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Full Length Research Paper

Comparing the persistency of different frequencies of stock returns volatility in an emerging market: A case study of Pakistan

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This study aimed at comparing the variance structure of high (daily) and low (weekly, monthly) frequencies of data. By employing ARCH (1) and GARCH (1, 1) models, the study found that the intensity of the shocks was not equal for all the series. The study found that statistical properties of the three data series of returns were substantially different from one another and the persistence of conditional volatility was also different for the three series. The presence of persistency was more in the daily stock returns as compared to other data sets, which showed that the volatility models were sensitive to the frequencies of data series. In simple, the results revealed that the variance structure of high-frequency data were dissimilar from the low frequencies of data, and variance structure in the daily data were more linked with the stylized facts associated with stock returns volatility as compared to other data series.

Key words: ARCH, GARCH models, KSE 100-index, persistence.

INTRODUCTION

The most significant topic of research in the financial markets for the last three decades is the stock returns volatility. After the publication of Engle (1982) paper, on ARCH, the volatility has received substantial attention from researchers, practitioners and policy makers. This interest is due to the fact that the volatility is a risk measure, and different participants use this for different reasons. The volatility is high in the developing and developed countries in recent years, but is much higher in the developing countries. So volatility study is more important in the developing countries. After the crash of 1987, the need for volatility measurement is the focus of attention by the practitioners, regulatory concerns and empirical researchers.

Persistency in volatility clustering is normally due to the inefficiency in the market. Rizwan and Khan (2007) studied the volatility of the Pakistani stock market and found volatility clustering, which signifies inefficiency in the stock market. They found that lagged returns are significant in explaining current returns. The volatility persistence measures the time period for which any shock has a significant impact on variance.

Volatility has different phenomenon when it is measured on short, medium and long term basis. So the different frequencies must be examined to see the short, medium and long term effects of the volatility. Dawood (2007) investigated volatility in the Karachi stock exchange and found that in 1990's, the market has become more volatile both on short-term (daily) and medium-term (monthly) basis. He found that the stock market reacts too actively to economic shocks, but this reaction take place on a daily basis and die away within a month.

High-frequency data series is considered to be the most volatile series than the low frequencies of data. As

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Chang (2006) investigated the mean reversion behavior of different series of data and concluded that the daily, weekly, and monthly returns are negatively auto correlated in both the short and the long term and mean reversion situation exists in the low-frequency data, but not in the high-frequency data. He found that though the three frequencies have the mean reversion behavior, but the behavior is different for high-frequency data and low-frequency data. Caiado (2004) also found the same results, by employing GARCH-type models to model the volatility for daily and weekly returns of the Portuguese Stock Index (PSI-20), he found support for asymmetric shocks to volatility in daily stock returns, but not in weekly stock returns. This establishes the need for this study to compare the variance structure of different frequencies of data, because the volatility affects the variance structure of different frequencies of data, differently.

This study fills the gap by addressing the questions of volatility persistence in case of KSE returns and the existence of persistency for the different frequencies. The study has the following objective: "To compare the variance structure of high (daily) and low (weekly, monthly) frequencies of data".

This study extends the work on volatility of the emerging financial markets. ARCH/GARCH models are employed in this study to compare the volatility behavior of the different frequencies of data (daily, weekly and monthly). The heteroscedasticity is the major characteristics of developing market and so, the need for the volatility using different data set is important for the developing market. Thomas (1995) found strong heteroscedasticity in daily, weekly and monthly returns in the developing market of Bombay Stock Exchange. Hassan et al. (2000) examined these issues in the Bangladeshi stock market and also found the nonlinear properties in the market like skewness, excess kurtosis, significant serial dependence, stock market inefficiency and deviation from normality. This generates the need for studying the volatility behavior of developing markets and more importantly the promising stock market of Pakistan.

Pakistan's capital market

Karachi Stock Exchange (KSE) was established in 18th September 1947. The other exchanges in Pakistan are the Lahore Stock exchange (est. 1974) and the Islamabad Stock Exchange (est. 1997). KSE is the biggest of the three exchanges where, according to an estimate, more than 85% of the trade occurs, and in LSE 14% and 1% in ISE. 671 companies were listed in KSE at the end of the year 2007. KSE-100 index is representative of the KSE and is normally used as the proxy of the overall market. A number of securities trade in the market, but the market is known for the trade of the ordinary shares. Trade in Futures started in 2003, but are not common in the market. The exchange also plans to introduce options in the near future and according to their estimates by 2012, 50% of the stock market trading will be in derivatives. Due to the implementation of the code of the corporate governance, the number of companies reduced immensely during 2001 - 2003. The rapid growth in capitalization and trading volume were observed after 2001. The market was first and third in 2003 and 2006, respectively, when the turnover ratio of the market observed (Global Stock Markets Fact book, 2004; 2007).

Literature review

Defining volatility is the most important job before modeling and measuring the stock returns volatility. So, what is stock returns volatility? Stock returns volatility represents the variability in stock prices (Karolyi, 2001). Volatility is considered to be the time dependent and time varying. As concluded in research that the stock returns volatility follows the heteroscedastic property or time varying dynamic process (Zhu, 2007).

The researches in the developed markets show that financial time series data of different frequencies that exhibit diverse properties, which must also be studied for the developing stock markets. As Caiado (2004) used GARCH-type models to measure the volatility for daily and weekly returns of the Portuguese Stock Index-PSI-20 and found that some properties are substantially different in the two series. In the developing markets, this fact is also examined and found correct like in the Bombay Stock exchange. Strong evidence, of heteroscedasticity, in daily, weekly and monthly returns, was found in Bombay Stock Exchange from the period of April 1979 to March 1995 (Thomas 1995). GARCH models were used for estimating the conditional variance of the three data series.

Developing markets are much sensitive with respect to stylized facts of volatility. As Hassan et al. (2000) examined the issue of time-varying volatility for the Bangladeshi stock market and found positive skewness, excess kurtosis, significant serial dependence, stock market inefficiency and deviation from normality for the returns of Dhaka Stock Exchange (DSE). Kirchler and Huber (2004) examined the asset markets with varying information and observed leptokurtic returns and persistency.

Chang (2006) investigated the mean reversion behavior of different series of data and concluded that the daily, weekly, and monthly returns had negative autocorrelation in both short and long term basis, and great events cause over-reaction to the information impact and result in a stronger mean reversion, which was a long-term price behavior. Mean reversion situation exist in the low-frequency data and not in the high-frequency data. He found that three frequencies had the mean reversion behavior, but the behavior of high-frequency data was different from low-frequency data.

Persistency is related to the jumps, which changes the volatility pattern for a reasonable time period. Long memory and persistence is related with the longer movement in the returns series. As Maheuy and McCurdyz (2003) modeled the jump dynamics and volatility components, and concluded that no jump takes a significant period of time to return to normal level. The persistency in the volatility is due to the different reasons and it varies from country to country and time to time. Batra (2004) investigated Indian stock market from 1979 - 2003 and concluded that stock return volatility persistence was increasing on account of financial liberalization process. Persistency is found to be the characteristics of each and every stock market of the world. Floros (2008) found persistence for Egypt and Israel stock markets and concluded that long run component converges slowly. The volatility varies from time to time, and for different frequency, it shows a different pattern, as Caiado (2004) found that the conditional volatility of the stock returns was more persistent in daily series than the low-frequency series. Stock market has characteristic that high volatility periods tend to be persistent. In this study different frequency data are used for investigating this phenomenon of the volatility persistency. Thomas (1995) used GARCH model and estimated strong persistence in variance for daily, weekly and monthly stock returns. In monthly returns, he found seasonality in the volatility and there was one regime shift in the data.

Selcuk (2004) investigated volatility in emerging stock markets and found volatility persistency and high volatility in the developing markets. GARCH parameters are able to explain the level of persistency in the volatility. Magnus and Fosu (2006) found the parameter estimates of GARCH models close to unity and suggested a high level of persistence in the Ghana stock exchange.

There are little empirical evidences available for Pakistani market regarding this volatility characteristic. This study fills this gap by capturing this important phenomenon of stock returns volatility for different frequencies of data. The study uses the daily, weekly and monthly stock returns data in order to examine the volatility persistency and the study finds heterogeneous results for the different frequencies. The different frequencies must be examined in order to see the short, medium and long term effects of the volatility. Dawood (2007) investigated volatility in the Karachi stock exchange and found that in 1990’s market had become more volatile on short as well as medium term basis. He found that the stock market reacted too actively to economic shocks, but this reaction took place on a daily basis and die away within a month.

Non linear models are considered to be the dominant models than the linear class of models. Rashid and Ahmad (2008) investigated a class of models and found that the nonlinear GARCH models dominate the other class of models in predicting stock market volatility in Pakistan. Ali and Akbar (2007) used data from 1991 to 2006 and applied one Factor ANOVA and found that weekly and monthly effects did not show inefficiency in stock returns of Pakistani equity market, however, the market is inefficient in the short run (daily effects).

Persistency in volatility is normally due to the inefficiency in the market. Rizwan and Khan (2007) studied the volatility of the Pakistani stock market and found persistence, which signified inefficiency in the stock market. They found that lagged returns in the GARCH model were significant in explaining current returns.

DATA AND PROCEDURE

Data and sample period

The study uses the daily, weekly and monthly KSE-100 index and its log returns, rt = log (It/It-1). All the data are obtained from finance.yahoo.com and State Bank of Pakistan. For the returns, the study considers daily, weekly and monthly closing price data from 2 November 1991 to 9 January 2009 for a total of 4097, 884 and 212 observations, respectively.

Procedure

Unit root and stationarity tests, modeling time series in differences, provide different predictions. The most important unit root test, the Augmented Dickey Fuller test, was developed by Dickey and Fuller (1979). This study employs Augmented Dickey Fuller (ADF) test for testing the hypothesis of null of unit root. Linear models are considered unable to capture the nonlinear movements in the stock returns like leptokurtosis and long memory or persistency. This is because the assumption of homoscedasticity is not appropriate for the financial time series data. It demands the use of the nonlinear models, which allow the variance to depend upon its past variance. Therefore, for modeling the conditional volatility, the study uses ARCH/ GARCH-type models. These models allow the conditional variance of a stock market returns to depend upon their own lags.

The current study employs following methods and models:

1. Correlograms of Squared Residuals
2. ARCH (1)
3. GARCH (1, 1)

RESULTS AND DISCUSSIONS

The results in the Table 1 show that all the data series show positive returns, but the mean of monthly returns are higher than the daily and weekly returns. All the data sets are leptokurtic; however, the daily stock returns have more of kurtosis than the other two series. The standard deviation and variance are much higher in the monthly stock returns. The high Jarque-Bera test rejects the normal distribution in all the series. This difference in the different frequencies of data is also observed by Ali and Akbar (2007). Chang (2006) also found the same results

Table 1. Summary statistics for KSE-100 stock return.

Statistic	Daily	Weekly	Monthly
Mean	0.0004385	0 .00199	0 .0081772
Median	0.000947	0.004643	0.012328
Maximum	0.127622	0.137226	0.246980
Minimun	-0.132133	-0.200976	-0.448796
Variance	0.0002754	0.0015858	0.0100631
Skewness	-0.2568742	-0.6319676	-0.7207387
Kurtosis	8.096714	5.67202	5.73721
Standard deviation	0.0165963	0.0398225	0.100315
Covariance	37.84815	20.01124	12.26771
Jarque-Bera	4477.273	321.4571	84.13780
Probability	0.000000	0.000000	0.000000
Observation	4095	883	211

Analysis of daily stock returns.

Table 2. Correlograms of squared residuals.

Included observations: 4095						
Autocorrelation	**Partial correlation**		**AC**	**PAC**	**Q-Stat**	**Prob.**
| |	| |	1	0.023	0.023	2.2529	0.133
| |	| |	2	-0.011	-0.011	2.7386	0.254
| |	| |	3	-0.025	-0.025	5.3162	0.150
| |	| |	4	-0.017	-0.016	6.4721	0.167
| |	| |	5	-0.002	-0.001	6.4822	0.262
| |	| |	6	-0.027	-0.028	9.4209	0.151
| |	| |	7	-0.024	-0.023	11.743	0.109
| |	| |	8	-0.009	-0.009	12.071	0.148
| |	| |	9	0.008	0.006	12.310	0.196
| |	| |	10	0.005	0.003	12.430	0.257

that the mean reversion situation exists in the low-frequency data, but not in the high-frequency data. The aforementioned results show that the unconditional variances and covariance of all the stocks studied are leptokurtic and highly skewed, confirming the results of Andersen et al. (2001), Magnus and Fosu (2006), Khedhiri and Muhammad (2008) and Eisler (2007). Turan et al. (2006) and Zhu (2007) also concluded that the stock returns volatility follows the time varying dynamic process and the stock returns exhibit the time varying characteristics. The developing markets are mostly affected by these characteristics as also confirmed by Hassan et al. (2000) and Li (2007). The daily data shows more volatile characteristics than other two series. So the properties of the three data series are different from one another, confirming the results of Caiado (2004). Thomas (1995) also found the presence of heteroscedasticity in daily, weekly and monthly returns in Bombay Stock Exchange. Daily data shows more volatility as compared to other two series. Dawood (2007) also confirms our results for the Karachi stock exchange.

The Table 2 finds the presence of ARCH effects and Table 3 finds the stationarity in the daily data. The Table 4 shows that the value of ARCH coefficient is significantly positive though not close to one, which indicates an integrated ARCH process in which shocks have a persistent effect on volatility. The results confirm the findings of Pryymachenko (2003). The volatility clustering phenomenon is the main characteristics of the emerging markets, as in this case, KSE-100 index exhibits the same characteristics confirming the findings of Hassan et al. (2000), as they found the same results that the DSE returns tends to change over time and is serially correlated. This serial correlation implies stock market inefficiency, which is true for the emerging markets. Chowdhury et al. (2006) employed impulse response function in the Bangladeshi capital market and concluded that market returns are basically influenced by their own

Table 3. Augmented Dickey Fuller test.

		1% Critical value*	-3.4351
ADF test statistic	-25.25386	5% Critical value	-2.8628
		10% Critical value	-2.5675
Durbin-Watson stat	2.000379	Prob(F-statistic)	0.000000

*MacKinnon critical values for rejection of hypothesis of a unit root.

Table 4. ARCH (1). Dependent variable: Returns; Method: ML – ARCH; Included observations: 4095; Convergence achieved after 15 iterations.

	Coefficient	Std. error	z-Statistic	Prob.
		Variance equation		
C	0.000154	3.03E-06	50.68273	0.0000
ARCH(1)	0.519529	0.021454	24.21545	0.0000

shocks and confirm the volatility clustering phenomenon for the inefficient market. As also found by Rizwan and Khan (2007) that the volatility clustering exists for the Pakistani stock market, which signifies inefficiency in the stock market.

The Tables 6 and 7 find the presence of ARCH terms and stationarity in the weekly data series. The results in the Table 8 reveal a heteroscedastic behavior of stock returns series, which is a time varying volatility. The weekly returns lagged error term coefficient is not so high (0.311598), but it shows that the volatility shocks are somewhat persistent. The Table 10 finds the presence of ARCH effects and Table 11 finds the stationarity in the monthly data. The lagged error term coefficient in the monthly returns series is not that high (0.292916) in the above Table 12, it shows that the volatility shocks are somewhat persistent. The coefficient of ARCH term is higher for the daily data, but not significantly high for the weekly and monthly data, which means that the high-frequency data is more affected by the lagged innovations or lagged error terms as compared to low frequencies of data. The results confirm the finding of Caiado (2004), who found same results for the PSI-20 index. Thomas (1995) also concluded that daily and weekly returns exhibit strong ARCH effects, which is in line with the results of this study.

Peiro (2001) also found the same results for the stock returns at different frequencies: daily, weekly and monthly. He also concluded that though there are weak asymmetries observed in daily returns, which disappear at lower frequencies (weekly or monthly returns).

High GARCH term (0.728331) in Table 5 shows that the past variance terms have a strong impact on the conditional variance. The high persistence (0.952399) shows that the volatility of the stock returns dies down slowly. In the Table 9, the results indicate high volatility presence in the conditional variance, as the sum of ARCH and GARCH coefficients is 0.832239. The ARCH term shows that the current period volatility is dependent on the lagged error terms, whereas, the GARCH term is significantly positive (0.616962), which exhibits that the last period volatility has a significant impact on the current period conditional volatility. Table 13 shows that the value of the sum of ARCH and GARCH coefficients is high (0.889508) though not close to one. The ARCH and GARCH effects are more in daily data as compared to low frequencies of data. This confirms the results of Rehim, who concluded that the ARCH/GARCH effects decrease with the decrease in the frequency of observations. He concluded that the ARCH/ GARCH effects are prominent in the daily and weekly data and less for the monthly data. McMillan et al. (2000) investigated the usefulness of GARCH type models using different stock market and concluded that there is no clear consensus across the world markets about the superior model. They used daily, weekly and monthly frequencies and concluded that the short term investment decisions focus on short-term volatility measurement, whereas, the valuation of long lived-assets requires longer-term volatility measurement.

Ng and McAleer (2004) used ARCH type models for measuring the volatility of S&P 500 Composite Index and the Nikkei 225 Index, and concluded that the performance of both models is sensitive to the data. This also supports our results that the volatility measurement is sensitive to the frequency of the data set.

The different results for the different data series are due to the fact that in the short run, market activity at the KSE is mostly driven by speculations and sentiments rather than rational decision-making process and the information provided in the market is poor and thus the market remains inefficient (Dawood, 2007). Our results state that the Karachi stock market has become the volatile market both on short and medium term basis, but

Table 5. GARCH (1, 1). Dependent variable: Returns; Method: ML – ARCH; Included observations: 4095; Convergence achieved after 19 iterations.

	Coefficient	Std. error	z-Statistic	Prob.
		Variance equation		
C	1.58E-05	1.24E-06	12.74603	0.0000
ARCH(1)	0.224068	0.013103	17.10081	0.0000
GARCH(1)	0.728331	0.013300	54.76236	0.0000

Analysis of weekly stock returns.

Table 6. Correlograms of squared residuals.

Included observations: 883						
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob.
.|. |	.|. |	1	0.012	0.012	0.1343	0.714
.|. |	.|. |	2	-0.038	-0.038	1.4383	0.487
.|. |	.|. |	3	-0.028	-0.027	2.1263	0.547
.|. |	.|. |	4	0.055	0.055	4.8467	0.303
.|. |	.|. |	5	0.000	-0.003	4.8469	0.435
.|. |	.|. |	6	0.012	0.015	4.9763	0.547
.|. |	.|. |	7	-0.011	-0.008	5.0846	0.650
.|. |	.|. |	8	0.036	0.034	6.2206	0.623
.|. |	.|. |	9	-0.020	-0.021	6.5855	0.680
.|* |	.|* |	10	0.097	0.099	14.998	0.132

Table 7. Augmented Dickey Fuller test.

ADF test statistic	-12.98912	1% Critical value*	-3.4405
		5% Critical value	-2.8652
		10% Critical value	-2.5687
Durbin-Watson stat	2.002735	Prob (F-statistic)	0.000000

*Mackinnon critical values for rejection of hypothesis of a unit root.

Table 8. ARCH (1). Dependent variable: Returns; Method: ML – ARCH; Included observations: 883; Convergence achieved after 11 iterations.

	Coefficient	Std. error	z-Statistic	Prob.
		Variance equation		
C	0.001094	5.25E-05	20.82219	0.0000
ARCH(1)	0.311598	0.049320	6.317936	0.0000

Table 9. GARCH (1, 1). Dependent variable: Returns; Method: ML – ARCH; Included observations: 883 after adjusting endpoints.

	Coefficient	Std. error	z-Statistic	Prob.
		Variance equation		
C	0.000264	5.57E-05	4.734335	0.0000
ARCH(1)	0.215277	0.038484	5.593874	0.0000
GARCH(1)	0.616962	0.058977	10.46099	0.0000

Analysis of monthly stock returns.

Table 10. Correlograms of squared residuals.

Included observations: 211						
Autocorrelation	**Partial correlation**		**AC**	**PAC**	**Q-Stat**	**Prob.**
.|. |	.|. |	1	0.043	0.043	0.3920	0.531
*|. |	*|. |	2	-0.084	-0.086	1.9246	0.382
*|. |	*|. |	3	-0.071	-0.064	3.0052	0.391
.|. |	.|. |	4	0.020	0.019	3.0910	0.543
.|. |	.|. |	5	0.063	0.051	3.9546	0.556
.|. |	.|. |	6	0.058	0.052	4.6803	0.585
.|. |	.|. |	7	0.047	0.055	5.1636	0.640
*|. |	*|. |	8	-0.076	-0.065	6.4332	0.599
*|. |	*|. |	9	-0.098	-0.082	8.5524	0.480
.|. |	.|. |	10	0.025	0.022	8.6945	0.561

Table 11. Augmented Dickey Fuller test.

		1% Critical value*	-3.4634
ADF test statistic	-5.836935	5% Critical value	-2.8756
		10% Critical value	-2.5742
Durbin-Watson stat	1.989919	Prob(F-statistic)	0.000000

*MacKinnon critical values for rejection of hypothesis of a unit root.

Table 12. ARCH (1). Dependent variable: Returns; Method: ML – ARCH; Included observations: 211 after adjusting endpoints; Convergence achieved after 14 iterations.

	Coefficient	**Std. error**	**z-Statistic**	**Prob.**
		Variance equation		
C	0.007679	0.000935	8.216806	0.0000
ARCH(1)	0.292916	0.104481	2.803527	0.0051

Table 13. GARCH (1, 1). Dependent variable: Returns; Method: ML – ARCH; Included observations: 211 after adjusting endpoints; Convergence achieved after 21 iterations.

	Coefficient	**Std. error**	**z-Statistic**	**Prob.**
		Variance equation		
C	0.001007	0.000546	1.845120	0.0650
ARCH(1)	0.042789	0.026038	1.643315	0.1003
GARCH(1)	0.846719	0.067387	12.56495	0.0000

for the short-term basis, is more volatile as compared to the long-term basis confirming the results of Dawood (2007).

SUMMARY AND CONCLUDING REMARKS

The objective of the study is to compare the volatility of the daily, weekly and monthly data series of KSE-100 index by applying the ARCH and GARCH type models. The study first compares the statistical properties of the three data series. The stylized fact of persistency is also examined in the study.

The study concludes that some statistical properties of the daily KSE-100 return series are different from the weekly and monthly return series (like high Kurtosis and Jarque-Bera statistic for the daily data as compared to the other frequencies). Which means that the mean reversion situation exist in the low-frequency data and not in the high-frequency data, confirming the results of Andersen et al. (2001), Magnus and Fosu (2006), Khedhiri and Muhammad (2008) and Eisler (2007). The daily data shows more volatile characteristics than other two series. Therefore, the properties of the three data series are different from one another, confirming the results of Caiado (2004). This study also confirms the results of Dawood (2007) for the Karachi stock exchange, where he found that the shocks take place on a daily basis and die away within a month. The results of the study may be summarized as follows:

1. The daily data shows more volatile characteristics than other two series and the properties of the three data series are different from one another.
2. The coefficient of ARCH term is high for the daily data, but not significantly high for the weekly and monthly data, which means that the high-frequency data is more affected by the lagged innovations or lagged error terms as compared to low frequencies of data.
3. The GARCH model shows the presence of persistency in the three data series, which is higher in high-frequency (daily) data than the low-frequency (weekly and monthly) data. Whereas, the monthly data results show the presence of persistence in the conditional variance, which is though less than the daily coefficient value, but slightly above than the weekly series.
4. The inability of previous studies to measure volatility accurately, was due to the loss of information in low-frequency data and the existence of different features in low and high-frequency data.

The findings of this research have many implications for volatility modeling and forecasting in general and for KSE in particular. These implications are as follow:

1. Modeling the stock returns volatility, using indices with different frequencies, gives different results for the different frequencies. This may have implications for making decisions on the basis of volatility linked with the different frequencies.
2. The study checks the sensitivity of results to the choice of sample frequency and also assesses and concludes that the short-term investment decisions focus on short-term volatility measurement, whereas, the valuation of long-lived assets requires long-term volatility measurement.
3. Different frequencies data have different volatility structure, where high-frequency data is more volatile than the low-frequency data.
4. The volatility on the KSE was found to be highly persistent for all the data series specially the daily data with the GARCH (1, 1) parameters close to one. Although volatility persistence is high for all data, the volatility persistence is different between data series ranging from as low as 211 days and as high as 4095 days.
5. Lastly, it is important that though KSE-100 index is comparatively well, its return rate and volatility level are also very high when compare with those of other stock markets in the region and of the world. For sustained growth and development, KSE should set its target as “less volatility with stable rates of return”.

This study, on like other studies, also has its limitations. These limitations are time constraints and current inadequacies in the analytical techniques used. The time constraints were related to the availability of data, as the stock data were available only for the period sampled. However, in order to go for further generalizations from the results, volatility on the KSE must be modeled for a period before or after the sample period used in this research. In terms of the later limitation, the current analysis is limited to the fixed effects in the GARCH equation. We limited this study with the stock returns variable and mostly focused on the univariate kind of analysis.

Further researches can be done on the relationship between the volatility on the KSE and the characteristics of stocks listed in KSE, that is, whether the volatility of panel sector returns is affected by the size of the firms included in the panel. In addition the present methodology can be used to model the volatility structure of individual firms. One can also test whether variance shifts in the returns of the firm reflects the release of specific information. The advanced methodology can be used in order to test for volatility spillover from one market to the other market. The most important is that the researchers must study volatility on a dynamic basis, because its behavior changes over time. At last the volatility researches must continue because this is the most important topic in finance.

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