



Impact de la pandémie COVID-19 sur la volatilité du marché boursier tunisien

Impact of the COVID-19 pandemic on Tunisian stock market volatility

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Abstract: *The rapid spread of COVID-19 pandemic has dramatic impacts on financial markets all over the world notably on Tunisian stock market. This study explains the exceptional behavior in financial return's conditional volatility of Tunindex and Tunindex-20 indices before and during pandemic. We assess the financial return's conditional volatility using daily data over the period 02 Janvier 2017 to 31 March 2022. Several approaches have been proposed for the description of its dynamics. Among these, we find ARCH and GARCH models. Our findings suggest a strong and statistically significant relationship between the COVID-19 pandemic and the volatility of Tunisian stock market index. The volatility of the Tunindex and Tunindex-20 financial return series tend to increase more when bad news is announced than good news.*

Key Words: COVID-19 pandemic, GARCH models, Tunisian sectorial stock market indices.

Résumé : *La propagation rapide de la pandémie COVID-19 a des impacts dramatiques sur les marchés financiers du monde entier, notamment sur la bourse tunisienne. Cette étude explique le comportement exceptionnel de la volatilité conditionnelle du rendement financier des indices Tunindex and Tunindex-20 avant et pendant la pandémie. Nous évaluons la volatilité conditionnelle du rendement financier à partir des données quotidiennes sur la période allant du 02 Janvier 2017 au 31 Mars 2022. Plusieurs approches ont été proposées pour décrire sa dynamique. Parmi celles-ci, on retrouve les modèles ARCH et GARCH. Nos résultats suggèrent une relation forte et statistiquement significative entre la pandémie de COVID-19 et la volatilité. La volatilité des séries de rendement financier de Tunindex et Tunindex-20 a tendance à augmenter davantage lorsque de mauvaises nouvelles sont annoncées que de bonnes nouvelles.*

Mot clefs : Pandémie COVID-19, Modèles GARCH, indices boursiers sectoriels tunisiens.

1. INTRODUCTION

The outbreak of COVID-19 and its rapid transformation into a global epidemic has forced entire swaths of the global economy to shut down and confused experts on all sides of the stock market community and decision makers. Faced with an exceptional increase in the number of contaminations in the world, massive confinements and the fear of a global economic recession, the stock markets fell one after the other. This crisis has induced significant negative impacts on the performance of different stock markets worldwide.

Several studies have investigated the effect of COVID-19 and its lockdown on stock market performance (Hong et al 2021; Alfaro et al 2020; Zhang et al 2020; Eleftheriou and Patsoulis 2020). These studies have focused on developed and emerging markets like US, France, Germany, Japan, China and Spain. Few of studies have explored the influences of COVID-19 on stock return volatility in African countries like Tunisia. While the Tunisia stock market has not always recovered from the revolution shock and is struggling to regain its full form, the COVID19 crisis is adding new constraints to stock market investment. The fallout from the COVID crisis such as border closures, restrictions on the movement of goods and services, and temporary closure of factories have cast a shadow over the outlook for Tunisian listed firms. All Tunisian firms have been negatively impacted from near or far by this current crisis. The permanent instability of volatility has certainly amplified by the pandemic, the capital market recorded very high volatility and significant declines in financial asset prices. At the trading session on March 2020, the Tunindex had declined by 3.33% whereas the Tunindex had fallen by 4.9%.

Return and price volatility are essential to the functioning of financial markets. There are two important indicators of market performance and are considered barometers of uncertainty surrounding investments and lack of investor confidence. The present study examines the impact of COVID-19 on the volatility of Tunisian stock market. It contributes to the existing literature in two important ways. Investigating on Tunisian stock market is very interesting because it suffers from several political problems. Furthermore, there are few of studies that explored this relation in Tunisian market, Tunisian context is fertile ground for investigation. The remainder of this paper proceeds as follows. Section 2 serves to present briefly the literature review. Section 3 describes the data used for empirical analysis. Section 4 evaluates the impact of COVID-19

on the volatility of Tunisian stock market. Finally, we conclude the paper with suggestions to both investors and policy makers.

2. LITERATURE REVIEW AND DEVELOPMENT HYPOTHESIS

2.1 The impact of crises on international stock markets

In the 21 st century, the world system has experienced many crises, epidemics and failures that resulted in the collapse of large financial institutions, the bailout of banks by governments and downturns in stock markets. Many studies have investigated the impact of different crashes on stock performance. The late 2000s financial crisis is considered to be the worst financial crisis, it is already causing a considerable slowdown in most developed and emerging stock markets (Ezzine et al 2011; Alen 2009; Johnson et al 2009).

Nippani and Washer (2004) show a negative association between SARS pandemic and China's and Vietnam's stock markets. Furthermore, Jiang et al (2017) find that H7N9 epidemic negatively impacts stock market performance. Also, Ichev and Marinc (2018) find that small firms's stocks were more affected by Ebola than bigger firm. Actually, the COVID-19 pandemic has caused an unprecedented human and health crisis. This virus has caused an economic slowdown and a collapse of several stock markets. Two particularities of this upheaval of the markets distinguish it from the previous ones. The first is the speed at which stock prices have fallen and the second is the acute growth in volatility. Since the first cases of COVID detected in China towards the end of 2019, the epidemic has spread across the globe. Many studies confirm the adverse impact of COVID-19 lockdown on stock returns in many countries in the world (Hong et al 2021; Alfaro et al 2020; Zhang et al 2020; Eleftheriou and Patsoulis 2020; Baek et al 2020). These different studies assert that the fluctuations in stocks markets caused by investors's worries, loss confidence and pessimism on the future income because of crisis have brought significant economic losses to markets.

2.2 The COVID-19 pandemic and macroeconomics aggregates

During 2020, the Tunisian stock market activity held up quite well in the face of the economic slump caused by Covid-19. This is confirmed by the stock market activity report at the end of the 2020. In this report, the Tunisia Stock Exchange Market indicated that the Covid-19 crisis dealt a severe blow to the

Tunisian economy. This economy was already suffering long even before this pandemic especially with a high frequency of social tensions and the fragmentation of the political landscape, although the public authorities have also taken support measures for households and businesses and monetary order aimed at mitigating the economic shock stemming from the pandemic. The poor performance of our economic fabric is also observed in Tunisia's trade with the outside world.

The following Table summarizes the results of the general equilibrium estimates of the impact of COVID-19 on the main macroeconomic aggregates:

Table -1: Pre and Post COVID-19 Macroeconomic Indicators (%)

	Reference Scenario	Scenario of COVID crisis
Gross Domestic Product (GDP)	2.7	-4.4
Inflation Rate	6.7	7.0
Unemployment Rate	15.0	21.6
Gross Fixed Capital Formation	2.9	-4.9
Household consumption	1.9	-8.0
Exports	5.8	-8.0
Imports	3.8	-8.0
Indirect taxes	11.3	-9.6
Income Tax on parties	9.5	
Corporation tax	4.6	-9.6

The Table 1 shows that overall effect of COVID-19 on Tunisian economy is negative, with a decline in growth (GDP) of -4.4%. This decrease is mainly justified by the drop in investments (-4.9%), private consumption (-8%) and exports (-8%), compared to the reference scenario. The COVID-19 pandemic has affected the whole world, and in particular Tunisia's main partners as France and Italy, and due to the difficulties of maintaining international transport, the overall impact on exports and imports would be negative.

2.3 The impact of the COVID-19 lockdown on Tunisian stock market

Tunisian stock market activity in 2019 was marked by a very difficult national economic situation for investors disoriented by the lack of visibility and the climate of attention. This situation is favoured by the electoral deadlines, the upward movement of interest rates and consequently an arbitration of investors in favour of monetary investments. Despite this situation, the companies' overall performance declined moderately, with semestrial results in down but overall income up for the first three quarters of 2019.

2020 was a very tough year. Tunisian economic recession due to the COVID19 pandemic has been totally unexpectedly sharp and deep. Like the repercussions on all countries around the world, the COVID19 crisis has dealt a severe blow to the economy. In Tunisia, the gross domestic product of the previous year decreased during the fourth quarter of the same year. According to the National Institute of Statistics, the tunisian economy recorded an unprecedented decline compared to 2019, following the contraction of economic activity in the main productive industries. Thus, the poor performance of the economic fabric has observed on Tunisia's trade with the outside world. Strong declines for exports and imports in 2020 are retraced.

The COVID19 crisis did not fail to have an impact on stock market activity indicators during 2020. The Tunindex20 and Tunindex are still falling. This fall is due to the decline of stock price of more than ten firms witch constitue these indices as ATB, STB, SOTPAPIER, BNA and UIB. Mohammed et al (2020) show that building materials, construction, food and beverage sector return volatilities have an insignificant asymmetric effect while consumer service, financial and distribution, industrials, basic materials and banks sector return volatilities have negatively high positive and effect significant asymmetrics effect compared with those during the pre-COVID19 period. Furthermore, they find that financial services, automobile and part, insurance and Tunindex-20 sectors have an insignificant leverage effect.

Hence, we put our following hypothesis:
The COVID-19 pandemic increases Tunisian Stock Market Volatility.

3. RESEARCH DESIGN

3.1 Sample and Data

This study is conducted on Tunisian stock market in order to explain the exceptional behavior of Tunis Stock Exchange TUNINDEX Index and its conventional counterpart TUNINDEX-20 during COVID 19 pandemic. The period of crisis pandemic is subdivided in two periods, the pre-crisis and the crisis. The pre-COVID-Pandemic period is from 02 January 2017 to 28 February 2020 and the COVID-pandemic is from 02 March 2020 to 31 March 2022. The daily Tunis Stock Exchange TUNINDEX and TUNINDEX-20 indices values are obtained from Tunis Stock Exchange website¹ (BVMT) from 02 January 2017 to 28 February 2022. These data are used to generate series of daily financial returns for Tunisia (1306 observations). These series will be obtained according to the following formula:

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}}$$

With,

R_t : The index return for day t

P_t : The index price for day t.

P_{t-1} : The index price for day t-1.

We calculated the daily financial return of Tunindex and Tunindex-20 using the series of the closing indices prices during the two sub-periods of crisis. We used ARCH-GARCH models to examine the temporal variation of Tunisia market indices. All data and tests are analyzed using Eviews 13 Software.

3.2 ARCH and GARCH Specification

The present study examines the impact of COVID-19 on the financial return's conditional volatility (FRCV) during two sub-periods of crisis, before and during COVID-19 pandemic. Abundant research has been conducted to study the behavior of the volatility of stock indices during the periods of the Covid-19 crisis. Several approaches have been proposed for the description of its dynamics. Among these, we find ARCH models, introduced by Engle (1982) then generalized by Bollerssev (1986) (GARCH-Generalized ARCH). These models present the particularity to better model the temporal variation of the first and second moments of the different types of assets and which help to better understand

the dynamics of the investors' behaviour during the crisis and calm periods. The measures of unconditional variance face some criticism not only regarding the choice of the order process (more arbitrary), but also the impossibility to take into account the changes in volatility over time (Jansen 1989). The GARCH (p, q) model has the following characteristics :

$$y_t = \varphi(x_t) + \varepsilon_t$$

$$\varepsilon_t / \psi_{t-1} \sim N(0, h_t)$$

$$h_t = \alpha_0 + \sum_{i=1}^p \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^q \beta_j h_{t-j} \quad \text{avec}$$

$$\alpha_i \geq 0; \beta_j \geq 0 \quad \text{et} \quad (\sum_{i=1}^p \alpha_i + \sum_{j=1}^q \beta_j) < 1$$

With :

y_t = The endogenous variable

x_t = The vector of exogenous variables

ε_t = The unexpected value of or the random shock y_t

$$\varepsilon_t = y_t - E_{t-1}(y_t) \quad \text{with} \quad E_{t-1}(y_t) =$$

$$\varphi(x_t)$$

ψ_{t-1} = Set of information used for forecasting y_t

h_t = The conditional variance of ε_t

p = Order of Effect ARCH

q = Order of Effect GARCH

In our research the vector x' only contains one constant for every sub-period and so the model reduces to:

$$y_t = c + \varepsilon_t$$

$$\varepsilon_t / \psi_{t-1} \sim N(0, h_t)$$

$$h_t = b_0 + b_1 \varepsilon_{t-1}^2 + b_2 h_{t-1}$$

4. RESULTS ANALYSIS

4.1 Data Analysis Description

The first step of sample analysis consists to generate and analysis the descriptive statistics of daily series of financial returns for the two sub-periods of COVID19 pandemic. The results of Table 2 show that means and medians are very low for each return index before crisis and in crisis. In fact, in pre-crisis, our results show low means returns of the Tunindex (0.0376%) and the Tunindex-20 (0.0355%). These low values are justified by a very difficult national situation for the investor disoriented by the lack of visibility and the climate of attention due to the electoral deadlines, as well as by the upward movement of interest rates. In the period of Covid-19 pandemic, the effects of the pandemic are very visible for the two indices. They posted negative

¹ <https://www.bvmt.com.tn/fr/content/historique-des-donn%C3%A9es>.

means returns, Tunindex (0.0355%) and Tunindex-20 (0.00196%).

Table -2: Results of Descriptive Analysis

	Pre-COVID 19 period		Pre-COVID 19 crisis	
	Tunindex Return	Tunindex 20 Return	Tunindex Return	Tunindex 20 Return
Mean	0.000376	0.00035	-0.000352	-0.0000196
Median	0.000255	0.000203	0.0002	0.0000127
Max	0.159849	0.159848	0.0191	0.020828
Min	-0.135022	-	-0.0409	-0.046737
SD	0.008646	0.009925	0.0052	0.006062
Observations	789	789	517	517

4.2 Econometrical analysis of data

The econometric analysis of the series of financial returns consists mainly in testing the hypothesis of stationarity and normality of the distribution. The verification of stationary character time series is possible thanks to the tests of Dickey & Fuller (1979, 1981). These authors have modeled tests that allow Stationary). For normality hypothesis, Jarque - Bera (1984) constructed a JB-statistic by calculating the distribution asymmetry (Skewness) and its shape (Kurtosis). The following table resumes the main results of tests.

Table- 3: Normality and Stationarity Results

	Tnindex Return	Tunindex 20 Return
Normality Hypothesis		
Skewness	3.006	3.203
Kurtosis	224.197	145.623
JB	1609710	670071.299
Stationarity Hypothesis		
Model 1	$x_t - x_{t-1} = b_1 x_{t-1} + \mu_t$	
b₁	-0.703 (-22.702)	-0.640 (-21.930)

R²	0.351	0.321
DW	2.009	1.992
ADF-T	-22.702	-21.930
Model 2	$x_t - x_{t-1} = b_1 x_{t-1} + c + \mu_t$	
c	-0.001 (-0.523)	-0.643 (-21.219)
b₁	-0.703 (-22.997)	-0.643 (-21.219)
R²	0.352	0.322
DW	2.009	1.991
ADF-T	-22.699	-21.219
Model 3	$x_t - x_{t-1} = b_1 x_{t-1} + c + b_2 t + \mu_t$	
c	-0.004 (-0.647)	-0.001 (-0.715)
b₁	-0.704 (-22.694)	-0.646 (-21.278)
b₂	-0.580 (-0.445)	-0.22 (-0.169)
R²	0.352	0.323
DW	2.009	1.989
ADF-T	-22.694	-21.278

The Table 3 indicates that skewness coefficient is positive during crisis period for both indices. The financial return series are slightly symmetrical to the right. These series are perfectly flattened to the right because their Kurtosis are greater than 3. This confirms that null hypothesis of normality is rejected for all significance levels. This conclusion is justified by the values of the JB statistics, which are significantly higher than the value of 2. This finding on the deviation of financial return series is supported by the majority of studies that prove the non-normality of financial return series (Suchman 1995). Furthermore, the results of this test show that the DF statistics are well below the various critical values at the thresholds of 1%, 5% and 10% and the coefficient is statistically different from 0 which means that all the series are stationary. The estimated model 3 shows that all series do not

present a significant trend since the coefficient associated with the time variable is not statistically significant for any of the series.

4.3 Results of GARCH (1, 1) model estimations

In order to explain the dynamics of the behaviour of the volatility of the financial return series, we propose to estimate the conditional volatilities of the different series of financial return by the GARCH model (1,1) in the first in pre- Covid-19 and in the second during the crisis.

4.3.1 Pre-COVID 19 crisis Results

The results of the test of the GARCH model (1.1) on the series of returns of the Tunindex and Tunindex-20 indices in pre- Covid-19 pandemic are presented in Table 4.

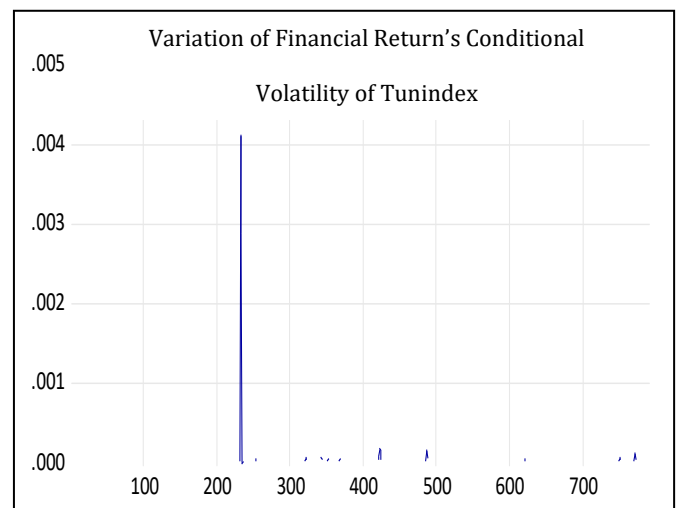
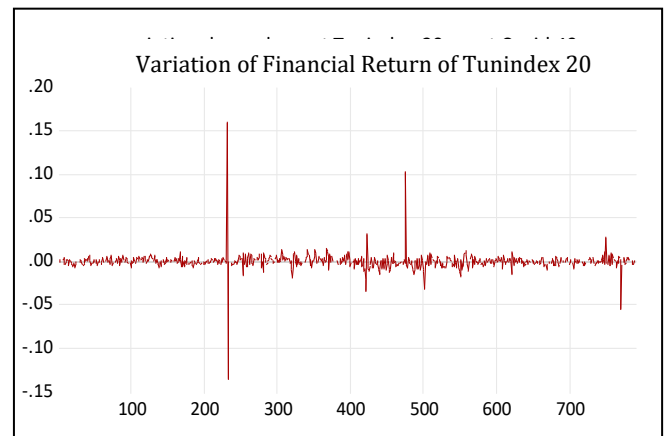
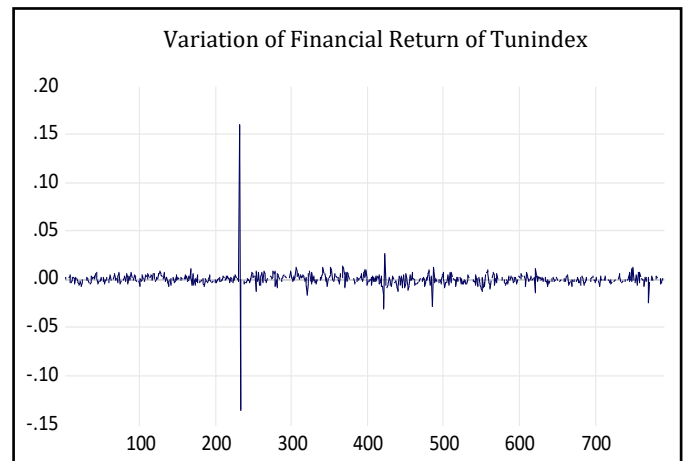
Table -4: Pre-Crisis Results

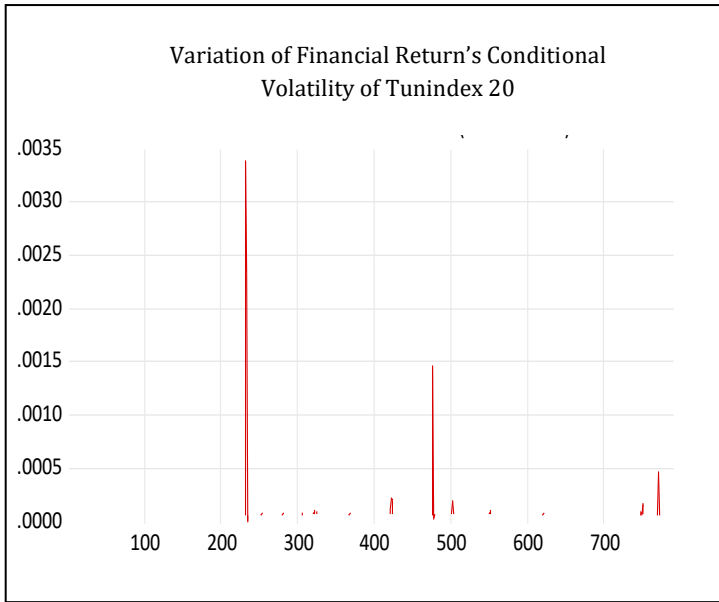
	Tunindex Return	Tunindex 20 Return	Z-Statistic	Prob
$b_0 (10^{-5})$	4.97	7.50	7.70058	0.000
b_1	0.1598	0.129	2.990	0.0028
b_2	-0.0172	-0.0322	Aé	0.8948

Table 4 shows that coefficients of the variance equation are significantly different from zero, positive for the coefficient b_1 and negative for b_2 . These coefficients verify the positivity constraints of the conditional variance. The ARCH effect measured by b_1 is significant but the GARCH effect which assessed by coefficient b_2 and which better modelling the persistence of volatility is not significant. This result is confirmed by the Figure 1 that shows a small variation in the conditional volatility of the financial return series in pre-COVID19 crisis. However, we suddenly observe a peak at the beginning of 2018 following the finance law 2018 which announced favourable measures for firms as the reducing of corporate tax rate to 25% within 5 years. In the other hand, the increases in the Value Added Tax, in the inflation rate and in the several other taxes caused a sudden drop in the returns of stock market indices. Without forgetting the ban on Tunisia's activity on cryptocurrency exchange, Bithumb the largest digital currency exchange due to non-compliance with international anti-money laundering and anti-terrorism financing

standards. We also notice another peak for the conditional volatilities following the political conflicts between President Béji, the head of government and the Ennahdha political party, which led to a paroxysmal and economic crisis at the top of the state.

Figure-1: Variation of the financial return and financial return's conditional volatility in pre-pandemic COVID period





4.3.2 In-COVID19 crisis Results

The results of the test of the GARCH model (1.1) on the series of returns of the Tunindex and Tunindex-20 indices in pre- Covid-19 pandemic are presented in Table 5.

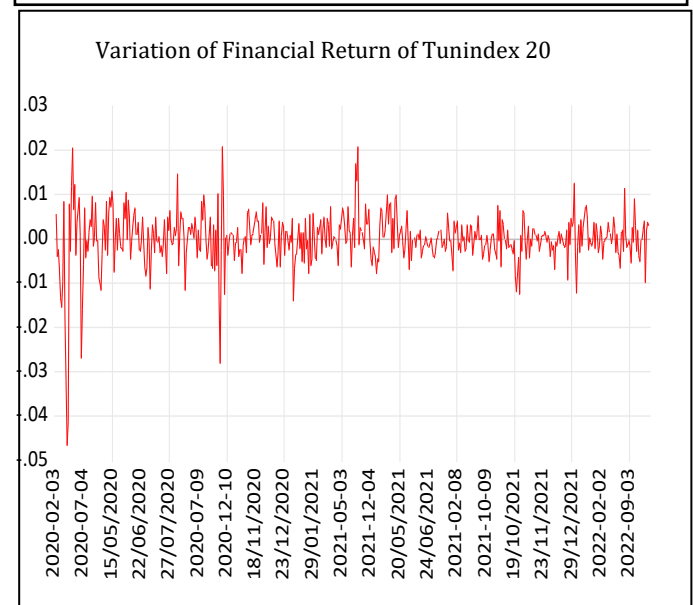
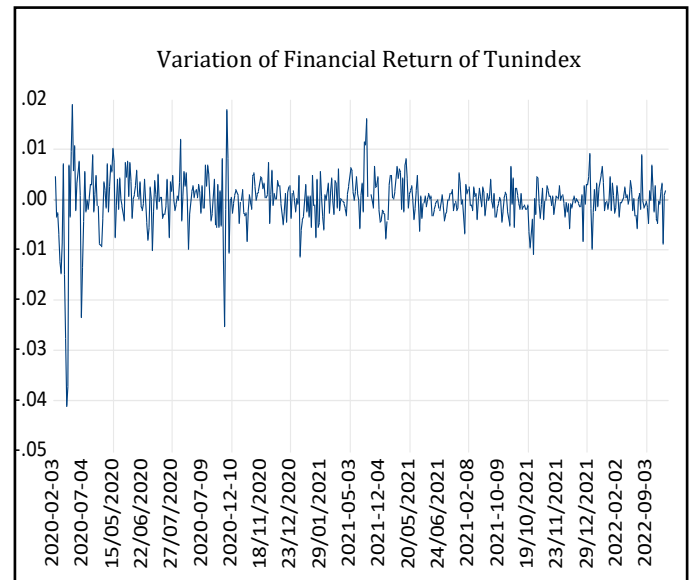
Table -5: In-Crisis Results

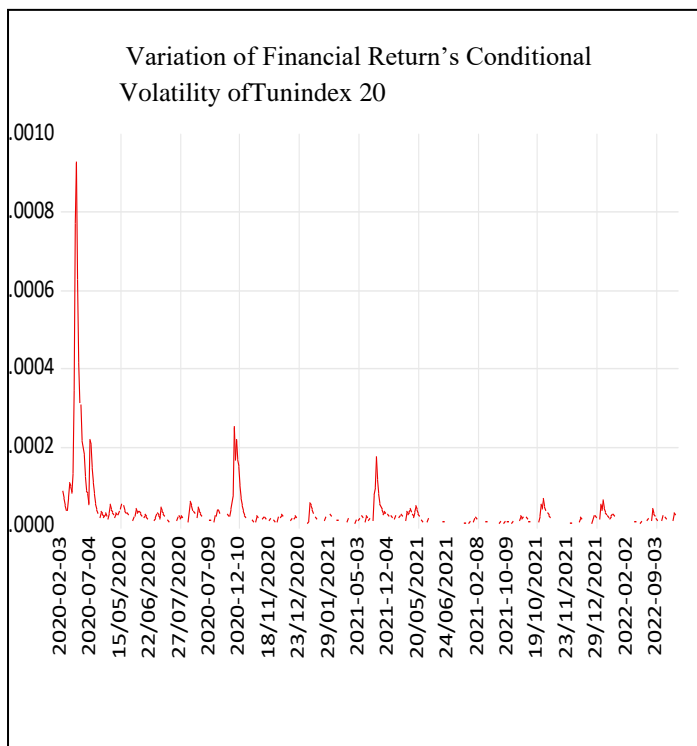
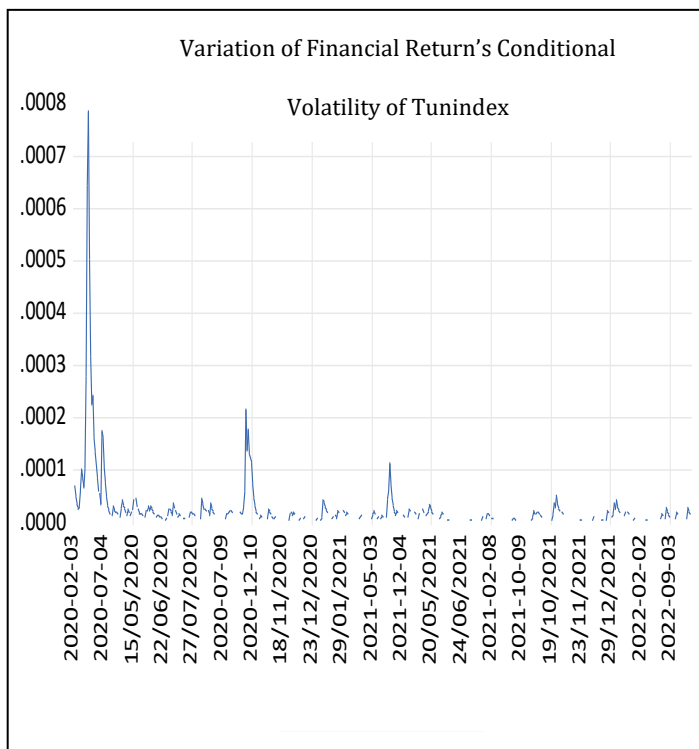
	Tunindex Returnr	Tunindex 20 Return	Z-Statistic	Prob
$b_0 (10^{-5})$	2.23	2.86	6.3500	0.0000
b_1	0.279246	0.247886	6.4539	0.0000
b_2	0.619755	0.657094	20.2391	0.0000

Table 5 shows that coefficients of the variance equation b_1 and b_2 are significantly different from zero. These coefficients verify the positivity constraints of the conditional variance. Z statistics is very greater than 0 with null probabilities. Hence, the ARCH and GARCH effects are significant. Most financial returns series which clearly explains the harmful effect of the pandemic on the Tunisian stock market. These results confirm our hypothesis. The Figure 2 shows an acute volatility of financial return series for the Tunindex and Tunindex-20 in crisis. The variation records low levels in the beginning of the Covid-19 crisis, the peak is reached on 03/02/2020 and 04/07/2020 for all companies

listed on the Tunisian stock exchange. Indeed, during the Covid-19 crisis period, stock indices lose their links with listed companies for a short period. Furthermore, the Figure 2 shows that financial return volatility records negative values during the second wave of the pandemic characterized by a medium peak (end of September 2020 - 10/12/2020). This can be explained by many factors. First, the decrease in gross domestic product compared to the years before Covid-19. Second, the decline in the economy recorded during the whole of 2020 following the contraction of economic activity in the main productive industries due to the effects of the Covid-19 pandemic. Third, this significant volatility is justified by the poor performance of the Tunisian economic fabric regarding Tunisia's trade with the outside world, characterized by the decline in exports and imports in 2020.

Figure- 2: Variation of the financial return and financial return's conditional volatility in pre-pandemic COVID period





5. CONCLUSION

Analyzing and understanding the behaviour of the Tunisian stock market is very important especially since the outbreak of the COVID-19 pandemic. For a long time, this market has been characterized by volatility which continues to increase year after year following the spread of crashes and crises affected not only Tunisia by all countries in the world.

Volatility modelling during COVID-19 pandemic is a rather tricky problem. In this study, using GARCH models to analyze the volatility dynamics of the Tunisian stock market before and during the COVID-19 outbreak conducts to very interesting results. First, an acute volatility of financial return series for the Tunindex and Tunindex-20 is demonstrated especially during COVID-19 period. The volatility of the show Tunindex and Tunindex-20 financial return series tends to increase more when bad news is announced than good news. Second, our results confirm that Tunisian market volatility can be influenced not only by its own past values or by domestic shocks such as political instability, but also by external shocks originating from international markets. Third, the increases in the Value Added Tax, in the inflation rate and in the several other taxes caused a sudden drop in the returns of stock market indices and acute volatility.

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