Volatility Jump: The Effect of COVID-19 on Turkey Stock Market

Oynaklık Sıçraması: COVID-19’un Türkiye Hisse Senedi Piyasası Üzerindeki Etkisi

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**Ö Z**

Bu çalışma Koronavirüs (COVID-19)’un Türkiye hisse senedi piyasası üzerindeki etkisini incelendirdir. Bu amaç için, Borsa İstanbul’daki işlem gören 23 birincil sektör endeksinin Haziran 2019 ile Temmuz 2020 arasındaki aylık gerçeklesen oynaklıkların hesaplanmıştır. Gerçekleşen oynaklık değerleri analiz edildiken sonra (1) COVID-19’un Türkiye’deki vakaların ortaya çıktığı ve hızla arttığı Mart 2020’de tüm sektör endekslerinde volatilite sıçraması neden olduğu; (2) COVID-19 pandemisi döneminde en fazla oynaklık sıçramasının spor şirketlerinin hisselerinde görüldüğü, en az oynaklık sıçramasının ise sigorta firmalarının senetlerinde görüldüğü; (3) Mart 2020’den sonra bütün sektör endekslerinin gerçekleşen oynaklık değerlerinin normale döndüğü ve COVID-19’un Türkiye hisse senedi piyasası oynaklığına etkisinin kaybolduğu bulunmuştur. Bu sonuçlar diğer bir önemli oynaklık ölçütü olan GARCH-temelli oynaklık ile doğrulanmıştır.

COVID-19’un Türkiye hisse senedi piyasasına etkisini ve piyasının güncel durumunu gösteren bu çalışmamız, sadece yatırımcılar, portföy yöneticileri ve politika yapıcılar için değil aynı zamanda COVID-19’un ekonomik ve finansal etkilerini göstermek isteyen ekonomi ve finans alanındaki akademisyenler için de önemli çıkarma sağlayacaktır.

**A B S T R A C T**

This paper investigates the effect of Coronavirus (COVID-19) on Turkey stock market. For this purpose, monthly realized volatilities of 23 primary sector indices traded on Borsa Istanbul are calculated for the period of June 2019 to July 2020. After analyzing realized volatility values, it is found that: (1) COVID-19 caused volatility jump for all sector indices in March 2020, when cases in Turkey appeared and increased rapidly; (2) While the most volatility jump occurred in stocks of sports companies during the period of COVID-19 pandemic, the least volatility jump occurred in stocks of insurance firms; (3) After March 2020, realized volatility values back to normal for all sector indices and the effect of COVID-19 on Turkey stock market volatility has disappeared. These results are confirmed by another important volatility measure, namely, GARCH-based volatility. This paper showing the impact of COVID-19 on the Turkish stock market and the recent state of the markets is believed to provide important implications for not only investors, portfolio managers, and policymakers, but also for academics in economics and finance, who are all looking to demonstrate economic and financial effects of COVID-19.
EXTENDED ABSTRACT

Artık 2019 tarihinde Çin’in Hubei eyaletindeki Wuhan şehrinde ortaya çıkan Koronavirüs (COVID-19) hızla bir şekilde Dünya genelinde birçok bölgeye yayılmıştır. Dünya Sağlık örgütü 11 Mart 2020 tarihinde COVID-19’u küresel bir pandemi ilan etmiş ve ülkeler COVID-19 salgının kontrol etmek için an ve katı önlemler almaya yönelmiştir. Her ne kadar COVID-19 salgınına karşı ülkeler sıktı tedbirler alsa da, COVID-19’u insanlar arasındaki yayımı henüz durdurulamamıştır. 8 Temmuz 2020 tarih itibariyle Dünya genelinde COVID-19 toplam 215 ülkede görülmüş, 11.973.641 vaka vaptanmış ve 547.120 insan hayatını kaybetmiştir. Türkiye de ise COVID-19’un ilk vakası 11 Mart 2020 tarihinde Türkiye Sağlık Bakanlığı tarafından duyurulmuştur. 11 Mart 2020 tarihinden 8 Temmuz 2020 tarihine kadar Türkiye’de de toplam 207.897 vaka tespit edilmiş ve 5.260 kişi hayatını kaybetmiştir. Sadece insanların sağlığına zarar vermekle kalmayan, küresel ekonomik aktivitelerin yaşamasına neden olmuştur. Bu önemli şirkette, yatırımcılar ve tüketicilerle ortaya çıkan panik havası tüketim davranışlarını değiştirmiş ve finansal piyasalarda anomaliler ortaya çıkmıştır. Ülkelerin finansal piyasaları da ortaya çıkan bu duruma hisse senedi endekslere meydana gelen düşüşlerle tepki göstermiştir.

COVID-19’nun finansal ve ekonomik etkileri son zamanlarda literatürde araştırılmaya başlanmıştır. Alber (2020) COVID-19’un hisse senedi üzerindeki etkilerini, Çin, Fransa, Almanya, İtalya, İspanya ve ABD için araştırmış ve hisse senedi piyasalarının COVID-19 kültürlük vaka sayılarına daha fazla duyarlı olduğunu tespit etmiştir. Çalışma ayrıca COVID-19’un Italia ve ABD için hisse piyasaları üzerinde olumlu bir etki olduğu belirtmiştir. Ayittey vd. (2020) ile Luo ve Tsang (2020) COVID-19’un Çin ve Dünya üzerindeki ekonomik etkilerini açığa vurmışlardır. Baker vd. (2020) ABD borsasının COVID-19’da tepkisini incelemiş ve COVID-19 nedeniyle ABD borsasının getirisi onaylanma sürecinin olduğu belirtmiştir. Ciniel (2020) COVID-19’nun küresel makroekonomik etkilerini belirlemiştir ve bazı ülkelerde hisse senedi piyasalarında çarpıcı düşüşler yaşanmıştır. COVID-19’u makroekonomik etkileri touches the financial and real sector endekslere ait etkisi aynca Estrada vd. (2020) tarafından belirtilmiştir. Gökler vd. (2020) COVID-19’u Türkiye’deki sektör endekslere etkisi analiz etmiş ve COVID-19 salgının ortasında spor, turizm ve ulaşım sektör endekslere etkisini belirtmiştir. Güney (2020) COVID-19’un hisse senedi piyasaları üzerindeki etkisi Çin, İtalya, İspanya, Türkiye, İngiltere ve ABD örnekleminde araştırılmış ve COVID-19’nun yayın etkileri nedeniyle Çin ve Türkiye borsalarındaki öncülüklerinin diğer borsalar arasındaki ilişkileri ve Türkiye borsalarındaki hisse senedilerinin daha fazla arttığı belirtmiştir. Kılıç (2020) COVID-19’un Borsa İstanbul sektör getirileri üzerindeki etkisi incelemiş ve birçok sektörde COVID-19 nedeniyle negatif anormalliklerin bulunduğu belirtmiştir. McKibbin ve Fernando (2020) COVID-19’nun küresel makroekonomik etkilerini, Fransa, Almanya, İtalya, İspanya ve ABD için araştırmış ve olası sebepleri analiz etmiştir. Serin ve Katal (2020) COVID-19’nun altını yatırımlarını ve VIX endeksi üzerindeki etkisi belirlemiştir. Soylu (2020) COVID-19 nedeniyle Türkiye ekonomisinde bazı makroekonomik değişimlerle meydana gelen değişimlerin çevrimiçiliğinin ve COVID-19’nün Türkiye ekonomisinde sektörlerin güven endeksleri, dış ticaret istatistikleri, işveren piyasası, sanayi üretimi endeksi ve turizm endeksi ile dünya endekslere etkisini dikkate almakta ve Türkiye borsalarının sektörel endekslere etkisini de incelemiştir. Tekel (2020) COVID-19’u Türkiye ve dünya ekonomisinde çeşitlilik ve ciddi daralma etkisini ve Türkiye borsasına etkisini analiz etmiştir. Trabzon ve Demir (2020) COVID-19’un “sosyo-elektromeyn” üzerindeki etkisini ve Türkiye borsalarının sektörel endekslere etkisini incelemiştir.
**Introduction**

The Novel Coronavirus (COVID-19), which appeared in December 2019 in the city of Wuhan in Hubei province of China, quickly spread across the World. The World Health Organization declared COVID-19 as a global pandemic on March 11, 2020, and directed countries to take strict measures to control the COVID-19 outbreak (Göker, Eren, & Karaca, 2020: 15). Although countries take strict measures against COVID-19, the spread of COVID-19 among people has not been stopped yet. As of 8 July 2020, COVID-19 has been seen in 215 countries, 11,973,641 cases have been detected, and 547,120 people died worldwide (https://www.worldometers.info/coronavirus). For Turkey, the first case of COVID-19 was announced by Ministry of Health in Turkey on March 11, 2020. From March 11, 2020 until July 8, 2020, 207,897 cases have been detected, and 5,260 people died in Turkey (https://covid19.saglik.gov.tr). The COVID-19 outbreak has affected not only the health of people but also the economies of the countries negatively. Limited and restricted countries’ borders due to COVID-19 have slowed down global economic activities. Most importantly, panic seen among companies, investors and consumers has distorted usual consumption patterns and also created some market anomalies. Financial markets of countries have also been responsive to the changes and countries’ stock indices have plunged (McKibbin and Fernando, 2020: 2).

There are recent empirical studies that investigate economic and financial effects of COVID-19. Alber (2020) investigates the effects of COVID-19 spread on stock markets for China, France, Germany, Italy, Spain, and the United States. He finds that returns of the stock market are more sensitive to COVID-19 cumulative cases than cumulative or new deaths and new cases. He also reports that COVID-19 does not have the negative effect on stock market returns for Italy and United States. The economic effects of COVID-19 on China and the World are reported by Ayittey, Ayittey, Chiwero, Kamasah, & Dzuvor (2020). Baker, Bloom, Davis, Kost, Sammon, & Viratyosin (2020) examine the US stock market reaction to COVID-19. They report that the volatility of the US stock market returns jumped due to COVID-19 outbreak. Cinel (2020) focuses on global macroeconomic impacts of COVID-19. She reports the potential global economic costs of COVID-19 with some possible scenarios. Estrada, Park, Koutronas, Khan, & Tahir (2020) empirically assess the effect of COVID-19 on the Chinese trade and financial markets. Göker et al. (2020) analyze the effect of COVID-19 on sector index returns for Turkey. They find that the returns of Sports, Tourism and Transportation sectors are affected more than the other sector index returns during COVID-19 pandemic. The influence of COVID-19 on stock markets for China, Italy, Spain, Turkey, the United Kingdom, and the United States is examined by Gunay (2020). He reports that Chinese and Turkish stock markets co-movement increased more than the other stock markets co-movements due to contagious effects of COVID-19. Kılıç (2020) investigates the effect of COVID-19 on Borsa İstanbul sector returns. He finds that many Borsa İstanbul sectors have negative abnormal returns. He also finds that while tourism and textile sectors have the highest negative abnormal returns, the trade sector has positive abnormal returns. Luo and Tsang (2020) estimate on the economic impact of COVID-19 on China and the global economy. McKibbin and Fernando (2020) investigate global macroeconomic impacts of COVID-19 with seven scenarios. They report that COVID-19 outbreak could significantly impact the global economy only in the short run and future costs of COVID-19 might be avoided by greater investment in public health systems. The impact of COVID-19 on financial markets for China and the USA is reported by Sansa (2020). Sarı and Kartal (2020) show the effect of COVID-19 on gold prices and VIX index. The changes occurring in the macroeconomic indicators specified in Turkey’s economy is examined by Soylu (2020). He reports that COVID-19 has directly affected sectoral confidence indices, Foreign Trade Statistics, labour market, Industrial Production Index and tourism revenues in
the Turkish economy. Şit and Telek (2020) investigate the impacts of COVID-19 on gold ounce prices and the dollar index. According to the cointegration and causality tests, they find that the cointegration relationship has between the number of COVID-19 deaths and cases and the dollar index and that positive shocks in the number COVID-19 cases and deaths cause shocks on the dollar index and gold ounce price. Yan (2020) examines how Chinese stock markets react to COVID-19. He finds that stock prices in the Chinese stock markets fall sharply due to COVID-19 pandemic. Zeren and Hızarcı (2020) examine the possible effects of COVID-19 on stock markets for China, France, Germany, Italy, South Korea, and Spain. They report that all stock markets are cointegrated with the COVID-19 total death numbers.

The existing literature provides some useful information about the effects of COVID-19 pandemic on stock returns for Turkey; however, almost nothing is known about the effects of COVID-19 pandemic on stock volatilities, which is often identified as a measure of uncertainty and also one of the most important indicators for not only investment and portfolio management decisions but also option pricing and financial market regulation (Balcilar, Gupta, & Kyei, 2018; Poon and Granger, 2003: 478), for Turkey. Therefore, in this paper, the effect of COVID-19 outbreak on Turkey stock market is investigated with monthly realized volatility, which frequently used in the empirical finance literature (see for example, Kambouroudis, McMillan, & Tsakou (2016); Suleman, Gupta, & Balcilar (2017); Apergis, Bonato, Gupta, & Kyei (2018); Balcilar et al. (2018); Gkillas, Gupta, & Wohar (2018); Bouri, Demirer, Gupta, & Marfatia (2019); Demirer, Gkillas, Gupta, & Pierdzioch (2019); Balcilar, Gupta, Wang, & Wohar (2020)) to determine the volatilities of financial assets, values of 23 primary sector indices traded on Borsa İstanbul. This paper contributes to the literature in at least five important ways: First, this paper is one of the first to examine the effect of COVID-19 pandemic on the Turkish stocks volatilities. Second, this paper shows which of the primary sector indices traded on Borsa İstanbul are more affected by COVID-19. Third, this paper demonstrates the primary sector index traded on Borsa İstanbul, which is least affected by COVID-19. Fourth, this paper provides information about the period when COVID-19 affected the Turkish stock market. Fifth, this paper contributes to the recently emerging literature which examines the effect of COVID-19 pandemic on financial markets.

The rest of the paper is organized as follows: Section 2 presents some information about the methodology and the data, while Section 3 reports and discusses the empirical results. Section 4 includes the robustness analysis. Finally, Section 5 concludes the paper.

**Data and Methodology**

In this paper, one-year data of 23 primary sector indices traded on Borsa İstanbul are used for analysis. Primary sector indices daily data are downloaded from the database of www.investing.com for a period of June 7, 2019 to July 6, 2020, with a total of 270 observations for each index. Primary sector indices used in the paper are given in Table 1.

**Table 1: Primary Sector Indices**

| Index Name                  | Code | Index Name                          | Code |
|-----------------------------|------|-------------------------------------|------|
| 1. Banks                    | XBANK| 13. Non-Metal Mineral Product       | XTAST|
| 2. Basic Metal              | XMANA| 14. Real Estate Invest Trusts       | XGMYO|
| 3. Chem Petrol Plastic      | XKMYA| 15. Services                        | XUHIZ|
| 4. Electricity              | XELKT| 16. Sports                          | XSPOR|


In order to calculate the realized volatility of sector indices, first daily returns are calculated as:

\[ r_t = \ln \left( \frac{p_t}{p_{t-1}} \right) \times 100 \]  

(1)

where \( p_t \) is the closing value of the index on day \( t \) and \( \ln (\cdot) \) the natural logarithm. After the daily returns of the sector indices are calculated, monthly realized volatilities, i.e. the sum of squared daily returns over the number of trading days in a month as suggested in Andersen and Bollerslev (1998), are calculated as:

\[ RV_t = \sum_{i=1}^{M} y_{t,i}^2 \]  

(2)

where \( y_{t,i} \) is the daily \( M \times 1 \) return vector and \( i = 1, \ldots, M \) the number of daily returns. Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model are also used to calculate the volatility of financial assets in the literature (see for example, Sadorsky (2006); Ben Nasr, Lux, Ajmi, & Gupta (2016); Demirer, Gupta, Suleman, & Wohar (2018); Gupta and Yoon (2018)). Since GARCH model are linear in nature, it does not take into account nonlinearity, often seen in financial time series, while capturing the volatility (Balcilar, Bouri, Gupta, & Roubaud, 2017). To test for nonlinearity in the daily return series used in this study, the BDS test of Broock, Dechert, Scheinkman, & LeBaron (1996) is employed with 10,000 bootstrap replications. Table 2 exhibit the results of the BDS test of nonlinearity.

**Table 2: BDS Test of Nonlinearity**

| Return Series | Dimension |
|---------------|-----------|
|               | 2  | 3  | 4  | 5  | 6  |
| XBANK         | 1.241 | 1.570 | 2.489*** | 3.266*** | 4.010*** |
| XMANA         | 1.444 | 2.797*** | 3.740*** | 4.754*** | 5.281*** |
| XKMYA         | 3.773*** | 5.094*** | 5.502*** | 6.013*** | 6.623*** |
| XELKT         | 4.345*** | 4.944*** | 5.480*** | 6.047*** | 6.396*** |
| XUMAL         | 1.110 | 1.454 | 2.602** | 3.432*** | 3.982*** |
| XGIDA         | 1.330 | 2.239** | 2.939*** | 3.566*** | 3.751*** |
As shown in Table 2, the null hypothesis of linearity is rejected at 1 percent level of significance for all daily return series across various dimensions, providing strong evidence of nonlinearity in the return series. This evidence indicates that, volatility values are more reliable based on squared returns i.e. realized volatilities than GARCH model.

The summary statistics of realized volatilities of primary sector indices used in the paper have been provided in Table 3.

**Table 3: Summary Statistics**

| Indices | Statistic |
|---------|-----------|
|         | Mean  | Med.  | Max.  | Min.  | S.D.  | Skew. | Kurt. | J-B.  | p-values |
| XBANK   | 0.962 | 0.748 | 3.997 | 0.128 | 0.982 | 2.205 | 7.684 | 24.141 | 0.000 |
| XMANA   | 0.592 | 0.487 | 2.377 | 0.189 | 0.542 | 2.750 | 9.789 | 44.535 | 0.000 |
| XKMYA   | 0.539 | 0.351 | 2.934 | 0.059 | 0.715 | 2.928 | 10.461 | 52.481 | 0.000 |
| Symbol | Mean (µ) | Max (M) | Min (m) | S.D. | Skewness | Kurtosis | JB | p-value |
|--------|----------|---------|---------|------|-----------|----------|-----|---------|
| XELKT  | 0.842    | 4.461   | 0.136   | 2.739| 9.597     | 42.889   | 0.000|
| XUMAL  | 0.694    | 3.414   | 0.115   | 2.602| 9.127     | 37.700   | 0.000|
| XGIDA  | 0.677    | 3.300   | 0.100   | 2.721| 9.546     | 42.271   | 0.000|
| XHOLD  | 0.588    | 3.323   | 0.120   | 2.886| 10.171    | 49.427   | 0.000|
| XUSIN  | 0.437    | 2.838   | 0.105   | 3.122| 11.216    | 62.126   | 0.000|
| XBLSM  | 1.367    | 7.806   | 0.180   | 2.687| 9.411     | 40.825   | 0.000|
| XSGRT  | 0.350    | 1.997   | 0.028   | 2.735| 9.517     | 42.232   | 0.000|
| XFINK  | 2.001    | 9.720   | 0.136   | 2.648| 9.425     | 40.446   | 0.000|
| XMESY  | 0.573    | 3.712   | 0.089   | 3.075| 11.000    | 59.397   | 0.000|
| XTAST  | 0.801    | 3.959   | 0.132   | 2.968| 10.650    | 54.670   | 0.000|
| XGMYO  | 0.763    | 4.469   | 0.077   | 2.889| 10.221    | 49.890   | 0.000|
| XUHIZ  | 0.430    | 2.509   | 0.096   | 3.085| 11.086    | 60.348   | 0.000|
| XSPOR  | 3.289    | 15.670  | 0.273   | 4.550| 5.298     | 11.450   | 0.000|
| XUTEK  | 1.040    | 5.456   | 0.021   | 2.777| 9.797     | 44.951   | 0.000|
| XILTM  | 0.747    | 3.047   | 0.107   | 2.377| 8.249     | 29.256   | 0.000|
| XTEKS  | 0.924    | 6.274   | 0.122   | 3.060| 10.967    | 58.884   | 0.000|
| XTRZM  | 1.525    | 8.822   | 0.132   | 2.630| 9.068     | 37.616   | 0.000|
| XULAS  | 1.312    | 7.080   | 0.093   | 2.599| 8.978     | 36.603   | 0.000|
| XTCRT  | 0.588    | 3.412   | 0.127   | 2.879| 10.052    | 48.344   | 0.000|
| XKAGT  | 0.979    | 5.852   | 0.107   | 2.798| 9.871     | 45.810   | 0.000|

**Note:** Med., Max., Min., S.D., Skew., Kurt., and JB stands for median, maximum, minimum, standard deviation, skewness, kurtosis, and Jarque-Bera, respectively. p-values are the probability values of the Jarque-Bera normality test.

Mean values in Table 3 show that Sports Index has the highest average monthly realized volatility with 3.289%, while Insurance Index has the least average monthly realized volatility with 0.350%. In terms of standard deviation, Sports Index has the highest standard deviation with 4.55% and Insurance Index has the least standard deviation with 0.504%. Skewness values indicates that the distribution of realized volatilities of all primary sector indices skewed to the right relative to the normal distribution. According to the kurtosis values, the distribution of realized volatilities of each primary sector indices has fat tails relative to the normal distribution. In short, Skewness and Kurtosis values state that monthly realized volatility distributions belonging to primary sector indices are deviated from the normality distribution. The deviation from the normality distribution can be also observed with the p-values of the Jarque-Bera normality test.
Empirical Results

Figure 1 shows time series plots of monthly realized volatilities calculated for each primary sector indices used in this paper to examine the impact of COVID-19 on Turkey stock market. Time series plots in Figure 1 shows that there are significant volatility jump for all sectors in March 2020 when the first cases seen in Turkey and when the World Health Organization declared the COVID-19 as a pandemic. While the sector most affected by COVID-19 with 15.7% volatility jump is the sports sector, the sector least affected by the COVID-19 with 2% volatility jump is the insurance sector. Leasing Factoring, Tourism, Information Technology, Transportation, and Textile Leather sectors are also more affected by COVID-19 than other sectors. Realized volatilities in Figure 1 also shows that after March 2020, Turkey stock marked back to normal and the effect of COVID-19 on the market has disappeared. Although it is expected that there will be a second wave related to COVID-19, it is not thought that Turkey stock market’s response to the virus will be so high.

Figure 1: Monthly Realized Volatilities
Robustness Check

For the robustness check of the findings obtained in this study, following the literature (e.g., Ben Nasr et al., 2016; Bouri et al., 2019; Demirer et al., 2019), another measure of volatility i.e., GARCH-based volatility, is used. Although it is stated in previous sections that realized volatility is better suited to the return series in this study, it is thought that GARCH-based volatility may be suitable for robustness check of the findings obtained from realized volatility. Monthly GARCH-based volatility of the primary sector indices is obtained as a standard deviation from GARCH(1,1) model. The basics of the model is as follows:

\[
y_t = \mu + \varepsilon_t \tag{3}
\]
\[
h_t = \omega + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1} \tag{4}
\]

where \(y_t\) denotes the sector indices returns, \(h_t\) the conditional variance, \(\omega\) the mean volatility level, \(\varepsilon_{t-1}^2\) the lagged error, \(h_{t-1}\) the lagged conditional variance, and \(\varepsilon_t\) the stochastic disturbance term that is assumed to be normally distributed with zero mean.

Monthly GARCH-based volatilities of the primary sector indices are plotted in Figure 2. It can be easily seen that the volatility jump of the sports sector (insurance sector) due to the COVID-19 pandemic is quite high (low) relative to the other primary sector indices. These results robust the findings of the study.

![Figure 2: Monthly GARCH-Based Volatilities](image-url)
Conclusion

In this paper, monthly realized volatilities of 23 primary sector indices traded on Borsa İstanbul are used to investigate the effect of COVID-19 on Turkey stock market. Monthly realized volatilities of indices demonstrate that: (1) Volatility jumps for all sector indices occurred in March 2020, when COVID-19 emerged in Turkey and spread rapidly; (2) Sports sector is the most affected sector in Turkey from COVID-19; (3) The sector least affected by COVID-19 in Turkey is the Insurance sector; (4) In Turkey, COVID-19 were affected Leasing Factoring, Tourism, Information Technology, Transportation, and Textile Leather sectors more than other sectors used in the paper; (5) The impact of COVID-19 on Turkey stock market disappeared after March 2020; (6) Turkey stock market returns to normal after March 2020. These findings are robusted with another important volatility measure, GARCH-based volatility. Further studies can be carried out investigating the effect of COVID-19 on other financial markets in Turkey. In addition, studies can be carried out examining the impact of COVID-19 on Turkey financial markets using other volatility calculation methods.

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