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Measurement of Volatility in NSE Nifty Spot and Futures Market during COVID-19 Pandemic Period

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Abstract

This study empirically studied the volatility in the NSE Nifty spot and futures market in India prior to and during the Covid-19 epidemic period. This study used NSE Nifty spot and futures index data from January 1, 2019 to December 31, 2020. The total study period is divided into two sub periods: pre-COVID-19 (1 January 2019 to 31 December 2019) and COVID-19 pandemic era (1st January 2020 to 31st December 2020). The GARCH family models were employed in the research. The total ARCH and GARCH coefficients in the Nifty before COVID-19 are 69.07 per cent, but they are 94.49 per cent during Covid-19, which is positive and statistically significant. TGRACH (1,1) also shows that during the Covid-19 outbreak phase, the news impact on the futures market is asymmetric. The coefficient gamma (γ) (-0.606182) is negative and highly significant during the Covid-19 pandemic period, showing the presence of a strong asymmetry impact in volatility, i.e., volatility increases disproportionately with negative shocks in spot and futures markets.

Keywords*: NSE Nifty, Volatality, COVID-19.*

Introduction

In June of 2000, index futures were initially allocated to Indian stocks, and thereafter to futures stocks and options, as well as future interest rates. Alternatives fetch substantially higher prices on the market, notably on the NSE, and present-day market gains exceed market revenue. Towards the end of the year 2019, a novel coronavirus (SARS-CoV-2) was found in Wuhan, Hubei province, China. Since then, it has spread to approximately 180 nations. As of 2020-06-11, more than 75.5 million people had contracted Covid-19. About four hundred thousand individuals lost their lives. Majority of the deaths reported in Italy, Spain, France, and Iran. Meanwhile, global stock markets were highly volatile during 2020, due to COVID-19 pandemic. Amidst this, a medical student from Wuhan, the epicentre of the virus, returned to Trissur on January 30, 2020, and was subsequently found positive for COVID-19. A case of COVID-19 has now been confirmed in India.

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The economic impact of the country-wide closure in India till April 14, 2020, is substantial. The travel and hospitality sector, as well as the transportation, passenger, manufacturing, and leisure sectors, have all taken a major hit. In particular, low-income people felt the effects of Covid-19 more strongly. Elderly persons who rely on tips alone (such as rickshaw drivers, daily wagers, street vendors, beggars, and informal workers) were particularly vulnerable. The rate of economic growth consequently fell dramatically throughout the outbreak. The Indian stock market was expected to reach new heights in 2020 due to the robust expansion of significant corporations. Several stocks have pushed the Sensex and Nifty to new highs and lows this year, while the majority of stocks across all market caps, but especially in the mid- and small-cap segments, have seen their values fall. India's currency growth in the market is behind the top ten markets worldwide due to the poor performance of small and medium-sized enterprises, which damaged overall market performance. Indian financial market have been highly volatile as a result of global market volatility. Since the global financial system is in a slump, the Indian stock market has also been hit hard. There has also been a precipitous decline in the COVID-19 pandemic. Very little has been done about the devastating effect of the COVID-19 outbreak on the national stock market, even in the instance of India, a country with a rapidly expanding economy.

This article examines the effect of COVID-19 pandemic on the Indian stock market by focusing on the Nifty Spot indexes and Nifty futures.

Review of Literature

Ozili and Arun (2020) examined the consequences of a policy called "social distance" that was put in place to stop the spread of the coronavirus (SARS-CoV-2) by using data from North America, Africa, Asia, and Europe. The focus of the study is on how a policy of social distance or a lockout for 30 days hurts the economy by making stock prices go down. Azimili (2020) examines the impact of COVID-19 on the structure and extent of risk-return dependence in the United States using quantile regression. The findings show that during the COVID-19 event, the higher quantiles' reliance on the market portfolio rose, diminishing the benefits of diversification. Osagie et al. (2020) used quadratic GARCH and EGARCH models with dummy variables to determine that the coronavirus (SARS-CoV-2) negatively affects stock returns in Nigeria, and that a stable political environment, incentives for local businesses, economic diversification, and a flexible exchange rate regime should be implemented to improve the financial market. The nonlinear behaviour of the financial markets in the United States, Italy, Japan, and China was studied by Shezad et al. (2020) using the Asymmetric Power GARCH model. The coronavirus (SARS-CoV-2) was discovered to have a detrimental effect on S&P 500 stock returns. But the Nasdaq Composite index showed no effect from the study. Liu, Manzoor, Wang, Zhang, Manzoor (2020) evaluated the impact of COVID-19 on 21 stock market indices in severely hit nations such Korea, Singapore, Japan, and the U.S. Italy, the UK, and Germany. Using an event study, they found that stock prices in these countries dropped after COVID-19. Asia had the most negative anomalous returns.

Data and Methodology

The present research used secondary data. The website www.nseindia.com offered Nifty Spot index and Nifty Futures index closing numbers. The data collection period includes both before and after COVID-19. From 1st of January 2019 to the 31st of December 2020, encompassing both before and after COVID-19. Firstly, returns for spot and futures were calculated as following:

$$Rt = 100 * \ln(St / St\text{-}1)$$

The study used Augmented Dickey-Fuller (ADF), ARCH-LM, and GARCH models. The study uses E-views 11. Volatility is calculated using daily NSE Nifty and Nifty Index Futures returns.

Augmented Dickey-Fuller (ADF) Test

The standard DF test is carried out by estimating the following Equation after subtracting yt-1 from both sides of the equation:

Dyt = ayt – 1 + xt ¢d + et,

Where a = r – 1. The null and alternative hypotheses may be written as,

H0: a = 0 , H1: a < 0

Null Hypothesis: H0: There is a unit root; the time series is non-stationary.

Alternate hypothesis: Ha: There is no unit root; the time series is stationary

Heteroscedasticity Test

Before employing GARCH, examine residuals for heteroscedasticity. The Lagrange Multiplier (LM) test checks for heteroscedastic residuals.

Tools for Measuring Volatility

In contrast to similar downward swings, increasing stock market moves are often accompanied by small fluctuations. Asymmetric moment is leverage effect. So, the symmetrical GARCH approach can't determine how unpredictable a time series is.

Nelson (1991) developed Exponential GARCH (EGARCH), and Glosten, Jaganathan, Runkle, and Zakonian (1993) pushed Threshold GARCH (TARCH). Both capture asymmetrical data.

Empirical Results

Descriptive Statistics Results

This research used the NSE Nifty Spot Index and Nifty Index Futures' daily close values and returns. The pre-COVID-19 average return is higher than the during-COVID-19 average return. A negatively skewed return with a high kurtosis value indicates Nifty Index and futures losses during COVID-19. During the COVID-19 pandemic, the standard deviation was higher, indicating increased variability. Spot and futures market returns during COVID-19 had a higher kurtosis value than typical. A high Jarque-Bera (JB) score in spot

and futures markets suggests atypical distribution. Since p<0.05, the null hypothesis of normality is rejected.

Table 1: Overview of the GARCH-family models used

Model	Short Description	Formula
GRACH (1,1)	indicator about the time a shock will persist	$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2$ $\alpha_0 > 0,\ \alpha_1 \geq 0,\ \beta_1 \geq 0,$ $\alpha_1 + \beta_1 < 1$ (Stationarity constr.)
Exponential GARC H (EGARCH) (1,1)	Capture the asymmetry of the volatility	$\ln(\sigma_t^2) = \omega + \beta \ln(\sigma_{t-1}^2) + \gamma \frac{u_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \alpha \left[\frac{\lvert u_{t-1} \rvert}{\sqrt{\sigma_{t-1}^2}} - \sqrt{\frac{2}{\pi}} \right]$
Integrated GARCH (IGARCH) (1,1)	Any shock to volatility is permanent and the unconditional variance is infinite	$\sum_{i=1}^{q} \alpha_i + \sum_{j=1}^{p} \gamma_j = 1,$

Table 2: Descriptive Statistics of Nifty spot and Futures index daily Returns from 2019 to 2020

Descriptive Statistics	Nifty Spot Index		Nifty futures Index	
	Pre Covid-19	During Covid-19	Pre Covid-19	During Covid-19
Mean	0.051569	0.059382	0.050320	0.000571
Median	0.050589	0.256275	0.056878	0.002306
Std. Dev.	0.898134	2.074668	0.901348	0.021115
Skewness	0.999562	-1.625581	1.128824	-1.517187
Kurtosis	8.032277	14.62499	8.342529	14.82407
Jarque-Bera	276.0996	1408.535	316.7728	1440.490
Probability	0.00000	0.000000	0.00000	0.00000

Augmented Dickey-Fuller Test Results

The Augmented Dickey-Fuller test is used in this study to determine whether or not the time series features of the Spot and futures markets are stationary. Table 3 contains the results. At the 1%, 5%, and 10% level of significance, all series of data remain steady. The key conclusion drawn from this study is that the ADF test is statistically significant at the 1% level. This means that the null hypothesis is rejected, and the Nifty spot and futures index returns are found stationary before and after Covid-19.

Table 3: Augmented Dickey Fuller Test (ADF) for
Nifty Spot and Future Index during January, 2019 to December 2020
H0: Variables have unit root

Indices		Augmented Dickey Fuller Test (ADF) Level with Intercept	
		T-Statistics	Prob. Value
Nifty Spot Index	Pre Covid-19	-4.999178	0.00000*
	During Covid-19 era	-4.974801	0.00000*
Nifty Futures Index	Pre Covid-19	-13.76205	0.00000*
	During Covid-19 era	-13.70270	0.00000*

Note: *ADF Test critical values: 5% level-3.45
Note: Optimal lag length is determined by the Schwarz Information Criterion (SIC)

ARCH Test Results

The ARCH test (Table 4) shows heteroscedastic residuals. ARCH family models should be used to study the relationship between spot and futures markets before and during COVID-19 pandemic. GARCH (1,1) is better to all other ARCH family models due to its high conditional variances and reduced AIC value. ARCH test (Table 4) shows heteroscedastic residuals. ARCH family models should be used to analyses the relationship between spot and futures markets before and after Covid-19. GARCH (1, 1) is better to all other ARCH family models due to its high conditional variances and lower AIC value.

Table 4: Heteroskedasticity Test: ARCH

Pre Covid-19	F-Statistic	80.68520	Prob.F (1,241)	0.0000*
	Obs.*R-squared	59.77957	Prob. Chi.-Square (1)	0.0000*
During Covid-19 era	F-Statistic	71.40003	Prob.F(1,247)	0.00000*
	Obs.*R-squared	59.90481	Prob. Chi-Square (1)	0.00000*

Note: * indicates significance and rejection of null hypothesis

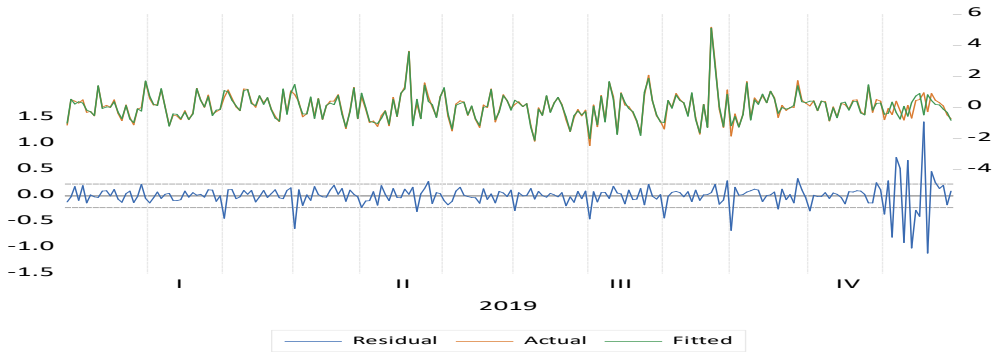

Figure 1: Residuals Plot of Estimation in pre Covid-19 period

Figure 2: Residuals Plot of Estimation in during Covid-19 pandemic period

Table 5: GARCH (1, 1) Model for Volatility Forecasting

H0: No volatility impact				
GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH (-1)				
	Pre Covid-19		During Covid-19 era	
Variance Equation	Coefficient	Prob.	Coefficient	Prob.
Constant C(3)	0.331990	0.0058	2.07E-05	0.0026
RESID (-1)^2 ((4)	0.509722	0.0000*	0.234908	0.0001*
GARCH (-1) (5)	0.180944	0.3021	0.709989	0.0000
Durbin – Watson Statistics	1.818605		2.320014	
Akaike Info Criterion	2.563636		-5.509792	
Schwarz criterion	2.654176		-5.450365	

GARCH (1, 1) Results

The model's combined ARCH and GARCH coefficients are positive and statistically significant at 0.944897 in the during-covid-19 period (1st January 2020 to 31st December 2020) and 0.690666 in the pre-covid-19 period (1 January 2019 to 31 December 2019) (Table 5). Higher coefficients for the ARCH and GARCH terms suggest that the selected model is reliable and stable. At a 1% level, the ARCH term RESID (-1)2 is statistically significant. This suggests that the volatility of the Nifty Index return in both the current and future markets has been significantly positively impacted by recent historical data. The volatility of the spot and future markets is greatly influenced by the GARCH (-1) term. The fact that the GARCH coefficient is higher than the ARCH coefficient indicates that the conditional variance in the COVID-19 period mainly relies on forecast variance from the previous period rather than knowledge about the previous period's volatility. Therefore, this study's findings are consistent with Crain and Lee's (1995) assertion that volatility shifts from futures markets to spot markets.

Table 6: TARCH (1, 1) Model for Volatility Forecasting

H0: No volatility impact				
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*RESID(-1)^2*(RESID(-1... C(5)*GARCH(-1)				
	Pre Covid-19		During Covid-19 era	
Variance Equation	Coefficient	Prob.	Coefficient	Prob.
Constant C(2)	0.002893	0.0032	0.013873	0.0000
RESID(-1)^2 (3)	1.000805	0.0002*	0.393762	0.0054
RESID(-1)^2*(RESID(-1)<0) (4)	-0.996844	0.0004*	4.236685	0.0000*
GARCH(-1) (5)	0.629185	0.0000	0.060225	0.0157
Durbin – Watson Statistics	2.950002		2.854164	
Akaike Info Criterion	-0.829832		-0.157408	
Schwarz criterion	-0.739022		-0.068268	

TGARCH (1, 1) Results

The findings of the TGARCH (1,1) method are utilised to determine the leverage impact, and they are shown in Table 6. The C (4)*(RESID (-1) 2*(RESID (-1) 0) is statistically significant and positive during the COVID-19 pandemic timeframe (4.236685). This is supported by the assertion that the model has a leverage effect, which unfavorable news creates more volatility than favourable news, or that positive and negative shocks affect Nifty spot and futures market returns differently. It continues by stating that news has an imbalanced effect on returns on the Indian stock market during the COVID-19 pandemic. In the pre-COIVD-19 pandemic period of both the spot index and index futures markets of Nifty, the coefficient before the pandemic variable is less than zero (-0.9966844), indicating that the volatility of the stock yield does not have an obvious leverage effect. However, it is not equal to zero, indicating that, while there is an asymmetric effect, the amount of bad news and good news of the fluctuations is not the same.

EGARCH (1, 1) Results

The EGARCH (1,1) model explain financial market volatility when the price series exhibits any amount of asymmetry and leverage impact. When negative news has a greater impact on volatility than positive news, there is a leveraging effect. The results of the EGARCH model are shown in Table 7. The Nifty spot and futures markets' financial returns are examined using the EGARCH model to identify the influence of leverage and take advantage of the presence of asymmetric behaviour (asymmetric). The EGARCH model should have a negative and significant sign of gamma () before and during the COVID-19

epidemic. When an asset's volatility is discovered to be adversely connected with its returns, this is known as the leverage effect. The coefficient gamma () (-0.606182) is negative and very significant throughout the COVID-19 pandemic period, demonstrating the significant presence of an asymmetry impact in volatility, i.e., volatility increases disproportionally with negative shocks in the spot and futures markets. Therefore, it is evident that adverse shocks during the COVID-19 pandemic timeframe of the research had an impact on the return of the Indian stock market. EGARCH(1) forecasts a volatile term structure with a falling slope as a result.

Table 7: EGARCH (1, 1) Model for Volatility Forecasting

H0: No volatility impact				
LOG(GARCH) = C(1) + C(2)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(3) *RESID(-1)/@SQRT(GARCH(-1)) + C(4)*LOG(GARCH(-1))				
	Pre Covid-19		During Covid-19 era	
Variance Equation	Coefficient	Prob.	Coefficient	Prob.
Constant C(1)	-3.457734	0.0000	-2.739251	0.0000
ARCH (C2)	1.195248	0.0000	1.325396	0.0000
EGRACH(C3)	0.213664	0.0281	-0.606182	0.0000
GRACH (C4)	0.270215	0.0044	0.390202	0.0000
Durbin – Watson Statistics	2.955238		2.821541	
Akaike Info Criterion	-0.697193		-0.116471	
Schwarz criterion	-0.6060383		0.027277	

Conclusion

The study analysed COVID-19 and Nifty futures' impact on India's Nifty Spot Index. The pre-COVID-19 (1st January 2019 to 31st December 2019) and during-COVID-19 (after outbreak of pandemic) GARCH family models analyse stock market volatility (1st January 2020 to 31st December 2020). During COVID-19, the spot market is unpredictable. The finding that the GARCH coefficient is greater than the ARCH coefficient shows that COVID-19 conditional variance relies mainly on forecast variance rather than volatility information. During the COVID-19 pandemic period, EGRACH was positive (4.236685 and significant). Positive and negative shocks have differing effects on Nifty spot and futures market returns, which supports the idea that the model has a leverage effect.

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References

Azimili A, (2020) The impact of COVID-19 on the degree of dependence and structure of risk-return relationship: A quantile regression approach. Finance Research Letters. https://doi.org/10.1016/j.frl.2020.101648

Bollerslev T. (1986): "Generalised Autoregressive Conditional Heteroscedasticity" Journal of Econometrics, 31, 307-327.

Engle, R. (1982), "Autorregressive Conditional Heteroskedasticity with Estimates of United Kingdom Inflation", Econometrica, 50, 987-1008.

Leduc S, Liu Z, (2020) The Uncertainty Channel of the Coronavirus. FRBSF Econ. Lett.

Osagie M, Maijamaa B, John D O, (2020) On the Effect of COVID-19 outbreak on the Nigerian Stock Exchange performance: Evidence from GARCH Models. doi:10.20944/preprints202004.0444.v1

Ozili P, Arun T, (2020) Spillover of COVID-19: impact on the global economy. MPRA paper no 9985.

Shehzad K, Xiaoxing L, Kazouz H, (2020) COVID-19's disasters are perilous than Global Financial Crisis: A rumor or Fact? Financial Research Letters https://doi.org/10.1016/j.frl.2020.101669.