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Market volatility of banking stock return vis-à-vis banks merger: An application of GARCH model

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A B S T R A C T

The objective of this research was to investigate the effects caused by the announcement of mergers of SBI and its associate banks i.e. State Bank of Bikaner and Jaipur (SBBJ), State Bank of Hyderabad (SBH), State Bank of Mysore (SBM), State Bank of Patiala (SBP) and State Bank of Travancore (SBT) with State Bank of India on the volatility of the return of SBI stock during the event window of 300 days. In order to achieve the proposed objective, this study applied Generalized autoregressive conditional heteroscedasticity (Garch) class model to the return series to model their volatility because it is considered an important tool for time series data analysis. Our results confirmed the impact of the announcement of Merger on volatility. The results suggest that merger announcement was expected to cause a reaction in the returns, which is related to higher abnormal return in lesser time through merger announcement for investors.

1. Introduction

The mergers announcements are always a critical issue regarding decisions for expansion of companies' growth and development. The decision for announcements of M&As mainly focuses on variability of the returns of securities, systematic risk and least associated with trading volume and returns. There may be a difference between the initial effects of an announcement and their subsequent impacts, markets are quite efficient in the sense that prices adjust very quickly to the public news releases. However, an announcement decreases information asymmetry and uncertainty for future rewards. Due to the volatility effect, the efficiency of the firm's contracting activities lies on underlying uncertainty about future outcomes. The merger and acquisitions were started in the beginning of late 19th century. The first great merger movement was started from 1895-1905. During this period small firms with little market share consolidated with similar firms to form a large firm to dominate the market. In 1900, the merger acquired nearly 20% of growth domestic product (GDP) of the nation and nearly more than 1,800 of these firms disappeared after the merger. One of the major factors of great merger movement was to keep high price, because high prices attracted the firms to enter into the industry and to maintain profitability. The economic history of the merger and the acquisitions have been divided into the number of merger waves based on the merger activities in the business world shown in Table 1. During the period from 1985 to

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2018, Merger and Acquisitions (M&As) occurred around the world in terms of the numbers and the value in the banking sector shown in Table 2 followed by Fig. 1. Previously various studies carried out in this field, here the researchers enlightened some studies which are particularly in the banking sector.

The Fama and Miller (1972) market model and Cox and Portes (1998) two factor model form the theoretical framework of this study. The aim is to understand the shareholder wealth effects of bank mergers. Jayaraman et al. (1991) in their research which is based on empirical findings found that market forecasting or anticipation about merger of the targeted firm plays significant role while the first announcement has not been done for the merger. The market anticipation or projection is analyzed by variances existed in target firms' stocks by listing the call options in Premia. Boon Tan, and Wooi Hooy (2004) examined the merger program initiated in Malaysia and investigated the impact of this whole merger program on stock returns and fluctuations in stocks of the Malaysian banks. According to the study, financial sector of the Malaysia suffered from the uncertainty due to financial crisis occurred worldwide in general and Asia in specific and needed some fundamental reforms in the banking sector of Malaysia. The findings of the study suggested that prosperity in stock prices and return would be the outcome of merger program as it is based on projections of conditional variances. Karmakar (2005) did empirically traced the volatility in Indian stock market and for this author used conditional volatility model. The leverage effect has been checked by the author in Indian companies taking two national level stock market indices as Nifty and Sensex. Alberg et al. (2008) made an attempt to determine the asymmetry in volatility through GARCH and EGARCH model. Anand and Singh (2008) attempted to judge the effect of wealth of shareholder by merger in the banking sector of India. The study was focused on five bank mergers. Khan (2011) shed light on pre and post-merger environment of Indian banking sector by computing some financial ratios such as ROCE, Gross and Net profit margin, etc. The author tried to explore various motives behind the M&A. The author did extensive study on the work accomplished previously on this aspect and found that plethora of work had been executed on impact on M&A on many aspects of the companies but performance during pre and post-merger was relatively new area to search. Khan and Ikram (2012) critically examined the efficiency of the Indian Stock Market with respect to the announcement of Mergers and Acquisitions (M&As) in the Indian Banking Sector by employing the Standard Risk Adjusted Event Study Methodology. They took 6 recent mergers from 21st Jan 2003 to 19thMay 2009. The result supported that the efficiency of the market in its semi-strong form of EMH and observed that neither before nor after the merger announcement investors were able to earn abnormal/excess return. Shanmugasundram et al. (2013) highlighted the risk factors in sector-based Index. The study was performed on some reputed indices such as CNX Nifty Index, FMCG, AUTO index, etc. ranging the financial year from 2004 to 2012. With the help of two tailed T-Test and ANOVA, it was observed that significant difference did not exist among the sectoral indices risk and CNX Nifty as the Standard deviation was insignificant. Zhu et al. (2014) empirically investigated the effect of idiosyncratic volatility on various acquisition parameters. The study found positive relationship between the aspects. The authors emphasized that knowing this relationship is necessary especially where the information of poor economies exists because acquirers do not have the information of the target company. Birau et al. (2015) tried to capture the volatility of BANKEX by the famous econometrics modeling tools GARCH. BANKEX is the index used to measure the performance of Indian Banking sector. The period taken for the analysis was from January 2002 to June 2014. The authors concluded that this index increased seventeen times in just twelve years and showed clockwise positive returns. Pessanha et al. (2016) studied the impact of announcement of M&A on stock volatility of Brazilian Banks during the period 1994-2015. By using the GARCH model, the authors revealed that low reputed Banks were associated with negative reactions while high reputed Bank were attached with positive reactions due to the announcement of M&A. Khan and Javed (2017) investigated how the National and International market, namely (S&P BSE Sensex) (Nasdaq) (SSE) (FTSE) could influence the volatility of (S&P BSE BANKEX) return in India. Seo et al. (2019) created the hybrid model for prediction of volatilities in more accuracy manner. The authors used Google Domestic Trends (GDTs) as a raw material to predict the accurate volatility.

Table 1
Exhibit the History of Merger Waves and Facet during Period

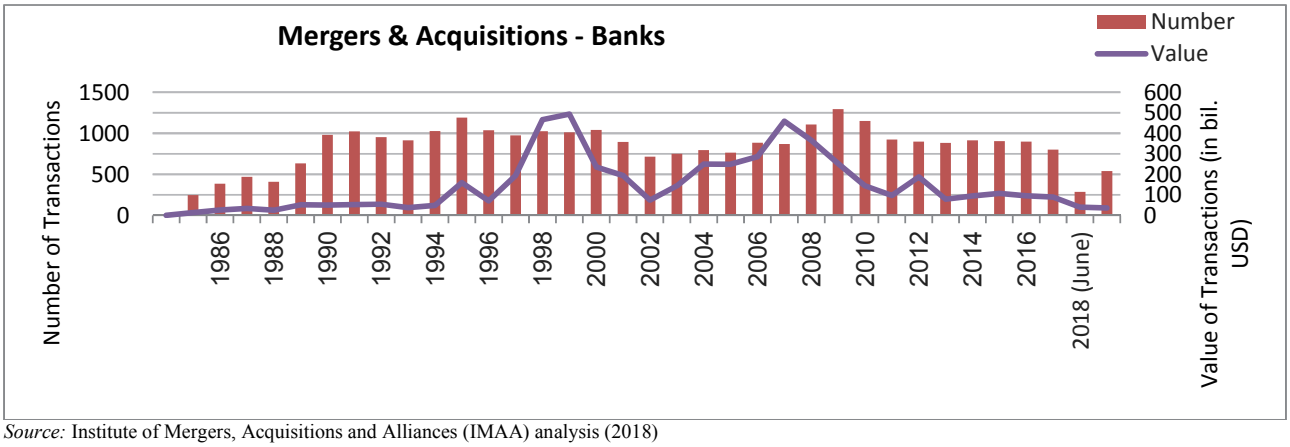
Period	Waves	Type/ Facet of Merger
1893–1904	First Wave	Horizontal mergers
1919–1929	Second Wave	Vertical mergers
1955–1970	Third Wave	Diversified conglomerate mergers
1974–1989	Fourth Wave	Co-generic mergers; Hostile takeovers; Corporate Raiding
1993–2000	Fifth Wave	Cross-border mergers, mega-mergers
2003–2008	Sixth Wave	Globalizations-, Shareholder Activism, Private Equity, LBO
2014-	Seventh Wave	Generic/balanced, horizontal mergers of Western companies acquiring emerging market resource producers

Source: Researchers Compilations

Table 2
Showing the M&As in Banking Sector in the World in Terms of Value and Numbers.

Year	Number	Value in terms of			
		in bil. USD	in bil. EUR	in bil. GBP	in bil. YEN
1985	247	13	17	10	3183.1165
1986	386	25	26	17	4151.9123
1987	468	34	29	21	4868.1546
1988	409	25	19	14	3161.2157
1989	634	51	46	32	7180.116
1990	979	50	37	27	6914.9899
1991	1,024	52	42	31	7061.4141
1992	954	54	42	30	6907.022
1993	914	37	32	25	4104.6942
1994	1,027	48	40	31	4816.1183
1995	1,192	159	124	101	15103.413
1996	1,036	71	56	45	7782.3686
1997	975	194	172	118	23942.205
1998	1,025	466	423	281	61707.784
1999	1,011	494	483	307	55247.477
2000	1,041	236	257	156	25473.242
2001	895	194	219	136	24012.768
2002	715	74	77	49	9175.2299
2003	750	144	124	86	16257.401
2004	796	250	200	136	26906.964
2005	765	249	201	138	27340.994
2006	884	286	225	153	33366.257
2007	869	459	332	226	54453.298
2008	1,107	366	262	210	37067.499
2009	1,295	252	185	164	23424.734
2010	1,151	144	110	94	12472.306
2011	925	96	70	60	7670.7227
2012	898	187	144	117	15548.148
2013	883	78	59	50	7723.946
2014	913	95	73	58	10148.941
2015	905	107	97	70	12942.524
2016	899	95	86	70	10430.043
2017	802	89	78	68	9,951.52
2018 (June)	287	39.52	32.96	28.80	4,310.21
2018 (Forecast)	541	35.421608	28.848444	25.527431	3871.9492

Source: Institute of Mergers, Acquisitions and Alliances (IMAA) analysis



Source: Institute of Mergers, Acquisitions and Alliances (IMAA) analysis (2018)

Fig. 1. Exhibits the Merger and Acquisition(M&As) in the Banking Sector around the World

2. Merger and Acquisitions (M&As) In Indian Banking Sector

In the history, the Indian banking sector has witnessed great mergers occurred in the recent decade which includes one of the most prominent mergers that is SBI with their associate banks in 2017. The restructuring through merger, SBI gained a large number of customers within less time and increased the scale of their business. Mergers bring better efficiency ratio in the operations of business which minimize the inherent risk by merging into one. Mergers help in improving the professional standards, where the banks' employees will be under one umbrella to their services and wages by removing disparities. Merger and Acquisitions (M&As) were started several years ago in the banking sector of India. The oldest and the largest bank still active, i.e., the State Bank of India (S.B.I).

Table 3

Exhibit the List Banks Merger and Acquisitions (M&As) Since Nationalization of Banks in India

Name of the Banks Acquired	Name of the Banks got Merged	Year of Merging happened
State Bank of India	Bharatiya Mahila Bank (BMB)	2017
State Bank of India	State Bank of Travancore (SBT)	2017
State Bank of India	State Bank of Bikaner and Jaipur (SBBJ)	2017
State Bank of India	State Bank of Hyderabad (SBH)	2017
State Bank of India	State Bank of Mysore (SBM)	2017
State Bank of India	State Bank of Patiala (SBP)	2017
Kotak Mahindra Bank	ING Vyasa Bank	2014
ICICI Bank	Bank of Rajasthan Ltd.	2010
HDFC Bank	Centurion Bank of Punjab	2008
ICICI Bank Ltd	Sangli Bank	2007
Indian Overseas Bank	Bharat Overseas Bank	2007
Centurion Bank of Punjab	Lord Krishna Bank	2006
Federal Bank	Ganesh Bank of Kurandwad	2006
Nainital Bank	Bank of Baroda	2006
IDBI Ltd	United Western Bank	2006
IDBI Ltd	IDBI Bank	2005
Bank of Punjab (POB)	Centurion Bank	2005
Bank of Baroda	South Gujarat Local Area Bank	2004
Oriental Bank of Commerce	Global Trust Bank	2004
Punjab National Bank	Nedungadi Bank Ltd.	2003
ICICI Bank	ICICI Ltd.	2002
Bank of Baroda	Benares State Bank Ltd.	2002
ICICI Bank Ltd	Bank of Madura Ltd	2001
HDFC Bank Ltd.	Times Bank Ltd.	2000
Bank of Baroda	Bareilly Corporation Bank Ltd.	1999
Union Bank of India	Sikkim Bank Ltd.	1999
Oriental Bank of Commerce	Bari Doab Bank Ltd.	1997
Oriental Bank of Commerce	Punjab Co-operative Bank Ltd.	1996
State Bank of India	Kashinath State Bank Ltd	1995
Bank of India	Bank of Karad Ltd.	1994
Punjab National Bank	New Bank of India	1993
Bank Of India	Parur Central Bank Ltd.	1990
Central Bank Of India	Purbanchal Bank Ltd.	1990
Indian Bank	Bank of Thanjavur Ltd.	1990
Indian Overseas Bank	Bank of Tamilnadu Ltd	1990
Allahabad Bank	United Industrial Bank Limited	1989
Bank of Baroda	Traders Bank Ltd	1988
Punjab National Bank	Hindustan Commercial Bank Ltd	1986
State Bank of India	Bank of Cochin Ltd	1985
Canara Bank	Lakshmi Commercial Bank Ltd	1985
Union Bank of India	Miraj State Bank Ltd	1985
State Bank of India	National Bank of Lahore Ltd	1970
State Bank of India	Bank of Bihar Ltd	1969

Source: Reserve Bank of India

It was originated and started working as the Bank of Calcutta in mid-June 1806. In 1809, it was renamed as the Bank of Bengal. Later on, the presidential government merged three banks in 1921 to form the Imperial Bank of India, the Bank of Bengal and the other two were the Bank of Bombay and the Bank of Madras which were founded in 1840 and 1843. These three banks after 1947 India's independence were known as the State Bank of India in 1955. This phenomenon of mergers has not stopped even after nationalization of SBI. The events like merger and acquisition were not so much popular up to 1980's because there were a very small percentage of businesses running in the country. However mostly all the merger during that period were friendly acquisition with a negotiated deal. However, at the beginning of 1990's the volume was tremendously increased nearly four times more merger than before. The most recent mergers in the Indian banking are SBI merged with associate in 2017, Kotak Mahindra bank

merged with ING Vyasa Bank in 2014 and ICICI Bank merged with Bank of Rajasthan in 2010. Table 3 shows the list of banks mergers and acquisition since nationalization of banks in India.

3. The proposed study

This paper examines the impact of Merger and Acquisition(M&As) on volatility of SBI security return.

3.1. Hypothesis of the Study

$H_0$1: The occurrence of M&As does not impact the volatility of stock return of State Bank of India.

3.2 Research Methodology

The data used in this paper have been collected from some reliable sources. The historical daily security data of State Bank of India were retrieved from Bombay stock exchange which include daily stock price quotations of banks involved in Merger and Acquisitions. The research is limited to acquiring bank due to scarcity of data of acquired bank after M&As. The analyzed series covers the period from 18/7/2016 to 29/9/2017 nearly 300 (event window) working days. The period of analysis is shorter, because the researcher wants to examine the volatility of stock returns with respect to the M&As. Thus the stock price series of the acquiring bank was transformed into the return series. The market return of SBI security price is calculated using the formulae,

$$R = \frac{Pi - Pj}{Pj} \times 100.$$

By defining a return: r_i at time i, where p_i is the price at time *i* and *j* = (i - j): Firstly, Researchers have checked return series with the help of graph to know the outlier or break point. If it was observed that the behaviour is changing on certain point then the researchers have opted to go for Stationarity test. Stationarity literally mean riveting, again and again crossing their mean. Historically, the stationary of data is usually derived from time plot and Correlogram. The unit root test determines whether a time series is stationary or not, to deal this problem, the researchers applied Augmented Dickey-Fuller Test on return series and found data is stationary at level, where exogenous constant, Constant with linear trend and none are satisfied (See Table 4). The researchers chose lag length automatically by e-views software to run the test, the lag length should be selected rationally so that the residuals are not serially correlated.

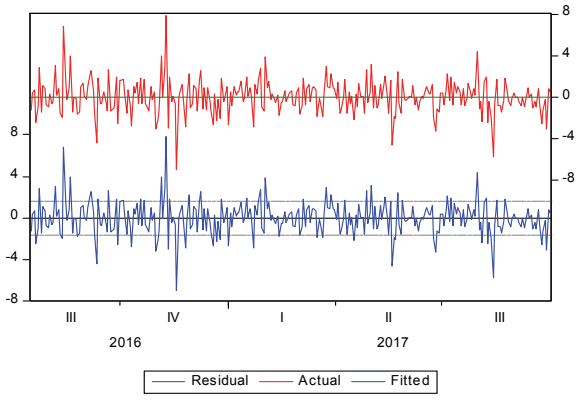
Table 4
Exhibit the Output of Augmented Dickey-Fuller Test Statistic at Exogenous Constant, Constant with Linear Trend and None

Exogenous (Regression model)	Test critical values at 5% level	t-Statistic	Prob.*
Constant	-2.870996	-17.79362	0.0000
Constant, Linear Trend	-3.424926	-17.87483	0.0000
None	-1.941888	-17.81519	0.0000

Source: Output E-views by researchers' compilations

4. Results and Discussion

After testing the Stationarity of the return series, the researchers have to check the residual diagnostic with three statistics Correlogram Q-statistics, Correlogram squared residual and Heteroscedasticity test, the researchers estimated the equation at C, where researchers checked the condition of satisfied equation by residual diagnostics which includes the Correlogram Q-statistics, Correlogram squared residual and Heteroscedasticity tests. The unstable behaviour of the volatility or Heteroscedasticity of the stock of the SBI stock return of acquiring bank, an initials visual analysis of the graph indicates that the return of the stock show high volatility and shows the stylized facts in the financial time series (See Fig. 2), which indicates the use of Arch class statistical model which is an important tool to support decision making, evaluation and final result before estimating the mean and variance equation, in pre-test for estimating model.



Source: Output E-views

Fig. 2. Actual, fitted and residuals of SBI security return of 300 days

The autocorrelation coefficient has revealed a predictable pattern of the conditional mean of the stock return of the acquiring bank. The same pattern was observed for the estimated autocorrelation for the squared return of the series. This gives some evidence of Arch effect in the variance of the return series of the banking stock. Residual diagnostic is to be tested for best fit model for estimating volatility of SBI stock return. Therefore, the researchers checked the residual diagnostic and tested the return series to Correlogram q –statistics, here the information of the announcement of the merger gives negative as well as positive reaction of the stock return. Both auto correlation and partial correlation values show negative or positive sign. All the p-value are shown more than 0.05 which show the model was viable or acceptable (See Table 5). Simultaneously, Correlogram square residual shows that mean return was based on the past term, where the p-value is greater than 0.05 which is satisfactory for model (See Table 6). Lastly the researchers examined the hetroscedasticity (Arch test) by taking six lags under the selected period of event window (300 days) which showed p-value is 0.0024 (See Table 7) and clearly stated that there was Arch effect, therefore, the researchers moved to variance equation. Finally after estimating the mean equation, the researchers have taken the residual for estimating the variances of the residual equation. The method used ML-Marquardt normal distribution, the convergence achieved after 18 iterations and the pre-sample variance or back cast parameter (0.7). Under 300 days observations, in the mean equation variable return SBI is regressed at constant, which shows the coefficient is 0.033729 and the standard error is 0.086181. The Z-statistics is 0.391373 and p-value is equal to 0.6955, the variance equation (C2) shows the p-value is 0.0017, the resid (-1) ^2 is 0.0010, which shows variance was dependent on squared residual. Garch (-1) shows the p-value of 0.000 which is highly significant, which means the volatility is associated with the previous day or variance is dependent on the past term or conditional variance and is affected by previous day variance (See Table 8).

*GARCH = C (2) + C (3) ×RESID (-1) ^2 + C (4) *GARCH (-1)*

After estimating the model, the researchers examined the goodness of the fit. In order to find out whether the Arch- Garch (1,1) model is viable or not, the researchers checked all the convention again in the post model formed.

1. Autocorrelation: after the estimation of the model, we have found that there was no serial correlation in the residual term, where the p-value lies greater than 0.05 shown in Table 9.
2. Arch effect; In the post estimation analysis, the result shows that F-statistics is 0.48 and p-value is equal to 0.488 which is more than 0.05 and this means the Hetroscedasticity has been removed, for the LM-test which has been performed (See Table 11).
3. All the values of Correlogram square residual are above 0.05 which is acceptable for the model (See Table 10).

5. Final comments

This study has examined the impact of announcement of mergers on the volatility of banking stock return by using Arch-Garch model. The result shows that mergers were responsible for an increase in security return volatility on different ways, however it suggests that merger tend to have negative or positive reaction, but here the results have indicated some volatility in the stock and after the merger of SBI and associates increased SBI market shares from 17 to 23 percent in post-merger, which means that SBI benefited from the merger with their associate's banks. The study evaluated the impact of Merger and Acquisitions on the volatility of the return of Indian Banking stock using Garch class model. The results have shown that M&As were responsible for an increase in stock volatility and in different ways. Thus, our results do not support our assumption and the formulated hypothesis was rejected, therefore, there is a significant impact of mergers and acquisitions on the volatility of SBI stock returns. They suggested that the results may also be useful for prediction of security returns in the Indian banking sector, if the researchers consider other factors effecting on the volatility of the return, the results could also bring some new facts. Finally, researchers concluded that, more robust financial model could be used, such as E-Garch, T-Garch and Multivariate Garch Model.

Table 5
Exhibit the Pre-Estimation Model Output of Residual Diagnostics Correlogram Q- Statistics

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|. |	.|. |	1	-0.031	-0.031	0.2938	0.588
.|. |	.|. |	2	-0.019	-0.020	0.4026	0.818
.|. |	.|. |	3	0.054	0.053	1.2873	0.732
.|. |	.|. |	4	-0.022	-0.019	1.4372	0.838
.|. |	.|. |	5	-0.033	-0.033	1.7759	0.879
.|. |	.|. |	6	-0.052	-0.058	2.6229	0.854
*|. |	*|. |	7	-0.091	-0.094	5.1706	0.639
.|. |	*|. |	8	-0.061	-0.067	6.3165	0.612
.|. |	*|. |	9	-0.060	-0.066	7.4430	0.591
.|. |	.|. |	10	0.025	0.024	7.6462	0.663
.|. |	.|. |	11	0.030	0.029	7.9300	0.720
.|. |	.|. |	12	0.030	0.030	8.2225	0.768
.|. |	.|. |	13	-0.017	-0.033	8.3140	0.823
.|. |	*|. |	14	-0.043	-0.068	8.9008	0.837
.|. |	.|. |	15	0.028	0.002	9.1475	0.870
.|. |	.|. |	16	0.039	0.031	9.6376	0.885
.|. |	.|. |	17	0.040	0.053	10.155	0.897
.|. |	.|. |	18	-0.007	0.003	10.171	0.926
*|. |	*|. |	19	-0.109	-0.109	14.017	0.783
.|. |	.|. |	20	0.038	0.020	14.480	0.805
.|. |	.|. |	21	-0.046	-0.057	15.172	0.814
.|. |	.|. |	22	0.044	0.054	15.814	0.825
.|. |	.|. |	23	-0.052	-0.052	16.695	0.824
.|. |	.|. |	24	0.028	0.047	16.952	0.851
.|. |	.|. |	25	0.010	0.006	16.985	0.882
.|* |	.|* |	26	0.088	0.087	19.554	0.812
.|. |	*|. |	27	-0.048	-0.072	20.326	0.817
.|. |	*|. |	28	-0.047	-0.075	21.056	0.823
.|. |	.|. |	29	-0.007	-0.017	21.074	0.856
.|. |	.|. |	30	0.013	0.031	21.129	0.884
.|. |	.|. |	31	-0.008	0.026	21.150	0.908
.|. |	.|. |	32	-0.031	-0.037	21.467	0.921
.|. |	.|. |	33	0.042	0.036	22.055	0.926
.|. |	.|. |	34	0.032	0.029	22.395	0.936
.|. |	.|. |	35	0.054	0.065	23.389	0.933
*|. |	*|. |	36	-0.118	-0.141	28.172	0.821

Source: Output by E-views

Table 6
Exhibit the Pre-Estimation Model Output of Residual Diagnostics Correlogram Squared Residuals Statistics

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|. |	.|. |	1	0.049	0.049	0.7187	0.397
.|. |	.|. |	2	-0.028	-0.030	0.9521	0.621
.|. |	.|. |	3	0.070	0.073	2.4382	0.487
.|. |	.|. |	4	0.027	0.019	2.6659	0.615
.|* |	.|* |	5	0.088	0.091	5.0644	0.408
.|** |	.|** |	6	0.233	0.225	21.841	0.001
.|. |	.|. |	7	-0.001	-0.017	21.841	0.003
.|. |	.|. |	8	-0.064	-0.063	23.120	0.003
.|. |	.|. |	9	0.058	0.030	24.184	0.004
.|. |	*|. |	10	-0.060	-0.092	25.328	0.005

Table 6

Exhibit the Pre-Estimation …. (Continued)

.|. |	.|. |	11	0.008	-0.015	25.350	0.008
.|. |	*|. |	12	-0.011	-0.074	25.390	0.013
.|. |	.|. |	13	-0.042	-0.021	25.949	0.017
.|. |	.|. |	14	0.003	0.032	25.951	0.026
.|. |	.|. |	15	-0.004	-0.012	25.957	0.038
.|. |	.|. |	16	-0.011	0.032	25.994	0.054
.|. |	.|. |	17	-0.058	-0.048	27.058	0.057
.|. |	.|. |	18	-0.055	-0.042	28.022	0.062
.|. |	.|. |	19	0.025	0.048	28.228	0.079
.|. |	.|. |	20	0.033	0.017	28.590	0.096
.|. |	.|. |	21	-0.014	-0.001	28.650	0.123
.|. |	.|. |	22	-0.049	-0.047	29.431	0.133
.|. |	.|. |	23	-0.006	0.016	29.445	0.166
.|. |	.|. |	24	-0.032	-0.018	29.789	0.192
.|. |	.|. |	25	0.000	-0.029	29.789	0.232
.|. |	.|. |	26	0.046	0.041	30.483	0.248
.|. |	.|. |	27	0.002	0.015	30.485	0.293
.|. |	.|. |	28	-0.010	0.009	30.517	0.339
.|. |	.|. |	29	-0.008	-0.009	30.538	0.388
.|. |	.|. |	30	0.006	0.008	30.551	0.438
.|. |	.|. |	31	0.027	0.032	30.789	0.477
.|. |	.|. |	32	-0.015	-0.048	30.868	0.524
.|. |	.|. |	33	0.019	0.022	30.984	0.568
.|. |	.|. |	34	0.014	0.008	31.055	0.613
.|. |	.|. |	35	-0.010	-0.021	31.089	0.657
.|. |	.|. |	36	-0.014	-0.014	31.153	0.698

Source: Output by E-views

Table 7

Exhibit the Pre-Estimation Model Output of Residual Diagnostics by ARCH LM-Test Using Least Squares Method

F-statistic	3.483698	Prob. F(6,287)	0.0024
Obs*R-squared	19.95843	Prob. Chi-Square(6)	0.0028

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.621489	0.490863	3.303344	0.0011
RESID^2(-1)	0.029697	0.057432	0.517070	0.6055
RESID^2(-2)	-0.044760	0.057266	-0.781624	0.4351
RESID^2(-3)	0.059944	0.057395	1.044414	0.2972
RESID^2(-4)	0.023760	0.057411	0.413857	0.6793
RESID^2(-5)	0.080453	0.057366	1.402435	0.1619
RESID^2(-6)	0.226011	0.057558	3.926696	0.0001

R-squared	0.067886	Mean dependent var	2.595085
Adjusted R-squared	0.048399	S.D. dependent var	6.262670
S.E. of regression	6.109237	Akaike info criterion	6.481002
Sum squared resid	10711.64	Schwarz criterion	6.568707
Log likelihood	-945.7073	Hannan-Quinn criter.	6.516125
F-statistic	3.483698	Durbin-Watson stat	1.991134
Prob(F-statistic)	0.002433		

Source: Output by E-views

Table 8

Exhibit the ML - ARCH (Marquardt) - Normal distribution Model Output

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.033729	0.086181	0.391373	0.6955
Variance Equation				
C	0.361860	0.115585	3.130683	0.0017
RESID(-1)^2	0.142215	0.043107	3.299117	0.0010
GARCH(-1)	0.730557	0.068884	10.60568	0.0000

R-squared	-0.000003	Mean dependent var	0.030721
Adjusted R-squared	-0.000003	S.D. dependent var	1.614844
S.E. of regression	1.614847	Akaike info criterion	3.774999
Sum squared resid	779.7110	Schwarz criterion	3.824383
Log likelihood	-562.2499	Hannan-Quinn criter.	3.794763
Durbin-Watson stat	2.060045		

Source: Output by E-views

Table 9

Exhibit the Post Estimation Model Output of Residual Diagnostics Correlogram Q- Statistics

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
.|. |	.|. |	1	-0.025	-0.025	0.1872	0.665
.|. |	.|. |	2	-0.010	-0.010	0.2150	0.898
.|. |	.|. |	3	0.038	0.038	0.6576	0.883
.|. |	.|. |	4	-0.014	-0.012	0.7136	0.950
.|. |	.|. |	5	-0.048	-0.048	1.4349	0.920
.|. |	.|. |	6	-0.030	-0.034	1.7156	0.944
*|. |	*|. |	7	-0.101	-0.103	4.8433	0.679
.|. |	.|. |	8	-0.055	-0.059	5.7806	0.672
.|. |	*|. |	9	-0.063	-0.069	7.0266	0.634
.|. |	.|. |	10	0.026	0.025	7.2389	0.703
.|. |	.|. |	11	0.030	0.029	7.5296	0.755
.|. |	.|. |	12	0.029	0.025	7.7915	0.801
.|. |	.|. |	13	-0.017	-0.030	7.8830	0.851
.|. |	.|. |	14	-0.019	-0.043	7.9993	0.889
.|. |	.|. |	15	0.035	0.017	8.3910	0.907
.|. |	.|. |	16	0.033	0.025	8.7351	0.924
.|. |	.|. |	17	0.029	0.038	9.0089	0.940
.|. |	.|. |	18	0.004	0.010	9.0141	0.959
*|. |	*|. |	19	-0.120	-0.116	13.681	0.802
.|. |	.|. |	20	0.029	0.020	13.954	0.833
.|. |	.|. |	21	-0.038	-0.044	14.432	0.850
.|. |	.|. |	22	0.033	0.044	14.782	0.871
.|. |	.|. |	23	-0.052	-0.049	15.676	0.869
.|. |	.|. |	24	0.024	0.032	15.861	0.893
.|. |	.|. |	25	-0.011	-0.012	15.902	0.918
.|* |	.|. |	26	0.075	0.060	17.773	0.884
.|. |	.|. |	27	-0.029	-0.044	18.059	0.902
.|. |	*|. |	28	-0.045	-0.073	18.745	0.906
.|. |	.|. |	29	-0.004	-0.002	18.750	0.928
.|. |	.|. |	30	0.009	0.011	18.779	0.945
.|. |	.|. |	31	0.000	0.025	18.779	0.959
.|. |	.|. |	32	-0.041	-0.059	19.360	0.961
.|. |	.|. |	33	0.046	0.045	20.077	0.962
.|. |	.|. |	34	0.031	0.031	20.394	0.968
.|. |	.|* |	35	0.061	0.075	21.679	0.962
*|. |	*|. |	36	-0.130	-0.148	27.504	0.844

*Probabilities may not be valid for this equation specification.

Source: Output by E-views

Table 10

Exhibit the Post Estimation Model Output of Residual Diagnostics Correlogram Squared Residuals Statistics

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
.|. |	.|. |	1	-0.040	-0.040	0.4890	0.484
*|. |	*|. |	2	-0.071	-0.073	2.0264	0.363
.|. |	.|. |	3	0.052	0.046	2.8458	0.416
.|. |	.|. |	4	-0.014	-0.015	2.9033	0.574
.|. |	.|. |	5	0.056	0.062	3.8646	0.569
.|* |	.|* |	6	0.088	0.090	6.2642	0.394
.|. |	.|. |	7	-0.017	0.000	6.3527	0.499
*|. |	*|. |	8	-0.072	-0.067	7.9509	0.438
.|* |	.|. |	9	0.078	0.065	9.8567	0.362
*|. |	*|. |	10	-0.079	-0.086	11.800	0.299
.|. |	.|. |	11	-0.014	-0.015	11.865	0.374
.|. |	.|. |	12	-0.015	-0.044	11.940	0.451
*|. |	.|. |	13	-0.067	-0.054	13.364	0.420
.|. |	.|. |	14	0.008	0.002	13.382	0.497
.|. |	.|. |	15	0.010	0.002	13.411	0.571
.|. |	.|. |	16	0.010	0.029	13.443	0.640
.|. |	.|. |	17	-0.065	-0.050	14.787	0.611
*|. |	*|. |	18	-0.075	-0.084	16.602	0.551
.|. |	.|. |	19	0.040	0.045	17.120	0.582
.|. |	.|. |	20	0.026	0.013	17.343	0.631
.|. |	.|. |	21	-0.026	-0.023	17.560	0.677
.|. |	.|. |	22	-0.056	-0.054	18.596	0.670
.|. |	.|. |	23	-0.005	-0.005	18.605	0.724
.|. |	.|. |	24	0.005	0.008	18.613	0.772
.|. |	.|. |	25	0.013	-0.006	18.666	0.813
.|. |	.|. |	26	0.054	0.055	19.626	0.809
.|. |	.|. |	27	0.002	0.027	19.627	0.846
.|. |	.|. |	28	-0.020	-0.020	19.756	0.873
.|. |	.|. |	29	-0.023	-0.032	19.934	0.895
.|. |	.|. |	30	0.010	-0.008	19.965	0.917
.|. |	.|. |	31	0.034	0.023	20.358	0.928
.|. |	.|. |	32	-0.032	-0.043	20.700	0.938
.|. |	.|. |	33	0.018	0.021	20.812	0.951
.|. |	.|. |	34	0.029	0.033	21.101	0.959
.|. |	.|. |	35	-0.008	-0.018	21.125	0.969
.|. |	.|. |	36	-0.018	-0.019	21.236	0.976

*Probabilities may not be valid for this equation specification.

Table 11

Exhibit the Post Estimation Model Output of Residual Diagnostics by ARCH LM-Test Using Least Squares Method

F-statistic	0.480431	Prob. F(1,297)		0.4888
Obs*R-squared	0.482885	Prob. Chi-Square(1)		0.4871
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.040632	0.132501	7.853787	0.0000
WGT_RESID^2(-1)	-0.040200	0.057997	-0.693131	0.4888
R-squared	0.001615	Mean dependent var		1.000325
Adjusted R-squared	-0.001747	S.D. dependent var		2.056897
S.E. of regression	2.058692	Akaike info criterion		4.288686
Sum squared resid	1258.750	Schwarz criterion		4.313438
Log likelihood	-639.1585	Hannan-Quinn criter.		4.298593
F-statistic	0.480431	Durbin-Watson stat		2.004742
Prob(F-statistic)	0.488769			

Source: Output by E-views

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