

A STUDY ON VOLATILITY IN INDIAN STOCK MARKET PARTICULAR REFERENCE WITH NSE

Submitted in partial fulfillment of the requirements for the award of

Master of Business Administration

By

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SCHOOL OF BUSINESS ADMINISTRATION

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade "A" by NAAC | 12B Status by UGC | Approved by AICTE
Jeppiaar Nagar, RAJIV GANDHI SALAI, CHENNAI - 600 119**

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of Ms. **MOUNIKA. T 39410126** who has done the project work entitled “**A STUDY ON VOLATILITY IN INDIAN STOCK MARKET PARTICULAR REFERENCE WITH NSE**” under my supervision from December 2021 to February 2021.

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ABSTRACT

In stock market there are many investor invest is money and some time they get profit but some time they get loss. The market is not stable is ups and downs based on demand and supply factor. To predict the market it helps the investor to make the correct decision. If the market goes up the investor also able to take decision before itself. It helps the investor to safe the capital and gain more profit.

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CHAPTER- I

INTRODUCTION

Prices of securities move up and down every day in the stock markets. These ups and downs are known by namely fluctuation in the prices. Fluctuation in the prices of a security comes from the unbalanced demand and supply of that security. If demand side of a security is greater than its demand, the price would start to go down. The relative rate of fluctuation at which price of a security moves up and down is called volatility. In other words, volatility refers to the amount of risk about the size of changes in the security's value.

It means if volatility increases in the prices of a financial instrument, the risk also increases on that instrument. Sometimes a question arises that why volatility is important? The volatility does not measure the direction of prices but it measures desperation among the prices which helps to know the risk (probable deviation from the expected) on an instrument. On the basis of risk on an instrument, investor can analyze their capacity to bear risk and also can make decision relating to invest their excess fund in financial assets.

The stock market is basically an aggregation of various buyers and sellers of stock. A stock (also known as shares more commonly) in general represents ownership claims on business by a particular individual or group of people. The attempt to determine the future value of a stock market is known as a stock market prediction. The prediction is expected to be robust, accurate and efficient. The system must work according to the real-life scenarios and should be well suited to real-world settings. The system is also expected to take into account all the variables that might affect the stock value and performance.

Volatility in stock markets evokes varying responses from market participants. While some perceive it as an opportunity to make money, others perceive it as a threat and start unwinding their position. While affecting portfolio choice, changes in stock market volatility also give some idea about the current economic state. In today's globalized environment, increased volatility reflects global uncertainty. Volatility in the stock market as a whole can be due to macroeconomic factors, both internal and external.

Examples could be oil price shocks, an increase in rate of interest in the US, or domestic elections.

Volatility in individual stocks, on the other hand, can be due to perceived growth prospects of the company or the sector. It could also be triggered by company specific news or policy announcement. The effects of stock market volatility can be six fold. First, it enhances the profit making opportunities from intraday trading for spot market traders. Second, it leads to portfolio rebalancing by fund managers. Third, it increases volatility trading in the options market. Fourth, it increases hedging activity in financial markets. Fifth, it does influence policy makers in taking hard decision as their actions can cause loss of wealth to retail holders. Sixth, it affects capital formation, as volatile markets are not conducive for fresh equity issues in the market.

Volatility refers to the spread of all likely outcomes of an uncertain variable. Typically, in financial market, it is measured by a standard deviation or variance of returns. Volatility is often used as a crude measure of total risk of financial asset. It is, however, not exactly the same as risk, but it is related. Risk is associated with undesirable outcome, whereas volatility as a measure of uncertainty could be due to positive outcome. This importance difference is often overlooked (Poon, 2005, pp.1).

Returns on financial assets are often thought of as being as nearly unpredictable. However, this “unpredictability” refers to the mean and not the variance. In many situations the volatility carries valuable information that can be used in estimation and forecasting. It's, for example, very common that financial time series exhibit periods of usually large volatility followed by periods of relative tranquility. This stylized fact is referred to as volatility clustering (Enders, 2015, pp.123). Typically, the most volatile periods correspond to major (economic) events such as oil crises, stock market breakdowns or technological changes.

Being able to accurately estimate and predict volatility is crucial in various fields of finance such as option pricing (eg. Black-Scholes formula), risk management (eg.

Value-at-risk calculations) and portfolio management (eg. CAPM). Nowadays, volatility also has become the subject of trading itself. There are now exchange-traded contracts written on volatility (eg. The VIX index). Financial market volatility, as well, has a wider impact on financial regulation, monitoring policy and macroeconomic (poon, 2005, pp. 15).

As a part of the process of economic liberalization, the stock market has been assigned an important place in financing the Indian corporate sector besides enabling mobilizing resources for investment directly from the investors, providing liquidity for the investors and monitoring and discipline company management are the principal functions of the stock market. The main attraction of the stock market is that they provide entrepreneurs and governments a means of mobilizing resources directly from the investors, and to the investors they offer liquidity. It has also been suggested that liquid market improve the allocation of resources and enhance prospects of long term economic growth.

Stock markets are also expected to play a major role in discipline company's managements. In India, equity market development received emphasis since the very first phase of liberalization in the early 80's. Additional emphasis followed after the liberalization process got deepened and widened in 1991 as development of capital markets was made an integral part of the restructuring strategy. Today, Indian markets conform to international standards both in terms of structure and terms of operation efficiency.

Stock price prediction is very important as it is used by the most of the business people as well as common people. People will either gain money or lose their entire life savings in stock market activity. It is a chaos system. Building accurate model is difficult as variation in price depends on multiple factors such as news, social media data, fundamentals, production of the company, government bonds, historical price and country's economics. Prediction models which consider only one factor might not be accurate. Hence incorporating multiple factors news, social media data and historical price might increase the accuracy of the model. There are two common methods to predict the stock market price.

One among that is chartist or technical theories and the second one is fundamental or intrinsic value analysis. Proposed method is built on the principle of technical theories. Basic assumption of this theory is history tends to repeat itself. Prediction model can be applied on the historical data to get future trend. As research have discussed in S.J. Grossmara and R.J. Shiller and L. Andrew and M.A. Craig, as and when new information comes in the market stock market value varies. Technical analysis and semi strong form of efficient market hypothesis are followed, to build prediction model in the proposed work. The goal of the research work is to build a model which predicts stock trend movement (trend will be up or down) using historical data and social media data.

The stock exchange is a centralized market where stocks, bonds and other security are traded. Across the globe hundred of stock exchanges function in different time zone providing capital for businesses. The market participants called brokers place buy or sell order on behalf of their clients ranging from retail investors to large firms the prices of security are in constant fluctuation as the participants digest information that facts the business and make decisions.

The National Stock Exchange (NSE) in India was established in 1992 and is the leading stock exchange in the country. The NIFTY 50 index which is a weighted average of 50 significant companies provides a snapshot into the business investment scenario in India much like a heart monitor measures the health level of a patient. In this paper the volatility in stock markets has been studied for the benefit of investors and traders. The presence of volatility increases market risks and it leads to lesser investment in the stock market. Hence the proper study and understanding of volatility is needed in volatility situations.

In financial theory, the efficient market hypothesis is a widely discussed theory that says that market prices reflect all available information at any point of time. Still the response of traders and investors to the same information varies widely leading fluctuations. Sometimes fluctuations are caused by uncertain economic climate due

to global and national events. Although fluctuations in prices are accepted as natural, excessive price fluctuations known as market volatility severely hinders investment and economic growth. Market Volatility has a strong impact on capital costing and asset allocation.

The investors are interested in quantifying market risks to avoid unexpected financial shocks and be better prepared for eventualities. In times of extreme uncertainty it has been observed that investors stay out of the markets leading to declining valuations and capital erosion in the economy. Therefore it is vital to understand market volatility and be able to predict and manage it using risk management techniques.

The fundamental analysis of stock prices is the prediction of future prices through analysis of the business parameters of the company and the macro economic factors. The subjective nature of fundamental analysis and the difficulty in accurate prediction has lead to technical analysis. In technical analysis, the historical price movements are used to predict the future based on certain patterns. Although both approaches have their usefulness, successful always employ prudent risk management investors and traders techniques. The ability to gauge and understand market volatility is essential in risk management.

All financial markets have numerous participants in the form of investors, fund managers and policy makers. Every investor has different risk appetite and wants to make returns according to the same. Few do this on their own and many consult fund managers. All their attempts are affected by the decisions of the policy makers. But the underlying aim of all participants is to see that the financial markets move in their favor. All of them use past data to see how the asset prices have varied and how the prices will be the next working day.

In this context, volatility and the measure there of play a very important role to equity and derivatives traders as well. They are interested in the present and future direction and the degree to which the market is moving. Historically, volatility has been defined as the variation in asset prices. Volatility has been used as a proxy for riskiness

associated with the asset. And hence volatility estimation is of central importance to risk management, pricing (especially option and portfolio construction both from investors and the perspective of fund managers. Volatility has remained the central concept in finance, whether in derivative pricing, asset allocation, or risk management.

This dissertation focuses on volatility in financial markets, with a special concern for: (i) volatility transmission between different financial markets and asset categories and, (ii) the effect of macroeconomic announcements on the returns, volatility and correlation of stock markets. These issues are analyzed taking into account the phenomenon of asymmetric volatility and incorporating the period of financial turmoil caused by the Global Financial Crisis. The study focuses the attention on the emerging markets of the region of Southeast Asia.

Data from financial markets offer challenging signal processing problems and have attracted much interest from quantitative researchers and traders. The underlying complexity of the financial system that generates such data is enormous, and hence data arising from the system can show both non-linear and non-stationary characteristics. With easy availability of electronic data, there is significant recent growth in their analyses, and such analyses translating into automated trading systems, with one estimate suggesting algorithmic trades accounted for 85% of market volume in 2012, compared to just 15% in 2003. The derivatives markets, too have grown significantly with the number of U.S.- listed equity and index options averaging 16.5 million contracts daily across the first five months of 2017² and the global exchange-traded options market was valued at over 41 thousand billion US dollars in December 2016.

Optimization of portfolios based on expected returns from financial instruments (such as stocks) and uncertainties in their price movements (e.g.4e6), pricing derivatives and other complex contracts based on some predicted future value of an underlying asset, and general time series analysis using a myriad of univariate

and multivariate analytical techniques have been explored in literature, spanning a range of disciplines including statistics, quantitative finance, signal processing and machine learning. These tools of quantitative modeling, elementary forms of which are captured in the practice of technical trading, complement what is termed fundamental analysis in which qualitative information about an asset is its value.

Qualitative information used in fundamental analysis includes periodic reports published by companies on their profitability, payments of dividends etc. as well as news about them and the economic environment, available via news feeds. More advanced data-driven models including artificial neural networks and support vector machines have been used in combination with traditional methods of technical analysis (e.g.), and varying degrees of success have been claimed.

An intriguing development that has significant bearing on the above is in natural language processing and understanding, whereby news feeds and other sources of textual information can be automatically mined and relevant information extracted. 15 Information extracted from text has been successfully applied in several disciplines; IBM's question answering system Watson, 16 and the construction of gene regulatory networks¹⁷ are examples of this. Coupled with this is the exponential increase in information generated and propagated via social media, with a much wider and faster reach to individual investors and professional practitioners.

There are many examples of applying text mining to news data relating to the stock market (e.g.), with a particular emphasis on the prediction of market close prices. An example is the work of Gidofalvi, which, similar to our own, uses a naïve Bayes classifier to predict close price direction on an intraday basis using news as input. In addition to news feeds, sources of textual and behavioral data used by researchers include StockTwits, GoogleTrends and even Wikipedia page views. Analysis of Google trends query volumes led to the discovery and formation of “patterns that may be interpreted as ‘early warning signs’ of stock market moves”.

In terms of extracting information from social media, the work of Bollen et al had a significant impact in the literature.²⁶ These authors derived a six dimensional representation of mood (Calm, Alert, Sure, Vital, Kind, and Happy) by mining large volumes of tweets. The resulting characterization of mood was used to predict the direction of movement of the Dow Jones Index. However, their claim of predicting daily up/down market movement at an accuracy of 86.7% was met with broad skepticism in the computational finance community.

Firstly, the prediction accuracy reported was the best of 8 models attempted in the study and could be viewed as selective reporting. Secondly, the testing period considered by the authors was very short, at only 15 trading days in total, with 1315 days predicted correctly. The uncertainty in this result is bound to be high and not explored by the authors. Lastly, the authors test Granger causality between sentiment and financial time series. However, Granger causality assumes stationary covariance (mean and variance unchanged) over time, which is not the case for market prices, exhibiting non-stationary characteristics. The authors do not explain whether or not they have adjusted for this assumption, for instance by constructing data windows.

Despite this, the very idea of relating information extracted from news feeds to market movement via the intermediate step of characterizing sentiments is an elegant one. Overall emotions, both at the level of groups of traders and at the level of wider society, are bound to influence the behavior of financial markets. While the behavior of individual investors might be heavily modulated by context, Bollen et al correctly postulate that an overall collective signal which influences trends in market behavior may exist and this may be recoverable by mining messages exchanged on social media. We address some of the concerns in the work of Bollen et al by testing on large, heterogeneous data sets.

All of the work reviewed above aims to predict market prices or change in prices from literature derived information. To the best of our knowledge, with the sole exception

of, 27 using information mined from news to predict second order statistics such as volatility, or even volume traded in the markets has not been attempted. Forecasting and modeling volatility, however, has been of interest in quantitative modeling of financial data, with a rich literature on statistical models and algorithms. The family of conditional heteroskedasticity models (e.g. GARCH) is examples of time series models with stochastic dynamics imposed on residual variances. Data-driven approaches to modeling volatilities include the use of advanced machine learning methods such as support vector machines, to predict volatility changes from previous values of the volatility time series.

There is some work in the literature in combining time series modeling of volatilities (GARCH) in combination with news-derived data. A standalone model in attempts to correlate Stock Twits posting volumes to volatility, though with no underlying information extraction from natural language processing. The relationship between notes in Federal Reserve board meeting minutes to market volatility has been explored in, and is the attempt closest to the work in this paper. The work reported in compares news-driven linear regression with GARCH modeling, but the authors make no attempt at comparing the predictions against predicting asset price movement.

In this paper, we explore the hypothesis that news-derived information is likely to have a greater effect on the second order characteristic of market volatility than on the asset values or their direction of movement. We carry out an empirical study and show evidence in support of this hypothesis. We construct a Latent Dirichlet Allocation (LDA) model, which is effective in natural language feature reduction, though proves to be computationally expensive to train. Classification is achieved using a naïve Bayes algorithm, which performs well despite the simplistic assumption of feature independence.

The novel contribution we present is in making predictions about asset price and volatility changes from news derived information alone, as opposed to integrating with

a time series model. This results (see the section on results) in the prediction of volatilities giving rise to a small, yet statistically significant, signal, and the direction of movement of the asset price itself performing no better than random. Further, our work is illustrated on a much larger set of data than what we find as usual in the literature. We assess the performance of our model against a range of benchmarks, including a technical analysis model making use of only time series data.

We take account of non-stationary in the data firstly by applying a decay function to weight news in the feature vector according to regency, and secondly by repeatedly training and testing models on sliding temporal windows, and presenting results that quantify the variation obtained across these different periods. In making a systematic comparison between predicting volatility and predicting close price movements, accounting for non-stationary in a systematic way and in the scale of the empirical evaluation, our work goes substantially beyond what has been touched upon in.

In recent years, travel and leisure emerged to become the most important economy activity around the world. According to UN World Tourism Organization travel and tourism contribute \$7.2 trillion and 283.5 million job opportunities to the global economy in 2015, and leisure travel spending comprises of 76.6% of travel and tourism. Especially, international tourists spending have a positive contribute to the foreign exchange earnings, balance of payment and consequently to the national economy of destination country. Given a significant role of travel and leisure in the global economy, reliable forecast of this sector is important for policy decision making and generating positive return from investment.

Despite, a wide range of techniques have been proposed by researchers to successfully forecast the dynamics in this sector, there is no conclusive model that outperform others in all forecast accuracy criteria. Earlier studies on forecasting travel

and leisure used traditional linear modeling techniques such as Autoregressive Integrated Moving Average (ARIMA) specifications. Due to advancement in econometric techniques and pervasiveness of nonlinear behavior in some financial and economic time series, nonlinear techniques such as artificial neural networks (ANNs), exponential smoothing (ETS), regime switching models and fuzzy time series become widely applied to achieve higher level of forecasting accuracy.

The forecasting performance of both linear and nonlinear models investigated by numerous studies. Kulendran and Witt compare the forecasting performance of ARIMA-type models against a basic structural model, a causal structural time-series model and the naïve specification. Their finding shows that ARIMA models outperform others in the short-run forecasts and naïve model in the mid-run. A study of Vu and Turner confirms that ARIMA model exhibit superior forecasting accuracy relative to basic structural model. Similarly, Chu⁴ investigate the performance of regression models, naïve models and ARIMA specifications, and report better predictive ability of fractionalized ARIMA (ARFIMA) model in both short-run and long-run, and seasonal autoregressive integrated moving average (SARIMA) specification in the long-run.

On the other hand, to uncover the most reliable forecasting technique, Hassani et. al evaluate nine alternative parametric and nonparametric models; and indicate the least accurate prediction of fractionalized ARIMA (ARFIMA) and neural networks specifications.

Law examine the feasibility of back propagation neural networks to forecast tourism demand, and show outstanding performance of back propagation neural network relative to regression models and feed-forward neural networks. Xu et. al examine the applicability of fuzzy Takagie- Sugeno rules extracted from support vector machines (SVMs) method, and demonstrate the superiority of this method for tourism demand predictions. Furthermore, Liet. al proposed generalized dynamic factor model (GDFM) to forecast tourism demand. They argue that GDFM improve

the forecast accuracy of traditional regression models.

Nonlinear time-series models are widely advocated to characterize the asymmetric dynamics of data. One of these models which allows regime switching is the smooth transition autoregressive (STAR) model of Luukkonen et al and Teräsvirta. STAR model is an extended version of the popular Autoregressive (AR) model that implies the existence of nonlinear behavior in the time series. In this model the transition between regimes exogenously determined by the transition function, which is commonly described as either logistic or exponential function. STAR model allows researchers to explain the nonlinear dynamics of financial and economic time series, although empirical studies provide mixed results in favor of STAR model.

STAR model is widely applied in macroeconomic studies. Leybourne and Mizen¹¹ use STAR models to investigate the disinflations in three countries, and Skalin and Teräsvirta to examine the nonlinearities in Swedish business cycle. Sarantis investigate real exchange rate of G-10 countries and report the absence of much difference in out-of-sample forecasting performance between STAR and linear model. Similar results are also reported by Boero and Marrocu using three exchange rates.

On the other hand, Bradley and Jansen¹⁵ investigate the forecasting performance between linear and STAR models and found the superiority of STAR model against linear models to forecast industrial production. Moreover, Teräsvirta et al examine the performance of STAR model using 47 macroeconomic variables of the G7 economies. The result shows that forecasting performance of STAR model outperforms linear AR models.

In the tourism sector, Claveria and Torra analyze the forecasting ability of ARIMA, ANN and STAR specifications for tourism demand. They find that the forecasting accuracy of ARIMA model outperforms nonlinear self-exciting threshold autoregressive (SETAR) and ANN models, especially in the short-term. On the other hand, Saayman and Botha¹⁸ compare the ability of SARIMA, STAR, the basic

structural model (BSM) and singular spectrum analysis (SSA) to forecast tourism demand by allowing structural breaks in the data. They show the superior performance of nonlinear models relative to SARIMA model.

In this paper, we employ monthly travel and leisure index from April 1997 to August 2016 to investigate whether forecasts from STAR model outperform the linear autoregressive model. In order to compare the quality of forecast between these models, we apply root mean squared forecast error (RMSE), the mean absolute forecasts errors (MAE) and the most versatile forecast accuracy tests of Diebold and Mariano (DM, 1995). The rest of the paper structured as follows: Section 2 introduces the method used to examine the forecasting ability of STAR and linear AR models. Section 3 describes the data and demonstrates the performance of travel and leisure index. Section 4 presents empirical result of the study and examine the predictive performance of models. Section 5 the conclusions.

Time series data is a sequence of observations of the defined variable at a uniform interval over a period of time in successive order. Most common series are in annual, quarterly, monthly, weekly and daily frequencies. Economic time series data often possess unique features such as clear trend, high degree of persistence on shocks, higher volatility over time and meandering and sharing co-movements with other series. Researchers need to understand such features of time series data properly and address them.

In time series analysis, it is important to understand the behavior of variables, their interactions and integrations over time. If major characteristics of time series data are understood and addressed properly, a simple regression analysis using such data can also tell us about the pattern of relationships among variables of interest. This paper attempts to highlight the basic econometric issues related to the time series data and provides a basic methodological framework for time series analysis. In addition, the paper analyses the relationship between money and price in Nepal using the methodological framework presented in this paper to provide practical

example.

An individual can broadcast a brief statement in real time to some or all members of the sender's social network through Twitter. Twitter, which has large audience potential, currently attracts an estimated average of 271 million users every month. Recent research has explored whether the 'Twitter effect' is economically substantial. Twitter effect has been shown to be particularly relevant to experiential media products (e.g., movies, music, and electronic games); these are generally the products for which 'instant' success is essential. For instance, the failure of *Bruino*, a multimillion-dollar movie, has been attributed to the negative sentiments about the movie expressed on Twitter. Positive sentiments, on the other hand, have been the perceived cause of the unexpected opening success of the remake of *Karate Kid*.¹⁶ Twitter-based models can then be built to aggregate the opinions of the collective population.

They can be used to predict future trends while gaining useful insights into individual behavior. Social networks offering micro blogging services enable the rapid spread of user generated content (UGC) from a handful of individuals to millions of people around the world in the form of short text, images or videos. Micro blogging platforms have grown so exponentially, that they are now perceived as indispensable sources of information²⁵ and are fast gaining popularity amongst users, organizations and researchers in various disciplines.

The popularity of micro blogging can be explained by its distinctive features such as convenience and accessibility, which allows users to instantly respond and disseminate information with limited or no restrictions on content. It can be argued that social media has significantly impacted our daily lives and has changed the way that individuals and businesses perform, create awareness and seek advice. It is therefore not surprising that the rich and continuous mass of data made available by these platforms is being harnessed with the purpose of studying individual and group behavior as well as global patterns especially in regards to sentiment towards brands,

products, events, recent news and social and political issues.

Twitter is currently the 10th most popular website globally with over 300 million active monthly users. Twitter is updated hundreds of millions of times a day with content varying from individual daily life updates to worldwide news and events. Twitter allows users to create personal profiles that others may subscribe to or 'follow'; publish status updates known as 'tweets' limited to 140 characters and to communicate with others through 'replies'. 'Retweeting' is a common practice whereby a user can choose to forward a tweet they find interesting to their followers whilst crediting the original author, allowing popular posts to travel well beyond the network of the original creator. It is therefore perceived that highly retweeted posts reflect the views of the global Twitter community.

Twitter also encourages the use of hash tags which allow tweets to be collated in a thread that can be used for following specific events and topics. Twitter tracks the most mentioned phrases and hash tags and posts them under a list of 'trending topics', which is updated regularly, and allows users to keep track of what is most popular at any given time.

Originally, Twitter was set up as a type of communication platform designed to allow friends to keep tabs on one another. Thanks to the availability of an application programming interface (API), which stores tweet that may be accessed by researchers, and its convenient features such as filtering by variables like location and keywords, Twitter has encouraged researchers to take an interest and explore its potential beyond that of a social network. Since the conception of Twitter in 2006 studies into properties of Twitter have grown in popularity and can be classified in one of the following streams; structural, content or sentiment.

When evaluating the structural properties of Twitter as a social network studies have focused on user influentially.¹⁰ Content analysis studies have focused on analyzing the content, virility and motivations of tweets. Java et al²⁴ categorized the

motivations of tweets into the following categories; daily chatter, conversations, sharing information and reporting news. Sentiment analysis studies have focused on using Twitter chatter sentiment for predicting behavior. Bollen et al⁸ arguing that although each tweet represents individual opinion, an aggregate sample should provide an accurate representation of public mood.

Motivated by the prospect of a forecasting relationship between politics and market performance,^{28,37} the EU Referendum debates inspired an investigation into the short term impact of user-generated content defined as the collection of UK based tweets recording user sentiment towards politics and the government during the 2016 local elections, on financial market movements specifically looking at the FTSE 100 at the stock market level. The research questions we are aiming to answer are:

1. Does correlation exist between public sentiment regarding the local elections, and stock market movements in the FTSE?
2. Does the relationship of causation exist between public sentiment regarding the local elections and stock market movements in the FTSE?

In order to explore the potential relationship between politics-related sentiment and FTSE 100 movements a UK based political event has been identified and will be the main focus of the data mining in this investigation. On the 5th of May 2016 UK saw the biggest set of elections in years outside of the general election.⁶ Voters were deciding on a variety of issues including but not limited to; local councils, the police commissioner and the Mayor of London. During the days before and after the election highly charged debates took place over Twitter with users weighing in and sharing their sentiment towards candidates and political issues of concern. The debates on Twitter reached a high number of posts with many politics-related hash tags achieving the 'Trending Topic' status, including: #toryelectionfraud, #mayoralelections, #VoteConservative, #iVoted, #PollingDay and #LondonElects.

The rest of the paper is organized as follows: Section 2 will look at existing literature in order to illustrate the motivation behind the study. Section 3 will describe the method used and Section 4 will illustrate the empirical results. Section 5 will form a discussion of the main findings in context of the existing literature and original aims and objectives. Finally, Section 6 will conclude with a summary of the findings, key limitations and future research implications.

The Realized GARCH model (RGARCH) and Realized Exponential GARCH model¹ (REGARCH) (Hansen, Huang, and Shek, 2012; Hansen and Huang, 2016) provide an advantageous structure for the joint modeling of stock returns and realized measures of their volatility. The models facilitate exploitation of granular information in high-frequency data by including realized measures, which constitute a much stronger signal of latent volatility than squared returns (Andersen, Bollerslev, Diebold, and Labys, 2001, 2003). Various models have been proposed to utilize similar information with notable innovations including the GARCH-X model (Engle, 2002), the multiplicative error model (Engle and Gallo, 2006), and the HEAVY model (Shephard and Sheppard, 2010).

It is, however, generally recognized that volatility is highly persistent. This persistence is typically documented via a positive and slowly decaying autocorrelation function (long range dependence) or a persistence parameter close to unity, known as the "integrated GARCH effect". Despite the empirical success of the R(E)GARCH models, these models do not adequately capture this dependency structure in volatility (both latent and realized) without proliferation in parameters. Indeed, Hansen and Huang (2016) point out that the REGARCH does a good job modeling the returns, but falls short in terms of describing the dynamic properties of the realized measure. In the class of GARCH models without realized measures, several contributions have been made to account for these two stylized features.

A few notable references include the Integrated GARCH (Engle and Bollerselv,

1986), the Fractionally Integrated (E)GARCH (Baillie, Bollerslev, and Mikkelsen, 1996; Bollerslev and Mikkelsen, 1996), FIAPARCH (Tse, 1998), regime-switching GARCH (Diebold and Inoue, 2001), HYGARCH (Davidson, 2004), the Spline-GARCH (Engle and Rangel, 2008), and the time-varying component GJR-GARCH (Amado and Teräsvirta, 2013). In the class of R(E)GARCH models, Vander Elst (2015) proposed a fractionally integrated RE-GARCH, whereas Huang, Liu, and Wang (2016) suggested the addition of a weekly and a monthly averaged realized measure in the GARCH equation of the RGARCH.

In this paper, we introduce parsimonious extensions of the REGARCH to capture this evident high persistence by means of a decomposition of the conditional variance. We utilize a multiplicative decomposition into a short-term and long-term component. This structure is particularly useful since it enables explicit modeling of a "baseline volatility", whose level arguably shifts over time, and is the basis around which short-term movements occur. Such a structure is motivated by Mikosch and Střaricřa (2004), who show that long-range dependence and the integrated GARCH effect may be explained by level shifts in the unconditional variance, and by Amado and Teräsvirta (2013), who support this finding empirically in a multiplicative component version of the GJR-GARCH model.

The idea of decomposing volatility originates from Engle and Lee (1999) and has primarily been used to empirically support counter-cyclicalities in stock market volatility (see e.g. Engle et al. (2013) and Dominicy and Vander Elst (2015)). The multiplicative component structure (see e.g. Feng (2004), Engle and Rangel (2008), Engle et al. (2013) and Laursen and Jakobsen (2017)) is appealing since it is intuitive and facilitates parsimonious specifications of a slow-moving component in volatility.

Moreover, it allows for great flexibility as opposed to formal long-memory models employing, e.g., fractional integration. Whether the high persistence arises due to structural breaks, fractional integration or another source (see e.g.

Lamoureux and Lastrapes (1990), Diebold and Inoue (2001), Hillebrand (2005), McCloskey and Perron (2013), and Varneskov and Perron (2017)) our proposed models are able to reproduce the high persistence of volatility observed in stock return data and alleviate the integrated GARCH effect, without formally belonging to the class of long-memory models.

This plays an important role in stationarity of the short-term component and existence of the unconditional variance (which requires the persistence parameter $|\beta| < 1$), but also provides a means to obtain improved multi-step forecasts by reducing the long-lasting impact of the short-term component and its innovations (via faster convergence to the baseline volatility).

When specifying our models, we retain the dynamics of the short-term component like those from a first-order REGARCH, but model the long-term component either via mixed-data sampling (MIDAS) or a heterogeneous autoregressive (HAR) structure. The former specifies the slow-moving component as a weighted average of weekly or monthly aggregates

of the realized measure with the backward-looking window and weights estimated from the data.

The MIDAS concept was originally introduced in a regression framework (Ghysels, Santa-Clara, and Valkanov, 2004, 2005; Ghysels, Sinko, and Valkanov, 2007), allowing for the left-hand and right-hand variables to be sampled at different frequencies. It has recently been incorporated successfully into the GARCH framework with the GARCH-MIDAS proposal of Engle et al. (2013). The latter is motivated by the simple, yet empirically successful HAR model by Corsi (2009), which approximates the dependencies in volatility by a simple additive cascade structure of a daily, weekly and monthly component of realized measures. Both our extensions introduce only two or three additional parameters; hence avoid parameter

proliferation otherwise incurred by means of the classical ARMA structures embedded in the original REGARCH. Moreover, they remain dynamically complete.

That is, the models fully characterize the dynamic properties of all variables included in the model. This property is especially relevant for forecasting purposes, since it allows for multi-period forecasting. This contrasts GARCH-X models, which only provide forecasts one period into the future, and related extensions including macroeconomic factors that typically rely on questionable assumptions about the included variables' dynamics.

We apply our REGARCH-MIDAS and REGARCH-HAR to the exchange-traded index fund, SPY, which tracks the S&P 500 Index, and 20 individual stocks and compare their performances to a quadratic REGARCH-Spline and a fractionally integrated REGARCH, the FloEGARCH, (Vander Elst, 2015).

We find that both our proposed models better capture the autocorrelation structure of latent and realized volatility relative to the original REGARCH, which is only able to capture the dependency over the very short term. This leads to substantial improvements in empirical fit (log-likelihood and information criteria) and predictive ability, particularly beyond shorter horizons, when benchmarked to the original REGARCH. We document, additionally, that the backward-looking horizon of the HAR specification is too short to sufficiently capture autocorrelation beyond approximately one month. While the REGARCH-Spline comes short relative to our proposals (with four-five extra parameters) the FloEGARCH performs well. It does, however, not perform better than our best-performing REGARCH-MIDAS specifications in-sample and lack predictive accuracy in the short-term. This leaves the REGARCH-MIDAS as a very attractive model for capturing volatility persistence in the REGARCH framework and improving forecasting performance.

The remainder of the paper is laid out as follows. Section 1.2 introduces our extensions to the original REGARCH: the REGARCH-MIDAS and the REGARCH-

HAR. Section 3.4 outlines the associated estimation procedure. Section 1.4 summarizes our data set, examines the empirical fit and predictive ability of our proposed models, and introduces a procedure for generating multi- period forecasts. Section 1.5 concludes. Technical details concerning Proposition 1 are presented in the Appendix.

This dissertation focuses on volatility in financial markets, with a special concern for: (i) volatility transmission between different financial markets and asset categories and, (ii) the effect of macroeconomic announcements on the returns, volatility and correlation of stock markets. These issues are analyzed taking into account the phenomenon of asymmetric volatility and incorporating the period of financial turmoil caused by the Global Financial Crisis. The study focuses the attention on the emerging markets of the region of Southeast Asia.

The analysis of financial assets volatility is important to academics, policy makers, and financial market participants for several reasons. First, prediction of financial assets volatility is crucial to economic agents because it helps them make rational portfolio risk management decisions. Volatility is critically important to economic agents because it represents a measure of risk exposure in their investments.

Furthermore, from a theoretical perspective, volatility occupies a central stage in pricing of derivative securities. For example, to price an option we need to know, as a risk measure, the volatility of the underlying asset from now until the option expires. Moreover, in a market risk context, it is vital to know the volatility of an asset in order to calculate the Value-at-Risk of a portfolio selection. Finally, volatility is important for the economy as a whole. Policy makers often rely on market estimates of volatility as a barometer for the vulnerability of the financial markets and the economy. All these reasons have sparked an enormous interest in modeling the conditional variance and a large number of volatility models have modeling the conditional variance and a large number of volatility models have (2003) for an

extensive review].

In the financial literature there are two well-known stylized features about volatility. First volatility responds asymmetrically to bad and good news and second, the existence of volatility spillovers between different financial markets and asset categories.

The asymmetric behavior of volatility refers to the empirical evidence according to which a negative return shock (unexpected drop in the value of the stock) generates an increase in volatility higher than a positive return shock (unexpected increase in the value of the stock) of the same size. In the financial literature two explanations of the asymmetric effect of news on stock return volatility have been put forward.

The first one is based on the leverage effect hypothesis. According to this explanation, a drop in the value of the stock (negative return) increases financial leverage, which makes the stock riskier and increases its volatility [Black (1976) and Christie (1982)]. The second explanation is known as volatility feedback and Christie (1982)]. The second explanation is known as volatility feedback to the fact that returns could simply reflect the existence of time-varying risk premiums.

If volatility is priced, an anticipated increase in volatility raises the required return on equity, leading to an immediate stock price decline [Campbell and Hentschel (1992), Pindyck (1984), French et al. (1987)]. This hypothesis relies on two basic tenets. Firstly, volatility is persistent and secondly, there exists a positive inter-temporal relation between expected returns and conditional variances.

If we consider these two principles, it is possible to observe what happens when news arrives at the market. Firstly we will consider the case of bad news, for example a large piece of bad news about future dividends. Large piece of news

tend to be followed by other large piece of news (volatility is persistent), so these piece of news increases future expected volatility, which in turn increases the required rate of return on stock and lowers the stock price, amplifying the negative impact of the dividend news. Now consider a large piece of good news about future dividends. Once again, the stock price falls because higher volatility raises the required rate of return on stock and lowers the stock price, but now the volatility effect dampens the positive impact of the dividend news. Therefore, volatility increases more after bad news than after good news.

Finally notice the two theories on asymmetric volatility propose reversal causality. According to the leverage effect, the return shocks lead to changes in conditional volatility; whereas according to the volatility feedback hypothesis return shocks are caused by changes in conditional volatility.

Which effect, leverage effect or volatility feedback effect, is the main determinant of asymmetric volatility, remains an open question. Those studies that focus their analysis on the leverage hypothesis [Christie (1982) and Schwert (1989)], show that this effect is too small to explain the full asymmetry. On the other hand, authors like Braun et al. (1995), Bekaert and Wu (2000) and Wu (2001) find clear evidence in favor of the volatility feedback effect as the main cause of the asymmetric behavior.

The second stylized feature about volatility is that volatility is often observed to move together over time across assets and markets. The study of volatility transmission has long been a challenge to both academic and practitioners. Transmission mechanisms between volatilities of different markets and assets are important for a number of reasons. First, transmission mechanisms may be useful for portfolio management, where knowledge of return spillover effects may be useful for asset allocation or stock selection. Second, information about volatility spillover effects may be useful for applications in finance that

rely on estimates of conditional volatility, such as option pricing, portfolio optimization, Value-at-Risk calculation and hedging.

In recent years, the interrelations between the US and the Asian markets have raised due to the increasing financial relations. One typical portfolio diversification strategy consists of investing in similar asset classes in multiple markets (international diversification). In order to make appropriate risk management strategies it is vital to know the characteristics of the markets of the different geographical areas and how the markets co-move. Likewise, it is very important to analyse which factors can influence the behavior of the assets in the financial markets.

Within Asian markets, this thesis distinguishes between mature and emerging countries. Japan represents the mature market and the emerging economies are divided into three groups: the Asian Tigers (tigers hereafter), the Asian Tiger Cub (cubs hereafter) economies and, finally, China.

Japan is one of the largest economies in the world in terms of nominal GDP and purchasing power parity. During the Meiji period from 1868, Japan expanded economically, founding at the time many of today's enterprises, emerging as the most developed nation in Asia. In the 1990s the growth slowed significantly, after the Japanese asset price bubble.

The Government made efforts with little success to revive the economic growth. The economy showed strong signs of recovery in 2005, with a great GDP growth. Nowadays, Japan is the third largest economy in the world, after the United States and China, in terms of nominal GDP. The Tokyo Stock Exchange is the largest stock exchange in Asia and the second largest stock exchange in the world by aggregate market capitalization of its listed companies, which is mainly represented by the Nikkei 225 Index.

The tigers refer to the economies of Hong-Kong (old British colony nowadays

belonging to China), Singapore, South Korea (Korea hereafter) and Taiwan. The tigers emerged between the years 1945 and 1990, and were notable for maintaining exceptionally high growth rates sustained over decades and rapid industrialization, with a wide range of characteristics similar to other Asian economies, such as China and Japan. These economies experienced a great growth, not only in quantity, but also in quality of their products, with a low price, reaching the international markets.

All four markets have developed into advanced and high-income economies, specializing in areas of competitive advantage, so that Hong-Kong and Singapore have become world leading international financial centers and Korea and Taiwan are world leaders in manufacturing and information technology. Prior to the 1997 Asian Financial crisis, the growth of these economies has been attributed to export-oriented and strong development policies. These four economies were commonly referred as to “The Asian Miracle”.

The economic success of these markets has turned into models for other developing countries, especially the Asian Tiger Cub economies. In 1997 the tigers experienced their first major setback, the Asian financial crisis. While Singapore and Taiwan were relatively unhurt, Hong-Kong suffered intense speculative attacks in the stock and currency markets and Korea performed a great stock market crash. However, in the years after the crisis all these four economies rebounded robustly, offering high levels of growth again.

Currently, Hong-Kong is one of the world’s leading international financial centers. It is noteworthy that Hong-Kong is a city-state and is a Special Administrative Region of People’s Republic of China, hence within the group of tigers, is distinguished as a separate market from China, as it has been a British colony until 1997, and nowadays maintains an independent economic, administrative and judicial system. The Hong-Kong Stock Exchange (represented by the Hang Seng Index) is the Asia’s second largest stock exchange in terms of market

capitalization behind the Tokyo Stock Exchange, and the sixth largest in the world behind Euronext.

Singapore, officially the Republic of Singapore, is a sovereign city-state and island-country in Southeast Asia. It is the third most densely populated country in the world after Monaco, another city-state, and Macau. Singapore has a highly developed trade-oriented market economy and its economy has been ranked as the most open in the world, less corrupt and most pro-business with low tax rates, having the world's third highest GDP per capita. Besides, this country is one of the world's major commercial hubs, with the fourth biggest financial centers and one of the five busiest ports. Its globalised and diversified economy strongly depends on trade, especially manufacturing. The Singapore Exchange was formed in December 1999 as a holding company, becoming in November 2000 the second exchange in Asia-Pacific. Its main stock exchange benchmark is the Straits Time Index.

South Korea, officially the Republic of Korea, constitutes the southern part of the Korean Peninsula. It is one of the world's wealthiest nations, being a member of the G-20 major economies. It was one of the world's fastest growing economies from the early 1960s to the late 1990s, and it is still one of the fastest growing countries in the 2000s, along with the other three tigers. South Korea is ranked twelfth in the Human Development Index, while in terms of average wage; it has the Asia's highest income and the world's tenth highest income. It ranks highly in education, quality of healthcare, rule of law, ease of doing business, government transparency, job security, tolerance and inclusion. The South Korean economy is heavily dependent on international trade, being among the top ten largest exporters and importers in the world. Its exportations are driven by high-tech multinationals as a world leader in innovation as it is. The Korea Exchange is the sole securities exchange operator in South Korea and its mainly representative benchmark is the Kospi Index.

Finally, the last tiger is Taiwan, a state located in East Asia. Since 1945, the island of Taiwan has been under the political system of the Republic of China, the state that governed entire China until the end of the civil war. Since then, the old Chinese regime has remained on the island of Taiwan, leading to a complex legal and diplomatic situation, although in practice it is an independent partially recognized state. After the quick industrialization and rapid growth of this country during the latter half of the 20th century, which has been called the “Taiwan Miracle”, Taiwan has developed an advanced and capitalist industrial economy with great position in the ranking of world economic growth. Taiwan is highly ranked in terms of health care, public education, economic freedom and human development. The stock exchange in this country is represented by the Taiwan Stock Exchange Index.

The cubs include Philippines, Indonesia, Malaysia and Thailand. The cubs achieved their industrialization later, following the same export-driven model of economic development pursued by the tigers. These markets became the newly industrialized countries that, following the steps of the tigers, are considered the rising tigers. In consequence, these economies have suffered, in general, in a less painful way the 1997 Asian financial crisis. Afterwards, all these countries have managed to keep high rates of industrialization and evolution, becoming important destinations for foreign investment. Within the cubs, Indonesia and Philippines are the ones with the major rapid industrialization and large population. Moreover, overseas Chinese entrepreneurs (residents with Chinese roots living outside of the People’s Republic of China that keep business ties with China), contributed to the economic growth of private sectors from the cubs by establishing a business network between Southeast Asia and the Greater China (China, Hong-Kong, Taiwan and Macau).

The Philippines, officially known as the Republic of Philippines, is a sovereign island country in Southeast Asia. The Philippines is the seventh most populated country in Asia and the twelfth in the world. Its economy has been growing steadily over decades, but it is not part of the Group of 20 (G-20) nations. The Philippine economy

has been transitioning from one based on agriculture to one based more on services and manufacturing. It is a newly industrialized country that has a high dependence on the United States, as a former American colony, thus has a large presence of US companies in the country. Its major trading partners include the United States, Japan, China and the Asian Tigers, among others. The Philippine Stock Exchange is one of the oldest stock exchanges in Southeast Asia and its main index is the Philippine Stock Exchange Composite Index.

The large economy of Indonesia (officially the Republic of Indonesia) is the largest economy in Southeast Asia and a member of the G-20 major economies, classified as a newly industrialized country. It has a market economy in which both the private sector and the government, through ownership of state-owned enterprises and the administration of prices of a range of basic goods (including fuel, rice and electricity), play significant roles. The industry sector is the economy's largest, accounting almost half of its GDP, followed by increasing services and agriculture. Indonesia was the country hardest hit by the Asian financial crisis of 1997, suffering sudden capital outflows leading the Indonesian rupiah into free fall. Afterwards, the rupiah stabilized and economic growth accelerated. In addition, it is noteworthy that corruption has been a persistent problem in Indonesia.

For example, Transparency International ranked Indonesia below 100 in its Corruption Perceptions Index. However, since 2007, due to an improvement in banking sector and domestic consumption, national economic growth has revitalized, performing strongly during the Global Financial crisis. Regarding the Indonesian Stock Exchange, the Jakarta Composite Index is the main benchmark index of all stocks.

Malaysia is a federal constitutional elective monarchy in Southeast Asia, consisting of thirteen states and three federal territories. Malaysia has a newly industrialized market economy, which is relatively open and also state-oriented. The state plays a

significant, but declining, function in conducting the economic activity through macroeconomic policies. Malaysia has had one of the best economic records in Asia in terms of average GDP annual growth. Since 1980 the industrial sector, with a high level of investment, has led the country's growth and the economy began a transition towards a more multi-sector economy.

Malaysia recovered from the Asian financial crisis earlier than its neighbors, but economic inequalities still exist between different ethnic groups. International trade and manufacturing are the key sectors of this country. Furthermore, Malaysia is an exporter of natural and agricultural resources, and petroleum is a major export. Bursa Malaysia, previously known as Kuala Lumpur Stock Exchange, operates as a fully integrated exchange, with the FTSE Bursa Malaysia Kuala Lumpur Composite Index as the main index.

Thailand, officially the Kingdom of Thailand, is a monarchy in Southeast Asia and is also a newly industrialized country, with a heavily export-dependent economy (the exports account more than two-thirds of its GDP). Despite its low gross national income per capita, the nation is recognized by the World Bank as "one of the great development success stories". After experiencing the world's highest growth rate from 1985 to 1996 (averaging 12, 4% annually), increasing pressure on Thailand's baht, its currency, in 1997, led to a crisis that provoked a great financial sector weakness. Thailand's economy started to recover in 1999, thanks to strong exports.

Major exports include Thai rice, textiles and footwear, fishery products, rubber, jewellery, cars, computers and electrical appliances. Rice is the most important crop in the country (Thailand has long been the world's number 1 exporter of rice, nowadays stays behind both India and Vietnam). Concerning the stock exchange, The FTSE SET Shariah Index is one of the main indexes of the Thailand Stock Exchange.

In general, the region of Southeast Asia has an elevated population growth rate, political instability and a great economic boom. On the other hand, the Southeast Asian economies are quite vulnerable to the economic decisions taken abroad, since they have a small internal market and a high dependence on foreign energy and technology.

The Southeast Asian region makes an interesting case study as both tigers and cubs are growing economies that offer major opportunities for international industry. As developing countries, they are following the lead set by China, the motor of growth in Asia, and, in recent decades, the financial and commercial ties established with the US have been strengthened considerably, since these countries are making an increasing contribution to global economic development while establishing themselves as key players in international industrialization.

Finally, China is included in the study due to its spectacular growth performance over the last two decades. It is a country that cannot be missed when analyzing the Asian market. This economy, considered the engine of growth for Asia in general, is not included within the tigers because the concept of tiger obeys to emerging small country with great growth. China does not meet the characteristic of a small country. The People's Republic of China is a sovereign state governed by the Communist Party and it is the most populous country in the world. As of 2013, China has the world's second largest economy in terms of nominal GDP, after the Africa's positive growth projections and its surging economy have had more investors attracted to it over the recent years. In the 2011 Africa Attractiveness Survey, Ernst & Young (EY) indicated that the perceptions about Africa among investors have become more distinctly positive over the long-term horizon. In its subsequent survey of 2015, EY stated that it believed that Africa now has the potential to bring about a future that would have been unimaginable a generation ago.

To harness these growth prospects, Africa's stock markets have been key in availing receptive avenues as the first points of contact with investors. Investors now

confidently participate in the African financial markets, specifically, the equity market with assurance and security from the existing Stock Exchange structures.

Favorable to Stock Exchanges, is also their known power to enable businesses to raise investment capital for expansions, far better than other asset classes. Alagidede (2011) deposed that part of the expansion in financial flows in emerging markets has been brought about by the growth of equity funds dedicated to investing in publicly listed securities in developing countries. Ojah and Kodongo (2015) pointed out that Stock Exchanges provide a platform for corporations to access external capital through debt and equity issuances (primary markets) and for holders of the issued ownership certificates to trade them in a secondary market (liquidity provision).

Hence, Stock Exchanges also give investors the opportunity to directly invest in large corporations whilst also playing a regulatory role in ensuring that they (investors) are not exploited. Inevitably, their role extends and spills over to promoting growth within an economy by boosting economic development and raising standards of living. Singh and Hamid (1992) have, in their study, observed that through equity, the corporate sector is able to contribute to the economic development in developing countries. Empirical evidence also suggests that movements in equity prices are fundamental in explaining aggregate investment behavior (Barro, 1990). The results from the study undertaken by Yarty and Adjasi (2007) showed that stock markets have contributed to the financing of the growth of large corporations in certain African countries.

The importance of a stock market particularly in transitioning economies, a status enjoyed predominantly by most African countries, cannot be overstated. However, Singh (1999) made a statement in his study about “Africa countries’ promotion of stock market capitalism being a costly irrelevance which they can ill-afford.” He recommended focus to be shifted to the banking industry, although noting in the same breadth that Africa’s banking systems are bedeviled by state ownership which

more or less caters for multi-national firms. He further noted that the inept, corrupt and political mismanagement of the banking system are inappropriate characteristics that blanket the banking system.

His arguments have since been challenged in detail by Ojah and Odongo (2011), who hold that the recommendation for the extinction of stock markets in Africa merely for the pursuit and advancement of a banking system is not a strong enough basis. They highlight that Singh's (1999) observation that bank-based capital markets such as Germany and Japan are superior to stock-based ones, ignores the reality that these cited countries also have public equity markets. To that end, it is a legitimate locus, to recognize that the banking system and the public equity markets co-exist and they assist each other to equally play a role in providing external capital to firms.

In fact, Levine (2002) concluded in his cross-country study of differentiation growth effect of financial market-type, that there is no evidence of such differentiation. To that end, he contends that it is an unnecessary and biased exercise to sequence the financial market types within a given economy. Cho (1986) pointed out that since equity finance does not experience adverse selection to the same extent as debt finance, the credit market needs to be supported well-functioning equity markets.

However, some of the shortfalls observed by Singh (1999) in Africa equity markets are a reality that requires practical solutions. Alagidede (2009) argued that the risk perception and institutional underdevelopment remain obstacles to the development of Africa's emerging equity markets. He recommended lessening of political and economic policy risk, and /or reducing existing barriers to movement of financial resources in order to deepen and foster integration of Africa's capital market.

Adrianaivo and Yartey (2010) reiterated the assertion made by Alagidede (2009), citing that Africa stock markets suffer infrastructural bottlenecks, highlighting that slow

trading, clearing and settlement systems hamper information production and activity turnover.

Despite the differing opinions on the relevance of equity markets in Africa, it is common cause that African markets have been experiencing an influx of investors and as a result have grown over the past decades. De Santis (1997) observes that foreign investors have shown an increasing interest in equities from developing countries. The number of active securities exchanges in Africa has since increased from seven (Egypt, Morocco, Tunisia, South Africa, Zimbabwe, Kenya, and Nigeria) in 1989 to twenty-nine, representing thirty-eight nations in 2016. In- depth Report of 2013, a publication of Applied Capital Markets Ltd, ACM- Insight, found that African frontier equity markets currently exceed their European and American counterparts by market capitalization in the Russell Frontier Index (RFI), having posted 14.5 per cent. The RFI represents investable frontier equity market and its segments and it is constructed using float-adjusted market capitalization weights.

All these external factors when integrated with stock prices and stock technical indicators have shown the effect on stock price movements. The stock market is considered a volatile market due to the external factors affecting its movements, dynamicity of the market and complexity of dimensionality which makes the prediction task of the trend/price of the stock a difficult and challenging task even with deep learning models(Singh, Aishwarya 2019). These external factors can be grouped into fundamental factors, technical factors and market sentiments as follows:

Supply and demand. For example, if traders tend to buy this stock more than selling it, this will affect the price probably by rising since the demand will be more than the supply.

Stock prices can have unexpected moves because of a single news which keeps a stock artificially high or low. Hence, investors cannot predict what will happen with a stock on a day-to-day basis. This is called market sentiment

factors and they include company news, economy, and world events.

Global economy. The flow of money and transactions is based on the economy of the traders which is affected by the economy of the country.

Stock historical prices. Each stock has a range which tick data moves within, when looking into chart patterns and behavior of investors.

Public sentiments and social media. A tweet from a president or an article release affects the price of the related stock(s). For example, an unofficial resignation of a CEO on twitter.

Natural disasters. For example, the “haiti earthquake” that killed around 316,000 people affected the S&P index by going down 6.6% after 18 trading days.

Earnings per share (EPS) are a fundamental factor that affects stock price. Investors tend to purchase stocks with high EPS since they know that they will gain substantial profits. The demand on this stock, the company management, the market sector dominance and the cyclical industry performance result in the movement of the stock price.

Inflation and deflation are technical factors. Inflation means higher buy price and thus higher interest rates. This will result in a decrease of stock price. On the contrary, deflation means lower buy prices and thus lower profits and interest rate.

All these diverse factors and others affect price movements, leading to a difficulty in stock prediction. Researchers assume that market prediction does not exhibit random behavior (Schumaker, R. et al. 2009). Many publications have been done on the topic attempting to increase the accuracy of future price predictions.

Mark L. et al. (1994) studied the influence of public information reported by Dow Jones and concluded that a direct relation does exist between released news articles and stock market activities.

1.1 NEED FOR THE STUDY

1. It needs to raise the capital it is a global financial system
2. Regulators are there to protect the investors from abusive trading practices
3. It also use stocks for merger and acquisition transactions
4. Stock markets are central to financial planning.

1.2 STATEMENT OF THE PROBLEM

1. Stock values are changing depending on the market condition day by day.
2. The challenge is to guide the investor for the right time to buy and sell the shares.
3. There are many regression and classifiers available for the prediction.
4. Need for determining the best technique that provides better result in predicting the stock prices and give accurate trends.

1.3 OBJECTIVES OF THE STUDY

1. To Study the volatility of share prices in Nifty 50.
2. To test the significance of Volatility in Stock Market of Nifty 50.

1.4 SCOPE OF THE STUDY

The scope of the research comprises of information derived from secondary data from various websites. The various information and statistics were derived from the websites of BSE, NSE, Money Control, RBI and SEBI. Sensex and NIFTY was a natural choice for inclusion in the study, as it is the most popular market indices and widely used by market participation for benchmarking.

1.5 LIMITATIONS O THE STUDY

In this study, the factor that affects the stock return and volatility has been confined to internal variable only. No macro environment factors such as inflation, GDP have been factored in this study. Therefore future studies should aim by taking a long time series data and should incorporate macro-environment variables while determining the volatility.

Moreover the study has been confined only to NIFTY Index and its sectoral indices. Thus, future studies should aim to analyze cross multiple exchanges that too operating in different geographies.

CHAPTER II

2. 1. LITERATURE OF REVIEW

The stock market prediction process is filled with uncertainty and can be influenced by multiple factors. Therefore, the stock market plays an important role in business and finance. The technical and fundamental analysis is done by sentimental analysis process. Social media data has a high impact due to its increased usage, and it can be helpful in predicting the trend of the stock market. Technical analysis is done [6] using by applying machine learning algorithms on historical data of stock prices. The method usually involves gathering various social media data, news to extract sentiments expressed by individuals. Other data like previous year stock prices are also considered. The relationship between various data points is considered, and a prediction is made on these data points. The model was able to make predictions about future stock values

In the past, various numbers of works have been conducted and completed on this topic and some of the renowned works out of them are mentioned below:

Roy, et al. (1995) focused on two key issue: (a) what is the average level of volatility and whether it has increased in the current period; (b)whether the present trend of share price movement is likely to impair the development process of our economy through study “Stock Market Volatility: Roots and Results”. In this study, they examined that, several volatility measures based on different price indices had been used to evaluate the stock price movement in historical perspective. In such, instance, the conclusion was essentially the same, i.e., stock market volatility had increased in the that period if the changes in share prices had been response to fundamental economic factor or information and expectations about them, there was no social cost associated with such volatility.

Reddy, (1996) analyzed the volatility of securities traded on the National stock Exchange (NSE) and the Bombay Stock Exchange (BSE). In this study, researcher employed stock market trading data relating about 3,000 securities traded on Bombay Stock Exchange (BSE) and over 1,000 securities traded on NSE.

Volatility of individual securities was also analyzed in this study and it was found that the securities traded on BSE had more volatility than the securities traded on NSE. Researcher also showed through this study that Indian Capital Markets were highly volatile.

Mitra (2002) made a study on “Profiting from Technical Analysis in Indian Stock Market”. He tried to find out a trading strategy that is profitable even after transaction cost. He used daily closing prices of ACC, Reliance industries, State bank of India, and TISCO from the stock market published quotes during the period Dec, 1995 to Feb, 1999. He used two tools for analysis purpose: Moving average crossover, and Filter rules. The trading tools or methods tested in the study were giving profitable results, which helps investor to believe that making profit in stock market is not just a matter of chance. He concluded that investor do not always to be right to enjoy the trading, but they need to have an analytical and systematic approach to make trading profit on a cumulative basis.

U Rao, (2007) in the study “Impact of Financial Derivatives Products on Spot Market Volatility: A study on Nifty” examined the impact of index future, index options, stock options and stock futures on the volatility of Nifty. For the purpose of this study the collected data from National Stock Exchange and time period of study was June-7, 1999 to dec-31, 2005. He found that Nifty volatility has increased with the introduction of derivatives product such as index futures. This may be due to speculative operation and the Foreign Institutional Investors” active participation in the market.

According to “Debjit Chakraborty” (1997) in his study attempts to establish a relationship between major economic indicators and stock market behavior. It also analyses the stock market reactions to changes in the economic climate. The factors considered are inflation, money supply, and growth in GDP, fiscal deficit and credit deposit ratio. To find the trend in the stock markets, the BSE National Index of Equity Prices (Natex) which comprises 100 companies was taken as the index. The study

shows that stock market movements are largely influenced by, broad money supply, inflation, C/D ratio and fiscal deficit apart from political stability.

According to “Redel” (1997) concentrated on the capital market integration in developing Asia during the period 1970 to 1994 taking into variables such as net capital flows, FDI, portfolio equity flows and bond flows. He observed that capital market integration in Asian developing countries in the 1990s was a consequence of broad-based economic reforms, especially in the trade and a financial sector, which is the critical reason for economic crises which followed the increased capital market integration in the 1970s in many countries, will not be repeated in the 1990s. He concluded that deepening and strengthening the process of economic liberalization in the Asian developing countries is essential for minimizing the risks and maximizing the benefits from increased international capital market integration.

According to “Avijit Banerjee” (1998) reviewed Fundamental Analysis and Technical Analysis to analyze the worthiness of the individual securities needed to be acquired for portfolio construction. Technical Analysis detects the most appropriate time to buy or sell the stock. It aims to avoid the pitfalls of wrong timing in the investment decisions. He also stated that the modern portfolio literature suggests 'beta' value P as the most acceptable measure of risk of scrip. The securities having low P should be selected for constructing a portfolio in order to minimize the risks.

According to “Madhusudan”(1998) found that BSE sensitivity and national indices did not follow random walk by using correlation analysis on monthly stock returns data over the period January 1981 to December 1992.

According to “Arun Jethmalani” (1999) reviewed the existence and measurement of risk involved in investing in corporate securities of shares and debentures. He commended that risk is usually determined, based on the likely variance of returns. It is more difficult to compare 80 risks within the same class of investments. He is of the opinion that the investors accept the risk measurement

made by the credit rating agencies, but it was questioned after the Asian crisis. He concluded his article by commenting that risk is not measurable or quantifiable. But risk is calculated on the basis of historic volatility. Returns are proportional to the risks, and investments should be based on the investors' ability to bear the risks, he advised.

According to “Suresh G Lalwani” (1999) emphasized the need for risk management in the securities market with particular emphasis on the price risk. He commented that the securities market is a 'vicious animal' and there is more than a fair chance that far from improving, the situation could deteriorate.

According to “Nath and Verma” (2003) examine the interdependence of the three major stock markets in south Asia stock market indices namely India (NSE-Nifty) Taiwan (Taix) and Singapore (STI) by employing bivariate and multivariate co integration analysis to model the linkages among the stock markets, No co - integration was found for the entire period (daily data from January 1994 to November 2002).

According to “Bhanu Pant and Dr. T.R.Bishnoy” (2001) analyzed the behavior of the daily and weekly returns of five Indian stock market indices for random walk during April 1996 to June 2001. They found that Indian Stock Market Indices did not follow random walk.

According to “Juhi Ahuja” (2012) presents a review of Indian Capital Market & its structure. In last decade or so, it has been observed that there has been a paradigm shift in Indian capital market. The application of many reforms & developments in Indian capital market has made the Indian capital market comparable with the international capital markets. Now, the market features a developed regulatory mechanism and a modern market infrastructure with growing market capitalization, market liquidity, and mobilization of resources. The emergence of Private Corporate Debt market is also a good innovation replacing the banking

mode of corporate finance. However, the market has witnessed its worst time with the recent global financial crisis that originated from the US sub-prime mortgage market and spread over to the entire world as a contagion. The capital market of India delivered a sluggish performance.

CHAPTER- III

3. RESEARCH METHODOLOGY

3.1 Research Design:

The present study is description in nature.

3.2 Data Collection:

The present study is based on secondary data it has been collected from NSE annual report, article or journal, magazine or website.

3.3 Period of study:

The present study is conclusive in nature, where various volatility models have been used in forecasting the volatility by making use of the secondary data. The daily closing values of the NSE index from Jan 1st, 2020-Dec 31st, 2020 have been drawn from the NSE website. The forecasting period has been chosen from Jan 1st, 2021-Dec 31st, 2021. The data from 1st May, 2021-31st December, 2021 has been kept for out of sample forecasting.

3.4 Statistical tools used:

The study has made use of Two different models for volatility estimation

1. Historical/rolling window moving average estimator
2. Exponentially Weighted Moving Average (EWMA)

3.5 Historical/rolling window moving average estimator:

The historical or n-period rolling window moving average estimator of the volatility corresponds to the average standard deviation of the returns over the recent window of size n. It is given by the square root of the expression:

Where,

r = Represents the weekly market return

μ = Indicates the average return of the selected period

$$\sigma_{t+1}^2 = \frac{1}{n} \sum_{s=t-n+1}^t (r-\mu)^2$$

This method is the easiest of all the methods, though the final value of volatility depends a lot on the size of the window. If the size is very small and if there is a black swan in the small window selected then the effect would be very high. Moreover this estimate measures only the unconditional volatility of time series and does not take into account the dynamic properties of the model. In this method all the returns are given equal importance and no special importance is given to the time of occurrence.

3.6 Exponentially Weighted Moving Average (EWMA):

The Exponentially weighted moving average (EWMA) refers to an average of data that is used to track the movement of the portfolio by checking the results and output by considering the different factors and giving them the weights and then tracking results to evaluate the performance and to make improvements.

This method is an improvement over the historical moving average estimator in which the returns are given weights according to the time of occurrence. The most recent observation is given the highest weight and the last observation in the window is given least weight. The weights decrease exponentially. In this way the current events have a higher effect on the volatility being estimated.

The EWMA is often used for smoothing irregular fluctuations (i.e., noise) in a time series to permit the data analyst to better reveal trend/cycle patterns over time. Additionally, the EWMA is frequently used to compute short-term forecasts of time series (e.g., sales and stocks). Some common applications of the EWMA in the management science and quality engineering disciplines are discussed. Further, some properties of the EWMA, such as the expected value, variance, and one-step ahead prediction variance are also discussed.

Suppose there is a large and unwarranted move in the market, the higher weight age given to that variable helps in moving the volatility upward. A smoothing factor λ is chosen and declines exponentially. Here the value of λ determines how much of the move is transferred to the next day's volatility. A low value of λ makes sure that the volatilities respond faster when compared to higher value of λ . It usually lies between 0.94 and 0.97 (daily to monthly respectively). Various research papers have shown that the best results are obtained when λ is equally to 0.94 when calculating weekly volatility.

EWMA estimate is calculated as a square root of the following expression:

$$\hat{\sigma}^2 = \lambda \sigma^2 + (1 - \lambda)(r - \mu)^2$$

One drawback of the EWMA model is that it can perform only a one period forecast and not h-period ahead forecasts. However in the present exercise, the weights series is calculated with $\lambda = 0.94$. The variance (for the 157th week) is calculated using the formula stated above. The variance for the next week is calculated using the 2nd-157th observations. A sensitivity test can be performed using different values of lambda.

CHAPTER-IV

4. DATA ANALYSIS & INTERPRETATION:

In finance, volatility is the degree of variation of a trading price series over time, usually measured by the standard deviation of logarithmic returns. Historic volatility measures a time series of past market prices.

Their research found that higher volatility corresponds to a higher probability of a declining market, while lower volatility corresponds to a higher probability of a rising market. Investors can use this data on long term stock market volatility to align their portfolios with the associated expected returns.

Table no. 4.1

Historical/rolling window moving average estimator

	Mean	variance	Standard deviation
ADANI PORTS	0.107418729	0.000438444	
ASIAN PAINT	0.046666371	0.000190475	0.013801267
AXIS BANK	0.066899118	0.000273058	0.016524455
BAJAJ-AUTO	0.04694425	0.000191609	0.013842297
BAJAJ FINSV	0.083409996	0.000340449	0.018451259
BAJ FINANCE	0.098612372	0.000402499	0.02006239
BHARTIARTL	0.128466676	0.000524354	0.022898772
BPCL	0.059561057	0.000243106	0.015591868
BRITANNIA	0.059561057	0.000243106	0.015591868
CIPLA	0.049606678	0.000202476	0.014229414
COAL INDIA	0.076993044	0.000314257	0.017727304
DRREDDY	0.047845171	0.000195286	0.013974491
EICHER MOT	0.140475592	0.00057337	0.023945141
GAIL	0.608925142	0.002485409	0.049853874

GRASIM	0.105685478	0.000431369	0.020769432
HCLTECH	0.097462088	0.000397804	0.019945036
HDFC	0.053112179	0.000216784	0.0147236
HDFCBANK	0.507062827	0.002069644	0.045493342
HEROMOTOCO	0.097462088	0.000397804	0.019945036
HINDALCO	0.077780757	0.000317472	0.017817757
HINDUNILVR	0.032035912	0.000130759	0.011434982
ICICIBANK	0.076031563	0.000310333	0.017616268
INDUSINDBK	0.153453673	0.000626342	0.025026816
INFRATEL	0.192480621	0.000785635	0.028029185
INFY	0.078923866	0.000322138	0.01794821
IOC	0.100334613	0.000409529	0.020236824
ITC	0.040998148	0.000167339	0.012935972
JSWSTEEL	0.122687035	0.000500763	0.022377744
KOTAKBANK	0.045631098	0.000186249	0.013647321
LT	0.060614792	0.000247407	0.015729187
M&M	0.083414656	0.000340468	0.018451775
MARUTI	0.089104926	0.000363694	0.019070752
NESTLEIND	0.046801788	0.000191028	0.013821277
NTPC	0.085718606	0.000349872	0.018704862
ONGC	0.08493778	0.000346685	0.018619474
POWERGRID	0.044465813	0.000181493	0.013471938
RELIANCE	0.068288195	0.000278727	0.016695129
SBIN	0.113300466	0.000462451	0.021504671
SUNPHARMA	0.102591527	0.000418741	0.02046316
TATAMOTORS	0.310732575	0.001268296	0.035613147
TATASTEEL	0.138764433	0.000566385	0.023798854
TCS	0.050745134	0.000207123	0.014391768

TECHM	0.049961794	0.000203926	0.014280255
TITAN	0.083447519	0.000340602	0.018455409
ULTRACEMCO	0.080567148	0.000328846	0.018134098
UPL	0.221639264	0.00090465	0.030077401
VEDL	0.178147673	0.000727133	0.02696541
WIPRO	0.119477468	0.000487663	0.022083096
YESBANK	0.933384388	0.003809732	0.061723028
ZEEL	0.447265266	0.001825573	0.042726719

SOURCE:

NSE Annual Report Jan 2020 – Dec 2020

On the basis of Historical moving average to analyze the volatility in 2020 Top50 stock of Nifty50. On the analysis the volatility comes in the range of (0.01380126742, 0.01652445529, 0.01845125912, 0.02006238964, 0.02289877243, 0.01422941443 upto 0.06172302809).

The volatility different on the basics of company performance, Market situation, Micro Economies, Macro Economies, government policies or any other situation.

If take the Example of some companies for volatility stage in ADANI PORTS 0.02093904942, ASIANPAINT 0.01380126742, Infosys 0.01794820957, UPL 0.03007740113, YESBANK 0.06172302809, ZEEL 0.04272671897.

In these companies the ASIANPAINT 0.01380126742 is low volatility, ZEEL 0.04272671897 is medium volatility, YESBANK 0.06172302809 is high volatility.

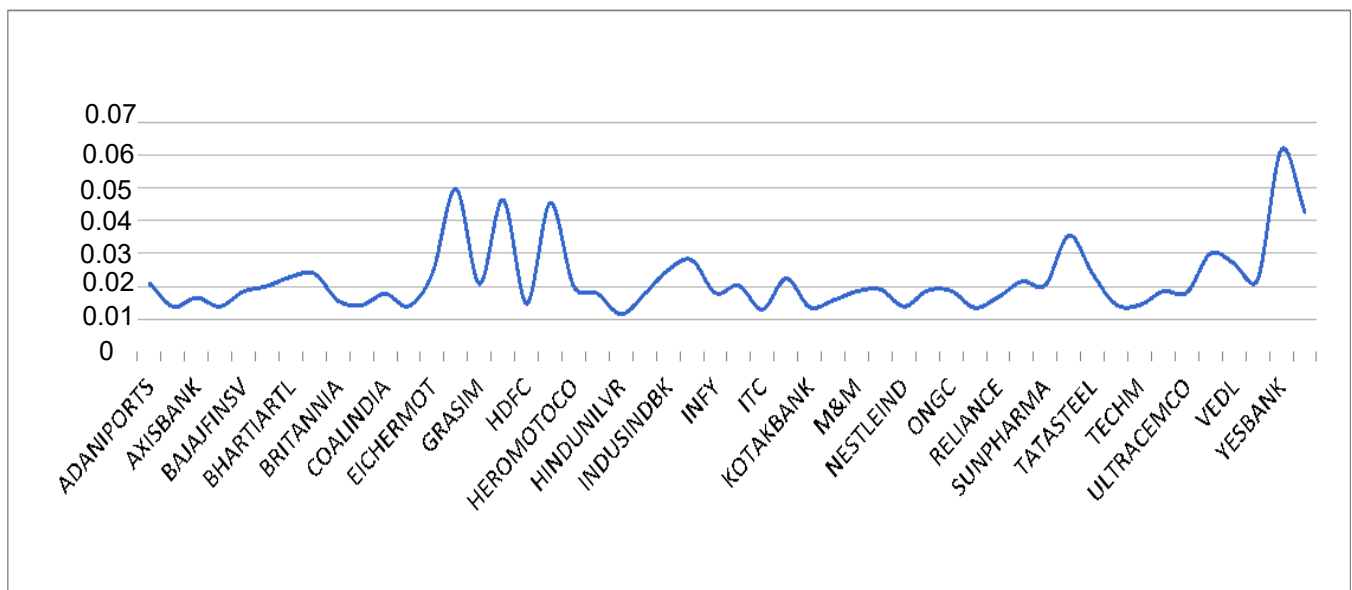
In this Example we will be able to understand the Volatility Range. Some companies come under 0.0200 but some companies are above the 0.0200. If you see some rare companies are above 0.0600 in these types of company the volatility range is so high. Which are all the companies are below 0.0200 these companies are

volatility range is high.

The High Volatility it arise high risk because market is highly fluctuation. So which investor is ready to take risk it is suitable for the high volatility shares because it give both high and low return.

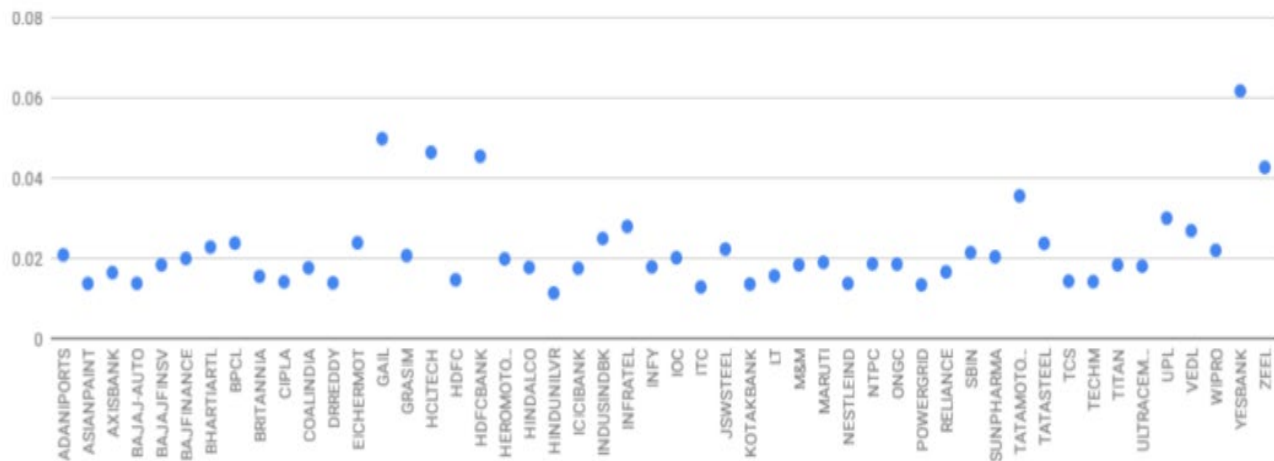
The Medium Volatility it arise high risk because market is Medium fluctuation. So which investor is ready to take medium risk it is suitable for the medium volatility shares because it give medium return.

The Low Volatility it arise low risk because market is minimum fluctuation. So which investor is needed return with safe investment it is suitable for the Low volatility shares because it give low return but highly safe.



HISTORICAL VOLATILITY IN NIFTY50 USING LINE CHART

Fig No. 4.1.1



HISTORICAL VOLATILITY IN NIFTY50 USING SCATTER

Fig No. 4.1.2

YESBANK

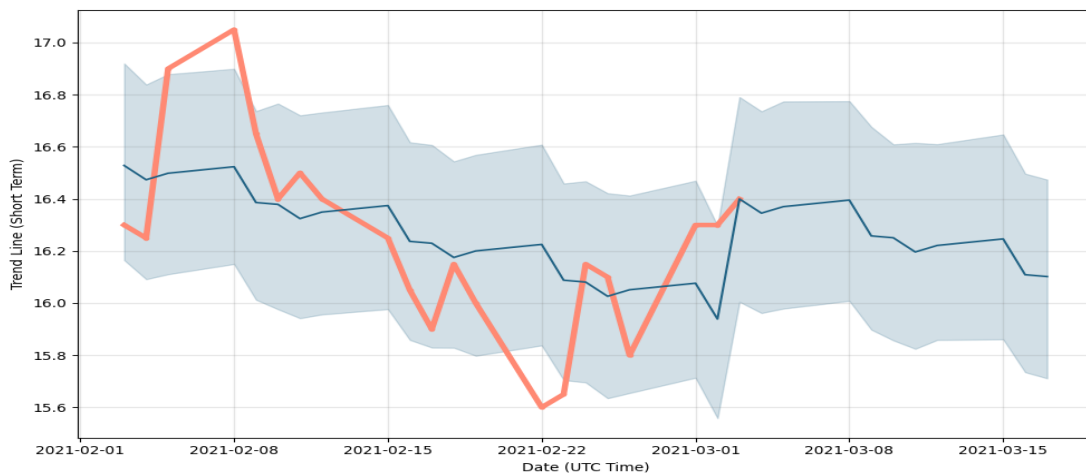


Fig No. 4.1.3

The volatility is high (0.06172302809) Yes bank compare to other stock. So based on the Result the Yes Bank is huge volatility because of so many reason.

So my suggestion is to avoid buying a share which has high volatility Ex. Yes bank because the shares price may go upward or it will come downward because it has huge risk.

My Study is proven that use this method the Yes Bank is highly volatile in the market. It is the first time the share price of the yes bank is come 7Rs and 10rs.

On the basis of my study the market is highly volatile from JAN2021to MARCH 2021. So My Study is proved.

Table No. 4.2

Exponentially Weighted Moving Average (EWMA):

	STANDARD DEVIATION
ADANI PORTS	0.015480814
ASIAN PAINT	0.006812735
AXIS BANK	0.018501702
BAJAJ-AUTO	0.013048144
BAJAJ FINSV	0.011956054
BAJ FINANCE	0.011701395
BHARTIARTL	0.01791675
BPCL	0.01893746
BRITANNIA	0.008090546
CIPLA	0.008852365
COALINDIA	0.010710025
DRREDDY	0.008795989
EICHERMOT	0.045797941
GAIL	0.021145518
GRASIM	0.016554717
HCLTECH	0.01099017

HDFC	0.014599817
HDFCBANK	0.006765517
HEROMOTOCO	0.015550286
HINDALCO	0.021006956
HINDUNILVR	0.006837966
ICICIBANK	0.011522737
INDUSINDBK	0.013767335
INFRATEL	0.026316477
INFY	0.011417494
IOC	0.016061877
ITC	0.010008699
JSWSTEEL	0.027120359
KOTAKBANK	0.009319994
LT	0.012396873
M&M	0.02373861
MARUTI	0.016735926
NESTLEIND	0.016567521
NTPC	0.015168033
ONGC	0.017928902
POWERGRID	0.014246452
RELIANCE	0.012236781
SBIN	0.015786538
SUNPHARMA	0.020429223
TATAMOTORS	0.023204202
TATASTEEL	0.024512857
TCS	0.012121566
TECHM	0.016736443
TITAN	0.008302174
ULTRACEMCO	0.014760898
UPL	0.011568027
VEDL	0.027271084

WIPRO	0.014916885
YESBANK	0.023565991
ZEEL	0.027843272

SOURCE:

NSE Annual Report Jan 2020-Dec20202

On the basis of Exponentially Weighted Moving Average to analyze the volatility in 2020 Top 50 stock of Nifty50. On the analysis the volatility comes in the range of (0.01548081364, 0.006812735314, 0.01424645249, 0.02784327165, up to 0.04579794117).

The volatility different on the basics of company performance, Market situation, Micro Economies, Macro Economies, government policies or any other situation.

If take the Example of some companies for volatility stage in ADANI PORTS 0.01548081364, ASIANPAINT 0.006812735314, EICHERMOT 0.04579794117, HDFC 0.01459981746, YESBANK 0.02356599131, ZEEL 0.02784327165.

In these companies HDFC BANK 0.006765517 is low volatility, HDFC 0.01459981746 is medium volatility, EICHERMOT 0.04579794117 is high volatility.

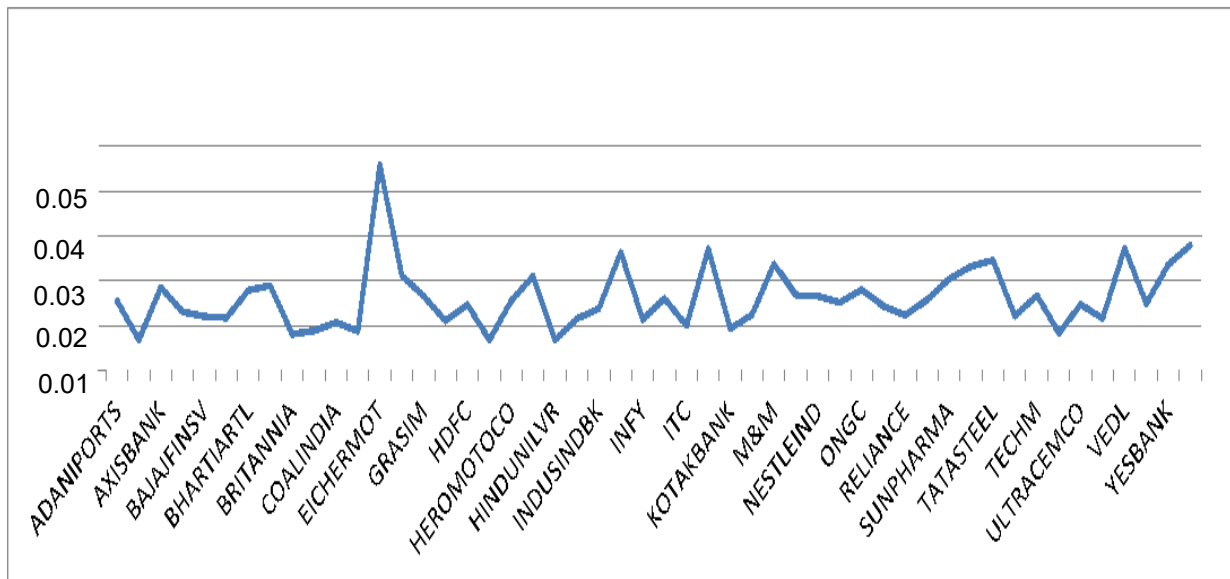
In this Example we will be able to understand the Volatility Range. Some companies come under 0.0200 but some companies are above the 0.0200. If you see some rare companies are above 0.0400 in these types of company the volatility range is so high. Which are all the companies are below 0.0200 these companies are volatility range is high.

The High Volatility it arises high risk because market is highly fluctuation. So the which investor is ready to take risk it is suitable for the high volatility shares because it gives both high and low return.

The Medium Volatility it arise high risk because market is Medium fluctuation. So which investor is ready to take medium risk it is suitable for the medium volatility shares because it give medium return.

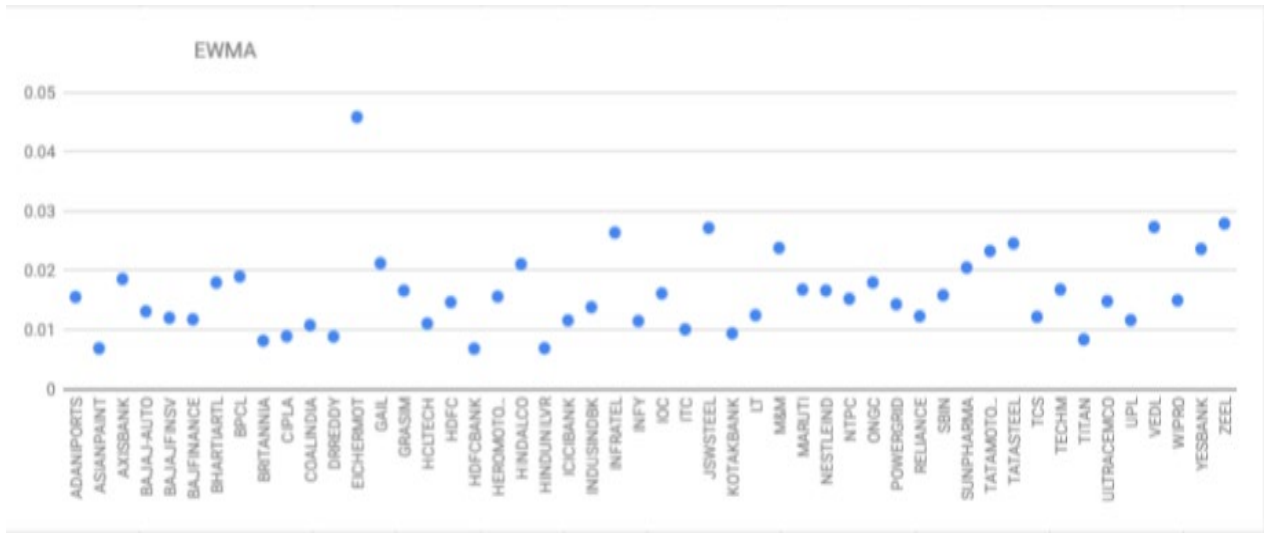
The Low Volatility it arise low risk because market is minimum fluctuation. So which investor is needed return with safe investment it is suitable for the Low volatility shares because it give low return but highly safe.

EWMA



EWMA IN NIFTY50 USING LINE CHART

Fig No. 4.2.1



EWMA IN NIFTY50 USING SCATTER CHART

Fig No. 4.2.2

EICHER MOTOR

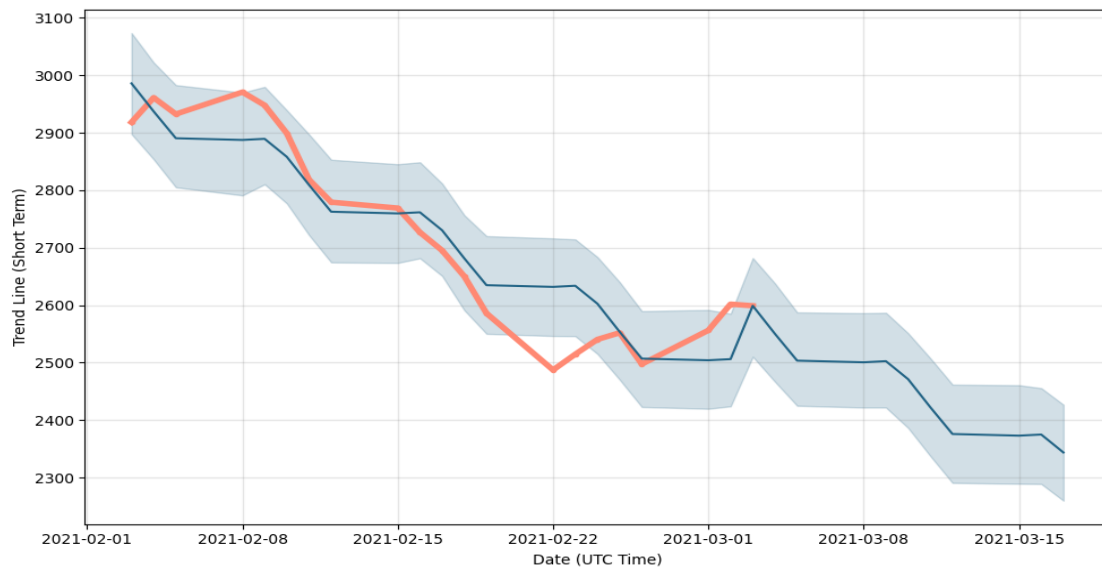


Fig No. 4.2.3

The volatility is high (0.04579794117) EicherMot compare to other stock. So based on the Result the EicherMot is huge volatility because of so many reason.

So my suggestion is to avoid buying a share which has high volatility Ex. EicherMot because the shares price may go upward or it will come downward because it have huge risk.

My Study is proven that use this method the EicherMot is highly volatile in the market. It is the first time the share price of the EicherMot is come 7Rs and 10rs.

On the basis of my study the market is highly volatile from JAN 2021 to MARCH2021. So My Study is proved.

CHAPTER- V

5. FINDINGS AND SUGGESTIONS:

5.1 FINDINGS

5.1.1 Historical/rolling window moving average estimator

On the basics of Historical volatility the volatility of the stock will comes around 0.01380126742, 0.01652445529, 0.01845125912 and 0.01422941443 up to 0.06172302809.

The volatility is low (0.01380126742) ASIANPAINT compare to other stock. So based on the Result the volatility because of so many reasons.

The volatility is high (0.06172302809) Yes bank compare to other stock. So based on the Result the Yes Bank is huge volatility because of so many reason.

5.1.2 Exponentially Weighted Moving Average (EWMA):

On the basics of Exponentially Weighted Moving Average (EWMA) the volatility of the stock will comes around 0.01548081364, 0.006812735314, 0.01424645249, 0.02784327165, upto 0.04579794117.

The volatility is low (0.006765517) HDFC BANK compare to other stock. So based on the Result the volatility because of so many reason.

The volatility is high (0.04579794117) EicherMot compare to other stock. So based on the Result the EicherMot is huge volatility because of so many reason.

5.2 SUGGESTION

5.2.1 Historical/rolling window moving average estimator

So my suggestion is to avoid buying a share which has high volatility Ex. Yes bank because the shares price may go upward or it will come downward because it has huge risk.

My Study is proven that use this method the Yes Bank is highly volatile in the market. It is the first time the share price of the yes bank is come 7Rs and 10rs.

On the basis of my study the market is highly volatile from JAN2021 to MARCH 2021. So My Study is proved.

5.2.2 Exponentially Weighted Moving Average (EWMA):

So my suggestion is to avoid buying a share which has high volatility Ex. EicherMot because the shares price may go upward or it will come downward because it have huge risk.

My Study is proven that use this method the EicherMot is highly volatile in the market. It is the first time the share price of the EicherMot is come 7Rs and 10rs.

On the basis of my study the market is highly volatile from JAN 2021 to MARCH2021. So My Study is proved.

5.4 CONCLUSION

On the basis of result of various tests can be concluded Nifty50 companies was fairly weak from efficient and follow of Historical/rolling window moving average estimator and Exponentially Weighted Moving Average (EWMA) during the study period. In this period, Indian stock market is approaching towards the state of fairly weak efficient market. As per the results, stock market efficiency is improving which can be the results of improvement in technology, regulation regarding disclosure, and an amount of retail investor particulars etc. In the net shell, with the growth of technical facilities in the capital market and removal of investment barriers, the integration of Indian stock market along with international stock market will increase in future.

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APPENDIX:

SYMBOL	COMPANY NAME	SECTOR
ADANIPORTS	Adani Ports and Special Economic Zone Ltd.	Services
ASIANPAINT	Asian Paints Ltd.	Consumer goods
AXISBANK	Axis Bank Ltd.	Financial services
BAJAJ-AUTO	Bajaj Auto Ltd.	Automobile
BAJAJFINSV	Bajaj Finserv Ltd.	Financial services
BAJFINANCE	Bajaj Finance Ltd.	Financial services
BHARTIARTL	Bharti Airtel Ltd.	Telecom
BPCL	Bharat Petroleum Corporation Ltd.	Oil & gas
BRITANNIA	Britannia Industries Ltd.	Consumer goods
CIPLA	Cipla Ltd.	Pharma
COALINDIA	Coal India Ltd.	Metals
DRREDDY	Dr. Reddy's Laboratories Ltd.	Pharma
EICHERMOT	Eicher Motors Ltd.	Automobile
GAIL	GAIL (India) Ltd.	Oil & gas
GRASIM	Grasim Industries Ltd.	Cement & cement products
HCLTECH	HCL Technologies Ltd.	IT
HDFC	Housing Development Finance Corporation Ltd.	Financial services
HDFCBANK	HDFC Bank Ltd.	Financial services
HEROMOTOCO	Hero MotoCorp Ltd.	Automobile
HINDALCO	Hindalco Industries Ltd.	Metals
HINDUNILVR	Hindustan Unilever Ltd.	Consumer goods
ICICIBANK	ICICI Bank Ltd.	Financial services

INDUSINDBK	IndusInd Bank Ltd.	Financial services
INFRATEL	Bharti Infratel Ltd	Telecom
INFY	Infosys Ltd	IT
IOC	Indian Oil Corporation Ltd.	Oil & gas
ITC	ITC Ltd.	Consumer goods
JSWSTEEL	JSW Steel Ltd.	Metals
KOTAKBANK	Kotak Mahindra Bank Ltd.	Financial services
LT	Larsen & Toubro Ltd.	Construction
M&M	Mahindra & Mahindra Ltd.	Automobile
MARUTI	Maruti Suzuki India Ltd.	Automobile
NESTLEIND	Nestle India Ltd.	Consumer goods
NTPC	NTPC Ltd.	Power
ONGC	Oil & Natural Gas Corporation Ltd.	Oil & gas
POWERGRID	Power Grid Corporation of India Ltd.	Power
RELIANCE	Reliance Industries Ltd.	Oil & gas
SBIN	State Bank of India	Financial services
SUNPHARMA	Sun Pharmaceutical Industries Ltd.	Pharma
TATAMOTORS	Tata Motors Ltd.	Automobile
TATASTEEL	Tata Steel Ltd.	Metals
TCS	Tata Consultancy Services Ltd.	IT
TECHM	Tech Mahindra Ltd.	IT
TITAN	Titan Company Ltd.	Consumer goods
ULTRACEMCO	UltraTech Cement Ltd.	Cement & cement products
UPL	UPL Ltd.	Fertilizers & pesticides
VEDL	Vedanta Ltd	Mining & minerals

WIPRO	Wipro Ltd.	IT
YESBANK	Yes Bank Ltd.	Financial services
ZEEL	Zee Entertainment Enterprises Limited Fully Paid Ord. Shrs	Entertainment