



**Strathmore**  
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**IMPACT OF PENSION FUNDS ON THE STOCK MARKET VOLATILITY IN  
KENYA**

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079835

**Submitted in partial fulfilment of the requirements for the degree of Bachelor of  
Business Science in Actuarial Science at Strathmore University**

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**[December, 2017]**

**DECLARATION**

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the Research Proposal contains no material previously published or written by another person except where due reference is made in the Research Proposal itself.

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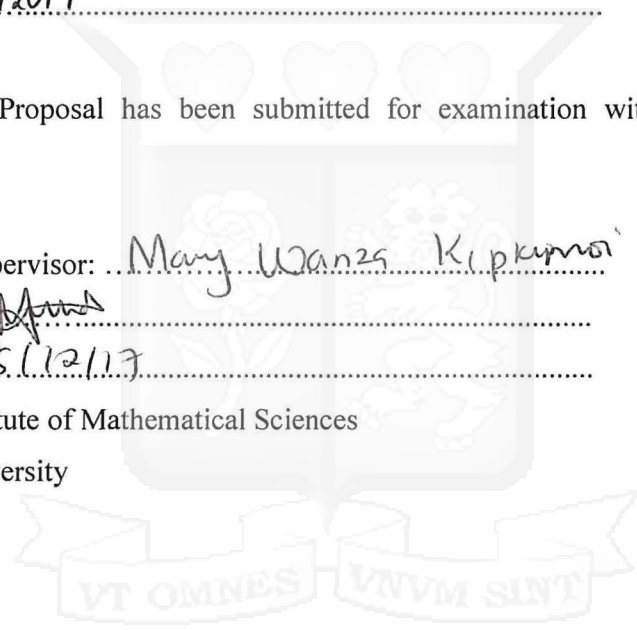
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## LIST OF ABBREVIATIONS

NSSF	National Social Security Fund
RBA	Retirements Benefits Authority
NSE	Nairobi Stock Exchange
CMA	Capital Markets Authority



## ABSTRACT

This study is an empirical test of the impact pension funds have on the volatility of monthly stock returns in Kenya. The study involved RBA funds invested in equities and monthly NSE index returns. The time period under study ranged from the year 2002-2015. An ARMA (p,q)- EGARCH (1,1) model was used to evaluate the effect on the invested funds on the stock market volatility. However, the study did not find any significant influence of the RBA funds on the NSE market volatility



# CHAPTER ONE

## 1. Introduction

### 1.1 Background to the Study

It has been widely recognized that institutional investors have various impacts on stock market volatility. Other things being equal, an increase in demand from institutional investor such as pension funds will increase equity prices. Pension savings are compulsory “pots” that enable people to be able to maintain a certain standard of living after retirement. Other than being investment and saving mechanisms, pensions also play an important role in the financial markets.

On one hand, they can act as market stabilizers; reducing the volatilities of stock markets, thus providing a reassuring font for other investors in the case of volatility shocks. Pension funds have a long horizon outlook whose main goal, other than to obtain abnormal returns, is to ensure that pensioners do not lose their capital. Meng and Pfau (2010) confirm that pension fund investments have a positive impact on the stock market and the market for corporate bonds. However, they also stress that this impact differs considerably depending on the level of a country’s financial development.

However, it is assumed that a significant proportion of pension fund portfolios are used for short-term investments that seek high returns, liquid assets, and greater desire for risk. In this regard, Hu (2006) shows that pension funds inject volatility shocks that undermine financial markets. Due to their specific investment behaviour institutions move stock prices away from fundamentals and thereby induce autocorrelation between and increases in the volatility of stock returns.

Pension funds have significantly accumulated large amounts of money over the years. The shift from the defined benefits to defined contributions is one of the major factors that have led to such growth as schemes move from the Pay-As-You-Go reliance to the funded. Such a shift has been primarily originated by the changes both in the industrial structure and in the labour markets triggered by the globalization, which has led both capital and workforce to be increasingly mobile. As a consequence, many countries have implemented reforms aiming at

coping with the deterioration in the funding of DB pension plans and with some long standing concerns regarding the effect of complex, opaque pension accounting methods (Thomas et al, 2012).

## 1.2 Review of the Financial Sector in Kenya

The financial markets can be said to have two broad classes of investors: individual and institutional. Institutional investors have made greater impacts on the market than individual due to the large sums of money invested. Lakonishok, Shleifer and Vishny (1992) defined institutional investors as those who held about 50 percent of the equities in the United States. Gompers and Metrick (2001) added by saying that institutional investors were those managers with assets under management amounting to at least \$100 million. Institutional investors include insurance firms, pension funds, banks, foundations, endowments and investment companies.

According to the 2017 Capital Markets Authority released financial report, institutional investor 41,487 investors in the equity market compared to the local individuals who held first place with 1,196,995 investors trading in equities.

The CMA Quarterly Capital Markets Statistical Bulletin – Q1.2017

### 4.0 INVESTOR PROFILES AT THE NAIROBI SECURITIES EXCHANGE

Table 22: NSE Investor Numbers (Q1.2017)

Equity		
Account Type	Category of Investor	No. of Investors
EACI	East African Corporate	258
EAI	East African Individuals	7,490
FCI	Foreign Corporate Investors	682
FII	Foreign Investors (Individuals)	8,078
LCI	Local Corporate Investors	41,487
LII	Local Individual Investors	1,196,995
Corporate Bonds		
EACI	East African Corporate	11
EAI	East African Individuals	11
FCI	Foreign Corporate	4
FII	Foreign Investors (Individuals)	111
LCI	Local Corporate	1,106
LI	Local Individuals	3,626

\*Statistics on equity investor holdings/no. of investors excludes accounts held by JR (Junior Investor), BR (Broker), IS (issuers), and CU (custodians).

Source: CDSC

### **1.3 Review of the Kenyan Pension Sector**

The Kenyan pension sector was by far unregulated before 1997. Though members made contributions, the funds were subject to embezzlement from employers leading to unfulfilled promises. In 1997, the Retirement Benefits Authority was enacted and came into full force in 2000 with regulations on how pension investments would be carried out. Its aim is to protect the member's pension income from other use by the employer.

The current benefit scheme in Kenya can be classified as follows:

1. The National Social Security Fund- the is the main scheme of which every person in the formal sector is expected to make contributions to
2. Public service pension scheme- serves all public service employees such as civil servants
3. Occupational schemes- operates for formal sector workers in companies that operate retirement schemes
4. Individual schemes- open to all on voluntary basis

All the sectors above are regulated by the Retirement Benefits Authority apart from the Public Service Pension Schemes which are regulated by an Act of Parliament.

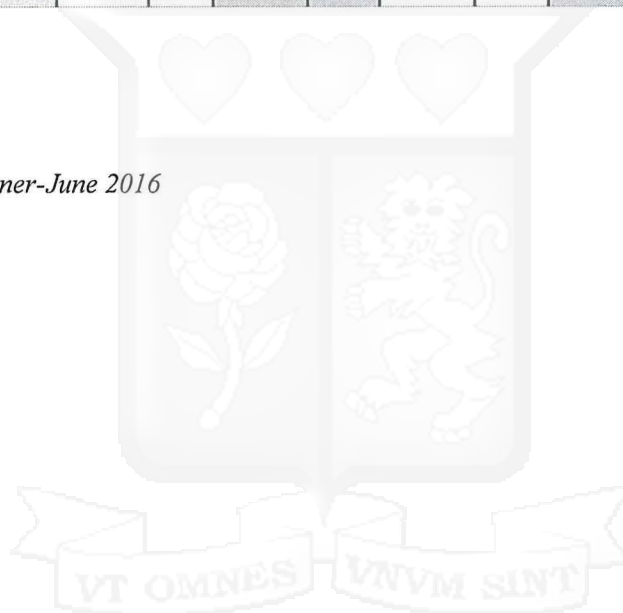
With the RBA in force, the pension sector has grown tremendously over the past years. According the 2015 pension performance report released by the RBA for the half year period June-December 2015 published in June 2016, assets under management have grown by 6.8 Billion a 0.8 percent rise of assets under management from Kshs.807.3 Billion reported in June 2015. However, over the one year period the total Industry assets have grown by 3.3 percent from 788.15 Billion reported in December 31st 2014 to Kshs.814.11 billion as at December 31st 2015. This is a 25.9 billion increase for a turbulent 2015 characterized by significant currency instability and an aggressive bout of monetary tightening.

Out of the Kshs.814.11 billion, fund managers and insurance issuers held majority of the assets at Kshs.709.4 billion, Kshs.38.2 billion internally administered by the National Social Security Fund (NSSF) and an additional Ksh.66.47 billion of property investments that are directly managed by trustees. The assets under fund management include Ksh.118.1 billion of NSSF funds managed by 5 contracted fund managers. The internal assets that are managed by NSSF are in immovable property, that is either commercial or residential, unquoted securities and other assets. The table below shows the overall industrial portfolio;

**Overall industry investment Portfolio (Billions)**

		June 2014		December 2014		June 2015		December 2015		Change Dec 2014- Dec.2015
		Kshs	%	Kshs	%	Kshs	%	Kshs	%	% Change
1	Government Securities	239.04	32	241.97	31	221.64	27	242.43	30	0.19
2	Quoted Equities	198.73	26	203.73	26	206.65	26	186.81	23	-8.30
3	Immovable Property	127.52	17	130.39	17	148.25	18	150.78	19	15.64
4	Guaranteed Funds	84.65	11	94.09	12	97.03	12	99.40	12	5.65
5	Fixed Income	33.23	4	46.52	6	51.45	6	48.09	6	3.37
6	Fixed Deposits	38.05	5	41.47	5	41.24	5	55.61	7	34.09
7	Offshore	14.57	2	14.68	2	14.80	2	7.16	1	-51.23
8	Cash	10.35	2	10.74	1	12.73	2	11.26	1	4.87
9	Unquoted Equities	3.90	1	4.55	1	2.63	1	2.77		-39.07
10	Private Equity					0.007		0.17		100
11	U Classified/Others	0	0	0.01	0	10.93	1	9.62	1	100
	<b>TOTAL</b>	<b>750.04</b>	<b>100</b>	<b>788.15</b>	<b>100</b>	<b>807.35</b>		<b>814.11</b>		

Source: the pensioner-June 2016



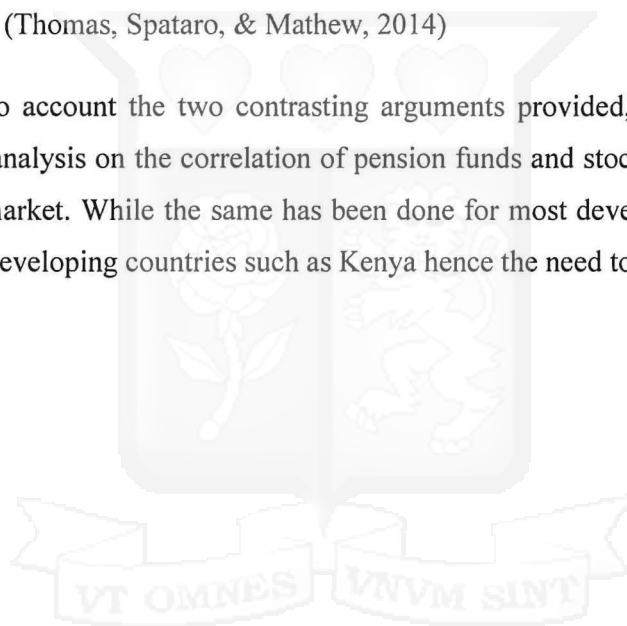
#### **1.4 Problem Statement**

The high level of assets managed by pension funds gives them significant bargaining power and thus their actions in the market are relevant. The level of funds managed enables them to act as intermediaries, acting as either stabilizers or destabilizers of the market.

Due to their specific investment behaviors pension funds move stock prices away from the fundamentals and thereby increasing the volatility. Theories such as herding and positive feedback have been the main argument put forward for the destabilization effect (Bohl, Brzeszczyński, & Wilfling, 2005)

However, other pieces of literature have been put forward showing that pension funds stabilize the market. According to (Arbel et al. 1983; Badrinath et al. 1989), pension funds are governed by prudent man rules, thus accumulate less risky stocks which indirectly reduce overall volatility (Thomas, Spataro, & Mathew, 2014)

Thus, taking into account the two contrasting arguments provided, this paper aims to add more empirical analysis on the correlation of pension funds and stock markets in the context of the Kenyan market. While the same has been done for most developed countries, there is limited data on developing countries such as Kenya hence the need to fill the gap.



### **1.5 Research Objectives**

The main objective of this paper is to determine the influence pension funds have on Kenyan stock market volatility. The study will determine if the pensions as institutional investors act as stabilizers; lowering market volatility, or as destabilizers; increasing the market volatility.

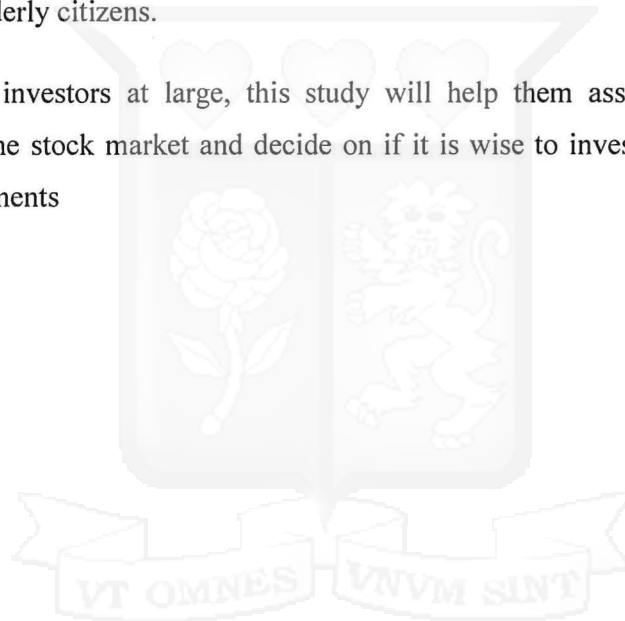
### **1.6 Research Questions**

1. Does the pension industry investment influence stock market volatility in Kenya?
2. To what extent does the pension industry investment influence stock market volatility

### **1.7 Significance of the Study**

To students, learning institutions and researchers, this paper contributes to the various empirical studies looking at the effect of pensions on stock market volatility. In addition, this might help the government in assessing the pension investment allocations so as to ensure the security of its elderly citizens.

To institutional investors at large, this study will help them assess the effects of large investments in the stock market and decide on if it is wise to invest huge lump sums or to phase the investments



## **CHAPTER TWO**

### **2. Literature Review**

#### **2.1 Introduction**

This chapter reviews the findings of similar studies conducted in the same field. Among the issues featured in this chapter are the factors that affect the stock market volatility; a review of the relevant theories that explain pension funds and market volatility and an empirical review that provides evidence from actual studies that have been carried out.

#### **2.2 Concept of Pensions**

Rono, Bitok, & Asamoah (2010) defined pensions as the amounts of money paid regularly to an individual by the state or employer upon ill health or normal retirement. Pensions can be grouped into two broad categories as noted by (Bodie, 1990): the defined contributions and the defined benefits plan. He explained that under the defined contributions, the contributions are specified as a predetermined fraction of the salary although the fraction may not be constant over the career .upon retirement, the employee receives a lump sum or an annuity of the amount accumulated in his fund. The defined benefit plan pays out a fixed benefit to the contributor of which had been pre-determined by a formula that incorporated the employee's history of service and salary (Bodie, 1990).

#### **2.3 Theoretical Literature Review**

##### **2.3.1 Efficient Market Hypothesis**

Developed by Eugene Fama, the efficient market hypothesis (EMH) maintains that market prices fully reflect all available information. An efficient market is assumed for the concept of passive management approach (Hobbs, 2001).

There are three forms of the EMH: the weak hypothesis assumes that the information in the market today has already incorporated all historical trends in the market (Reilly, 1989). Therefore, technical analysis is of no use when attempting to outperform the market; it is merely an approach that is used in the hope of predicting future trends (Hobbs, 2001). As all historic data is already incorporated then this means that we cannot use the past trend to predict future trends, thus stock prices behave according to a random walk (Malkiel, 1999).

The second form of EMH is the semi-strong one which states that the market adjusts itself to public information rapidly (Cuthbertson et al., 2004). Thus, fundamental analysis is of no use in outperforming the market, instead it is used in the hope of identifying new information (Correria et al., 2003).

Finally, the strong-form of the EMH contends that security prices fully reflect all information, whether it might be public or private (Reilly, 1989).

Fama (1965) proposed a market model in which, due to poor information processing, heterogeneous investors act irrationally; buying stocks that have enjoyed recent gain and selling those that have been losing; but such trading cannot have huge impacts on the market as there are always rational investors present to offset any long term imbalance. The rational investors include the institutional investors such as pension funds.

This model has however elicited different views over the years with many as such opposing or supporting it

#### **In Favor of Efficient Market Hypothesis**

Jensen (1968) evaluated 115 funds and concluded that on average none of them was able to predict future prices and consequently failed to overcome the buy and hold strategy. In 1973, Malkiel (1973) published a book, "A random walk down wall street". This book set out to confirm the random behavior of stock prices and of returns in a formal market such as a stock exchange.

Samuelson (1973a, 1973b) established a theoretical basis claiming stock prices follow a random walk or a martingale, and thus it becomes very difficult for investors to obtain above normal yields returns. Grossman (1976) presented a theoretical model where there is more than one asset manager and two assets; a risk free asset and a risky asset. He found that current prices reveal information to each manager that is of higher quality than his own information. Hence, the market has incorporated all possible information. However, if the markets are efficient, this removes the incentives for those managers who would have been willing to pay for the additional information.

Laffont and Maskin (1990) indicated that compliance with the efficient market hypothesis in cases of perfect market competition where each individual is too small to affect market prices.

### **Against Efficient Market Hypothesis**

Grossman and Stiglitz (1989) proposed a model that considers transaction costs considering an informed and uninformed agent. They conclude that although theorists like Fama (1970) consider lower transaction cost constitute a sufficient condition for prices to be fully reflected in the information available, they do not consider the condition to be more than sufficient because it should be a necessary condition. They therefore propose a model which reflects the information informed agents have, but only partially because of the costs incurred to acquire such information. In this regard, information is expensive to acquire, hence agents who spend money to acquire this information would not have the incentive to search for it if there is no compensation gained.



## 2.4 Empirical Literature Review

Lakonishok et al (1992) examines the impact of pension funds on the stock prices in the United States of America using two methods: herding and positive feedback hypothesis. The positive feedback hypothesis used argues that investors extrapolate past market trends; buying when prices are high and selling when prices are low. While this rational behaviour is justifiable, it may lead to a substantial deviation of prices from fundamentals as more transactions by rational investors create an ever higher volume of speculative trading by positive feedback traders (Hu, 2006). They use data on holdings of 769 tax exempt funds to evaluate their potential effect in trading on stock prices. According to their finding, there is relatively no concluding evidence that the pension funds as institutional investors destabilize the market. Instead, the investors follow emerging trends and investment strategies that do not have large impacts on the stock market.

Jones et al (1999) investigates the relationship between stock prices and different types of institutions in the US quarterly data from 1984 to 1993. They find that all institutions are engaged in positive feedback trading. However there is no evidence of institutions destabilizing equity prices. The authors report that PF managers act as feedback traders especially on the buy side and mostly in small stocks with a high past performance.

Bohl et al. (2003) focused on a case of the polish pension markets. From 19 may 1999 onwards, the polish pension sector was allowed to trade in the financial markets. He considered the issue of institutional trading stock returns autocorrelation by using data from July 1999 to 30 December 2000. Using the MARKOV-GARCH switching model, the results obtained were that the polish pension funds rather stabilized the financial markets than destabilizing it.

Using a dataset of 33 emerging countries, Walker and Lefort (2002) conclude that the growth of pension assets reduced the stock market volatility, which is proxied by the 24 month annualized moving volatiles.

Davis (2004) conducted an empirical study on the G7 countries and showed that equity price volatility and the shares of equity held by a pension fund were positively linked. The selected countries advanced growth of equity holdings by institutional investors gave rise to increased stock market volatility, this study however uses pension and mutual funds thus the results may be a bit blurred by the potential different roles played by mutual and pension funds (Dennis and Strikland,2002; Lipson and Puckett.2005). Dennis and Strikland (2002) find evidence supporting the fact that institutional investors have a stronger reaction than

individual investors when the absolute value of market returns is substantial on particular days. The evidence is consistent with the hypothesis that institutional managers are evaluated in the short term which requires them to make short term decisions instead of the required structured decisions. In the case of banks is negative with abnormal returns on days with an upward or downward market trend. Lipson and Puckett (2006) find a contrasting conclusion when studying the behaviour of bank and pension managers in days when the market an upward or downward change by 2%. They find strong evidence that the managers behave as net sellers when the market experiences an upward trend and as buyers when the market experiences a downward trend.

The volatility of the stock market has direct consequences on liquidity levels. Blume and Keim (2012) show that the participation of institutional investors in the stock market has increased and has played a significant role in explaining the variability of the illiquidity in these markets. Gompers and Metrick (2001) show that the demand of shares by institution is different from that of individual investors. Institutions show preference for shares from large companies that are relatively liquid and exhibited low returns in previous period. These demands have certain price consequences on the stocks desired.

## **2.5 Summary**

Volatility in the stock markets has mainly been attributed to human behaviour. Shiller (2003) contradicts the age-old efficient markets hypothesis citing it never holds because asset price movements are attributed to human behaviour and not just fundamental backings. Some authors have however noted that the volatility of asset prices were never persistent and in fact lasted up to two years only (poterba & Summers, 1984).

Friedman (1953) summarized the arguments by most scholars citing that rational investors are expected to stabilize asset prices. Although most of the literature was based on mature markets, Bohl and Brzeszczyński (2005) investigated the Polish stock market, an emerging market and filed the same conclusions; that institutional investors aided in stabilizing the volatility in the stock market.

As mentioned, the main focus of this study is to evaluate the effects the pension funds held by the retirement benefits authority would have on the volatility at the NSE market.

## **CHAPTER THREE**

### **3. Research Methodology**

#### **3.1 Introduction**

This chapter is divided into two parts. The first part outlines the most appropriate methods of design, sample selection, data collection and analysis. The second part covers the mathematical construction of the various Finite models.

#### **3.2 Research Design**

The exploratory study sought to determine the following objectives: (i) the relationship between pension fund investment and stock market returns in Kenya, (ii) the influence of pension industry investment on stock market volatility in Kenya. All in all, the study sought to explore whether such participation in the stock market stabilized or destabilized the movement of asset prices.

#### **3.3 Nature of Study and Source of Data**

This study employed secondary data that was of quantitative nature. The data set included daily index returns from the NSE 20, 91 day T-bill and interbank rates, ranging from 2005 to 2015: The data sets were sourced from secondary sources.

#### **3.4 Population and Sampling**

The study applied stock market data particularly that from the NSE 20 index and Retirement Benefits Authority's Assets under Management. The NSE 20 index is selected due to its representative nature of the NSE All Share Index, which happens to be the most important index in the NSE as it has all publicly traded shares listed on it. The data was obtained from the Nairobi securities exchange. Returns of the NSE 20 index were computed according to equation (4) below, and volatility measured thereafter.

#### **3.5 Model Specification**

##### **3.5.1 Stationarity of Data**

The analysis of data commenced with the stationarity of data test. The test employed Augmented Dickey Fuller test which catered to the serial correlation in the error terms which would be potentially present in a stock return series. It is represented as,

Equation 1

$$\Delta r_t = \alpha_0 + \alpha_1 t + \beta \Delta r_{t-1} + \sum_{i=1}^n \alpha_i \Delta Y_{t-i} + \varepsilon_t$$

The test's null hypothesis is that the  $\beta = 0$  i.e. the series is stationary. The coefficient  $\alpha_1$  shows the time trend for change in return and the last term  $\varepsilon_t$  is the white noise error term. Stationarity tests are carried out since non-stationary time series would lead to spurious regressions.

### 3.5.2 Analytical Framework

The classical linear regression models are known to assume homoscedasticity (constant variance of the error terms). This has been the basis for the use of the least squares model. However financial series data exhibits volatility clustering which suggests that asset returns are serially correlated, thus violating the homoscedasticity assumption. Heteroscedasticity is the assumption in which the variances of the error terms on data are not equal. In presence of Heteroscedasticity, the regression coefficients for an ordinary least squares regression are still unbiased, but the regression coefficients estimated will be too narrow, giving a false sense of precision (Engle, 2001).

The generalized autoregressive conditional Heteroscedasticity –GARCH model was introduced by Bollerslev (1986) as a more developed model of the autoregressive conditional Heteroscedasticity- ARCH, developed by Engle (1982). GARCH has been widely used to predict and model stock volatility by many financial analysts. It is parsimonious and reduces the chances of violation of the non-negativity constraint with regard to conditional variance.

The Garch model has proven to be able to predict conditional variances even in the simplest forms. The equation is as shown below (Engle, 2001):

EQUATION 2

$$\sigma_t^2 = \alpha_0 + \alpha_1 \mu_{t-1}^2 + \beta \sigma_{t-1}^2$$

The conditional variance  $\sigma_t^2$  is dependent on lagged squared error terms  $\mu_{t-1}^2$ . The arch coefficient represented by  $\alpha_1$  while the Garch term is represented by  $\beta$ . If the summation of the two coefficients is greater than one, then there exists persistency of shocks.

However Garch (1, 1) does not show leverage effects, leading the extension of Egarch (1, 1). The leverage effects are represented by the coefficient  $\gamma$  :

### Equation 3

$$\ln h_t = \omega + \alpha \frac{|\varepsilon_{t-1}|}{\sqrt{h_{t-1}}} + \gamma \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} + \beta \ln h_{t-1}$$

The 91-day T-bill and interbank rate are used as control variables. To check for the effect of pension funds on stock market volatility, the following mean equation is applied:

### Equation 4

$$r_t = \alpha + \sum_{i=1}^p \alpha_i r_{t-i} + \sum_{i=1}^q \delta_i \varepsilon_{t-i} + \beta_1 Tbill_t + \beta_2 IBR_t + \gamma D_i + \varepsilon_i$$

Where  $r_t$  is the stock return rate,  $Tbill_t$  is the 91 day treasury bill rate and is the pension funds variable.

The variance equation is

$$\sigma_t^2 = \alpha + \delta \mu_{t-1} + \beta \sigma_{t-1}^2 + \theta_1 TBill_t + \theta_2 IBR_t + \varphi D$$

Where represents the conditional variance dependent on its lagged squared error terms, lagged variance and the pension fund variable.

The generic ARMA(p,q)-Egarch (1,1) formulation consists of the following mean and variance equations:

### Equation 5

$$r_t = \alpha + \sum_{i=1}^p \alpha_i r_{t-i} + \sum_{i=1}^q \delta_i \varepsilon_{t-i} + \beta_1 Tbill_t + \beta_2 IBR_t + \gamma D_i + \varepsilon_i$$

$r_{t-i}$  in the mean equation above represents the lags (autoregressive terms) of the NSE Returns whereas  $\varepsilon_{t-i}$  represents the average moving terms.

### Equation 6

$$\ln h_t = \omega + \alpha \frac{|\varepsilon_{t-1}|}{\sqrt{h_{t-1}}} + \gamma \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} + \beta \ln h_{t-1} + \beta_1 Tbill_t + \beta_2 IBR_t + \gamma D_i + \varepsilon_i$$

## CHAPTER FOUR

### 4.0 FINDINGS

#### 4.1 Introduction

This section provided an analysis of the structure of stock market volatility and the impact of pension funds on the same. The study employed monthly data for the period from January 2005 to December 2015, which include 131 observations. The tests were conducted on Eviews 9.0. The results of the study were assessed for their significance at a 95% confidence level i.e. 5% significance level.

The section below (section 4.2) began with a diagnostic analysis on the variables in the study, particularly, the stock index, the Treasury bill rate and the interbank rate. Section 4.3 provides a discussion of the results from the mean and variance equation results from the ARMA (p, q)-EGARCH (1, 1) model.

#### 4.2 Preliminary Analysis

##### 4.2.1 Descriptive Statistics

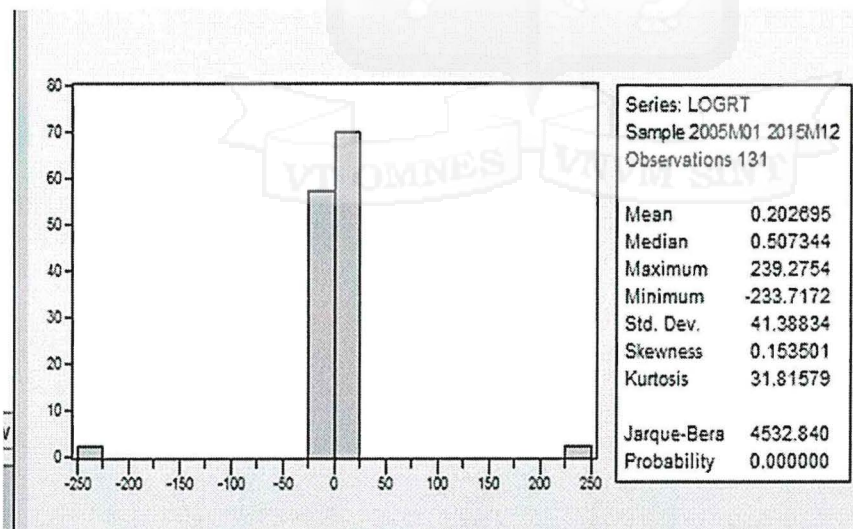
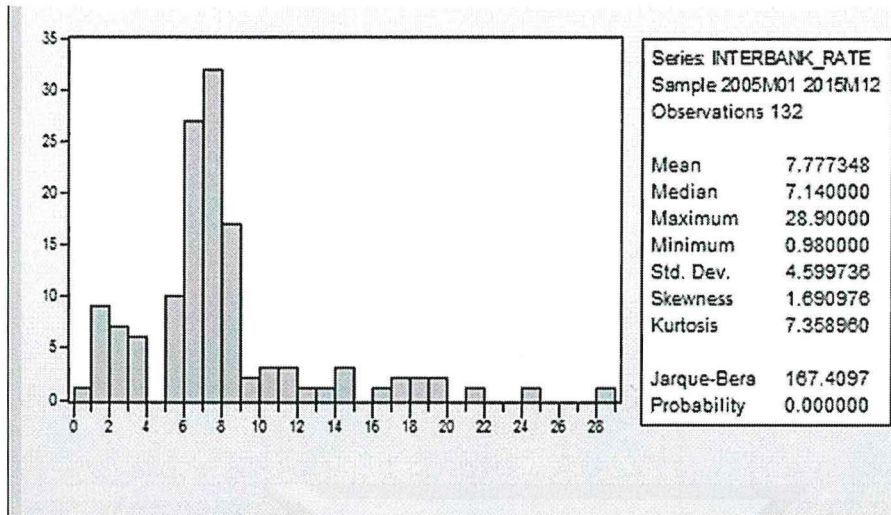


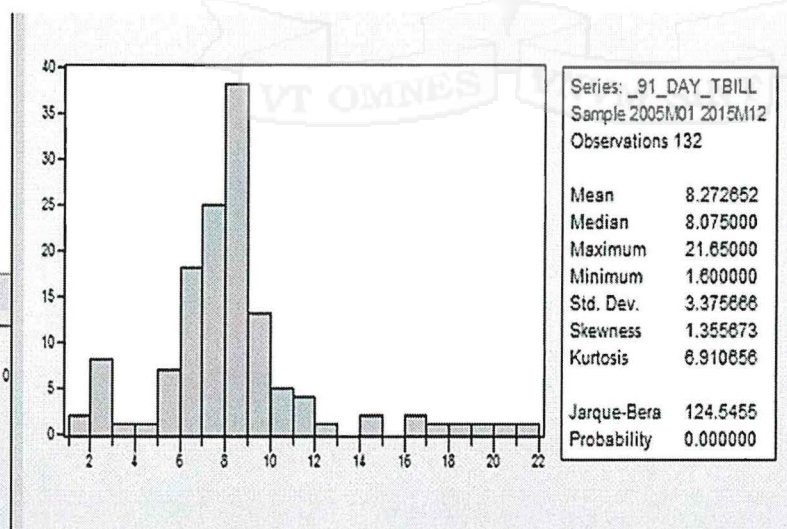
Table 1 Descriptive Statistics for the stock index returns from 2005 to 2015

Table 1 shows the descriptive statistics for the log returns on the stock index. The mean is 0.202 with a positive skewness of 0.1535. The high Jarque-Bera test of 4532.840 indicates the failure to reject the null hypothesis of normality.



**Table 2 Descriptive Statistics for the interbank rates from 2005 to 2015**

The summary statistics for the interbank rate series are as shown in table 2. The mean is 7.78 and the standard deviation is 4.6. The study tests for the normality of the interbank rates. This assists in assessing the distributional adjustments needed for the model specifications. The series is positively skewed at 1.69 and leptokurtic. This implies that the distribution has fatter tails in contrast with a normal distribution, indicating presence of outliers in the data. The assumption of normal distribution in modelling the interbank rate volatility will underestimate the number and magnitude of shocks.



**Table 3 Descriptive Statistics for the T-Bill rates from 2005 to 2015**

The statistics above indicate that the T-bill rates series for the period 2005-2015 is not normally distributed based on the Jacque-Bera test which checks for normality of data. The statistic is 124.5456 with a corresponding p value of 0.000. The series is positively skewed at 1.356.

#### 4.2.2 Stationarity Test

The study carried out a stationarity test on the stock returns series to check for the invariance of statistical properties of the rates over time (Cont, 2011). Non stationary series may exhibit serial correlation which leads to a false regression and the changing statistical properties make it difficult to come up with general inferences about the sample study.

**Table 4: Stationarity Test for NSE Return Series**

Null Hypothesis: LOGRT has a unit root Exogenous: Constant Lag Length: 4 (Automatic - based on SIC, maxlag=12)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.387893	0.0000
Test critical values:	1% level	-3.482879	
	5% level	-2.884477	
	10% level	-2.579080	

\*Mackinnon (1996) one-sided p-values.

The absolute value of the Augmented Dickey Fuller test statistic is greater than the absolute critical value at 5% significance level. This indicates that the return series is stationary, that is, a unit root is not present. This means that the return series is integrated at level zero thus eliminating the need to differentiate it to make it stationary.

**Table 5 Stationarity Test for T-bill Series**

Null Hypothesis: `_91_DAY_TBILL` has a unit root  
Exogenous: Constant  
Lag Length: 3 (Automatic - based on SIC, maxlag=12)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.111691	0.0281
Test critical values:		
1% level	-3.482035	
5% level	-2.884109	
10% level	-2.578884	

\*Mackinnon (1996) one-sided p-values.

Similarly, the T-bill rate series also has an absolute value of the Dickey fuller test (3.111691) that is greater than the value at critical. The series is stationary at level.

**Table 6 Stationarity Test for Interbank rate Series**

Null Hypothesis: `INTERBANK_RATE` has a unit root  
Exogenous: Constant  
Lag Length: 4 (Automatic - based on SIC, maxlag=12)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.460929	0.0107
Test critical values:		
1% level	-3.482453	
5% level	-2.884291	
10% level	-2.578981	

\*Mackinnon (1996) one-sided p-values.

The absolute value of the Fuller test statistic (3.460929) is greater than the absolute critical value at 5% significance level and has a corresponding p-value of 0.0107, indicating statistical significance. As such this indicated that the interbank rate series is stationary as well. The series can be used to draw inferences at level.

### 4.2.3 ARCH Lagrange Multiplier

According to Cont (2001), it is known that the absence of serial correlation does not imply the independence of increments. Independence implies that any non-linear function will also have no autocorrelation. A popular phenomenon is volatility clustering. As such, the autocorrelation coefficient of the squares of the returns is often used as a moment condition for fitting GARCH models to financial time series. The study tested for presence of ARCH effects

**Table 7: ARCH TEST**

Heteroskedasticity Test: ARCH				
F-statistic	41.96107	Prob. F(1,128)	0.0000	
Obs*R-squared	32.09523	Prob. Chi-Square(1)	0.0000	
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Date: 12/03/17 Time: 11:12				
Sample (adjusted): 2005M03 2015M12				
Included observations: 130 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	490.9866	530.3334	0.925807	0.3563
RESID^2(-1)	0.496876	0.076705	6.477736	0.0000
R-squared	0.246886	Mean dependent var	975.8457	
Adjusted R-squared	0.241003	S.D. dependent var	6871.180	
S.E. of regression	5986.203	Akaike info criterion	20.24757	
Sum squared resid	4.59E+09	Schwarz criterion	20.29168	
Log likelihood	-1314.092	Hannan-Quinn criter.	20.26549	
F-statistic	41.96107	Durbin-Watson stat	1.670093	
Prob(F-statistic)	0.000000			

Using 1 lag, presence of Heteroscedasticity is observed with the coefficients of the squared lagged error terms being statistically significant at the 5% confidence level. The f-statistic presented in the test above is 41.96107, which is greater than the critical value at 95% confidence level (the corresponding p value is 0.0000). We therefore reject the null hypothesis of “No Arch effects”.

## MODEL ONE RESULTS

**Table 8: ARMA (2, 2) - EGARCH (1, 1) Without the Pension Variable**

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.162466	0.255602	-0.635620	0.5250
INTERBANK_RATE	0.529139	0.069302	7.635248	0.0000
_91_DAY_TBILL	-0.430550	0.082354	-5.228021	0.0000
AR(2)	0.012965	0.014490	0.894783	0.3709
MA(2)	-0.002579	0.015807	-0.163133	0.8704
Variance Equation				
C(6)	5.383831	5.465701	0.985021	0.3246
C(7)	0.249240	0.561535	0.443854	0.6571
C(8)	0.308333	0.571457	0.539555	0.5895
C(9)	0.164930	0.641278	0.257190	0.7970
C(10)	-0.138179	1.131156	-0.122157	0.9028
GED PARAMETER	0.475369	0.047604	9.985846	0.0000
R-squared	0.011651	Mean dependent var		0.202695
Adjusted R-squared	-0.019725	S.D. dependent var		41.38834
S.E. of regression	41.79454	Akaike info criterion		6.997979
Sum squared resid	220094.8	Schwarz criterion		7.239408

From the table above (without the pension fund variable), the interbank rate significantly affects the NSE returns with coefficients of 0.529138. The 91 day T-bill rate however is shown to negatively affect the NSE returns.

The arch terms in the variance equation capture volatility clustering of the NSE Returns series. This is significant across the model at 5% significance level. In model 1, the interbank and 91 day T-bill rate have positive and significant effect on conditional volatility with coefficients of 0.249240 and 0.308333 respectively.

The autocorrelation of the standardized residuals was obtained using the correlogram Q statistic shown below. The model shows that the functions at different lags are statistically insignificant at 5% significance level in the ARMA (2, 2) EGARCH (1, 1) model. This shows that the mean equation has been adequately specified and the data is well captured by the model specified. The residuals follow white noise with the p-values being greater than 0.05.

Date: 12/03/17 Time: 13:33  
Sample: 2005M01 2015M12  
Included observations: 131  
Q-statistic probabilities adjusted for 2 ARMA terms

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob*
		1	0.009	0.009	0.0111
		2	0.012	0.012	0.0318
		3	-0.062	-0.062	0.5545 0.456
		4	0.002	0.003	0.5553 0.758
		5	-0.034	-0.032	0.7119 0.870
		6	-0.026	-0.029	0.8050 0.938
		7	-0.013	-0.011	0.8289 0.975
		8	0.013	0.010	0.8542 0.991
		9	-0.035	-0.038	1.0266 0.994
		10	-0.016	-0.018	1.0626 0.998

### MODEL 2 RESULTS

**Table 9: ARMA (2, 2) - EGARCH (1, 1) With the Pension Variable**

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.211810	0.231906	0.913344	0.3611
INTERBANK_RATE	0.553084	0.099622	5.551848	0.0000
_91_DAY_TBILL	-0.388350	0.098208	-3.954368	0.0001
PENSION_FUNDS	-8.83E-06	1.00E-05	-0.881641	0.3780
AR(2)	0.004818	0.019576	0.246149	0.8056
MA(2)	0.003498	0.019524	0.179185	0.8578
Variance Equation				
C(7)	1.849766	1.135386	1.629196	0.1033
C(8)	0.458067	0.544293	0.841583	0.4000
C(9)	-0.139049	0.566839	-0.245307	0.8062
C(10)	0.188476	0.341835	0.551365	0.5814
C(11)	0.546955	0.258683	2.114386	0.0345
GED PARAMETER	0.527225	0.044419	11.86946	0.0000
R-squared	0.009442	Mean dependent var	0.202695	
Adjusted R-squared	-0.030180	S.D. dependent var	41.38834	
S.E. of regression	42.00825	Akaike info criterion	6.977317	

With the introduction of the pension funds, the interbank rate and 91 day T-bill are still seen to be significantly positive and negative respectively. The pension funds variable is negative and insignificant at both 10% and 5% significance level. The persistence term 0.188476 however show to be significant at 5% level. This indicates that the volatility of the NSE returns is long lived rather than transitory.

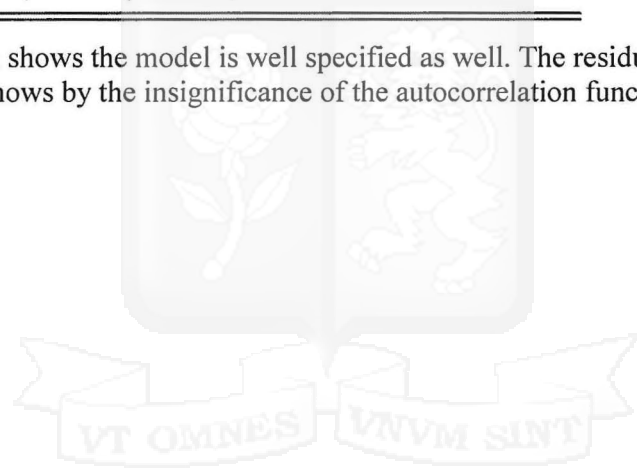
MODEL 2

**Table 10: Autocorrelation of Standardized Residuals**

Date: 12/03/17 Time: 14:28  
 Sample: 2005M01 2015M12  
 Included observations: 131  
 Q-statistic probabilities adjusted for 2 ARMA terms

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob*
		1 0.005	0.005	0.0038	
		2 0.009	0.009	0.0152	
		3 -0.059	-0.059	0.4950	0.482
		4 0.002	0.003	0.4956	0.781
		5 -0.034	-0.033	0.6525	0.884
		6 -0.021	-0.024	0.7150	0.949
		7 -0.020	-0.019	0.7736	0.979
		8 0.012	0.009	0.7951	0.992
		9 -0.034	-0.037	0.9615	0.995
		10 -0.018	-0.021	1.0072	0.998
		11 0.007	0.008	1.0152	0.999
		12 -0.001	-0.007	1.0155	1.000

The correlogram shows the model is well specified as well. The residuals follow a white noise which is shown by the insignificance of the autocorrelation functions at 5% significance level.



## **CHAPTER FIVE**

### **CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 CONCLUSIONS**

The study investigated the effect of pension funds on stock market volatility in Kenya between 2005-2015. The study uses an ARMA (2, 2)-EGARCH (1, 1) to analyze the conditional volatility using the 91-day T-bill and Interbank rate as control variables. The q statistic shows the model to be suitable with the autocorrelation being statistically insignificant at 5% significance level. The results from model 2 indicate that pension variable has a negative and insignificant effect on the stock market returns series with no significant effect of the volatility therefore we fail to reject the null hypothesis that “*Pension funds do not affect the volatility of the stock market*”.

#### **5.2 LIMITATIONS OF THE STUDY**

There were significant challenges in getting RBA investment data on a monthly basis as they only calculate on a quarterly one. Thus an assumption was made that the investments were made uniformly in each month of a quarter.

#### **5.3 RECOMMENDATIONS**

The results of this study may be improved if the time span is increased to more than 20 years thus the quarterly data can be used as it is instead of breaking it down to monthly.

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