Estimating Volatility and Investment Risk: An Empirical Case Study for NIFTY MIDCAP 50 Index of National Stock Exchange (NSE) in India

Ramona Birau
"Constantin Brancusi" University of Targu Jiu,
Faculty of Education Science, Law and Public Administration, Romania
ramona.f.birau@gmail.com
Jatin Trivedi
National Institute of Securities Markets, India
contact.tjatin@gmail.com
Cristi Spulbar
University of Craiova,
Faculty of Economics and Business Administration, Craiova, Romania
cristi_spulbar@yahoo.com

Abstract

This study evaluates performance of Indian index considering NIFTY MIDCAP 50 index daily series returns. Autoregressive model EGARCH forecasts the volatility predictability and empirically analyze volatility pattern considering daily returns from NIFTY 50 index. The study tests presence of asymmetry in volatility transmitting patterns, Movement of higher positive and negative magnitude of shocks and fitness of the model. For this purpose data series considered from October 2007 to April 2021 consisting 3321 daily observations. This empirical study also attempts to capture the opportunity for investment returns and involvement of risk. Findings provide financial series movement, volatility sketches, summary of statistics and property of EGARCH model and fitness of series returns in EGARCH model.

Key words: emerging stock market, returns, volatility pattern, investment risk
J.E.L. classification: G10, G11, G15

1. Introduction

The approach of an investor to execute the trade practice creates larger difference in impact on movement of price. Intra-day operators create stronger impact on price change. Financial markets are one of the parameter of any economy. This paper focuses to test presence of asymmetry in series return of NIFTY MIDCAP 50 index which consist of 50 top selected stocks with weighted average and changes of volume and trade makes changes in index. NIFTY MIDCAP 50 index captures impact of global financial crisis and also COVID-19 pandemic during selected time period. The index movement provides information about short and long memories created from several small and large magnitudes of shocks. Several researchers attempted to forecast, predict and modeling the behaviour of NIFTY50 cash market, future and option market. For instance, Bendob and Bentouir (2019) worked on option pricing, abstracting investment behaviour and various techniques and choices that evolve in option market. The study covers details from launch of option trading since 1973. The main finding of paper indicates high level of volatility in the money category.

2. Literature review

In the existing literature, there is a large amount of information that can be abstracted from historical financial series returns, for instance to check presence of leverage effect, i.e. if that series movement follows long memory for news impact. Different investors follow investing to specific sector or market based on different reasons. For instance, higher volatility, prospects for greater or faster returns. In India, FIIs been increasing their inflow. The study conducted by Sathyanarayana and Gargesha (2019) provides useful insights about change in investment by FIIs in Sensex and NIFTY50 index. Moreover, this study provides information about policy set off by the regulatory, SEBI. Further, Kumar et al. (2020) assessed commonality in liquidity considering the NIFTY50 stocks from the Indian emerging stock, by using high frequency data from across variety of liquidity measures. A very important aspect of the empirical framework was to examine the movements in stock liquidity. Choudhary et al. (2019) explored the relationship between FIIs hearding and returns considering empirical evidence from NIFTY50 market of India for the sample period from January 1999 to May 2017. On the other hand, the authors also concluded that foreign institutional investors also known as FIIs represent an essential pillar in the case of financial markets, but trading volume did not revealed any connection with herding.

Spulbar et al. (2020) argued that international portfolio diversification is very important for long-term investment strategies. Trivedi et al. (2021) investigated volatility spillovers, cross-market correlation, and comovements for a cluster of developed and emerging stock markets from European Union. The empirical findings based on EGARCH model highlighted the existence of leverage effects in the cluster of selected European stock markets thus suggesting that negative shocks strongly influence the behavior of sample markets. Sucarrat (2013) demonstrated usage of variety of GARCH family models including EGARCH with various indices including National Stock Exchange index. Finding indicates that model allows heavy tails and skewness in the conditional return. Zulfiqar et al. (2020) conducted a complex empirical study and concluded that stock markets which function in the context of an efficient governance and institutional environments are able to achieve superior performance on stock returns and a lower level of risk. Ejaz et al. (2020) suggested that emerging stock markets are characterized by more tempting portfolio diversification opportunities compared to developed stock markets.

3. Research methodology

We consider NIFTY50 volatility estimation, testing of presence of leverage effect using Exponential GARCH (EGARCH) model considering a number of 3331 daily observations for the sample period from October 2007 to April 2021. We run EGARCH model designed by Nelson (1991). The details of methodology are the following:

Log conversion:

$$r_t = \ln\left(\frac{p_t}{p_{t-1}}\right) = \ln(p_t) - \ln(p_{t-1})$$

ADF process:

$$(1 - L)\text{yt}=\beta 0 + (\alpha - 1)\text{yt} - 1+\varepsilon\text{i}$$

EGARCH model:

$$log(\sigma_t^2) = \omega + \sum_{j-i}^{p} \beta i\, log\left(\sigma_{t-i}^2\right) + \sum_{j-1}^{q} \alpha i \left\langle \frac{\varepsilon i - t}{\sigma \quad i-t} \left| \frac{-\sqrt{2}}{n} \right| - yi \frac{\varepsilon i - t}{\sigma i - t} \right\rangle$$

Exponential GARCH, or poluparly known as EGARCH, the model developed by Nelson (1991) which captures asymmetric responses of time-vary variances to volatilty shocks and also ensures that variance is always positive.

4. Empirical results

The property of summary of statistics provides merely zero mean with 0.014 degree of standard deviation. The negative skewness and excess of kurtosis increases risk factor in the NIFTY50 returns. The abnormal pattern of kurtosis indicates presence of leptokurtik impact on the series returns.

Table no.1. Summary Statistics

Mean	Median	Minimum	Maximum
0.00032939	0.00062348	-0.13904	0.16334
Std. Dev.	C.V.	Skewness	Ex. kurtosis
0.014322	43.480	-0.24375	13.593
5% Perc.	95% Perc.	IQ range	Missing obs.
-0.020863	0.020361	0.012833	1

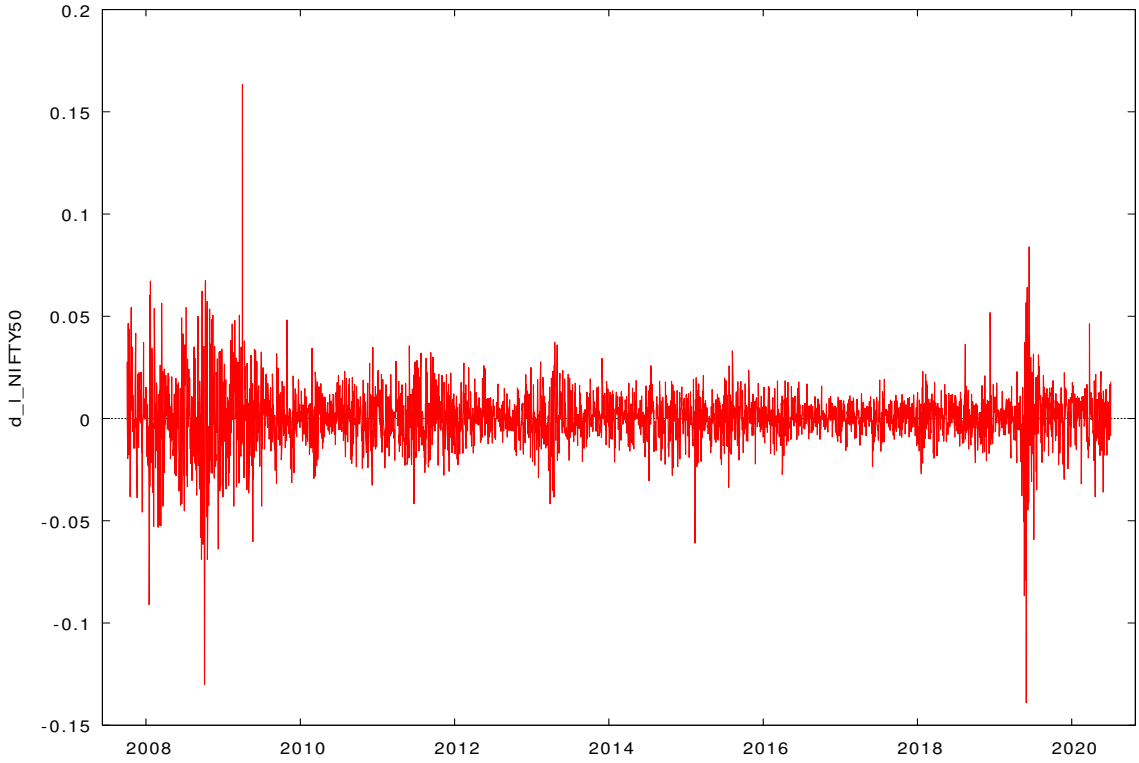
Source: Author's computation

The study covers NIFTY 50 movement from index level less than 3000 to over 15000, making index trading over 5 times in duration of about 13 years. The series movement (See Fig1) indicates that only at time of global financial crisis, the index made its lowest trading points. However, the COVID-19, pandemic impact clearly visible on the series returns.

Figure no.1. NIFTY MIDCAP 50 index movement pattern

Source: Author's computation

Figure no. 2. Stationary Series movement pattern for NIFTY MIDCAP 50 index for the sample period from October 2007 to April 2021



Source: Author's computation

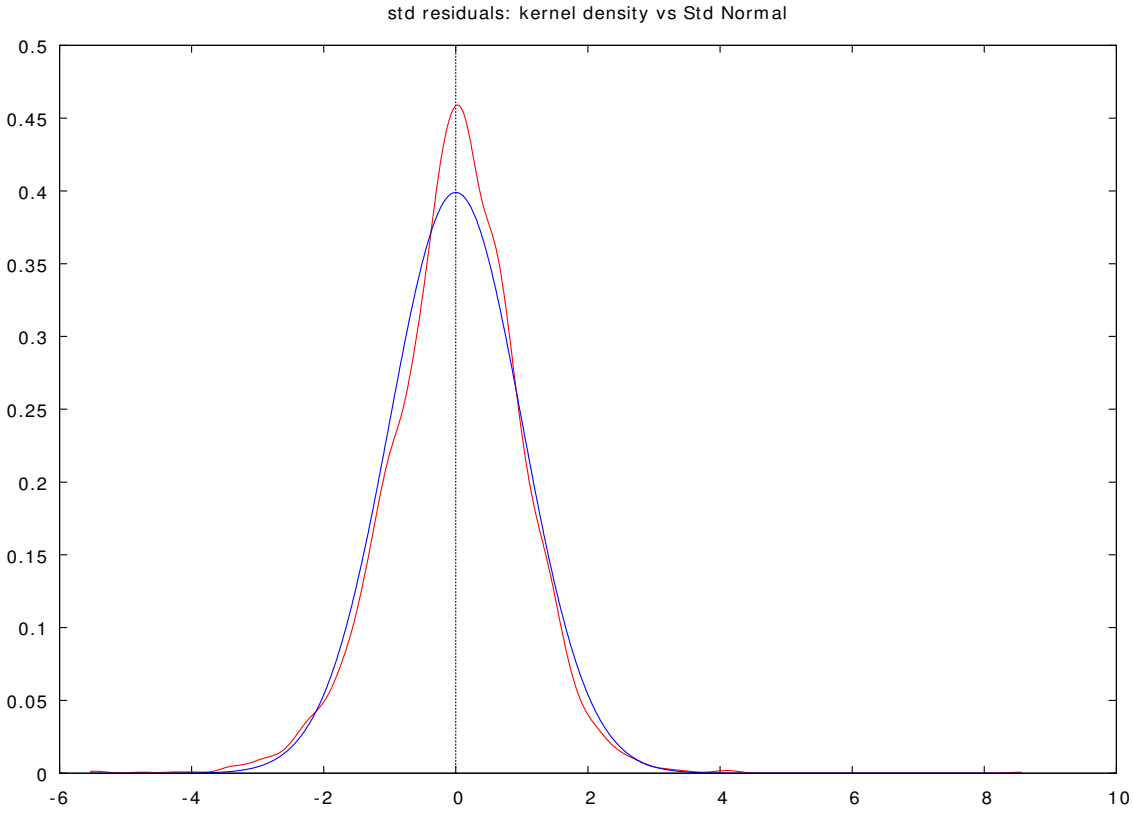
The property of Fig2 indicates (after conversion of log return and considering first log difference) stationary, also allows to observe small and large volatility sketches from the selected period. To test the normality of returns (before employing EGARCH) we tested Augmented Dickey-Fuller test, testing down from 28 lags, criterion BIC method and considering sample size 3328, unit-root null hypothesis: a = 1. The test with constant including 0 lags(1-L)y = b0 + (a-1)*y(-1) + e, estimated value of (a - 1): -0.9576, test statistic: tau_c(1) = -55.2936 and derived p-value 0.0001, the 1st-order autocorrelation coeff. for e: 0.001.

Table no.2. Statistical property of EGARCH model using NIFTY MIDCAP 50 index

Conditional mean equation					
	coefficient	std. error	z	p-value	
Const	0.000314567	0.000187292	1.680	0.0930	*
Conditional variance equation					
omega	-0.260	0.039	-6.571	4.99e-011	***
alpha	0.164	0.022	7.424	1.14e-013	***
gamma	-0.098	0.016	-5.777	7.60e-09	***
beta	0.985	0.004	232.3	0.0000	***
Llik: 10255.50844		AIC: -20501.01688			
BIC: -20470.46474		HQC: -20490.08537			

Source: Author's computation

Figure no.3. EGARCH model density vs. Standard normal distribution



Source: Author's computation

5. Conclusions

The the previous empirical results provide a relevant comparative framework on standard density and EGARCH (Exponential GARCH) model plotted in the figure 3. This indicates a measurement of abnormality in volatility and density of high magnitude in case of return series. We considered the value of BIC in order to measure the fitness and significance of empirical results. The statistical property for conditional mean equation is significant at the significance degree of 10% whereas, variance equation fitted perfectly at degree of 1%, suggesting the highest significance. The value of BIC is considered at -20470 and highlighted the fact that EGARCH model can be used to estimate the volatility spillovers in case of NIFTY50 stock market index returns. Moreover, EGARCH model also provides significant results suggesting the presence of leverage effects (asymmetry) in selected financial series. It also indicates that negative shocks (volatility) will repeat the negative shocks for a longer period of time.

One of the main limitations of this research study is the selection of only one stock market, such as the Indian stock market. For future research studies, we will consider a comparative empirical analysis between the countries of the European Union and BRICS member states. Moreover, the research methodology will be diversified by including hybrid techniques and we will also extend the selected time interval.

6. References

- Bendob, A., & Bentouir, N. 2019. Options Pricing by Monte Carlo Simulation, Binomial Tree and BMS Model: a comparative study of Nifty50 options index. *Journal of Banking and Financial Economics*, 1(11), 79–95, https://doi.org/10.7172/2353-6845.jbfe.2019.1.4.
- Choudhary, K., Singh., P., & Soni., A. 2019. Relationship Between FIIs' Herding and Returns in the Indian Equity Market: Further Empirical Evidence, *Global Business Review*, ISSN: 0972-1509, Online ISSN: 0973-0664, https://doi.org/10.1177/0972150919845223.
- Ejaz, A., Birau, R., Spulbar, C., Buda, R., Tenea, A.C. (2020) The impact of domestic portfolio diversification strategies in Toronto stock exchange on Canadian textile manufacturing industry, *Industria Textila*, 71, 3, 215–222, http://doi.org/10.35530/IT.071.03.1696.
- Kumar, G., Misra, A. K., Pant, A., & Rahman, M.R. 2020. Assessing Commonality in Liquidity: Evidence from an Emerging Market's Index Stocks. *Global Business Review*, ISSN: 0972-1509, Online ISSN: 0973-0664, https://doi.org/10.1177/0972150920942902.
- Nelson, D.B. 1991. Conditional heteroskedasticity in asset returns: A new approach. *Econometrica*, 59(2), 347–370.
- Sathyanarayana, S.S. & Gargesha, S. 2019. FIIS Inflow (Equity and Debt) and its Impact on Indian Stock Market: Evidence from Sensex and Nifty50. *International Journal of Management Studies*. VI(4):105, https://doi.org/10.18843/ijms/v6si4/14.
- Spulbar, C., Trivedi, J., & Birau, R. 2020. Investigating abnormal volatility transmission patterns between emerging and developed stock markets: a case study. *Journal of Business Economics and Management*, 21(6), 1561-1592. https://doi.org/10.3846/jbem.2020.13507.
- Sucarrat, G. 2013. Betategarch: Simulation, estimation and forecasting of Beta-Skew-t-EGARCH models, *The R Journal*, 5(2), 137-147, https://doi.org/10.32614/rj-2013-034.
- Trivedi, J., Spulbar, C., Birau, R., & Mehdiabadi, A. 2021. Modelling volatility spillovers, cross-market correlation and co-movements between stock markets in European Union: an empirical case study. *Business, Management and Economics Engineering*, 19(1), 70-90. https://doi.org/10.3846/bmee.2021.13588.
- Zulfiqar, A.I., Ejaz, A., Spulbar, C., Birau, R. & Nethravathi, P.S.R. 2020. Measuring the Impact of Governance Quality on Stock Market Performance in Developed Countries, *Economic Research-Ekonomska Istraživanja*, 33(1), 3406-3426, https://www. tandfonline.com/doi/full/10.1080/1331677X.2020.1774789.