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Futures trading and the underlying stock volatility: A case of the FTSE/JSE TOP 40

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Abstract

Purpose: This study analyzed the impact of listing and trading futures contracts on the underlying stock index volatility behavior. The FTSE/JSE TOP 40 index was the index of interest.

Methodology: To capture the non-constant variance of the residuals, a modified Generalized Autoregressive Conditionally Heteroscedasticity (GARCH) model was adopted given that financial time series data exhibited ARCH effects. The GARCH model was estimated after dividing the sample period into pre-and post-futures eras.

Findings: The research findings point towards stabilization effects on underlying stock volatility and refute the suggestion that futures markets improve the dissemination of information to the corresponding spot markets. On the same note, the introduction of futures increased the volatility persistence of index returns.

Unique contribution to theory, policy, and practice: This paper applied a modified-GARCH by incorporating a dummy variable to the traditional GARCH model. The study used an emerging economy as a case study which makes the results and conclusions more specific and applicable. On the same note, the study covered the pre-and post-global crisis of 2007/8 in a Sub-Saharan nation. In practice, stock markets are encouraged to introduce futures contracts on highly volatile spot market assets.

Keywords: *Heteroscedasticity, persistence, time series, financial markets, news*

1.0 INTRODUCTION

1.1 Background of the study

Ekong and Onye, (2019) and Wilson *et al.*, (2019) described stock market volatility as a measure of the magnitude and frequency of asset price fluctuations over time. Thus, the uncertainty about future stock price movements is measured by volatility. Risk and uncertainty are inherent in all investments, and their levels determine to a large extent, the attractiveness of any asset. Therefore, estimating and forecasting volatility is one of the greatest concerns for investors and portfolio managers as this helps in risk and portfolio management. The need for risk management and market completeness aroused the need to create some financial instruments that allow investors to hedge price risk (Mashamba & Magweva, 2019). Apart from enhancing portfolio performance and risk management, such financial assets can be used for speculative purposes and to generate some profits from price variations (Maris *et al*, 2004). Generally, speculation is blamed for nurturing and accentuating wide market volatilities.

Financial instruments that have been devised to enhance risk management and increase portfolio efficiency include derivatives. Though no universally agreed and clear-cut definition, derivatives are financial contracts whose values are derived from the values of other underlying assets, such as foreign exchange, bonds, equities, or commodities (Hundman, 1999). A futures contract is an agreement between a buyer and a seller to trade underlying security or index at a future date on organized exchanges (Clarke, Silva, and Thorley,2013). The introduction of index futures can impact the underlying spot price through hedging, speculation, and arbitrage seeking behavior (Chen and Han, 2012). On the other hand, through information transmission and the process of price discovery, futures can stabilize the volatility of asset spot prices. Hence, the effect of futures introduction on the underlying asset price volatility should be empirically investigated, as carried out in this study.

Several explanations have been offered to explain the reduction in spot index return volatility following the introduction of futures. Thenmozhi (2002) observed that the inception of futures trading has reduced the volatility of spot index returns due to increased information flow. Thenmozhi (2002), Damodaran and Subramanyam (1992) argue that futures trading produces a narrower bid-ask spread in the spot market and thus result in increased liquidity. Schwarz and Laatsch (1991) concluded that futures markets aid in price discovery in cash markets, Powers (1970) reported that futures markets raise the total market profoundness and informativeness, and finally, Stroll and Whaley (1988) reported futures markets to boost market efficiency. All these arguments support the stabilization hypothesis.

On the contrary, the introduction of futures can destabilize the underlying cash market due to the impact of uninformed traders who induce 'noise' in the price discovery process and reduce the prices` information content (Engle *et al.,* 2009 and Antoniou & Holmes 2004). According to Skinner (1989), the existence of derivative markets may also result in investors in the spot markets migrating to derivative markets and thus decrease the volume of trade in the underlying asset and subsequently raise its volatility (Sung *et a.,* 2004).

Other researchers like Rahman (2001) and Mallikarjunappa and Afsal (2007) found no significant changes in the Dow Jones Industrial Average after the introduction of futures. It is against this background of inconclusive results that the researchers wanted to check the effect of futures trading on the FTSE/JSE TOP 40 index.

1.2 Statement of the problem

Financial innovation and engineering are expected to reduce risk, and volatility in capital markets. We expect innovations and new products to solve economic and financial problems in capital markets. In the case that new products bring with them new risks, losses, and great uncertainty, then their economic and financial role is questionable.

Stock markets the world over have introduced derivatives on stocks, commodities, and indices. Practitioners and the academic world have labeled these contracts 'weapons of mass financial destruction' citing the associated risks (Islam, 2013).

The effect of introducing futures derivatives on the underlying asset price volatility is questionable and seems to vary from market to market. Empirical studies have shown that the effect can be positive (Gulan & Mayhew, 2000; Lee & Ohk, 1992) and negative (Hsiao et al., 2012; Debashis, 2008) to different stakeholders. As such this present study assesses the effect of introducing futures derivative on the FTSE/JSE TOP 40 index.

1.3 Purpose of the study

The purpose of this paper is to assess the effect of introducing futures trading on the index's volatility. It compares the volatility stylized features before and after the introduction of the futures derivatives on the FTSE/JSE TOP 40 index.

1.4 Hypothesis

The study is premised on the following hypothesis:

H_0: The introduction of futures derivative on the FTSE/JSE TOP 40 index does not affect the index's volatility behavior.

2.0 LITERATURE REVIEW

Diverse perspectives exist in the literature on the influence of futures introduction on the underlying stock or asset price volatility. Despite various studies having been undertaken on the same, the results are inconclusive. Some researchers support the proposition that the listing of derivatives do not alter the underlying asset price volatility (Illenca & Lafuente 2003; Calado *et al*., 2005; and Mallikarjunappa & Afsal 2007) while other researchers reported greater volatility (Gulan and Mayhew 2000; Lee and Ohk 1992) whilst other studies found a decrease in volatility after the introduction of derivatives (Hsiao et al 2012; Debashis 2008; Drimbetas *et al*., 2007). Consequently, the impact of futures listing on the spot market volatility is still debatable and the conclusions thereon mainly empirical.

2.1 Theoretical Review

2.1.1 Efficient market theory

The efficient market hypothesis postulated by Fama (1970) indicates that asset prices and subsequent returns respond to news (new information) as market participants incorporate new information into prices. Any development or announcements which affect the prospects of a company is expected to influence its stock price or value and trading volume. This results in turbulence and increased trading depending on the impact of new information on the asset price. By the same token, the introduction of a derivative instrument (futures) on the underlying index (FTSE/JSE TOP 40) is likely to be a signal to stakeholders. The existence of the spot and futures market on the same asset is expected to influence the behavior and fundamentals of the underlying asset in line with the dictates of the efficient market theory. The effect will be evidenced on spot market volatility and trading volume of the spot market (He and Liang, 2002).

2.2 Empirical Review

2.2.1 Futures introduction and increased underlying stock volatility

Antoniou and Holmes (2004) documented an increase in spot volatility after the listing of the FTSE 100 index futures contract on the London Stock Exchange. The authors were of the view that the increase in volatility following futures trading was due to greater informational efficiency rather than destabilizing speculation. Gulen and Mayhew (2000) conducted a broad study of stock market volatility in the pre- and post-index futures eras in 25 countries comprising of mature and emerging markets and found that futures trading increased conditional volatility for the United States and Japan, but reported either no significant effect or declining volatility in the other countries.

Similar results were obtained by Lee and Ohk (1992) when they examined the cash market volatility in five countries namely Australia, Hong Kong, Japan, UK, and the USA by making use of data for five hundred business days before and after the listing of futures. They concluded that stock market volatility rises meaningfully for Japan, the UK, and the USA in the post futures period. The same approach of breaking the sample period into two periods was used in this study to establish whether volatility increased or decreased after the introduction of futures.

2.2.2 Futures introduction and reduced underlying stock volatility

Chiang and Wang (2002) employed an asymmetric time-varying GJR model and their results showed that the introduction of futures on the Taiwan Index stabilized spot volatility, while the introduction of MSCI Taiwan futures had no influence, save the asymmetric response. In a similar study, Drimbetas *et al* (2007) explored the effects of the introduction of futures and options on the volatility of the underlying index on the Greek market using the FTSE/ASE 20 Index using an EGARCH model. Their results show that derivatives reduce conditional volatility in the FTSE/ASE20 Index and consequently increase its efficiency. This research also employed the GARCH family of models to establish the effects of the introduction of futures on the volatility of the JSE TOP 40 index.

Thenmozhi (2002) looked for changes in the volatility of the S&P CNX Nifty Index in India following the listing of Nifty futures. The results of the study showed that information flow increased after futures listing leading to a decrease in the volatility of the cash index. Futures trading improved information flow to the cash market and helped to improve the efficiency of the spot market thereby reducing its volatility. Debashis (2008) using India data, examined the impact of futures introduction on the volatility & operating efficiency of the Nifty Index using paired sample statistic and concluded that listing of Nifty Index Futures was accompanied by both a decrease in spot price volatility and decreased trading efficiency of the cash market.

In a similar study, Chen *et al*. (2013) used the panel data approach developed by Hsiao *et al*. (2012) and found that the listing of Nifty Index futures reduces the volatility of the spot market. Their sample period however only covered the period when the market was still in its infancy and hence the long-term effects of futures trading could not be detected. The sample period under this study was relatively long enough to allow the long-term benefits of futures trading to be incorporated into the volatility of the underlying stock.

Bandivadekar and Ghosh (2003) conducted a similar study on the S&P CNX Nifty and BSE and reported a decrease in the volatility of Nifty and BSE Sensex post futures listing. They used daily closing prices and the ARCH/ GARCH models to account for the time-varying nature of volatility and volatility clustering for the period January 1997 to March 2003. They concluded that although futures introduction significantly reduces the volatility of the S&P CNX Nifty, the effect seems to be insignificant for the BSE Sensex where derivative turnover is significantly lower.

2.2.3 Futures introduction and no effect on underlying stock volatility

While studying the Spanish market, Illenca and Lafuente (2003), using a non-parametric approach, did not find any significant connection between futures listing and the underlying stock volatility. Mallikarjunappa and Afsal (2007) examined the volatility behavior of the CNX IT Index in India and found that underlying volatility does not increase or decrease with the introduction of futures. They however reported a structural change in the pre and post futures era after applying the CHOW test for parameter stability opining a variation like volatility after the introduction of futures. Based on their findings, they inferred that the difference in the volatility may be due to better information dissemination, more transparency, and other factors rather than derivatives trading.

Rahman (2001) studied the effect of futures listing on the conditional volatility of constituent stocks of the Dow Jones Industrial Average (DJIA). The study employed the GARCH (1,1) model to approximate the conditional volatility of intraday returns. The estimated parameters of conditional volatility were then compared for periods before and after the introduction of futures to determine if the estimated parameters had changed significantly following the listing of the various derivatives. The findings suggested that the introduction of index futures and futures options on the DJIA caused no structural changes in the conditional volatility of component stocks.

On the Portuguese market, Calado *et al* (2005) examined prices for 8 stocks to study the impact of the initial introduction of options and futures. They used unadjusted and adjusted variance and changes in betas of the underlying stocks following the introduction of derivatives and tested for the significance of the changes. Their conclusions were mixed. They found that on average the listing of derivatives did not affect the overall and systematic risk of the underlying stocks. However, on an individual basis, some underlying stocks showed noteworthy rises or fall in volatility post derivatives introduction.

Similarly, Boyer and Popiela (2004) examined whether the listing of futures on the S&P500 Index changed the consequence of including to, or exclusion from, the S&P500 Index. Their study used the S&P500 price effect to show that overall price volatility did not significantly increase for added stocks after trading began on the S&P500 Index futures.

2.2.4 Persistence of volatility after futures introduction

The presence of long memory implies that once an amount of information has been absorbed into the financial market, it takes a long time to die out. Therefore past price changes can be used as a significant indicator for predicting future price changes. Persistence refers to how quickly (or slowly) the variance reverts towards its long-run average. High persistence equates to slow decay and low persistence equates to rapid decay and quick reversion to the mean. One implication of this slow decay is that shocks to the volatility tend to have long-lasting effects according to Engle and Bollerslev (1986).

Poterba and Summers (1987) applied variance ratio tests to market returns for the United States over the 1871-1986 period and found long memory in returns and volatility to impact significantly on the pricing of derivatives as well as estimating market volatility. Shembagaraman (2003) examined the effect of the listing of derivative trading on underlying stock volatility using the Nifty Index. Using a univariate GARCH (1, 1) model with dummy variables for days of the week the results suggested that futures and options listing did not alter the volatility of the underlying spot, but the nature of volatility was different from the period before the introduction of futures. Before the introduction of futures, there was greater persistence however, after futures listing, the persistence died out. This might point to increased market efficiency since there is faster assimilation of information by underlying prices.

Vougas (2004) examined the long memory on returns and volatility in the Athens Stock Exchange, employing the ARFIMA-GARCH model, weak long memory was reported. Similarly, Korkmaz *et al*. (2009) examined persistence on the Istanbul Stock Exchange (ISE) by employing the ICSS algorithm in volatility and the ARFIMA-FIGARCH model. Their results show that although persistence does not exist in returns it nonetheless exists in variance. They concluded the Istanbul Stock Exchange to be a weak-form inefficient market due to volatility persistence as it displays predictability. This research aims to establish whether there is the persistence of volatility in the pre- and post-futures introduction and whether there is any change in the persistence post futures introduction.

2.3 Research Gaps

Past studies concentrated on one underlying asset feature (post derivative introduction) at a time like persistence level (Vougas, 2004; Korkmaz et al., 2009) and volatility (Boyer & Popiela, 2004; Calado et al., 2005; Mallikarjunappa & Afsal, 2007). The current study exposes the effect of introducing derivative contracts on the underlying asset volatility and persistence level. On the same note, the current study used a modified GARCH model by including a dummy variable into the GARCH equation. Previous studies utilized traditional symmetry and asymmetry GARCH models (Shembagaraman, 2003); Calado et al., 2001; Rahman, 2001). On the same note, the study focused on the effect of derivative introduction on an index rather than an individual stock. To add on, this present paper considered a Southern Africa economy rather than developed markets as in some past studies.

3.0 RESEARCH METHODOLOGY

Though several models can be used to model volatility such as moving averages and exponentially weighted average, the ARCH family received much empirical usage and acceptance. This study is no exception.

3.1 Data Sources

The data used in this research was obtained from the Johannesburg Stock Exchange. The study was based on the weekly returns of the FTSE/JSE Top 40 Index which is a capitalization-weighted index comprised of the 40 largest companies by market capitalization. The weekly returns for the period 03 June 2002 to 31 December 2014 were obtained by assuming that the investor bought the stock on the first day of the week and sold on the last day of the week, thus the weekly return R_t was determined as follows:

$$(R_t) = \ln(\frac{P_t}{P_{t-1}}) * 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where $P_t$and P_{t-1} represents the closing price of the underlying index under study at time *t* and *t*-1 respectively.

The FTSE/JSE All Shares Index was developed in June 2002 whereas, the MINI FTSE/JSE Top 40 (ALMI) was introduced on 03 June 2008 and this date was the basis for dividing the sample period into two sub-periods that is the pre futures period and the post futures period. The ALMI is known as the Mini ALSI and is an index derivative with the JSE Top 40 index as the underlying instrument (JSE, 2015).

3.2 Empirical tests

The following tests were carried out in this study in an endeavor to ascertain the effects of futures trading on the underlying index:

3.2.1Testing for stationarity

Estimating any model using non-stationary data can result in spurious results where the standard errors produced are biased and this may result in a model establishing a significant causal relationship between variables that in fact may not exist. The existence of unit root in the time series was checked using the Augmented Dickey-Fuller (ADF) test.

3.2.2Testing for 'ARCH/GARCH' effects

Before estimating an ARCH/ GARCH model it is essential to check whether there are significant ARCH effects in the error terms (Brooks 2008). If no ARCH effects manifest in the residuals, then an ARCH model is pointless and misspecified according to Zivot and Wang (2006). The Lagrange Multiplier the test statistic is given by TR^2, where R is the sample multiple correlation coefficient computed from the regression of $\varepsilon_t{}^2$ on a constant and T is the sample size, was adopted in this study.

3.3 Model Specifications

The GARCH (1, 1) model was used in this research following its use by Floros and Vougas (2006), Sibani and Uma (2007), and Thenmozhi (2002) among others. Since the ARCH/ GARCH models capture the tendency in financial data for volatility clustering, information can be related to volatility explicitly, as any variation in the rate at which information arrives on the market will change the volatility in that market. Therefore, except if information stays constant, which is almost not the case, volatility must be time-varying, even when considered over short time frames.

3.3.1 ARCH/ GARCH model

According to Bollerslev (1986), a model with residuals that track a GARCH (*p*, *q*) process is denoted as below

$Y_t = a_0 + a_1 X_t + \in_t \quad \in/\omega_{t-1} \sim \mathrm{N}(0;h_t)$ ………..(2)

$h_t = a_0 + \sum_{i=1}^{q} a_i \in^2{}_{t-1} + \sum_{j=1}^{p} \beta_j \, h_{t-j}$ ………..(3)

With $a_0 > 0$, $\sum_{i=1}^{q} a_i$, $\sum_{j=1}^{p} \beta_j \geq 0$

Where *h* is the variance, *t* is the time, *p* and *q* are the lengths of GARCH lags, ∈ is the disturbance term and α and β are empirical parameters determined by maximum likelihood estimation. In the GARCH (*p, q*) model, the conditional variance is thus a function of *p*-lagged conditional variance and *q*-lagged squared disturbance terms. Similar to Engle's ARCH model, the intercept must be positive, while the coefficients must be nonnegative to ensure that the volatility estimate is positive. In many cases, $q=p=1$, is an adequate model to fit real-world data. Equation 2 is the conditional mean equation, and equation 3 is the conditional variance equation.

3.3.2 GARCH model with a dummy variable

To test for the effect of the listing of futures on the underlying stock volatility (h_t) a dummy variable *D* was added to the model and this dummy took the value of zero for the pre futures era and the value of one for post futures period. The model was estimated assuming normally distributed errors. According to Bollerslev (1986) equation (2) thus becomes:

$$h_t = a_0 + \sum_{i=1}^{q} a_i \in^2{}_{t-1} + \sum_{j=1}^{p} \beta_j\, h_{t-j} + \gamma \mathrm{D} \ldots\ldots\ldots\ldots (4)$$

The sign of the coefficient of the dummy variables shows whether the underlying volatility increased (positive) or decreased (negative) following the onset of futures trading and also the significance of the coefficient of the dummy variable implies that the listing of futures trading affected the underlying stock's volatility. This method was also employed by Mallikarjunappa and Afsal (2007).

3.3.3 Volatility persistence

To establish whether old news continued to have an impact on current volatility the GARCH AR statistic was computed. This was done by breaking the sample period into 2 sub-periods (pre and post futures) and proceeding to estimate separate GARCH (1, 1) equations for each period. Persistence was then measured by summing up the coefficients of the GARCH (1,1) model implying that the persistence coefficient is given by (from equation 3):

$$\mathrm{p} = \alpha_1 + \beta \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

A value of 1.0 implies no mean reversion. A value of less than 1.0 implies reversion to the mean, whereas a lower persistence implies greater reversion to the mean. Persistence greater than 1.0 implies a high degree of persistence (Rahahleh & Kao, 2018).

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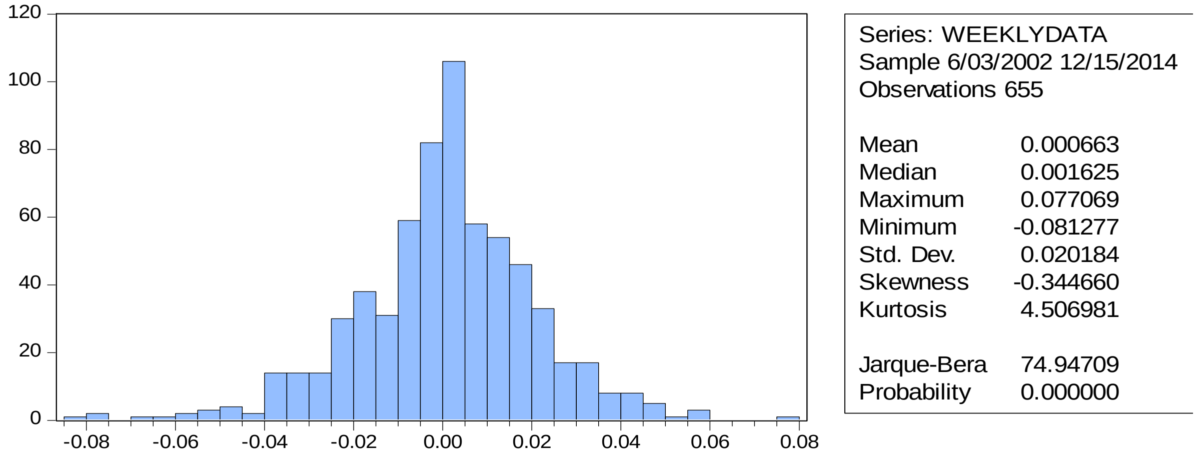
4.0 FINDINGS AND PRESENTATIONS

Various tests were conducted and the results obtained are presented and analyzed in this section. The augmented Dickey-Fuller test was used to check for stationarity of the data, the ARCH heteroscedasticity test was employed to test for the ARCH characteristics in the residuals and the researchers estimated the GARCH equation with a dummy variable and separate GARCH equations for the pre and post futures period to evaluate persistence. The results for the various model tests are presented in this section.

4.1 Descriptive Statistics

Using the whole data sample, the following results were obtained (see figure 1 below)

Figure 1: ***Weekly returns histogram***



Weekly distribution

The histogram above shows that the data is slightly negatively skewed and the kurtosis is above the generally accepted level of around 3 for normally distributed series. However, for large sample sizes, the assumption of normality can be relaxed as the Central Limit Theorem ensures that the distribution of disturbance term will approximate normality as asserted by Kallenberg (1997). The minimum return of -0.081277 and the maximum return of 0.077069 give a relatively small range of 0.158346 within which the returns oscillate. The relatively small standard deviation of 0.020 implies that the returns are close to the mean of the series

Figure 2: ***Weekly returns***

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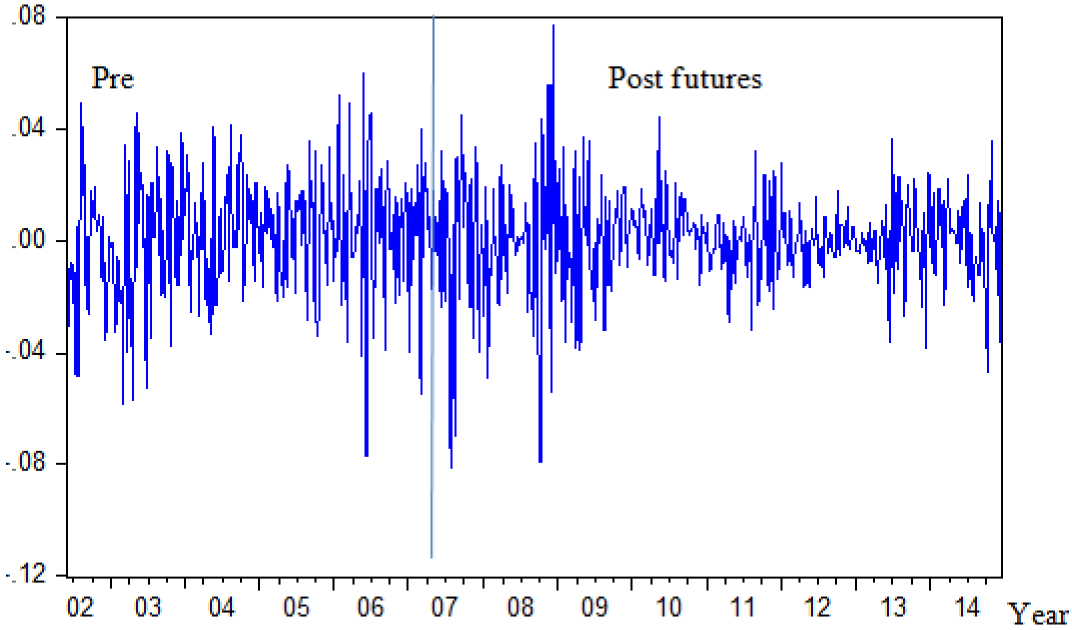

Source: Raw data

Figure 2 above shows 655 weekly returns of the FTSE/JSE TOP 40 index from June 2002 to December 2014. There is no obvious upward or downward trend and mean-reversion is evidently evidencing that the mean seems to be constant. The variability occurs in bursts and chunks mixed with occasional spikes and the presence of volatility clustering is evident. This concurs with the findings made by Mashamba & Magweva, (2019) study in SADC nations.

4.2 Stationarity results

Table 1: Unit root test

Variable	Test	Critical value	t-statistic	P-value
Weekly returns	Augmented Dickey-Fuller	1%level 3.440120 5%level 2.865742 10%level 2.569065	-28.66929	0.0000
Top40 Pre futures	Augmented Dickey-Fuller	1%level 3.451078 5%level 2.870561 10%level 2.571647	-18.94532	0.0000
Top40 Post futures	Augmented Dickey-Fuller	1%level 3.449389 5%level 2.869825 10%level 2.571253	-22.30564	0.0000

Source: Authors extract from Eviews

The ADF test rejected the null hypothesis that the weekly returns for the whole sample period have a unit root since the P-value is less than 0.05 at a 1% level of significance and hence the series is stationary in levels. For the pre-futures period, the Augmented Dickey-Fuller test was applied to the weekly returns and the null hypothesis that the series has a unit root was rejected at the 1% level of significance as the P-value was less than 0.005. The ADF test also revealed that the Top 40 post futures series was also stationary at levels at the 1% level of significance.

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4.3 'Arch' effects

To ensure the correct specification of the GARCH model, the presence of ARCH effects was tested in the weekly returns for the entire period as well as in the sub-periods. According to Gujarati (2005), if there is heteroscedasticity, the usual Ordinary Least Squares estimates do not give the best linear unbiased estimator, (Wilson *et al.*, 2019; Sibani & Uma 2007; Thenmozhi, 2002). The ARCH heteroscedasticity test was applied to all the sample periods and the findings are tabulated below (Table 2).

Table 2: ***Heteroscedasticity Tests***

Variable	Test Applied	Result		P-value	
Weekly returns	ARCH	F-statistic	30.97024	F (1,650)	0.0000
		Obs*R-squared	29.65269	Chi-Square (1)	0.0000
Pre futures	ARCH	F-statistic	12.49863	F (1,311)	0.0005
		Obs*R-squared	12.09301	Chi-Square (1)	0.0005
Post futures	ARCH	F-statistic	44.22953	F (1,337)	0.0000
		Obs*R-squared	39.33014	Chi-Square (1)	0.0000

Source: Primary data

The null hypothesis for this test was that there is homoscedasticity in the series. As can be from the table above, the results indicate evidence of heteroscedasticity which is a green light for GARCH estimation.

4.4 Empirical model Results

The ARCH heteroscedasticity test rejected the null hypothesis for all the sample periods and thus the researcher concluded that there is heteroscedasticity proceeded to estimate the GARCH model. Researchers including Pati *et al.*, (2018), Rahman (2001), and Bologna and Cavallo (2002) also reported heteroscedasticity in time series and used the GARCH family of models to model volatility in their estimations.

4.4.1 The impact of futures introduction on underlying stock volatility

The GARCH (1, 1) equation with a dummy variable for the before and after futures periods was estimated and the results are shown below. The GARCH (1, 1) model was also used by Rahahleh and Kao, (2018), Floros and Vougas (2006), Sibani and Uma (2007), and Thenmozhi (2002). The results from the model are presented below in Table 3:

Table 3: ***GARCH (1, 1) Equation with Dummy variable***

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000641	0.000628	1.020233	0.3076
FTSEJSETOP40(-1)	-0.069859	0.045510	-1.535030	0.1248
	Variance Equation			
C	5.31E-05	2.14E-05	2.484475	0.0130
RESID(-1)^2	0.183592	0.039743	4.619508	0.0000
GARCH(-1)	0.741755	0.059223	12.52482	0.0000
DUMMY	-3.58E-05	1.63E-05	-2.193211	0.0283

Source: Authors extract from Eviews

The *residual(-1)^2* or ARCH term, the GARCH term as well as the dummy variable are all significant in explaining volatility as evidenced by the P values which are less than 0.05. The above results show that the volatility of the FTSE/JSE TOP 40 is sensitive to the introduction of futures trading as evidenced by the significance of the dummy coefficient (Islam, 2013). Notably, the coefficient of the futures dummy, is significantly different from zero, implying that the listing of futures had a stabilization impact on spot market volatility according to Bollerslev (1986).

The researchers failed to reject the hypothesis and conclude that futures introduction has a significant effect on the volatility of the FTSE/JSE TOP 40. The negative sign on the dummy variable coefficient means that the introduction of the ALMI futures on the FTSE/JSE TOP 40 results in a decline in the volatility of the FTSE/JSE TOP 40. This conclusion was also reached by Pillar and Rafael (2002) and Figuerola-Ferretti and Gilbert (2001) on the Ibex-35 in Spain when they applied the GARCH, EGARCH, and GJR models of conditional volatility incorporating a dummy variable to check the effect of the listing of derivatives on the volatility of the Ibex-35.

4.4.2 Persistence of volatility

To compare the persistence of old news before and after futures listing the GARCH (1,1) model was applied separately to the pre futures period as well as the post futures period and the sum of the ARCH term and the GARCH term for both periods were compared. The results for the regressions are displayed below (Table 4) taking note of the fact that the pre futures period stretches form 03 June 2002 to 02 June 2008:

Table 4: ***FTSE/JSE Top 40 pre futures GARCH estimation***

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.001181	0.001365	0.865296	0.3869
TOP40PREFUTURES(-1)	-0.070431	0.064361	-1.094299	0.2738
	Variance Equation			
C	0.000117	8.70E-05	1.341483	0.1798
RESID(-1)^2	0.125720	0.068953	1.823275	0.0683
GARCH(-1)	0.652734	0.211006	3.093440	0.0020

Source: Authors extract from Eviews

The conditional variance equation for the pre futures period was estimated and the GARCH term was statistically significant in explaining the volatility whereas the ARCH term was not significant. As indicated by Pati *et al.*, (2018), a persistence coefficient of 0.778454 was observed implying that there is some degree of reversion to the mean. The post futures impact on the underlying stock index is estimated below:

Table 5: ***FTSE/JSE Top 40 post futures GARCH estimation***

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000354	0.000699	0.506293	0.6127
TOP40POSTFUTURES (-1)	-0.064914	0.067055	-0.968070	0.3330
	Variance Equation			
C	1.38E-05	5.88E-06	2.349825	0.0188
RESID (-1)^2	0.220624	0.055749	3.957413	0.0001
GARCH (-1)	0.744204	0.065850	11.30158	0.0000

Source: Authors extract from Eviews

In this case (Table 5), both the ARCH and GARCH terms were significant in explaining volatility. The persistence coefficient increased from 0.778454 in the pre futures era to 0.964828 in the post futures period implying a slower reversion to the mean. In other words, this implies that shocks to the conditional variance will be highly persistent. The higher persistence in volatility was also reported by Korkmaz *et al*. (2009) on the Istanbul Stock Exchange. The results of this study contrast the results obtained by Shembagaraman (2003) who reported a decline in persistence post futures introduction on the Nifty Index.

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of findings

The FTSE/JSE TOP 40 is sensitive to the introduction of futures trading as evidenced by the significance of the dummy coefficient. Notably, the coefficient of the futures dummy, is significantly different from zero, implying that the listing of futures had a stabilization impact on spot market volatility according to Bollerslev (1986)The results of this study support the argument that the introduction of derivatives does not present a problem for the spot market because their impact is beneficial. This conclusion contradicts the popular belief that derivative trading increases the volatility of the underlying market. As such the introduction of the ALMI futures was beneficial to the FTSE/JSE Top 40 index and this concurs with the results reported by Illenca and Lafuente (2003) on the Spanish market.

A slightly increased ARCH and GARCH terms' impact expose a more persistent shock-effect due to the longer-lasting influence of old news. The increase in persistence observed in the post futures era contradicts the efficient market hypothesis as prices fail to incorporate all past available information since past events continue to have a bearing on future prices.

5.2 Conclusion

Against these findings, it can be concluded that the introduction of futures derivative dampens the volatility of the underlying asset or index in line with conclusions made by Hsiao *et al.* (2009), and Debashis (2008). A reduction in volatility is a welcome development in the eyes of risk-averse investors. On the same note, increased persistence results from the introduction of futures derivative on an index. This is in line with conclusions reached by Korkmaz *et al.*, (2009) study in Turkey. This implies that shocks on the index take time to decay, thereby making volatility prediction possible. Persisting volatility makes investors more averse to holding the underlying index because of uncertainty, which in turn demands a higher risk premium to insure against the increased uncertainty.

5.3 Recommendations and contributions of the study

JSE might consider finding ways to increase transparency and boost investor confidence to increase information dissemination and reduce the persistence of old news. Besides that, bourse can also consider listing more futures if the results of this study are to be generalized to the whole stock market even though the futures effect is not immediate as the futures listing succeeds in reducing the underlying stock volatility in the long run. Finally, the current risk measurement strategies may be maintained or improved as they help prevent market runs and crashes, and also the trades in the futures have resulted in decreased underlying volatility which may be attributed to investors having confidence in the system. This study made notable contributions by modifying the traditional GARCH model by incorporating a dummy variable. On the same note, the study focused on the effect of derivative introduction on an index rather than an individual stock. To add on, this present paper considered a Southern Africa economy rather than developed markets as in some past studies.

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