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## **The impact of the covid-19 pandemic on the stock markets of some countries in the MENA region: An assessment with GARCH modeling**

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**Abstract.** This study examines the impact of the COVID-19 pandemic on stock market volatility for stock indices of a few MENA countries. The analysis consists of several elements: first, we assess the impact of this infectious disease on the standard deviations of stock market variables; second, we analyze the influence of the number of new daily cases and the number of new daily deaths on the standard deviations of these returns; and third, we assess the impact of the coronavirus on stock market volatility for these market variables using GARCH models. We find that the minimum value for most indices occurred in March 2020. Additionally, the results of the regression analysis reveal that the COVID-19 dummy variable, the number of daily new cases, and the number of new daily deaths have all had a significant negative impact on stock market volatility. Finally, the GARCH model reveals that the coefficients of COVID-19 endemic in the conditional variance equation had a significant positive impact on the conditional variance for stock indices, further indicating that the COVID-19 outbreak increased market volatility.

**Keywords.** the pandemic, COVID-19, GARCH

### **Introduction**

The COVID-19 pandemic is characterized by fairly difficult economic conditions and hard financial situations. The strong fluctuation in the prices of raw materials and the chain bankruptcy of several financial organizations characterize the extent of this crisis. It has hit both developed and developing countries hard, although the shock wave reached the latter after some time.

The WHO identified the first case of the new wave of coronavirus (COVID-19) in Wuhan, China on December 31, 2019. On March 11, 2020, the WHO declared the spread of the COVID-19 virus contagion.

On November 17, 2019, the COVID-19 pandemic spread to 210 countries and territories. The rapid spread of the health disaster has caused economic crises and strongly affected financial markets around the world.

On April 23, 2020, there was total of 2,638,909 cases, with 184,249 deaths (Worldometers, 2020). No other infectious disease has ever influenced the stock market as powerfully as the COVID-19 pandemic Baker et al., (2020).

Because of the swift exchange of news information via social media, The Covid-19 pandemic has had a much greater impact on financial markets compared to previous outbreaks.

Many studies have been conducted on the effect of other infectious diseases on stock prices. Chen et al., (2007) and Chun-Da Chen et al., (2009) have studied severe acute respiratory syndrome (SARS) in Taiwan. Ichev&Marinč, (2018) studied Ebola for the United States, while Curigliano et al., (2017) studied H7N9 influenza for China.

The first objective of our study is to examine the impact of the COVID-19 pandemic on the stock market indices of countries in the MENA region since the beginning of the crisis.

Many factors affected the price movement in the stock market. Such as the impact of monetary policy on the stock market, which is extremely important. If an accommodating monetary policy is implemented in a year, the probability of a rise in the stock market index will increase. Similarly, if a relatively restrictive monetary policy is put in place in a year, the probability of a decline in the stock market index will increase.

To carry out this study, we will use the GARCH methodology (generalized autoregressive conditional heteroscedasticity) adopted by Bollerslev, (1986) to model the impact of this health crisis on stock market indices.

The rest of this paper is organized as follows. Section 1 provides an overview of recent related research. Section 2 Discussion Data collection process and research methodology. Section 3 discusses the descriptive empirical results analysis; regression analysis, and GARCH models, section 4 draws conclusions.

## **I. Literature review**

The first case of the new coronavirus known as COVID-19 was reported in December 2019, therefore scientific research on the economics of the pandemic has urgently been developed.

The new coronavirus (COVID-19) has disrupted economic activities in affected countries and has become a real threat to the global economy and financial markets Barro et al., (2020); Ramelli& Wagner, (2020). Most global stock markets have fallen and international financial institutions have lowered their growth forecasts since 2020.

The outbreak of pandemic 'coronavirus' triggered fear; There were more and more confirmed deaths, the economic implications were detrimental not only to public health systems, but also to certain industries, food and agricultural industries, various types of markets, banks (The MSCI Europe Index has lost 33.7% since the start of the year, with the banks sub-index having fallen by 43.5% (source: FactSet, as of March 19)). Of which, (Mazur et al., 2021) claim that the financial market crash has negative effects that were more noticed in specific industries such as crude oil, real estate, entertainment and hospitality, and travel (according to (Jidar et al., (2021))).

According to the World Tourism Organization, international travel fell by 87% in January 2021 compared to 2020. The total number of travelers fell to 81% from 42,978 to 8,242 between two periods: from March 01, 2019 to February 29, 2020 and from March 01, 2020 to February 28, 2021. The smallest drop concerned trips of more than 90 days with - 65% between the 2 period's vs - 83% for shorter duration stays.

We noticed a decrease in trips to Asia (-94%), and a lesser drop to Africa (-75%). Thus, stays in Asia now represent only 3% of trips compared to 22% before the COVID-19 disease.

Because of this pandemic, the major banks in the euro zone announced a sharp drop in 2020 performance, and even suffered heavy losses for some. The cumulative net profit of the

four listed French banks (BNP Paribas, Agricultural credit, general society and French bank du Commerce Exterior) decreased, from 18.2 billion euros in 2019 to 9.6 billion euros in 2020. BNP Paribas, Europe's leading banking group, fell 13.5% to 7.07 billion euros in 2020, while general society suffered a loss of 258 million euros. La Group Mutual BPCE also fell to half (its net income was 1.6 billion euros), insurance (SwissRe's projections showed a decline in the global insurance market of 1.4% in 2020 after increases of 2.3% in 2019 and 4.8% in 2018.),...

However, for some industries, such as the pharmaceutical and biotechnology industries, the reactions could be positive due to the increase in sales.

Few studies have recently analyzed the impact of the current global health pandemic (COVID-19) on the macroeconomic situation. Wu et al., (2020) used daily data from June 1, 2019 to March 16, 2020 to study the direct and indirect effects of COVID-19 disease on the stock markets of China, France, Germany, Italy, Japan, South Korea, Spain and the United States. According to the Whitney test, the study observed that the COVID-19 virus had a negative but short-term impact on the stock markets of the affected countries.

The article by Alber, (2020) attempts to explain the behavior of stock market returns due to the spread of the coronavirus indicator; the spread of coronavirus increased during the research period from 01 March 2020 until 31 May 2020 in all GCC countries, where Saudi Arabia registered the highest indicators and Bahrain registered the lowest (<https://www.worldometers.info/coronavirus>) and stock returns trend lower in March 2020 and appeared to flatten out in April and May.

Albulescu, (2020) indicated that the coronavirus created fear and uncertainty, hitting the global economy and amplifying financial market volatility. The reaction of oil prices during this epidemic was gradually accommodated until March 09, 2020. 49 days after the publications of the first coronavirus monitoring report by the World Health Organization (WHO). As a result, international prices fell by more than 20% in a single day. The ARDL estimate showed that daily reported cases of new infections of COVID-19 disease have had a marginal negative impact on long-term crude oil prices. However, by amplifying financial market volatility, this virus is also having an indirect effect on recent crude oil price dynamics.

The Association for African Studies (CEDAM), predicted that the global economic growth, including that of Burkina Faso's trading partners, Europe, the United States and China, would become slow, which would negatively affect its exports. The situation could worsen if the prices of raw materials such as gold and cotton, which accounts for more than 80% of Burkina Faso's exports, fall sharply. According to the analysis, global merchandise trade fell by 13% to 32% in 2020 due to the COVID-19 pandemic. For countries like Mali and Burkina Faso, gold prices have logically continued to rise during the COVID-19 pandemic. Investing in gold is always a profitable investment for those looking to secure long-term savings, especially in times of uncertainty

## II. **Data and Methodology**

As the coronavirus is a new topic in the literature, the selection of control variables for this study was based first on recent empirical studies and then on data availability.

### 1. **Basic Regression Models**

We analyzed of the influence of the COVID-19 pandemic on index volatility using heteroscedasticity-corrected models. In models 1 to 3 below, they exist:

The dependent variable is the standard deviation for each index.

- Independent variables include:
- A dummy variable for the coronavirus period

- The number of new infected cases
- The number of new cases of death
- The control variables: the price of oil and the price of gold

These models are specified as follows:

$$SD_t = \beta_0 + \beta_1 \text{COVID}_t + \beta_2 \text{GOLD}_t + \beta_3 \text{OIL}_t \quad (1)$$

$$SD_t = \beta_0 + \beta_1 \text{NC}_t + \beta_2 \text{GOLD}_t + \beta_3 \text{OIL}_t \quad (2)$$

$$SD_t = \beta_0 + \beta_1 \text{ND}_t + \beta_2 \text{GOLD}_t + \beta_3 \text{OIL}_t \quad (3)$$

Where  $SD_t$  is the standard deviation for each index at time  $t$ ; COVID is a dummy variable equal to 1 for the coronavirus period (January-2020 to May-2020) and 0 for the pre-coronavirus period; NC is the number of new infected cases on day  $t$ ; and ND is the number of new death cases. In addition, we add to our regression in models 1 to 3 a set of control variables GOLD is the price of gold and OIL is the price of oil.

The oil price variable is based on the spot price of Brent crude oil. Brent and WTI are considered the global references for crude oil. Brent was chosen here. Gold price variables are based on international spot gold prices.

## 2. GARCH Model

Three characteristics of financial time series data distinguish it from normal time series data and thus distinguish the analysis of the return of financial assets from the returns of other asset classes, namely the distribution of the spikes (leptokurtic), the clustering of volatility is an important aspect of stock trading with various applications for financial institutions and leverage. In statistical terms, it refers to conditional heteroscedasticity and explains the conditional standard deviations of the returns of the underlying assets. Stock market volatility is said to be time-varying because it fluctuates over time, and volatility clustering occurs when periods of high volatility follow periods of low volatility and vice versa.

In situations of financial crisis and corresponding negative shocks, the leverage effect (or the asymmetric quality of financial time series data) is accentuated, and therefore volatility cannot be modeled by normal means. In this case, time-varying volatility models are needed Cordero, (2019).

Engle, (1982) is the first one who proposed the use of the conditional autoregressive heteroskedasticity (ARCH) process to incorporate variable nature and volatility at time, and Bollerslev (1986) later developed GARCH models to overcome some limitations of ARCH models.

Like the overflow and breaking of the non-negativity constraint. GARCH family models have since become the most widely used method for analyzing stock market volatility.

Such research studies, the GARCH family of models have consistently yielded highly accurate results, which have allowed the system to become the standard method for modeling the volatility of financial time series data.

The GARCH model can be enumerated as follows Brooks, (2002):

### *Conditional Mean Equation*

$$y_t = \mu + \varepsilon_t \quad (4)$$

### *Conditional variance equation*

$$h_t = \omega + \sum_{i=1}^r \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^p \beta_i h_{t-i} \quad (5)$$

Where  $y_t$  is the conditional mean, where  $h_t$  is the conditional variance,  $\omega$  and  $\mu$  are the constant terms,  $\varepsilon_t$  is the error term of the mean equation, and  $q$  and  $p$  are the offset of the residual (error) term and of term conditional variance in the conditional variance equation.

The simplest, yet often most common, GARCH mechanism is the GARCH (1,1) model, also known as the generic or "plain vanilla" GARCH model. Karmakar, (2005) suggested using GARCH(1,1) to record the conditional volatility of stock returns. However, the model does not take into account the leverage effect and sometimes leads to a violation of the non-negativity constraint. Nevertheless, the GARCH (1,1) model is considered excellent for a wide range of financial data, and it is the process chosen for this study.

Equation (5) is transformed into equation (6). The GARCH (1,1) model is written as follows,

Where  $\begin{cases} p = 1 \\ q = 1 \end{cases}$

$$h_t = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} \quad (6)$$

In equation 6,  $\alpha_1$  and  $\beta_1$  are the coefficients of the ARCH and GARCH terms, respectively. Then:

- $\alpha$  (ARCH effect) estimates the shock response.
- $\beta$  (GARCH effect) quantifies the time it takes for any change to disappear in one way.

Higher values of  $\alpha$  indicate greater responsiveness to new information, while higher values of  $\beta$  indicate a longer time for the change to fade away.  $(\alpha + \beta)$  provides a measure of the persistence of the relevant time series and therefore higher values for  $(\alpha + \beta)$  should tend towards 1 and imply greater volatility persistence Rastogi, (2014).

Of the three particular features of financial time series data mentioned above, leptokurtic distribution and volatility clustering were captured by GARCH models, but not asymmetric behavior. In other words, since the conditional variance equation is the amplitude of the residuals and therefore does not consider their signs (positive or negative), GARCH models impose a symmetric volatility response to positive and negative shocks, although negative shocks are likely to cause more increases in volatility than positive shocks. To overcome this limitation, the GJR-GARCH method was introduced by Glosten et al., (1993).

In our study, we therefore use the GJR-GARCH model to examine precisely the effect of the coronavirus on stock market volatility.

In order to capture the asymmetric response of conditional volatility to information, the standard GARCH variables can be supplemented by also including the squared values of  $\varepsilon_{t-1}^2$  when  $\varepsilon_{t-1}^2$  is negative.

The GJR-GARCH specification can therefore be written as follows:

$$h_t = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma I_{t-1} \varepsilon_{t-1}^2 \quad (7)$$

Then

$$h_t = \omega + (\alpha_1 + \gamma I_{t-1}) \varepsilon_{t-1}^2 + \beta_1 h_{t-1} \quad (8)$$

$$I_{t-1} = \begin{cases} 1 & \text{if } \varepsilon_{t-1} < 0 \\ 0 & \text{Otherwise} \end{cases}$$

In this new model, the non-negativity condition is now  $\omega \geq 0$ ,  $\alpha_1 \geq 0$ ,  $\beta_1 \geq 0$ , and  $\alpha_1 + \gamma_1 \geq 0$ .

Where  $\varepsilon_{t-1} > 0$  is good news and  $\varepsilon_{t-1} < 0$  is bad news, and each exhibit differential impacts on the conditional variance, which means good news has an impact of  $\alpha$ , while bad news have an impact of  $\alpha + \gamma$ .

If  $\gamma > 0$ , bad news increases volatility, indicating the presence of leverage.

If  $\gamma_i \neq 0$ , the information impact is asymmetric. It should also be noted that, to analyze the impact of the coronavirus on the volatility of the ten indices, a dummy variable was included in the variance equation.

The model has therefore been modified according to the GJR-GARCH approach, can be written as follows:

$$y_t = \mu + \varepsilon_t \quad (9)$$

$$h_t = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma_1 I_{t-1} \varepsilon_{t-1}^2 + \delta_1 \text{COVID}_t + \sum_{i=1}^4 \beta_i \text{CONTROL}_i \quad (10)$$

The dummy variable *COVID* takes a value of 0 for the pre-coronavirus period (which means before December 2019) and 1 for the current coronavirus period (which means January 2020 to October 2021).

Therefore, a negative and statistically significant coefficient for COVID would indicate a correlation between the virus and reduced MENA market volatility.

While a positive and statistically significant coefficient for COVID-19 would indicate a correlation between the virus and an increase in the volatility of this market.

As mentioned above, we also include two control variables, namely the price of oil and the price of gold.

### III. Results of the Data Analysis

We present in this section the different descriptive statistics of the variables, the results of the Augmented Fuller dickey test and the estimation results of the GARCH models.

#### 1. Descriptive Analysis

Table 1 presents the basic descriptive statistics relating to the different variables selected for our study over a 24-month horizon; i.e. 731 observations for the variables expressed in real values.

**Table 1: Descriptive statistics relating to stock market indices of MENA countries**

	Tadawul All Share	Bahrain All Share	S&P/ES G Egypt	Morocca n All Share	Tunindex 20	OIL	GOLD
Mean	8846.012	1487.13	628.5327	11337.99	2998.109	55.50841	1777.268
Median	8474.81	1481.39	632.23	11528.24	2984.89	58.46	1784
Minimum	5959.69	1232.4	451.51	8987.89	2628.26	19.33	1462.25
Maximum	11939.6	1743.06	762.77	13579	3285.99	77.16	2103.2
SD	1525.451	128.682	65.74514	1116.357	157.7294	14.85163	130.4941
Skewness	0.39425	-0.094815	-	-	-0.151941	-0.380922	-3.92E-01
kurtosis	2.047818	2.047818	0.320176	0.216665	2.115399	1.988547	2.717975
Jarque-Bera	46.55203	22.30308	2.474382	2.028395	26.64689	48.8381	21.16552
Prob.	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
Obs	731	731	731	731	731	731	731

The descriptive analysis of the indices shows that the highest average return is that of Morocco (with mean of Moroccan All Share = 11337.99). While the highest average return of variables is that of gold with a value equal to 1777.268

The statistical values of median are usually lower than the mean, that is, the distribution is asymmetric and spread to the right. It can be seen that the minimum return value for the Tadawul All Share index took place on March 16, 2020 (min= 5959.69), similarly, the minimum

value for the Tunindex 20 index fell from 2628.26 on March 17, 2020, while the minimum values for the Moroccan All Share and S&P/ESG Egypt indices which took place on March 18, 2020 are respectively 8987.89 and 451.51, thus, the minimum return for the Barhin All Share index took place on May 13, 2020 with a value equal to 1232.4. The data further illustrates heavy losses in the Saudi market, with a spread equal to 5979.91. Additionally, the Moroccan All Share experienced the second largest one-day drop in history with a difference of 4591.11.

Indeed, their skewness and kurtosis coefficients are significantly different from their levels predicted by the normal distribution.

The values of the skewness coefficients are all different from zero, which supports the skewness of the distributions. The series of Bahrain All Share, S&P/ESG Egypt, Moroccan All Share, Tunindex 20, the oil price and gold show negative skewness coefficients. This implies that its distribution is left-elongated. Moreover, the Tadawul All Share series has a positive skewness coefficient. This indicates that their distribution is asymmetrical and spread to the right.

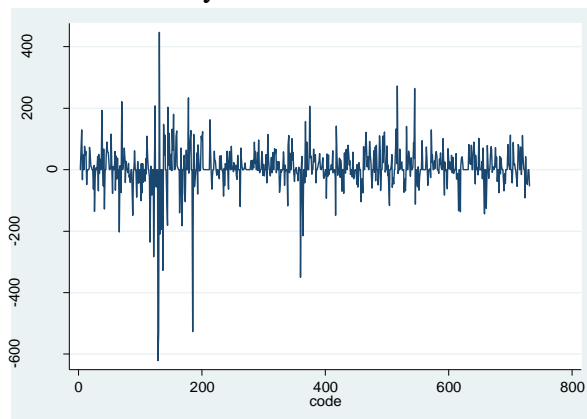
Similarly, the kurtosis coefficients are all different from three. All seven datasets display kurtosis values less than three indicating the leptokurtic character of their distributions.

JarqueBera's stats are statistically very high compared to the tabulated value for all indices.

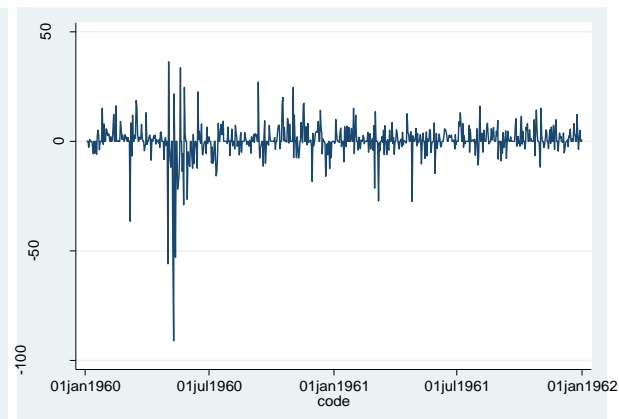
As well as the critical probabilities are always below the threshold of 5%, this makes it possible to reject the null hypothesis of normality

## 2. Results of the Basic Regression Models

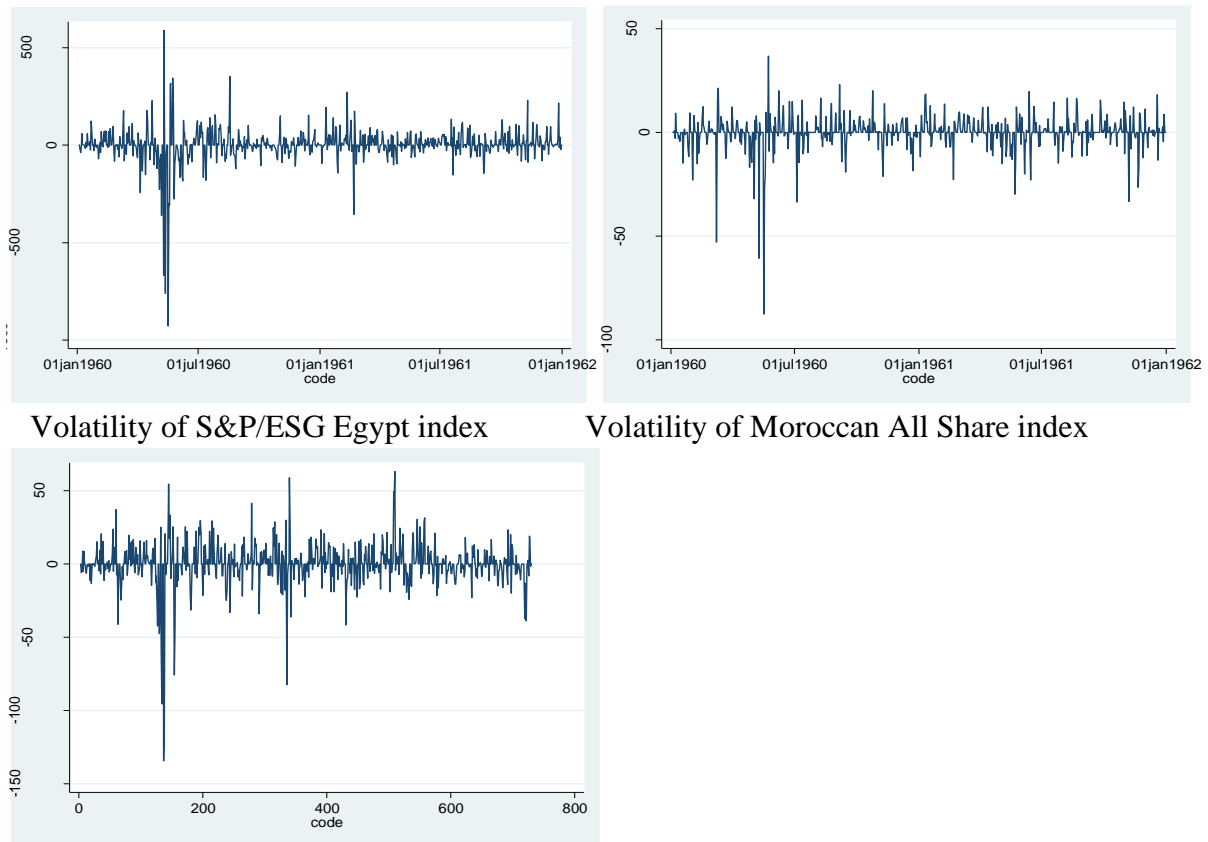
Before proceeding with the GARCH approach and in order to ignore any spurious regression, we tested the stationarity of the returns of financial markets of five countries of the MENA region and of oil and gold prices, to ensure that none of them is integrated of order two or more. To double-check the conditional variance obtained using stock index volatility modeling, we will analyze by sub-period. This explains the low volatility and the more or less similar volatility of our stock market variables:



Volatility of the Tadawul All Share Index



Volatility of the Bahrain All Share Index



Volatility of Tunindex 20 index

**Figure 5: Volatility of stock market indices in MENA countries**

In this section, we discuss the impact of COVID-19 on stock returns by looking at the posterior distribution plot. Here, we assess stock market volatility in selected MENA countries and short-term oil and gold prices. The map of these variables is shown in Figure 5.

In this case, the latter features charts of countries experiencing significant negative impacts during the COVID-19 pandemic on stock markets, it can be seen that the negative impact of the COVID-19 disease on stock markets is statistically significant for these countries.

The figure above shows that stock market returns react strongly and negatively to the numbers of infected and deaths from the COVID-19 pandemic.

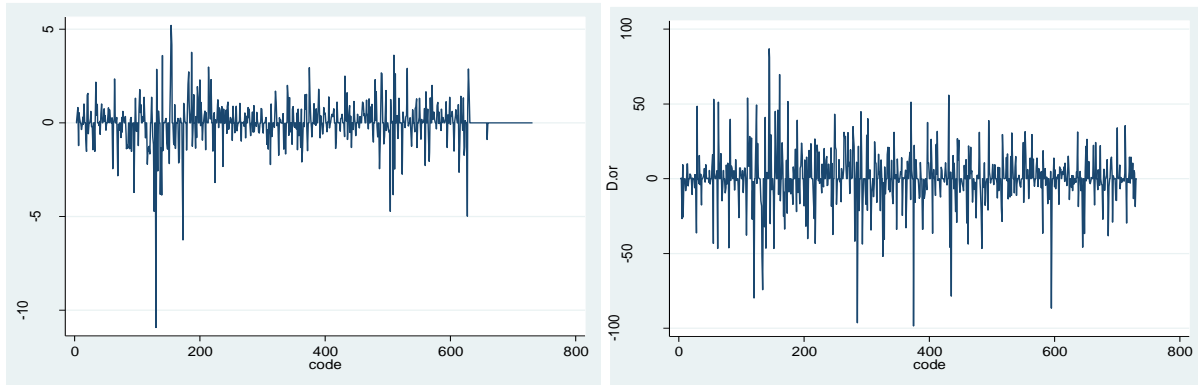
Regarding the volatility of the first stock index linked to Saudi Arabia (Tadawul All Share), there are three very important peaks. The first peak took place on March 16, 2020 with a strong fall of 5959.69. Thus, the second peak is less important at 6603.96 on May 11, 2020. A return to the drop in November 2020 with a value of 7864.78; which shows the first graph.

According to the second chart, the Bahrain stock market got two big drops. A small decrease on January 05, 2020 equal to 1575.67. A sharp reduction in volatility value set at 1232.4.

For Egypt, according to the third graph, the Egyptian financial market shows a sharp increase on February 08, 2020 in value of 751.18 and a sharp drop on March 18, 2020 of 451.51.

Even more, the fourth graph illustrates that there are two peaks. A first smaller decrease on February 12, 2020 (12027.31) and a larger decrease on April 07, 2020 equal 9056.04

While for Tunisia, there are three very remarkable peaks. One took place on March 17, 2020 with a minimum value equal to 2628.26. A second less strong than the first (2671.22) on April 06, 2020. The third is weaker than the others, equal to 2871.11.



Oil price volatility                      Gold price volatility  
**Figure 6: Volatility of control variables**

The price of oil had experienced a strong evolution during the period of the COVID-19 pandemic. The most outstanding fall took place on April 21, 2020 from a value of 19.33. Oil has been trading since June 2020, which represents a drop of more than 30% compared to the price on January 1, 2020.

While for the price of gold increased by 4.7% and reached its highest level ever recorded in August 2020 (2081.7). A record never seen since the establishment of the price of this precious material in the 2000s. From the graph above we can conclude that the price of gold is very volatile in the short term.

To test if the time series is stationary, we refer to the Dickey Fuller test. It is a statistical test whose purpose is to test the null hypothesis that there is no unit root and the alternative hypothesis that there is a unit root. The test results are shown in the table below:

**Table 2: Dickey Fuller test result in level**

	ADFinlevel		
	coefficient	t-ratio	P-Value
Taawul All Share	5.635356	2.12	0.9843
Bahrin All Share	0.3048631	1.05	0.9797
S&P/ESG Egypt	-0.1316575	-0.45	0.2215
Maroccan All	2.712192	0.86	0.9515
Share	2998.109	513.92	0.6405
Tunindex 20	0.0157	0.39	0.8536
Oil	0.3143973	0.47	0.1857
Gold			

H0: la série comporte une racine unitaire: la série est non stationnaire

H1: la série ne comporte pas une racine unitaire la série est stationnaire

The level ADF test (Table 2) reveals the presence of a unit root in our time series. The processes associated with our series are therefore compatible with the property of non-stationarity at the level.

**Tableau 3: Résultat de test de Dickey Fuller en différence première et de test ARCH-LM**

\*\*\* : Significativité au seuil 1%

	ADFinFirstDifferences			ARCHEffects
	coefficient	t-ratio	P-Value	LM
Tadawul All Share	6.449204	2.19	0.0000***	117.161
Bahrin All Share	0.5724029	-0.28	0.0000***	1.962
S&P/ESG Egypt	-0.993816	0.89	0.0000***	19.461
Maroccan All Share	3.490864	0.65	0.0000***	701.956
Tunindex 20	0.346726	0.15	0.0000***	6.487
Oil	0.0072806	0.32	0.0000***	5.532
Gold	0.2089696			

In general, ARCH models can estimate past transient chronic fluctuations and make dynamic predictions based on mean and variance Engel, (1982).

All results presented in Table 3 are statistically significant for the first difference, with an ADF p-value of less than 1%. This indicates that the time series data is stationary throughout the study period. Therefore, we reject the null hypothesis of a unit root in the return series at the 1% level.

The heteroscedasticity existence test is based on the Lagrange multiplier (LM) test. There is an ARCH effect on a series of returns. The results of the ARCH heteroscedasticity test (ARCH-LM) were significant in all return series, confirming the null hypothesis of an ARCH effect in our time series. Moreover, the ARCH-LM test shows that all the series of returns of the seven variables have a time-varying variance, and it can be inferred that the statistic of the ARCH-LM test is highly significant (The values of ARCH-LM from our data ranges from 1.962 up to 701.956).

Since the p-value for LM is less than 1% (the variables have P-Value values of zero, hence less than the threshold), the null hypothesis is rejected at the 1% level, which means that it there is a volatility of the variables.

These results therefore justify the estimation by the family of GARCH models, for this part of the analysis we used the GARCH(1,1) models.

### 3. Results of the GARCH Models

**Table 4: Result of GARCH models**

	GARCH (1,1)	P-Value
Tadawul All Share	0.9154041	0.0000**
Bahrin All Share	0.795269	0.0000**
S&P/ESG Egypt	0.8916599	0.0000**
Moroccan All Share	0.8432255	0.0000**
Tunindex 20	0.7034135	0.0000**
Oil	0.8024948	0.0000**
Gold	0.8334234	0.0000**

All estimated GARCH models for these variables produced statistically significant coefficients of up to 5%. We now turn to the conditional mean equation Eq4 and the conditional variance equation Eq6 of the GARCH(1,1) model as shown in Table 4.

Where the coefficients of the conditional variance equation, i.e.,  $\alpha$  (ARCH effect) and  $\beta$  (GARCH effect) are all related to timeliness. Specifically,  $\alpha$  represents recent news and its value is statistically significant, meaning that recent news has an impact on stock market volatility.  $\beta$  stands for old news, and its value is also statistically significant, suggesting that old news also has an impact on market volatility.

Moreover, high GARCH coefficients for stock market asset returns mean that conditional variance shocks take a long time to abate, so volatility is persistent.

This table presents the results of the GARCH(1,1) model, which adds the coronavirus variable and the control variables (oil, gold) to the conditional variance equation. The main variable of interest is the estimated coefficient for COVID-19, which aims to analyze the impact of the virus on asset volatility. The results reveal that the coefficient of the COVID-19 variable in the variance equation was positive and significant for all market returns. Based on the positive sign and p-value less than 0.05, we reject the null hypothesis of no effect of coronavirus. Instead, the COVID-19 pandemic has been shown to have a positive impact on stock return volatility for all MENA countries in our study.

Regarding the price of crude oil, the price of gold, we observe that both have a significant impact on the volatility of stock markets in MENA countries.

Nevertheless, the results clearly indicate that both variables play some role in predicting stock market volatility.

#### IV. Conclusion

In this study, we analyze the impact of the COVID-19 pandemic on the standard deviations of the returns of the main indices of a few MENA countries. Additionally, we analyze the impact of the daily number of new cases and daily new deaths on the standard deviations of index returns. Finally, we examine the implications of the virus on stock market volatility for the five indices using GARCH models.

The results of the regression analysis reveal a significant negative impact of COVID-19 on the standard deviations of index returns. Additionally, we are seeing a significant negative impact in both the daily number of new cases and the daily number of new deaths. Additionally,

GARCH model results reveal that the coefficient of COVID-19 in the conditional variance equation has a significant negative impact on the conditional variance of five country indices, implying that the coronavirus has increased stock market volatility in these countries.

We also find that ARCH effects are highly significant for all five country market indices (Saudi Arabia, Bahrain, Egypt, Morocco and Tunisia), indicating the presence of volatility clustering in the data set. It should be noted that our estimates of GARCH effects are even larger than estimates of ARCH effects, implying that changes in current volatility levels will continue to have an impact for a long time. Our results show that the sum of the ARCH and GARCH coefficients ( $\alpha + \beta$ ) is close to 1, suggesting that these volatility shocks are very persistent. In terms of financial implications, these results indicate a clustering of volatility for index returns.

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