THE EFFICIENT MARKET HYPOTHESIS IN DEVELOPING ECONOMIES:

AN INVESTIGATION OF THE MONDAY EFFECT AND JANUARY EFFECT ON THE

ZIMBABWE STOCK EXCHANGE POST THE MULTI-CURRENCY SYSTEM (2009-

2013).

A GARCH APPROACH ANALYSIS.

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ABSTRACT

The paper investigates the presence of two calendar anomalies; the day of the week or Monday effect and the Month of the year or January effect by modelling volatility of the industrial index returns on the Zimbabwe Stock Exchange (ZSE) pre and post the multi-currency system. The procedure is carried out by employing non-parametric models from the Generalized Autoregressive Conditional Heteroscedastic (GARCH) family; GARCH, Exponential GARCH (EGARCH) and Threshold GARCH (TGARCH). The models are better suited in modelling daily and monthly seasonality as they can capture the time-varying volatility of the stock return data. The period of analysis is from the January 2004 to April 2008 (pre-dollarization period) and the second period of analysis is from the post-currency reform which runs from February 2009 to December 2013.

The results obtained from the study are mixed. The day of the week test finds significantly negative returns on Monday, Wednesday and Friday pre the currency reform whilst a negative Wednesday effect is found post the currency reform period. The TGARCH model is the only one that captures a negative monthly effects on all the months of the year with the exception of January pre the currency reform period. No monthly effects are found on the ZSE post the currency reform period by all models employed. The absence of monthly seasonality effects and the reduced number of days of day of the week effects from all the GARCH models employed can infer that the currency reform had a positive impact which translated to market efficiency.

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DECLARATION

I, *Abba Paradza*, declare that the research work reported in this dissertation is my own, except where otherwise indicated and acknowledged. It is submitted for the degree of Master of Management in Finance and Investment in the University of the Witwatersrand, Johannesburg. This thesis has not, either in whole or in part, been submitted for a degree or diploma to any other universities.

Abba Paradza---

Signed at---

On the-----------------------------------Day of---2015

DEDICATION

To my loving and dear father Honourable Kindness Paradza. You are the constant wind beneath my wings. Thank you for getting me this far in life and for believing in me more than I believe in myself. To my mother, you have been a pillar of inspiration. Thank you both

ACKNOWLEDGEMENTS

CHAPTER ONE

1.1. BACKGROUND

The Stock Exchange is a market where stocks or shares are purchased or sold and capital is raised for the purposes of industry for both the local and central government (Armstrong, 1957).The market essentially provides a mechanism for garnering capital from savers and channelling it to the system's investors such that this becomes a way that the lion's share of the economy's savings flow accrues to those industries. These funds are directed to firms and individuals with the most promising investment opportunities (West &Tinic; 1971).

Markets for the trading of shares or securities have existed for centuries all over the world and the earliest known markets were established in Paris, France around 1138 (Edwards,1963). The Stock Exchange is now recognised as an important cog in the financial structure of the capitalist system in a 'modern economy'. In the context of developing economies, the increased importance of Exchanges has been mainly stimulated by the strong need of capital for the growth of mining, manufacturing and agriculture sectors.

Once a company is listed on the Exchange, there are certain rules and trading practices that the company should adhere to. For instance, a listed company is obliged to keep the Exchange informed of any of its changes such as restructuring of capital, an issuance of new shares or dividends announcements that are due to its shareholders. This rule of freely and publicly availing the information on these listed companies positively affects the Exchange's level of efficiency.

Therefore the term efficiency in capital markets refers to the wide availability of information on past prices (returns) to the general public and in turn stock price movements are said to

respond to information in a both timely and accurate manner. Consequently, prices (returns) of securities fully incorporate market participants' expectations and all available information.

The arrival of new information is expected to affect the prices in a random pattern were period to period price (returns) changes are expected to be not only random but also independent. Thus the more efficient a market is, the more random and completely unpredictable the sequence of its price (return) movements. Essentially this infers that the most efficient market is one which no discernible pattern exists (Fama, 1965; Lo, 1997).Therefore in such a market with no discernible pattern, forecasting becomes a futile activity and therefore no speculative trading activity. The incapability to establish any future market movements make it impossible to craft appropriate investment strategies for consistent easy profits for the market participants.

1.2. THE EFFICIENT MARKET HYPOTHESIS

Given such perfect indications of an efficient market, this proposition in financial markets studies is usually referred to as the Efficient Market Hypothesis (EMH) developed and proposed by Eugene Fama in 1970. The model postulates that an efficient market is one that all relevant information is captured in the market price of financial assets. Thus the market price is an aggregate of all the past and present information that is publicly available. At any point in time, the price of securities is an unbiased reflection of all the available information including the discounted future cash flows and risk involved in owning such a security (Reilly and Brown 2003). Such an Exchange presents correct signals for the garnering of resources as stock market prices are a true reflection of each security's intrinsic worth. Although there are instances where the market prices can deviate from the securities' true value, but these deviations are completely random and uncorrelated.

The implication of the EMH is that any past period stock price movement of a positive or a negative does not indicate its performance pattern in the future. As such, correlation of how well or badly a stock price performed today is almost exactly zero to how it will perform tomorrow. Further, the theory involves defining an efficient market as one in which trading on available information does not provide an abnormal profit and therefore any attempts by investors to identify mispriced securities is fruitless.

Given the high return appetite by investors who may attempt to identify mispriced and take advantage of any possible arbitrage opportunities, academics and practitioner researchers have observed exciting and intriguing behaviour exhibited by stock prices (returns) time series. Such occurrences are sometimes puzzling and potentially difficult to reconcile with market efficiency (Jordan and Miller, 2009). In testing procedures, cases have been observed where some cyclical behaviour of return series is present and have established the phenomenon as anomalies to the random-walk or weak-form efficiency; it essentially means the stock price series should be unpredictable so as to conform to the proposition of the EMH.

The patterns observed take numerous forms as they occur during time of days, particular holidays, days of the week, some weeks of the month and some months of the year and as a result they have been termed calendar anomalies in financial markets literature. Stock returns that have been have systematically been linked to particular days of the week; Monday return tends to be significantly negative than any other days and Friday return is significantly positive. Cross (1973) and French (1980) were amongst the first researchers to support this phenomenon which is referred to as "Day of the week effect". Another tendency is for stock market returns in January to be higher than other months and this has been referred to as the January effect. Past studies in developed markets that have supported the existence of this anomaly include Rozeff and Kinney (1976), Gultekin and Gultekin (1983), Keim and Stambaugh (1984).

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While the trends contradict the validity of the Efficient Market Hypothesis and present a paradox in empirical finance, the model is still widely received in financial markets studies. Numerous studies have been offered as increasing evidence against its proposition and cast a considerable doubt on its validity in asset pricing. The model has become a historical centre-piece for the analysis of stock market prices until and unless a better model is developed.

1.3. A BRIEF HISTORY OF EFFICIENT MARKET HYPOTHESIS

Dimson and Mussavian (1998) provide an account on the origins and contributions to the concept of market efficiency. The history of the efficient market hypothesis can be traced as far back into the 1900 were a French mathematician, Louis Bachelier published his PhD thesis, *Theorie de la Speculation* which recognised that past returns were independent of present or future returns (Bachelier, 1900). Sadly, not much attention was given to his contribution up until Paul Samuelson and Cootner (1964) distributed his study to economists was then published and became well known. Currently, a couple of dozen of highly influential articles have been published which focus on the concept of market efficiency. One of the famous contributors to the efficient market hypothesis was Eugene Fama (1965) who later reviewed and presented formally this intriguing paradigm that has been central to finance professionals.

1.4. THE THEORATICAL FRAMEWORK OF THE EFFICIENT MARKET HYPOTHESIS.

Building from the work of Samuelson (1965), Fama (1970) later reviewed and presented formally the main principle behind the EMH. The implication of this paradigm is that at any point in time, the price of a security is an unbiased reflection of all the available information (Reilly and Brown 2003:57).A market is said to be efficient with respect to some particular information, if that particular information is not useful in earning positive excess returns on

the investment. When the prices of securities in a stock market react very quickly to new information and in anticipation of news before it is publicly available, this is an indication of informational efficiency in the market. The implication is that all relevant information is publicly available as market participants evaluate prices correctly. (Fama, 1965) distinguished three general types of information or forms of the Efficient Markets Hypothesis depending on the notion of what is meant by the term 'all available information'. These are; weak, semi-strong and strong-form. In this regard, a discussion of the three information sets will follow.

The weak-form hypothesis is the first, and is based on historical sequence of prices; it affirms that the prices of stocks at any given point in time are a reflection of all information that can be derived by analysis and examination of past volumes and past prices of market trading data. A market is said to be weak-form efficient when efforts by technical analysts attempts to establish a trend or pattern to predict future stock price movements which enables them to continuously earn an excess return is fruitless (Jordan and Miller, 2009).

The second type of market efficiency is the semi-strong form which asserts that all publicly available information of all kinds pertaining to the company's previous performance and its future prospects are already incorporated in the price of the stock. In other words, past stock prices, volumes and other information which include the fundamental data on the firm's product line namely; quality of management, balance sheet composition, patents held, earning forecasts, and accounting practices (Olasunkanmi, 2011).Therefore according to the semi-strong form of efficiency, fundamental analysis is of no use whatsoever in earning positive excess returns on the market.

The third and last version of the EMH is the strong-form level of market efficiency. It states that the price of the stock is a reflection of all the relevant information pertaining to the firm. That is past, public or private information (Jordan and Miller, 2009). Hence the implication

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of this form asserts that the stock market is strong-form efficient when even company insiders who have access to the firm's future plans and policies cannot use such information to continuously earn a positive excess return. Given the above scenarios of this robust hypothesis, below is the graphical illustration which aids in building intuition on the three forms of market efficiency. A great contributor to this informational set to the modern definition was Roberts (1967).

Figure1: FORMS OF MARKET EFFICIENCY

Strong-form- all information of any kind, public or private. (Even insiders cannot beat the market)

Semi-strong form-all publicly available information (fundamental analysis is useless in beat-

Weak form-Past prices and volume (technical analysis is useless in beating the market)
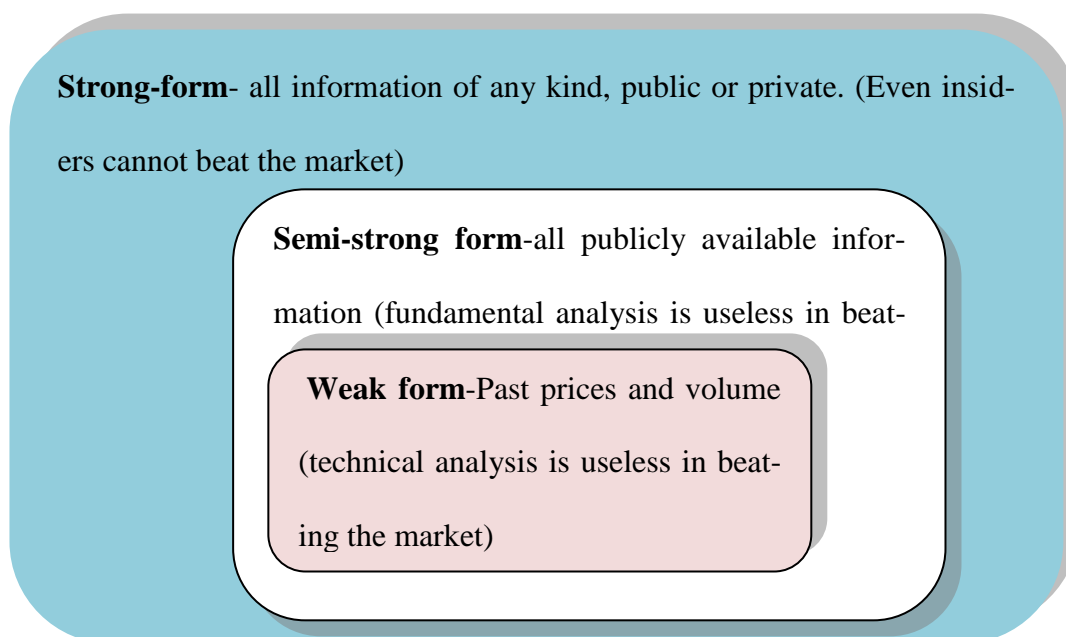
Source: Jordan and Miller, 2009:210

1.4.1. WEAK-FORM EFFICIENCY

As already previously discussed, a market that is said to be efficient in the weak-form implies that the information reflected in past prices is of no value in earning a profit. It's in the early 1950's that the first researchers with the aid of electronic computers were able to study the behaviour of lengthy price series. The presence of this form of efficiency can be investigated by using sophisticated mathematical models which test for autocorrelation which essentially refers to the presence of any discernible pattern or any statistically significance in the share price changes over the period. The test of this hypothesis study investigates if investors are

able to determine the right time to buy or sell consistently making profits with a pre-determined strategy as the stock market   exhibits certain   patterns. With regard to this financial theory, perhaps the question begging attention in this paper; is it possible for skilful investors to make excess profits or continuously beat the market from devising technical trading mechanism?

Then again these tests have been criticised for several reasons and there is need to consider rival views. An argument that critics have stressed is that when conducting the tests, researchers only make use of publicly available data such as prices and trading volumes. Whilst investors, firms and fund managers use other information that is exclusively availed or known to members of the exchange. To illustrate this argument further, Reilly and Brown (2003) give an example of traders using the spreads between bid and offer prices combined with prices and volumes while researchers mainly use (closing) prices and volumes and failing to appropriately to take into account transaction costs and adjusting for risk.

The weak-form is the most researched hypothesis and therefore abundant in literature and most studies in developed markets have supported the weak form inefficiency.

1.4.2. SEMI- STRONG-FORM MARKET EFFECIENCY

In its semi-strong form, stock prices changes when trader's activity of buying and selling is based on their view of future prospects of the firm. Traders can react to unexpected news announcements such as dividend announcements or even an increase or decrease in projected future earnings. In an efficient market, the reaction to new information is the immediate adjustment to fully react to new information and there is no trend for subsequent increase or decrease to occur.

The principal research tool in this area is the event study, which averages the cumulative performance of the stocks over specified period of time before and after the event (Dimison and

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Mussavian, 1998). The main concern of this form is both speed and accuracy of the market's reaction to information that has been availed publicly. Accordingly the test of market efficiency at a semi-strong involves an examination of the market reaction to new information that has just been made publicly available. For instance during the announcements of earnings, an observation is made on the average returns on the company's stock days before the announcement and is compared to the average returns immediately subsequent to the announcement.

Citing the Nigerian experience, Afego (2011) observed stock returns on the Nigerian Stock Exchange (NSE) specifically on the information content of earnings announcements. He reported that the stock price changes in Nigeria are not random but follow a pattern which makes it possible for negative abnormal earnings to be earned by trading around earnings announcement dates. A worthy observation is that most researches on African Stock Markets have shown more interest on the weak-form efficiency of the EMH and not much work has been done on semi-strong form efficiency. A plausible explanation could be that most ASMs are weak-form inefficient and hence according to the theoretical frame work it is not possible for a market to be semi-strong efficiency while it is inefficient in the weak-form. In as much as this aspect of the EMH and the forms of efficiency are presented with a logical and persuasive manner, Mazviona and Nyangara (2013) cogently argue that it can be empirically possible to contest the rigidity of the EMH model as financial markets are full of surprises anyway.

1.4.3. STRONG-FORM MARKET EFFICIENCY

When a firm is said to be strong form efficient, the implication that even professional investment managers who have the advantage of the privilege to information, are unable to consistently make use of such information to beat the market. To establish the presence of this hy-

pothesis, a comparison is made on the investment returns earned by insiders against those earned by outsiders and analysing the outcome for a significant difference on these two returns.

Literature has employed the Capital Asset Pricing Model (CAPM) which was developed by Treynor (1965) and Sharpe (1965). The tool is used as a standard benchmark which enables performance analysis and facilitates comparison among the participants. To achieve the same objective, an alternative way would be for the researcher to observe the presence of high trading activity and abnormal returns before a firm's public announcement. Given that investors discover in advance about a firm's intention to report bad earnings later, they will subsequently react by selling off their shares before the actual announcement is made public. The increase in activity leads to the share price going down and such a scenario signifies the presence of insider information and thus an indication of market inefficiency in its strong form.

Afego (2011) presents documented empirical evidence from the Nigerian Stock Market (NSM) which was found to be strong-form inefficient in response to earnings announcement. Most studies conducted in this area focuses on developed markets such as the US and the relatively few in the UK and evidence that has been found is consistent with the EMH.

1.5. SEASONALITY AND THE EFFICIENT MARKET HYPOTHESIS

Seasonality is the repetition of regular observable fact in periodical occurrence over a span of less than a year. The patterns have been attributed to an array of factors –settlement procedures, negative information releases and bid-ask-spread biases, changes in climate, tax-loss-selling and investor perceptions (Alagidede and Panagiotidis, 2009).

The most common group have been referred to as calendar (seasonal) anomalies or effects as the movement of the stock prices are related with a particular time period. Certain months

provide greater return than others and thus referred to as the month of the year effect. Similarly certain days can have a lower return as compared to other trading days and this is referred to as the day of the week effect. However seasonality affects the basic presumption of the market and that efficiency of the market hypothesis.

1.6. A REVIEW OF SEASONALITY STUDIES ON THE AFRICAN CONTINENT.

African stock markets are characterised by several institutional features that sets them apart from one another and from developed industrialised economies. There are very few studies investigating substantial evidence around this hypothesis on the continent. Most evidence is drawn from developed markets especially those in Europe and the United States. Despite the limited studies on the Africa's markets, the review in this section focuses exclusively those that have been carried out on the continent.

Claessens, Dasgupta and Glen (1995) find no evidence of seasonality in Zimbabwe and significant returns in the months of March and June for Nigeria. Coutts and Sheikh (2002) found no evidence of seasonality after investigating the All Gold Index of South Africa. Of the limited studies that have covered this topic, Paul Alagidede is one outstanding author who has contributed immeasurably by modelling seasonality in the largest markets across the continent. Alagidede (2008) investigates the day of the week anomaly by observing the first and second moments of returns and no evidence of day of the week effect was found for Egypt, Kenya, Morocco and Tunisia. However, the study observes significance evidence of seasonality in Zimbabwe, Nigeria and South Africa. On the ZSE, the average return on Friday is found to be significantly higher than other days in the week. The NSE All Share index of the Nigerian markets exhibits more seasonality in volatility than in expected return and the reverse is found for the JSE All share index for South Africa.

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A further recent contribution by Alagidede (2012), investigated the existence of two calendar anomalies in security returns; month of the year and pre-holiday effects on Africa's seven largest bourses (Egypt, Kenya, Morocco, Nigeria, South Africa, Tunisia and Zimbabwe). The study also accounted for volatility in the month of the year effect and concluded the present of pre-holiday effects in South Africa and was absent in all other markets. Plausible reasons attributable to this finding were investors good mood around holidays, and optimistic about future prospects.

He further finds that January returns are positive and significant for Egypt, Nigeria and Zimbabwe. For Kenya, Morocco and South Africa February returns were higher. No evidence of monthly seasonality was found in Tunisia. In this paper, the tax loss selling hypothesis was ruled out as possible reason for the existence of the January effect as which is usually the reason in developed market. Rather for the African market monthly seasonality was attributable to liquidity constraints and omitted risk factors.

1.7. CONTEXT OF STUDY

The focus of this paper is to investigate the existence of such patterns in stock returns of a Sub-Saharan African market. The study will exclusively investigate the presence of two calendar anomalies; the day of the week effect and the month of the year effect on the Zimbabwean Stock Exchange (ZSE) and their implications for stock market efficiency. The Zimbabwean Stock Exchange is the third largest bourse on the African continent after Egypt and the Johannesburg Stock Exchange in South Africa leading the pack.

Public attention to African Stock markets has grown since the 1970's from both academics and investors due to the growth trends that they exhibit and furthermore they have low correlations with the more developed markets .The markets have grown not only in terms of num-

bers and market capitalisation but also in relation to their increased importance on the international financial scene (Mitura and Hall; 1998).

The International Finance Corporation (IFC) grouped five countries with investable but lower market capitalisation, high long term returns but low correlation with global markets and potential to grow into emerging and developed markets. The Frontier Markets, Africa (MSCI) countries include Kenya, Mauritius, Morocco, Nigeria and Tunisia.

Moreover the equity markets in most of the African countries have integrated with those in developed markets due to the unrestricted flow of investments across countries. In the last decade, Africa has experienced a significant growth of its stock exchanges. Between 1992 and 1995 market capitalisation increased from $113 billion to $569 billion. Outside South Africa, market capitalisation increased from US$99 billion in 1992 to US$ 160 billion in 2005 (African Securities Exchanges Association (ASEA) as cited in Afego, 2011).

The significance of the markets has been in terms of local and foreign participation as they have delivered superior returns which tend to outperform developed markets. For instance in 1994,African stock markets were reported to have posted the biggest gains in U.S. dollar terms among all markets worldwide-Kenya (75%),Ghanaian stocks (70%),Zimbabwe (30%) and Egypt (67%).

Mitura and Hall (1998) assert that the level of efficiency on a stock market naturally translates to its level of development. Further support for this claim comes from previous studies on efficiency in African markets carried out between the periods from mid-1990s till recent have also agreed to this view implying that older markets are likely to be efficient than newer markets (Mazviona and Nyangara,2013). The oldest exchanges on the continent being in South Africa, Egypt and Zimbabwe respectively.

The largest and oldest market in Africa, the Johannesburg Stock Exchange (JSE) which is very much comparable to developed markets when measured in terms of market capitalization and level of sophistication; and as a result it has been the most researched stock market on the continent. It is not surprising that most of the findings on this bourse have found it to be efficient. However for the other two markets, the persuasive argument of age and stock market maturity has not been convincing due to the mixed findings. It can be argued that the constantly changing political and economic environment in Africa is the greater reality that influences the efficiency of stock markets rather than their period of existence. The impact of such dynamics can actually lead to older and established markets behaving like markets in embryonic stage in terms of efficiency.

Developing economies are relentlessly experimenting fiscal/financial/electoral reforms such that the success of a country's experiments (win or lose) may transmit to the long run returns on the stock markets. A case in point, the current and radical change by Zimbabwean monetary authorities in 2009 of completely discarding their local Zimbabwean Dollar as the official currency and adopting new basket of regional and international currencies; United States dollar, South African Rand, Botswana Pula and British sterling pound. Subsequently, the multi-currency system improved to be a solution to the much needed stability in the economy after almost a decade of chaotic hyperinflation environment.

The currency reform led to the Zimbabwean Stock Exchange adopting the United States Dollar (USD) as its main currency for transactions. This paper builds from the work of Mazviona and Nyangara (2013) who examined the weak-form efficiency during this period of currency reform. The authors employed a number of tests namely auto-correlation, the run test and the Q-statistic test to examine the bourse and which was found to be weak form inefficient. The paper will extend from this traditional of examining stock market efficiency by modelling

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day of the week and month of the year calendar anomalies. This will be done by examining the seasonal volatility of returns of the index.

The very few notable studies which examine seasonality on the ZSE using a data set before the currency reform were done mainly by Alagidede (2008) who investigated the day of the week seasonality on other African large stock markets. Alagidede (2012) further examines month of the year and pre-holiday effects on Africa's frontier markets which also included the ZSE for the period of June 1995 to September 2006.The ZSE industrial index was used to examine any evidence of seasonality.

The paper will be of interest as the work will contribute to the debate of whether or not currency reforms have a general positive impact on stock market activity mainly volatility and predictability which translates into efficiency. While recognizing that such a currency reform has an impact on the stock market volatility in general; investor confidence, market liquidity and investor risk aversion. Thus it is reasonable to examine the level of efficiency on the bourse in light of the recent policy.

The ZSE has been moderately researched over the last decade but although it is one of the oldest markets on the continent after Egypt and South Africa. This current study will not cover the detailed account of how efficiency on the ZSE has evolved over time but rather attempt to give an efficiency check of the recent period of 2009-2013 through modelling seasonal volatility. However a pre and post analysis multi-currency reform analysis will be carried out to provide a good comparison of the existence/non-existence of Monday and January effects.

It is the first study according to the researcher's knowledge that investigates the presence of these calendar anomalies on the bourse during the aforementioned period. The study is unique as it will serve as the first attempt to extend the traditional approach to modelling dai-

ly and monthly seasonality by looking at the first and second moments of returns; this essentially refers to the expected mean and volatility of the index returns.

Stock market returns are volatile and some relevant common features have been observed and have motivated the use of sophisticated and more suitable new procedures employed from the Generalised Autoregressive Conditional Heteroscedasticity (GARCH) family. As well as their extensions which are Threshold Generalised Auto Regressive Conditional Heteroscedasticity (TGARCH) and Exponential Generalised Auto Regressive Conditional Heteroscedasticity (EGARCH). It is for this reason that the study will employ such procedures to uncover the phenomenon of seasonality at different time points in the period of study.

1.8. PROBLEM STATEMENT

A number of empirical questions have been raised post the inception of multiple currencies which are now used for transactions on ZSE and this research attempts to tackle the question of volatility and seasonality which translates into efficiency after the adoption of a stabilising monetary policy. Ever since in its history, between 2006 and 2008 the bourse experienced a record high stock market bubble accompanied with very high volatility which was then instantly burst by the currency reform of 2009. The analysis of the ZSE in this current period is of immerse importance as the market was faced with a daunting task of restoring investor confidence.

The evolving nature of frontier markets in Africa has increased concern over their levels of efficiency, although Anomaly studies have been mainly focused on developed mature markets and there is barely any work done on developing markets on the continent. This worldwide phenomenon of anomalous behaviour and volatility of stock market indices is also an important theme in African stock markets (Alagidede, 2008). The search for seasonality in the returns of the industrial index of the ZSE during the two time periods could shed more

light in the return behaviour post the monetary system which was introduced in order to fight against hyperinflation.

1.9. SIGNIFICANCE OF THE STUDY

Private capital has a very pivotal role in the framework of African economies and its importance cannot be overemphasized. Thus checking the changes in volatility post macroeconomic or political policies is essential for workings of capital markets on the continent. The present study will be the first attempt according to the researcher's knowledge to investigate calendar effects on the bourse post the currency reform which if present may indicate market inefficiencies. An analysis of both the mean and variance (volatility) of the returns of the index will reveal the statistical properties of the Zimbabwean Stock Exchange and establish whether currency reforms enhance efficiency in emerging markets.

 In order to thoroughly analyse   the value of the markets post drastic changes such as these, it is worth investigating the behaviour of their share index (return) patterns by extending the traditional approach of modelling anomalies and examining the mean and variance (volatility) of returns through sophisticated and appropriate volatility capturing statistical models.

Investigating daily and monthly seasonal effects is of interest for both foreign and local market participants .It is important for investors to understand the trends on the ZSE enabling the tailoring of suitable investment strategies that ensemble the characteristics of the bourse. Furthermore asset managers whose portfolio contains stocks listed on the ZSE can devise mechanisms that minimize risk, maximise return for them and improve stock market performance.

Even though decades have gone by most African economies after acquiring political independence from their colonial masters, the reality is that they are still in desperate need of capital inflows from the industrialised developed nations. For that reason stock market efficiency

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is of immerse importance in developing economies. Thus there is a need for continuous and thorough analysis of their capital markets so that they gain investor confidence on the international financial scene.

1.10. RESEARCH OBJECTIVES

1.10.1. GENERAL OBJECTIVE

The main purpose of this paper is to test the presence of two calendar anomalies (effects) on the Zimbabwean Stock Exchange; the day of the week effect or the weekend effect and the month of the year effect or January effect in both the returns and volatility equations.

1.10.2. SPECIFIC OBJECTIVES

To determine whether there is any significant evidence of day of the week effect in the volatility of returns of the index?

To determine whether there is also any significant evidence of monthly seasonality of the index returns?

1.11. HYPOTHESIS FORMULATION

Hypothesis one

H_0: The daily volatility of returns of the index are equal on all weekdays.

H_1: The daily volatility of returns of the index is not equal on all weekdays.

Hypothesis two

H_0: The monthly volatility of returns of the index are equal on months of the year or there is no monthly effect.

H_1: The monthly stock volatility of returns of the index is not equal on whole year.

1.12. OUTLINE OF THE STUDY

The study is divided into six chapters. The first chapter comprises an introduction of the market efficiency concept and highlight the vital role an efficient market plays in garnering capital resources in developing or emerging markets. The theoretical framework and the three forms of market efficiency is also discussed as well as a brief review of seasonality studies in the African context. The problem statement, significance of the study and hypothesis formulation are also part of this chapter. Chapter two provides an overview of the history and development of the Zimbabwe Stock Exchange. Chapter three provides the literature review. Chapter four presents the detailed methodology and data used in this study. The results of this study are followed in Chapter five, findings interpreted as well as addressing and answering the questions proposed for the study. Finally the paper is concluded in chapter six which draws conclusions about the study in relation to research questions as well as areas of further research are also discussed.

1.13. CHAPTER SUMMARY

This chapter introduced the world-wide phenomenon of seasonal anomalies that have been observed in stock market returns and their volatility in particular. The anomalous pattern of daily and monthly stock returns are a serious violation of the EMH. Moreover, such occurrences can have predictive power on the price (return) mechanism of an efficient market while proponents of the EMH expect an efficient market to be random and unpredictable. The

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chapter concludes by presenting the problem statement, significance of the study and the research objectives as well as the hypothesis.

CHAPTER TWO

OVERVIEW OF THE ZIMBABWE STOCK MARKET

INTRODUCTION

The Zimbabwe Stock Exchange (ZSE) is the only exchange that is currently officially operating in the country. There are two market indices on this bourse, the Industrial index and the Mining index and both have a base value of 100 as from February 2009. All the mining companies are listed under the Mining index and the rest of them on the Industrial index. The Zimbabwe Industrial Index is a stock index that derives values of industrial stocks on the exchange.

It's headquartered in Harare, which is the capital city. It has 19 member firms and 78 listed companies (4 of these suspended) as at 31st December 2011. The ZSE is considered one of the major active stock markets on the African continent. Due to the continued economic and political problems that prevail in the economy, the bourse has not received much academic attention. Furthermore, policy authorities have made the market highly volatile especially for foreign investors reflecting strict exchange controls on residents and a highly unstable macro-economic environment.

2.1. THE ORIGINS AND DEVELOPMENT OF THE ZSE

The first stock exchange in Zimbabwe opened in Bulawayo in 1896. It was however only operative for about six (6) years. Other stock exchanges were also established in Gweru and Mutare. The latter, also founded in 1896, thrived on the success of local mining industry, but with the realization that deposits in the area were not extensive, activity declined and closed in 1924.

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After the end of World War II in January 1946, Alfred Mulock established a new exchange in Bulawayo, the second largest city in Zimbabwe. Between 1903 and 1945, the colony had to rely on the London and Johannesburg Stock Exchange. In December 1951, a second duplicate floor was opened in Salisbury (Harare) due to the expansion of the exchange. Trading and communication of daily call over prices was done by telephone between the two centres. Brokers met in Salisbury (Harare) for the daily price list.

By 1952, the Exchange became an important institution in Southern Rhodesia's (Zimbabwe) financial system. During this period the main problem was foreign domination, both in terms of the listed companies and investors. It was only in January 1974 that the Zimbabwean Stock Exchange Act was passed and started its operation as per the act. The bourse has stood the test of time throughout the period of Federation, Unilateral Declaration of Independence, and Socialism and in the 1990's the country experienced both expansion and contraction in response to the political and economic conditions prevailing at any given time (Karekwaivenani, (2003).

2.2. TRADING AND SETTLEMENT

The Zimbabwe Stock Exchange is open for trading from 10h00 to 12h00 from Mondays to Fridays. Settlement is on a T+7 bases against physical delivery of scrip, this simply means the settlement of a deal happens 7 days after the deal has been transacted. The ZSE uses an open outcry system on the trading floor of the Stock Exchanges and currently conducts one call over session daily between 10am and noon. Share prices are quoted in United States Cents (USc).

2.3. REGULATION

The Zimbabwe Stock Exchange (ZSE) Act reached the statute book in January 1974. The members of the Exchange continued to trade as before. However for legal reasons, it became necessary to bring into being a new Exchange coincidental with the passing of the legislation. The ZSE has rules that govern the conduct of its members and operates according to Securities Act (Chapter 24:25) which was passed for the securities investment purpose in 2004. The ZSE is regulated by the Securities Commission of Zimbabwe which has been operational since 2008 which provides strict supervision and monitoring of the trading process to ensure transparency and avoid market manipulation.

Moreover apart from the strict supervision the bourse has an Investor Protection Fund which is funded from every trade on the exchange. The fund is administered through the Securities Commission of Zimbabwe with trustees selected from SEC, ZSE, Pension administrators and Asset managers. Each broker has a Professional Indemnity policy that covers professional negligence, fraud and dishonesty by the employees.

The ZSE also has an aggregate Umbrella Professional indemnity policy to pick up excess losses from the underlying brokers policies. The ZSE has a security fund part of which comes from contributions by members. Furthermore it is an active member of the Committee of SADC Stock Exchanges (CoSSE) which also includes Botswana, South Africa, Mauritius, Zambia and Namibia.

2.4. INFORMATION DISSEMINATION

Trading reports are published and circulated to different stakeholders' including broking houses, the investing public, information vendors and published in the press daily. The ZSE

also provides comprehensive information on its website which includes company profiles, market data and corporate news and announcements.

2.5. OTHER MARKET DEVELOPMENTS

Other policies that may have impacted on the efficiency of trading was the IMF inspired Economic Structural Adjustment Programme (ESAP) in 1991 and the most recent Indigenization and Economic Empowerment Bill passed in 2008.The bill which gave Zimbabweans the right to take cover and control many foreign owned companies in the country had repercussions on investors and foreign companies. This period is the most current and also it's when the economy is using multi-currency monetary system mainly the United States Dollar and the South African rand. It must again be noted that the main focus on this paper is not on the events of the macro-economic policies but rather their purported effect on market efficiency.

Zimbabwe has a developed capital market with an active institutional base which includes a pension fund industry, an insurance industry, and a local asset management industry supported by nineteen (19) registered stock broking firms.

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CHAPTER THREE

LITERATURE REVIEW

INTRODUCTION

The Literature review chapter discusses background knowledge relevant to the study. Calendar anomalies (effects) which are a periodical pattern of fluctuation (volatility) of the stocks. In addition, significant previous research will also be discussed while exposing possibilities for future studies. It is organised as follows: Section 3.1 and Section 3.2 discusses the forms of seasonality that will be under study in this paper; Section 3.3 is a review of the different methodological approaches that have been employed to investigate stock market anomalies; Section 3.4 reviews studies on calendar anomalies. Lastly the chapter is concluded in section 3.5

3.1. JANUARY EFFECT

Another strange pattern that has been observed in stock market data is the tendency of small company stocks to make an excess return than other asset classes on the market in the first weeks of January on a year to year basis such that it has been referred to as the January effect. The anomaly states that investors sell a lot of their securities a few weeks before the year ends increasing liquidity and   volumes pushes their market prices down. Then as the New Year starts, those stocks are repurchased or other stocks that look attractive. Such that this increase in demand pushes up prices and thereby resulting in high January returns. The effect is said to be more pronounced to those stocks that would have performed not so well during the year.

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Studies of this anomaly have been mainly focused on developed markets and most of these have supported evidence of the seasonal effects in the markets observed. Rozeff and Kinney (1976) found the New York Stock Exchange to have an average return for the month of January to be higher with approximately 3.48% compared to only 0.42% for the other months. These findings were also consistent with those of Choudhry (2000) who employed the GJR (Glosten, Jagannathan and Rankle) model, the US and UK returns were significantly higher in January but not for the German markets.

Contrary to the January pattern, Alagidede and Panagiotidis (2009) found presence of the April effect on the Ghana Stock Exchange from 1990 to 2004 by employing GARCH procedures. The April effect is also found in the UK markets by Gultekin and Gultekin (1983).

Comparing with the day of the week hypothesis, the January effect is partly understood with two main competing hypotheses that have been put forward to explain this calendar anomaly. These have been referred to as the 'tax loss' hypothesis and the 'window dressing' hypothesis (D'Mello, et.al, 2003). The former proposes that the mentality behind this investor behaviour is to reduce their income tax liability. The latter has to do with institutional investors and portfolio managers who at the end of the year rebalance their portfolios such that they sell stocks that did not do so well during the year such that they do not report poor performance (Agrawal and Tandon, 1994).

Although critics can question how can efficient markets exhibit such behaviour? And why arbitrageurs not take advantage of the opportunity and drive it out of existence? But an evaluation of the January effect, it does not happen to the market as a whole and it does not occur every time so any trading strategy around this anomaly can result in huge losses.

Although numerous research work has discovered hundreds of anomalies that exist in the stock markets, their presence cannot shake the pillar of Efficient Market Hypothesis. Until and unless a better paradigm is suggested to replace the existing paradigm.

3.2. DAY OF THE WEEK EFFECT

The daily return of a stock is calculated by taking the percentage changes in closing prices from one trading day to the next. For all the days except Monday there exists a twenty four hour period from end of the trading day to the next. Due to the fact that stock markets are closed on weekends, the average return on Monday is expected to be to higher as computation is done over a seventy-two hour period. Surprisingly Mondays return is not three times as high which is expected but rather it gives a negative return.

3.3. GLOBAL EVIDENCE

Past studies such as French (1980) and Cross (1973) were among the first to observe and document these stock market irregularities. French carried out the analysis on the United States Stock Exchange by observing the S&P index returns for a period between 1953 and 1977.Significantly negative returns were observed on Mondays and Wednesdays, Thursdays and Fridays had significantly positive returns. Gibbons and Hess (1981) tested the same index for the period 1962-1978 and observed negative returns for Mondays while other days of the week were significantly positive.

Al-Loughani and Chappell (1997) found evidence of the day-of-the-week effect in the Kuwait Stock Exchange for the period 1993 to 1997 using the daily closing values in a GARCH (1,1) model. Daily returns of the S&P 500 were also analysed by Franses and Paap (2000) employing GARCH procedures and positive (negative) autocorrelation is found in returns on Monday (Tuesday).

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This behaviour of the stock exchange has been referred to as the-day-of-the-week-effect. Plausible explanations for this occurrence which has been put forward by other studies is that the negative returns experienced on Monday due to the liquidity in the market as a result of individual investors selling at the last week of the month.

Studies in European countries for this anomaly carried out by Dubois and Louvet (1995) resulted in mixed findings. A general pattern of lower returns at the beginning of the week were found in Canada and Hong Kong but not precise negative returns falling on a Monday. A study of the Indian market revealed an opposite pattern, Monday turned out to have a significantly greater higher return than other days. A plausible explanation for this pattern was the settlement period in India of a period of 14 days which starts on a Monday and ends on a Friday (Agrawal and Tendon; 1994).

3.4. EVIDENCE FROM AFRICAN STOCK MARKETS.

Previous studies on this anomaly have concentrated mainly on developed markets and there a very few documented studies on African Stock Markets. Poornima (2013) analysed the Friday effect, month of the year and the pre-holiday effect in NSE (Nigeria Stock Exchange) Nifty companies accounting for conditional volatility in the month of the year effect. An attempt by Alagidede and Panagiotidis (2009) with the use of non-linear procedures from the GARCH family found evidence of the day of the week effects on the Ghana stock market. Alagidede (2012) further reviewed the Nigeria, Egypt and Zimbabwe and found January returns to be positive and significant while Kenya, Morocco and South Africa had significant positive returns in February. No monthly seasonality was found in Tunisia. Liquidity constraints and omitted risk factors were put forward as possible reasons for the January effect for Egypt, Nigeria and Zimbabwe.

Critics of the Efficient Market Hypothesis refer to this strange behaviour as evidence of market inefficiency. The presence of such seasonality in stock returns violates the weak-form efficient hypothesis as equity prices are no longer random but can be predicted using past patterns. However it is not clear whether it is possible to exploit this pattern to make continuous excess return on the market such that it becomes difficult to refer to this strange behaviour as inefficiency.

3.5. CONCLUSION OF LITERATURE REVIEW

This section introduces the January effect and previous studies on this calendar anomaly. Section 3.2 discusses the Monday effect. Section 3.3 presents global evidence of seasonality studies while section 3.4 discusses evidence from African Stock Markets. Most of the seasonality studies were carried out on major markets such as Nigeria, Ghana. Egypt and Zimbabwe which presented mixed findings. However the persistence of these return patterns strands in opposition of the to the efficient market hypothesis and has been target for investigation.

CHAPTER FOUR

RESEARCH METHODOLOGY AND DESIGN

INTRODUCTION

This chapter deals with the research methodology and the data sample used in the study. The section also presents a detailed discussion of the traditional parametric tests and the motivation to the non-parametric approach to modelling seasonality. A detailed discussion of the extensions of conditional heteroscedastic models which are employed in this paper for a concrete comparative analysis is also presented. These models present their own motivations to estimate volatility in equity returns; The Exponential GARCH (EGARCH) and Threshold GARCH (TGARCH).

4.1. THE DIFFERENT METHODS EMPLOYED IN CALENDER EFFECTS STUDIES

In general, there are two approaches that have been employed to test for evidence of seasonality in stock market returns. These include parametric tests which are based on the assumption of normality of the data and calculate returns, means, and variances for each day (month) of the week (year). The second approach are non-parametric procedures which do not rely normally distributed returns for the data.

4.1.1. ORDINARY LEAST SQUARES (OLS) REGRESSION MODELS AND MONDAY /JANUARY EFFECT

The earliest studies of seasonality in stock markets were initially restricted to a simple OLS regression model with dummies as input variables for analysis. For instance, the null hypothesis test that all returns for each day (month) are all statistically similar and whilst a rejection of the null entail that one of the days (month) has statistically significantly positive or negative returns relative to other days of the week or months of the year. Brooks (2008) describes a model which is linear in nature if one parameter multiplied by each variable in the model. For instance in day (month) of the week (year) analysis with the use of dummy input variables, whereby the average return is calculated for each day (month) of the week (year); the regressions can take the form of equation {1} and {2} below.

$$Y_t = \alpha + \beta_1 \text{Tue} + \beta_2 \text{Wed} + \beta_3 \text{Thur} + \beta_4 \text{Fri} + \varepsilon_t \qquad \{1\}$$

$$Y_t = \alpha + \beta_1 \text{Feb} + \beta_2 \text{Mar} + \beta_3 \text{Apr} +, \beta_{11} \text{Dec} + \varepsilon_t \qquad \{2\}$$

Where in equation {1} Y_t the stock is price return on day t, and $\beta_1, \beta_2, \beta_3, \beta_4$ are the coefficient parameters of the dummy variables for each day of the week except for Monday where the average return is captured by α coefficient. $\beta_i (i = 1, 2, 3, 4)$ shows the excess return relative to Monday, be it positive or negative (Dupernex, 2007).

Likewise in equation {2}, the monthly returns are also modelled with the same approach and specifying the model with eleven variables and were January average return is captured with the coefficient α. were Y_t is the mean return for the month t. $\beta_1, \beta_2, \beta_3, \beta_4 ....., \beta_{11}$ are the coefficients of dummy variables for each month of the year. β_i (i =1, 2, 3, 4) shows the excess return relative to other months, be it positive or negative (Dupernex, 2007).

In order to check the significance and equality of each day (month) average return is statistically different from the other, standard t and F tests or ANOVA may be employed. For which the null hypothesis tests for equal average returns for each day or month. A rejection of the hypothesis implies that at least one of the daily (monthly) returns is not equal to the other returns (Zhang,2001).The earliest studies that employed the OLS models on the Monday effects on USA stock returns include Cross (1973), French (1980), Lakonishok and Levi (1982).

4.1.2. A SHIFT TO THE NON-PARAMETRIC APPROACH

The OLS linear models assume theerror term ε_t in equation {1} and {2} to be normally distributed with a mean of 0 and a constant variance. The assumption of the variance of errors to be constant is known as homoscedasticity. When the variance of errors is not constant, it is known as heteroscedasticity. It is very unlikely for financial time series data that the variance of the errors to be constant over time hence it makes much more sense to consider a non-parametric model. Such a model does not hold the assumption of a constant variance and does much better in describing how the variance of how the errors evolves. OLS linear regression models have their own challenges and limitations such that the estimated parameters will infer wrong conclusions (Brooks, 2008).

The main motivation for employing non-parametric procedures is due to their ability to capture some relevant common features of time series financial data that have been observed by past researchers. Some of these have been outlined by (Brooks, 2008) and are now commonly referred to as 'stylised facts' of financial time series data and are outlined below.

Leptokurtosis –this describes the tendency for financial asset returns to have income distributions that exhibit fat tails and excess peakedness at the mean.

Volatility clustering/Volatility pooling- this describes the tendency for volatility in financial markets which tend to appear in bunches. Its implications are that large returns (either positive or negative) are expected to follow large returns and small returns (either positive or negative) to follow small returns. Plausible explanations for this phenomenon has been that the information arrivals which drive price changes themselves occur in bunches rather than being spaced over time.

Leverage effects- the tendency for volatility to rise more following a large price fall than following a price rise of the same magnitude.

These observations have motivated the consideration of more appropriate use non-parametric models which deal with non-uniform variance which is time-varying.

4.2. ARCH MODELS

Although there are an infinite different types of non-parametric models for modelling financial data, the most popular are the ARCH or GARCH models (ARCH stands for 'autoregressive conditionally heteroscedastic' and GARCH stands for 'generalised autoregressive conditionally heteroscedastic'). ARCH models are widely used to analyse time series heteroscedastic data.

Linear models assume that the variance of the error terms is constant and this feature is known as homoscedacity implying that the volatility dispersion is constant. In contrast, non-linear models (ARCH) assume the error term is not constant and this assumption is referred to as heteroscedastic which describes the varying volatility dispersion. In financial time series data, it is unlikely that the variance of the error terms is constant over time and therefore it is more sensible and appropriate to employ a model that does not assume the variance to be constant but describes how the variance of the errors evolves (Brooks, 2008).

The term conditional describes the dependence on the most recent observations. Autoregressive explain a feedback mechanism by which recent observations are incorporated into the present observation. With regard to the ARCH model, the "autocorrelation in volatility'' is modelled by allowing the conditional variance of the error term ε_t^2 , to depend on the immediately previous one period value of the squared error term. This gives the conditional variance equation below {3}:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 \qquad \qquad \{3\}$$

Where σ_t^2 is the conditional variance, $t-1$ is the lag length of the error term which is the immediately previous period in this case represented by 1.And $\alpha_0 \alpha_1$ are coefficients of the lagged square error terms $\alpha_i > 0$ for all I =1,2,......q and ε_{t-1}^2 are previous squared residuals.

The above equation {3} describes a model that is referred to as the ARCH (q) model for a conditional variance that depends on a lag of 1.The ('q') describes the number of lags therefore it becomes an ARCH (1) process since it depends on only one lag.

Although ARCH models have provided a good framework for the analysis and development of time series models, however there have not been used for more than a decade as they present a number of challenges. For instance there is no clearly best approach for determining the value of ('q').Another difficulty is that there are instances when the model is parsimonious (very large) and   difficulties arise when the number of lags that are required to capture all of the dependence in the conditional variance is large too. This requirement of many parameters and a high order (q) to capture the volatility process presented it as its main challenge leading to the extension into other models which will subsequently be discussed in detail.

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4.3. GENERALISED ARCH (GARCH) MODELS

Developed independently by Bevollerslev (1986) and Taylor (1986), the Generalised ARCH (GARCH) models are a natural extension of the ARCH models. The GARCH model allows the conditional variance to be dependent upon previous own lags and variances. Consequently the conditional variance equation in its simplest form becomes:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta \varepsilon_{t-1}^2 \qquad \{4\}$$

Or similarly;

$$h_t = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta \varepsilon_{t-1}^2 \qquad \{5\}$$

The above is a GARCH (1, 1) model, σ_t^2 is known as the conditional variance since it is a one-period ahead estimate for the variance calculated based on any past information thought relevant. The use of the GARCH model enables the interpretation of the current fitted variance, h_t as a weighted function of a long term average value (dependent on α_0), information about volatility during the previous period ($\alpha_1 \varepsilon_{t-1}^2$) and the fitted variance from the model during the previous period ($\beta \varepsilon_{t-1}^2$).Instead of calling the conditional variance σ_t^2 at time t, the term h_t is used in literature since it is easier not to use Greek letters and these terms will be used interchangeably in this paper. Likewise the coefficient ω will be used interchangeably with α_0 .

The GARCH is a better model and far widely used than the ARCH model as is it more parsimonious which means it can take up very large samples and avoids over fitting and therefore more likely to breach the non-negativity constraints.

The GARCH (1, 1) model can be extended to a GARCH (p, q) formulation, where the current conditional variance is parameterised to depend upon p lags of the squared error and $l$ags of the conditional variance. This can be expressed as a formula below.

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_1 \varepsilon_{t-1}^2 + \sum_{j=1}^{q} \beta_j \varepsilon_{t-1}^2 \qquad \{6\}$$

However, generally a GARCH (1, 1) model is sufficient to capture volatility clustering in data and in very few cases is a higher order model estimated or entertained in the academic finance literature (Brooks, 2008). Nevertheless to model seasonality of both day-of-the-week effect and month-of-the-year effect from the above intuition, the variance equations in $\{7\}$ and $\{8\}$ can be estimated.

$$h_t = \omega + \alpha \varepsilon^2_{t-1} + \beta h_{t-1} + \sum_{i=1}^{5} \emptyset_i D_{it} \qquad \{7\}$$

$$h_t = \omega + \alpha \varepsilon^2_{t-1} + \beta h_{t-1} + \sum_{i=1}^{12} \emptyset_i M_{it} \qquad \{8\}$$

Where the coefficients $\emptyset$ accounts for volatility returns on Monday to Friday after correcting for autocorrelation and heteroscedasticity. Where D_{it} are dummy variables such that $D_1 = 1$ if day t is Monday and zero otherwise; $D_2 = 1$ if day t is Tuesday and zero otherwise and so forth. Likewise, equation $\{8\}$ the coefficient $\emptyset$ shows the volatility returns from January to December. Where M_{it} are dummy variables such that $M_{1t} = 1$ if day t is in January or zero otherwise; $M_{2t} = 1$ if day t is in February or zero otherwise and so forth (Brook, 2008).

4.4. RESEARCH SAMPLE DATA DESCRIPTION

The study will examine calendar effects on the Zimbabwe Stock Exchange using a sample data of the industrial index daily closing prices for a 10 year period. The data used to carry out this empirical study covers the period pre and post currency reform. The former period runs from the 2nd of January 2004 to 30th of April 2008 and the latter runs from the 2nd of February 2009 to 30th of December 2013 giving us a total of 1067 and 1198 observations respectively excluding public holidays.

The industrial index has been selected as it is the larger one of the two market indices, the other one being the mining index that consists of all the listed mining companies but is smaller. The data is complete over the period and was obtained from the ZSE website and Big Law Management which is an authorised vendor.

4.5. RESEARCH METHODOLOGY

The daily market return series for the ZSE industrial index is calculated from the daily continuously compounded return (Rt) as follows,

$$Rt = 100\% \times \ln\{pt/pt\text{-}1\} \qquad\qquad \{9\}$$

The equation used in {9} above enables a stationary series to be achieved (Brooks, 2008).

Where;

Rt denotes the continuously compounded index returns on day   t

Pt denotes the closing value of the index on day t

Ln is the natural logarithm.

4.6. EXTENSIONS TO THE BASIC GARCH MODEL

From the time that the GARCH model was developed, numerous variations have been proposed as a consequence of the perceived problems that are presented by the standard GARCH (p, q) models. The model presented its own share of limitations which included placing artificial constraints in order to achieve non-negativity in the coefficients. Secondly, the model is unable to account for leverage effects (the tendency for volatility to rise more following a large price fall than following a price rise of the same magnitude) in the series, although there are able to account for volatility clustering (the tendency for financial asset returns to have

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income distributions that exhibit fat tails and excess peakedness at the mean) and leptokurto-sis (the tendency for volatility in financial markets which tend to appear in bunches).Lastly, the model does not allow for any direct feedback between the conditional variance and conditional mean (can also be referred to as the first and second moments of return).The modified models remove the restrictions or limitations that are presented by the basic GARCH model.

The one main restriction that GARCH models present is that positive and negative shocks are enforced into a symmetric response of volatility. This is a consequence of the conditional variance in equation {6} which is a function of their lagged residuals. The lagged error is squared hence the sign is lost. However this feature of the model has been argued not to be valid when it is applied to equity returns as leverage effects have been observed. Such asymmetric behaviour in return series led to the extensions of GARCH into two popular models which were developed to capture this behaviour of equity returns.

4.6.1. THE Threshold GARCH (T-GARCH)/GJR MODEL

Developed after the authors Glosten, Jagannathan and Runkies (1993), the GJR model also referred to as the TGARCH model is an asymmetric formulation which captures the possible leverage effects of equity returns. The GJR model makes it possible to calculate the conditional variance for a positive and negative shock and hence show that these are different. The conditional variance is given by equation {10} below.

$$h_t = \omega + \alpha_1 \varepsilon_{t-1}^2 + \gamma \varepsilon_{t-1}^2 \beta \, h_{t-1} \qquad \qquad \{10\}$$

Where $I_{t-1}=1$ if $\varepsilon_{t-1}^2 < 0$, or 0 otherwise. For a leverage effect of $\gamma > 0$. For $h_t > 0$, the following restrictions on the model parameters must hold; $\omega \geq 0$, $\alpha \geq 0$, $\beta \geq 0$ and $\alpha + \gamma \geq 0$. Clearly in the negative shock case the squared error term will have two components, the individual part and the dummied part.

4.6.2. THE EXPONENTIAL GARCH (EGARCH) MODEL

Developed by Nelson (1991), the exponential GARCH model can take one possible structure,

$$\text{Ln } (h_t) = \omega + \alpha \left[\frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} - \sqrt{\frac{2}{\pi}} \right] + \gamma \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} + \beta \ln (h_{t-1}) \qquad \{11\}$$

The EGARCH model has several advantages compared to the pure GARCH specification. Since the conditional variance (h_t) is modelled in logs, such that even if the parameters are negative, h_t will be positive. There is thus no need to artificially impose non-negativity constraints on the model parameters. Lastly, asymmetries are allowed for under the EGARCH formulation, since the relationship between volatility and returns is negative, γ, will be negative.

4.7. ESTIMATIONOF THE MODELS

It is now appropriate to discuss how the parameters in the models employed in this study are estimated from the historical data. The Ordinary Least Squares (OLS) method is usually used in estimation of parameters for the linear models but as for GARCH model estimation and other non-linear/non-parametric models, it becomes invalid. Several reasons have been put forward that have rendered it invalid but the main one being that OLS minimises the residual sum of squares (RSS).It then becomes inappropriate as the RSS depends only on the parameters in the conditional mean equation and not in the conditional variance.

A technique known as quasi-maximum likelihood (QMLE) is therefore employed for estimation of GARCH parameters in models. The maximum likelihood estimates (QMLE) is used to estimate the most likely values that the parameters can take given the actual data. Bolloerslev and Wooldridge (1992) emphasize that QMLE is generally consistent, has normal limiting distribution and provides asymptotic standard errors that are valid under non-normality.

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When the models have been estimated E-Views provides a variety of pieces of information and procedures for inference and diagnostic checks which will be discussed in the next chapter

CHAPTER FIVE

PRESENTATION AND DISCUSSION OF RESULT

INTRODUCTION

This section will commence by reporting descriptive statistics of the distributional properties of the return series. An outcome from the statistics which infers that the series are significantly leptokurtic (this describes the tendency for financial asset returns to have income distributions that exhibit fat tails and excess peakedness at the mean) relative to normal distribution presents a validation for the use of GARCH models to investigate the presence of anomalies.

5.1. THE DESCRIPTIVE STATISTICS

Table 1a and 1b below presents a bar graph and descriptive statistics based on return series observed pre and post currency reform respectively. After the currency reform the bourse delivers a mean return of 0.07% and a standard deviation of 1.5% implying a high volatility level. Before the currency reform the result show a mean was 1.86 % and a standard deviation of 6.84 % which implies extremely high volatility as compared with the period of the currency reform. In the former period the series has a skewness of -1.41 and kurtosis is measured at 55.26 whilst the series post the currency reform has a skewness of -1.50 and a kurtosis is measured at 28.67.The corresponding Jarque-Bera statistic is 121646.5 and 3333.74 respectively, both with a p value of 0.00.This shows that the returns distribution is non-normal at the 1% level of significance. Negative skewness is observed in both time periods as well as excess kurtosis. The result is not surprising outcome as such is the typical feature of developing markets stock returns to be non-normally distributed. Suppose the returns were normally

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distributed, both the histograms should be bell-shaped and the Jarque-Bera statistic would not

be significant.

Table 1.

a: Descriptive Statistics for Continuously Compounded Daily Returns of the Industrial Index from 2 January

2004-30 April 2008 (pre-dollarization period)

Series: PRETURNS	
Sample 1 1067	
Observations 1066	
Mean	1.858501
Median	0.722773
Maximum	54.62801
Minimum	-99.87769
Std. Dev.	6.843023
Skewness	-1.410879
Kurtosis	55.25701
Jarque-Bera	121646.5
Probability	0.000000
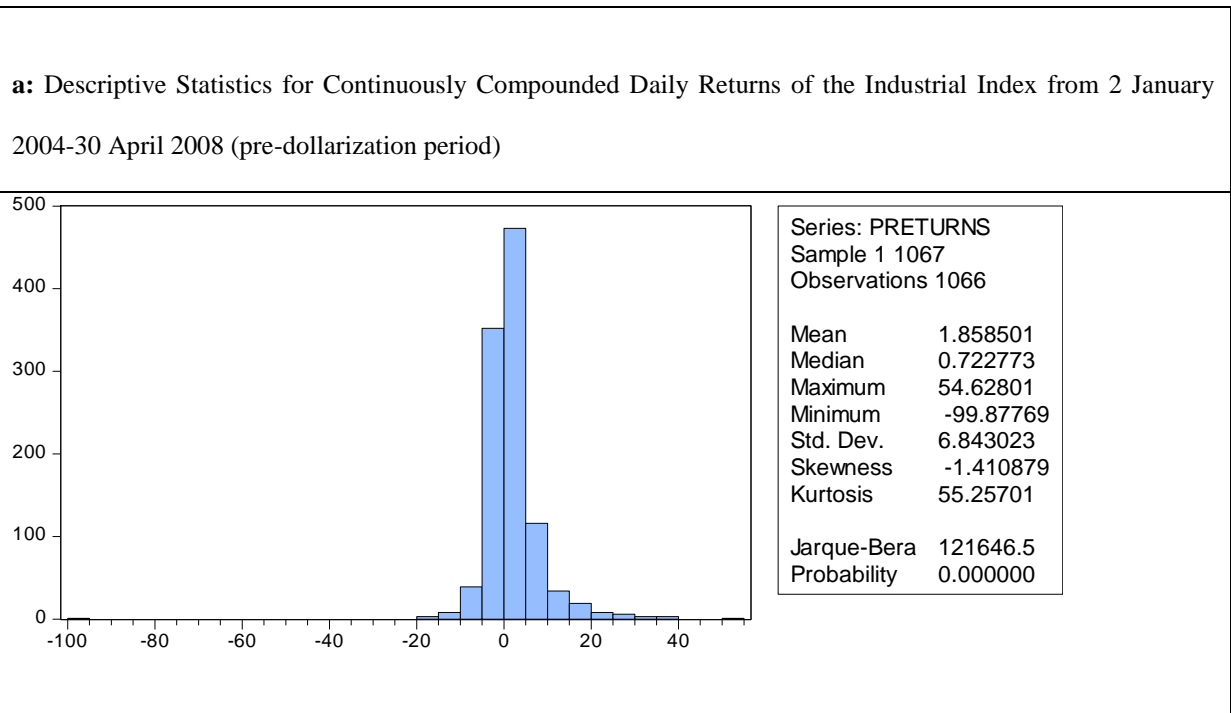
b: Descriptive Statistics for Continuously Compounded Daily Returns of the Industrial Index from 2 February

2009-30 December 2009 (post-dollarization period)

Series: RETURNS	
Sample 1 1198	
Observations 1197	
Mean	0.072827
Median	0.025320
Maximum	9.896730
Minimum	-17.33484
Std. Dev.	1.529365
Skewness	-1.509319
Kurtosis	28.67699
Jarque-Bera	33337.44
Probability	0.000000
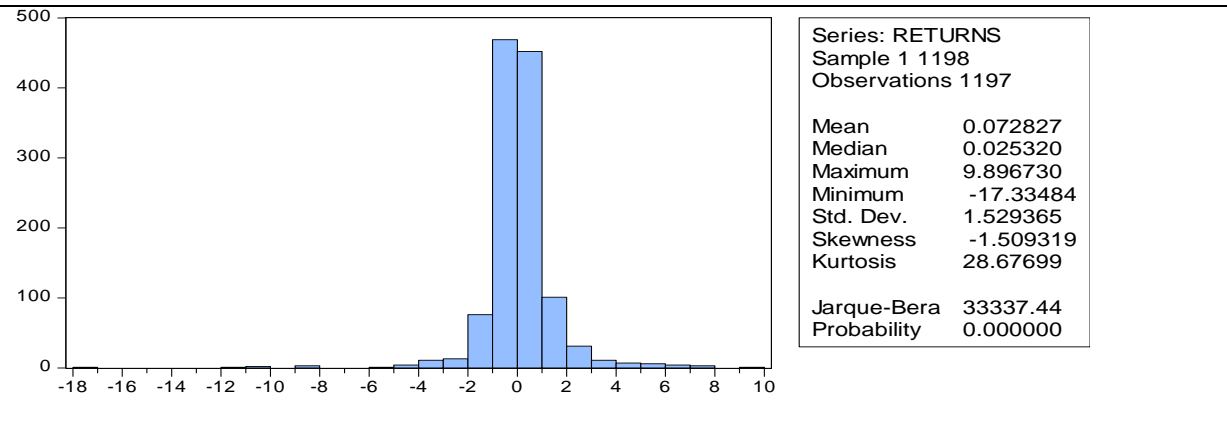
Due to the evidence of non-normality that has been found in both time periods, it is then more appropriate to use non-parametric models that do not assume normality. Table 2a and 2b below displays the returns pattern during the two time periods under investigation. A look at the tables enables a better intuitive analysis of the "stylised facts", a term which refers to the previously discussed common characteristics of financial markets trends of the return series in section 4.1.2. The result in both time periods show evidence of volatility clustering/volatility pooling which describes the tendency for volatility in financial markets which tend to appear in bunches. Its implications are that large returns (either positive or negative) are expected to follow large returns and small returns (either positive or negative) to follow small returns. Plausible explanations for this phenomenon has been that the information arrivals which drive price changes themselves occur in bunches rather than being spaced over time.

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Table 2.

a:Daily Continuosly Compounded Returns for the Industrial Index from the2nd of January 2004-30th of April 2008 (pre-dollarization period).
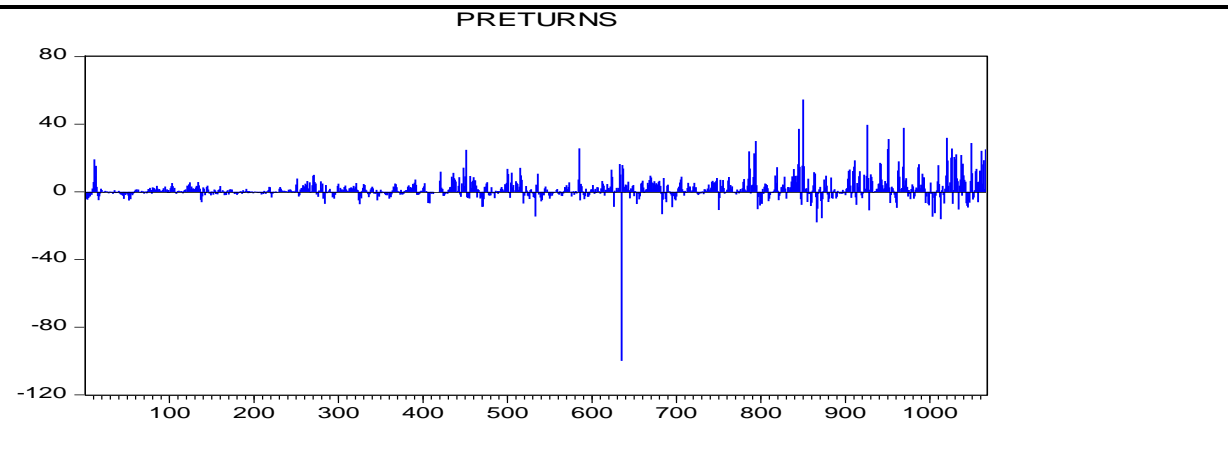
b: Daily Continuously Compounded Returns for Industrial Index from February 2009-December 2013 (post-currency reform period).
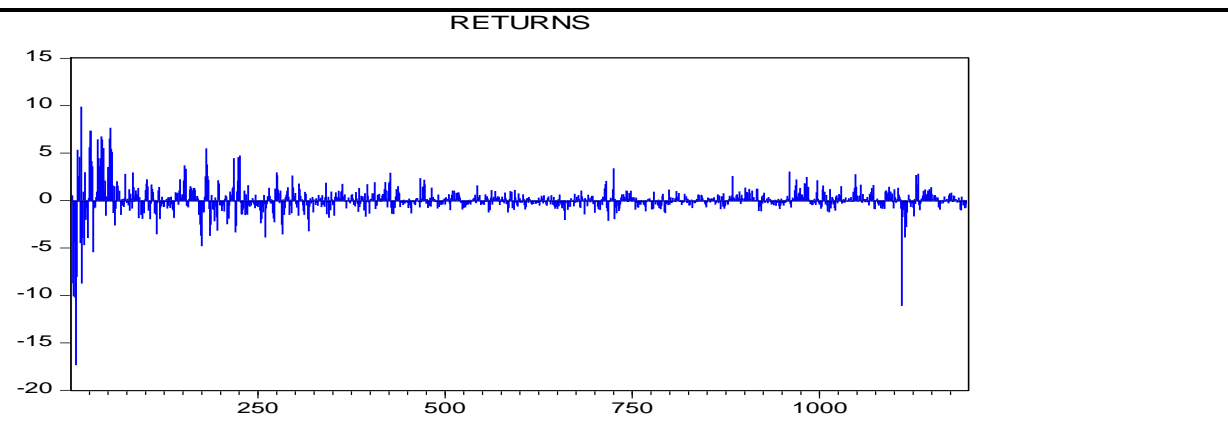
5.2. RESULT OF DAY OF THE WEEK SEASONALITY IN VOLATILITY

The results for the day of the week effect employing for all three GARCH models: GARCH,

EGARCH and TGARCH are presented in Table 3a and 3b below.

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Table 3.

a : Day of Week Effect of the Industrial Index from 2 January 2004-30 April 2008 (pre-dollarization period).

ESTIMATED	MODELS		
	GARCH	**EGARGH**	**TGARCH/GJR**
Monday	-4.934315*** (0.0000)	-0.483433* (0.0055)	0.578181** (0.0475)
Tuesday	-2.947151** (0.0039)	0.251129 (0.1370)	2.762510*** (0.0000)
Wednesday	-4.375794*** (0.0001)	-0.354885* (0.0828)	1.016078** (0.0050)
Thursday	-4.024237*** (0.0017)	-0.090400 (0.6084)	2.246414*** (0.0000)
Friday	-4.573302*** (0.0001)	-0.428139* (0.0091)	0.857989)*** (0.0160)
ω	4.822101*** (0.0000)	-0.019648 (0.9035)	-0.597075*** (0.0004)
α	0.904954*** (0.0000)	0.991604*** (0.0000)	1.175622*** (0.0000)
β	0.439307*** (0.0000)	0.291291*** (0.0000)	-0.519670*** (0.0000)
γ		0.815718*** (0.0000)	0.398310*** (0.0000)
SE of regression	7.107628	7.000513	7.076879
AdjR²	-0.074779	-0.046559	-0.065500

Table 3.

The AR (1) is significant at 1% level of significance in all cases and the highest coefficient of last period (t-1) volatility is 1.175622 recorded by the TGARCH model. The estimated GARCH term β which indicates the impact of long-term volatility is statistically significant and positive in all models with the exception of the TGARCH model which has a negative coefficient. Thus according to the TGARCH model, positive and negative shocks of equal magnitude have different effects on conditional volatility.

The asymmetry term γ is significant and positive in both EGARCH and TGARCH models. This implies that positive shocks have a greater impact on volatility rather than negative shocks of the same magnitude. The significance of positive shocks persistence or the volatility asymmetry indicates that investors are more prone to the positive news in comparison to the negative news. All models are showing evidence of day of the week effect but when we use the least value of the likelihood function as selection criteria for the model we select the EGARCH model. The EGARCH model shows evidence of seasonality on Mondays, Wednesdays and Fridays on the bourse before the introduction of the United States Dollar.

b. Day of the Week Effect February 2009-December 2013(Post currency reform period).

ESTIMATED MODELS			
	GARCH	EGARGH	TGARCH/GJR
Monday	0.203745 (0.7228)	0.003171 (0.9933)	0.315317 (0.1983)
Tuesday	0.133540 (0.8189)	-0.26357 (0.5163)	-0.206486 (0.4309)
Wednesday	0.080499 (0.8890)	-0.837660* (0.0301)	-0.148013 (0.5484)
Thursday	0.245204 (0.6711)	0.191046 (0.6264)	0.134052 (0.5892)
Friday	0.316548 (0.5847)	-0.364622 (0.3750)	0.120246 (0.6442)
ω	-0.105557 (0.8548)	0.055021 (0.8871)	0.032116 (0.8976)
α	0.459850*** (0.0000)	0.267015*** (0.0000)	0.249043*** (0.0000)
β	0.568380*** (0.0000)	0.972846*** (0.0000)	0.721725*** (0.0000)
γ		0.03521 (0.01199)	-0.000955 (0.9799)
SE of regression	1.532372	1.533042	1.530460
AdjR²	-0.003936	-0.004813	-0.002269

Notes: test statistics (p-values) reported in parenthesis.*, **, * denotes significance at 10%,   5% and 1% respectively.**

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The AR (1) is significant in all cases. The estimated GARCH term β is always significantly positive; 0.568380, 0.972846, 0.721725in the GARCH, EGARCH and TGARCH respectively. As is typical of GARCH model estimates for financial asset returns data, the sum of the coefficients on the lagged squared error and lagged conditional variance are greater than unity in all three cases. This implies that shocks to the conditional variance will be highly persistent (Brooks, 2008). In a forecasting domain, a large sum of these coefficients will imply that a large positive return will lead future forecasts of the variance to be high for a protracted period.

The asymmetry term γ is significant in the EGARCH model but not the TGARCH. This implies significant leverage effect via the EGARCH. Since the relationship between volatility and returns is negative, a positive return on a particular day leads to a higher next period volatility than when there is a negative return of the same amount.The magnitude on the ZSE is estimated to be around 0.035%.The EGARCH model shows evidence of seasonality on Wednesdays only after the currency reform period.

5.3. RESULT OF THE MONTHLY SEASONALITY IN VOLATILITY

The results for the Month of the Year effect after employing for all three GARCH models: GARCH, EGARCH and TGARCH are presented in Table 4a and 4b below.

Table 4.

a: Month of the Year effect of the Industrial Index from 2nd January 2004-30th April 2008 (pre-dollarization period).

ESTIMATED MODELS			
	GARCH	EGARGH	TGARCH/GJR
January	1.347379 (0.9915)	-1.004664 (0.5883)	-1.133452 (0.4125)
February	1.891393 (0.9880)	-1.184815 (0.5236)	-5.100186*** (0.0000)
March	-1.124544 (0.9929)	-1.258072 (0.4979)	-4.320012*** (0.0000)
April	-1.708987 (0.9892)	-1.10467 (0.5519)	-4.820738*** (0.0000)
May	-0.866155 (0.9945)	-1.286440 (0.4886)	-3.984186*** (0.0000)
June	-1.995895 (0.9874)	-1.349386 (0.4677)	-5.137758*** (0.0000)
July	-0.895078 (0.9943)	-1.132784 (0.5419)	-3.095945** (0.0040)
August	-1.535086 (0.9903)	-1.283471 (0.4900)	-4.895583*** (0.0000)
September	-1.677091 (0.9894)	-1.193125 (0.5207)	-4.658481*** (0.0000)
October	-1.883278	-1.157198	-5.086009***

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	(0.9881)	(0.5332)	(0.0000)
November	-2.031694	-1.25488	-5.172582***
	(0.9871)	(0.4992)	(0.0000)
December	-1.689851	-1.23880	-4.749893***
	(0.9893)	(0.5050)	(0.0000)
ω	2.163040	0.917390	5.363224***
	(0.9863)	(0.6216)	(0.0000)
α	1.030002***	1.047986***	1.131643***
	(0.0000)	(0.0000)	(0.0000)
β	0.407183***	0.249653***	0.412185***
	(0.0000)	(0.0000)	(0.0000)
γ		0.817350***	-0.365389***
		(0.0000)	(0.0011)
SE of regression	7.065462	7.006713	5.732349

Notes: test statistics (p-values) reported in parenthesis.*, **, * denotes significance at 10%, 5% and 1% respectively**

The autoregressive term AR (1) is statistically significant in all cases with the smallest co-efficient of 1.030002 in the GARCH model. Given that all terms in a GARCH model are squared, there will always be a symmetric response to positive and shocks such that the model does not capture any leverage effects in the time series.

The estimated β term is statistically significantly positive in all models; 0.407183, 0.249653, 0.412185 for GARCH, EGARCH and TGARCH respectively. It indicates the impact of long-term volatility of returns of the index. The sum of the coefficients in the lagged squared error and lagged conditional variance is greater than unity on all models, implying that shocks to the conditional variance will be extremely and highly persistent.

However the term γ which indicates the leverage effect in the EGARCH and TGARCH model is statistically significant in both models. A negative shock should be more damaging than a positive shock and therefore produce greater volatility of the returns of the index. The coefficient estimate γ is positive for the EGARCH model so this stylised fact holds. Interestingly it does not hold for the TGARCH model as the coefficient estimate is negative and also statistically significant. This implies that a positive shock produced greater volatility on the market than a negative shock of the same magnitude. Plausible explanation for this result is due to the hyperinflationary environment that was present during the investigated period. A rise in the share prices on the index increased trading on the market as investors responded more to a share price increase than a drop.

The TGARCH model reports all months to have a negative monthly effect with the exception of January. This is not surprising as the returns on the index are very volatile, increasing at an accelerating rate due to hyperinflationary macro-environment. The TGARCH model has the least value of the standard error of regression and hence becomes the best model to explain the presence of monthly seasonality on the bourse. Thus pre the currency reform period there is evidence of a negative monthly effect on all the months of the year except the month of January.

b: Month of the Year Effect of the Industrial Index February 2009-December 2013 (post-currency reform).

ESTIMATED	MODELS		
	GARCH	EGARGH	TGARCH/GJR
January	4.049766 (0.7464)	1.197510 (0.3583)	3.422975 (0.7890)
February	3.978147 (0.7506)	1.228620 (0.3471)	3.348957 (0.7934)
March	3.957501 (0.7519)	1.217533 (0.3489)	3.328093 (0.7947)
April	3.968611 (0.7512)	1.255624 (0.3345)	3.340204 (0.7939)
May	3.983639 (0.7503)	1.190253 (0.3600)	3.355108 (0.7930)
June	3.985997 (0.7502)	1.215708 (0.3500)	3.356468 (0.7930)
July	3.955422 (0.7520)	1.324537 (0.3083)	3.326939 (0.7947)
August	4.469795 (0.7210)	1.197026 (0.3576)	3.839429 (0.7640)
September	4.014827 (0.7484)	1.252566 (0.3355)	3.386647 (0.7931)
October	3.981810 (0.7504)	1.238760 (0.3408)	3.354047 (0.7931)
November	3.943833 (0.7527)	1.164815 (0.3705)	3.315005 (0.7955)

December	4.050222 (0.7463)	1.360256 (0.2968)	3.425266 (0.7888)
ω	-3.920712 (0.7541)	-1.372921 (0.2912)	-3.291765 (0.7969)
α	0.347889*** (0.0000)	0.180834*** (0.0000)	0.341803*** (0.0000)
β	0.625419*** (0.0000)	0.985460*** (0.0000)	0.622797*** (0.0000)
γ		0.024306 (0.011299)***	0.020858 (0.7077)
SE of regression	1.533277	1.536873	1.530460

Notes: test statistics (p-values) reported in parenthesis.*, **, * denotes significance at 10%, 5% and 1% respectively**

The autoregressive term AR (1), is statistically significant in all cases with a smaller coefficient on the EGARCH model. The estimated β term is also statistically significant and positive; 0.625419, 0.985460, 0.622797 in the GARCH, EGARCH and TGARCH respectively. The sum of the coefficients in the lagged squared error and lagged conditional variance is very close to unity on all models, implying that shocks to the conditional variance will be highly persistent. However the term γ in the TGARCH model is not statistically significant but significant in the EGARCH model. This implies the presence of leverage effects via EGARCH. The market responds more to positive shocks than to negative shocks of the same magnitude. Interestingly all the GARCH family models fail to show any evidence of seasonality on the bourse as none of the monthly coefficient estimates are statistically significant. The result is not surprising as the introduction of the United States Dollar completely arrested hyperinflation which caused the return on the industrial index to be extremely volatile.

These results are therefore not supported by previous studies from international markets of the daily closing prices in UK, Japan, Canada and Australia that have observed a similar pattern in equity returns. Negative mean returns on Monday and positive mean on Friday or Saturday return (Jaffe and Westerfield, 1985).Given these patterns, a profitable investment strategy would be to buy low on Mondays and sell high on Fridays. However the presence of a negative Monday, Wednesday and Friday effect pre the currency reform and a negative Wednesday effect post the currency reform on the ZSE is an indication of market inefficiency. From this result which conforms to global findings, the day of the week effect is now a stylized fact in financial markets studies and market inefficiency cannot explain well the phenomenon on the ZSE.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1. SUMMARY OF FINDINGS

The research investigated the presence of two calendar anomalies; the day of the week or Monday effect and the Month of the year or January effect by modelling volatility of the industrial index returns on the Zimbabwe Stock Exchange (ZSE). The period of analysis is from the January 2004 to April 2008 (pre-dollarization period) and the second period of analysis is from the post-currency reform which runs from February 2009 to the December 2013.

The procedure is carried out by employing on-parametric models from the Generalized Autoregressive Conditional Heteroscedastic (GARCH) family; GARCH, EGARCH and TGARCH. The models are better suited in modelling daily and monthly seasonality as they can capture the time-varying volatility of the stock return data. The results obtained from the study are mixed. The day of the week test finds significantly negative returns on Monday, Wednesday and Friday pre the currency reform whilst a negative Wednesday effect is found post the currency reform period.

The same techniques are applied to model the January effect and interestingly the TGARCH model is the only one that captures a negative monthly effects on all the months of the year with the exception of January pre-reform period. All three models employed fail to find any evidence of monthly seasonality on the bourse post the currency reform period. However, the absence of monthly seasonality effects and the reduced number of days of day of the week effects from all the GARCH models employed can infer that the currency reform had a positive impact which translated to market efficiency.

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6.2. CONCLUSION OF THE STUDY

The research findings of investigating this well-known puzzle in finance are interesting. Seasonality in the day of the week effects post the reform is only captured on Wednesday, they are significantly negative returns. The pre-reform period shows evidence of day of the week effect on Mondays, Wednesdays and Fridays which are also negative. This is contrary to global studies of day of the week effect were Monday returns are usually significantly negative. A plausible reason for the existence of this anomaly can be attributed to the illiquidity in the market from investors selling at beginning of the week. A comparison analysis of both time periods can infer that the stabilising reform had a positive impact on the overall level of efficiency on the bourse as only evidence of seasonality is found on only one day of the week unlike the former period which had three days.

The failure of GARCH models to capture seasonality in the month of the year returns can lead us to document that monthly anomalies are non-existent on the ZSE post the reform. On the other hand, models to be statistically significant implying that the market is sensitive to past shocks so the market is determined by past movement and stock prices do not behave randomly. The paper provides new evidence on the calendar effect by ZSE with an approach that provides a new framework for investigating this puzzling phenomenon in Finance.

6.3. RECOMMENDATIONS FOR FURTHER RESEARCH

Previous studies on efficiency in stock markets usually believed that the older a market, the more efficient it is likely to become as age comes with sophistication gained over the years. In other words, stock market efficiency is said to evolve with time. The presence of seasonality on the ZSE has failed to agree to this view which was also put forward by Mitura and Hall (1998).The reality in most African markets is that the constantly changing political and economic environments have a pivotal role which translates to the level of stock market effi-

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ciency. Further research is required on how other macro-economic policies have an impact that translates to efficiency on stock markets.

Other studies of seasonal anomalies such as the pre-holiday effects can also be considered on the same period which is a more recent. The last study on pre-holiday effects was by Alagidede (2012) which investigated the period from 1995 to 2006 and no work has been done according to the writers knowledge which tests the this phenomenon. Finally the results from day of the week effects which found Wednesdays have significantly negative returns opens another door for future research by investigating if trading rules can profitably exploit this anomaly.

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APPENDIX.

Table 5.Diagnostic Checks for Day of the Week Models

	GARCH	EGARGH	TGARCH
BDS :Bootstrap			
2	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0000
5	0.0000	0.0000	0.0000
6	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0000
5	0.0000	0.0000	0.0000
6	0.0000	0.0000	0.0000
AIC	2.756876	2.738408	2.758546
SBC	2.790878	2.793661	2.796799
LL	-1 641.990	-1 625.937	-1641.990
Asymmetry test on the standardised residuals of the symmetric GARCH			
SB test	0.0001		
NB test	0.0005		
PB test	0.0000		
Joint test	0.0002		

Notes: Only *p*-values of BDS arereported.SB, NB, PB for sign bias, negative and positive sign bias respectively

AIC and SBC refer to Akaike and Schwarz information criterion while LL is the log likelihood function.

Table 6.

Diagnostic Checks for Month of the Year Models

	GARCH	EGARGH	TGARCH
2	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0000
5	0.0000	0.0000	0.0000
6	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000
4	0.0000	0.0000	0.0000
5	0.0000	0.0000	0.0000
6	0.0000	0.0000	0.0000
AIC	2.756876	2.738408	2.758546
SBC	2.790878	2.793661	2.796799
LL	-1 641.990	-1 625.937	-1641.990
Asymmetry test on the standardised residuals of the symmetric GARCH			
SB test	0.0002		
NB test	0.0001		
PB test	0.0003		
Joint test	0.0000		

Notes: Only *p*-values of BDS arereported.SB, NB, PB for sign bias, negative and positive sign bias respectively.

AIC and SBC refer to Akaike and Schwarz information criterion while LL is the log likelihood function.