IMPACT OF THE NEW NSSF ACT ON STOCK MARKET VOLATILITY

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REG NO 063823

Submitted in partial fulfillment of the requirements for the Degree of

Bachelor of Business Science in Financial Economics at Strathmore University

School of Finance and Applied Economics

Strathmore University

Nairobi, Kenya

November, 2015

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ACKNOWLEDGEMENTS

Foremost, I thank God for providing me with strength, health and the ability to carry out this demanding project.

I wish to express my sincere gratitude to my supervisor, Mr Steve Makambi. I am extremely thankful and indebted to him for sharing his expertise and kindly-worded criticisms. This study has also benefited enormously from the wisdom of Dr John Olukuru, Dean of School of Finance and Applied Economics. I am truly grateful to him for the recommended journals that got me started and the steadfast encouragement to complete this study.

To my family and friends who offered great ideas and encouragement as I worked on this project, I thank you all.

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 Project contains no material previously published or written by another person except where due reference is made in the Research Project itself.

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This Research Project has been submitted for examination with my approval as the Supervisor.

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Abstract

This study is an empirical test of the impact pension funds have on the volatility of daily stock market returns in Kenya. More so, this study looks at the impact the new NSSF Act has had on the volatility structure of aggregate stock returns. The analysis involved NSSF investments funds made at the NSE and daily NSE 20 index returns. The time period under study ranged from the year 2004 to 2015. An Autoregressive distributed Lag (ARDL) framework was used to determine the existing relationship between pension funds and stock market volatility whereas a Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model was used to evaluate the effect of the new NSSF Act on the daily volatility of asset returns at the NSE. The study finds a positive long run relationship between pension funds invested at the NSE and the returns of the market. However, the study did not find any significant influence of NSSF funds on the NSE market volatility.

List of Abbreviations

ARDL	Autoregressive Distributed Lag
AUM	Assets under Management
CBIR	Commercial Bank Interest Rate
CBR	Central Bank Rate
CBK	Central Bank of Kenya
CMA	Capital Markets Authority
DB	Defined Benefits
DC	Defined Contributions
E.A	East African
GARCH	Generalized ARCH
GDP	Gross Domestic Product
KNBS	Kenya National Bureau of Statistics
NASI	NSE All Shares Index
NSE	Nairobi Securities Exchange
NSSF	National Social Securities Exchange
OLS	Ordinary Least Squares
RBA	Retirement Benefits Authority
S&P	Standard and Poor's
U.S	United States

1. Introduction

1.0. Background of the study

1.0.1. Financial sector in Kenya: An outlook

Previous researchers have placed capital markets' participants in two broad categories: individual and institutional investors. Institutional investors are corporations or other legal entities that ultimately serve as financial intermediaries between individuals and investment markets. Frequently representing large pools of money, institutional investors have attained great importance and in many cases, dominance, in financial markets worldwide (Tschampion, Siegel, Takahashi, & L.Maginn, 2007). 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) valued this 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.

The financial sector in Kenya has grown significantly and has taken a paramount role in shaping the economy. It comprises of the banking, capital markets, insurance industry, pension industry, safety nets and resolution institutions like the Kenya Deposit Insurance Corporation, financial markets infrastructure, and Saccos sub-sectors. As a proportion of GDP, total assets of the financial sector excluding capital markets accounted for 108.00 percent in 2013 up from 96.48 percent in 2012 (Capital Markets Authority, 2013).

Table 1-1: Share of the Financial Sector to GDP

GDP/Sub-Sector Assets	Kshs in Mns (2012)	Share of GDP (2012)	Kshs in Mns (2013)	Share of GDP (2013)
Nominal GDP	3,403,547	N/A	3,797,988	N/A
Banking Assets	2,330,335	68.47%	2,703,394	71.18%
Pension Assets	548,700	16.12%	696,680	18.34%
Insurance Assets	311,000	9.14%	366,252	9.64%
Saccos Assets	93,765	2.75%	335,437	8.83%
Total	3,283,800	96.48%	4,101,763	108.00%

Source: Computed from KNBS, NSE and CBK data

Although not the largest financial driver of the economy, pension funds have an important role to play in Kenya's economy. As at June 30th, 2014, pension assets grew to Kshs. 750.02 billion. The amount was composed of the Kshs.628.18 billion held by the fund managers and insurance issuers, Kshs.76.8 billion internally managed by National Social Security Fund (NSSF) and an additional Kshs.45.02 billion of property investments directly managed by scheme trustees (Retirement Benefits Authority, 2014). The overall portfolio was well diversified through heavy investments in quoted securities, immovable property and government securities at 38.6 percent, 26.7 percent and 26.4 percent, respectively (Retirement Benefits Authority, 2014). NSSF is the largest pension fund manager, on the basis of assets under management.

With the enactment of the new NSSF Act, the funds collected and hence managed by NSSF are bound to increase. Moreover, the quoted equity asset class weighting will rise from the 38.6 percent allocated as at June, 2014. A question may thus arise on the effect the increased large influx of funds will have on the one asset that is heavily invested on, quoted securities. This study therefore sought to establish the effect pension fund investments would have on the volatility of asset prices in the stock market.

1.0.2. Investor profile at the Nairobi Securities Exchange

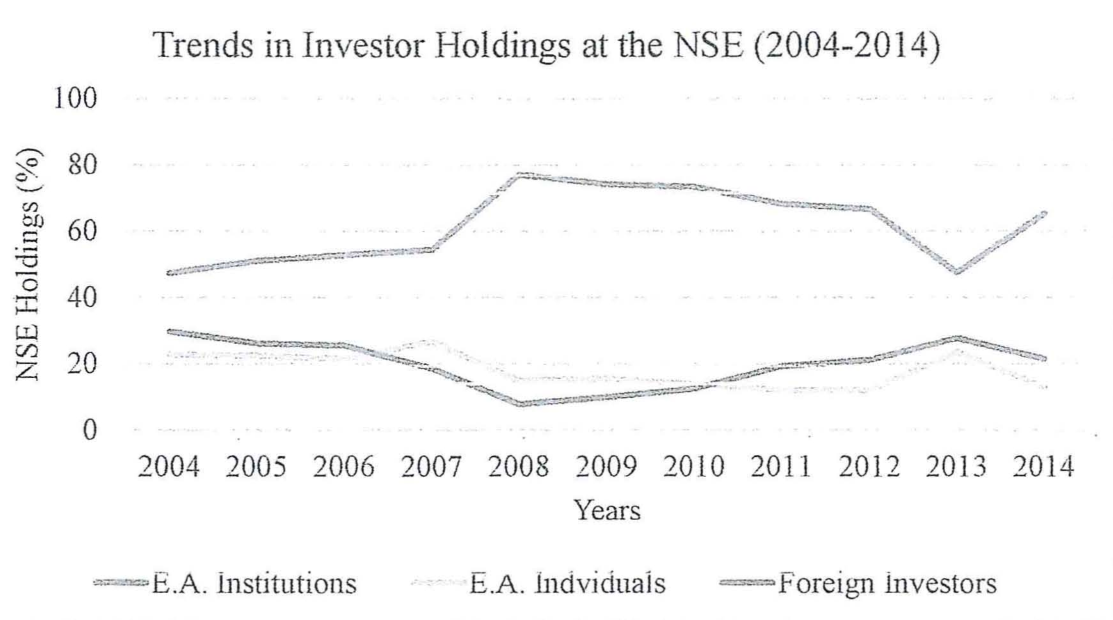
As at end of December 2014, local institutional and retail investors held 78.82 percent of all listed and trading equities at the NSE by category. The local corporates held 24.78 percent, whereas the local individuals held 52.04 percent market share (Capital Markets Authority, 2014).

Table 1-2: Equity Holdings as at Dec 2014

Category of Investors	No. of investors	No. of shares	Shares held (%)
East African Corporate	256	448,480,572	0.55
East African Individuals	7,845	109,587,987	0.13
Foreign Investors (Corporate)	593	17,497,162,894	21.49
Foreign Investors (Individuals)	7,996	816,460,050	1.00
Local Corporate	43,585	20,179,761,230	24.78
Local Individuals	1,241,187	42,372,609,192	52.04

Source: CDSC/CMA database

Figure 1: Trends in investor holdings at the NSE (2004-2014)



The shareholding of institutional investors has indeed been falling over the recent past but is set to increase in the near future, courtesy of the newly enacted NSSF Act, 2013.

1.0.3. New NSSF Act

The enactment of the new NSSF Act, number 45, of 2013, is likely to lead into the growth of the size of the social security fund in the near future. Mandatory 12 percent contributions to the fund (a rise from a fixed Kshs. 400 contribution from every plan sponsor, regardless of salary level), conversion from provident to pension fund and capping administrative fees to up to 2 percent of assets held, are some of the new features of the act that are expected to grow the fund. Masinde and Olukuru (2014) supported the foundation of this Act citing that the pension industry needed changes in management and governance in order to meet the ever changing scheme member needs. The Kenyan pension industry regulator, Retirement Benefits Authority (RBA), has set out investment guidelines for the social security fund (The Retirement Benefits Act, 1997). For instance, up to 70 percent of the funds may be invested in the Nairobi Securities Exchange. By extension, should the pension fund actually grow in size, NSE ought to receive additional investments from the pension fund. Because the fund managers are believed to be professionals with expertise knowledge on all matters investment, this increased participation may or may not have an impact on the level of efficiency in the market. It is however important to note that this transition of increased NSSF deduction from the payslip will take place in phases over a period of 5 years from commencement date. The phases are defined by the various income brackets as illustrated by appendix A.

Different scholars have held opposing views on the implications of pension fund investments on the stock market volatility. Fama (1965) argued that although heterogeneous agents could trade irrationally due to poor information processing, the presence of sophisticated and well informed institutional investors could help eliminate huge disparities in the deviation of equity prices from their fundamentals. In his support, Kothare and Laux (1995), Falkenstein (1995); Gompers and Metrick (2001) & Ang and Maddaloni (2005) are of the opinion that highly volatile securities are more likely than not going to attract institutional investors as they would be of the opinion that riskier assets are more likely than other stocks going to outperform market benchmarks.

However, other scholars such as Sias and Starks (1997) and Dennis and Strickland (2002) came to the conclusion that institutional investors have a destabilizing effect in stock returns. This was attributed to the fact that they, the institutional investors, differed in their trading behaviours because of the difference in the information collection and information processing.

Over the last ten years, different scholars have attempted to build on this particular field of knowledge. Gabaix, Gopikrishnan and Plerou (2006) sought to understand the origins of volatility in the stock market predictions which appeared to exceed the predictions made by simple models founded on rational expectations and simple discounting. They thus proposed a model where volatility was driven by the large trades of institutional investors and further analyzed how such trades may create price movements that are hard to explain by fundamental news. Thomas and Spataro (2014) provided an updated review of the empirical advances in this field of study, with particular focus on the effects that pension funds produce on labour markets, financial markets and economic growth.

1.1. Motivation of the study

Stock markets such as the NSE receive investments from various sources. As at December 2014, local individuals held the largest shareholding of the NSE (Capital Markets Authority, 2014). Local corporates followed second with a 21 percent market share compared to 52 percent market share of the local individuals.

Ginneken (1998) defined social security as the benefits that the society provides to individuals and households through public and collective measures to guarantee them a minimum standard of living and to protect them against low or declining living standards arising out of a number of basic risks and needs. The National Social Security Fund (NSSF) provides a platform for workers to make adequate contributions during their productive years to cater for their livelihoods in old age and other consequences resulting from there such as death or invalidity among others. Article 43(1)(e) of the constitution of Kenya, provides that every Kenyan has a right to social security; and Article 21 of the constitution commits the state to take whatever legislative, policy and other measures as necessary, including the settling of standards to ensure effective and efficient provision of social security (Kenya, 2010). The NSSF Act is also anchored on Vision 2030, National Social Protection Policy of 2013, EAC Common Market Protocol and the 1952 Convention 102 of ILO. NSSF's functions include provision of social security to members through enhanced coverage, efficient registration and collections, prudent fund management and competitive benefits. Before the enactment of the new Act, NSSF only covered workers in the formal economy and made benefit payments in lump sum. The new Act has seen the establishment of two funds: a pension fund and a provident fund. The pension fund is mandatory and will cover all workers in the formal economy. The provident fund is voluntary and it will cover the self-employed. Another important reform introduced with the new Act is the increased contribution rate from the plan sponsors. The Act clearly states that for every one earning above the year's minimum wage, a 12 percent contribution shall be expected into the fund (Kenya, 2010).

NSSF invests in various financial assets such as quoted securities in order to yield a good return that it will eventually pass on to the plan sponsors. With the new regulations in the Act, the NSSF fund is bound to increase in size. This by extension would translate into increased investments in financial assets such as quoted securities. Should this be the case, the difference in shareholding highlighted above is likely to narrow down as more funds will be available for investments in the NSE. Literature on both mature and emerging markets has it that this increased pension fund investment would lower the stock market's volatility thus making asset prices more stable (Jones, Lee, & Weis, 1999); (Bohl & Brzeszczy´nski, 2005). As for the researchers in Kenya such as Kipanga (2012), they have focussed on the relationship between the increased retirement savings and economic growth. A positive correlation was established between the two variables. Others such as Masinde and Olukuru (2014) sought to confirm the sufficiency of the 12% contribution rate introduced by the new Act. They found out that it was indeed sufficient to meet the welfare conditions of Kenyans.

This study therefore focussed on understanding the effects such a policy reform would have on a frontier market. More specifically, this study sought to find out whether the daily volatility structure of the NSE 20 index returns would change given the increased investments.

The following sections of this study will specify the problem statement, research objectives and justifications of the study. Thereafter, the paper presents seminal works of different authors on the spectrum of pension reforms, stock market volatility and the interactions between the two. In the third section, the time series methodology is outlined and in the fourth section, the data as well as the empirical findings are presented. The fifth section summarizes and concludes the findings.

1.2. Problem statement

Institutional investors such as pension funds invest some of their funds in the stock market. As shown in table 2, the year 2014 saw 25 percent of shares in the NSE were held by Kenyan institutions. Some pieces of literature find that the increased number of institutional investors trading on stock markets worldwide since the end of the 1980s has been associated with a rise in financial economists' interest in institutions' impact on stock prices. In particular, there is the suggestion that institutional traders destabilize stock prices thus causing stock prices to move away from fundamentals and thereby inducing autocorrelation between and increasing in the volatility of stock returns. Among others, herding and positive feedback trading are the two main arguments put forward for the destabilizing impact on stock prices induced by institutional investors. (Bohl, Brzeszczy´nski, & Wilfling, 2005). Other pieces of literature finds otherwise; that pension funds can stabilize the market because they are governed by prudent man rules (Arbel et al. 1983; Badrinath et al. 1989), aiding in accumulating less risky stocks thus indirectly reducing the overall volatility in equity returns (Thomas, Spataro, & Mathew, 2014). The aforementioned contradicting positions prompt the need to evaluate whether or not institutional investors stabilize or destabilize the stock market. While extensive research has been carried out in developed markets on the relationship between pension funds and stock market volatility, the same remains limited for a frontier market such as Kenya. This study therefore sought to fill an important gap in literature regarding the relationship between increased pension fund investments and the stock market volatility in a frontier market.

1.3. Research objective

The study's general objective is to investigate the influence of the Kenyan pension industry investment on stock market in Kenya. Specific objectives include:

i) To determine the relationship between pension industry investments and stock market returns in Kenya

ii) To investigate the influence of pension industry investments on stock market volatility in Kenya

iii) To evaluate the effect of the new NSSF Act of 2013 on stock market volatility in Kenya

1.4. Research question

Do pension fund investments have a relationship with the volatility of the stock market the funds are invested in?

i) What is the relationship between pension industry investments and stock market price in Kenya?

ii) How does the pension industry investments influence stock market volatility in Kenya?

iii) What is the effect of the new NSSF Act of 2013 on the stock market volatility in Kenya?

1.5. Scope of the study

The research investigated the effects of increased pension fund investments on the volatility of the stock market. Daily NSE 20 and S&P 500 returns were used from 30th November, 2012 through to 17th September, 2015. The dates were chosen such that there existed equal number of days before and after the date of implementation of the Act. The stock market under scrutiny was the Nairobi Securities Exchange (NSE). The market was selected because of the ease of access of its data. The stocks represented by the NSE 20 index were used as a market proxy to measure the volatility of the NSE.

1.6. Justification of the study

To academic students, research institutions and learning institutions, this study will contribute to the existing literature by looking at the macro effects of pension funds on stock market volatility and hence the economy. Further, understanding the stock market volatility will help guide the government on its investment allocations needed to yield the required rate of return that will ensure financial security for its citizens at their old age.

To investors in the NSE, this study will provide information on the efficiency of the financial market and just how they should expect their return to adjust once the new NSSF Act takes effect. This study will thereby serve to guide their long term investment decisions.

To policy makers and institutional investors at large who invest large sums of money into the market, the findings of this study will help them understand the effects their investments will have on the market and thus aid in deciding whether to make lump sum investments or phase out their investments over a period of time.

1.7. Limitations of the study

The main shortcoming of this study was that there was limited available market indices that fell in the new NSSF regime. This is a shortcoming because the Act was implemented on 1st May, 2014 and the study was carried out almost a year later.

2. Literature review

2.0. Introduction

According to government statistics (Kenya National Bureau of Statistics, 2014), Kenya's economy grew by 4.7 percent in the year 2013 maintaining a rise from the previous year where it had grown by 4.6 percent following a 4.4 percent growth rate in 2011 and a 5.8 percent rate in 2010. The ratio of national savings to GDP has been on a roller coaster of ups and downs since the year 2009. Rate of savings to GDP stood at 12.9 percent in the year 2009, rose to 14 percent in the year 2011 and then dropped to 11 percent in the year 2013. The proportion of people living under the poverty line in Kenya stood at 45.9 percent as at the year 2013. Public expenditure as a share of GDP has been rising and fiscal deficit has also been rising over the years. The aging population is forecasted to increase to nearly 15 percent by the year 2050, thus dependency ratio is set to increase. With these low saving rates and low income growth, one can easily predict a looming pension crisis.

Reynaund (2000, cited in Masinde & Olukuru, 2015) noted that over the past three decades, the living condition of older persons in Kenya had deteriorated. He attributed it to the erosions of their economic power, changes in the family structures and roles, particularly on the care of older members of the immediate family unsustainability of the pension schemes and inability of government to fulfil her expected role in the care and support of older persons in the community.

To protect the future of its citizens, many countries have introduced reforms in their pension and social security systems. Over the last decade, Kenya has introduced a number of pension reforms, such as the establishment of the RBA Act, 1997, which among many other guidelines, stipulated how the pension fund asset allocation ought to be done.

2.1. The concept of pensions

The term 'pensions' has been defined as sum of money paid regularly by the state or by trustees to an employee upon normal or ill- health retirement (Rono, Bitok, & Asamoah, Impact Of Retirement Benefit Act (RBA) On Investment Returns To Pension Funds In Kenya, 2010). To expound on the nature of pension benefits, Zvie Bodie (1990) highlighted two broad categories of pension programs; Defined Contribution (DC) and Defined Benefit (DB). Bodie (1990) explained that under a DC plan, the contributions are specified as a predetermined fraction of salary, although that fraction need not be constant over the course of a career. Upon retirement, the employee receives a lump sum or an annuity whose size depends on the accumulated value of the funds in the retirement account. As for the DB plan, a fixed amount (benefit) is paid out to the contributor. He added that the pension benefit itself was determined by a formula that took into account the employee's history of service and wages or salary. The plan is such that the sponsor (employer) provides this benefit regardless of the investment performance of the pension fund assets (Bodie, 1990).

The term 'social security' as defined by Ginneken (1998) refers to benefits that the society provides to individuals and households through public and collective measures to guarantee them a minimum standard of living and to protect them against low or declining living standards arising out of a number of basic risks and needs. Mghali (2003) suggested that firms ought to bear pension schemes such that the employer contributes a certain percentage together with the employee contribution and that and trustees should control the fund. Mugweru (2001) in his study on National Social Security Fund (NSSF) recommended that investment department at NSSF should consist of professionals who adhere to proper investment policies and procedures.

2.1.1. Pension reforms

Over the last few decades, a number of African countries have put in place reforms in their pension and social protection systems. Kenya, being one of them, has initiated some reforms in its pension industry which has resulted in the growth of the fund over the years. The primary motivation for reform of pension systems in many countries worldwide has been to address the growing fiscal burden of pension liabilities. Masinde and Olukuru (2015) suggested that the main reason many countries were reforming their pension industries was due to OECD

Secretary-General Angel Gurría's assertion that further reforms were needed as the world could not risk a resurgence of old-age poverty in the future. "This risk", he said, "is heightened by growing earnings inequality in many countries, which will feed through into greater inequality in retirement."[1] Raichura (2008), argued that Kenya's major driver for a pension reform was to strengthen the governance, management and effectiveness of the existing pensions system. Although every country handles the reforms differently, they all have similar fundamental

[1] http://www.oecd.org/els/public-pensions/

principles on how to diversify and thus balance out risk and return in order to attain the optimal return (Rono, Bitok, & Asamoah, 2010).

One of the biggest milestones attained by the Kenyan pension industry was the enacting of the RBA Act in 1997. The Act had five main objectives. Firstly to Regulate & supervise the management of retirement benefit schemes. Secondly, to protect interest of members and sponsors of retirement benefit. Thirdly promote the development of the retirement benefit sector, fourthly to advise the Minister on the national policy and to implement Government policies and fifthly to perform such other functions as are conferred by the Act (Kiptanui, 2003). Over time, stakeholders questioned the efficiency of the Kenyan pension industry. This in effect led to the formulation of a new NSSF Act 2013. The Act proposes a raft of measures that aims at enhancing the old age financial security in Kenya (Masinde & Olukuru, 2014). Should the Act be successful, this by extension would mean that the national savings level would increase.

Below is a pictorial representation of the different reforms that have been implemented in the Kenyan pension industry thus far:

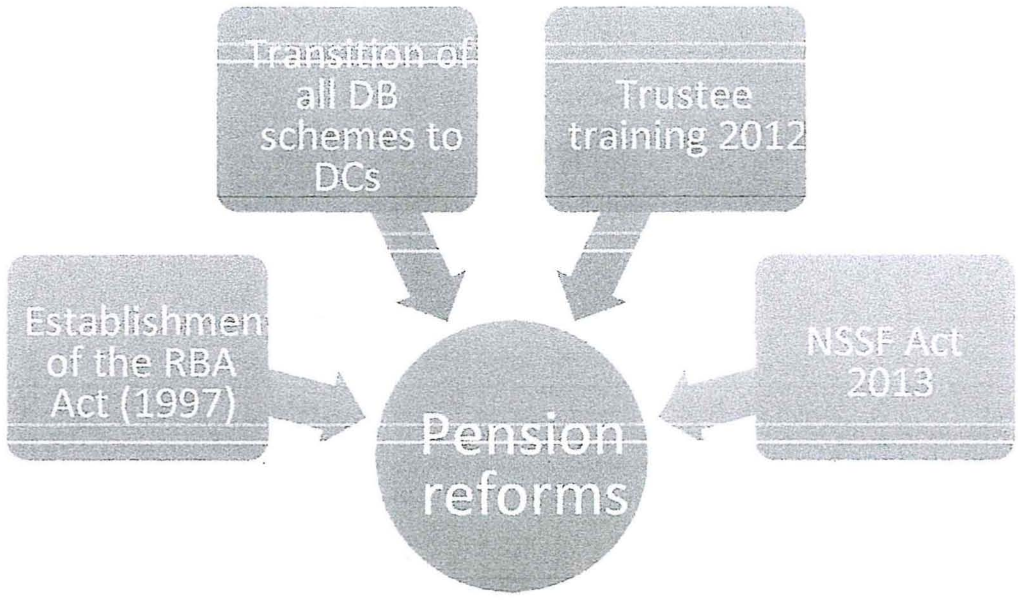


Figure 2: Different pension reforms in Kenya

There exists a few theories that support pension reforms. For instance, Friedman (1957) in his Permanent Income Hypothesis, investigated pre- and post-retirement living standards in "straightening out the consumption stream". The theory suggested that individuals based their consumption on a long term view of income measure. The basic hypothesis posited was that individuals consumed a fraction of that permanent income and that was the average propensity to consume which would equal the marginal propensity to consume. The lifecycle hypothesis by Modigliani, (1963) deals with economic decisions on retirement saving in particular the rationalization of an individual's income in order to maximize its utility over his lifetime. As articulated by Masinde and Olukuru, (2015), the lifecycle hypothesis stated that households accumulate savings during their working careers up to their retirement, and de-accumulate wealth thereafter. Such a saving behaviour enabled households to smooth out their marginal utility of consumption over their lifecycle. However, this hypothesis assumed that the human beings were forward looking, understood the financial resources they would need in successive periods and made informed choices about the use of financial resources.

2.2. Volatility in the stock market

Some researchers have argued that the stock market in general overreacts to events because investors' pursuit of fads and other herd-like behaviour. Shiller (1981), for example, used time series analysis to study stock prices and found that stock price volatility is too high to be attributed to new information; instead he attributed this volatility to changes in real interest rates. Further, the author allowed the real discount rate to vary over time thus providing explanation for share price volatility.

Other authors suggested that shocks in stock market volatility were never persistent. Poterba and Summers (1984) suggested that changes in volatility affected expected required returns for periods not substantially greater than two years. Thus any shock would only have a very limited impact on the share of prices.

In his paper, From Efficient Markets Theory to Behavioural Finance, Shiller (2003) introduced a new school of thought to asset pricing. After calculating the present values of S&P 500 stock prices using a geometric average real return, he found that the stock prices had a stable trend but the real price index bore a volatile movement. He thus suggested that the excess volatility was brought about by "sunspots" or "animal spirits" or just mass psychology. This led to the development of the concept on behavioural finance which contradicted the efficient markets theory, citing that the volatility of asset prices depended on human behaviour and not just fundamental backings (Shiller R. J., 2003).

2.3. Pension funds and stock market volatility

Previous literature has emphasized that pension funds can be beneficial to financial development through different channels. For instance, according to Vittas (1996); Meng and Pfau (2010); and Rocholl and Niggemann (2010), pension fund long term planning horizon favours more efficient and innovative investment opportunities. Bailliu and Reisen (1998); James (1998); and Kohl and O'brien (1998) suggest that pension funds may stimulate both private and national savings. Other scholars propose that pension funds may boost economic growth via improved corporate performance (Myners & Britain, 2002); (Coronado, Engen, & Kngiht, 2003) and improve performance of firms (Guercio & Hawkins, 1999). Another channel through which pension funds can be beneficial to financial development is by lowering the asset price volatility thus improving the market efficiency. It is that last channel that forms the basis of this paper.

Discussions on whether institutional investors stabilize or destabilize the stock prices have been going on for a long time. Herding and positive feedback trading are the two main arguments put forward for the destabilizing impact on stock prices induced by institutional investors. Consequently, empirical investigations in the existing literature have been focused on the question of whether institutional traders exhibit these types of investment behaviour (Bohl & Brzeszczy´nski, Do institutional investors destabilize stock prices? evidence from an emerging market, 2005).

Friedman (1953) argued that the role of rational speculators was to stabilize asset prices. Later contributions by Chopra, Lakonishok and Ritter (1992); Aggarwal and Rao (1990); Daigler and Wiley (1999) and Brennan (2004) argued that institutional investors were more likely to behave rationally as they were less sensitive to fads and noise.

Evidence of either herding or positive feedback trading was found not to imply destabilizing of stock prices by institutional investors. Bohl and Brzeszczy'nski (2005) proposed that if institutions herd and all reacted to the same fundamental information in a timely manner, then institutional investors would speed up the adjustment of stock prices to new information and thereby make the stock market more efficient. Moreover, institutional investors would stabilize stock prices, if they collectively countered irrational behaviour in individual investors' sentiment.

If institutional investors are better informed than individual investors, institutions are likely to herd to undervalued stocks and away from overvalued stocks. Such herding can move stock prices towards rather than away from fundamental values. Similarly, positive feedback trading has been shown to be stabilizing, if institutional traders underreact to news (Lakonishok et al., 1992).

Lakonishok, Shleifer and Vishny (1992) examined the impact of pension funds on stock prices in the United States. They investigated the holdings of 769 US pension funds and concluded that pension fund herding and positive feedback trading in large stocks was at a minimal. Although there was evidence of positive feedback trading for smaller stocks, this did not have a destabilizing effect on stock prices. The scholars found out that pension fund managers did not exhibit herding behaviours except for smaller stocks. Jones, Lee and Weis (1999) examined the relationship between stock prices and different types of institutions in the US from the year 1984 to the year 1993. It was discovered that all institutions were engaged in positive feedback trading. However there was no evidence of institutions destabilizing equity prices. They noted that pension fund managers acted as feedback traders especially on the buy side and mostly in small stocks which exhibited a high previous performance. According to such views, institutional investors are depicted as smart money investors that stabilize asset prices by offsetting the irrational trades of individual investors (Thomas, Spataro, & Mathew, 2013).

As for emerging markets, Voronkova & Bohl (2005) analysed the investment behaviour of pension funds on the polish market. They applied a measure suggested by Lakonishok et al. (1992) to compare the degree of herding and feedback trading between the Polish and developed stock markets. The estimated values of herding and positive feedback trading measures were found to be considerably higher than the corresponding measures of developed markets. This finding is primarily attributed to a stringent investment regulation and high market concentration. In short, trading by pension funds exerts significant influence on the future stock prices (Thomas, Spataro, & Mathew, 2013).

Recent researchers took up a macro approach to analyse the relationship between stock market volatility and pension funds. Walker and Lefort (2002) carried out a panel study for 33 emerging markets and found a positive link between capital markets development and pension funds. In addition, they found a statistically significant negative relationship between market volatility and growth of pension fund assets. Davis and Hu (2004) explored the G-7 countries and found out that the share of institutional investors in total equities had a positive effect on equity price volatility; thus showing a positive relationship between pension funds and market volatility. Thomas, Spataro, & Mathew (2013) used a macro-approach as well with a focus on the panel of the whole set of OECD countries from the year 2000 to the year 2010. Having estimated both a random effects panel model and a Prais-Winsten regression, it was found that their existed a negative relationship between the shares of pension funds' assets invested in stocks and stock market volatility in OECD markets. The binary Probit and Logit models further validated the argument that pension funds as institutional investors could dampen the stock market volatility.

2.3.1. Case study: Pension system reforms and investors' structure in Poland

The Polish stock market was re-established in the year 1991 and in terms of market capitalization, it has shown immense growth over the last decade. The major change the market underwent was that of pension system reforms. According to Bohl et al. (2005) in the year 1999, the Polish public system was enriched by a private component, represented by open-end pension funds. Participation in this component was mandatory for the employees below certain age. They were obliged to transfer 7.3 percent of their gross salary to the government-run social insurance institute called Zak lad Ubezpieczen Spo lecznych (ZUS), which in turn would transfer it to the pension funds. The first transfer of money from the ZUS to the pension funds took place on May 19, 1999. This date changed the investors' structure of the Polish stock market significantly. In 1999, about 20 percent of the domestic institutional investors and 45 percent of the domestic individual investors traded at the Warsaw Stock Exchange. That situation has nearly reversed until 2003 so that the number of institutional traders has approximately doubled over the 1999 – 2003 period (Bohl & Brzeszczy´nski, 2005).

Before May 19, 1999, majority of traders were small, private investors. After that date however, pension funds became important players on the Polish stock market. Bohl et al. (2005) thus compared the period before May 19, 1999 characterized mainly by non-institutional trading with the period after that date, where pension funds as institutional investors acted on the stock market. They performed a GARCH analysis and found empirical evidence that the increase of institutional ownership temporarily changed the volatility structure of aggregate stock returns. However, the findings did not support the hypothesis that institutional investors had destabilized stock prices.

The results were interpretable in favour of a stabilizing effect on index stock returns induced by institutional investors.

2.4. Summary

Government statistics over the last one decade have indicated a reduced saving rate and an increased expenditure rate (Kenya National Bureau of Statistics, 2014). Researchers have it that the ageing population shall increase to nearly 15 percent by the year 2050 thus increasing the dependency ratio. With the decreased savings and increased dependency ratio, there is need for reforms in the pension system to ensure that the future of the Kenyan citizens is protected.

The term 'pensions' has been defined by Rono, Bitok, & Asamoah (2010) as sum of money paid regularly by the state or by trustees to an employee upon normal or ill- health retirement. This savings concept was borrowed from the British system. Mugweru (2001) advocated for the need for professional investment managers who would adhere well to the policies stipulated by the pensions' regulatory board in Kenya, RBA. Over the decades, the Kenyan pension system underwent reforms to help increase its efficiency and ultimately the well-being of its contributors.

Volatility in the stock markets have mainly been attributed to human behaviours. Shiller (2003) contradicted 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).

As for the relationship between pension funds and stock market volatility, scholars assumed that institutional investors would act rationally (Aggarwal & Rao, 1990). Friedman (1953) summarized the arguments by most scholars citing that rational investors are expected to stabilize asset prices. Herding and positive feedback trading were discovered to aid in stabilizing the volatility in the market (Lakonishok, Shleifer, & Vishny, The impact of institutional trading on stock prices, 1992). Although most of the literature was based on mature markets, Bohl and Brzeszczy´nski (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 on frontier markets (as was the case with the Polish stock market) and the main objective of the study is to evaluate the effects the NSSF pension reform would have on the volatility at the NSE market.

3. Methodology

3.0. Research Design

The research work invoked the use of two sets of different dummy variables: once set captured the periods before and periods after the implementation of the new Act whereas the second set of dummy variables captured the day-of-the-week effect.

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 and (iii) the effect of the new NSSF Act of 2013 on the stock market volatility in Kenya. In a nutshell, the study sought to explore whether such participation in the stock market stabilized or destabilized the movement of asset prices.

3.1. Population and sampling

The study applied stock market data particularly that from the NSE 20 index and NSSF's AUM. The NSE 20 index is selected due to its representative nature of the NASI, 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 (5) below, and volatility measured thereafter. The international influence on the NSE market was measured with the US S&P 500 index

The dummy variable D_t was set at 0 before 1st May 2014 and 1 after the cut-off date of 1st May 2014, when the implementation of the new Act commenced.

3.2. Nature 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, central bank interest rates, commercial bank interest rates, inter-bank lending rates and inflation rates, ranging from 2009 to 2015. The data sets were sourced from secondary sources.

3.3. Data Analysis

3.3.1. Preliminary analysis

The study carries out a preliminary analysis of the data was carried out first. The analysis commences with a stationarity test. The test employed was the Augmented Dickey Fuller test which catered to the serial correlation in the error terms which would be potentially present in an stock return series. It is represented as,

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

The test's null hypothesis is that the $\beta = 0$ i.e. the series is stationary.

The coefficient α_1 shows the time trend for change in return and the last term ε_t is the white noise error term. Stationarity tests are carried out since non-stationary time series would lead to spurious regressions.

In addition, an asymmetric GARCH (1, 1) model:

$$h_t = (1 + \gamma_D D_t)(\gamma_0 + \gamma_1 h_{t-1} + \gamma_2 \varepsilon_{t-1}^2 + \gamma_3 \varepsilon_{t-1}^2 I_t) \qquad (2)$$

whose coefficients imply non-stationarity in variance ($\alpha + \beta \geq 1$) is considered undesirable in that as the prediction horizon increases, the conditional variance does not converge to the unconditional variance. This then makes forecasting problematic as the prediction horizon increases. As such, the series found to be non-stationary should be differenced to make it stationary.

This study thereby carried out tests with regard to empirical properties of asset returns including volatility clustering and heteroscedasticity. The presence of the same will provide justification for the use of a conditional heteroscedasticity framework.

3.3.2. Analytical framework

The classical linear regression models are known to assume constant variance of the error terms (homoscedasticity). However, financial time series data exhibits volatility clustering which suggests that asset returns are serially correlated, thus violating the homoscedasticity assumption. Campbell, Mackinlay, & Lo (1997) argued that it was both statistically inefficient and logically inconsistent to use volatility measures that assume that volatility is constant over time. Engel (2001) argued against the OLS to model volatility, citing that in the presence of heteroscedasticity, the regression coefficients from the OLS framework would still be unbiased but provide narrow standard errors that would give a false sense of precision.

To address the first objective of establishing the relationship between pension fund investments and stock prices, this study adopted an ARDL model which estimated stock price movement as a function of NSSF investment funds. Other macroeconomic variables including inflation rate and relevant market interest rates are included to control for macroeconomic conditions. The following empirical model was estimated:

$$SP_t = \beta_0 + \beta_1 EX_t + \beta_2 CBR_t + \beta_3 NSSF_t + \beta_4 CBIR_t + \beta_5 IBLR_t + \beta_6 IR_t + \varepsilon_t \quad (3)$$

Where:

SP_t = the stock price at time t

EX_t = the exchange rate at time t

$NSSF_t$ = NSSF investment funds at period t

CBR_t = the Central Bank Rate at time t

$CBIR_t$= the Commercial Banks Interest Rates at time t

$IBLR_t$ = the Inter Bank Lending Rates at time t

IR_t= the Inflation Rate at time t

β_0 = the constant term

$\beta_1, \beta_2, \ldots \beta_5$ = variable coefficients

ε_t= the error term

To address the second and third objectives, this study employed an asymmetric GARCH 1, 1) model. The GARCH model was proposed by Bollerslev (1986) as an improvement to the ARCH model developed by Engle (1982).The model is an infinite order ARCH model that is highly parsimonious and as such reduces the chances of violation of the non-negativity constraint with regard to the conditional variance. The GARCH (1,1) is usually highly favoured in many volatility modelling studies as it not only parsimonious but also reveals volatility clustering.

The empirical investigation on the institutional traders' influence on stock market autocorrelation and volatility will thereby rely on the following asymmetric GARCH model:

$$R_t = \sum_{i=1}^{5} \propto_{i0} D_0 W_{it} + \sum_{i=1}^{5} \propto'_{i0} D_{0t} W_{it} + \propto_1 R_{t-1} + \propto'_1 D_t R_{t-1} + \propto_2 \sqrt{h_t} R_{t-1} + \propto'_2 D_t \sqrt{h_t} R_{t-1} + \propto_3 R^F_{t-1} + \varepsilon_t \quad (4)$$

$$h_t = (1 + \gamma_D D_t)(\gamma_0 + \gamma_1 h_{t-1} + \gamma_2 \varepsilon^2_{t-1} + \gamma_3 \varepsilon^2_{t-1} I_t) \quad (5)$$

$$D_t = \begin{cases} 1 \; if \; t \geq 2014:6:1 \\ 0 \; if \; t < 2014:6:1 \end{cases} \quad (6)$$

Where the following holds:

Index return, R_t, is defined as a logarithmic difference such that:

$$R_t = ln \, P_t - ln \, P_{t-1} \quad (7)$$

Equation (4) is inclusive of five dummy variables representing the days of the week from Monday to Friday. The intercept has been removed from the equation to circumvent the dummy variable trap. With the dummy variable D_t, the structural change in the components of the mean equation (4) and the conditional volatility process (equation (5)) connected with the amplified entrance of institutional traders on the NSE market on 1st May, 2014 is modelled.

R^F_{t-1} denotes the logarithmic return on a foreign stock market index.

I_t takes on the value of 0 if the return innovation is 0 or positive, $\varepsilon_{t-1} \geq 0$, and 1 in case the return shocks are negative, $\varepsilon_{t-1} < 0$.

In its general form the mean equation (4) takes into account (i) a day-of-the-week-effect, (ii) first-order autocorrelation in stock index returns, (iii) non-linearity in the first-order autocorrelation pattern, (iv) international interdependence of the NSE market; as well as (v) a structural change in the autoregressive structure after the entrance of institutional traders (Bohl & Brzeszczy'nski, 2005).

The inclusion of the dummy variable $D_{ot}W_{it}$ is driven by the often documented seasonality in stock returns across the days of the week. (French, 1980; Lakonishok and Levi, 1982; Aggarwal and Tandon, 1994). Moreover, substantial empirical evidence shows that the autocorrelation pattern of stock returns exhibits complexities that cannot be captured by the simple first-order autocorrelation coefficient (LeBaron, 1992; Sentana and Wadhwani, 1992; Campbell et al., 1993). To account for this effect, it is assumed that autocorrelations of daily stock returns change with the square root of the conditional variance of returns which are from our asymmetric GARCH model (Sentana and Wadhwani, 1992). In addition, due to the interdependence of the NSE market with international stock markets, index returns on a foreign stock market R_{t-1}^{F} is included as a control variable (Jochum, Kirchg¨asser, and Platek, 1999; Tse, Wu, & Young, 2003; Voronkova, 2004).

For the day-of-the-week dummies as well as the linear and non-linear first order autoregressive components the possibility of a structural change after the entrance of institutional traders is modelled using the dummy variable D_t (Bohl & Brzeszczy´nski, 2005).

Statistically significant coefficients $\propto'_{i0}$, $\propto'_1$ and $\propto'_2$ indicate a structural change in the pattern of stock returns after 1st May, 2014. In particular, while $\propto'_1$ measures the extent of autocorrelation during the period before the entrance of institutional investors, the sum ($\propto_1 + \propto'_1$) provides an autocorrelation measure for the period after the appearance of institutional investors.

The volatility equation (5) is a version of the asymmetric GARCH model put forward by Glosten, Jagannathan and Runkle (1993) in which positive and negative shocks can have different effects on subsequent volatility via the dummy variable I_t. Setting the asymmetry coefficient γ_3 equal to 0, yields the conventional GARCH specification as a special case of GJR model (Bohl & Brzeszczy´nski, 2005).

More important for the question under scrutiny are the properties of the estimated parameter γ_D. If institutional traders have an influence on the volatility structure of index returns, the coefficient γ_D should be statistically significant. The estimated coefficient γ_D provides, thus, a measure of the shift in the conditional volatility process. A statistically significant and positive coefficient γ_D can be interpreted as the evidence in favour of the destabilizing hypothesis. In this case the entrance of institutional investors increases stock market volatility. If γ_D is statistically significant but negative, then institutional investors exhibit a dampening influence on volatility (Bohl & Brzeszczy´nski, 2005).

An error correction term, ε_t, has been included in the model to denote the unpredictable component of index returns.

$$\varepsilon_t = (0, h_t) \tag{8}$$

Bernd, Hall, Hall, & Hausman (1974) jointly estimated equations (4) and (5) via maximum likelihood. Bollerslev and Wooldridge (1992) however reported robust errors on that algorithm. This study will thus implement a general-to-specific procedure; starting with the ARDL process to measure stock prices as a function of NSSF funds, then the mean Equation (4) in its general form including the day-of-the-week dummies, the linear and non-linear first-order autoregressive arguments and the lagged foreign stock returns. Then the day-of-the-week dummies and the non-linear components are excluded to get an impression about the robustness of the empirical findings. In the case of the exclusion of the day-of-the-week dummies, a constant term $\propto_0$in the mean equation is included.

4. Findings

4.0. Introduction

This first part of the data analysis looked at the Autoregressive distributed lag model and more so, a long run cointergration relationship was sought. Thereafter, an Error Correction model was developed to define the short run relationship of the variables. The two models were aimed at addressing the first objective. The second part of this chapter sought to address the second and third objectives. The second part of the data analysis looked at the asymmetric GARCH framework so as to investigate and evaluate the effect of the pension funds on stock market volatility.

4.1. Autoregressive Distributed Lag Model

The purpose of executing this model was to address the first objective which sought to determine a long run relationship between pension funds and stock market prices.

The equation that represented the model was as indicated in equation (3).

4.1.1. Stationarity tests

The first thing that was done was a stationarity test on all data series. Under this test, the Augmented Dickey Fuller test was employed and not surprisingly, they were all found to bear a unit root at level; thus, they were non stationary at level. However, all the data series were found to be stationary at first difference with intercept. CBIR, EXCH and FUNDS were also found to be stationary at first difference with neither trend nor intercept. New differenced variables were thus generated for the purpose of modelling. Because all were I(1), the ARDL model was justified.

4.1.2. Pre-estimation findings

A lag of 1 was selected for both dependent variable and regressors. Model selection was done by the Hannan Quinn criterion. To prove the strength of the model selected, a Hannan Quinn graph is plotted; see appendix 1.1. The model selected (1, 1, 1, 1, 0, 1, 1) appeared to be the strongest of all other models tested as it bore the lowest Hannan Quinn value. The model results were as follows:

Table 4-1: ARDL model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCH(-1))	-3338.385	1498.222	-2.228231	0.0284
D(CBIR(-1))	609.3413	272.7771	2.233844	0.0281
D(FUNDS(-1))	-0.026106	0.408682	-0.063879	0.9492
D(CBR(-1))	0.696644	0.168497	4.134455	0.0001
D(INFLATION(-1))	1683.777	756.1140	2.226882	0.0285
D(IBR(-1))	-0.142722	0.056621	-2.520653	0.0135
ECT(-1)	-0.902834	0.189250	-4.770602	0.0000

R-squared	0.949591	Mean dependent var	-0.001080
Adjusted R-squared	0.946114	S.D. dependent var	0.157264
S.E. of regression	0.036506	Akaike info criterion	-3.711122
Sum squared resid	0.115945	Schwarz criterion	-3.521727
Log likelihood	181.4227	Hannan-Quinn criter.	-3.634620
Durbin-Watson stat	2.027007		

4.1.3. Diagnostic testing

4.1.3.1. Serial correlation test

Assuming a lag 2, a Breusch-Godfrey Serial Correlation LM Test was carried out. As shown in appendix 1.2, the probability value was 0.1754 meaning that the null hypothesis that claims absence of serial correlation could not be rejected. Thus the data had no serial correlation.

4.1.3.2. Normality test

A normality test was carried out on the residuals of the model to see if they followed a normal distribution. The high Jarque-Berra statistic and the very low probability value resulted in the rejection of the null hypothesis that claimed normality at the 1% significance level. See appendix 1.3 for the histogram plotting the residuals of the model.

4.1.3.3. Heteroskedasticity test

As shown on appendix 1.4, the null hypothesis of a Breusch-Pagan-Godfrey heteroskedatic test was rejected citing that the data was heteroskedastic. It is however almost guaranteed that time series data will have constant variance across time. In this light, a White heteroskedasticity test was carried out but the p-value was still too low that the null hypothesis was rejected.

4.1.3.4. Bound test

To address the first objective that seeks to find out if the variables have a long run association or not. In that light, a cointegration relationship and long run form of the model were sought. The table below summarizes the findings from the test. Save for CBIR and CBR, all other variables, including pension funds, were found to have a long run relationship with NSE 20 index returns. The p-value of pension funds was below 5% thus resulting in the rejection of the null hypothesis that claimed no long run relationship.

To further test the long run relationship, a bound test was carried out. It was discovered that the F-statistic was greater than the upper bound at all significance levels, thus resulting in the rejection of the null hypothesis and the adoption of the alternative hypothesis that cited a long run relationship. See table 4.1.3 for the summary statistics.

Thus, save for CBR and CBIR, it was shown that all the other variables (i.e. inflation, NSSF funds, inter-bank lending rate and exchange rate) would move together with the NSE 20 index returns, in the long run.

Table 4-2: Cointegration and long run form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCH)	-1.256854	0.188102	-6.681767	0.0000
D(CBR)	-0.045723	0.037739	-1.211551	0.2283
D(FUNDS)	0.062955	0.006356	9.904971	0.0000
D(CBIR)	-0.004594	0.022149	-0.207405	0.8361
D(INFLATION)	-0.578564	0.041273	-14.017844	0.0000
D(IBR)	0.091915	0.021358	4.303618	0.0000
CointEq(-1)	-1.876073	0.070357	-26.664926	0.0000

Cointeq = NSE20 - (-1.7081*EXCH + 0.0095*CBR + 0.0442*FUNDS -0.0024*CBIR -0.2670*INFLATION + 0.2730*IBR + 0.1334)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXCH	-1.708064	0.142437	-11.991682	0.0000
CBR	0.009452	0.033202	0.284687	0.7764
FUNDS	0.044248	0.004195	10.546684	0.0000
CBIR	-0.002449	0.011801	-0.207499	0.8360
INFLATION	-0.267047	0.025927	-10.299806	0.0000
IBR	0.272977	0.013609	20.058095	0.0000
C	0.133399	0.004804	27.766118	0.0000

Table 4-3: ARDL Bound test

Test Statistic	Value	k
F-statistic	214.8338	6

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.12	3.23
5%	2.45	3.61
2.5%	2.75	3.99
1%	3.15	4.43

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCH)	-1.261345	0.188104	-6.705559	0.0000
D(CBR)	-0.046518	0.037736	-1.232730	0.2203
D(FUNDS)	0.062927	0.006349	9.910951	0.0000
D(INFLATION)	-0.578691	0.041217	-14.03996	0.0000
D(IBR)	0.091666	0.021251	4.313432	0.0000
C	0.250704	0.015747	15.92051	0.0000
EXCH(-1)	-3.216054	0.255464	-12.58910	0.0000
CBR(-1)	0.015751	0.062365	0.252567	0.8011
FUNDS(-1)	0.082764	0.010111	8.185320	0.0000
CBIR(-1)	-0.011297	0.021999	-0.513552	0.6086
INFLATION(-1)	-0.500020	0.057264	-8.731907	0.0000
IBR(-1)	0.511165	0.026854	19.03484	0.0000
NSE20(-1)	-1.876419	0.070193	-26.73221	0.0000

R-squared	0.970065	Mean dependent var	-0.001188
Adjusted R-squared	0.966829	S.D. dependent var	0.136806
S.E. of regression	0.024916	Akaike info criterion	-4.447663
Sum squared resid	0.068911	Schwarz criterion	-4.151988
Log likelihood	288.7551	Hannan-Quinn criter.	-4.327553
F-statistic	299.7573	Durbin-Watson stat	1.924673
Prob(F-statistic)	0.000000		

4.2. Error Correction Model to show the short run relationship

The purpose of this model was to derive the short run relationship between the dependent and independent variables. The residuals of the long run model represented by equation (3) were derived and used as the error correction terms. Using a lag of 1, the model was developed further. The model yielded results as shown in the table below:

Table 4-4: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCH(-1))	-3338.385	692.9063	-4.817946	0.0000
D(CBIR(-1))	609.3413	128.1017	4.756700	0.0000
D(FUNDS(-1))	-0.026106	0.222339	-0.117416	0.9068
D(CBR(-1))	0.696644	0.103082	6.758133	0.0000
D(INFLATION(-1))	1683.777	344.0998	4.893279	0.0000
D(IBR(-1))	-0.142722	0.025783	-5.535425	0.0000
ECT(-1)	-0.902834	0.050881	-17.74399	0.0000

R-squared	0.949591	Mean dependent var	-0.001080
Adjusted R-squared	0.946114	S.D. dependent var	0.157264
S.E. of regression	0.036506	Akaike info criterion	-3.711122
Sum squared resid	0.115945	Schwarz criterion	-3.521727
Log likelihood	181.4227	Hannan-Quinn criter.	-3.634620
Durbin-Watson stat	2.027007		

All the coefficients are short run coefficients and more so, the coefficient for ECT variable represented the speed of adjustment. Thus the speed of adjustment towards a long run equilibrium stood at 90.28%. Given that this coefficient value was seen to be negative and significant, it was argued that the whole system could get back to its long run equilibrium at the speed of 90.28%.

4.2.1. Diagnostic checks

4.2.1.1. Serial correlation

Using the lag of 2, a Breush-Godfrey Serial Correlation LM test was carried out. See appendix 1.5 for a tabulated summary. With a p-value of 26.38%, the null hypothesis was rejected citing that the short run model had no serial correlation.

4.2.1.2. Normality test

The model failed the normality test.by adopting the alternative hypothesis that stated that the model residuals were not normally distributed. However, this may be because the model was a short run model and thus the data sets had not enough time to fully adopt a particular distribution pattern much less a normal distribution patters. Also, the sample size may have had an adverse effect on this absence of normality. See appendix 1.7 for a summary of this test.

4.2.2. Short run causality from NSSF Funds

To carry out this coefficient diagnostic, a Wald test was performed taking the null hypothesis to be that the coefficient of NSSF Funds was equal to zero. Appendix 1.9 summarizes the hypothesis statistics that failed to reject the null hypothesis; meaning that the NSSF Funds lag 1 cannot cause NSE 20. Thus there was no short run causality running from NSSF Funds to the NSE 20 index returns.

4.2.3. Speed of adjustment

The coefficient of ECT was found to be significant and negative at a value of 90.28% (see table 4.1.4). As a result, it was argued that the system was being adjusted at the speed of 90.28% towards long run equilibrium.

4.3. Conclusion of ARDL model

The ARDL model with lag one was found to be the best model as it had no serial correlation, the model was stable and the model approached long run equilibrium at the speed of 90.28%.Although there was no short run causality running from the independent variable, Funds, to the dependent variable, NSE 20, there existed a long-run relationship whereby the two variables were seen to move together.

4.4. Asymmetric GARCH (1, 1)

To address the second and third objectives that sought to investigate and evaluate the effects of the new NSSF Act on stock market volatility, an asymmetric GARCH model was employed.

4.4.1. Preliminary analysis

4.4.1.1. Tests for stationarity

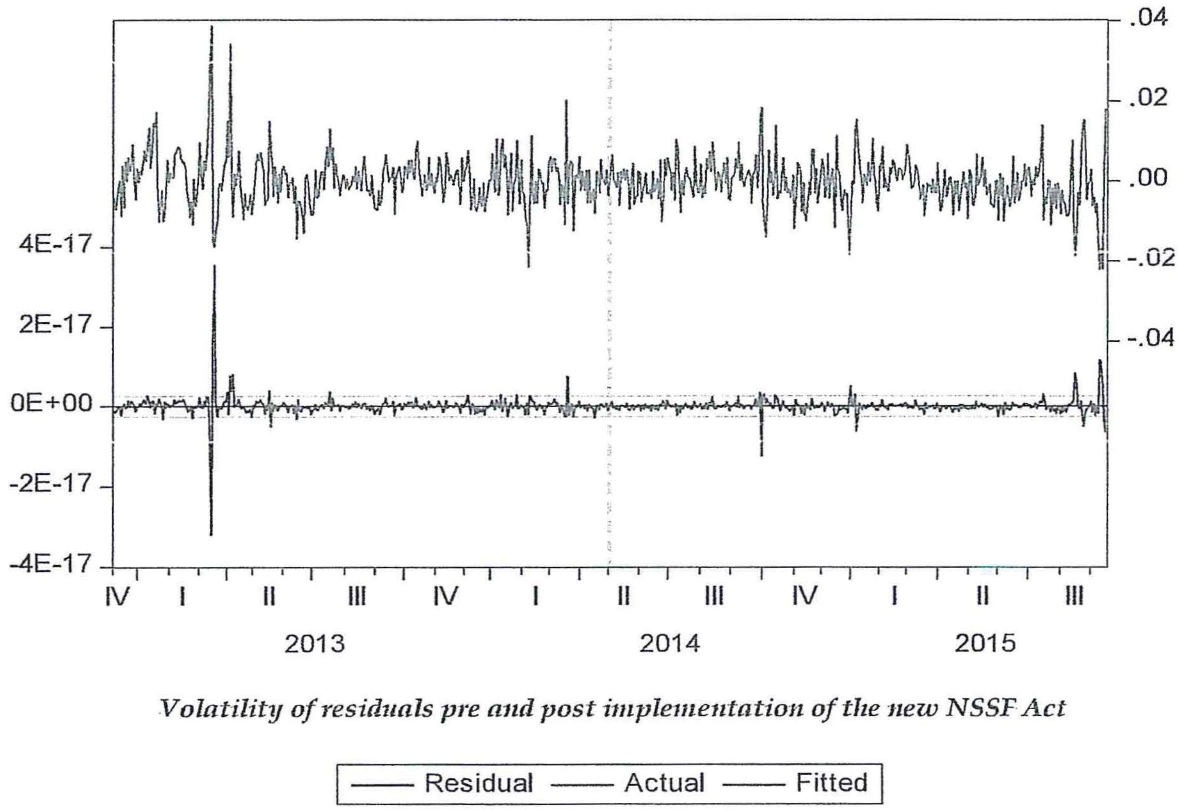
The analysis commenced with a stationarity test. The test employed the Augmented Dickey Fuller test which catered for serial correlation in the error terms.

The NSE-20 index return, S&P 500 index return and the conditional variance were all found to be stationary at level with intercept. Thus the null hypothesis that claimed presence of a unit root, was rejected. See appendices 2.1, 2.2 and 2.3.

4.4.1.2. Justification of the GARCH model

The following step tested for heteroscedasticity in order to validate the use of a GARCH model. The aim was to check for any ARCH effects in the residuals. Thus, a heteroskedasticity test on lag 1 was performed and it was found that the p value was less than 5%. This therefore validated the presence of an ARCH effect hence use of an ARCH/GARCH model. See table 4.2.1 for results. Another validation test used for ARCH effects was that of volatility clustering of residuals. It was seen that periods of high volatility were followed by periods of high volatility and periods of low volatility are followed by periods of low volatility. See the figure 4.2.1 below.

Figure 3: Volatility of NSE 20 index residuals



Volatility of residuals pre and post implementation of the new NSSF Act

Table 4-5: Justification of GARCH model

Heteroskedasticity Test: ARCH

F-statistic	11.31894	Prob. F(1,685)	0.0008
Obs*R-squared	11.16745	Prob. Chi-Square(1)	0.0008

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.173223	0.059467	2.912911	0.0037
WGT_RESID^2(-1)	0.127504	0.037898	3.364363	0.0008

R-squared	0.016255	Mean dependent var	0.198428
Adjusted R-squared	0.014819	S.D. dependent var	1.557847
S.E. of regression	1.546261	Akaike info criterion	3.712463
Sum squared resid	1637.781	Schwarz criterion	3.725658
Log likelihood	-1273.231	Hannan-Quinn criter.	3.717568
F-statistic	11.31894	Durbin-Watson stat	2.037788
Prob(F-statistic)	0.000810		

4.4.1.3. Descriptive statistics

The figure 4.2.2 below provides descriptive statistics of the NSE 20 return series. The mean return is positive, with a maximum and minimum almost equal in absolute magnitude. The returns are not normally distributed; rather they are positively skewed and have a kurtosis of in excess of 3. As evidenced by the histogram in figure 4.2.2, the return series are more peaked around the mean, with thicker tails compared to the normal distribution. The Jarque-Berra statistic and corresponding p value from the series confirm the rejection of the null hypothesis of normality at the 1% significance level.

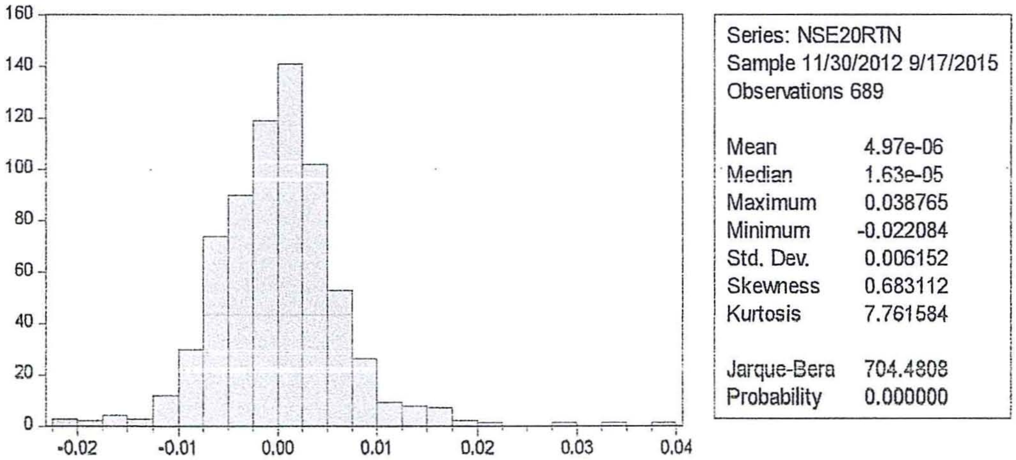


Figure 4: Histogram of Monthly NSE-20 Returns

4.5. Applying the asymmetric Garch (1, 1)

The mean model was as described by equation (2) and the variance model was as described by equation (3). The data series, Enactment, described the dummy variable represented by equation (4) whereas H represented the conditional variance of the NSE 20 index returns as well as S&P 500 index returns. Enactment and lagged H were used as variance regressors for the GARCH equation. The error distribution followed was student's t distribution. The asymmetric GARCH model assumed (1) ARCH effect, (1) GARCH effect and (1) Threshold order. The result was as seen in table 4.2.3 below:

Table 4-6: The Asymmetric GARCH model

GARCH = C(12) + C(13)*RESID(-1)^2 + C(14)*RESID(-1)^2*(RESID(-1)<0)
+ C(15)*GARCH(-1) + C(16)*ENACTMENT*H(-1) + C(17)*H(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
ENACTMENT	-0.000599	0.000287	-2.090328	0.0366
NSE20RTN(-1)	0.581812	0.147002	3.957853	0.0001
ENACTMENT*NSE20RTN(-1)	-0.485707	0.220979	-2.197981	0.0280
H*NSE20RTN(-1)	-28.27968	22.44763	-1.259807	0.2077
H*NSE20RTN(-1)*ENACTMENT	50.65444	32.28477	1.568989	0.1167
SPRTN(-1)	-0.029847	0.015779	-1.891490	0.0586
@WEEKDAY=1	0.000343	0.000343	0.999118	0.3177
@WEEKDAY=2	0.000721	0.000349	2.064801	0.0389
@WEEKDAY=3	0.000864	0.000349	2.476892	0.0133
@WEEKDAY=4	-0.000540	0.000358	-1.506867	0.1318
@WEEKDAY=5	0.000218	0.000370	0.589197	0.5557
Variance Equation				
C	0.000154	6.50E-05	2.371353	0.8177
RESID(-1)^2	0.999314	0.370703	2.695725	0.0070
RESID(-1)^2*(RESID(-1)<0)	-0.046593	0.133550	-0.348881	0.7272
GARCH(-1)	0.410700	0.115558	3.554052	0.0004
ENACTMENT*H(-1)	-0.000268	0.000381	-0.620015	0.9449
H(-1)	0.001546	0.013712	-2.213763	0.6710
T-DIST. DOF	7.892028	2.280808	3.460189	0.0005

R-squared	0.160055	Mean dependent var	1.45E-05
Adjusted R-squared	0.147630	S.D. dependent var	0.006158
S.E. of regression	0.005686	Akaike info criterion	-7.662744
Sum squared resid	0.021852	Schwarz criterion	-7.543993
Log likelihood	2650.153	Hannan-Quinn criter.	-7.616800
Durbin-Watson stat	1.884769		

4.5. Discussion

The second objective was addressed by the signs, sizes and significance of the ARCH, GARCH and Threshold terms of the variance equation. Because the ARCH and GARCH terms were found to be significant at 5% significance level(i.e. 0.7% and 0.04% respectively), and because they both had positive coefficients to the variance equation, it was argued that internal volatility such as that one coming from the previous day's information, cannot influence the volatility of the NSE 20 index return. The Threshold order was however found to be insignificant with a p-value of 72.72%.

To answer the third objective, the model further tested whether external shocks could affect the volatility of NSE 20 index returns. More specifically, the model tested whether the implementation of the new NSSF Act could influence the volatility of the NSE 20 index returns. The p-value was found to be greater than 5% thus the introduction of the new funds into the NSE market would not have an effect on the volatility of the NSE index returns.

Thus in this model, internal shocks such as ARCH (1) and GARCH (1) can affect the volatility of the NSE 20 index returns however external shocks such as a policy change cannot affect the volatility of the NSE 20 index returns.

The structure of the conditional variance was measured and it was found not to be significant at 5% significance level. Thus, whether or not the volatility structure of the NSE had been affected by the pension funds could not be established as the change in the volatility structure was insignificant. This may be attributed to the fact that policy reform effects take time before they are felt in the market.

4.5.1. Additional tests: Wald Test

The model further looked at whether the internal shocks and external shocks could jointly influence the dependent variable. Thus a joint significance test was carried out which assumed a null hypothesis as below:

$$C(13) = C(14) = C(16) = 0 \qquad \text{equation (6)}$$

Where C(13): coefficient of ARCH (1)

C(14): coefficient of GARCH (1)

C(16): coefficient of Enactment

Meaning that ARCH (1), GARCH (1) and the new policy enactment, jointly, cannot influence the NSE 20 index returns. The results from the test were as shown in appendix 2.4. The p-value was found to be 1.28% which was less than 5%. Therefore the null hypothesis was rejected, showing that internal and external shocks jointly could affect the volatility of the NSE 20 index return.

4.6. Diagnostic Tests

4.6.1. ARCH effect

Appendix 2.5 shows the statistics from this test. The p-value was found to be 56.98% which was more than 5%. Thus the null hypothesis of absence of ARCH effect could not be rejected. The model bore no ARCH effect.

4.6.2. Serial Correlation

The p-values were found to be more than 5%. Thus the null hypothesis that claimed no serial correlation was adopted. The model was thus free from serial correlation. See appendix 2.6 for summary of results.

5. Conclusion and Recommendations

Over the last two decades, the Kenyan financial system has received a surge of reforms from its various sectors. The pension industry being one of them, has brought forth a number of reforms starting with the RBA Act of 1997 and now, the NSSF Act of 2013. One common feature of all these reforms experienced in the Kenyan financial market is that they all seek to increase investment activities from institutional and individual investors. Concerning the institutional investors, studies have indicated that they engage in herding and tend to exhibit positive feedback trading strategies and thus contribute to stock returns autocorrelation as well as excess volatility. This paper sought to challenge that popular view and provide different empirical evidence on the influence of institutional investors on stock market dynamics. Using an asymmetric GARCH framework for the analysis and the new NSSF Act of 2013 as the reform in question, the paper sought to determine the relationship between pension funds and stock market returns, the influence and the overall effect changes in pension funds would have on the volatility of asset returns.

To answer the first research question, an ARDL framework was employed and it was discovered that there was no short run causality running from pension funds to the returns of the NSE 20 index. However, it was discovered that the two variables shared a cointegrating relationship; that the pension funds and market returns would move together in the long run. This may be true as a generous amount of pension funds is usually invested in the securities market; thus, a long run increase in the market would mean more returns to the pension fund and hence an upward movement for the fund as well. The reverse will hold; that is, an adverse movement of the market would translate to the pension funds invested there decreasing in value. As for the short run relationship, the absence of a causality can be argued on the grounds that it takes some time for any policy change to be felt in the market. And seeing that this research was carried out a year from the implementation date of the policy, the relationship has not yet been felt in the short run.

To answer the second and third objectives, the GARCH model presented robust empirical findings that failed to support any significant changes in the volatility of stock prices. It was found that the new funds would have no impact on the NSE 20 index returns. In addition, changes in the structure of the volatility of asset returns pre and post implementation of the new NSSF Act were found to be insignificant.

Recommendations

While the mean equation of the of the asymmetric GARCH (1,1) model in this study had many significant coefficients, most of the conditional variance coefficients were insignificant at the 10% level. These results may however improve if the study is carried out at a much later date, for instance 10 years. Only then will we be sure that the policy has fully taken effect and that the volatility in the market has reacted accordingly. In addition, the researcher then will be able to use monthly or quarterly data which would be free from the noise experienced in this particular research work. The noise was brought about by use of daily data.

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Appendices

Appendix A:

Table 4: Phasing out of the new NSSF Act between years 2014 and 2018

Year	Lower Earnings Limit	Upper Earnings Limit
1	Ksh. 6,000	50 percent of National Average Earnings
2	Ksh. 7,000	1 times National Average Earnings
3	Ksh. 8,000	2 times National Average Earnings
4	Ksh. 9,000	3 times National Average Earnings
Year 5 onwards	Amount gazetted by the Cabinet Secretary, Ministry of Labour, Social Security and Services as the minimum monthly basic wage for the year	4 times National Average Earnings

Source: NSSF

Appendix 1.1: Hannan-Quinn criterion graph

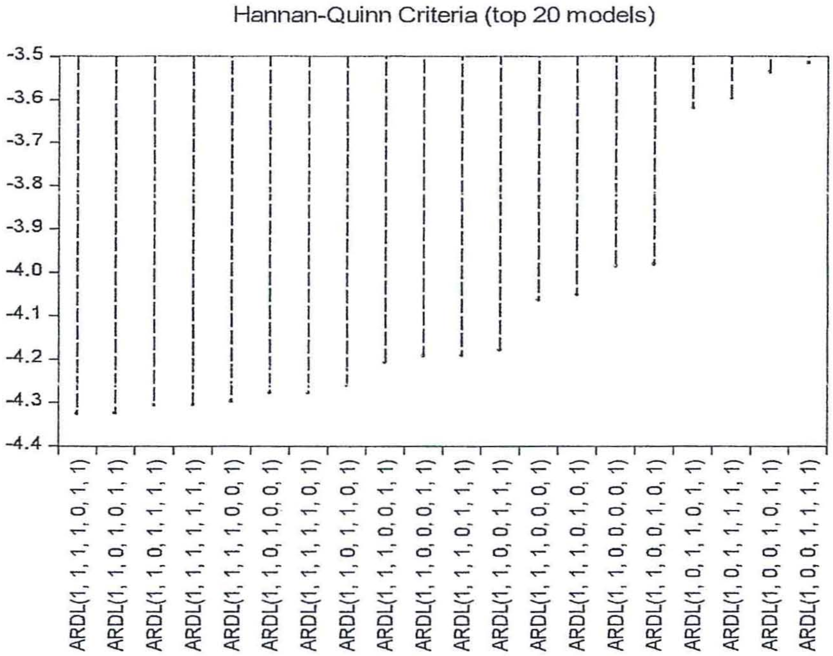


Figure 5: Hannan-Quinn criterion graph

Appendix 1.2: Serial Correlation test for ARDL

Breusch-Godfrey Serial Correlation LM Test:

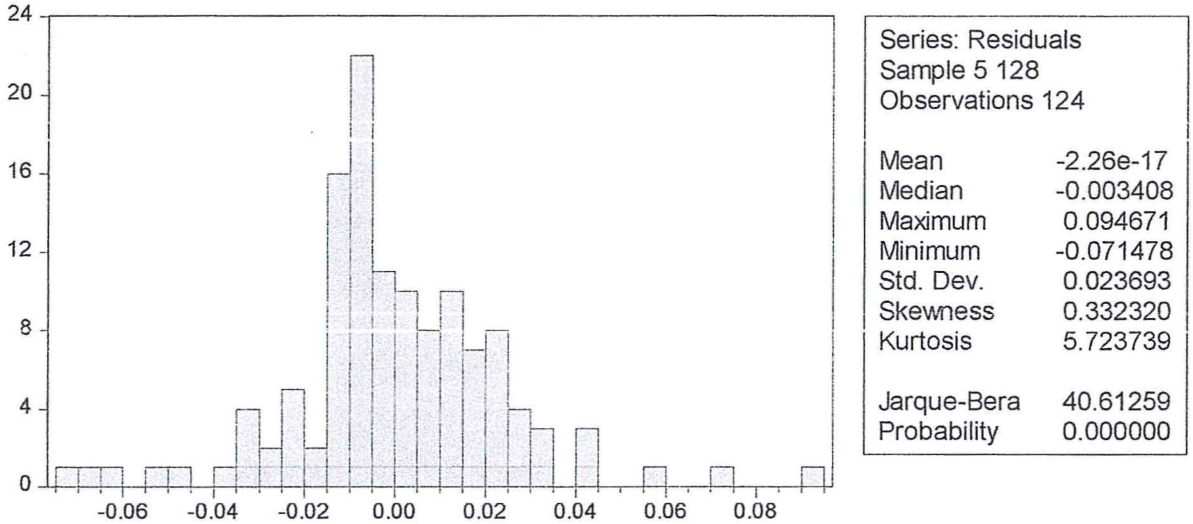
F-statistic	1.574305	Prob. F(2,109)	0.2118
Obs*R-squared	3.481341	Prob. Chi-Square(2)	0.1754

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NSE20(-1)	-0.004961	0.070241	-0.070625	0.9438
EXCH	-0.035096	0.198294	-0.176989	0.8598
EXCH(-1)	-0.147573	0.196805	-0.749843	0.4550
CBR	-0.007031	0.037811	-0.185938	0.8528
CBR(-1)	-0.004906	0.037687	-0.130171	0.8967
FUNDS	-0.001164	0.006386	-0.182211	0.8558
FUNDS(-1)	0.001158	0.004858	0.238342	0.8121
CBIR	0.004668	0.022232	0.209981	0.8341
INFLATION	0.000808	0.041477	0.019487	0.9845
INFLATION(-1)	0.015357	0.032570	0.471493	0.6382
IBR	0.002248	0.021297	0.105550	0.9161
IBR(-1)	-0.006368	0.033058	-0.192638	0.8476
C	0.001634	0.015694	0.104143	0.9172
RESID(-1)	-0.000234	0.114191	-0.002051	0.9984
RESID(-2)	-0.202556	0.114280	-1.772452	0.0791

Table 0-1: Serial Correlation test for ARDL

Appendix 1.3: Normality test for ARDL

Figure 6: Normality test for ARDL



Appendix 1.4: Heteroskedasticity test for the ARDL model

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	5.064842	Prob. F(12,111)	0.0000
Obs*R-squared	43.87337	Prob. Chi-Square(12)	0.0000
Scaled explained SS	83.03469	Prob. Chi-Square(12)	0.0000

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002206	0.000649	3.399396	0.0009
NSE20(-1)	0.001424	0.002901	0.490830	0.6245
EXCH	-0.003940	0.007755	-0.508114	0.6124
EXCH(-1)	-0.006125	0.007334	-0.835132	0.4054
CBR	-0.001979	0.001556	-1.271860	0.2061
CBR(-1)	-0.002863	0.001530	-1.871689	0.0639
FUNDS	-0.000537	0.000262	-2.050599	0.0427
FUNDS(-1)	-0.000326	0.000199	-1.634509	0.1050
CBIR	0.000199	0.000913	0.217835	0.8280
INFLATION	0.000868	0.001702	0.510270	0.6109
INFLATION(-1)	-0.000123	0.001300	-0.094767	0.9247
IBR	-0.001702	0.000881	-1.932703	0.0558
IBR(-1)	-0.002724	0.001359	-2.004182	0.0475

Table 0-2: Heteroskedasticity test for the ARDL model

Appendix 1.5: Serial Correlation test for Error Correction Model (ECM)

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.730613	Prob. F(2,85)	0.1834
Obs*R-squared	2.665131	Prob. Chi-Square(2)	0.2638

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCH(-1))	703.5064	788.6019	0.892093	0.3749
D(CBIR(-1))	-131.6112	146.2493	-0.899910	0.3707
D(FUNDS(-1))	0.305864	0.277479	1.102294	0.2734
D(CBR(-1))	0.137283	0.126275	1.087180	0.2800
D(INFLATION(-1))	-344.4435	390.2059	-0.882722	0.3799
D(IBR(-1))	0.032629	0.032161	1.014544	0.3132
ECT(-1)	-0.059004	0.059789	-0.986869	0.3265
RESID(-1)	-0.134358	0.127854	-1.050871	0.2963
RESID(-2)	-0.224762	0.130302	-1.724928	0.0882

Table 0-3: Serial Correlation test for Error Correction Model (ECM)

Appendix 1.7: Normality test for ECM

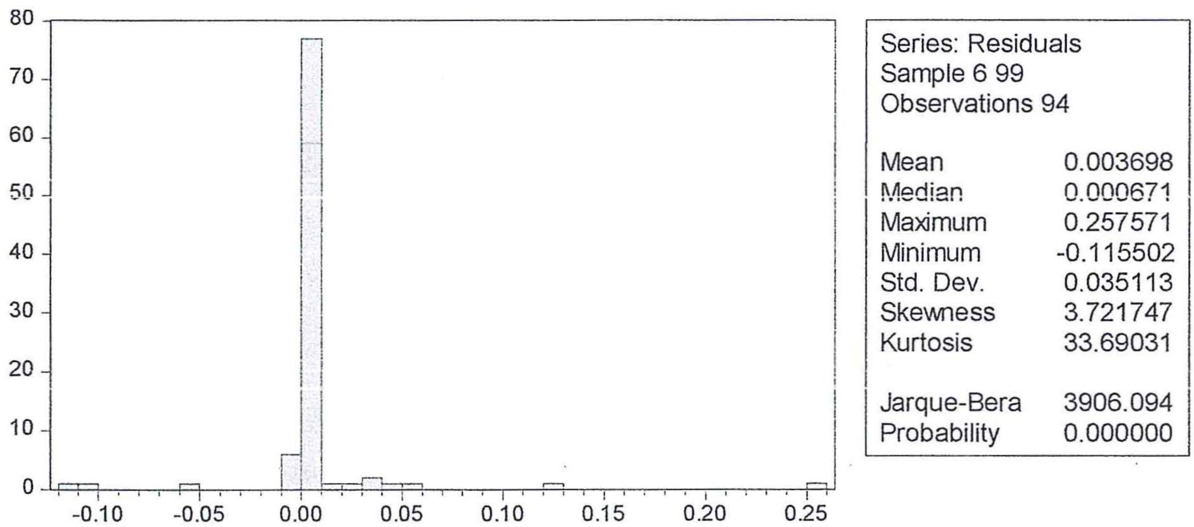


Figure 7: Normality test for ECM

Appendix 1.8: Heteroskedasticity test ECM

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	2.944467	Prob. F(7,86)	0.0082
Obs*R-squared	18.17312	Prob. Chi-Square(7)	0.0112
Scaled explained SS	261.1786	Prob. Chi-Square(7)	0.0000

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000937	0.000701	1.337435	0.1846
D(EXCH(-1))	67.53587	128.4735	0.525679	0.6005
D(CBIR(-1))	-9.901089	23.74482	-0.416979	0.6777
D(FUNDS(-1))	-0.049275	0.040988	-1.202198	0.2326
D(CBR(-1))	-0.030796	0.018983	-1.622269	0.1084
D(INFLATION(-1))	-40.83327	63.81930	-0.639826	0.5240
D(IBR(-1))	-0.006883	0.004746	-1.450232	0.1506
ECT(-1)	0.021336	0.009354	2.280924	0.0250

Table 0-4: Heteroskedasticity test ECM

Appendix 1.9: Short run causality running from NSSF funds to NSE 20 returns

Wald Test:
Equation: ARDLSR

Test Statistic	Value	df	Probability
t-statistic	-0.117416	87	0.9068
F-statistic	0.013786	(1, 87)	0.9068
Chi-square	0.013786	1	0.9065

Null Hypothesis: C(3)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(3)	-0.026106	0.222339

Restrictions are linear in coefficients.

Table 0-5: Short run causality running from NSSF funds to NSE 20 returns

Appendix 2.1: Stationarity test for the NSE 20 index

Null Hypothesis: NSE20RTN has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=19)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-17.74591	0.0000
Test critical values:	1% level	-3.439626	
	5% level	-2.865524	
	10% level	-2.568948	

Table 0-6: Stationarity test for the NSE 20 index

Appendix 2.2: Stationarity test for S&P 500 index

Null Hypothesis: SPRTN has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=19)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-25.95830	0.0000
Test critical values:	1% level	-3.439626	
	5% level	-2.865524	
	10% level	-2.568948	

*MacKinnon (1996) one-sided p-values.

Table 0-7: Stationarity test for S&P 500 index

Appendix 2.3: Stationarity test for the conditional variance of returns

Null Hypothesis: H has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=19)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-16.78882	0.0000
Test critical values:	1% level	-3.439640	
	5% level	-2.865530	
	10% level	-2.568952	

*MacKinnon (1996) one-sided p-values.

Table 0-8: Stationarity test for the conditional variance of returns

Appendix 2.4: Wald Test of internal shocks (ARCH, GARCH) and external shock (Enactment)

Wald Test:
Equation: LAST

Test Statistic	Value	df	Probability
F-statistic	3.601989	(3, 669)	0.0133
Chi-square	10.80597	3	0.0128

Null Hypothesis: C(13)=C(14)=C(16)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(13)	0.251286	0.087637
C(14)	-0.094696	0.098313
C(16)	-2.68E-05	0.000387

Restrictions are linear in coefficients.

Table 0-9: Wald Test of internal shocks (ARCH, GARCH) and external shock (Enactment)

Appendix 2.5: ARCH effect test for the Asymmetric GARCH model

Heteroskedasticity Test: ARCH

F-statistic	0.322255	Prob. F(1,684)	0.5704
Obs*R-squared	0.323046	Prob. Chi-Square(1)	0.5698

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.976101	0.082341	11.85442	0.0000
WGT_RESID^2(-1)	0.021701	0.038228	0.567675	0.5704

R-squared	0.000471	Mean dependent var	0.997746
Adjusted R-squared	-0.000990	S.D. dependent var	1.910532
S.E. of regression	1.911478	Akaike info criterion	4.136542
Sum squared resid	2499.164	Schwarz criterion	4.149751
Log likelihood	-1416.834	Hannan-Quinn criter.	4.141653
F-statistic	0.322255	Durbin-Watson stat	2.000877
Prob(F-statistic)	0.570442		

Table 0-10: ARCH effect test for the Asymmetric GARCH model

Appendix 2.6: Correlogram of Standardized Residuals Squared

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
.|. |	.|. |	1	0.022	0.022	0.3249	0.569
.|. |	.|. |	2	0.031	0.030	0.9714	0.615
.|. |	.|. |	3	-0.009	-0.010	1.0242	0.795
.|. |	.|. |	4	-0.001	-0.001	1.0245	0.906
.|. |	.|. |	5	0.037	0.038	1.9793	0.852
.|. |	.|. |	6	0.001	-0.000	1.9805	0.921
.|. |	.|. |	7	-0.045	-0.047	3.3696	0.849
.|. |	.|. |	8	-0.028	-0.025	3.9167	0.865
.|. |	.|. |	9	-0.007	-0.003	3.9527	0.914
.|. |	.|. |	10	-0.002	-0.003	3.9560	0.949
.|. |	.|. |	11	0.038	0.038	4.9749	0.932
.|. |	.|. |	12	0.017	0.019	5.1827	0.952
.|. |	.|. |	13	0.059	0.058	7.5905	0.869
.|. |	.|. |	14	0.067	0.063	10.727	0.707
.|. |	.|. |	15	0.074	0.067	14.560	0.484
.|. |	.|. |	16	0.009	0.000	14.620	0.553
.|. |	.|. |	17	-0.021	-0.027	14.942	0.600
.|. |	.|. |	18	-0.022	-0.022	15.288	0.642
.|. |	.|. |	19	0.020	0.020	15.575	0.685
.|. |	.|. |	20	-0.009	-0.008	15.631	0.739
.|. |	.|. |	21	0.037	0.045	16.612	0.734
.|. |	.|. |	22	0.013	0.025	16.734	0.778
.|. |	.|. |	23	-0.009	-0.006	16.794	0.819
.|* |	.|* |	24	0.079	0.074	21.237	0.625
.|. |	.|. |	25	0.004	-0.006	21.246	0.679
.|. |	.|. |	26	0.055	0.039	23.452	0.607
.|* |	.|* |	27	0.088	0.078	28.979	0.362
.|. |	.|. |	28	-0.022	-0.034	29.317	0.397
.|. |	.|. |	29	0.041	0.030	30.499	0.389
.|. |	.|. |	30	-0.015	-0.015	30.653	0.433
.|. |	.|. |	31	0.005	0.011	30.672	0.483
.|. |	.|. |	32	-0.013	-0.012	30.790	0.528
.|. |	.|. |	33	-0.013	-0.008	30.915	0.571
*|. |	*|. |	34	-0.068	-0.067	34.243	0.456
.|. |	.|. |	35	-0.025	-0.032	34.686	0.483
.|. |	.|. |	36	0.019	0.018	34.955	0.518

Table 0-11: Correlogram of Standardized Residuals Squared