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VOLATILITY OF DAILY NEPAL STOCK EXCHANGE (NEPSE) INDEX RETURN: A GARCH FAMILY MODELS

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ABSTRACT

The major intend of this study is to investigate the volatility clustering in NEPSE index. To reach the conclusion, 3392 annually observed time series data from 1 June 2006 to 7 April 2021 were obtained from various volume of annual trading report of Nepal Stock Exchange (NEPSE) and website of NEPSE and symmetric Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models—GARCH (1,1), GARCH-M(1,1) and asymmetric GARCH family models—TGARCH(1,1), EGARCH(1,1), and PGARCH(1,1) were employed. The stylized facts confirm that the volatility clustering and leverage effect on the return of NEPSE index are existed. The empirical analysis reveals that the positive correlation between volatility and the expected return of NEPSE index in terms of risk premium and then conditional variance process is persistent. The empirical results also show that the symmetric model is better fitted to full sampled period and asymmetric GARCH family models to before-and after-earthquake sampled period. This study covers the larger dataset which is divided into different episodes with different economic condition of Nepal and thus, it is assumed to be a purely an initial work on Nepalese stock exchange.

Keywords: stock return - symmetric and asymmetric GARCH - volatility clustering - conditional variance - leverage effect

JEL classification. C13, C22, C32, C55, C58, G11, G17, G32

INTRODUCTION

Variance of the disturbance terms is remain constant over the period of time (homoskedasticity). Financial series, on the other hand, tend to have unusually high volatility periods followed by more tranquil periods of low volatility (Asteriou & Hall 2006). Volatility is estimated by the standard deviation of returns (Brooks 2008).

Volatility cluster played the crucial role in measuring risk of stock price. Higher volatility leads the higher risk in stock. The stock price is volatile while positive and negative shocks are happened in stock market. Engle (1982) developed the ARCH model to analyse the volatility in stock return that the current variance of the residuals depends on the squared error terms from previous periods. This ARCH specification mostly based on moving average and Bollerslev (1986) proposed the GARCH models with lagged conditional variance terms as autoregressive terms (Asteriou & Hall 2007). With this gene, Taylor (1986), Glosten, Jagananthan & Runkle (1993), Nelson (1991), Zakoian (1990) and Ding, Granger and Engle (1993) developed the different version of GARCH family models to study the volatility of stock returns. Recently, GARCH family models are widely accepted volatility modeling for financial as well as economic time series.

Some studies of daily observed NEPSE return series revealed strong evidence of time-varying volatility (G.C. 2008, Gaire 2017). Rana (2020) examined the time varying volatility of daily NEPSE return from 2011-2020. This study revealed that there is no evidence of significant leverage effect but symmetric GARCH family models confirmed that volatility is persists in daily returns of NEPSE index. Some literatures concluded the stock market volatility by dividing three periods—pre–, during, and post–crisis. In pre-and post-crisis period, symmetric GARCH model perform better and during crisis period asymmetric GARCH model is preferred to know the volatility in stock market (Lim & Sek 2013, Roni, Wu, Jewel & Wang 2017).

Ugurlu, Thalassinos, and Muratoglu (2014) studied the volatility of European emerging economies and Turkey by applying GARCH family models and which revealed that volatility shocks are quite persistent in emerging economy of Europe. The another study of volatility of Indian stock market concluded that GARCH (1, 1) indicates the volatility clustering and revert in mean are satisfactory (Goudarzi & Ramanarayanan 2010).

Koima, Mwita, and Nassiuma, (2015) used the GARCH (1, 1) model to explain the volatility of Kenyan stock markets. The stylized facts of this study indicated the more satisfying volatility clustering, fat tails, and mean reverting in stock returns. The study had an evident of the existence of volatility which is in a time of financial crisis, the negative returns shocks caused higher volatility is stock return.

Okičić (2015) studied the stock market of Central and Eastern Europe region over the period of October 2005 to December 2013 by using both symmetric and asymmetric GARCH family models. This study revealed that the presence of leverage effects in the study market which indicates that the volatility increased due to the negative shocks than positive shocks.

Most of the reviewed literatures have been applied the one of the GARCH family model with daily time series. There is no sufficient literature of it in Nepalese context. So, this study has attempted to fill the gap with breaking down stock prices into the different time blocks of different economic scenario. This paper is investigating the presence of volatility and capturing the leverage effects in the returns of NEPSE. In particular, both the asymmetric and asymmetric GARCH model is applied to fulfill the objective of this study. The stylized facts are compared for three episodes—full period (1 June 2006 to 7 April 2021), before earthquake (1 June 2006 to 23 April 2015), and after earthquake period (25 April 2015 to 7 April 2021). The rest of the study is structured with methods, results and discussion, and conclusion.

METHOD

To evaluate the volatility shocks of Nepal Stock Exchange (NEPSE) index, the NEPSE daily price index was taken as a source of data. To estimate the volatility NEPSE index, Autoregressive Conditional Heteroscedasticity (ARCH) and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) family models—GARCH-M, EGARCH, TGARCH, and PGARCH were employed for three episodes—before earthquake, after earthquake, and full sampled.

DATA SOURCE AND COLLECTION

The secondary data obtained from the different volume of annual trading report of NEPSE and website of NEPSE. This study covered 3392 observations of NEPSE daily closing price index from 1 June 2006 to 7 April 2021.

Daily returns of NEPSE index and volatility measurement

To GARCH family models, the daily price indexes were computed as the daily return series by taking logarithm of the ratio between current and previous NEPSE index. It is also expressed as the function of NEPSE index in the present day and past day. This can be calculated in the following ways:

$$r\_NEPSE_t = 1n\left(\frac{NEPSE_t}{NEPSE_{t-1}}\right) = \frac{NEPSE_t\text{-}NEPSE_{t-1}}{NEPSE_{t-1}}$$

In this specification, r_NEPSE_t is the returns of NEPSE price index, $NEPSE_t$ is today's present day index, and $NEPSE_{t-1}$ is the NEPSE price index of previous day. This return series used in this paper to know the volatility of NEPSE index. The volatility can be measured as variance of return of NEPSE index.

Unit root test for stationarity

To employ the GARCH family models, free from spurious regression, test of the stationarity of variable is essential. Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests for the return series of NEPSE index is used to know the order of integration of the series. The ADF, parametric test, and PP, nonparametric test, are employed with the null hypothesis of nonstationarity (having unit root/random series) of return series of NEPSE index. ADF test can be started with the following equation.

$$\Delta y_t = \beta_0 + \beta_1 t + \rho y_{t-1} + \sum_{i=1}^{k} \gamma_i \Delta y_{t-i} + \varepsilon_t$$

where, y_t is the variables of interest (r_NEPSE_t), ε_t is pure white noise error term, k is optimal lag length.

Estimation of Garch family model

ARCH model was proposed by Engle (1982) which states that the variance of the residuals at present period which is based on the squared error terms from past (Asteriou & Hall 2006). After that, Bollerslev (1986) proposed new idea, GARCH specifications, with considering autoregressive terms regarding the lagged conditional variance terms.

Testing for (Arch) effect

Stationary data series is essential to employ the ARCH (p) for heteroskedasticity which is determined by the conditional variance using a simple autoregressive (AR) process (Kozhen 2010). There are two specifications of ARCH process—mean and variance. The ARCH model can be stated as follows:

$$P_t = u_{t,} \text{ where, } u_t = \sigma_t \varepsilon_t$$

Where, P_t = Return series on price of stock

ε_t = residual returns or white noise (0,1)

Now, an ARCH(a) model is

$$\sigma_t^2 = \omega_0 + \omega_1\varepsilon_{t-1}^2 + \omega_2\varepsilon_{t-2}^2 + \ldots\ldots.. + \omega_a\varepsilon_{t-a}^2$$

Where, σ_t^2 is the conditional variance at time *t* and *a* is order of the lagged used in model. Here, σ_t^2 must be positive and that is ensured by positive coefficient ($\omega_0 > 0$, $\omega_1 \geq 0$) otherwise meaningless. To test the existence of ARCH (a) effect on return time series, regress the squared regression residuals, ε^2 on their lags ε_{t-a}^2(where *a* is the order of lagged used in model):

$$\varepsilon_t^2 = \omega_0 + \omega_1\varepsilon_{t-1}^2 + \ldots.. + \omega_a\varepsilon_{t-a}^2 + \Lambda_t \quad \text{[where } \Lambda_t\text{, is a random term at t]}$$

The ARCH effect test based on null hypothesis (H_0: $\omega_1 = 0$) of there is no ARCH effects. When the LM test (Heteroskedasticity Test) based on R^2 is significant, there are ARCH effects on return series and GARCH model can be employed.

The generalized autoregressive conditional heteroscedasticity (Garch) model

Engle's ARCH specification enlarged by Bollerslev (1986) as the GARCH family models. Taylor (1986), Glosten, Jagananthan and Runkle (1993); and Nelson (1991) further added the different family of GARCH models. The conditional variance in the GARCH model can be influenced by earlier own lags (Brooks 2008). Generally, GARCH (a, b) model can be written a:

Mean equation: $P_t = \mu + u_t$ [where, $u_t = \sigma_t\varepsilon_t$ and μ_t = average return]

Variance equation: $\sigma_t^2 = \omega_0 + \sum_{i=1}^{a}\omega_i\varepsilon_{t-i}^2 + \sum_{j=1}^{b}\varpi_j\sigma_{t-j}^2$

All positive parameters in σ_t^2 and $\omega + \varpi$ is expected to be less than one but it is close to 1. This specification interprets the current fitted variance, ε_t, information of the past period $\omega_1\varepsilon_{t-1}^2$ volatility and the past period ($\varpi_1\sigma_{t-1}^2$) fitted variance (Brooks 2008).

The Garch-In-Mean (Garch-M) model

GARCH-M models allow the conditional mean affect its own conditional variance (Asteriou & Hall 2006). The variance equation form of GARCH is

Variance equation: $\omega_0 + \sum_{i=1}^{a} \omega_i \varepsilon_{t-i}^2 + \sum_{j=1}^{b} \varpi_j \sigma_{t-j}^2$

Here, μ and γ are constant and parameter γ is known as the risk premium parameter that indicates the return is positively related to the volatility.

The threshold Garch (Tgarch) model

Both positive and negative news or shocks are applied asymmetrically on TARCH model (Hill, Griffiths, and Lim, 2018). It was introduced by the works of Zakoian (1990) and Glosten, Jaganathan, and Runkle (1993). The conditional variance equation of TGARCH model is:

$$\sigma_t^2 = \omega_0 + \sum_{i=1}^{a} \omega_i \varepsilon_{t-i}^2 + \sum_{k=1}^{c} \gamma_k d_{t-k} \varepsilon_{t-k}^2 + \sum_{j=1}^{b} \varpi_j \sigma_{t-j}^2$$

Where d_{t-k} is a dummy variable representing the bad and good news shocks. Depending on the upper and lower threshold value of zero (Kozhen, 2010), if $\varepsilon_{t-i} < 0$ (bad news), d_{t-k} is 1 and if $\varepsilon_{t-i} \geq 0$ (good news), d_{t-k} is 0. In other words, in TGARCH model, ω show the effect of good news and while bad news show their impact by $\omega + \gamma$.

The exponential GARCH (EGARCH) model

The GARCH family model, EGARCH, was developed by Nelson (1991) to allow for leverage effects and consider the external unexpected shocks in the stock volatility. The variance equation for EGARCH is given by:

$$\ln\sigma_t^2 = \omega_0 + \sum_{i=1}^{a} \omega_i \left| \frac{\varepsilon_{t-i}}{\sigma_{t-i}} \right| + \sum_{k=1}^{c} \gamma_k \frac{\varepsilon_{t-k}}{\sigma_{t-k}} + \sum_{j=1}^{b} \varpi_j \ln\sigma_{t-j}^2$$

While ε_{t-1} is positive, its total effect is $(1+\gamma_k)\,|\varepsilon_{t-i}|$ and $(1-\gamma_k)\,|\varepsilon_{t-i}|$ in negative ε_{t-i}. Value of γ_k is expected to be negative, and bad news can have a greater impact on volatility in EGARCH (Kozhen 2010).

The power Garch (Pgarch) model

The PGARCH model is proposed and extended by Ding, Granger and Engle (1993) allows for leverage effects and deals with asymmetry. Special treatment of power is employed in variance specification in this model. The PGARCH variance specification is given by:

$$\sigma_t^{\partial} = \omega_0 + \sum_{i=1}^{a} \omega_i (|\varepsilon_{t-i}| + \gamma_i \varepsilon_{t-i})^{\partial} + \sum_{j=1}^{b} \varpi_j \sigma_{t-j}^{\partial}$$

where, ∂ is a positive exponent ($\partial > 0$), and γ_i treats as the parameter for leverage effects ($\gamma_i < 1$).

RESULT AND DISCUSSION

Stationarity of time series

To test the existence of unit root, Augmented Dickey-Fuller Test (ADF) and Phillips-Perron Test (PP) are employed. The result confirms that the returns series is significant in the both ADF and PP test. In other words, the time series of returns of NEPSE price have no unit root and 0 order of integration, I(0). It is displayed at the Table 1.

Table 1: ADF and PP test results

Variables	ADF test			PP test		
	Intercept	Trend and intercept	Order of integration	Intercept	Trend and intercept	Order of integration
r_NEPSE	-39.04998 (0.0000)	-39.05668 (0.0000)	I(0)	-46.32515 (0.0001)	-46.31313 (0.0000)	I(0)

So Table 1 has strong evident to run the ARCH and GARCH family model with log returns of NEPSE price.

Testing arch effects

The trend of NEPSE price from first June 2006 to seventh April 2021 presents in the left panel of Figure 1. NEPSE price began from 371.97 to 2671.62 during the study period. It can be observed from the figure that in the last of 2008, mid-2016, and beginning of 2021, the NEPSE was peaked. After mid-2019, NEPSE was increased continuously and was observed highest from previous prices. However, the plot of NEPSE price in figure 1 shows that the data does not fluctuate around some common mean or location. Thus there is no sufficient evidence of stationarity of time series.

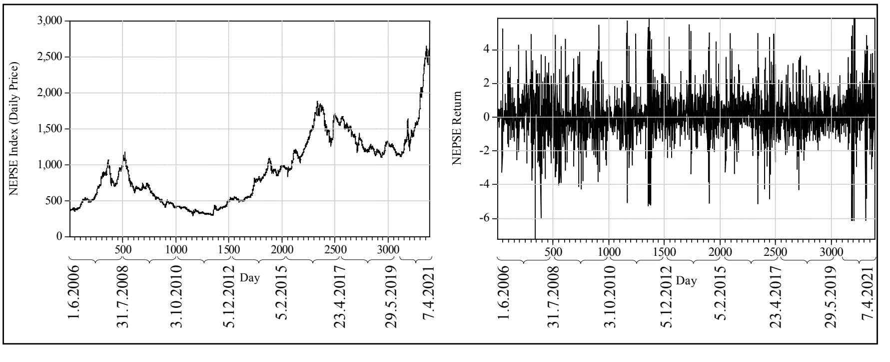

Figure 1: Time series plot for the daily price and log returns for NEPSE.

The right hand panel of Figure 1 shows the plot of log returns for NEPSE. This non-linear time varying plot shows above and below fluctuations of returns of price for NEPSE from the zero. This type of variance in returns of NEPSE leads the evident of heteroscedasticity then the ARCH effect in the return series. In the right hand panel of Figure 1, the small changes in returns of NEPSE to follow the small changes from 23 April 2017 afterward to mid-2020. It can be observed the more and less volatility in the return series in the study.

Now, test for ARCH in the residuals is estimated by regressing the squared residuals on a constant and *r* lags, where *r* is set by the user (Brooks 2008). The test results of observed R^2 and corresponding p-value are presented in the Table 2.

Table 2: Results of heteroskedasticity test: ARCH

	Full period		Before earthquake		After earthquake	
Model	Observed R^2	p-value(χ^2)	Observed R^2	p-value (χ^2)	Observed R^2	p-value (χ^2)
ARCH (1)	529.5760	0.0000	300.6377	0.0000	171.7696	0.0000

Results of the ARCH test for heteroscedasticity with null hypothesis—there is no ARCH effect—show the significant. It implies that there is ARCH effect in variance of the residual term varies widely and indicates the volatility in stock price of Nepal.

Basic autoregressive conditional heteroskedasticity (Arch) Model

Engle (1982) suggested that the ARCH model is the variance of the residuals at time *t* depends on the squared error terms from previous periods. It simultaneously explains the mean and variance of the return price for NEPSE. It is useful to anlyse the changes in volatility structures in returns for stock price. The results for returns of NEPSE price for ARCH (1) for three sampled study are presented in the Table 3.

Table 3: ARCH (1) Results of returns for NEPSE price

	Variables	Full period	Before Earthquake	After Earthquake
Mean Equation	C	0.006157	-0.014981	0.036804
		(0.6862)*	(0.4566)	(0.1589)
	r_NEPSE_{t-1}	0.276363	0.226904	0.338347
		(0.0000)	(0.0000)	(0.0000)
Variance Equation	C	0.826031	0.772851	0.864670
		(0.0000)	(0.0000)	(0.0000)
	ε2t-1	0.545196	0.593277	0.504393
		(0.0000)	(0.0000)	(0.0000)

** Figure of parenthesis indicates the corresponding p-value.*

Mean equation shows that the average returns of NEPSE price in different sampled periods. Variance equation gives the time varying volatility (σ_t^2). ARCH effects, ε^2_{t-1}, is statistical significant with positive values and lies between 0 to 1 that fits the models. Likewise, significant average returns and square of residual (ARCH effect) for the before earthquake and after earthquake sample period of NEPSE have an evident of ARCH effect and fitted the model.

Estimations of symmetric (Garch) family models

GARCH models can be determined as an ARMA model of squared residuals (Kozhen, 2010). GARCH (1,1), GARCH-M(1,1) models are the symmetric GARCH models. The mean and variance of estimated standard symmetric GARCH (1,1) and GARCH-M (1,1)—which allows the conditional mean affect on its own conditional variance (Asteriou & Hall 2006)—model for full sampled period, before earthquake period, and after earthquake periods are presented in

Table 4: Results of symmetric GARCH models

	Variable	GARCH (1,1)			GARCH-M(1,1)		
		Full period	Before Earthquake	After Earthquake	Full period	Before Earthquake	After Earthquake
Mean equation	C	0.024238	0.001482	0.062047	0.016608	0.000108	0.042190
		(0.0797)*	(0.9309)	(0.0213)	(0.4144)	(0.9967)	(0.2364)
	r_NEPSE$_{t-1}$	0.269037	0.280942	0.245013	0.268360	0.280875	0.242435
	(risk premium)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
	GARCH-M Term	-	-	-	0.007789	0.001417	0.020484
					(0.6177)*	(0.9458)	(0.4001)
Variance Equation	Constant (ω_0)	0.152597	0.170831	0.115639	0.152632	0.170722	0.116774
		(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
	ARCH Term	0.316382	0.336203	0.283183	0.316430	0.336107	0.284854
	(ω_1)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
	GARCH Term	0.614775	0.590184	0.659521	0.614647	0.590338	0.657081
	(ϖ_1)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
	$\omega_1 + \varpi_1$	0.931157	0.926387	0.942704	0.931077	0.926445	0.941935
Heteroskedasticity Test:		0.198900	3.18E-07	0.873307	0.183230	1.49E-09	0.686544
ARCH		(0.6556)	(0.9995)	(0.3500)	(0.6686)	(1.0000)	(0.4073)

** Figure of parentheses indicates the corresponding p-value.*

The mean equations of all sampled period of symmetric GARCH specifications show the significant and positive r_NEPSE$_{t-1}$ (risk premium) which suggests that the present mean returns of NEPSE influenced by past conditional variance. It refers to a higher return while there will be higher level of risk on stock. Table 4 shows the insignificant coefficient of GARCH-M term in mean return of NEPSE for all three sampled periods but positive. It reveals that if there is an effect of the risk on the mean return this is captured better by the variance (Asteriou & Hall 2006). But it suggests the present variance in mean of *r_NEPSE* series depends on previous innovation and conditional variance or return of NEPSE series is positively correlated with its volatility.

Table 4 also presents all the ARCH and GARCH terms' coefficients in variance equation for all three sampled periods in standard GARCH (1,1) and GARCH-M(1,1) are positively significant and which implies that present day's returns for NEPSE will be affected by previous day's. The larger GARCH term (ϖ_1) in terms of ARCH term (ω_1) of symmetric GARCH models indicates that the volatility is persistent (longer shocks to conditional variance). Since the sum of parameters—$_1$ and ω_1 is less than 1 for all sampled periods in asymmetric GARCH models which suggest that the volatility reverts slowly. The post-estimation test of Heteroskedasticity test cannot reject the null hypothesis and hence it indicates no further ARCH effect and thus, the models are efficient.

Estimations of asymmetric (Garch) family models

TGARCH(1,1), EGARCH(1,1), and PGARCH(1,1) models are the asymmetric GARCH family models that demonstrate the leverage effects. The results of asymmetric GARCH specifications are presented in the Table 5.

In Table 5, for TGARCH (1,1) and PGARCH (1,1); sum of ARCH and GARCH term, $\omega_1 + \varpi_1$ are less than 1 for three sample periods indicates that volatility of shocks is persisted, and thus, model is fit for the returns of NEPSE. In all sample periods, the statistically significant and positive GARCH term (ϖ_1) is higher than statistically significant and positive ARCH term (ω_1) implies that the previous innovation or old news, and conditional variance influenced the present returns of NEPSE. In other words, smaller ω_1 is evident that there is no longer effect of negative shocks on volatility. Contrary, in EGARCH (1,1), constant (ω_0) is negatively significant. Nelson

(1991) proposed to a specification that does not require nonnegativity constraints (Enders 2010). The sum of $\omega_1 + \varpi_1$ for all three sample periods are greater than 1, implies that EGARCH (1,1) is nonstationary and conditional variance (volatility) process is infinite and explosive.

Table 5: Results of asymmetric GARCH family models

	Variable	TGARCH (1,1)			EGARCH (1,1)			P(GARCH)		
		Full period	**Before earth-quake**	**After earth-quake**	**Full period**	**Before earth-quake**	**After earth-quake**	**Full period**	**Before earth-quake**	**After earth-quake**
Mean Equation	C	0.021999	0.011344	0.042352	0.016790	0.009392	0.039162	0.019037	0.002512	0.046233
		(0.1780)*	(0.5829)	(0.1343)	(0.2048)*	(0.5586)	(0.1470)	(0.2377)*	(0.9016)	(0.0968)
	r_NEPSE_{t-1}	0.268977	0.281538	0.247494	0.286759	0.300980	0.261156	0.267773	0.282609	0.248975
		(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Variance Equation	Constant (ω_0)	0.152496	0.166950	0.109521	-0.368859	-0.345779	-0.404032	0.157547	0.159411	0.095139
		(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
	ARCH Term	0.309110	0.365395	0.218816	0.538311	0.512024	0.560198	0.313007	0.297435	0.219803
	(ω_1)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
	Leverage	0.014461	-0.065253	0.119635	0.005796	0.039981	-0.045939	-0.002785	-0.073522	0.127893
	Effect (γ_1)	(0.6066)	(0.0879)	(0.0048)	(0.6146)	(0.0035)	(0.0442)	(0.9071)	(0.0280)	(0.0001)
	GARCH Term	0.615148	0.594959	0.671355	0.846089	0.854912	0.862145	0.631238	0.646590	0.655255
	(ϖ_1)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
	Power	-	-	-	-	-	-	1.515945	1.290213	3.024393
	parameter (∂)							(0.0000)	(0.0000)	(0.0000)
	$\omega_1 + \varpi_1$	0.924258	0.960354	0.890171	1.38440	1.366936	1.422343	0.944245	0.944025	0.875058
Heteroskedasticity:		0.210809	0.000472	1.208677	0.149711	0.072210	0.149653	0.799285	0.381636	0.764686
ARCH Test		(0.6461)	(0.9827)	(0.2716)	(0.6988)	(0.7881)	(0.6989)	(0.3713)	(0.5367)	(0.381)

** Figure of parentheses indicates the corresponding p-value.*

In the all asymmetric GARCH models except PGARCH (1,1), the asymmetry or leverage effects (γ) is positive but not statistically significant for return of NEPSE with full sampled period for all models. It implies that there is no supporting evidence of leverage effect which reveals that there is no effect of positive and negative shocks of same direction on conditional variance.

In TGARCH (1,1) and PGARCH (1,1) for before earthquake period and after earthquake period for EGARCH (1,1), the leverage effects (γ) is negative and statistical significant reveals that the returns of NEPSE series negatively correlated with volatility. Meaning that, the bad news or negative shocked caused higher volatility in Nepalese stock returns at those periods. Since $\gamma > 0$, and statistically significant for after earthquake sampled period under TGARCH (1,1) and PGARCH (1,1) and before earthquake sampled period under EGARCH (1,1); the good news or positive shocks increases the higher volatility or asymmetric news impact on the returns of NEPSE stock at those periods.

The heteroskedasticity test for post-estimation of all asymmetric GARCH specification is not significant then there is no ARCH effect is accepted. It indicates that there is no additional ARCH effect left in the asymmetric models.

CONCLUSION

The basic intend of this paper is to examine the volatility cluster in NEPSE stock price. This study divided into three periods—before earthquake, after earthquake and full periods. The stylized facts revealed that the full sample periods have no evidence of leverage effects but volatility is persisted. In this case, the symmetric GARCH models are the best. On the contrary, TGARCH and PGARCH models have evidence that bad news and negative shocks caused the longer volatility in return of NEPSE than positive shocks and good news but EGARCH confirmed the positive shocks and good news played a volatility in stock price. After earthquake period, volatility of NEPSE index mostly influenced by positive shocks and good news indicated by TGARCH and PGARCH but EGARCH showed the negative leverage effects. The empirical study confirmed that asymmetric GARCH family models are the best fitted model to study the volatility of NEPSE index after and before earthquake periods. This study has differed from previous literatures and offered crucial contributions to the study of NEPSE index and its volatility clustering by dividing the NEPSE series into three periods. Previous studies of NEPSE index volatility focused on symmetric GARCH is the best but we tried to show the asymmetric effects on the stock price of Nepal. For that, this study executed the symmetric and asymmetric GARCH family models with three sampled periods covering from 1 June 2006 to 7 April 2021 daily closing NEPSE index to investigate the volatility shocks and its effect on return of NEPSE. The study explored that the positive and negative shocks on volatility and its persistence behavior and it is suggested that both good and bad news played a crucial role before and after earthquake.

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