Persistent stock market returns volatility in emerging capital markets as evidenced in Tanzania

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Abstract: This study examined the stock returns volatility in Dar es Salaam Stock Exchange for the year 1998 through 2018 period. The study employed quantitative research design on time series data in which autoregressive conditional heteroskedasticity and generalised autoregressive conditional heteroskedasticity models were used determine the existence of volatility. The study employed Win Rat and E-views Econometric software for data analysis. Serial correlation and unit root analysed to determine seasonal dependencies of the stock market returns and stationarity, respectively. Results showed that all-time series of returns were non-stationary except at market level and volatility of stock returns had a constant decaying coefficient value of 0.75 per trading period. The study concluded that the shocks to volatility were more persistent and had a slower and constant decaying rate in various trading periods in DSE. Therefore, it was recommended that the public should buy and sell shares in the market.

Keywords: stock market; market returns; volatility; ARCH; GARCH; DSE.

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Biographical notes: Asheri Mwidege is a Senior Lecturer in the Department of Business Management, Mbeya University of Science and Technology. He has published articles on social interventions, sustainability of created assets to vulnerable poor rural people, graduates intention of being self-employed, graduates perceived innovations; determinants of entrepreneurial attitudes of university students and market stock returns volatility. His research interest is in agricultural economics related issues, social interventions and M&E of projects.

1 Introduction

Emerging capital markets are becoming increasingly important for both institutional and individual investors (Koutmos, 1998). Stock market enables the transfer of economic resources to a wider spectrum of the population globally. This increases the efficiency of allocation of scarce resources through a competitive pricing mechanism. Levine (1997)

contends that stock markets facilitate: trading, hedging and pooling of risk; easy in acquiring information about investments and allocating resources as stock markets influence the acquisition and dissemination of information; and in mobilising and pooling of resources which involves the agglomeration of capital from disparate savers for investment.

As stock markets become larger and more liquid, market participants have greater incentives to acquire information about firms. As a result, mobilisation of resources through creation of small denomination instruments, provide opportunities for households to hold diversified portfolios invested in efficient scale firms and increase asset liquidity for economic growth. Consequently, stock market players express concern over the level of stock market volatility (Schwert, 2018). Similarly, Schmitt and Westerhoff (2017) explained that volatility in stock market are due to speculators' herding attitude. Further, Zhan (2019) found that investor behaviour bias creates excess volatility as a result it drives stock prices away from fundamentals.

Accordingly, Christie and Huang (2019) observed that daily and monthly stock returns volatility are inconsistent with herding during periods of large price movements. Berument and Kiymaz (2001) observed the presence of the day of week effect in both volatility and returns equations. Contrary, Edwards (2018) found that the day-to-day price volatility of the stock market is not affected by introduction of futures trading. Furthermore, Jebran (2018) and Hung (2018) observed unidirectional volatility spillovers from foreign exchange market to the stock market and vice versa during pre- financial crisis period. Moreover, Mallikarjuna and Rao (2019) found that information asymmetries are evidenced as a source for persistent stock volatility in both developed and emerging markets. Besides, Bouri (2011) believed that good news in the market generates more volatility than bad news for investors. However, little information on stock market returns volatility was available in Dar es Salaam stock exchange. This study therefore, examined stock market returns volatility in Dar es Salaam Stock Exchange (DSE) using time series data for 1998 through 2005 so as risk averse investors may adjust their portfolios by reducing their investments in the assets whose volatility is high.

2 Statement of the problem

Since early 1990s, Tanzania has been implementing a wide range of economic reforms that have included financial sector reforms. The Government liberalised the financial markets under the Banking and Financial Institutions Act No. 12 of 1991; and it liberalised the foreign exchange market under the Foreign Exchange Act of 1992 supported by International Monetary Fund (IMF). The financial reforms were necessitated by the deterioration in the performance of state controlled financial sector (AfDB, 2000). The problems in the financial were caused by excessive government interference in the management of financial institutions due to directives on policies and interest rates (AfDB, 2000). Consequently, Capital Markets and Securities Act (CMSA) was enacted by the Parliament in 1994 in order to serve the development of both primary and secondary markets as a source of capital for long term investment (URT, 1994). Thus, regional integration and globalisation of the Tanzania capital market is beneficial in terms of attracting foreign capital, efficiency utilisation of capital and corporate governance (Ziorklui, 2001). As a result, stock market players express concern over the

level of stock market volatility (Schwert, 2018). However, little information was available on persistent stock market returns volatility. Therefore, this study examined stock market returns volatility in Dar es Salaam Stock Exchange (DSE) using time series data for 1998 through 2018 for some companies so as risk averse investors may adjust their portfolios by reducing their investments in the assets whose volatility is high.

3 Research methodology

3.1 Model specification

Many financial tie series, especially stock returns exhibit changes in variance over time. These changes tend to be serially correlated with groups of highly volatile observations (Levine, 1997). Dexit and Agrawal (2020) observed that, presence of serial autocorrelation in market returns provides an opportunity for employing ARCH and GARCH models to explain the conditional variance of stock market returns volatility.

The measure of stock market return volatility was based on daily price and market index level changes. The estimator framework followed three steps.

The first step, the returns to market trading were generated by assuming away transaction costs, the returns to trading was expressed as:

$$r_{it} = \ln\left(\frac{p_{it}}{p_{it-1}}\right) \tag{1}$$

where:

p_{it} = Price level at date t for each firm i

p_{it-1} = Price level at date $(t-1)$ for each firm i

r_{it} = Stock return realised on date t for each firm i

ln = natural logarithm

This formula was used to calculate daily returns for each firm and the overall market. The correlation function problem and its cyclic patterns were tested to determine the nature of noise traders in the market.

Akthar and Khan (2016) employed autoregressive conditional heteroskedasticity (ARCH (1)) and generalised autoregressive heteroskedasticity as stock market volatility models for daily and weekly returns.

Second step, in order to ascertain return volatility ARCH models to determine the autoregressive conditional heteroskedastic nature of the return series (Engel, 1982, 2018).

$$h_{it} = \omega + \alpha_{i1} e_{it-1}^{\ 2} \tag{2}$$

where:

h_{it} = Conditional variance

$e_{it-1}^{\ 2}$ = Squared innovations

α_{i1} = Measure of volatility clustering

ω = Constant term

This model has only one memory period and generates difficulties in selecting the optimal lag length and ensuring non-negativity of the coefficient of conditional variance equation.

Third step, involved controlling calendar effects and assessing the behaviour of return volatility. This employed the generalised version of autoregressive conditional heteroskedastic, the GARCH (1, 1) model which introduced a lagged conditional variance to capture long memory to the ARCH (1) (Bollerslev, 1986).

$$h_{it} = \omega + \alpha_{i1} e_{it-1}^{\ 2} + \beta_{ii} h_{it-1} \tag{3}$$

where:

α_{i1} = Measure of volatility clustering, the extent to which a volatility today feeds through into next period's volatility.

β_{i1} = Coefficient that captures the persistence of volatility over time. This specification required that $(\alpha_{i1} + \beta_{i1}) < 1$ in order to satisfy the non-explosiveness of the conditional variances. Furthermore, each of ω, α_{i1} and β_{i1} had to be positive to satisfy the non-negativity of conditional variance for each given time.

3.2 Source of data

The study employed time series data from 1998 through 2018 period for early listed companies in DSE: TOL Gases Limited; Tanzania Breweries PLC; Tanzania Cigarette Company (TCC); Tanzania Tea Packers (TATEPA); Tanga Cement PLC (SIMBA); SWISSPORT Tanzania PLC were used to generate calendar effects on stock returns volatility in the market as representatives of other registered companies. Time series data were obtained from Dar es Salaam Exchange Authority. However, other registered companies which were represented in Dar es Salaam Stock Exchange were: CRDB Bank PLC; DCB Commercial Bank PLC; The Dar es Salaam Stock Exchange (DSE); East African Breweries Limited; Jubilee Holdings Limited; Kenya Airways Limited; KCB Group; and Maendeleo Bank PLC. Other registered companies include: Mwalimu Commercial Bank; Mkombozi Commercial Bank PLC; Mufindi Community Bank Ltd.; National Investment Company Limited; NMB Bank PLC; Nation Media Group; Precision Air Services PLC and Swala Oil and Gas (Tanzania) PLC. Furthermore: TCCIA Investment Company Limited; Tanzania Portland Cement Company Ltd.; Uchumi Supermarkets Ltd.; Vodacom Tanzania Limited; Yetu Microfinance Bank and African Barrick Gold make a total of over 27 listed companies in DSE to date, 2020.

3.3 Data analysis

Market index was generated using MS Excel from Time series data of which Win Rats and E-Views econometric software were employed in data analysis. Time and seasonal dependencies of the stock market returns were investigated to determine persistence of shocks. Furthermore, unit root test of time series data was analysed to assess the

existence of stationarity. The analysis technique involved dropping days and months of the calendar one after another so as to test returns volatility using the same GARCH model.

4 Results and discussion

4.1 Serial correlation

The test on autocorrelation showed that the decay process was slow with their coefficients declined as lags increased to 10 lags. However, their decay process become much quicker when they are differenced once. The results all firms depicted an oscillatory pattern. Consequently, the overall market results based on market index depicted a weak degree of negative autocorrelation of returns. Results (see Table 1) indicated that the firms were more characterised by negative feedback traders than the overall market. Findings suggest that most investors used the firms' announcements to earn consistently average returns as they bought and hold stocks at low price and sell at high price, thus complies with observations made by Dexit and Agrawal (2020).

Table 1 Overall market returns autocorrelation (AC) and partial correlation (PAC)

Lag length	*AC*	*PAC*	*Q-Stat*	*Prob. value*
1	–0.184	–0.184	14.787	0.000
2	–0.052	–0.089	15.977	0.000
3	–0.108	–0.141	21.077	0.000
4	–0.444	0.414	107.51	0.000
5	–0.116	0.025	113.38	0.000
6	–0.021	0.013	113.58	0.000
7	–0.113	–0.069	119.25	0.000
8	0.326	0.140	166.23	0.000
9	–0.127	–0.040	173.39	0.000
10	–0.092	–0.116	177.14	0.000

Source: Calculated from stock market returns index.

4.2 Unit root test

The time series of returns in this study were analysed to determine the existence of stationarity. Augmented Dickey Fuller (ADF) unit root test was applied to each of series. The test revealed that all-time series of returns appeared to be non-stationary at all levels except for overall market (see Table 2). However, when unit root test was conducted on non-stationary time series of returns in their first difference, the results showed that all the series were stationary (see Table 3). This implies that with exception of the overall market, all-time series of returns were integrated of order one such that they become stationary when differenced once.

Table 2 ADF statistics for unit root testing

Parameter	*Nature of selected*	*ADF statistics*	*Order of integration*
S/PORT	0 lags, with constant and no trend	–3.178993	I(0)
SIMBA	0 lags, with no trend and constant	–1.152322	I(0)
TBL	0 lags, with trend and constant	–2.741440	I(0)
TCC	0 lags, with constant and trend	–1.966399	I(0)
TATEPA	0 lags, with constant and no trend	–1.338581	I(0)
Overall market	0 lags, with constant and no trend	–24.98314	I(0)

Table 3 ADF statistics for unit root testing

Parameter	*Nature of selected*	*ADF statistics*	*Order of integration*
S/PORT	0 lags, with no trend and constant	–25.21485	I(0)
SIMBA	0 lags, with constant and no trend	–18.02810	I(0)
TBL	1 lag, with trend and constant	–35.04905	I(1)
TCC	0 lags, with trend and constant	–32.79345	I(0)
TATEPA	1 lag, with constant and no trend	–10.05846	I(1)

4.3 Market returns volatility

Conditional heteroskedasticity in stock market returns series was investigated using GARCH class of models. These models captured the serial correlation of volatility; the variance of the dependent variable was modelled as a function of past values of the dependent variable and independent variables (squared innovation).

Results (see Table 4) show the existence of some volatility in the evolution of market stock returns in DSE of which overtime, the volatility forecast reverts to its unconditional mean at the rate of 0.75 per trading period. The decay process in the DSE stock exchange was rather slow $(\alpha + \beta < 1)$. Results suggest that, volatility shocks in the trading period fed into volatility in subsequent period. Present findings comply with Dexit and Agrawal (2020) that the value of $\alpha + \beta$ when it is close to unit, it confirms the stock market volatility clustering in return series.

Table 4 GARCH-Test for DSE market index stock returns variance equation. independent variable: $\ln\left(\text{Market Index} \middle/ \text{Market Index}(-1)\right)$

Variables	*Coefficient*	*Std. error*	*z-statistic*	*Prob-value*
Constant	7.97E-06	3.40E-06	2.342764	0.0191
ARCH (1) (α)	0.150006	0.188300	0.796630	0.4257
GARCH (1) (β)	0.600002	0.473212	1.267935	0.2048

Notes: Dependent Variable: RETURNS

Method: ML-ARCH

4.4 Market returns and volatility control

This process of controlling volatility in DSE market involved four selected equities: TBL; TCC; SIMBA and SWISSPORT from November 2003 – December 2005 to control months and days of the week effect in stock returns the GARCH model technique. Results in Tables 5 and 6 show that shocks to volatility were more persistent and therefore had a slower decaying rate. Probably, this could be attributed by speculators who might dominate the market basing on short position from long position trading of financial assets in order to reap the profit due to price fluctuation in the market. Similar results were obtained by Edwards (2018) that price volatility of the stock market returns are not affected by introduction of futures trading.

Table 5 GARCH – testing for volatility before control variance equation independent variable: $\ln\left(\frac{P_t}{P_t(-1)}\right)$

Variable	*Coefficient*	*Std. error*	*z-statistic*	*Prob.*
Constant	1.72E-08	2.79E-06	0.006166	0.9951
ARCH (1) (α)	0.150000	0.820851	0.182737	0.8550
GARCH (1) (β)	0.600000	1.058735	0.566714	0.5709

Notes: Dependent Variable: RETURNS
Method: ML-ARCH

Table 6 GARCH –testing for monthly effect on returns volatility variance equation independent variable: $\ln\left(\frac{P_t}{P_t(-1)}\right)$

Variable	*Coefficient*	*Std. error*	*z-statistic*	*Prob.*
Constant	5.87E-10	5.83E-06	0.000101	0.9999
ARCH (1) (α)	0.150000	0.624910	0.240035	0.8103
GARCH (1) (β)	0.600000	1.541118	0.389328	0.6970

Notes: Dependent Variable: RETURNS
Method: ML-ARCH

4.5 Stock market daily returns and volatility control

Four trading days from Tuesday through Friday in DSE, were used to identify the day of the week effect on returns and volatility by dropping one day after another then tested for volatility using the GARCH Model. Results (see Table 7) showed that shocks to volatility were more persistent and therefore had a slower decaying rate in those trading days, suggested that there was no specific volatility effect on returns. Probably, volatility clustering was attributed to trade volumes, nominal interest rates, dividend yield, money supply and external shocks (Ngugi et al., 2002). The present findings agree with the argument made by Engel (2018) that stock volatility can be predicted using ARCH and GARCH models and can be priced for time varying risk premium. Also, findings concur with observation made by Berument and Kiymaz (2001) on the presence of the day of week effect in both volatility and returns.

Table 7 GARCH – testing for daily effect on returns volatility variance equation independent variable: $\ln\left(\frac{P_t}{P_t(-1)}\right)$

Variable	*Coefficient*	*Std. error*	*z-statistic*	*Prob.*
Constant	5.86E-10	4.60E-06	0.000127	0.9999
ARCH (1) (α)	0.150000	0.540296	0.277625	0.7813
GARCH (1) (β)	0.600000	0.633176	0.947604	0.3433

Notes: Dependent variable: RETURNS

Method: ML-ARCH

5 Conclusions and recommendations

Based on findings that, the sum of coefficients $(\alpha + \beta = 0.75)$ for both daily and monthly returns volatility were more persistent with a slower and constant decaying rate in various trading periods in the DSE market. It was therefore concluded that market participants had greater opportunity to invest in the stock market. It was therefore recommended that the public should be enlightened on buying and selling shares in the market.

References

Africa Development Bank (AfDB) (2000) *Tanzania Financial Sector Adjustment Programme Project Completion Report*.

Akthar, S. and Khan, N.U. (2016) 'Modeling volatility on the Krachi stock exchange in Pakstan', *Journal of Asia Business Studies*, Vol. 10, No. 3, pp.253–275. Doi: 10.1108/JABS05-2015-0060.

Available online at: https://www.emerald.com/insight/content/doi/10.110 8/IJMF-10-2018-0305/full/pdf.

Berument, H. and Kiymaz, H. (2001) 'The day of the week effect on stock market volatility', *Journal of Economics and Finance*, Vol. 25, pp.181–193. Available online at: https://link.springer.com/article/10.1007/BF02744521#citeas

Bollerslev, T. (1986) 'Generalized autoregressive conditional heteroskedasticity', *Journal of Econometrics*, Vol. 31, pp.367–387.

Bouri, E. (2011) 'An attempt to capture leptokurtic of returns and to model its volatility: the case of Beirut stock exchange', *Review of Economic and Business Studies*, pp.259–271.

Christie, W.G. and Huang, R.D. (2019) 'Following the pied piper: do individual returns herd around the market?', *Financial Analyst Journal*, Vol. 51, No. 4, pp.31–37. Doi: 10.2469/faj.v51.n4.1918.

Dexit, J.K. and Agrawal, V. (2020) 'Foresight for stock market volatility – a study in the Indian perspective', *Foresight*, Vol. 22, No. 1, pp.1–13. Doi: 10.1108/FS-05-2019-0040.

Edwards, F.R. (2018) 'Does futures trading increase stock return volatility?', *Financial Analysts Journal*, Vol. 44, No. 1, pp.63–69.

Engel, R.F. (2018) 'Statistical models for financial volatility', *Financial Analysts Journal*, Vol. 49, No. 1, pp.72–78.

Engle, R.F. (1982) 'Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation', *Econometrica*, Vol. 50, pp.987–1007.

Hung, N.T. (2018) 'Return and volatility spillover across equity markets between China and Southeast Asian Countries', *Journal of Economics, Finance and Administrative Science*, Vol. 24, pp.66–81. Doi: 10.1108/JEFAS-10-2018-0106.

Jebran, K. (2018) 'Volatiity spillover between stock and foreign exchange market of China: evidence from Subprime Asian financial crisis', *Journal of Asia Business Studies*, Vol. 12, No. 2, pp.220–232. Doi: 10.1108/JABS-01-2016-0003.

Koutmos, G. (1999) 'Asymmetric price & volatility adjustments in emerging Asian stock markets', *Journal of Business Finance and Accounting*, Vol. 26, pp.83–101.

Levine, R. (1997) 'Financial development and economic growth: views and agenda', *Journal of Economic Literature*, Vol. 35, No. 2, pp.688–926.

Mallikarjuna, M. and Rao, R.P. (2019) 'Volatility experience of major world stock markets', *Theoretical and Applied Economics*, Vol. 4, pp.35–52.

Ngugi, R.W., Murinde, V. and Green, C.J. (2002) 'Stock market development: what have we learnt?', *Journal of Financial Markets and the Macro Economy*, Vol. 2, No. 1, pp.90–153.

Schmitt, N. and Westerhoff, F. (2017) 'Herding behaviour and volatility clustering in financial markets', *Journal of Quantitative Finance*, Vol. 17, No. 8, pp.1187–1203. Doi: 10.1080/14697688.2016.1267391.

Schwert, G.W. (2018) 'Stock market volatility', *Financial Analysts Journal*, Vol. 46, No. 3, pp.23–34. Doi: 10.2469/faj.v46.n3.23.

URT (1994) *An Act to Establish a Capital Markets and Securities Authorities*, CMSA Bill No. 5.

Zhan, F. (2019) 'Individualism, synchronized stock price movements and market stock volatility', *International Journal of Managerial Finance*, Vol. 15, No. 3, pp.371–403.

Ziorklui, S.Q. (2001) *Capital Markets development and growth in Sub Saharan Africa: The case of Tanzania*, African Economic Policy, Discussion Paper No. 79.