haven assets for a short period. Moreover, the periods were chosen to facilitate a better understanding of investor behavior on average and during times of uncertainty. The data was obtained from Datastream, CCI30.com, and spglobal.com.

IV. Methodology

In this section, we introduce the modeling techniques used in our paper. First, we provide details of the dynamic conditional Correlation (DCC) GARCH model, first introduced by Engle (2002) and used in (Dar & Maitra, 2017) and (Omane-Adjepong & Alagidede, 2021) It estimates volatility spillovers and conditional correlations and is used to study the interaction between the MENA stock market, gold and silver, Oil, Cryptocurrency, and ESG indices. We then show how to use the DCC-GARCH results to calculate the hedge ratios and weights for a two-asset portfolio.

This paper estimates volatility transmission and dynamic correlations using a DCC-GARCH (1,1) specification following Sadorsky (2012), which also studies the volatility dynamics between emerging market stock prices and commodity prices.

The econometric specification used in this paper consists of two components. A one-lag vector autoregression (VAR) is used for returns modeling, allowing for autocorrelations and cross-autocorrelations in the returns. A multivariate GARCH model is used for modeling the time-varying variances and covariances. For the diagonal, dynamic conditional correlation models, the conditional variance is assumed to be VARMA-GARCH(1,1) based on Ling and McAleer (2003) study.

Let rt= (rts, rtg, rto, rtc, rte) be a k×1 vector containing the returns at time t on k= 5 assets, and in particular the stock market (rts), gold and silver (rtg), crude Oil (rto), cryptocurrency (rtc) and ESG index(rte). The conditional mean equation is specified by the following VAR model:

$$\begin{cases} r_t = c + \Psi r_{t-1} + \Xi b_t + \varepsilon_t \\ \varepsilon_t = H_t^{1/2} v_t\,, \quad v_t \sim N(0,1) \end{cases} \tag{1}$$

where $c = (c^s, c^g, c^o, c^c, c^e)'$ is a k×1 vector of constant terms; Ψ and Ξ are time-invariant k×k matrices of coefficients with elements $[\Psi]_{ij} = \psi_{ij}$, $[\Xi]_{ij} = \xi_{ij}$, where *i,j*={s,g,o,c,e}; $b_t = (b_t^s, b_t^g, b_t^o, b_t^c, b_t^e)'$ is a k×1 vector of dummy variables that take the value 1 for $t \geq tbreak$; $\varepsilon_t = (\varepsilon_t^s, \varepsilon_t^g, \varepsilon_t^o, \varepsilon_t^c, \varepsilon_t^e)'$ is a k×1 vector of error terms; $v_t = (v_t^s, v_t^g, v_t^o, v_t^c, v_t^e)'$ is a k×1 vector of independently and identically distributed errors. As for the volatility specification, Following Engle (2002), H_t is a symmetric k×k conditional variance-covariance matrix, which includes the time-varying conditional volatilities on the main diagonal, $[H_t]_{i=j} = h_{ii,t}$, and the time-varying conditional covariances on the off-diagonal elements, $[H_t]_{i \neq j} = h_{ij,t}$. H_t can be written as $H_t = D_t \, R_t \, D_t$, where $D_t = diag\{\sqrt{h_{ii,t}}\}$ is a diagonal k×k matrix of time-varying conditional volatilities following Engle (2002), and R_t is symmetric k×k matrix of time-varying conditional correlations with elements $[R_t]_{ij} = \rho_{ij,t}$, $so\ that\ h_{ij,t} = \sqrt{h_{ii,t}\, h_{jj,t}\, \rho_{ij,t}}$.

To measure volatility spillovers between assets, we follow Ling and McAleer (2003) and C.L. Chang et al. (2010). We obtain the elements of D_t from a multivariate GARCH specification. Ling and McAleer (2003) approach to modelling the conditional variances allows for measuring the volatility spillovers between assets. h_t is defined as the vector of conditional volatilities included in the principal diagonal of H_t

where The conditional variances are specified as

$$\mathrm{ht} = \gamma + \mathrm{A}\varepsilon_{t-1}^2 + \mathrm{B}h_{t-1} \qquad (2)$$

where $\gamma = (\gamma^s, \gamma^g, \gamma^o, \gamma^c, \gamma^e)$ is a k×1 vector of constant terms; A and B are k×k matrices that estimate ARCH and GARCH effects in coefficients, with the elements $[A]_{ij} = \alpha_{ij}$ and $[B]_{ij} = \beta_{ij}$ where *i,j*={s,g,o,c,e}. For *i=j*, A*ij* represents conditional ARCH effects which measure short-term

volatility persistence, whereas βij represents GARCH effects which measure long-term volatility persistence.

To be more specific, Aij and Bij coefficients capture volatility spillovers between assets. In particular, Aij measures the shock spillovers from asset j on the conditional volatility of asset i, while Bij measures past volatility spillovers from asset j on the conditional volatility of asset i.

In the DCC model, the time-varying conditional correlation matrix Rt takes the following form:

$$R_t = \left(\text{diag}\,(Q_t)\right)^{-\frac{1}{2}} Q_t (\text{diag}\,(Q_t))^{-\frac{1}{2}} \quad (3)$$

where Q_t is a $k \times k$ symmetric positive-definite matrix and is given by:

$$\mathrm{Q}_t = (1 - \mathrm{DCC(A)} - \mathrm{DCC(B)})\overline{\mathrm{Q}} + DCC(A)\, \varepsilon_{t-1}\varepsilon'_{t-1} + DCC(B)\, Q_{t-1} \quad (4)$$

$\overline{Q}$ is the unconditional covariance matrix of the standardized residuals ε_t, DCC(A) and DCC(B) are nonnegative scalar coefficients with a sum of less than unity that account for past influences on the current conditional covariances. At the same time, the elements of $[Q_t]_{ij} = q_{ij,t}$ can be interpreted as the dynamic conditional covariances between assets i and j. The parameters of the DCC model are obtained using the quasi-maximum likelihood (QML) algorithm of Bollerslev and Wooldridge (1992).

The conditional correlation coefficients can then be computed:

$$\rho_{ij,t} = \frac{q_t^{ij}}{\sqrt{q_t^{ii} q_t^{jj}}}, \forall\ \mathrm{i} \neq \mathrm{j} \quad (5)$$

The conditional volatility estimates are then used to compute optimal hedge ratios, which can be considered as the proportion of risk of asset i that can be hedged away by taking a short position in instrument (asset) j, while minimizing the variance of the formed portfolio. Based on Kroner and Sultan (1993), the hedge ratio between asset i (long position) and asset j (short position), can be computed as:

$$\beta_{ij,t}^{*} = \frac{\mathrm{Cov}(r_{it}, r_{jt})}{var(r_{jt})} = \frac{h_{ij,t}}{h_{jj,t}} \qquad (6)$$

And to calculate dynamic hedge ratios, we follow Sadorsky (2012)* Where the hedge ratios were interpreted as the dollar amount of the short position that needs to be taken in the hedge to cover one dollar of the long position in the asset under consideration. Making an instrument a *cheap hedge* for another asset when the associated hedge ratio is close to zero. Also, following the Baur & McDermott (2010) definitions an asset is a *strong hedge*, if negative correlations are observed with another asset and a *weak hedge* if it is uncorrelated with another assets on average. Similarly, a strong safe haven can be given to an asset when negative correlations are observed during crises and a weak safe haven when low (zero) correlations are observed.

* All computations are carried out using WinRats 10.0

V. Data analysis and preliminary statistics

The sample period for the data set for analysis covers January 1, 2015 to February 20, 2023. The sample period was chosen to study the behavior of the chosen assets on average and whether they can be considered good hedges for investors on a regular basis and safe-haven during crisis. (Fig 1.) Shows a plot of the raw data obtained from all the chosen indices.

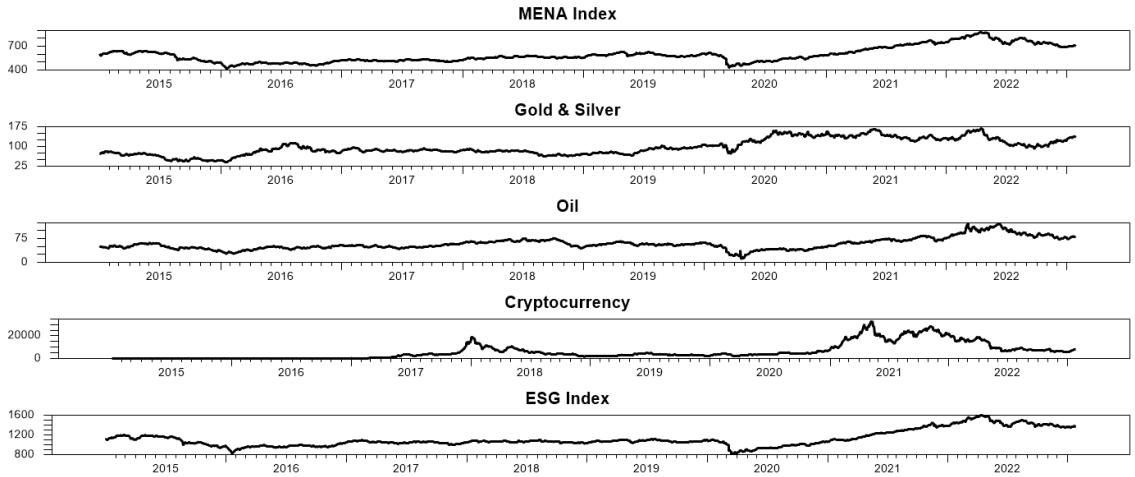

Fig 1. Time Series Plots of MENA Index, Gold & Silver, Oil, Cryptocurrency and ESG

We Focus on highlights in the MENA index to understand the significance of each event and how the other indices reacted during the same events. The plot shows that the MENA and ESG indexes tend to move together, which is expected as many of the ESG index constituents are also a part of the MENA index. Additionally, we noticed several downturns that were common among all markets. For instance, there is a downturn trend starting around mid-2015 and going into the start of 2016; this could be due to several significant events that occurred during that period, namely the downturn in Oil prices which was a sudden and significant decline in oil prices, caused by overproduction and weak demand, led to a sharp decline in the value of oil-related assets and a drop in the stock prices of energy companies this crisis can be classified as both an economic and financial crisis. From an economic perspective, the downturn in oil prices

had a significant impact on the global economy. Lower oil prices led to reduced investment and job losses in the energy sector, which had ripple effects on other industries and countries that are heavily dependent on oil exports. From a financial perspective, the downturn in oil prices had a significant impact on the energy sector, including oil companies and oil-producing countries. Many oil companies faced declining profits and significant financial pressure, leading to cuts to investment, job losses, and a wave of bankruptcies.

Additionally, countries heavily dependent on oil exports faced substantial budget shortfalls and were forced to take austerity measures. The downturn in stock prices could also be attributed to the Emerging Market Turmoil. Between 2015 and 2016, many emerging market currencies experienced significant depreciation, and stocks declined, leading to financial turbulence across these countries. Several factors, including rising U.S. interest rates and the Chinese economic slowdown, primarily triggered this financial crisis.

We also notice a slight period of low prices near the end of 2016; this could be in relation to The Italian Banking Crisis in 2016 and 2017; the Italian banking sector was hit by a crisis, leading to concerns about the stability of the eurozone and causing a drop in global stock markets. This crisis can also be Classified as a Financial Crisis as it led to a decline in investor confidence, a reduction in investment flows, and a general decline in the value of financial assets.

The 2016 U.S. presidential election also impacted stocks in the Middle East and North Africa (MENA) region, but the overall effect was limited. The uncertainty surrounding the election outcome, as well as concerns about the potential impact of the election on U.S. economic and foreign policy, led to a decline in investor confidence and a reduction in investment flows to global stock markets, including those in the MENA region. However, the impact on MENA

region stocks was limited compared to other regions. Many of the region's economies are highly dependent on oil exports, which are less sensitive to political developments in other parts of the world. Moreover, while the impact on MENA region stocks was limited, the election and its aftermath can be considered a political crisis because it disrupted the stability and predictability of the political and economic environment.

Following that, we see a steady trend on MENA index prices until the early 2020 period, where we see a sharp downturn in index prices as the COVID-19 pandemic effects start to have a significant impact on the global economy and financial markets, causing a sharp decline in stock prices, widespread job losses, and a contraction in economic activity. The COVID-19 pandemic can primarily be considered a health crisis; A health crisis refers to a situation in which there is a widespread outbreak of a disease or pandemic, resulting in a high number of infections and deaths and a significant burden on health systems. The COVID-19 pandemic fits this definition, as it has caused a global outbreak of the disease, resulting in millions of cases and hundreds of thousands of deaths worldwide. In addition to its health impacts, the COVID-19 pandemic has also had significant economic and financial impacts. However, the health crisis aspect of the pandemic has driven the other impacts and has been the primary concern for governments and populations globally.

It is important to note that the Gold and Silver index seems to be the only one with an immediate high improvement and recovery among the markets during that period. As 2021 comes to an end, we can see that Oil and the ESG index are also increasing in value. Cryptocurrency is notability decreasing after a short-lived Hight in mid-2021. Looking at early 2022, near the start of the Russia-Ukraine war, we notice no downward movements in the MENA index; however, there is a

slight decline in prices near the middle of 2022 as some of the effects from the war started to take place. These results show that although the Russian-Ukraine invasion was expected to have significant inverse effects on global markets, it does not affect the MENA index as severely as expected. However, it is important to note that the impact of the conflict will depend on its trajectory and resolution, and other factors such as the state of the global economy, commodity prices, and monetary policy may also play a role in determining the impact on the MENA region markets. The Russian-Ukraine conflict can be classified as a geopolitical crisis. Geopolitical crises can have a wide range of impacts, including on the economy, finance, and security of the countries involved, as well as on the global economy and security.

Table 1
Summary statistics for daily returns.

	MENA index return	*Gold & Silver return*	*Oil return*	*Crypto return*	*ESG return*
Mean	0.007728234	0.032414381	0.020520191	0.219774672	0.008789576
Median	0.017345552	0	0.194269124	0.391105721	0.010720986
Standard Deviation	0.837136082	2.46934527	4.595337271	5.083133582	0.725988595
Kurtosis	71.04143631	3.434773414	379.131459	8.333943697	73.57940187
Skewness	-4.442737763	-0.184927923	-10.00682243	-1.107516588	-4.451119178
Minimum	-15.60094933	-15.70547167	-132.4217011	-48.44830996	-13.65224418
Maximum	4.673747785	14.45374396	72.25412342	19.64234554	4.254859435
t-Statistic	0.412753	0.586898	0.199651	1.933092	0.541308
Observations	1999	1999	1999	1999	1999

Summary statistics for the returns are shown in Table 1. For each series, the mean and median values are close to zero. For each series the standard deviation is larger than the mean value. For each series, t-statistics indicate that the mean is statistically insignificant from zero. Each series displays a small amount of skewness and a larger amount of kurtosis and the returns are not normally distributed.

Time series graphs of the squared daily returns show how volatility has changed across time. Notice how all graphs show a huge spike in volatility by the end of 2019 and early 2020 at the peak of the covid19 pandemic. Before that, we can see that Gold and Silver had the most spikes in volatility between mid-2015 and mid-2016 corresponding with the period of decline in the value of stock prices globally that occurred between June 2015 to June 2016 which resulted from a combination of Financial and economic crises during that period, namely the Emerging Market Turmoil rising U.S. interest rates and the Chinese economy slowdown as discussed above. From all the potential hedging indices, the ones that had upwards movements as the MENA index returns stalled were the gold and silver and cryptocurrency indices. Indicating that, the inverse movements although small, could mean there's hedging and safe-haven potential.

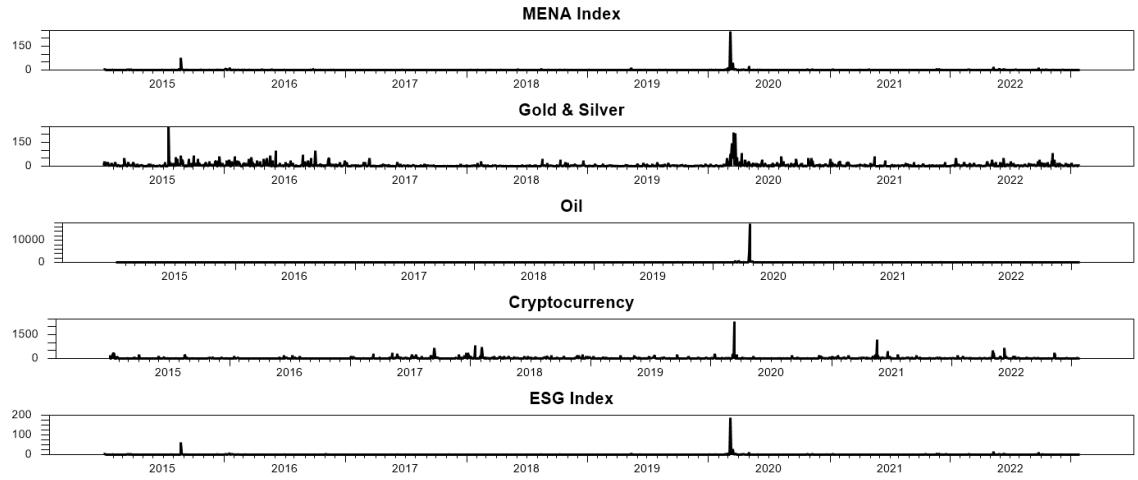

Fig 2. Squared Daily Returns

In (Table 2.) the unconditional correlations show that there is a strong positive correlation between MENA index and ESG. The strongest Correlation in fact among the tested indices. With the second strongest being MENA index and Oil.

Table 2
Correlations between daily returns.

	MENA index return	*Gold & Silver return*	*Oil return*	*Crypto return*	*ESG return*
MENA index return	1				
Gold & Silver return	0.1	1			
Oil return	0.2	0.2	1		
Crypto return	0.1	0.2	0.0	1	
ESG return	0.9	0.1	0.2	0.1	1

The correlations between the squared daily returns show a similar pattern as for the correlations between the returns (Table 3). The Correlation between MENA index and ESG is positive and larger than the Correlation between MENA index and other indices. The information presented in Fig. 2 and Table 3 shows volatility clustering and cross-correlations in volatility.

Table 3
Correlations between squared daily returns.

	MENA index return	*Gold & Silver return*	*Oil return*	*Crypto return*	*ESG return*
MENA index return	1				
Gold & Silver return	0.2	1			
Oil return	0.1	0.0	1		
Crypto return	0.1	0.2	0.0	1	
ESG return	1.0	0.2	0.1	0.2	1

VI. DCC estimation results

This section discusses the empirical results of our study. We first present the results from the DCC-GARCH models and then we compute hedge ratios resulting from including Gold and silver, Oil, Cryptocurrency and ESG stocks in the MENA index equity portfolio.

1. VAR results

Starting first with the VAR for returns, most importantly the estimated coefficients of Gold and silver, Oil, Cryptocurrency and ESG stocks on the MENA Index. Indicated by M(1,2), M(1,3), M(1,4) and M(1,5), respectively. The strongest effect is that a one period lag of ESG returns affects current period MENA index returns (Table 4). The estimated coefficient of ESG is the MENA equation M(1,5) is negative and establishes that there's a negative relationship between current period MENA returns and last period ESG returns. Followed by M(1,3) which represents the effects of a one period lag of Oil returns on current period MENA index returns. The coefficient in this case is positive, indicating that current period MENA Index returns are positively influenced by last period Oil returns.

2. Volatility spillovers

Additionally, In Table 4, own conditional GARCH effects which are represented by B(i,i), measure long-term persistence, and are important in explaining conditional volatility. The estimated coefficients on the own conditional volatility effects, the B(i,i) terms, are statistically significant at the 1% level. The coefficient B(1,1) refers to the GARCH term in the MENA index equation, while B(2,2) refers to the GARCH term in the Gold and Silver equation, B(3,3) refers to the GARCH term in the Oil equation, B(4,4) is referring to the

GARCH term in Cryptocurrency and Lastly, B(5,5) refers to the GARCH term in the ESG Index. Gold and Silver show the most amount of long-term persistence in volatility followed by Cryptocurrency, Oil, the MENA index and the ESG index.

Own conditional ARCH effects A(i,i) , which measure short-term persistence, are also important in explaining the conditional volatility (Table 4). For each i, the estimated A(i,i) values are smaller than their respective estimated B(i,i) values, indicating that own volatility long-run (GARCH) persistence is larger than short-run (ARCH) persistence.

For volatility spillovers between indices there are several significant instances.

Starting with short-term persistence, there is evidence of inter-sector volatility spillovers between The MENA index and Oil at A(1,3) where the MENA index and Oil have a positive relationship and at A(3,1) where Oil and the MENA index have a negative relationship. The MENA index and ESG index also show evidence of sector volatility spillovers at A(1,5) negatively, and at A(5,1) positively. Gold is also showing a evidence of short-term volatility spillover to the MENA index at A(2,1) where the coefficient is significant and positive. Cryptocurrency, on the other hand is insignificant in both instances of short-term volatility spillovers.

Looking at Long-term volatility spillovers, we notice all instances of volatility spillovers between the MENA index and the other markets are significant and vise versa.

the MENA index and Gold coefficient B(1,2) we find that it is positive, similarly the coefficient B(2,1) which represents the relationship between Gold and the MENA index is also significant and negative, resulting in an inter-sector volatility spillover.

Second, Oil is also showcasing an inter-sector volatility spillover with the MENA index at B(1,3) and B(3,1) where both coefficients are negative.

The coefficient between the MENA index and Cryptocurrency, B(1,4) is also significant and negative indicating that long-term volatility in the MENA index (Market) affects the Cryptocurrency index (Market) negatively, while on the other hand B(4,1) is positive indicating that long-term volatility in the cryptocurrency index (Market) positively affects the MENA index. Moreover, the ESG index and MENA index are also presenting inter-sector volatility spillovers at B(1,5) and B(5,1), both coefficients are positive in this instance. Lastly, the estimated coefficients on DCC(A) and DCC(B) are each positive and statistically significant at the 1% level. These estimated coefficients sum to a value which is less than one, meaning that the dynamic conditional correlations are mean reverting (Table 4).

3. Conditional Correlations

Figure 3. shows the time-varying dynamic conditional correlations from the DCC model.

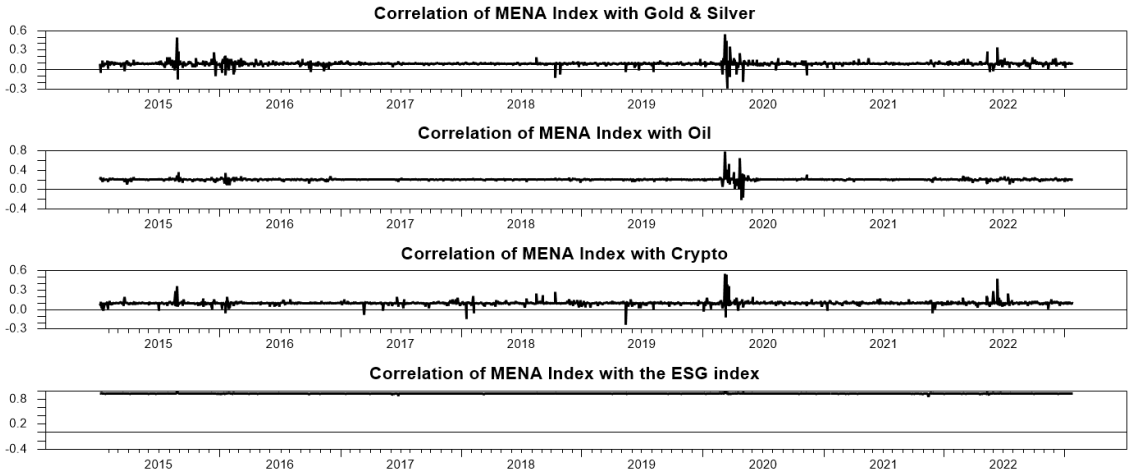

Fig 3. Time-varying conditional correlations from DCC model

we notice that the dynamic conditional correlations between the MENA index and Gold and Silver, are showcasing several instances of either zero or negative correlations, we notice

several zero correlations at the start of 2015 when the MENA index was having high stable stock prices. A similar behavior can be seen in the negative correlations in late 2018, zero correlations in mid-2019, negative and zero correlations can also be observed in mid to late 2022 which is also a period where MENA index stock prices were high. On the other hand, in times where the MENA index stock prices were relatively low, such as mid-2015 and early 2016 during the downturn in the oil prices, the Emerging Market Turmoil, and The China Slowdown, we notice a cluster of negative correlations. We also see the same pattern in late 2016 during the period of the Italian Banking Crisis where the correlations were zero or negative. Correlations are also negative during early 2020. In fact, we see the highest negative Correlation at almost -0.3 during that period.

Afterwards, we see slight, mainly upward movements in February, at the start of the Russia-Ukraine War, we notice some, weak negative and zero correlations paired with weak positive correlations. The weak volatility levels in the correlations lasts until the end of the year. Overall, the majority of the correlations are still positive values although they are close to zero on average.

Oil correlations with the MENA index showcased little to no levels of high volatility. With steady modest Correlation throughout the whole study period except for some volatility clustering in early 2020 similar to Gold, where we experience both the highest value of positive Correlation at 0.8 and the lowest value at -0.2. following that, the modest correlations trend continues even through the start of the Russia-Ukraine war and until the end of the study period. The Correlation are positive most of the time, which is in line with Arouri et al. (2011), Filis et al. (2011), Awartani and Maghyereh (2013) and Maghyereh et al.(2017), among others. It important to mention that Oil is the only index showcasing stable

correlations during the 2022 Russia-Ukraine invasion. though we do not see any negative or zero correlations.

The correlations between the MENA index and Cryptocurrency present many instances of negative and zero correlations between the pair. such as in early 2017 at -0.1, early 2018 at -0.2 and mid 2019 at almost -0.3. Most recently in early 2020, when Gold had its lowest Correlation, we notice that Cryptocurrency experienced only a modest negative correlation at -0.1. on average, similar to Gold and Silver, the majority of the correlations are still positive values although they are close to zero on average. we notice that the Cryptocurrency correlations do not act negatively during the times where the MENA index had low stock prices. We do notice zero or near zero correlations during those events. Cryptocurrency correlations also present us with the highest levels of positive correlations during the 2022 Russia-Ukraine invasion.

Lastly, the ESG index correlation with the MENA index is and ESG show no zero or negative correlations. As a matter fact, the correlation values are almost or nearing 1 for the whole study period. Indicating that the ESG index moves with the market with close to no deviations.

4. Hedging ratios

With the conditional volatility estimates we can construct hedge ratios according to (Kroner and Sultan, 1993). A long position in one asset (say asset i) can be hedged with a short position in a second asset (say asset j). The hedge ratio between asset i and asset j is;

$$\beta_{ij,t} = h_{ij,t} / h_{jj,t}$$

For most of the hedge ratios, computed from the DCC model, the graphs in Figure 4. show considerable variability. For most of the hedge ratios it is also the case that the maximum value was recorded in the early months of 2020. With another noticeable peak in 2015.

The average hedge ratio between the MENA index and Gold and Silver index is 0.03 while the average value of the hedge between MENA index and Oil index is 0.07. The average value of the hedge ratio between the MENA index and Cryptocurrency is 0.02 and least favorable ratio is the MENA index hedge ratio with the ESG index at 1.08. These results are important in establishing that a $1 long position in the MENA index can be hedged for 3 cents with a short position in the Gold and silver market, or for 7 cents with a short position in the Oil market. Moreover, the Cryptocurrency market provides the cheapest hedge price with 1 cent short position in the cryptocurrency market for each $1 long position in the MENA market. And the most expensive hedge price at a cost of $1.08 short position in the ESG market for each $1 in the MENA market.

5. Portfolio weights

Similarly, the conditional volatilities from the model can be used to construct optimal portfolio weights as in Kroner and Ng (1998):

$$w_{ij,t} = \frac{(h_{jj,t} - h_{ij,t}}{h_{ii,t} - 2h_{ij,t} + h_{jj,t}} \quad with\, w_{ij,t} \begin{cases} 0, & if \quad w_{ij,t} < 0 \\ w_{ij,t}, & if \quad 0 \le w_{ij,t} \le 1 \\ 1, & if \quad w_{ij,t}, > 1 \end{cases}$$

where wij,t is the weight of asset i in a one-dollar portfolio at time t, while the weight of asset j in is computed as $1 - w_{ij,t}$.

Summary statistics for portfolio weights computed from the DCC model are reported in Table 7. The average weight for the MENA Index/Gold & Silver portfolio of $1 is 0.93, indicating that for every dollar, 93 cents should be invested in the Gold and silver index and 7 cents should be invested in the MENA index. For the MENA Index/Oil pair, 96% of the dollar should be invested in Oil and 4% should be invested in the MENA index. Following that, the highest weight is present in the MENA Index/Cryptocurrency pair, where 99 cents should be invested in Cryptocurrency and 1 cent should be invested in the MENA index. And with the lowest weight, we have the MENA Index/ESG pair at only 1 cent in the ESG and 99 cents in the MENA index.

Following the Baur & McDermott (2010) and Sadorsky (2012) definitions, we can deduce from the hedge ratios presented in Table 5 as well as the conditional correlations presented in Figure 3. That Gold, Silver ,and cryptocurrency can be considered strong hedges to the MENA market on average as they both have zero and negative correlations present and they both have cheap hedging prices at 3 cent and 2 cents, respectively. Oil on the other hand can only be considered a weak hedge because although it's a cheap hedge at 7 cents and presents near zero correlations, it does not present negative correlations on average.

The ESG index does not give evidence for being a good hedge or safe haven instrument on average as nearly correlates directly with the MENA index and has the most expensive hedging price at 1.8 cents making an unfavorable hedging instrument.

Furthermore, we find that Cryptocurrency market can be considered a weak safe haven, as it presents near zero correlations during times of uncertainty, in addition to its cheap hedging price. These safe-haven characteristics mostly present during crisis periods classified as Financial and Economic. For our Health crisis, its important to note that although the Cryptocurrency index showcased negative correlations, it would not be our first choice for a safe haven during Health crisis periods. Conversely, during the period of Geopolitical turmoil (Crisis) Crypto is highly positively correlated making it a bad safe-haven choice.

Gold & Silver are also weak safe havens during times of uncertainty due to the near zero, and sometimes negative correlations during times of crisis as well as their cheap hedging price. These characteristics are present during most crisis periods; Financial, Economic, Political, Geopolitical. During our Health Crisis, however, Gold & Silver showcased the lowest negative Correlation with the MENA index as well as the highest positive Correlation. Making it a complex safe-haven option for Health crisis periods, nonetheless, it is our first choice for such crises. The study's results in regards to Gold and Cryptocurrency are in line with the results provided by (Chemkha et al., 2021) where they also found that Bitcoin and Gold are effective hedging assets in reducing risk. While gold is a weak safe haven during the COVID-19 pandamic and Bitcoin cannot provide any shelter to investors. Mokni et al.(2022) also provided corroborating results in regards to Bitcoin providing a weak safe haven during high volatility periods.

Lastly, although we do not consider it a safe-have per say, the Oil index presented stable correlations with the MENA index during the 1 year period since the start of the Russia-Ukraine invasion indicating that it could have potential as a safe investment.

VII. Conclusions and final remarks

This study examined the hedging and safe-haven capabilities of two assets traditionally associated with risk management and two current megatrends in the risk management and portfolio performance fields. We look into whether ESG and cryptocurrency stocks perform better than Gold, Silver, and Oil as hedging and safe-haven tools. We shed light on the often-abused concept of safe-haven asset and risk hedging, trying to address these differences related to the growing attention on ESG and cryptocurrency investments. We, therefore, combine two streams of research with open debates, sustainable finance and Cryptocurrency, addressing which of these two megatrends allows investors to hedge the exposure to financial volatility and shocks better strategically. And whether they are preferable to the true, tried Gold, Silver, and Oil.

We conclude that ESG stocks, although trending, they do not provide any safety to MENA region investors. Unlike Cryptocurrency and Gold and silver indices, which allow investors to hedge their investments cheaply, on average. We also find that the Cryptocurrency market provides a weak safe haven during Financial and Economic crisis periods. At the same time, the Gold & Silver market provides a weak safe haven during Financial, Economic, Political, and Geopolitical crises. As for Health crisis periods, we found that although both Cryptocurrency and Gold & Silver markets both have high negative and positive correlations, investing in Gold & Silver could be the better option during such crises.

Oil provided evidence for hedging capabilities; however, it was not a safe haven for investors during crisis. Although its behavior during the current Geopolitical crisis with Russia and Ukraine still needs further investigation.

Our study's findings provide important implications for policymakers who are interested in reducing the impact of global economic events on their country's economy. We recommend that policymakers consider diversifying their country's foreign exchange reserves to include safe haven assets, such as gold and cryptocurrency, in addition to traditional reserve currencies such as the US dollar and the euro. Furthermore, we recommend that govements and policy makers legalize and centralize cryptocurrency investing.

By doing so, policymakers can help protect their country's economy from external shocks and potentially reduce the impact of market volatility on their local financial markets. However, we acknowledge that investing in cryptocurrency may also pose some risks and challenges, such as potential regulatory uncertainty, cybersecurity risks, and the need for specialized expertise. Therefore, policymakers should carefully consider the potential benefits and risks of investing in cryptocurrency, and develop appropriate strategies to manage these risks effectively. Additionally, policymakers should consider the potential impact of including cryptocurrency in their foreign exchange reserves on their country's financial stability and international reputation.

Lastly, our paper is subject to limitations and suggests future research development in the ESG investing literature as different markets and/or different time periods could provide more in-depth results. In this context, expanding the analysis period may be of interest for future researchers to explore the consistency of our results. Additionally, Despite its usefulness, the DCC-GARCH model has limitations. It assumes that correlations remain constant over time, may not capture extreme dependencies, and is sensitive to lag length. Additionally, it can be computationally intensive. Therefore, results should be interpreted with caution and the use of other models could be employed in the future to further validate the results.

VIII. References

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IX. Appendix

Table 4

PanelA: Multivariate DCC-GARCH estimation results

Log Likelihood	-17045.3021			
Variable	Coeff	Std Error	T-Stat	Signif
Mean				
M(1,0)	0.03	0.01	4.65	0.00
M(1,1)	0.10	0.01	8.29	0.00
M(1,2)	0.03	0.00	7.39	0.00
M(1,3)	0.04	0.00	12.63	0.00
M(1,4)	0.01	0.00	4.52	0.00
M(1,5)	-0.05	0.01	-4.47	0.00
M(2,0)	0.03	0.06	0.55	0.58
M(2,1)	0.02	0.07	0.25	0.81
M(2,2)	-0.05	0.03	-1.98	0.05
M(2,3)	0.00	0.02	-0.11	0.91
M(2,4)	0.01	0.01	0.63	0.53
M(2,5)	0.04	0.09	0.44	0.66
M(3,0)	0.17	0.04	4.25	0.00
M(3,1)	0.08	0.03	2.99	0.00
M(3,2)	0.05	0.02	2.49	0.01
M(3,3)	-0.07	0.03	-2.56	0.01
M(3,4)	0.01	0.01	1.75	0.08
M(3,5)	-0.32	0.03	-10.80	0.00
M(4,0)	0.23	0.11	2.02	0.04
M(4,1)	0.70	0.05	12.81	0.00
M(4,2)	-0.02	0.04	-0.54	0.59
M(4,3)	0.02	0.03	0.53	0.59
M(4,4)	0.05	0.03	1.41	0.16
M(4,5)	-1.03	0.05	-19.77	0.00
M(5,0)	0.02	0.01	4.49	0.00
M(5,1)	0.05	0.01	7.17	0.00
M(5,2)	0.03	0.00	9.05	0.00
M(5,3)	0.03	0.00	10.77	0.00
M(5,4)	0.00	0.00	3.80	0.00
M(5,5)	0.02	0.01	2.24	0.03
Variance				
C(1)	0.05	0.00	19.55	0.00
C(2)	0.16	0.00	108.44	0.00
C(3)	-0.16	0.00	-78.86	0.00
C(4)	1.29	0.28	4.62	0.00

C(5)	0.03	0.00	7.05	0.00
A(1,1)	0.09	0.01	14.24	0.00
A(1,2)	0.00	0.00	-1.34	0.18
A(1,3)	0.01	0.00	63.85	0.00
A(1,4)	0.00	0.00	-0.53	0.59
A(1,5)	-0.06	0.01	-8.31	0.00
A(2,1)	0.27	0.01	29.79	0.00
A(2,2)	0.03	0.00	15.69	0.00
A(2,3)	0.00	0.00	1.06	0.29
A(2,4)	0.00	0.00	0.37	0.71
A(2,5)	-0.06	0.05	-1.36	0.17
A(3,1)	-0.64	0.02	-36.06	0.00
A(3,2)	-0.01	0.01	-2.43	0.02
A(3,3)	0.14	0.01	26.89	0.00
A(3,4)	0.00	0.00	-1.40	0.16
A(3,5)	1.01	0.04	27.27	0.00
A(4,1)	-0.07	0.06	-1.23	0.22
A(4,2)	0.02	0.01	1.64	0.10
A(4,3)	0.00	0.00	2.49	0.01
A(4,4)	0.12	0.01	11.23	0.00
A(4,5)	0.74	0.06	13.17	0.00
A(5,1)	0.02	0.00	3.62	0.00
A(5,2)	0.00	0.00	-0.90	0.37
A(5,3)	0.01	0.00	52.60	0.00
A(5,4)	0.00	0.00	-0.29	0.77
A(5,5)	0.04	0.00	8.18	0.00
B(1,1)	0.62	0.01	93.51	0.00
B(1,2)	0.02	0.00	19.29	0.00
B(1,3)	0.00	0.00	-2.99	0.00
B(1,4)	0.00	0.00	-2.89	0.00
B(1,5)	0.09	0.01	8.11	0.00
B(2,1)	-0.83	0.08	-9.84	0.00
B(2,2)	0.93	0.00	5796.58	0.00
B(2,3)	0.00	0.00	-0.21	0.84
B(2,4)	0.00	0.00	-2.58	0.01
B(2,5)	1.22	0.13	9.28	0.00
B(3,1)	-0.12	0.05	-2.57	0.01
B(3,2)	0.15	0.01	18.46	0.00
B(3,3)	0.76	0.00	167.49	0.00
B(3,4)	0.00	0.00	-0.44	0.66
B(3,5)	0.81	0.05	17.21	0.00
B(4,1)	0.41	0.10	4.14	0.00
B(4,2)	-0.22	0.01	-19.70	0.00
B(4,3)	-0.04	0.00	-9.26	0.00
B(4,4)	0.84	0.02	47.61	0.00
B(4,5)	2.02	0.05	43.12	0.00

B(5,1)	0.01	0.00	5.71	0.00
B(5,2)	0.02	0.00	13.50	0.00
B(5,3)	0.00	0.00	-2.79	0.01
B(5,4)	0.00	0.00	0.77	0.44
B(5,5)	0.52	0.00	200.10	0.00
DCC(A)	0.01	0.00	8.26	0.00
DCC(B)	0.97	0.01	177.09	0.00

Table 5

hedge ratios computed from DCC model

	Mean	*Std. Dev.*	*Min*	*Max*
MENA Index/Gold & Silver	0.03	0.01	-0.11	0.28
MENA Index/Oil	0.07	0.02	-0.01	0.32
MENA Index/Cryptocurrency	0.02	0.01	-0.05	0.27
MENA Index/ESG	1.08	0.05	0.88	1.58

Table 6

portfolio weights computed from DCC model

	Mean	*Std. Dev.*	*Min*	*Max*
MENA Index/Gold & Silver	0.93	0.01	0.8	1
MENA Index/Oil	0.96	0.02	0.84	1
MENA Index/Cryptocurrency	0.99	0.01	-0.05	1
MENA Index/ESG	0.01	0.04	0	0.73