Stock Market Volatility between Selected Emerging and Developed Economies Using ARCH and GARCH Model

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Abstract: The study explores the symmetry and asymmetry lies between selected emerging economies such as National Stock Exchange (NSE, India), Shanghai Stock Exchange (SSE, China), Stock Exchange of Hong Kong (SEHK, China) and developed economies such as New York Stock Exchange (NYSE, USA), and Euronext (Europe) using ARCH and GARCH model. The time series data of the daily adjusted closing prices from 1st April 2011 to 31st March 2021 have been collected for all five markets. By applying the model, empirical findings shows that the emerging market are more persistent toward the volatility as compared to developed economies whereas the responsiveness towards the crisis are high among the developed economies. The implications of the study are significant for various stakeholders in finance, economics and policy making. The study helpful for investors and portfolio manager for asset allocation, diversification and risk management. The results also helpful for policymakers in improving the regulation and to reduce the susceptibility of market shocks. The study contributes to existing literature by showing the connexion of the emerging and developed markets. The study recommends that investor should be aware about the market micro structure of different economies and crossover impact.

Keywords: Stock Market; Volatility; ARCH/GARCH; Emerging Economies; Developed Economies

1. Introduction

Investing is an art that has been learnt by experience and through rigorous study of the market. Financial markets are volatile across emerging and developed economies wherein huge volume is traded daily. Various investors participate in the markets with the expectation of maximising the returns which are backed with extreme volatilities of the markets. To evaluate the financial market risk, consumers adopt several techniques to analyse the risk and return. Asset managers and traders always try forecasting the market to beat the volatility and maximise the return. Volatility is the degree of variation in the trading price of a financial instrument over the period. The fact lies that markets are not immune to volatility. It is integral in financial markets and various factors are responsible for this volatility such as economic events, global market events, investor's reaction to a certain information and policy changes etc. Before investing in financial markets of emerging and developed economies. There is a need to understand the nature of stock markets. Emerging economies often experience speedy growth and development as huge investments are made by domestic and foreign investors and a general demographic change occurs due to change in market size which results in a rise in the standard of living among middle-class population. On the other side, developed economies are at a matured phase in which huge volume is traded. The prominent trading volume of these markets draws attention of new investors which fosters the development of trillion-dollar economies specific to each market. As per the report published by Statista Research Department, nearly 60% of global stocks are attributed by USA. The notable market share is also of The United Kingdom, which attributes 4.1% of the global stocks. Taking cues from the published report of Statista Research department, it has also been evidenced from past studies that market participants are tracking the stock market pattern of other countries to forecast the stock prices. The cross-border stock market analysis became one of the essential criteria due to increased liberalization, globalization and invention in the field of IT and Communication. This has also led to the enhancement of flow of funds in between developed and emerging nations because USA and UK stock markets dominate in the list of developed nations and China stands

out in the list of Emerging nations with a market share of 3.7%. Increased investment increases the market volatility as the economies are interconnected due to globalization. Due to the interrelation between the economies stimulates the curiosity to know the stock market movement in between India (NSE), USA (NYSE), China (Shanghai Stock Exchange and The Stock Exchange of Hong Kong) & Europe (Euronext).The present study explores the symmetry, and asymmetry lies between the emerging and developed economies by using the ARCH and GARCH model.

It has been theoretically found that the stock market volatility caused by leverage[1)], impact of good and bad news[2)]. Studies also found that market volatility is driven by government policies[3)]. Different studies measure the volatility using "Autoregressive Conditional Heteroskedasticity" (ARCH) and variants of "Generalized Autoregressive Conditional Heteroskedasticity" (GARCH)[4),5)] for forecasting future returns of a market. Most appropriate model for showing symmetric and asymmetric volatility is GARCH[6)]. Using ARCH and GARCH Model, researchers compared different country stock market indices for different reasons to confirm the volatility across the indices. The US spot index, US index futures, and the TAIEX (Taiwan Stock Exchange) exhibit a notable volatility asymmetry and price transmission effect[7)]. New York, London and Tokyo as well as those of Hong Kong, Shanghai and Shenzen are integrating more and more. Foreign investors benefit from the co-integrating relationship's periodic breakdown[8)]. Asian countries, i.e., Pakistan, India, Sri Lanka, China, Japan, and Hong Kong markets volatility were tested which reveals that there was no volatility spillover to the Chinese and Indian stock markets. Still, both one-way and two-way spillover effects are known to exist throughout additional Asian markets[9)]. Studies indicate the volatility of the US and Pakistan is adversely affected by the Indian market[10)] whereas studies found the positive volatility spillover between Indian and other markets such as Hong Kong, Korea, Japan, and Singapore and US market[11)] Studies revealed that the United States has the most impact over the other nations in terms of both mean and variance patterns. Additionally, bordering country markets and more developed nation markets are the primary sources of the volatilities to unanticipated shocks in diverse markets[12)].

However, it has been found that there has been minimal research on volatility in developing or emerging stock markets, compared to the extensive study of volatility in developed stock markets. Studies exhibited that developing nations are more volatile, and it persists for longer duration in comparison to developed nations. Studies also revealed that developed nations stock market pattern is followed by emerging markets and neighbouring countries. In view of this, the current study tried to explore the symmetry and asymmetry lies between India (NSE), USA (NYSE), China (Shanghai Stock Exchange and The Stock Exchange of Hong Kong) & Europe (Euronext) by using the ARCH and GARCH model. In order to bridge the gap in the literature, it forecasts market volatility between the developed economies such as USA, Europe and emerging economies such as India, China and Hongkong. The goal is to find any symmetry or asymmetry lies in between these markets that could help with the distribution of investment resources. Novelty of present study is lies in analyzing the different economies symmetry and asymmetry of stock market volatility and integration which belongs from different geopolitical, economic and regulatory environment and how market structures in these economies react to common global shocks like covid-19.

Insights into how economic or geopolitical shocks in one region impact volatility in another can be gained by evaluating cross-market volatility spillovers between Asia's emerging markets and the major Western developed markets (NYSE and Euronext). Examining whether emerging markets are more vulnerable to shocks from developed markets than vice versa might assist determine the direction and severity of volatility transmission.

2. Literature Review

2.1 Theoretical Framework

The volatility is a critical episode of financial markets which affects investment decisions and influence the stability of the markets. Investors need to understand the volatility trends and patterns which remain constant or fluctuating over time. Academicians, scholars, and other experts commonly accept volatility as a measure of investment risk, and it has become widespread in investment analysis. This is a time-variant variable and can be measured by various models[13)].

Economists of India, China and the USA are trying to see the impact and relationship between the volatility of these financial markets. This can help the investors for making decisions and to earn abnormal returns.

The National Stock Exchange (NSE), a leading Indian stock exchange, was incorporated in 1992. For the calendar year 2022, based on the number of contracts traded, it's the largest derivative exchange and third largest in cash equities and by market value, it's one of the largest value stock exchanges. The NIFTY-50 is the benchmark index of the NSE. The New York Stock Exchange (NYSE) was established after the Buttonwood Agreement was signed by the 24 stockbrokers. It is commonly called the "Big Board" since it has the most traded stocks. By market capitalisation, it is the world's largest stock exchange.

An International settlement in Shanghai resulted after the treaty of Nanking in the year 1842, which eventually ended the First Opium War. Shanghai's securities trading business started in the late 1860s. It is the world's third-largest stock exchange by market value. It is also the largest stock exchange in Asia. In 1866 the Hong Kong securities market came into existence, and in 1891, the

Association of the Stockbrokers in Hong Kong was formed, and the exchange started to function. In 1914, it was renamed as The Hong Kong Stock Exchange. Euronext (European New Exchange Technology) was formed in September 2000 by merging the Amsterdam, Brussels, and Paris stock exchanges. The idea was to develop a single, integrated, liquid market for European securities trading.

One can see the stock exchange linkages in the literature. The literature shows that the financial markets are not mutually exclusive. They work in tandem with other financial markets. In the times of crisis, volatility spills over to other markets which is due to the interconnectedness and interdependencies of the global markets. Conceptually stock market volatility circulates the option pricing theory, optimisation, asset pricing, and risk management. The stock markets are the barometers of the economy, and hence the volatility of the stock markets is derived from geopolitical risk and other macroeconomic variables. Literature has established a connection between the stock markets and geopolitical risk[14-17]. The macro-economic factors contribute to stock market volatility, like inflation, interest rates, money supply, current account deficit, and industrial production[18]. A more substantial impact of the COVID–19 on the European stock market volatility, mainly due to high-intensity searches on Google by the panicked investor[19]. To apprehend stock market volatility GARCH Model is widely used. The model introduced by Bollerslev (1986) which is an extension of the ARCH model proposed by Engle (1982). Model believes that volatility is not constant but varies over time and depends on past periods of volatility and shocks. ARCH model signal that the past errors influence future volatility while GARCH effects indicate the past volatility influences the current volatility. The GARCH model capture the volatility spillovers and co-movements between emerging and developed economies which helps in identifying the effects of global shocks across the borders. Previous studies exhibit that emerging markets are highly volatile and persist for longer duration due to external shocks, political instability, and liquidity constraints while developed economies remain more stable. Studies used ARCH and GARCH model to represent volatility over time and degree of market integration. Theoretical concepts which support stock market volatility and integration are efficient market hypothesis which says market is efficient and stock prices fully reflect all available information, but previous studies found that practically, market in inefficient which ARCH and GARCH model capture[20]. Previous studies also exhibit that in emerging and developed markets risk return trade-off may differ significantly which helps investor in asset allocation globally and minimizing risk[21]. Researchers also reveals that in case of global financial crisis market contagion occurs which spread from developed to emerging markets which leads to higher volatility that can be effectively modeled through GARCH[22]. ARCH and GARCH Models helps in measuring the market volatility and integration which helps investors in diversification and managing risk globally.

2.2 Empirical Framework

The stock market volatility may happen due to disinvestment in equity holding, keeping other things constant, leading to an increase in the debt-equity mix, which will further increase the volatility in the stock market. The dynamics of stock market volatility using 'volatility clustering' which means the pattern in stock market volatility of high periods followed by low volatility[23]. Research asserts that fluctuations are not constant as it is backed with time-varying nature of volatility. In the seminal study which emphasized volatility can affect return unpredictably[24]. It was evident that there is a negative relationship when volatility expectations are represented by standard deviations. Both the economies viz. emerging and developed economies show volatility clustering, but emerging markets have more asymmetry and volatility[25] but risk-return trade-off in emerging markets are competitive[26]. The market offers higher returns, but risk is also huge. The stock market volatility estimation by focusing upon heavy tailed distribution which shows that odd extreme events are most likely to happen[4]. The focus of the study was on precision in the estimation of volatility, also it was asserted that traditional model underestimates the risk. The dynamics of volatility in the emerging economy such as Kenya has been explored by the researchers[5]. The descriptives such as fat tails, mean reverting was explored and observed that emerging markets extends higher volatility due to macro-economic factors and political instability. In South Africa and Chinese markets for identifying the symmetry and asymmetry for exhibiting volatility, the paper highlights the fact that periods of high fluctuations are followed by constant simultaneous high volatility periods in both the markets[27]. The GARCH model uncovers the conditional volatility facts which has been emphasized by the previous researchers[28]. This explored the way the market reacted during the spread of virus, economic downturn, and lockdowns. Volatility was at peak in the beginning times of COVID-19. The impact of COVID-19 under first wave which incorporated unique google trends data[19]. This asserts that information seeking behavior, examining the impact of global events such as pandemic increased the market volatility. The empirical relationship between macroeconomic volatility and stock market volatility[29]. It was found that there is both side relationships between stock market volatility and macroeconomic volatility, both affects each other. The combination of multiple components for predicting the stock market volatility[30]. It combined various macro-economic variables and market sentiment measures. The forecast was done to predict the upside and downside volatility of S&P 500. The volatility transmission in the Japanese stock market by employing a

GARCH model[31]. The research highlights the contagion effect, periods of high correlation and interconnections among various investment classes. The international market happenings were having a huge impact on Japanese market volatility. Researcher focuses upon how volatility in one market can affect the global economies using DCC-GARCH model which asserts that the shocks, events and spillovers of one market can transform the same sentiments to other markets due to the interconnection of world economies[32]. The short-term volatility spillover effect is seen across all global stock markets, but the same is not present in the long run. The interconnectedness and interdependencies of financial markets are driven by liberalisation, globalisation, major reforms, cross border investments, trade agreement, economic policies, pandemic like Covid-19, geopolitical tensions such as Russia- Ukraine and Israel and Iran war and the regulatory norms[33]. In the situation of Pandemic Covid 19 which caused anxiety and increased volatility in the world's stock markets, recent previous studies revealed that emerging nation markets reacted similarly while the developed nations reacted differently[34]. Impact of market volatility on developed nations signifies that a nation's economic strength does not always protect it from economic stability.

Past studies analysed the nature and determinants of Asian markets integration between and India and other Asia-Pacific Countries. Studies revealed that market integration at high between two countries when they share economic linkages. In Asian Countries the magnitude of financial risk is heavier than developed markets. Even the volatility spillover between emerging and developed markets is smaller than pure spillover which signifies the diversification across borders and in different asset classes to minimize risk and earning returns[35]. A significant correlation between the volatility of China and the US financial markets & global oil prices[36]. This shows that the global oil markets observe the transmission of information. This asserts the interconnectedness of financial markets and insights of these markets are very important for investors, policy makers, financial analysts, etc. for financial decision making.

Many researchers have done empirical research on time series data to forecast future trade movements. By using ARCH (Auto-Regressive Conditional Heteroscedasticity) and GARCH (Generalized Auto-Regressive Conditional Heteroscedasticity) models the volatility of stock prices can be measured, which helps investors in maximising the returns. The ARCH and GARCH models explain the variance for the given data set in. Engle, 1982 identified ARCH and further Bollerslev, 1986 explored GARCH model which is the extension of ARCH model.

Stock market volatility may be forecasted using different financial econometric models. Firstly, the ARCH model determines the relationship between conditional variance and error[37]. Bollerslev continued his work, removing some of the ARCH model's limitations and introducing the GARCH model[38]. Several researchers have used the GARCH family to forecast volatility and stock returns[39-42]. The emerging and developed economies found that the Government's political risk impacts the volatility and returns of the stock exchanges by using the GARCH approach[43),44]. These forecasting techniques help an investor in fetching returns from the market. Financial tools provide insight to predict the trend of the market. Stock market volatility affects economic policy and growth[45),46]. Researchers in the past examined the stock market volatility of the New York Stock Exchange[47], the Nairobi Stock Exchange[48], Istanbul Stock Exchange[49] and Nigerian Stock Exchange[50] etc.

Based on previous studies, the current study tried to fill the gap in literature by exploring the symmetry and asymmetry lies between between the developed economies such as USA (NYSE), Europe (Euronext and emerging economies such as India (NSE), China (Shanghai Stock Exchange and The Stock Exchange of Hong Kong (SEHK) by using the ARCH and GARCH model. This provides insight to investors in framing the buying and selling strategies in maximising the return by understanding the information transmission mechanisms across the markets. The strategy can be made by understanding how the relationship appears to be between the financial markets. Based on the objective of the study, the paper addresses the following research questions:

Does the volatility between the emerged (India, China, Hong Kong) and developed (USA, Europe)

Markets are symmetry or asymmetry. To what extent do ARCH and GARCH Models capture the commonality among the emerging and developed economies?

3. Research Methodology

Stock exchange of any country plays an important role in the growth of the nation. NYSE, SSE, SEHK, NSE and Euronext are facilitating huge trade volumes and fostering buying and selling activities. The indexes provide international connections for broad investor base and for fund raising. In the objective of the study is to explore the symmetry and asymmetry lies between between the developed economies such as USA (NYSE), Europe (Euronext and emerging economies such as India (NSE), China (Shanghai Stock Exchange and The Stock Exchange of Hong Kong (SEHK) by using the ARCH and GARCH model. Based on the objective of the study the hypothesis is:

H_1: There is asymmetry between the developed economies such as USA (NYSE), Europe (Euronext and emerging economies such as India (NSE), China (Shanghai Stock Exchange and The Stock Exchange of Hong Kong (SEHK) by using the ARCH and GARCH model.

The sample used in the study consist of daily adjusted closing prices from 1st April 2011 to 31st March 2021.

The daily adjusted closing price of stock exchanges has

been taken from yahoofinance.com in their local currency. After that, data is cleaned by removing zero in respective stock exchanges. With this adjusted closing price, the stock return has been calculated using a log method in Ms-Excel.

$$lsr = \ 〚log〛\_(\ 〚price〛\_(t-1))\^(\ 〚price〛\_t\ ) \quad (1)$$

Where $price_t$ is the adjusted closing price at the end and $price_{t-1}$ adjusted closing price at the beginning of the period.

where price, t is the price of the asset at time t and price_{t-1} is the price of the asset at time t-1.

Several variants have been developed since the development of the GARCH model. These variants can be classified into symmetric and asymmetric GARCH Models. In the symmetric GARCH model[37], only the conditional variance depends on its magnitude, not the sign holding the underlying asset. While the asymmetric GARCH Model explained the leverage effect[38].

GARCH (1,1) Model:

$$\sigma\_t\^2 = \omega + \alpha\_1\ \varepsilon\_(t-1)\^2+ \beta\_2\ \sigma\_(t-1)\^2 \quad (2)$$

Equation 1 explains the forecasting of variance based on past information, i.e., σ_t^2. The constant term is defined by ω whereas the ARCH term is defined by ε_(t-1) ^2, which describes the volatility from the previous one computed by taking the lag of the squared residual. GARCH Term is described by σ_(t-1) ^2, denote the last period forecast variance. To know the existence of Symmetry and Asymmetry between NSE, NYSE, SSE, Euronext, and SEHK. Several diagnostic tests have been applied to test the model fit. These tests are performed on the STATA SE 11 Software.

4. Results

The analysis began with the examination of the stock return pattern. Smaller fluctuations and larger fluctuations follow small returns in the market followed by larger returns, which ultimately results in volatility clustering in the market[51]. Figure 1,2,3,4 and 5 depicts the positive and negative return trend in different countries' indices. Due to COVID-19, three financial markets, NSE, NYSE, and Euronext, have shown a more considerable fluctuation in the market, i.e., in the year 2020 compared to SSE & SEHK. All five countries' indices show high volatility clustering due to the world's pandemic in 2020-22. In Fig. 3 and *5* of SSE and SEHK, the irrational behavior of investors can be observed.

Daily Stock Return from 2011-2021 of NSE, NYSE, Shanghai Stock Exchange, Euronext & Hong Kong Exchange

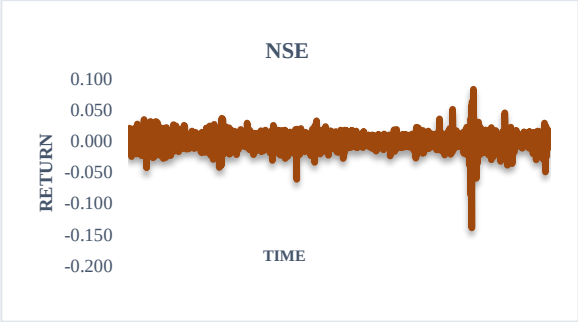

Fig. 1: Stock return of NSE. Source: Authors Calculation

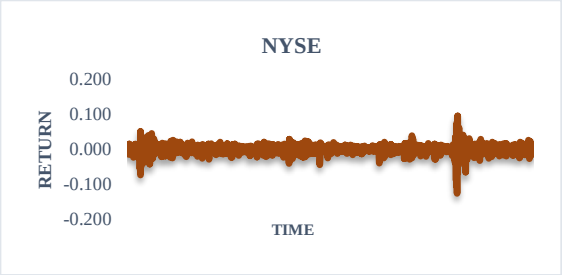

Fig. 2: Stock return of NYSE. Source: Authors Calculation

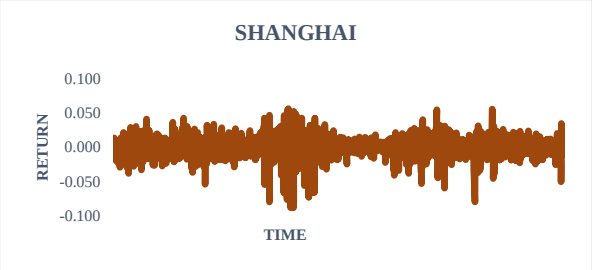

Fig. 3: Stock return of Shanghai Stock Exchange (SSE). Source: Authors Calculation

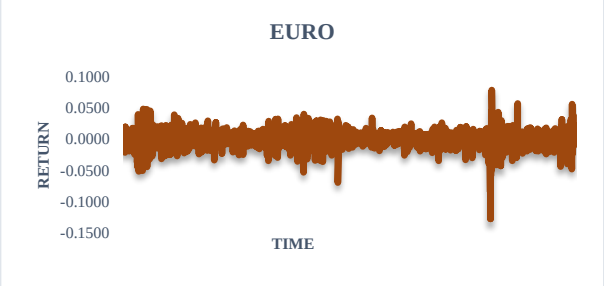

Fig. 4: Stock return of Euronext. Source: Authors Calculation

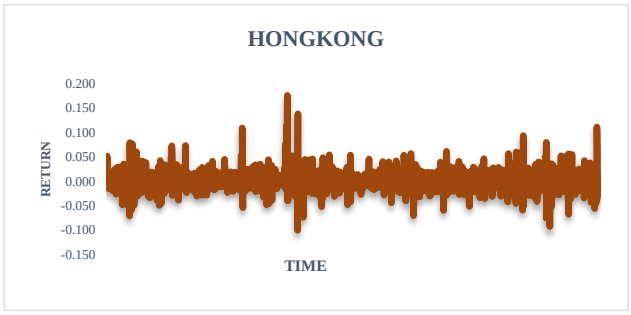

Fig. 5: Stock return- Stock Exchange of Hong Kong (SEHK). Source: Authors Calculation

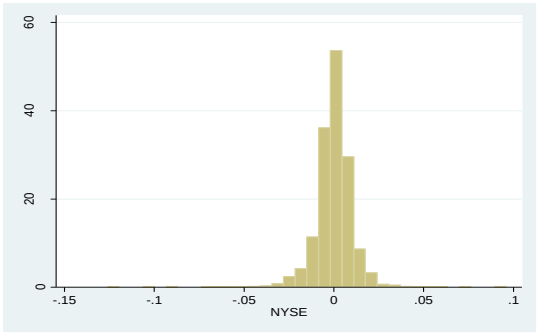

Fig. 8: Normality Test for SSE Index.
Source: Authors Calculation

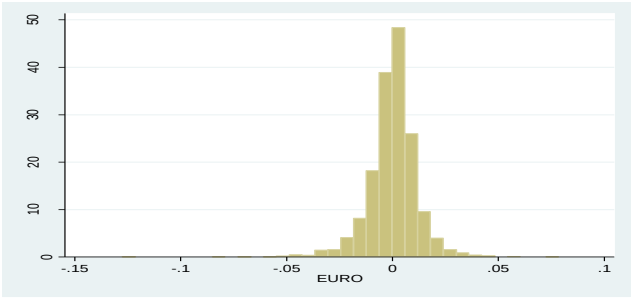

Fig. 6: Normality Test for NSE Index.
Source: Authors Calculation

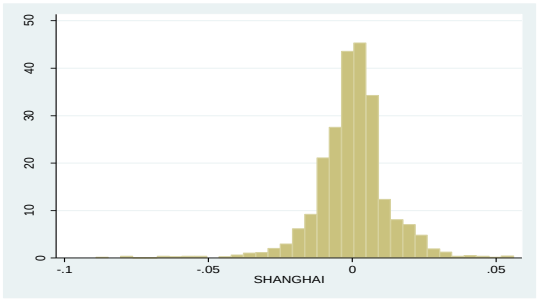

Fig. 9: Normality Test for Euronext.
Source: Authors Calculation

Figure 6,7,8,9, and 10 shows the descriptive statistics of the indices. The data shows that the skewed values for SEHK are negative, which means that the returns are asymmetric, and many data points are distant from the central part of the distribution. Kurtosis values are greater than three, indicating that data is heavily tailed and peaked. The index's mean return is almost the same except for SSE, which is relatively lower than others. Market volatility can be measured through standard deviation, which is almost the same at 1% (Table 1). This data indicates that markets are similar in average return and volatility. Table 1 asserts the result of the Jarque-Bera test, which rejects the null hypothesis of normality, which signifies that time series data is not normal.

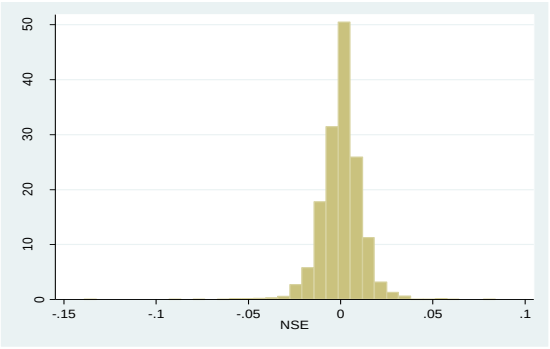

Fig. 7: Normality test for NYSE Index.
Source: Authors Calculation

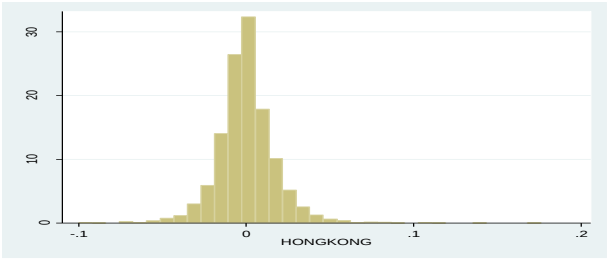

Fig. 10: Normality Test for SEHK Index.
Source: Authors Calculation

Table 1. Descriptive Statistics of Stock Returns.

	NSE	NYSE	SSE	EURO NEXT	SEHK
Mean	0.000404	0.000248	0.000015	0.0002103	0.000396
Standard Deviation	0.011088	0.010882	0.013154	0.0117316	0.018068
Minimum	-0.139	-0.126	-0.089	-0.1275	-0.1
Maximum	0.084	0.096	0.056	0.0786	0.176
Skewness	-1.04	-1.12	-0.96	-0.80	0.85
Kurtosis	15.07	15.07	6.90	9.30	8.58
Jarque-Bera (P-value)	0.00	0.00	0.00	0.00	0.00

Source: Authors Calculation

Table 2 indicates the unit root test of time series data on different indices. The unit root test has been conducted by

applying the Augmented Dickey-Fuller test (ADF Test) to know the stationarity of the data set. The result shows that the p-value is 0.00, which signifies that null is rejected at a 1% significance level and data is stationary at level 0.

Table 2. ADF Test Results.

	NSE	NYSE	SSE	EURO NEXT	SEHK
T-statistics	-51.231	-58.72	-49.63	-52.546	-50.628
P-Value	0.000	0.000	0.000	0.000	0.000

Source: Authors Calculation

ARCH results are shown in Table 3 at the lag order of 2. The null hypothesis is rejected, indicating that the residual series has Auto-Regressive Conditional Heteroscedasticity (ARCH) effect. We can conclude that return variance is not constant for all the indices for a specified period.

Table3. ARCH Test Results.

Statistics	NSE	NYSE	SSE	EURO NEXT	SEHK
Coefficient	0.260668	0.484192	0.352361	0.3939762	0.25569
Standard Error	0.016771	0.024753	0.023158	0.0249853	0.020867
P-Value	0	0	0	0	0

Source: Authors Calculation

GARCH Model results are shown in Tables 4, 5,6 & 7. Table 4 represents the statistics about the NSE and NYSE, Table 5 & 6 represents SSE & Euronext, and Table 7 shows the values for SEHK. The coefficients of the mean and variance equation are statistically significant. The sum of the coefficients of ARCH (α) and GARCH means β is nearest to 1 in all the markets. This high value indicates the persistence of volatility shock. This model's coefficients are smaller than residual and GARCH values, but all market coefficients are positive. In these five stock markets, the p-value is statistically significant, which signifies the tenacious conditional volatility in the market.

Table 4. GARCH (1,1) Results for NSE & NYSE.

	NSE			NYSE		
	Coefficient	z-statistics	p-value	Coefficient	z-statistics	p-value
Mean Equation						
Constant	0.0004062	214.35	0***	0.0002595	20.22	0***
Variance Equation						
Constant	0.000123	4.56	0***	0.000423	4.56	0***
Residual (α)	0.0854257	11.63	0***	0.5489542	14.5	0***
GARCH (β)	0.890771	87.18	0***	0.423565	18.59	0***
(α + β)	0.9761967			0.9725192		
Prob > chi2	0			0		

*Significance at 5% level** & 1 % level ****

Source: Authors Calculation

Table 5. GARCH (1,1) Results for SSE & Euronext.

SSE			
	Coefficient	z-statistics	p-value
Mean Equation			
Constant	0.0000187	2.18	0.029**
Variance Equation			
Constant	0.0000872	6.1	0***
Residual (α)	0.0652	3.675	0***
GARCH (β)	0.8839253	116.87	0***
(α + β)	0.9491253		
Prob > chi2	0		

*Significance at 5% level** & 1 % level****

Source: Authors Calculation

Table 6. GARCH (1,1) Results for Euronext.

EURONEXT			
	Coefficient	z-statistics	p-value
Mean Equation			
Constant	0.00023	78.66	0
Variance Equation			
Constant	7.80E-05	9.22	0
Residual (α)	0.14986	12.87	0
GARCH (β)	0.82053	64.26	0****
(α + β)	0.9704		
Prob > chi2	0		

*Significance at 5% level** & 1 % level****

Source: Authors Calculation

Table 7. GARCH (1,1) Results for Stock Exchange of Hong Kong (SEHK).

SEHK			
	Coefficient	**z-statistics**	**p-value**
Mean Equation			
Constant	0.0003631	23.42	0.0000***
Variance Equation			
Constant	0.118323	12.22	0.0000***
Residual (α)	0.1135878	14.23	0.0000***
GARCH (β)	0.8338265	76.86	0.0000***
(α + β)	0.9474143		
Prob > chi2	0		

*Significance at 5% level** & 1 % level****

Source: Authors Calculation

5. Discussion

The current study has explored the symmetry and asymmetry among NSE, NYSE, SSE, Euronext and SEHK in terms of volatility by using ARCH and GARCH Model.

In the present study NYSE has the highest ARCH coefficient which indicate the high sensitivity toward the shocks and volatility changes as compared to other markets. NSE and SEHK is less responsive towards volatility changes. Standard error coefficient of NSE is at it lower which indicate the most precise estimate of coefficient in comparison to other markets. Previous studies support the finding of current study that developed markets, like the NYSE, show greater responsiveness to shocks compared to emerging markets[44], in a similar way literature found that the NYSE unveiled higher sensitivity to market shocks compared to NSE and SEHK[52]. In contradict with current study results, in previous literature researchers found that in some specific situation NSE may demonstrate enhanced sensitivity to shocks[53]. In Current study, the high alpha value of NYSE which is followed by EURONEXT which indicates that the NYSE market is highly sensitive to recent shocks. This means that market participants may be overreacting to new information. Whereas a higher value of β indicates that volatility is persistent since the conditional variance shocks take a while to dissipate. The value of beta indicates that NSE and SSE both markets exhibited high persistence in volatility and have a long lasting impact in comparison to developed markets such as NYSE. The previous study also found that that NSE is high volatility persistence[54]. The previous literature concluded that NSE reactions are in tandem with the global market[55]. In the current analysis, the coefficient (β) signifies the impact of past news and study exhibit that NSE had a higher beta coefficient than any other market. The beta value indicates that NSE and other markets have an influence of past news. In addition to this, previous literature identified that US markets have a significant impact on various stock markets across the globe specially on the Indian market[56]. On the other side, there are downside risks associated with the Chinese stock market's unpredictability because it affects commodity prices, global commerce, and other areas (European Economic Forecast, 2016). According to Reuters, 2011, the Shanghai Composite Index reduced market value by almost US$ 3 trillion, which decreased investment but, the effect of SSE is not felt in other markets.

The Exchange Composite Index of all is almost close to 1. This demonstrates that volatility shocks are incredibly persistent in each Stock Exchange. Sum of large coefficient signals that both large positive and negative return causes the variance to be high in the future. The findings of the study are similar to[27),57)] in which the exchange composite index is closer to 1. The reason for the value closer to 1 is the presence of leverage effect[58], presence of volatility for long term and that will fall off over a period of time. In current study, the value closer to 1 in all the market indicate the commonality in the behavior of volatility across both emerging and developed markets[42].

Based on the findings of research paper, the study found that overall there is a commonality in terms of volatility pattern but in terms of persistence of volatility NSE and SSE is having long impact of volatility whereas in regard of responsiveness towards shock NYSE is having high alpha value. The result of the study is also validated through the stock return analysis which exhibit that the volatility pattern among the developed and emerging markets are common but except in 2015-16 of The Shanghai Stock Exchange and The Hong Kong Stock Exchange stock return figure 3,5. The reason for discrepancy in 2015-16, only 7% population of China was trading in the stock market, and about 80% of tradable shares were traded by a few wealthy investors[59]. The Shanghai Stock Exchange is the oldest one in China whereas Hong Kong Stock Exchange is one of the most mature exchanges of Asia. SSEs volatility is prominently influenced by domestic factors such as inflation, GDP rate, trade problems whereas SEHK is influenced both by domestic and international economic factors. This market is more sensitive when it comes to geopolitical events which are a tussle and affects international relations and trade. Another global shock, covid-19 in such crisis the developed economies such as NYSE and Euronext are more responsive, but the effect of shock was long lasting emerging economies except SSE as China economy rebounded and stabilize more quickly in comparison to the developed economies. Hence the null hypothesis is rejected which means there is asymmetry between the developed economies such as USA (NYSE), Europe (Euronext and emerging economies such as India (NSE),

China (Shanghai Stock Exchange and The Stock Exchange of Hong Kong (SEHK) by using the ARCH and GARCH model. In short, the reason for the asymmetry in between emerging and developed markets that emerging markets are economic dependency on global trade, less mature financial systems, greater sensitivity to capital flows and higher retail investor participation while developed market like NYSE and Euronext are more efficient information processing. Because of their well-established investor bases, robust regulatory frameworks, and substantial liquidity, the USA (NYSE) and Europe (Euronext) typically show lower volatility persistence. However, they are also greatly influenced by world events, as seen by the COVID-19 pandemic and the 2008 financial crisis, which had a global impact on volatility which current study also explored that NYSE, a developed market has higher sensitivity to market shocks in comparison to emerging markets while previous literature support that emerging markets are more volatile than developed markets.

6. Conclusion

The current study focused on the symmetry and asymmetry lies between emerging economies such as India (NSE), China (Shanghai Stock Exchange and The Stock Exchange of Hong Kong (SEHK) and the developed economies such as USA (NYSE), Europe (Euronext) by using the ARCH and GARCH model. The study found that developed economies such as USA (NYSE), Europe (Euronext) are more responsive towards the shocks but the emerging economies such as India (NSE), China (Shanghai Stock Exchange) and The Stock Exchange of Hong Kong (SEHK) having long persistence towards shock. Due to the difference in behaviour of developed and emerging markets, there is asymmetry lies in these markets. But study also found that the commonalities in volatility pattern which is also found by seeing the stock return figures except in SSE and SEHK 2015-16 stock return figures. But in pandemic situation i.e. Covid-19, developed economies are more responsive but the persistence of volatility is high in emerging economies except China. The study found that the reason for overall asymmetry between the developed and emerging is that the developed economies are more stable due to the economic policy, better access to capital and currency stability in comparison to emerging economies. Hence the results provide insights for economic stability and policy implication by analysing the responsiveness and persistence of volatility in between selected emerging and developed economies. The study contributes to the existing literature by directing investors in framing investment strategies which helps them in asset allocation, diversification and risk management. The results also helpful for policymakers in improving the regulation and to reduce the susceptibility of market shocks. The study showed the connexion of the emerging and developed markets. The study recommends that investor should be aware about the market micro structure of different economies and crossover impact. The implications of the study are significant for various stakeholders in finance, economics and policy making.

But the model used in the study cannot apprehend all aspects of asymmetry in between the economies. In view of the limitation future research can focus on other connections in between the emerging and developed economies. Other stock market indices may be included in the further scope of the study as the current study compares emerging and developed economies.

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