

# Cryptocurrencies' Time to shine in Tunisia

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# **Cryptocurrencies' Time to shine in Tunisia**

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## **Abstract**

Using the DCC-GARCH (1.1) model, we investigate the dynamic conditional correlations between Tunisian indices, digital assets, and gold prices for the period ranging from 4 January 2016 to 30 April 2020. Our findings reveal that digital assets (Bitcoin, Ripple, Ethereum, and Dash) and gold can be considered as hedge and diversifier assets before the 2020 global pandemic. Contrarily to Ripple which can be a safe haven asset for the Tunisian investors in early 2020, Monero can be considered as a diversifier asset more than a hedge. Finally, our results can be useful to Tunisian investors when accounting for implementing hedging strategies.

**Key words:** Tunisian indices, COVID-19 pandemic, Gold, Digital assets, Hedge, Safe haven.

**JEL classification:** C22, C5, G1

## **1- Introduction**

Firstly reported in Wuhan, China on December 31, 2019, the COVID-19 is declared as a world pandemic and affects many countries all over the planet. This pandemic continues to spread around the world, with more than 3.2 million confirmed cases in 188 countries on April 30, 2020. About 230,000 people have lost their lives due to this pandemic. The United States had by far the largest number of cases, with more than 85,000 deaths; it also has the highest death rate in the world. France, Italy, Spain, and the United Kingdom are the worst-hit European countries and have all registered more than 25,000 deaths. In China, the reported death rate is 4,600 out of 84,000 confirmed cases. The COVID-19 pandemic has been officially developing in Tunisia since March 2, 2020. The country registered 980 cases on April 30, 2020 and 39 deaths.

Over the last decades, financial markets and the diversity of financial assets have steadily grown in both value and volume. Since the Bretton Woods crash in 1973, gold does not have the same significance in the international monetary system. However, it still attracts tremendous interest nowadays from investors, the media, and researchers. Due to the increasing volatility of financial markets, the diversification of portfolios by hedges is becoming more and more relevant. In fact, during the global economic and financial crisis that started in 2007 with the subprime mortgage market crash in the United States, gold prices increased dramatically, while other assets suffered losses (Beckmann et al., 2015). In recent

years, correlations between most types of assets have increased dramatically. However, gold is still considered to be a zero-beta asset (McCown and Zimmerman, 2006) and is still assumed to be uncorrelated to other assets, which is an important aspect in an age of globalization in which correlations among most asset types grew dramatically (Baur and Lucey, 2010). Bentes (2016) indicated that gold returns had changed from long-term pre-crisis dependency to short-term memory during the crisis period. Gold also tends to be used as a hedge in periods of financial uncertainty (Selmi et al., 2018; Bouri et al., 2020; Jareno et al., 2020). Furthermore, the safe-haven property of gold is short-lived. In other words, gold is a safe haven when it is most needed (i.e. in extreme stock market conditions), but it is not a safe haven, and it is not supposed to be, in times of rising stock markets (Baur and Lucey, 2010). The main reason that explains why gold is usually referred to as a safe-haven commodity, is that it was among the first form of money and was often used as a hedge for inflation (Baur and Lucey, 2010). As with the COVID-19 outbreak, Ji et al. (2020) find that gold remains robust as a safe-haven asset. However, Cheema et al. (2020) find that gold fails to protect investors' wealth during the COVID-19 outbreak, and this finding is also supported by Jeribi and Snene\_Manzli (2021) who find that gold was neither hedge nor safe-haven for the Tunisian investors during this pandemic.

During the previous century, the exceptional speed of Blockchain's development has generated a number of avenues from which technological advances can move forward. According to Baek and Elbeck (2015), Dyhrberg (2016), and Blau (2017), Blockchain's most reported advancement has occurred in the growth of the cryptocurrency industry that appears to have expressed itself in substantial market valuations and product liquidity with cryptocurrencies being mainly seen as commodities rather than currencies. Dyhrberg (2016) asserted that the global uncertainty surrounding the 2008 global financial crisis has eased the emergence of the world's first decentralized blockchain-based cryptocurrency and strengthened its popularity. Bitcoin is invented by an unknown individual or group of individuals under the name of "Satoshi Nakamoto" on October 31<sup>st</sup>, 2008. It uses blockchain technology to verify transactions and avoid double-spending. This peer-to-peer payment system is a new type of monetary transaction; it allows online payments to be sent directly from one party to another without going through a trusted third party or a financial institution such as banks to verify the validity of the different transactions. Bitcoin has been the subject of challenges and opportunities for policy-makers, entrepreneurs, consumers, and economists since its creation. It is considered to be distinct from any other asset in the financial market. It

offers new opportunities for stakeholders in terms of portfolio analysis, risk management, and consumer sentiment analysis (Dyhrberg, 2016). Bitcoin is compared to gold because it has a lot of similarities. None of them is national or controlled by the government, and several independent operators and companies are extracting them.

Cryptocurrencies are widely viewed as disruptive innovations that lift both expectations and concerns in the minds of various groups of economic stakeholders. In reality, Cryptocurrencies deliver a range of potential advantages as an innovative and flexible payment mechanism, while at the same time posing possible risks that could affect investors, consumers, companies, financial systems and even national security (Guesmi et al., 2019). According to Brière et al. (2015), Selmi et al. (2018), Symitsi and Chalvatzi (2019) and Baur and Hoang (2020), Bitcoin is a highly volatile asset. It has become a major theme in the financial press and the academia. Given the acceptance of Bitcoin as an investment tool and its increasing importance, the modeling of Bitcoin price volatility is becoming increasingly important for investment decisions and risk management (Katsiampa, 2017). Many studies have used GARCH-Family Models as the basis of Bitcoin Volatility Modeling (Katsiampa, 2017, Bouri et al., 2017; Guesmi et al., 2019; Fakhfekh and Jeribi, 2020). Around the same period, another line of analysis focuses on the diversification ability of Bitcoin by researching the correlation between traditional asset classes and Bitcoin. Various studies use a number of approaches and suggest that Bitcoin is very weakly associated with traditional assets such as bonds, commodities, and equities (e.g., Bouri et al., 2017; Gajardo et al., 2018; Klein et al., 2018; Tiwari et al., 2019; Charfeddine et al., 2020; Jeribi and Fakhfekh., 2021). In addition, Brière et al. (2015), Bouri et al. (2017), Kajtazi and Moro (2018), Guesmi et al. (2019) and Charfeddine et al. (2020) suggested significant portfolio diversification and risk management gains when Bitcoin was incorporated.

Most of the works analyze returns and treat the volatility of Bitcoin as the market leader in digital currencies. A number of new cryptocurrencies occur and most of them are established on the basis of blockchains. Most of the literature, however, concentrates only on Bitcoin. Corbet et al. (2018) examined the relationship between the three cryptocurrencies (Bitcoin, Ripple, and Litecoin) and a variety of other financial assets. Their results, like those of Corbet et al. (2019), show that cryptocurrencies are rather isolated from other markets. In fact, the values for cryptocurrency market directional return and volatility from Bond, Gold, VIX, FX, GSCI, and S&P 500 to cryptocurrency markets are very low. They, therefore, suggest a role for cryptocurrencies as diversifying assets for investors with short investment horizons. Using a generalized DCC class model, Aslanidis et al. (2019) examine the behavior of conditional

correlations among four main cryptocurrencies (Bitcoin, Monero, Dash, and Ripple), stock (S&P500) and bond indices, and gold. These researchers argue that the cryptocurrencies analyzed are positively correlated and that the associations between cryptocurrencies and traditional financial assets are negligible. Using the BEKK-GARCH model, Ghorbel and Jeribi (2021) analyze the volatility spillover between five cryptocurrencies (Bitcoin, Ethereum, Dash, Monero, and Ripple), American indices (VIX, Nasdaq, and S&P500), gold, and oil prices, and they found evidence of a higher volatility spillover between cryptocurrencies and lower volatility spillover between cryptocurrencies and financial assets. By using four GARCH models (FIGARCH, FIEGARCH, EGARCH, and TGARCH), Fakhfekh et al. (2021) analyze the volatility dynamics of the Tunisian stock market before and during the COVID-19 outbreak. Among their results, they found that the volatility is more persistent in all the series studied. They also show that some of the Tunisian indices return volatilities (which are building constructs materials, construction, and food and beverage) have an insignificant asymmetric effect while the return volatilities of other sectors (which are consumer service, financials and distribution, industrials, basic materials, and banks) have relatively high positive and significant asymmetric effect compared with those during the pre-COVID-19 period. Finally, their findings show that the rest of the sectors (financial services, automobile and parts, insurance, and TUNINDEX20) have an insignificant leverage effect.

Also, using the copula-ADCC-EGARCH model, Tiwari et al. (2019) examine the time-varying correlations between the S&P 500 and six other cryptocurrencies. They find that the average time-varying correlations are very weak, suggesting that cryptocurrency acts as a hedge against the risk of the S&P 500 stock market. They also show that volatilities respond more to negative shocks than to positive shocks in both markets. Katsiampa et al. (2019) explore the dynamics of conditional volatility and conditional correlations between three pairs of cryptocurrencies, which are Bitcoin & Litecoin, Bitcoin & Ethereum, and Ethereum & Litecoin. While the price volatility of cryptocurrency appears to be dependent on its previous shocks and previous volatility, they found proof of bi-directional shock transmission impacts between Bitcoin and both Litecoin and Ethereum, and uni-directional shock spillovers from Ethereum to Litecoin. Also, their study describes the spillover effects of bi-directional volatility between all three pairs and provides evidence that conditional correlations are time-varying and are mostly positive. Charfeddine et al. (2020) studied the economic and financial advantages of Bitcoin and Ethereum to financial investors by researching their potential to produce advantages from portfolio diversification and hedge strategies. By estimating static and time-varying tail copulas, they found evidence of time-varying dependency and lack of

asymmetric tail dependency between digital and traditional financial assets. They stated that digital assets could provide new options for portfolio diversification by including just a limited amount of cryptocurrency in a portfolio of conventional financial assets. Jareno et al. (2020) analyzed Bitcoin's vulnerability to shifts in gold price returns, US stock market returns, interest rates, oil prices, and VIX. The findings revealed that Bitcoin is negatively affected by VIX, nominal interest rates, and crude oil prices. However, the relationship between the Bitcoin and the gold price returns is positive. In fact, Bitcoin is considered to be a safe haven asset during economic turmoil. Bouri et al. (2020) contrasted the safe-haven properties of Bitcoin, gold, and commodity index to the developed, emerging, US, and Chinese stock market indices. They show that the interdependence between Bitcoin, gold, commodities, and the stock markets is not very strong. So, they concluded that Bitcoin should be used as a modern virtual gold since it has some of the virtuosity of gold against the extreme downturn of stock market indices. Also, Corbet et al. (2020) examined the relationships between large cryptocurrencies during the Coronavirus pandemic and argued that similar to the role of precious metals during historic crises, digital assets acted as a safe-haven during the COVID-19. This means that during times of exceptional financial market turmoil, large cryptocurrencies operate as a store of value.

Bitcoin was created out of the financial crisis of 2008. The Coronavirus pandemic is gradually looking like the first real test in a crisis situation, as well as the other digital assets. Using the multivariate DCC-GARCH model, we investigate the time-varying conditional correlations between the Tunisian stock indices and cryptocurrencies on the one hand and between the Tunisian indices and gold on the other hand. In fact, we tested the safe haven and hedge properties of cryptocurrencies and Gold regarding the Tunisian indices. The content of this paper is structured as follows. The next section explores the Tunisian stock market during the COVID-19 pandemic. Section 3 discussed the empirical methodology. The data are presented in Section 4. Section 5 discussed the empirical results and finally, section 6 concludes the paper.

## **2- Tunisian stock market and COVID-19**

Since the appearance of the first case of Coronavirus in Tunisia on March 2, 2020, there has been panic and the main motivation is to ensure the protection and safety of the population against this virus. The health condition has become more and more critical. In fact, the number of infected persons is witnessing incredible growth every day, recognizing that the government and medical workers are making a great deal of effort to cope with this

unexpected health problem. On April 30, 2020, the number of people infected with COVID-19 reached 980 out of a total of 22,062 tests carried out since the first COVID-19 case in Tunisia last March. Also, the country registered 39 deaths, an average of 80 cases and 3 deaths per million inhabitants. However, the number of recoveries increased, with 294 cures reported nationally that time. The reduced number of cases observed in Tunisia is due to the efficiency of the medical teams and the responsiveness of the government that closed the borders on March 18 as well as the curfew from 18 March, from 6 p.m. to 6 a.m., the total containment, quarantines, social distancing, and the prohibition of all travels between built-up areas. The 4<sup>th</sup> of May 2020 was declared by the Tunisian government as the beginning of the first of three phases of progressive containment, which plans to gradually restart the economy between 4 May and 14 June, taking into account the evolution of the country's pandemic. On April 30, 2020, Yves Souteyrand, the representative of the World Health Organization (WHO) in Tunisia argues that the plan to combat the COVID-19 virus in Tunisia is a success. Even though the numbers of tests carried out are considered low, the situation in the country is different and studies have shown that the number of recoveries is increasing. Souteyrand explained that Tunisia had anticipated many measures to prevent the spread of the virus and closed its borders at the right time unlike other countries Like Italy, for example, which announced quarantine after registering 10,000 cases of infection, and France 7,000. And all this has given Tunisia the opportunity to control the contamination trend and thus control the first wave of the pandemic.

Considering the strong uncertainties and risks perceived by investors regarding the economic and social impact of the spread of the COVID-19 virus in Tunisia and the unprecedented measures taken by the Tunisian government to contain it, the TUNINDEX showed in March 2020 a strong decline of 9.59% after an increase of 1.29% during the month of February 2020, according to the analysis of the monthly activity of the Tunis Stock Exchange (TSE). Since the beginning of 2020, its losses have increased to 8.97%, compared to a loss of 5.64% during the same period in 2019. This downward trend has intensified following the transition to the second stage of containment and the closure of maritime borders on March 18, 2020. The TUNINDEX20, which represents the performance of the 20 largest and most liquid stocks listed on the equity markets of the Tunis Stock Exchange, followed the same trend with a decrease of 10.79% after an increase of 1.68% during February 2020. Since the beginning of 2020, its cumulative loss stands at 10.37% after a loss of 6.43% during the same period in 2019. Also, the TUNBANK values fell as for it of 9.76%. At first, this downward trend was

general and did not spare any sector. The banking sector, which represents 41.4% of the overall capitalization of the Tunis Stock Exchange and 52.6% of the TUNINDEX, seems to be the most affected. Following Tunisia's central bank<sup>1</sup> call for banks to suspend any dividend distribution measures for the 2019 financial year and to avoid allowing any repurchase transactions on their own shares, the stock market plunged again into the red. Regarding all these events and in spite of the pandemic's consequences, the Tunis Stock Exchange has resisted more than any other stock exchange in the world. It has experienced a decline of 10.5% since the beginning of 2020, which was defined as a very moderate decline relative to the behavior of other exchanges across the world since the Coronavirus spread, such as Germany (-19%), France (-25%), Egypt (-26%), Morocco (-22%).

### 3- Empirical methodology

To examine the time-varying volatilities and correlations between cryptocurrencies/gold and the Tunisian stock indices, we relied on the dynamic conditional correlation of the DCC-GARCH model introduced by Engle (2002). Firstly, we estimate the dynamic conditional correlation between cryptocurrencies and the Tunisian indices and secondly, between gold returns and the indices returns.

Let  $r_t$  be the vector composed of two returns series,  $r_t = (r_{1t}, r_{2t})'$ .

The variables are dependent on a constant and their own past values as follows:

$$A(L)r_t = \omega + e_t \quad (1)$$

where  $A(L)$  the lag polynomial and  $e_t$  the error-term.

The DCC model is based on the hypothesis that the conditional returns are normally distributed with zero mean and conditional covariance matrix  $H_t = E[r_t r_t']$  expressed as follows:

$$H_t = D_t R_t D_t \quad (2)$$

Where:  $D_t = [diag(h_t)]^{1/2}$  is the diagonal matrix of conditional variance resulting from univariate GARCH (1,1) process, and  $R_t$  is the conditional correlation matrix of the standardized returns  $\varepsilon_t$  with  $\varepsilon_t = D_t^{-1} r_t$ . The matrix  $R_t$  is given by:

$$R_t = \begin{bmatrix} 1 & \rho_{12t} \\ \rho_{21t} & 1 \end{bmatrix} \quad (3)$$

and decomposed into:

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<sup>1</sup> Note to the banks and to the financial establishments n °: 2020-17 of April 1st, 2020

$$R_t = Q_t^{*-1} Q_t Q_t^{*-1} \quad (4)$$

Where  $Q_t$  is the positive definite matrix containing the conditional variances–covariances of  $\varepsilon_t$ , and  $Q_t^{*-1}$  is the inverted diagonal matrix with the square root of the diagonal elements of  $Q_t$ :

$$Q_t^{*-1} = \begin{bmatrix} 1/\sqrt{q_{11t}} & 0 \\ 0 & 1/\sqrt{q_{22t}} \end{bmatrix} \quad (5)$$

The DCC (1,1) model is then given by:

$$Q_t = \omega + \alpha \varepsilon_{t-1} \varepsilon'_{t-1} + \beta Q_{t-1} \quad (6)$$

Where  $\omega = (1 - \alpha - \beta)\bar{Q}$ . Following Engle (2002),  $\bar{Q}$  is treated as the second moment of  $\varepsilon_t$ , and is proxied by the sample moment of the estimated returns in large systems.

Finally, in the context of our study, the key element of interest in  $R_t$  is the dynamic conditional correlation between cryptocurrencies/Gold and Tunisian indices, expressed as:

$$\rho_{ijt} = \frac{q_{ijt}}{\sqrt{q_{iit}q_{jtt}}} \quad (7)$$

To obtain the dynamic conditional correlation, Engle (2002) proceeds in two stages. Univariate GARCH models are estimated for each residual series in the first stage while for the second stage residuals, transformed by their standard deviation estimated during the first stage are used to estimate the parameters of the dynamic correlation.

## 4- Data and results

### 4-1- Data

We use the adjusted closing price data of thirteen sectorial indices and the benchmark TUNINDEX index listed in the TSE as well as the five popular cryptocurrencies (Bitcoin, Dash, Ethereum, Ripple, and Monero) and gold. The sector indices are: Food and beverage “TUNALIM”; Insurance “TUNASS”; Banks “TUNBANK”; Basic materials “TUNBASE”; Construction “TUNCONST”; Industrial index “TUNIND”, Financials “TUNFIN”; Automobile & parts “TUNAUTO”; Distribution “TUNDIS”; Building construct materials “TUNBATIM”; Consumer services “TUNSAC”; financial services “TUNSEFI”; Tunisian benchmark index containing 20 companies “TUNIDEX20”. The database was respectively collected from the TSE website, the Coin Market Cap basis, and the Data Stream basis for the period ranging from 04/01/2016 to 30/04/2020 with a daily frequency for a total of 1113

observations. It is worth noting that this period covers also the COVID-19 crisis. Daily returns are defined by  $r_t = \ln\left(\frac{p_t}{p_{(t-1)}}\right)$  with  $p_t$  the closing price of the stock market indices on day  $t$ .

#### **4- 2- Results**

Descriptive statistics of the Tunisian stock market indices are summarized in table 1. TUNALIM, TUNASS, TUNBANK, TUNBASE, TUNCONS, TUNFIN, and the two benchmark Tunisian indices, as well as digital assets and gold, recorded positive mean returns. However, TUNAUTO, TUNDIS, TUNBATIM, TUNIND, TUNSAC, and TUNSEFI indices registered negative mean returns. Whereas the TUNINDEX presents the lowest risk and MONERO presents the highest risk. Jarque-Bera test rejects the null hypothesis of normally distributed observed time series at a 1% significance level. The Skewness values show that the marginal distributions of TUNBANK, TUNBASE, TUNCONS, TUNDIS, TUNFIN, TUNSAC, TUNIDEX, TUNIDEX20, and Bitcoin are asymmetrically (left) distributed around the sample mean. However, the marginal distributions are skewed to the right (when the value is positive) for the rest. The kurtosis values represent the fatness of the tails of a probability distribution, relative to the normal distribution. All the kurtosis values are greater than 3 which show that returns are not normally distributed. The non-normality test results imply that a type of GARCH modeling can be fitted to model the variance in the variables. To do this, we must test for the presence of the ARCH effect. The null hypothesis of no ARCH effects is rejected at the 1% significance level for the thirteen sectoral indices and the TUNINDEX index as well as for the five popular cryptocurrencies and gold. This suggests that GARCH parameterization might be appropriate for the conditional variance processes.

#### **Insert table 1**

From Figure 1, we confirm this finding and can observe that the returns of digital assets are more volatile than the returns of the indices (Figure 1), which means that cryptocurrencies can be defined as highly volatile assets. This result is aligned with Brière et al. (2015), Selmi et al. (2018), Beneki et al. (2019), Symitsi and Chalvatzi (2019) and Baur and Hoang (2020). In addition, Ripple and Monero are among the most volatile; however, Bitcoin is the least volatile of all. We identify high volatility for all cryptocurrencies at the end of 2017, particularly with the launch of Bitcoin futures. This high volatility continued until early 2018, coinciding with the corrections of speculative bubbles that caused an increase in cryptocurrency prices. The crypto market became more volatile after the appearance of

COVID-19 in early 2020. The stock markets responded to the Coronavirus outbreak as a crypto market with worrying volatility, as traders were panic-sold out of fear. Gold is considered a safe haven (Baur and Lucey, 2010; Klein et al., 2018; Charfeddine et al., 2020) and investment in times of crisis. Gold is generally less volatile than other commodities but it was volatile this time. The price of gold continued to rise by mid-February, guided by two main factors. The first was a safe-haven investment resulting from global uncertainty and the second was low to negative returns on high-quality government bonds. In mid-March, the price of gold plummeted along with most other commodities and markets. Gold is not really playing the role of a safe haven that it has performed in the past.

### **Insert Figure 1**

Focusing on the time-varying conditional dependency between cryptocurrencies and Tunisian stock market indices in figure 2, we show that the dynamic correlations between cryptocurrencies and stock market indices are low before the appearance of COVID-19. We also discovered that cryptocurrencies are rather separated from other markets. This finding is similar to that of Corbet et al. (2018), Corbet et al. (2019), Aslanidis et al. (2019), Tiwari et al. (2019), and Charfeddine et al. (2020). Dynamic correlations between cryptocurrencies and stock market indices remain high and positive as news of the epidemic COVID-19 virus spreads further beyond China, unless some exceptions. When focusing on the time-varying conditional correlation between Bitcoin and stock market indices, we show that the dynamic correlation between Bitcoin and Tunisian stock market indices (TUNINDEX, TUNINDEX20, TUNALIM, TUNFIN, TUNASS, TUNBASE, TUNAUTO, and TUNDIS) is negative before the 2020 global pandemic. Applying the categorization of Baur and Lucey (2010), Bitcoin is considered as a hedge for these indices. After that, the correlations become positive. Bitcoin is considered as a diversifier for TUNBAT, TUNCONS, TUNIND and TUNSAC. However, it is a safe haven asset with regard to TUNSEFI investors.

### **Insert Figure 2**

The dynamic correlations between Ethereum/Dash and Tunisian stock market indices are similar to those between Bitcoin and Tunisia's indices. Turning to the Ripple, we note that the dependence structure is different from the previous ones, with two important observations. Firstly, the dynamic relationship between Ripple and the benchmark Tunisian indices

(TUNINDEX, TUNINDEX20) is positive in means. This result is similar to the case of Monero. Secondly, Ripple is considered as a safe haven for TUNASS, TUNDIS, TUNSAC and TUNSEFI investors in early 2020. We also observed that Monero is considered as a diversifier asset more than a hedge for Tunisian investors. Regarding the relationship between gold and Tunisian indices, we find that the Yellow metal can be used as a hedge for Tunisian investors. It is also considered as a safe haven asset for TUNBAT, TUNBASE, TUNIND and TUNSEFI financial investors during the COVID-19 outbreak (figure 3). This finding is consistent with Baur and Lucey (2010) who find that Gold acts as a safe haven asset in extreme stock market situations and Ji et al. (2020) who suggested, that given the irreplaceable role of gold in conserving the value of an investment, the yellow metal can be used as a safe-haven asset during the COVID-19 outbreak.

### **Insert Figure 3**

## **5- Conclusion**

This study analyses the hedge and safe haven proprieties of cryptocurrencies and gold for Tunisian financial investors by using the DCC-GARCH (1.1) model. The data covers the period between January 4<sup>th</sup>, 2016, and April 30, 2020. We observe that the returns of digital assets are more volatile than the returns of Tunisian indices and Gold, which means that cryptocurrencies can be defined as highly volatile assets. The results indicate that digital assets became more volatile after the appearance of COVID-19 in early 2020. The stock markets responded to the Coronavirus outbreak as the digital market with worrying volatility, as traders were panic-sold out of fear. We find that dynamic correlations between cryptocurrencies as well as gold and Tunisian indices remain high and positive as news of the epidemic COVID-19 virus spreads further beyond China, unless some exceptions. When focusing on the time-varying conditional correlation between cryptocurrencies and stock market indices, we show that Bitcoin, Ethereum, and Dash can be considered as a hedge for Tunisian indices before the 2020 global pandemic. However, it seems that during the COVID-19 outbreak, the correlation becomes positive and low. These digital assets act as diversifier assets. Contrarily to Ripple which can be a safe haven asset for Tunisian investors, Monero can be considered as a diversifier asset more than a hedge. Finally, we find that gold can be used as a hedge for Tunisian investors. It is also considered as a safe haven asset for TUNBAT, TUNBASE, TUNIND, and TUNSEFI financial investors during the COVID-19 outbreak. Our results can thus be useful for investors when accounting for future volatility and

implementing hedging strategies. Indeed, our empirical results have implications for both retail and institutional investors' risk management as well as for economic and financial policies.

- **Availability of data and materials**

Daily time series data are collected for Tunisian stock market indices from the TSE website. From the Data Stream basis, we extracted the Gold prices. Data concerning the five studied cryptocurrencies (Bitcoin, Dash, Ethereum, Ripple, and Monero) was collected from the Coin Market Cap basis.

In case of request, I provide all the requested data

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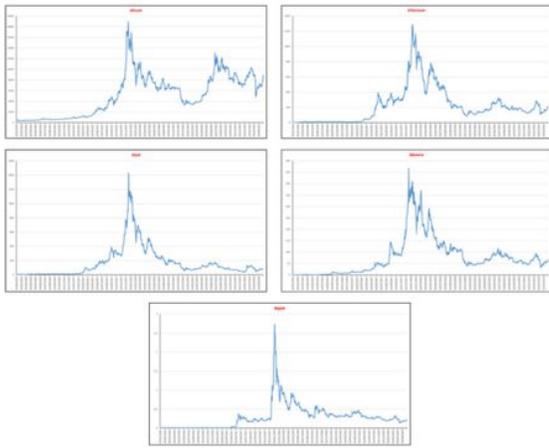
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# Figures

Panel 1: cryptocurrencies prices



Panel 2: Gold and Tunisian stock market indices price

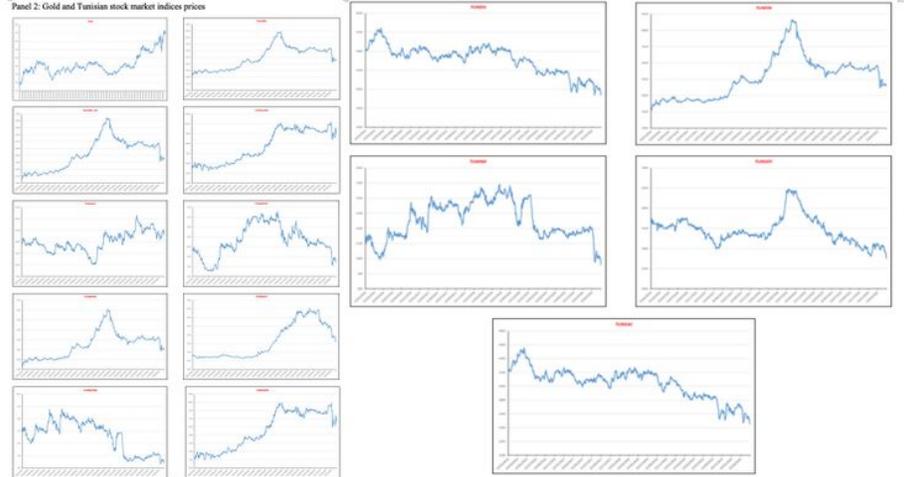
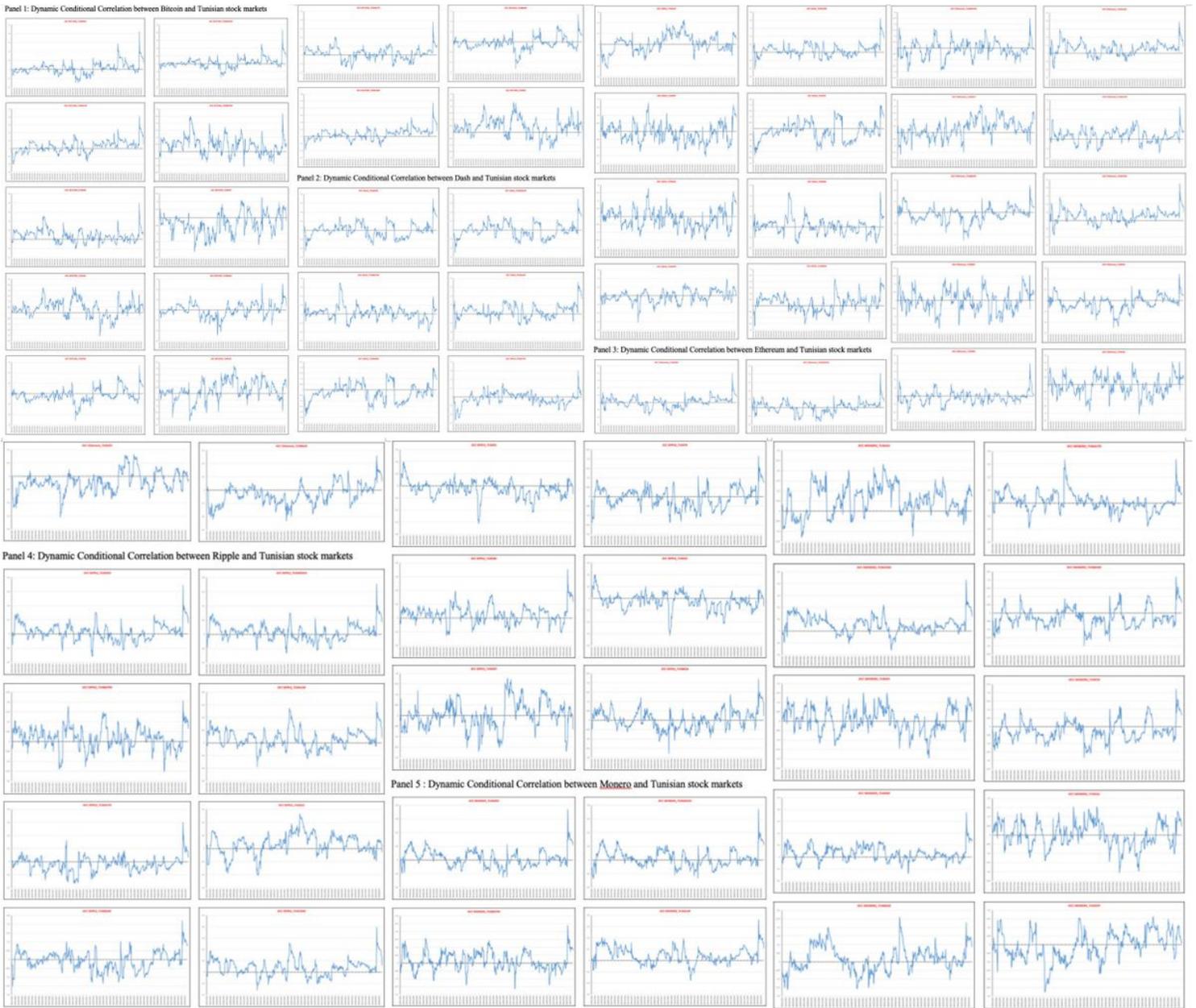


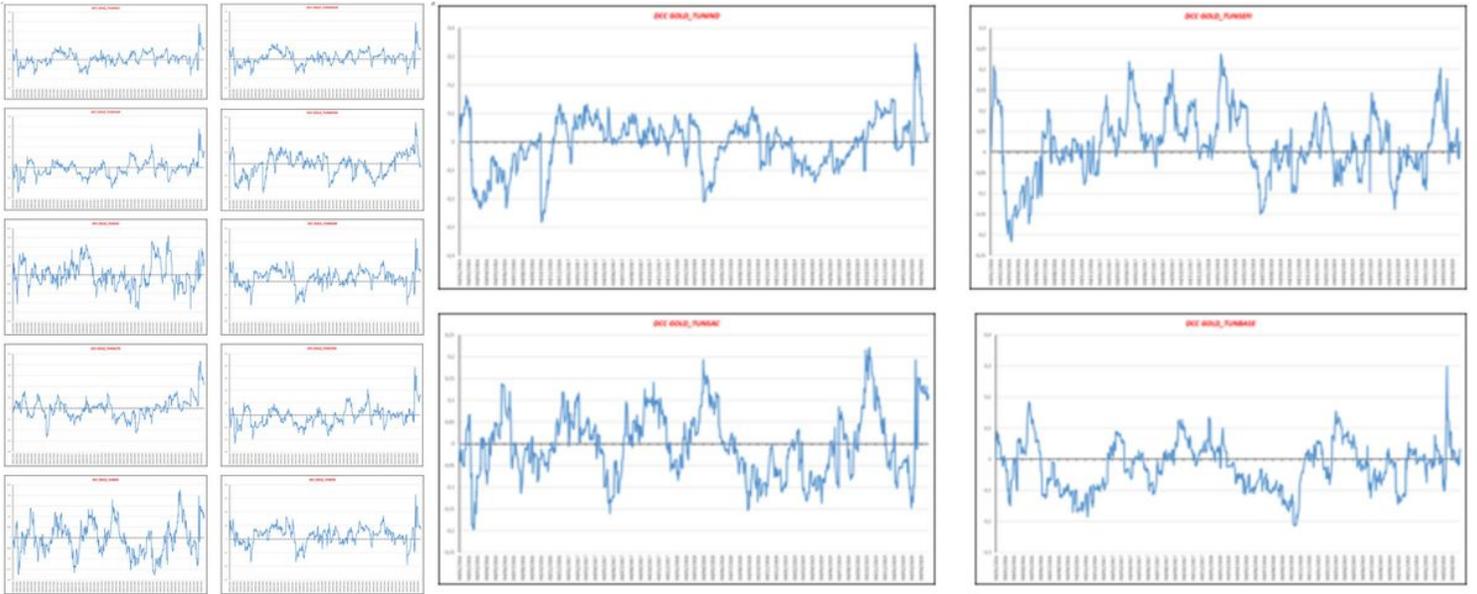
Figure 1

Prices of cryptocurrencies, Gold, and Tunisian stock market indices



**Figure 2**

Dynamic Conditional Correlations between cryptocurrencies and Tunisian stock markets



**Figure 3**

Dynamic Conditional Correlation between Gold and Tunisian stock markets