CAPITAL ASSET PRICING MODEL AND THE THREE FACTOR MODEL: EMPIRICAL EVIDENCE FROM EMERGING AFRICAN STOCK MARKETS

WILLIAM COFFIE

A Thesis Submitted for the Degree of Doctor of Philosophy (PhD)

At the Birmingham City University, Department of Finance, United Kingdom

2012

I, William Coffie, hereby attest that the entire length of this thesis is written by me and have not submitted it previously to apply for a higher research degree.

I hereby also certify that I was admitted to study for a PhD degree in March 2007 at Birmingham City University and this thesis is a record of study carried out at Birmingham City University Business School between 2007 and 2012.

Date………………   Signature of Candidate……….………

We hereby certify that the candidate has fulfilled the conditions of purpose and regulations required for the degrees of PhD at Birmingham City University. The candidate is qualified to submit this thesis in application for the PhD.

Date………………   Signature of Supervisor …...................

Abstract

This thesis explores two celebrated asset pricing models by investigating whether or not the capital asset pricing model (CAPM) and the Fama-French three factor model apply in Emerging African Stock Markets (EASM). While Sharpe (1964) and Lintner (1965) developed the capital asset pricing model (CAPM), it has been widely tested by finance researchers and applied in practice. The central theme of the CAPM is that the only risk variable that affects asset returns is the market factor (beta). However, empirical evidence suggests that the beta alone is not sufficient to wholly explain variation in asset returns (Jensen, 1968; Jensen *et al*, 1972). A search for an appropriate asset pricing model has led to the development of multifactor models (Ross, 1976; Fama and French, 1992; Carhart, 1997). Fama and French (1992 and 1993) introduced the size and BE/ME anomalies to the academic literature and advocates that it might be driven by changes in microeconomic factors missed by the single factor CAPM.

This study adopts Jensen (1968) version of Sharpe-Lintner CAPM and follows Jensen *et al*. (1972) and Fama and French (1993) time-series approaches.

The study provides substantial evidence of the benefits of volatility as augmenting factor in the classic CAPM in explaining asset returns in a new application to Africa and other emerging markets with similar economic characteristics. It was demonstrated that a pricing model that includes both market risk premium and volatility risk premium significantly captures patterns of returns in Africa than the classic CAPM or Fama-French model. Furthermore, this study makes three more important contributions to the literature on emerging African capital markets as follows:

1. That beta on its own cannot fully explain risk in Africa per CAPM's assertion as returns can be related to other non-beta factors.

2. The evidence here produces firm contradiction to the growing literature that size and BE/ME are fundamental risk factors. These two variables are not risk factors and indeed, small and value firms do no attract additional compensation for risk in Africa.

3. Lack of integration of African stock markets with the world market means that country specific risk as measured by volatility is persistent across all five countries and therefore volatility augmented asset pricing model is more appropriate than classic CAPM or multifactor model with size and BE/ME. Unlike Fama-French and liquidity augmented models, this model is underpinned by theory. Even, in circumstances where volatility risk premium is negative as documented elsewhere and in this study for certain assets in Africa; the model provides useful information for portfolio construction/allocation and hedging in line with Merton (1973) ICAPM.

Acknowledgement

First of all, I would like to thank the Almighty GOD and his Son JESUS for seeing me through all these years. I would also like to thank my lead Supervisor Osita Chukwulobelu for his contribution in choosing the topic, encouraging and guiding me throughout my research. My appreciation goes to Javed Husain my second supervisor and Bob Curry (Emeritus) my former Director of Studies for their support and contribution. I am very grateful to my mother Agnes Ntaadu and my late father Thomas K Serekye for bringing me up and pay for my education. At a more personal level, I am very much indebted to my wife Mavis and my beloved son William Jnr for their patience, endurance and being there for me always.

Dedication

Agnes Ntaadu my mother, Mavis my wife and William Jed-Manuel my beloved son, to you I dedicate this work.

Acronyms

AMEX	American Stock Exchange
APT	Arbitrage Pricing Theory
AR	Autoregressive
ARCH	Autoregressive Conditional Heteroscedasticity
ARMA	Autoregressive Moving Average
ASMs	African Stock Markets
BE/ME	Book Equity to Market Equity ratio
CAPM	Capital Asset Pricing Model
C-CAPM	Consumption Capital Asset Pricing Model
CMT	Capital Market Theory
ECM	Error Correction Model/Mechanism
EAMs	Emerging African Markets
GARCH	Generalised Autoregressive Conditional Heteroscedasticity
GARCH-M	GARCH-in- Mean
GDP	Gross Domestic Product
HML	High Minus Low
I-CAPM	Intertemporal Capital Asset Pricing Model
ICAPM	International Capital Asset Pricing Model
IFC	International Finance Corporation
MA	Moving Average
M-CAP	Market Capitalisation
NASDAQ	National Association of Securities Dealers Automated Quotations
NYSE	New York Stock Exchange
OLS	Ordinary Least Square
SMB	Small Minus Big

Contents

List of Tables

List of Figures

CHAPTER ONE: INTRODUCTION

1.1 Background

The Capital Asset Pricing Model (CAPM) of Sharpe (1964), Lintner (1965) and Mossin (1966) has been a dominant orthodoxy in financial economics, giving a simple solution to complex financial problems faced by investors and corporate managers. It was regarded as a good measure of risk for over two decades and a model that could explain why some assets earn higher returns than others. The CAPM theory states that return on assets are affected by systematic or market risk and this risk is measured by the beta. According to the CAPM asset can earn higher return if they have a high market beta.

According to Sharpe (1964), the CAPM beta is the correct measure of an asset risk and the higher the asset beta the higher the risk and therefore the higher the expected return. Beta measures an asset's risk, and shows the variation in asset returns relative to the market portfolio. Beta quantifies systematic (that is, undiversifiable) risk and assumes that only this type of risk is priced and compensated for (Sharpe, 1964 and Lintner, (1965). Therefore, investors should not be compensated for firm specific risks by not holding a diversified portfolio (Markowitz, 1959). Mathematically, the CAPM is expressed as:

$$E(R_i) = R_f + \beta_i \left\lfloor E(R_M) - R_f \right\rfloor \tag{1.1}$$

However, the CAPM has come under attack from pre and post 1980 finance researchers who have identified other patterns in asset and portfolio returns that are not captured by the classic CAPM's beta. For instance, a major criticism of CAPM is its view of using a single factor to determine expected asset return (Jensen, 1968 and Jensen, Black and Scholes, 1972) and the dominant impact of the market portfolio (Ross, 1976 and Roll, 1977). The CAPM emphasized that investors are only concerned with systematic risk, but are really? Banz (19981) and Reinganum (1981) find that small capitalisation equities experienced higher returns than what could be predicted by the CAPM. Basu (1983) find that low price-earnings ratios (P/E) stocks experience returns in excess of what could be explained by the CAPM, whereas high P/E ratio equities experience returns lower than what could be explained by the CAPM. These findings challenged the explanatory power of CAPM's beta as the only priced or explanatory factor. Those patterns that cannot be explained by the CAPM are termed anomalies in asset pricing.

In a ground-breaking paper, Fama and French (1992) evaluated the joint roles of market beta, firm size and book-to-market effect in the cross section of average returns on the NYSE, AMEX, and NASDAQ equities. Their results questioned the market beta as a sole measure of asset risk and therefore, advocate for a multifactor model, which has come to be known as the Three Factor Model. Their model suggests that investors are not only concerned with macroeconomic risk as emphasised by the CAPM, but are concerned also with microeconomic risks and therefore conclude that a three factor model which include SIZE (measured by market capitalisation) and BE/ME(i.e. book equity-to-market equity) better explain equity returns than the one factor CAPM.

Subsequently Fama and French (1993, 1996) provide further evidence in support of their model and affirm that the anomalies not captured by the classic CAPM disappear in their multifactor model. The three factor model states that expected excess return on an asset is expressed by:

$$E(R_i) = R_f + \beta_i\left[E(R_M) - R_f\right] + \beta_s\left[E(SMB)\right] + \beta_h\left[E(HML)\right] \qquad (1.2)$$

Where,

R_M-R_f is the excess return on the market portfolio or index as in CAPM;

SMB is the difference between return on a portfolio of small equities and the return on large equities; and

HML is the difference between the return on a portfolio of high BE/ME (i.e. value stocks) and the return on low BE/ME (i.e. growth stocks).

Other researchers have documented other anomalies such as momentum (Jagadeesh and Titman, 1993; Carhart, 1995; and Rouwenhorst, 1997) and this has led to a fourth factor included in the multifactor extension of the CAPM (Carhart, 1997).

$$E(R_i) = R_f + \beta_i\left[E(R_M) - R_f\right] + \beta_s\left[E(SMB)\right] + \beta_h\left[E(HML) + \beta_m\left[E(PR1YR_t)\right]\right] \qquad (1.3)$$

However, the study is restricted to CAPM and the Three Factor Model (see section 1.4 for justification).

1.2 Aim and Objectives

The aim of this research is to investigate whether or not the Capital Asset Pricing Model (CAPM) and the Fama-French Three Factor Model apply to Emerging African Stock Markets (EASM). This study is limited to these two asset pricing models and should in case none of these two models explain the return generating process fully in Africa; I propose to develop a suitable augmented model. Previous studies have supported additional tests of the three factor model in other emerging economies [Drew and Veeraraghavan, 2001; Bundoo, 2008]. In this research I have advanced the debate by testing the vigour of a two celebrated asset pricing models - examining the explanatory powers of the one-factor CAPM and the Multifactor Model of Fama and French (1992).

In order to achieve the preceding aim, an empirical test of the two models is carried out by examining the following objectives:

1 Test whether the one factor CAPM explains realised asset returns in African Stock Markets(ASMs)

    1.1 using OLS estimation and assume stability in error variance

    1.2 by adjusting for variation in conditional variance using GARCH

2 Test whether the multifactor model explains realised asset returns in African Stock Markets (ASMs).

    2.1 using OLS estimation and assume no cointegration and stability in error variance,

    2.2 by adjusting for errors caused by cointegration using ECM (Error Correction Mechanism),

    2.3 by adjusting for variation in conditional variance using GARCH.

3 Develop an augmented model suitable for estimating risks in emerging African Stock Markets.

The purpose of this research is to provide additional emerging market evidence on risk-reward relationship when investing and estimating cost of capital in emerging African markets in a manner that have not been explored a priori. This research contribute to the finance literature by investigating into factors that affect the structure of asset returns in the

Africa region- a class of emerging markets either ignored or escaped by many finance researchers in asset pricing.

1.3 Rationale

The CAPM and the Multifactor Model have been extensively tested over the years in the finance literature (see chapter three). However, most of these empirical evidences are concentrated in the developed markets particularly U.S, Japan and Western Europe and have left the Emerging African Markets largely uninvestigated. Nevertheless, the rapid growth of emerging African markets and increased flow of investment funds into Africa during the last two decade makes it imperative for additional evidence on investments rewards and their associated risks.

There are mixed evidences provided in the existing literature on asset pricing. For example, Hawawini and Keim (1999) while summarising their empirical studies state that ‘‘the proposal to displace the CAPM and replace it with multifactor model is premature’’. They went on to assert that many of these anomalies have been in existence for almost a century and there is no evidence to prove their existence in the future and therefore research in the next century may be important to settle this issue. Miller (1999) asserts that ‘although the one factor CAPM has managed to sustain more than three decades of fierce scrutiny and still the most widely used and taught asset pricing model in business schools, the current consensus is that a single risk factor is not enough to describe expected asset returns. Instead a three-factor model has now been shown to describe cross sectional average returns better than the CAPM’. However, this author believes that more work is still needed to establish the legitimacy of the new model particularly in emerging capital markets of Africa. This view is supported by Campbell *et al*. (1997), who documented that the practicality of the multi-factor models will not be entirely acknowledged till enough diverse confirmations are presented outside the US market.

The evidence of CAPM and multifactor model tests in Africa are also mixed and contradictory. For instance, Omran (2007) found that market risk premium provides significant explanation to returns in Egypt. His evidence was supported by Al-Rjoub *et al*. (2010), and Coffie and Chukwolobelu (2012), who found that the market beta has significant and positive relation with returns in MENA markets and Ghana respectively. However, Reddy & Thomson (2011) found very little evidence of the explanatory power of beta in South Africa and even rejected the CAPM when it was tested year by year on portfolios. In spite of this evidence, Nel (2011) found that South African firms considers CAPM as the appropriate model for estimating cost of capital and fund managers used it frequently in pricing assets and for analysing portfolio performance. Bundoo (2008) identified that in addition to beta, book-to-maket and size premia affect return generating process in Mauritius. Hearn *et al.* (2010) found similar results in South Africa, Kenya, Egypt and Morocco. In their results they document that in addition to beta, size and liquidity are priced in these markets, while the augmented CAPM renders superior performance than Sharpet-Lintner CAPM. Hearn (2009) found that beta has significant relationship with returns in South Africa compare to the little significant effect of size and liquidity premia. Nevertheless, in addition to beta they found that size and liquidity have significant explanatory power in Kenya and Uganda. Furthermore, Hearn (2011) found that size and liquidity have significant effect in explaining returns in Egypt and Tunisia and less so in Morocco and questionable in Algeria. Nevertheless, Habib and Mounira (2012) found that liquidity is not priced in Tunisia and this is supported by Danadelli and Prosperi (2012) evidence, that local liquidity factors have no effect on asset pricing in Egypt, Morocco and South Africa. Hearn and Piesse (2010) found that size-liquidity augmented CAPM is useful in estimating cost of capital in Ghana, Cote d'Ivoire, Nigeria, Morocco and Tunisia. Jun *et al.* (2003) found a correlation between stock returns and aggregate market liquidity in Nigeria, South Africa and Zimbabwe.

The literature on asset pricing in Africa is still at its elementary stage with much attempt to find anomalies instead of checking the rigour of the CAPM which has been used widely in estimating cost of capital and pricing of assets on the continent by practitioners. The scanty literature so far is crowded with contradictions with no clear recommendation(s) but this study is designed to fill this gap in the African literature by examining individual securities risk profile and proposes a suitable augmented model for Africa. So far none of the literature suggests such an augmented model in Africa. Levy and Roll (2010) reanimated the debate of asset pricing after the CAPM has received such an acknowledgement from its star critic (see Roll, 1977) that the market portfolio may be mean-variance after all. It feels like the test of CAPM has just begun. This new evidence rejuvenates such a study in Africa.

Two more reasons make this study different and important:
Firstly, voluminous empirical studies of Asset Pricing have focussed on portfolios of which Jensen *et al.,* (1972) are among the pioneers and most of emerging ASMs studies have been conducted at aggregate market levels rather than employing data on individual securities. Although estimation errors are reduced when portfolios are used, I believe that since asset pricing models were developed using data on single security rather than portfolio, accordingly, it is important to establish the performance of the models with regard to individual securities initially before jumping to portfolios in frontier market studies. This will also help individual companies to understand and evaluate the relevance of the asset pricing models on the basis of their firm specific risk profile rather than the risk characteristics of a

combination or portfolio of securities when estimating cost of capital. Investment practitioners in these markets will also price assets and evaluate individual security performances with the view of definitive firm risk profile. In order to avoid spurious regression, the methodology is designed to overcome the problem pose by using single securities.

Secondly, examining these classes of emerging markets is motivated by the degree to which these markets move independently from the developed and industrialised markets (that is, market segmentation, Bekaert and Harvey, 1997). The relative segmentation of the emerging ASMs provides this study an opportunity to investigate the performance of asset pricing models in the African markets (see chapter 6 for choice of markets) and how these markets may differ from the developed markets.

Most previous studies in asset pricing in ASMs have been conducted using cross sectional studies. This means that the beta risk is measured at one particular point in time. This study is designed to measure beta risk across time by following time series approach (see also Jensen, 1968; Jensen *et al.,* 1972; Fama and French, 1993).

1.4 Limitation

There are several asset pricing models contained in the finance literature. These include the classic CAPM (Sharpe, 1964; Lintner, 1965 and Mossin, 1966) which says that expected return is linearly related to market risk premium and the only risk factor that affect return is the systematic risk; Black, Jensen and Scholes(1972) version of the CAPM which posits that expected return is positively related to market risk premium but factor uncorrelated to market beta is also priced; Merton (1973) Intertemporal CAPM which account for multi-period characteristic of capital market equilibrium; Ross(1976) Arbitrage Pricing Theory as alternative to CAPM considers various macroeconomic variables as priced factors; Breeden(1979) Consumption CAPM which replace the market portfolio with aggregate consumption portfolio; Fama and French (1992) three-factor model extended the CAPM by adding firm size (M-CAP) and book-to-market equity ratio(BE/ME) and Carhart (1997) four factor model which added momentum factor to the three factor model.

However, this study is limited to testing the classic CAPM (Sharpe, 1964 and Lintner, 1965) and Fama and French (1992) three factor model. These two models are the most extensively researched asset pricing models in the finance literature and CAPM is most widely used in practice. This study aims at extending two of the most celebrated asset pricing models in finance literature focussing on emerging African stock markets (ASMs). Future direction of study will investigate the explanatory power of other asset pricing models in Africa.

1.5 Structure of the Thesis

The rest of this research is organised as follows. Chapter 2 two contains the theoretical foundations of Asset Pricing Models, and their mathematical or algebraic specifications. It begins by discussing the foundation of assets pricing theory and further explores the development of classic CAPM, its extensions and multifactor models.

Chapter 3 focuses on the review of empirical literature on CAPM and the Multifactor Model. Early empirical tests of classic CAPM are reviewed and extensions arising from these tests are also examined in both developed and emerging markets. The rationale of the study is teased out of the literature.

Chapter 4 reviews asset pricing tests and return volatility problems in Emerging Stock Markets. It further reviews the problem pose by thin trading in pricing assets.

Chapter 5 focuses on overview and the performance of emerging African Stock Markets. The historical background and performance of each stock market under study are examined.

Chapter 6 addresses data and methodological approach. It starts by examining data sources and sample and further explores methodological issues and empirical framework.

Chapter 7 reports the empirical findings and analysis of results. It begins by reporting and discussing results for the classic CAPM for each country, consisting of Ghana, Kenya, Morocco, Nigeria and South Africa. This is followed by the augmented versions of the CAPM adjusted for volatility in returns (that is, GARCH and GARCH-M).

Similarly, chapter 8 reports the results for Fama-French three factor on South Africa and Morocco. It starts by analysing the basic model; follow by augmented Fama-French with ECM, GARCH and GARCH-M.

Finally, chapter 9 draws conclusion by summarising the entire study, comparing and contrasting the results, highlighting the contribution of the study, exploring their implications and suggesting any future direction of research.

1.6 Chapter Conclusion

Capital asset pricing model and Fama-French three factor model has dominated the finance literature as two most competitive asset pricing models in empirical finance. The former has been widely empirically tested and used in practice than any other asset pricing model while the latter has also gained the attention of academics and researchers and increasingly been subjected to empirical scrutiny. None however, has received conclusive approval and this study will contribute to the empirical evidence on these two models by using data on a sample of African Stock Markets (ASMs).

CHAPTER TWO: DEVELOPMENT AND REVIEW OF ASSET PRICING MODELS

2.1 Introduction

This chapter examines the theories that underpin empirical asset pricing. It begins by discussing the foundation of assets pricing and further explores the development of the classic CAPM. The extensions of the model that emerged as a consequence of early tests of the classic CAPM are also reviewed as are the more recent theories that have come out of post 1980 studies. Summary and conclusion of the chapter is given at the end.

2.2 Foundation of Asset Pricing Model

2.2.1 Portfolio Theory

The Capital Asset Pricing Model (CAPM) was developed out of the Modern Portfolio Theory (Markowitz, 1952 and 1959) and the Capital Market Theory. According to Markowitz (1952), the portfolio selection process begins with pertinent beliefs concerning future security performances and end with choice of portfolio. Expected return is considered by investors as a favourable thing and variance of return as unfavourable. This belief, in many respects was not new and has always influenced investors' behaviour. However, Markowitz formalised the analyses and brought more rigour into investors' portfolio construction and selection process.

The fundamental foundation upon which portfolio theory was developed is that any stock has a probability to go up or down depending on the market and therefore by including or excluding stock in a portfolio does not matter individually. However, when they are put together, the interaction between the stocks reduces the overall price volatility (or risk) which then adds to the stability of the portfolio.

The theory was developed base on a number of assumptions and include: returns from the portfolio is (jointly) normally distributed random variables, correlation between the stocks are fixed or constant for a period of time, the investors seek to maximise their overall profit or economic utility, all players in the market are rational and risk averse, common information is available to all players in the market, there are no taxes or transaction costs, all securities can be purchased/sold in fractions and all investors are price takers (that is their actions do not influence prices).

The Markowitz model posits that a portfolio selected in time t_{-1} will produce a random return at time *t.* An underlying assumption of the model is that investors are risk averse and only concern with the mean and variance of their single period return on investment. Consequently investors choose portfolios that are mean-variance efficient that reduces return variance on portfolio at a given level of expected return and maximise expected return at a given level of variance.

Markowitz (1959) further states that investors are able to choose an optimal combination of risky assets if they knew the econometric relation between expected asset returns, variance of returns and their covariance's and algebraically express them as follows:

1. Expected return,

$$E\left[\widetilde{R}_i\right] = \sum_{i=1}^{N}\left[\widetilde{R}_i P_i\right] \qquad (2.1)$$

Or

$$E\left[R_i\right] = {[E(P_{t+1}) - P_t] + E[D_{t+1}]}\big/{P_t} \qquad (2.2)$$

Where *E (Ri)* is the expected return; *Ri* is the discounted expected return on investment *i* and *Pi* is the proportion of amount invested in security *i*. P_{t+1} is next period asset price, P_t is the current price of asset D_{t+1} is the next period dividend.

Ri is independent of *Pi*

Since $Pi \geq 0$

And

$\Sigma Pi = 1$, *E(R)* is a weighted average of *Ri*, with the *Pi*, as non-negative weights.

2. Variance or the standard deviation measures the degree to which result varies from expected return. The variance is the expected squared deviation from the mean,

$$Var(R) = \sum_{i=1}^{N} (R_i - E[R_i])^2 \qquad (2.3)$$

And the standard deviation is the square root of the variance,

$$\sigma_R = \sqrt{Var(R)} \qquad (2.4)$$

$$\sigma_R = \sqrt{\sum (Ri - E[Ri])^2} \qquad (2.5)$$

4 Covariance of assets.

$$Cov(Ri, Rj) = (Ri - E[Ri])(Rj - E[Rj]) \qquad (2.6)$$

$$Cov(Ri, Rj) = Corr(Ri, Rj) \times Var(Ri) \times Var(Rj) \tag{2.7}$$

Covariance measures the degree to which returns on R_i, R_j move in direction. It is the expected product of the deviations of R_i and R_j from their mean returns. Positive covariance means that assets variation follows in the same direction and negative covariance means assets variation follows opposite direction. If covariance is zero the assets variation have no covariance and thus are independent of each other. All other things being equal, investors will select stocks with negative covariance so that the misfortune of one company is compensated for by the fortune of the other.

However, investors and corporate managers will find it difficult to apply Markowitz's theory since they need to know expected return, variance of return and covariance's. The capital asset pricing model (CAPM) of Sharpe (1964); Lintner (1965) and Mossin (1966) developed this further by quantifying the risk-return relationship into a simplified model which is intuitively appealing and practically parsimonious.

2.2.2 Diversification, Correlation and Risk

It is more than a century ago since the idea that diversification reduces risk was formed. For example, in 18th century English translations of *Don Quixote*, Sancho Panza advises his master, 'It is the part of a wise man to…not venture all eggs in one basket' (see Perold, 2004). Herbison (2003) also states that the proverb 'Do not keep all your eggs in one basket' originated from Torriano's (1666) *Common Place of Italian Proverbs*.

Characteristically, we can think of diversification as the allocation of investor's wealth across various autonomous risks which cancel each other if held in adequate amount. However, according to Markowitz (1952), risks across assets are correlated to a certain degree due to broad economic influences. Consequently, investors can eliminate some but not all risks held by a well-diversified portfolio. Hence Markowitz concludes: 'This presumption that the law of large numbers applies to a portfolio of securities cannot be accepted. The returns from securities are too intercorrelated. Diversification cannot eliminate all variance'.

Correlation measures the degree to which asset returns share common risks and show how the systematic variation in the return of one asset leads to the systematic variation in the other. In other words, correlation measures the degree of interaction between portfolios of asset returns and quantifies the strength of the relationship between them. The magnitude of the correlation coefficients range between 1.0 and -1.0. The assets are perfectly positively correlated when the correlation coefficient between *Ri, Rj* is +1. This means that both returns move in the same direction by sharing common risk characteristics and substitute for each other. The returns are perfectly negatively correlated when the correlation coefficient is -1. This implies that when one asset return increases, the other decreases and serves as an insure to one another.

There is less than perfect positive relationship between portfolio return and the risks when the coefficient of correlation is less than 1. This leads to the risk from one asset cancelling out some of the risk of the other asset. Thus, the risk of portfolio becomes lower than the average risk of the underlying assets. More so, the benefit of diversification increases the farther away that correlation coefficient is from 1.0. Zero correlation coefficient means no relation exists between assets and movement in their returns are independent of each other. Mathematically, correlation is expressed as:

$$Corr(Ri, Rj) = {Cov(Ri, Rj)} \Big/ {Var(Ri) \times Var(Rj)} \tag{2.8}$$

2.3 Development of Capital Asset Pricing Model (CAPM)

2.3.1 The Capital Market Theory (CMT)

The literature is silent on the proponent(s) of the Capital Market Theory (CMT) but it is often credited to both Markowitz and Sharpe. The CMT adds two important assumptions to the Markowitz's portfolio theory to identify the mean-variance-efficient portfolio.

Firstly, that investors are in complete agreement (i.e. homogeneity of investor expectations because they have equal access to the same information set) on the joint distribution of returns on asset from *t-1* to *t* and it is from this distribution that we draw returns used to test the model. In other words, investors are assumed to agree on the prospects of various investments – the expected returns, variance of returns and correlation coefficients.

Secondly, that there is unrestricted borrowing and lending at a risk-free rate accessible to all investors and does not depend on the quantity borrowed or lent. The theory posits that the ability for an investor to choose an optimal or efficient portfolio (i.e. best combination of investments) of risky investments is determined by their ability to choose the amount of investment in risk-free and risky assets. Figure 1 illustrates and tells the story of the CMT and CAPM.

The Capital Market Theory specifies portfolio return expected by an investor and defines a linear relationship between risk and return on efficient portfolios. This is mathematically expressed as:

$$E(R_p) = R_f + \sigma_p \left[\frac{E(R_M) - R_f}{\sigma_M} \right] \tag{2.9}$$

R_p = portfolio return

R_f = risk free rate of return

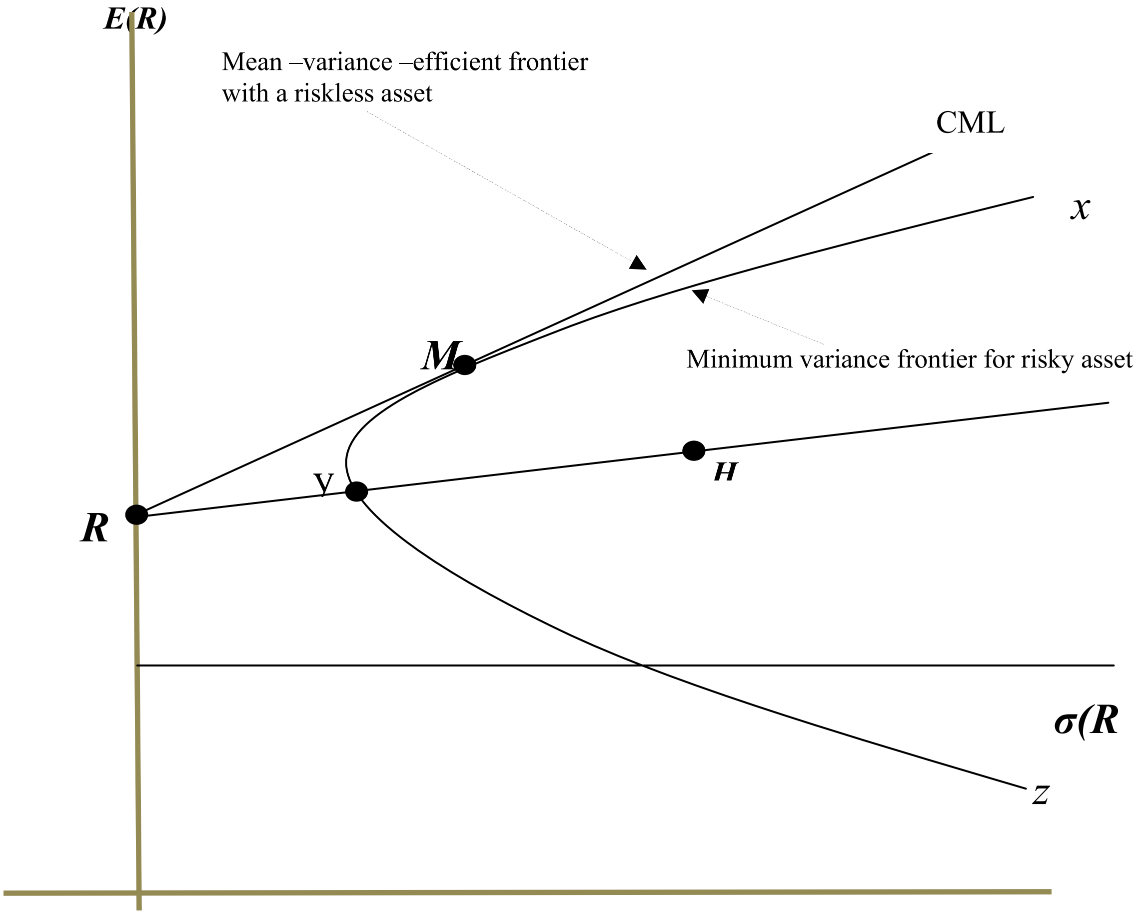
R_M = Return on market portfolio

σ_p = standard deviation of portfolio returns

σ_M = standard deviation of market portfolio returns

Given equation (2.9), expected portfolio return can be regarded as a sum of the return for deferring consumption *(R_f)* and a premium for taking up risk embedded in the portfolio. CMT is applicable to efficient portfolios only and states investors' behaviour vis-à-vis the market portfolio and their own investment portfolios.

Figure 1 The investment opportunity curve



The horizontal axis shows the portfolio return's standard deviation, which measures portfolio risk; the expected return is labelled on the vertical axis. The minimum variance frontier, *the curve xyz*, traces the permutations of expected return and risk for portfolios of risky assets that reduce return variance at different levels of expected returns and these portfolios do not include risk-free assets. The trade-off between risk and return for minimum-variance portfolio is clear. For example, it is obvious that investors who require higher expected return, maybe at point *x*, must agree to take up high volatility (or risk). At point *M*, the investor will receive a midway expected return with mild volatility. In the absence of risk-free asset, only portfolios above *y* along *xyz* are mean-variance efficient, as these portfolios maximise expected return, given their return variances. The existence of risk-free asset turns the efficient set into a straight line known as the Capital Market Line (CML). According to the CML, choosing an optimal portfolio is quite straightforward – it is the combination of the risk-free investment and the market portfolio.

2.3.2 The Single- Factor Capital Asset Pricing Model (CAPM)

The limitation of the CMT led to the development of CAPM (Sharpe, 1964 and Lintner, 1965). The key limitation of the CMT is that it failed to quantify risk that investors are exposed to in proportion to their investment expected return. The CAPM adds two important assumptions to the CMT and Portfolio Theory. Firstly, there is single-period transaction horizon and secondly, investors can short any asset.

The CAPM fundamentally seeks to quantify the relationship between asset expected return and risk (known as beta) which the CMT was unable to achieve. According to CAPM, once risk (beta) is quantified and known, it is practicable to quantify the corresponding expected return of an asset. The CAPM expresses the relationship between expected return of asset *i* and its corresponding risk exposure as:

$$E(R_i) = R_f + \beta_i \lfloor E(R_M) - R_f \rfloor \tag{2.10}$$

$$\beta_i = \frac{\mathrm{cov}(R_i, R_M)}{\sigma_M^2} = \frac{\sigma_i \sigma_M r_{iM}}{\sigma_M^2} = \frac{\sigma_i r_{iM}}{\sigma_M} \tag{2.11}$$

Where,

Ri = required return on asset *i.*

R_f = risk free return.

R_M = the market return

β_i = the coefficient for the risk premium, $E\ (R_M) - R_f$

σ_M = the variance of the market.

$Cov(R_i, R_M)$ = the covariance between the return of the market and the return of the asset.

Investors' are rewarded with returns because they take up risks by investing their money in the market. The risks occur due to variation in asset returns. This means that the variance of riskless asset is zero because the investor knows from the outset the risk-free interest rate when making the investment decision and this risk-free rate is fixed and does not move with or against the market portfolio or index (Sharpe, 1964). That is, there is no covariance between the riskless asset and the market portfolio. The CAPM implies that this risk is only a fraction of the volatility of the market portfolio based on the proportion of investment made in it. Increasing proportion of investment in the market portfolio increases both asset risk and market risk premium proportionately, hence the linear relationship between expected return, risk-free investment and risky investment.

2.4 Testable Implications of CAPM

The relation between the expected return and the market implied by the CAPM theory has three key testable implications.

1. Assets expected returns are linearly related to their betas and no other factor possess marginal explanatory power. Higher beta securities earn higher expected return than lower beta securities.
2. The beta premium must be positive, indicating that the expected return on the market portfolio must be greater than the expected returns on the assets whose returns are not correlated with the return on the market portfolio.

3. The expected returns of assets whose returns are uncorrelated with the market return are equal to the risk-free interest rate, and the risk premium is the difference between the expected market return and the risk- free interest rate.

Approaches used both in the past and present to test these predictions have been either via time series or cross-section regression analysis. This study adopts the former.

2.5 Extensions of the Classic CAPM

The early empirical contradictions of the classic CAPM (see Jensen, 1968 and Jensen et al, 1972 in chapter 3 for full reviews) argue for the need to search for a more complete capital asset pricing model. The CAPM was built on both Portfolio and the Capital Market Theories and these theories in turn were built on many unrealistic assumptions. For example, it is extreme to assume that investors are only concerned with the mean and variance of one period portfolio returns. Because it is also fair to say that investors care about how their portfolio returns co-varies with labour income and future investment opportunities. If this is the case, then, market beta is not sufficient to define an asset risk. This practical problem faced by the central theme of the CAPM means that the search for a more appropriate asset pricing models that may do a better job in capturing average returns must go on.

Following their own empirical test, Jensen, Black and Scholes (1972) developed a two factor model using information about aggregate portfolios of securities (see full review in chapter 3). They stated that, if $x_{jp}, j = 1,..., N,$ represent the weights for assets in certain portfolio *P*, the portfolio expected return and market beta will be related as:

$$E(R_p) = \sum_{j=1}^{N} x_{jp} E(R_j), \qquad (2.12)$$

and $\beta_{pM} = \sum_{j=1}^{N} x_{jp}\beta_{pM}$. (2.13)

Jensen et al went further to state that the market risk premium alone is not sufficient to explain mean returns of assets, leading them to construct a second variable called non-zero beta. Mathematically, this equation is expressed as:

$$\tilde{R}_j = \tilde{R}z\left[1-\beta_j\right] + \tilde{R}_M\beta_j + \tilde{w}_j \qquad (2.14)$$

$\tilde{R}z\left[1-\beta_j\right]$ = stochastic non zero-beta asset or asset whose return is uncorrelated to the market beta.

$\tilde{R}_M\beta_j$ = stochastic market risk premium

Black (1972) theoretically explored the nature of the capital market model under two restrictive assumptions contrary to those usual ones used in developing the CAPM and came out with models similar to that of Jensen *et al* version.

First, he assumed that there is no risk free asset and risk free borrowing or lending is not allowed.

$$E\left(\tilde{R}_i\right) = E\left(\tilde{R}_z\right) + \beta_i\left(E\left[\tilde{R}_M\right] - E\left[\tilde{R}_z\right]\right) \qquad (2.15)$$

$E\left(\tilde{R}_z\right)$ = is the non-riskless asset. The return on portfolio *Z* is independent of the return on portfolio *M*. Black inferred that even when there is no risk free asset and risk free borrowing or lending is not allowed, the expected return on every asset is a linear function of its beta.

Secondly, he assumed that risk free asset exists and risk free lending is allowed but taking short positions in the risk free assets (borrowing) are prohibited. The introduction of the riskless asset simply replaces $E\left(\tilde{R}_z\right)$ with R_f.

$$E\left(\tilde{R}_k\right) = w_{kM} E\left(\tilde{R}_M\right) + w_{kz} E\left(\tilde{R}_z\right) + w_{kf} R_f \tag{2.16}$$

$$\operatorname{var}\left(\tilde{R}_k\right) = w_{kM}{}^2 \operatorname{var}\left(\tilde{R}_M\right) + w_{kM}{}^2 \operatorname{var}\left(\tilde{R}_z\right) \tag{2.17}$$

The must satisfy constraint 12.18 and 2.19:

$$w_{kM} + w_{kz} + w_{kf} = 1; \tag{2.18}$$

$$w_{kf} \geq 0 \tag{2.19}$$

Black found that even when riskless asset is available such as Treasury bill and riskless lending is allowed, the expected return on any risky asset is a linear function of its beta as in equation 2.16.

Critics consider the CAPM to be a one period or static model and do not take into account the multi-period nature of trading. Essentially the multi-period of capital market participation is ignored. In fact, normally assets do not trade in just one-off period instead assets do trade continuously in time. Thus, the Intertemporal Capital Asset Pricing Model (ICAPM) was developed by Merton (1973) to take into account the multi-period characteristic of capital market equilibrium. Unlike the CAPM, ICAPM assumes that investors care about both their end-of-period payoff, and the opportunities to consume or reinvest the payoff.

The assumption of continuous trading underpinning the ICAPM suggests that returns and changes in opportunity set can be explained by continuous - time stochastic processes. However, trading intervals are stochastic and non-constant. The intertemporal nature of Merton's CAPM allows it to capture the continuous-in-time effect which the classical CAPM does not. Unlike the single period investor who does not take into account events beyond the present period, the intertemporal investor will take into account the relationship between returns of current period and the future available returns when choosing his portfolio. Embedded in ICAPM is the recognition of the investment opportunity set that might shift over time. Thus, intertemporal investors would like to protect themselves (hedge) against adverse moves in the available investments set. For example if a particular asset tends to give higher returns when adverse events occur to the investment opportunity set, intertemporal investors would like to hold on to this asset as a hedge.

One important characteristic of the ICAPM is the need to reflect the hedging requirement in pricing assets. The resulting demand function of the ICAPM model is:

$$w_i W = A\sum_{1}^{n} v_{ij}\left(\alpha_j - r\right) + \sum_{1}^{m}\sum_{1}^{n} H_k \sigma_j g_k n_{jk} v_{ij} \qquad (2.20)$$

The first term $A\sum_{1}^{n} v_{ij}\left(\alpha_j - r\right)$ is the demand function of a single period mean-variance utility maximizer for a risky asset, A is the proportionate reciprocal *(1/A)* of total risk aversion of the investor. The second term $\sum_{1}^{m}\sum_{1}^{n} H_k \sigma_j g_k n_{jk} v_{ij}$ reflects the demand for the asset as a hedging tool against adverse shifts in the available set of investments. All risk - averse investors will hedge against this adverse movement as an attempt to minimise the unexpected variability in consumption over time. For example, an intertemporal investor who faces an interest rate of say 6% in the present period and another 2% in the subsequent period will have different demands in portfolio selection from a single-period utility maximizer or an intertemporal investor facing a constant interest rate of 6%.

The ICAPM combines the characteristics of both the classic CAPM and Arbitrage Pricing Theory ([APT], see section 2.6). The model recognises that in equilibrium, investors obtain higher return for bearing systematic risk and also for exposing to risk cause by adversarial movements in investment opportunity set. The ICAPM is dynamic in that it can be stretched to comprise pertinent factors in an identical fashion as the APT except the shifts in the investment opportunity set. The ICAPM implies that investors do care about more than just expected return and variance of return and thus investors no longer select mean-variance efficient portfolios.

While the APT bears some similarity to the ICAPM, it gives little or no guidance as to the nature and number of variables; the variables that should emerge in the ICAPM should satisfy the following two conditions: firstly, explain the evolution of the investment opportunity set across time, and secondly, investors sufficiently care about them to hedge their special effects. For example unanticipated changes in real interest rate may have implication for asset pricing. This kind of change will shift the investment opportunity set and the effect would be persistent enough to warrant investors to hedge themselves against adverse consequences. Even though the ICAPM does not give the exact number of factors, at least it provides some guidance.

The problem with the ICAPM model is that it still keeps most of the prominent classical CAPM assumptions such as expectation homogeneity and thus subject to some of the CAPM's criticisms. The model was developed under the equilibrium market assumption however; it only deals with the demand side of the market and failed to develop the supply side. It also assumes that all dividends paid to shareholders are achieved through share buyback and thus asset returns is equal to the relative change in share price $P_{t+1} - P_t \big/ P_{t+1}$. This assumption is unrealistic since some investors receive dividends in cash without necessarily buying back shares.

Breeden (1979) further developed Merton's (1973) continuous time CAPM model by deriving a single-beta consumption-CAPM in a multi-good (or multi- economy) world, with uncertain consumption-goods prices and uncertain investment opportunities. His version of the CAPM replaces the market portfolio with aggregate consumption. He showed that the equilibrium expected risk premium of an asset is proportional to the beta of the aggregate real consumption (computed by the fractions of aggregate expenditure *(C)* on the various goods *(I)* as weight - $= C \big/ I$) and not the market portfolio. Intuitively, the model is specified as:

$$E(R_i) = R_f + \beta_c \left[E(R_M) - R_f \right] \qquad (2.21)$$

It uses consumption beta (βc) instead of market beta as in classic CAPM and simply extends the concept of CAPM to include the amount that investor wishes to consume in the future.

Unlike Merton's ICAPM which was developed based on only stochastic investment opportunities, Breeden's single-beta consumption-based intertemporal asset pricing model is based on stochastic investment opportunities and consumption opportunities. The testability of the single-beta ICAPM (popularly known as the C-CAPM) is attractive compare to the multi-beta version since it uses a single beta in respect to aggregate real consumption which is easy to implement in empirical tests. The key strength of the single beta consumption CAPM is that the aggregate consumption measures encompasses a greater proportion of the true consumption variable than the fraction measured by the market portfolio (that is, classic CAPM and Merton ICAPM) of the true market portfolio.

Note that the cash flows generated as a results of capital budgeting is closely related to aggregate consumption than to the market portfolio and thus make more sense to precisely measure projects with different risk levels with Breeden's CAPM than to use Merton's ICAPM or classic CAPM. Having said that, there are obvious weaknesses embedded in the computation of the aggregate consumption for empirical tests: first, immediate rate of consumption is not measured, instead weekly, monthly, quarterly or annual rates are measured, and second, there is considerable measurement error in computation of actual aggregate consumption data whereas there is little measurement error in prices and numbers of shares used in market portfolio.

Baek (1987) modify Breeden's version of the CAPM using permanent-income theory of consumption demand. Unlike Breeden, Baek differentiates between actual consumption and permanent consumption and demonstrate that expected rate of return on the market portfolio should be replaced by a permanent consumption and not actual consumption (see Breeden 1979). The permanent consumption based model claim that in the long run consumers form an estimation of what they are capable of consuming and then allocate a proportion of the estimate as permanent consumption. This estimate may be stated by consumers as wealth or permanent income. He went on to demonstrate that change of wealth or permanent income is highly correlated with the change in permanent consumption and not actual consumption. Thus, the risk premium on an asset is dependent on the covariance of the expected rate of return with permanent consumption. Mathematically, the model is expressed as:

$$E(R_i) - R_f = Cov_t\left(Ri, Rcp\Big/cp\right)\tilde{R}_R \qquad (2.22)$$

$$E(Ri) - R_f = Cov_t(Ri, R\ln cp)\tilde{R}_R \qquad (2.23)$$

$(R\ln cp)$ denotes change in permanent consumption,

$\tilde{R}_R$ denotes stochastic harmonic mean of the relative risk aversion across individuals with weight w^k.

The problem with Baek version of the CAPM is the difficulty of measuring permanent consumption since one can only observe total consumption over a time period, not the instantaneous flow of consumption. This obviously makes it practically difficult to accurately measure change in the permanent consumption.

2.6 Multifactor Asset Pricing Models

The preceding evidences show that several efforts have been made to develop a more appropriate asset pricing model that is capable of explaining variations in asset returns. However, these asset pricing models either relax some of the classic CAPM's assumptions or an assumption of its extended versions. In light of this, others have developed multifactor asset pricing models as a means to overcome the limitation(s) of the classic CAPM.

The restrictive assumptions that underlie the mean-variance theory have been recognised within the finance literature and some extensions of the asset pricing model have relaxed one or more of the CAPM's assumptions (see for example, Jensen *et al*. 1972). As an alternative of extending an existing theory, Ross (1976) developed a wholly new theory; the Arbitrage Pricing Theory (APT). In contrast to the CAPM which is based on capital market equilibrium, the APT was developed on a premise that arbitrage opportunities should not exist in efficient capital markets. APT posits that asset returns are driven by K factors and idiosyncratic noise:

$$E\left(\tilde{R}_i\right) = R_f + \beta_{i1}E(\tilde{F}_1) + \ldots + \beta_{iK}E(\tilde{F}_K) + \tilde{\varepsilon}_{it} \tag{2.24}$$

$$E\left(\tilde{\varepsilon}_i\right) = 0\ldots(i = 1,\ldots) \tag{2.25}$$

Empirically tested format of the above is:

$$R_{it} - R_{ft} = \alpha_{it} + \beta_{it1}(R_{F1t} - R_{ft}) + \ldots + \beta_{iKt}(R_{FKt} - R_{ft}) + \varepsilon_{it} \tag{2.26}$$

The attractiveness of the APT as an asset pricing model is its implication that risk - rewards may comprise of a number of risk premia rather than just a single risk premium postulated by the CAPM. Relative to the CAPM, APT relax the homogeneity of investors' expectations of the mean-variance efficiency theory assumption. That is investors may have the same future beliefs about return distribution, but may believe that the return generating process differ (that is underlying probability distributions). For example if ψ represent interest rate or unemployment factor, in such condition, as far as all investors hold the same attitude towards the impact of this factor on asset returns through β_{i1}, they can hold a diverse views on the distribution of ψ devoid of violating the central arbitrage condition. Likewise, investors can differ on the distribution of the idiosyncratic error terms ε_t without changing the arbitrage condition.

The APT unlike the CAPM recognises the possibility of disequilibrium in the market – that is, possibility that an asset can be in excess supply or demand. Despite the relaxed assumption with investors homogeneity or identical expectations, the arbitrage pricing theory still requires effectively identical expectations and agreement on the β coefficients if the detection of ex ante beliefs with ex post realisations is to present empirically successful results.

The market portfolio plays no particular role in the APT unlike the CAPM however; it is consistent with all plausible recommendation for portfolio diversification. A major limitation of the APT is that it does not specify the macroeconomic risk factors that affect asset returns and even those already identified by empirical works are being captured by the market portfolio. For example, changes in inflation rate or unemployment cause the market to vary.

Fama and French (1996) demonstrated that the ICAPM only generalises the logic of the classic CAPM by stating that if risk-free assets exist, then market clearing prices imply that the market portfolio is multifactor efficient. This implies that the relation between expected return and market beta would require additional beta risks alongside the market beta, to explain expected returns. Ideally, in implementing ICAPM, one need to identify the factors that affect expected returns. Fama and French (1992 and 1993) took an indirect approach by arguing that although size and B/M equity ratio are not themselves state variables; the higher average returns on small capitalisation stocks and high book-to-market stocks reflect missing state variables that produce undiversifiable risks in returns unrelated to the market beta. In the spirit of this, Fama and French (1992 & 1993) proposed a three-factor model of expected returns;

$$E(R_i) - R_f = \beta_i[E(R_M) - R_f] + \beta_s[E(SMB)] + \beta_h[E(HML)] \qquad (2.27)$$

SMB denotes the difference between the returns of small capitalisation and big capitalisation stocks.

HML denotes the difference between the returns of high book-to-market equity and low book-to-market equity.

Carhart (1995, 1997) extended the Fama-French three factor model to include Jegadeesh and Titman's (1993) one-year momentum anomaly. The four variables are interpreted as performance attributes, where the coefficients and the risk premia on the mimicking portfolios indicate the proportion of mean return attributes to four fundamental strategies; high versus low beta stocks, large versus small capitalisation stocks, value versus growth stocks and one-year return momentum versus contrarian stocks. He finds that the 4-factor model substantially improves on the average pricing errors of the CAPM and the 3-factor model. As a result, Carhart (1997) proposes a four-factor model for expected returns;

$$E(R_i) - R_f = \beta_i[E(R_M) - R_f] + \beta_s[E(SMB)] + \beta_h[E(HML)] + \beta_m[E(PR1YR)] \qquad (2.28)$$

Carhart measures momentum variable as the equal weight average of firms with the highest 30% eleven-month returns lagged one month minus the equal weight average of firms with the lowest 30% eleven-month returns lagged one month. On the other hand, Lam *et al*. (2009) and L'Her *et al*. (2004) measure momentum by ranking assets according to size and prior performance for each month from January to December of year t. They group the top 30% of assets with the highest average prior performance as winners *(W),* the bottom 30% of assets with lowest average prior performance as losers *(L)* and the remaining 40% in middle as neutral *(N).* At the intersection of size and prior performance, they formed six value-weighted portfolios as, *S/L, S/N, S/W, B/L, B/N,* and *B/W*. Following the portfolio formation, average monthly returns is calculated on the six equally weighted portfolios over 12 months period in year t. The simple average returns on winners portfolios minus losers' portfolios proxy for momentum risk premium.

2.7 Chapter Summary

This table summarises the key evidence identified in the theoretical literature.

Literature	**Findings**
Foundation of assets pricing model	Capital asset pricing model is built on portfolio and capital market theories (Markowitz, 1952 and 1959, Sharpe, 1964)

Development of the CAPM	The CAPM fundamentally seeks to quantify the relationship between assets beta and expected returns based on simplifying assumptions (Sharpe, 1964 and Lintner, 1965) as stated earlier.
Deviations from the CAPM arising from early tests	CAPM theory asserts that expected value of asset's expected return is completely explained by its risk premium. The CAPM also predicts that the market portfolio is mean-variance efficient. This means that security's expected return is entirely explained by the market beta. However, early empirical tests strongly reject these assertions implicit in the CAPM (Jensen, 1968; Black, Jensen and Scholes, 1972 and Fama and MacBeth, 1973-see review in next chapter). This led to various versions of the CAPM being developed with the aim of resolving the CAPM's problem.
CAPM Extensions	Jensen et al. (1972) and Black (1972) went on to develop versions of the CAPM by relaxing the riskless asset and riskless borrowing and lending assumptions. Merton (1973) extended the CAPM to account for the multiperiod characteristic of capital market equilibrium.

	Breeden (1979) developed single beta consumption –CAPM in a multi-economy world by replacing the market portfolio with aggregate consumption portfolio. Baek (1987) derived the permanent-income theory of the C-CAPM.
Multifactor Models	Ross (1976) attempted to resolve the CAPM anomalous problem by developing an alternative multifactor theory popularly known as the APT. His theory has not at least received much of attention in the practitioner world due to the model's inability to specify the missing links in the CAPM. Furthermore, Fama and French (1992) and Carhart (1995 and 1977) extended the CAPM to account for microeconomic factors.

Table 1 Summary of Theoretical Literature

2.8 Chapter Conclusion

The capital asset pricing model and its extensions are built on portfolio theory and the capital market theory. The CAPM, over the years has been a centre of attraction in both the academic and practitioner worlds, gained prominence in finance courses taught in Business Schools. At least, the CAPM has been used to determine cost of equity capital, portfolio evaluation and event studies for forty years. It was difficult for managers and investor, without finance background to cope with the mathematics involved in using portfolio theory to determine cost of equity capital or portfolio performance evaluation. The CAPM simplifies this by quantifying risk and return relationship in a simplified model and one no longer need to know the expected return, standard deviation (or return variance) and correlation between assets returns before offering an appropriate cost of equity to attract investors or select the right combination of assets.

However, the CAPM has come under fierce attach from both early and contemporary empirical work, largely because of its simplistic assumptions upon which it was developed. Consequently, alternatives to the CAPM have been presented in the academic literature but none of them has gained the prominence of the CAPM. The question still remain that if the CAPM has been that bad, why are we not seeing another asset pricing model emerging in prominence than the CAPM? Maybe the CAPM is still attractive because of its simplistic and intuitive appeal or the alternative asset pricing models are so weak such that they cannot stand the test of time. We live to see how the debate will continue. This study intends to contribute to the debate by examining the validity of the CAPM and the Fama-French three factor model (an alternative asset pricing model) in an emerging African Stock Markets (ASMs).

CHAPTER THREE: REVIEW OF EMPIRICAL LITERATURE

3.1 Introduction

The Capital Asset Pricing Model (CAPM) and the Fama-French Three Factor Model (3-Factor) have been widely tested empirically in the finance literature. The Sharpe-Lintner CAPM has faced both criticism and applause for almost fifty years and the Fama-French three factor model is yet to stand such a trial. Although the preceding chapter has examined various asset pricing models, the empirical review in this chapter is limited to the two asset pricing models (CAPM and 3-Factor) being tested in this study.

The empirical literature on CAPM and the 3-Factor is very extensive and will be difficult to review across all of these studies. However, this study concentrate on reviewing the key studies that have had significant impact on asset pricing theory and also reviews the observed anomalies and deviations from the CAPM in the context of both developed and emerging markets. The literature gap which underpins the rationale for this study is explicitly spelt out following the theoretical and empirical literature.

3.2 Empirical Tests of the CAPM Theory in US and the Developed Markets

Over the last four decades, financial and economic researchers have attempted to empirically prove the validity or otherwise of the Capital Asset Pricing Model of Sharpe (1964), Lintner (1965) and Mossin (1966) and the explanatory power of its beta in determining realised and/or expected asset returns.

Jensen (1968) empirical work is the pioneer in identifying that the CAPM can be tested using time-series regression approach. In testing the CAPM using 115 mutual funds in the US, Jensen's test modified the CAPM into its excess return empirical version as given below.

$$R_{i,t} - R_{f,t} = \alpha_{i,t} + \beta_{i,t}\left(R_{M,t} - R_{f,t}\right) + \varepsilon_{i,t} \qquad (3.1)$$

α_{it} denotes the regression intercept.

The intercept (or alpha) allows for the possibility that an asset may earn more than 'normal' risk premium for its level of risks. The problem of beta estimates for individual assets became obvious as Jensen finds significant alpha values, indicating that the excess market return does not absolutely explain returns on assets and that they may be other possible variables. However, using beta estimates for individual assets pose a measurement error problem when used to explain mean returns. One of the early empirical works on CAPM to address this problem is the celebrated work of Jensen, Black and Scholes (1972) which gave birth to the two-factor CAPM.

Jensen *et al.* (1972) tested the traditional form of CAPM model by using listed equities on NYSE from 1931 to 1965. The purpose was to provide evidence of the nature and structure of security returns using the strictest form of the CAPM. In order not to complicate the interpretation of the analysis they ignored the non-normality problems presented by the model and assume that variance of residuals are normally distributed. The CAPM was developed as a single security model. Meanwhile, there is information available on a large number of securities in the market. Jensen et al. designed a test that combines data on a large number of securities (that is portfolios). They assumed that the α estimates are independent of normal distribution of residuals. However, this assumption was violated in an earlier paper published by Jensen (1968) that ε_{jt} is not cross-sectionally independent, i.e. $\text{cov}(u_{it}, u_{jt}) \neq 0..for..i \neq j$. In order to overcome this problem they allowed for an average estimated α by aggregating portfolios of securities and conduct a time series test on a group data. Grouping securities (that is portfolios) reduces estimation errors in betas and hence minimise autocorrelation of residuals. So instead of individual securities the traditional form of the CAPM was tested on portfolios as,

$$r_{pt} = \alpha_p + \beta_p\left[(r_{Mt})\right] + \varepsilon_{pt} \qquad (3.2)$$

Securities were assigned into groups based on ranked values of time series estimates of beta using five years of past monthly data as risk measures for each security. β greater than 1 is assigned high risk and β less than 1 is low risk. Ten portfolios were formed from 1,952 securities in the data file for 35 year period. The test result revealed small autocorrelation across the 10 portfolios and high correlation between the portfolio returns and market returns. This is an evidence that the market β significantly contributes to portfolio return and exhibit linearity – a strong proof to warrant the explanatory capability of the CAPM in its traditional form.

The high risk portfolios (beta greater than 1) exhibit consistent negative intercepts and positive intercepts for low risk portfolios (beta less than 1). This means on average over the period under examination assets experiencing high risk earn less than the amount predicted by CAPM and assets with low risk earn more than the amount predicted by the traditional form of the model.

In order to test for stationarity of beta, they divide the period of 35 years into 4 equal sub periods. It is noted that the coefficient of the market return (β) is fairly stationary however, the α was non-stationary throughout the period. The high risk portfolios exhibit positive α which indicates that these securities earn more than the amount predicted by the CAPM model and negative α for low risk portfolios indicating that these securities earn less than the amount predicted by the CAPM.

The inconclusive evidence provided by the traditional form of the CAPM model led to Jensen et al. testing a two factor model deliberately constructed to allow for a non-zero α. They designed and developed a two factor version of the CAPM (see chapter 2) with the assumption that riskless borrowing and lending opportunities do not exist or simply not available. Their model takes the form,

$$R_j = \widetilde{R}s\left[1-\beta_j\right] + \widetilde{R}_M \beta_j + \widetilde{w}_j \qquad (3.3)$$

The test revealed that the coefficients of the above model are random through time. In an attempt to minimise the error in beta estimates, ten portfolios were formed in similar manner as in traditional CAPM and time series tests were conducted to estimate the risk measures for each security. The essence of the grouping of securities is an attempt to reduce or practically eliminate the sampling error in estimated risk measures.

The conduct of both cross-sectional and time series tests of the two factor model indicate that asset return is a linear function of the market factor, R_M with coefficient of βj and a second factor Rs with coefficient of $1-\beta_j$. The evidence suggests that all risky-asset pricing model explains the data better than the traditional form of the CAPM. The traditional form of the

CAPM seems to be capable of describing asset risk-return relationship only when the intercept has a zero mean. As a consequence, in light, with the evidence provided by Jensen et al., the traditional form of the CAPM model warrants a rejection when Ri has a non-zero beta.

Fama and MacBeth (1973), for example, added two variables to test whether the market portfolio is efficient using value-weighted portfolio of NYSE stocks. They included:

1. the squared market beta in order to test the prediction that there is a linear relationship between expected return and market beta,
2. Residual variances from regressions of returns on the market return in order to test the prediction that the market beta is the only risk factor that explains expected returns.

Their choice of model is mathematically expressed as:

$$R_{it} = \widetilde{\gamma}_{0t} + \widetilde{\gamma}_{1t}\beta_i + \widetilde{\gamma}_{2t}\beta_i^2 + \widetilde{\gamma}_{3t}S_i + \widetilde{\eta}_{it} \qquad (3.4)$$

β_i^2 = the squared market beta. This is included order to test the prediction that there is a linear relationship between asset expected return and market beta,

S_i = Residual variances from regressions of returns on the market return in order to test the prediction that the market beta is the only risk factor that explains expected returns. S_i measures the risk of security i that is not related to β_i.

Their results show that these variables did not provide any additional explanation to average returns provided by the market beta. They reported that on average, there is positive relationship between risk (beta) and return and suggested that the value-weighted NYSE index represents an efficient market portfolio. Therefore, Fama and MacBeth (1973) cross sectional results underpin the CAPM's assertion that the value weighted market portfolio is efficient and is on the minimum variance frontier. They also found that systematic risk (defined by CAPM as beta) affects average returns and that the coefficients and residuals of the regression support efficient capital market.

Furthermore, Blume (1975) investigated the beta and its regression tendency (i.e. trend) by constructing portfolios of NYSE equities in every seven years from 1926 to 1968. The portfolio betas are obtained by averaging 100 estimates of individual securities for a seven year period. The betas for these same portfolios are re-estimated using monthly portfolio returns adjusted for delisting from the subsequent seven years. To improve the accuracy of beta estimates, a regression procedure that estimate beta by regressing individual securities of time (t) on estimate from a previous period (t_{-1}) and adjust future estimates by using the coefficients from this regression. If the fundamental values of beta are stationary over time then the correlation coefficient of successive values will be 1.0 and the standard deviation of time t beta and time t_{+1} beta will be the same. When portfolio betas in one group are compared with the immediate subsequent period it discloses an explicit regression tendency and this is statistically significant at 5% level for each of the groupings from 1940 to 1961.

When large portfolios are formed by grouping individual security betas from lowest to highest, Blume observed a tendency of the portfolio betas to regress towards the mean over time (that is, mean reversion) – this means that betas of higher beta portfolios decreased and betas of lower beta portfolios increased over time. He further observed that the regression to the mean may be as a consequence of either non-stationarities of the individual securities betas or from statistical artefact known as order or selection bias, that is, errors or distortion in choosing the correct variables. The explanation of this tendency can be attributed to some uncaptured economic or behavioural variables. Blume went on to demonstrate that a statistical phenomenon is inconsequential and that real non-stationarities of the individual securities beta could cause the regression towards the mean over time. However, he noted in his own words that his test is ''a suspect because the formula used in adjusting for the order bias was developed under the assumption that the distributions of beta were normal... and it is not clear how sensitive the adjustment is to the violation of this assumption''.

Roll (1977) criticised the CAPM's recommendation of stock market portfolio as the efficient portfolio and felt that the model has not yet been tested and almost certainly never will be because the problem is that the market portfolio which is at the heart of the model is both theoretically and empirically indefinable. Roll's argument was that because the CAPM's tests use proxies instead of the true market portfolio, certainly, nothing is learnt about the model. And the reason why early tests have rejected Sharpe-Lintner version of the CAPM is that researchers have not discovered a realistic market proxy close to the minimum-variance frontier.

Basu (1977, 1983) is the first to investigate the relation between price-earnings ratio and equity investment performance using COMPUSTAT data file of NYSE equities, CRSP tape of stock returns and a delisted file containing accounting data and stock returns for equities delisted from the NYSE during the period of September 1956 – August 1971. Five P/E portfolios were formed and monthly returns on each of these portfolios were computed for the subsequent twelve months. Using the CAPM to evaluate performance, the two lowest P/E portfolios earn on average 13.5 per cent and 16.3 per cent per annum over the 14 year period whereas the two highest P/E portfolios earn on average 9.3 per cent and 9.5 per cent per annum. The average annual rate of return diminishes as one move from low P/E to high P/E portfolios. However, although low P/E portfolios earn higher returns than high P/E portfolios, its associated level of systematic risk is relatively lower than those of high P/E portfolios. This position does not change even after adjusting for market frictions such as searching for additional information and transaction costs, and differential taxes in capital gains and dividends or tax exempt investor and tax paying investor. Their results questioned the view that if P/E ratio information is fully reflected in asset prices instantaneously as proposed by the efficient market hypothesis (that is, semi-strong efficient), then why CAPM not able to price assets correctly regardless of their P/E values. It is obvious that disequilibria exist in capital markets for at least during the 14 year period under his study and therefore opportunities for earning abnormal returns (arbitrage) were available to investors.

Furthermore, Banz (1981) investigated the empirical relationship between total market capitalisation of NYSE equities and its return. The samples comprise all NYSE listed equities for at least five continuous years from 1926 – 1975. Monthly price and return data as well as number of outstanding shares at end of each month are obtained from CRSP of the University of Chicago. In response to Roll's (1977) critique of CAPM's empirical test which states that the market portfolio does not represent the true market index, Banz selected three different market indices, two are pure equity indices – the CRSP equally-weighted index and value-weighted index. The third takes a more comprehensive nature: aggregation of value-weighted CRSP index and return data on corporate and treasury bonds from Ibbotson and Sinquefield (1977) and in his own word termed this as the ‘‘market index’’(that is, the true market index). The risk-free rate is obtained by time series of commercial paper. His model allows equity's expected return to be a function of the market risk, β, and a further factor, ϕ, representing the market capitalisation of the equity. He based his study on a simple linear relationship model which assumed the form,

$$E(R_i) = \gamma_0 + \gamma_1\beta_i + \gamma_2([\phi_i - \phi_m]/\phi_m) \tag{3.5}$$

Where

$E(Ri)$ = the expected return on asset *i*,

γ_0 = expected return on a zero beta portfolio

γ_1 = the expected market risk premium

ϕ_i = market capitalisation of asset *i*,

ϕ_m = average market value

γ_2 = constantly measuring the contribution of ϕ_i to the expected return of a security.

Individual equities are grouped into portfolios first, on the basis of market capitalisation (that is, market value) and subsequently equities are assigned on the basis of their beta. Either ordinary least squares (OLS) regression is performed which assumes homoscedastic errors (see Fama and MacBeth, 1973), or a generalised least squares (GLS) regression which allows for heteroscedastic errors (see for example, Black and Scholes, 1974), on portfolios in each period of time using testable form of the above model,

$$R_{it} = \hat{\gamma}_{0t} + \hat{\gamma}_{1t}\hat{\beta}_{it} + \hat{\gamma}_{2t}[(\phi_{it} - \phi_{mt})/\phi_{mt}] + \varepsilon_{it} \tag{3.6}$$

Essentially the results produced by both OLS and GLS are identical for all three indices. The results showed that on average high capitalisation equities have lower returns compare to small capitalisation equities and this was persistent for at least forty years. Banz asserts that the CAPM could be misspecified. Holding very small equities long and very large equities short provides average monthly excess return of 1.52% and annual excess return of 19.8%. Small capitalisation portfolios have much bigger residual risk with respect to a value-weighted index than a portfolio of very large capitalisation firms with same number of equities. Banz model is not based on any equilibrium theory and therefore had no theoretical basis to explain the reason behind the size effect. He could not figure out whether the factor is size itself or just a proxy for size. Given the long run data used in the empirical study, it is not likely the presence of size anomaly is due to market inefficiency but instead could be an evidence of asset pricing model misspecification. In summary, the size effect exists but it is not clear why it existed and must be interpreted with carefulness.

Lakonishok and Shapiro (1986) investigated the monthly returns of all traded stocks on NYSE and found that individual security return is not related to its systematic risk (beta) but to the market capitalisation values. They concluded that the conventional beta as well as alternative risk measure (residual standard error) is not able to explain the cross-sectional variation in returns; however size can significantly explain it.

Eun (1994) modified the CAPM in such a manner that the asset expected return is correlated to a benchmark beta calculated beside an 'observable component of the market portfolio' such as the FSTE100 (he termed as benchmark portfolio – denoted as *B*), and unobservable market portfolio recommended for the CAPM (he termed as latent portfolio – denoted as *L*). He breaks up the market beta into its 'observable' and 'unobservable' elements and explores its implications for the CAPM. The CAPM is redefined as:

$$E(R_a) = r + \lambda_B \beta_{aB} + \lambda_L \beta_{aL} \tag{3.7}$$

Eun's results were summarised as follows:

1. expected asset return and *B*-observable beta are linearly correlated,
2. Cross-sectional variations in expected asset returns cannot wholly be explained by the *B*-observable beta.
3. Asset will be mispriced by the CAPM if the *L*-unobservable beta is ignored and this will give rise to asset pricing anomalies.

This means that both observable and unobservable risks contribute to asset returns. Eun observed that 'asset pricing effect' of the observable systematic risk and unobservable systematic risk is divorced. This implies that the benchmark beta computed from the observable market portfolio such as NYSE Composite Index or FTSE100 should not be taken as the true market beta since this will lead to mispricing.

Albeit the CAPM is simple model which is based on intuitive reasoning, some of its assumptions are unrealistic. The CAPM is a one period model that fail to account for discrepancies between betas of the same asset at different periods, that is, β_t and β_{t+1}. The testable ex post model is defined as;

$$R_{it} - R_{f_t} = \beta_i \left(R_{M_t} - R_{f_t} \right) + \varepsilon_t \tag{3.8}$$

$$\varepsilon_t \approx N\left(0, \sigma_t^{\,2}\right) \tag{3.9}$$

Empirically ε_t and σ_t are assumed to be stationary through time. The beta parameter can thus be estimated using OLS based on the hypothesis that β_t is constant through time. However loads of empirical tests have shown that β_t follow a random walk through time. Empirical implication of the CAPM is that the estimation of beta should be based on observable market portfolio which makes it not the true beta according to Eun. This means there is the possibility that the CAPM's beta as a measure of systematic risk may be unable to capture all the undiversifiable risks relating to an asset or portfolio of assets.

Pettengill *et al*. (1995) attempt to improve the explanatory power of the CAPM by developing a conditional test of the CAPM, suggesting that the separation of positive and negative relationships during up markets (that is, positive excess returns) and down markets (that is, negative excess returns) has contributed to the acceptance of market beta as a suitable measure of risk. They went on to test the conditional relationship between beta and realised returns for the period of 1926 to 1990 and their results show a significant relationship between beta and returns for the entire period.

Fama and French (1996) questioned whether the beta is wanted, dead or alive. The focus of their study was to address an earlier criticism by Kothari, Shanken and Sloan (1995) that the 1992 cross-sectional evidence provided by a Fama - French three factor model was as a consequence of survivor bias inherent in COMPUSTAT data used. Data suffer from survivor bias when there is the tendency that failed companies is excluded for the fact that they do not exist. In order to overcome this problem, Fama and French used NYSE stocks in centre for research into securities prices (CRSP) database which is free from this problem. Deciles portfolios are formed in every June from 1927 to 1993 based on size (market capitalisation) and each size decile is then subdivided into beta deciles using individual securities beta. It was established that the CAPM model failed to capture the sturdy positive relationship between beta and average return produced by the size sort portfolios. It was further observed that the relationship between beta and average return of beta sort portfolios is also weak. Their evidence led them to conclude that the beta alone cannot save the CAPM.

The main practical insinuation of the CAPM is that the value-weighted market portfolio is the mean-variance efficient portfolio, which asserts that (1) in regressing market return on security's return, the only risk factor that explains expected return is the beta; and (2) anticipated premium for beta risk is positive – this holds provided (1) is in existence. Given the weak performance of the CAPM model it is suggested that inappropriate market proxy could be blamed (see Roll, 1977). Consequently Fama and French used variables relating to size and BE/ME in the estimation process and confirmed the possibility that the choice of value-weighted market proxy could share the blame for the CAPM's failure. The fact that the market portfolio is unobservable, it could make the CAPM's recommendation of value-weighted equity index as a proxy for the mean-variance-efficient portfolio the untrue market portfolio.

Fletcher (1997) examined the unconditional and conditional relationship between beta and asset return in UK Equity Market from 1975 – 1994 following Pettengill et al. (1995) approach. The FTSE All Share Index and the 30 UK T-Bill rates were used as market proxy and risk free rate respectively. They ranked portfolios according to their market values and ten size portfolios were formed. He further performed cross sectional regression using the sized portfolios. Evidence from the unconditional CAPM test showed that there is no significant relationship between beta and returns. However, he performed a conditional CAPM test whereby he split the samples into two periods according to whether market risk premium is positive (up market) or negative (down market). The conditional test results showed a significant relationship between beta and return. Moreover, the evidence showed that the relationship between beta and return is stronger during periods of negative excess return (down market) than when excess return is positive (up market).

Hodoshima *et al*. (2000) examined the relationship between beta and return in Japan by using cross sectional regression studies from 1956 to 1995. They performed two different tests similar to Fletcher (1997) where firstly, both negative and positive excess market return are mixed and secondly, separate them into negative and positive excess market return from. The test results show that there is no significant linear relationship between beta and asset return when negative and positive excess returns are combined. However, splitting the sample into positive and negative excess returns provide significant relationship between beta and asset return. Moreover, beta appear to be of better fit when the market excess return is negative than when it is positive.

Tang and Shum (2003) investigated the conditional relationship between beta and return in 13 international stock markets from 1991 to 2000. Regardless of the market proxy used, either MSCI value weighted world index or equally weighted world index provide consistent results, that there is a significant positive relationship between beta and return in up markets and a significant negative relationship in down markets.

Elsas *et al.* (2003) conducted a comparative study into the unconditional and conditional risk-return relationship in the German stock market from 1968 to 1995 following Pettengill *et al*. (1995) approach. Their results showed a significant relationship between beta and return under the conditional test and this supports the hypothesis that the market beta sufficiently explains the systematic risk of asset return.

However, evidence provided by Fama and French (2004) shows a weak relationship between beta and return. Using CRSP database they first estimate a pre-ranking beta in December of each year*, t,* for every NYSE, AMEX and NASDAQ stock and then based on these pre-ranking betas, they form ten value-weighted portfolios and compute their returns for the next twelve months. This procedure is repeated for each year from 1928 to 2003. Evidence produced shows that the relationship between return and beta is weak. They documented that low beta portfolios earn higher returns and high beta portfolios earn low returns. However, they found approximate linear relationship between beta and return and lean more towards Black version of the CAPM which also predicts only positive beta premium.

Bartholdy and Peare (2005) evaluated the practical performance of the CAPM model using centre of research into securities prices (CRSP) data. They addressed a number of issues that affect the estimation of expected return for individual securities using the CAPM. The issues addressed in their paper include the proxy index, frequency of data and time frame that should be used, whether dividend should or should not be included in the proxy index and whether raw return or excess return should be used in the estimation procedure. In order to avoid problems that may arise as a consequence of thin trading they include only securities which must have traded more than 95% of days within the six year period under study.

The CAPM theory is specific in its recommendation of value - weighted index consisting of all traded assets in the market. The normal practice is that index consisting of exchange traded equities has been used as a proxy. However, only a small fraction of all assets in the market trade on the stock exchange. In order to establish which index gives the best estimate, Bartholdy and Peare used six conventional indices and constructed a seventh index termed as an Economy Index in an attempt to develop an alternative proxy that is very much related to the market index consisting of all assets in the economy than the benchmark indices. The Economy Index (which does not include dividends) was constructed using the sectoral share of GDP as a proxy for the weights in the market wide index. The other six indices are the S & P Composite Index (value weighted and does not include dividends), Morgan Stanley Capital World Index (an attempt to test the estimation power of a global market index which is value weighted and does not include dividends), and four CRSP equal and value-weighted indices, with and without dividends. This was designed to address the CAPM assumption that dividends are included in the returns on the market portfolio. Given that a number of indices are constructed without dividends they considered it imperative to establish whether or not including dividends affect beta or return estimate. They found that the constructed Economy Index and the equal-weighted CRSP index provide a better estimate for beta and expected returns than the value weighted indices prescribed by the CAPM. It is also established that the constructed Economy Index is highly correlated with the equal-weighted CRSP index regardless whether or not dividends is included.

They further estimate beta using raw returns and excess returns in separate equations and found a high correlation between the two beta estimates (0.999 or 99.9%), suggesting either raw returns or excess returns can be used in beta estimation. They found relatively high R^2 when monthly data is used in the estimation for most indices except for Economy Index and equal-weighted CRSP which provide high R^2 values. Monthly data and either equal-weighted CRSP index or the Economy Index gave superior estimates than the other indices. They suggested using monthly data provide better estimates than daily or weekly data. Overall average R^2 value for all data frequencies and indices are very low and show that beta explains only 3% of excess return. This led them to conclude that the performance of the

CAPM model is very poor and question why it is widely used by practitioners to estimate cost of capital and portfolio performance evaluation.

Avramov and Chordia (2006) developed a framework that applies to single securities. They went on to test whether asset pricing models can explain the size, value, momentum, liquidity anomalies and past returns using NYSE-AMEX and NASDAQ listed companies from 1964 to 2001. Their results show that the conditional (when beta is allowed to vary) and unconditional CAPM and C-CAPM do not capture any of the size, book-to-market ratio, turnover and past return effects. They also found that the unconditional Fama-French model was unable to explain the predictive ability of size, book-to-market, turnover and past returns. However, the conditional (when beta is allowed to vary with size, book-to-market ratio and business cycle variables) Fama-French model does capture the impact of firm size and book-to-market ratio on the cross-section of individual returns. They further found that none of the models examined capture the impact of liquidity or momentum on the cross-section of individual stock returns.

Levy and Roll (2010) examined the mean-variance efficiency of the market proxy recommended by CAPM by adopting a reverse engineering approach, where they first oblige that the return parameters ensure that the market proxy is efficient. Given this constraint, they looked for parameters that are as close as possible to their sample counterparts. Their sample consists of the 100 largest stocks in the US market by market capitalisation with consistent monthly return data from January 1997 to December 2006. They found that parameters that make the market proxy efficient can be found very close to the sample parameters. Therefore, these minor changes in estimation error are in conflict with earlier damaging and unsatisfactory results for the CAPM theory. Their methodology is different from previous studies, which suggest various variations of the return parameters relative to the sample parameters and check whether these variations led to an efficient market proxy. Earlier, in 1977, Roll criticised the CAPM's recommended market proxy as not being mean-variance efficient and unlikely to be testable. However, after thirty three years he seems to suggest that the ex-ante mean-variance CAPM's market index proxy is after all consistent with empirical observed return parameters and the market proxy portfolio weights. In effect their findings re-affirm the fact that it will be premature to reject the CAPM as suggested by others regardless of whether it is in developed or emerging markets. This evidence re-emphasizes the importance of extending the test of classic CAPM in emerging markets. It can be concluded that after all those who use CAPM to estimate cost of capital and evaluate portfolio performance are not receiving a worthless advice.

3.3 Argument against the Anomalies Identified in CAPM Tests

A more recent empirical work have criticised the anomalous models in that the inclusion of additional risk factors in an asset pricing model may be premature. Some of these criticisms are that the deviation from the CAPM may be due to data snooping (Lo and Mackinlay, 1990); selection bias (Kothari, Shanken and Sloan, 1995; Breen and Korajczyk, 1995); irrational investors' behaviour (DeBondt and Thaler, 1985; Lakonishok, Shleifer, and Vishny, 1994) and market friction (Amihud and Mendelson, 1986). These are described as nonrisk-based factors by MacKinlay (1995). The literature is expanded as below.

3.3.1 Irrational investors' behaviour

DeBondt and Thaler (1985) interprets the deviation from the CAPM as investors' overreaction to dramatic and unexpected news events (that is, irrational investors' behaviour).

It is observed that equities with high pricing earnings ratio earn higher risk-adjusted returns than that of low price earnings ratio (see for example, Basu, 1983; Fama and French, 1992) and value stocks outperform growth stocks (see for example, Fama and French, 1998, 2005). Most finance researchers regard this as anomaly due to missing risk factors unable to be captured by the CAPM but DeBondt and Thaler provide opposite evidence. Their research used monthly return data of NYSE equities compiled by CRSP for the period of 1926 to 1982. They focused on equities that have experienced either excessive capital gains (that is, winners) or excessive losses (that is, losers) over period up to five years. Thus, they formed 'winner' (W) and 'loser' (L) portfolios based on past excess returns rather than on some firm fundamentals such as earnings or cash flows. For fifty years, DeBondt and Thaler find that 35 equities of loser portfolios outperform the market by 19.6% on average after three years of portfolio formation and winner portfolios on the other hand earns only 5.0% less than the market. However, the CAPM's beta estimates for equities in the winner portfolios were significantly larger than the betas of the loser portfolios. They concluded that this result is consistent with the overreaction hypothesis where loser stocks are underestimated and winners stocks are overestimated hence low average returns. The same interpretation is given to the price earnings anomaly.

To reinforce the irrational investors behaviour discovered by DeBondt and Thaler (1985) was the extensive work of Lakonishok, Shleifer and Vishny (1994) who argued that deviation from the CAPM is due to 'naive' (momentum) strategies adopted by investors by extrapolating past growth rates too far into the future, presuming a trend in equity prices, overreacting to good and bad news or simplistically likening good investment with a well-run company regardless of price. Irrespective of the basis, some investors become desperately thrilled with shares that have performed very well over the past period (that is, termed as ‘glamour’ shares – shares with high growth in the past and high expected future growth rate) and purchase them up, thus these shares become overpriced because of demand. In the same manner, they overreact to shares that have performed badly in the past (that is, termed as ‘value’ shares – shares with low growth in the past and is expected to continue growing slowly) and oversell them and thus these shares are under-priced. On the other hand, contrarian investors bet against ‘naive’ (or momentum) investors. The reason is that contrarian investors put disproportionate investments in under-priced shares and under invest in shares that are overpriced.

There is some consensus that value strategies outperform the market (example, Fama and French, 1998, 2005) but contrarian strategies have been cited as one of the reason (see DeBondt and Thaler, 1985). Another explanation of why value strategies outperform the market is that they are essentially riskier, argument forcefully supported by Fama and French (1992). This means, investors in value shares such as high book-to-market shares appear to bear inherent fundamental risk of some nature and the higher returns are simply a compensation for this risk. The question remains open as to whether higher returns produced by value strategies are due to contrarian to naive or momentum strategies or fundamentally riskier.

This prompted Lakonishok, Shleifer and Vishny (1994) to shed more light on the these two potential explanation for value performance using NYSE and AMEX equities from CRSP data file from April 1963 to 1990. Decile portfolios of book-to-market equity (BE/ME) were formed at the end of April with returns data from CRSP (that is, market equity) and accounting data from COMPUSTAT (that is, book equity). In order to overcome the survivorship bias problem raised by Kothari, Shanken and Sloan (1994), they did not use returns data for the first five years that the firm appeared on the COMPUSTAT because this first five years is where the survivorship bias in returns is found. They also used only NYSE and AMEX firms excluding 'successful' NASDAQ firms which actually were behind the major expansion project of COMPUSTAT.

They found that extreme extrapolation and expectational errors certainly characterise the glamour and value equities. The spirit of extrapolation is that investors are excessively hopeful in the future returns of glamour shares and extremely hopeless in the future returns of value shares because they attached their expectations of future growth to past growth. A direct test of extrapolation by Lakonishok, Shleifer and Vishny by comparing actual future growth rates with past growth rates and expected growth rates demonstrated that over a period, glamour shares grow faster than value shares five years prior to portfolio formation and deteriorate five years post formation whereas as value shares experience relatively higher growth rates. The second explanation of superior performance of value shares is due to inherent fundamental risk. They explored this by measuring both value and glamour shares using traditional risk measures of beta and standard deviation of returns. Their results showed that value strategies have persistently outperformed glamour strategies and using one year horizon, value shares outperformed glamour shares in 17 out of 22 years if C/P (cash flow/price) or BE/ME is used to categorize equities. It was documented that the beta of value-weighted portfolio was about 0.1 higher than glamour portfolio and value portfolio has an average standard deviation of 2.5% higher than glamour portfolio. They also found that value portfolios underperformed during bad states of the world such as recession, severe market declines etc., and the evidence does not provide much support that value strategies are fundamentally riskier. They conclude that extreme extrapolation and expectational error on the part of investors could explain abnormal returns produce by value shares. Even though investors expected glamour shares to grow continuously, they became disappointed for at least 17 years. Using fundamental risk approaches, it appears value strategies are no riskier than glamour strategies and therefore fundamental risk does not seem to explain higher returns on value shares than glamour shares.

3.3.2 Market Microstructure

Amihud and Mendelson (1986) provided evidence suggesting that market frictions (or market microstructure) such as transaction cost, marketability and liquidity could explain the CAPM's deviations rather than some fundamental risks. They investigated the effects of illiquidity on asset pricing and measured illiquidity as the cost of immediate execution. An investor will face a trade off if they are prepared to execute and this means that an investor will either have to wait and execute at a favourable price at a later date or insist on immediate execution at the current bid or ask price. The ask (offer) price quoted will include premium to motivate immediate purchase and the bid price reflects concession necessary for immediate sale. Therefore, the spread between bid and ask prices, which is the sum of the purchase premium and selling concession become a natural measure of illiquidity.

They presented an empirical test of the relationship between asset returns and bid-ask spreads from 1961 - 1980 of NYSE monthly equity returns from CRSP and relative bid-ask spreads for NYSE equities from Fitch's stock Quotation. Portfolios were formed by grouping equities based on their spreads and relative risk (beta) and examined the cross sectional relation between average excess return, spread and relative risk over time. A regression of excess returns on beta, the spread and nineteen-year dummy variable was run using both OLS and GLS. They found that average portfolio risk adjusted returns increased with their bid-ask spread and the slope of the return-spread relationship declines with the spread. When firm size (that is, market capitalisation) is added in the regression model as an explanatory variable, they found that the effect of firm size on equity returns is negligible and insignificant and the spread effect persists. However, Amihud and Mendelson assert that the effect of spread on asset returns is by no means an anomaly of CAPM or a sign of market inefficiency, but instead a representation of rational response from investors in an efficient market to the existence of the spread. Their results provided an important insight into securities market microstructure in determining asset returns and suggest that increased liquidity can reduce firm's opportunity cost of capital

3.3.3 Data Snooping

Lo and MacKinlay (1990) believe that data snooping is responsible for deviation from the CAPM as detected by Fama and French. They explored the degree to which financial asset pricing test may be biased by the constructing test statistics using characteristics of the data. They specifically focus their tests by using portfolio returns constructed from market capitalisation of common equities. They demonstrate that if portfolios are formed using the characteristics of data and if the same data to be used in performing the test, it can lead into spurious correlation between the characteristic and estimation error.

The source of this spurious correlation is correlation between the characteristics and the estimation errors in expected intercept vector. Significant biases are created if classical statistical tests on portfolios are constructed in this manner. This is the data snooping biases. This has significant implication for testing the null hypothesis $H_0 : \alpha = 0$. Estimation errors may be confused with the violation of the null hypothesis. It is clear that deliberately ignoring the features of data in constructing portfolios can lead to illogical conclusions even if the procedures for estimation are most favourable in some metric.

3.3.4 Nonrisk Based Factors

MacKinlay (1995) examines the empirical deviation from the CAPM by differentiating risk-based (that is, missing risk factors) and nonrisk-based (that is, methodological errors) categories using ex-ante analysis. The objective of his research was to examine the proposition that the deviation from CAPM is due to additional missing risk factors. MacKinlay argues that 'ex-ante CAPM deviations due to missing risk factors will be difficult to detect because deviations in expected return is accompanied by increased variability'. He used mean-variance efficient set mathematics together with the zero intercept F-test to analyse this problem. The framework for his analysis took the form of a linear regression model expressed as,

$$\gamma_t = \hat{\alpha} + \hat{\beta}\gamma_{pt} + \varepsilon_t \tag{3.10}$$

According to the CAPM α will be zero if the tangent portfolio (mean-variance efficient portfolio of risky assets given the existence of risk free asset) comprises linear combination of portfolios. He constructed portfolios on the basis of price-to-book (P/B) and size (ME). Value and growth portfolios were formed as P/B proxies using equities from S&P 500. Decile portfolios for size were formed on the basis of market capitalisation for the period 1963 – 1991.

In case MacKinlay's factor portfolios do not conform to tangent portfolio, the intercept and the residual covariance matrix will be non-zero, contrary to the CAPM's prediction. He analysed the usefulness of the above equation by constructing three distribution tests statistic: the null hypothesis $H_0 : \alpha = 0$ that is, the intercept vector is equal to zero and the alternative hypotheses: the missing risk factors alternative and the nonrisk-based alternative $H_a : \alpha \neq 0$ that is, the intercept vector is non-zero. He followed Fama and French (1993) framework to test missing risk factors and for non-risk based test he adopted Lo and MacKinlay (1990) and Lakonishok, Shleifer and Vishny (1993) methodology.

Most asset pricing models posits that the intercept vector should be zero. Rejection of this hypothesis using single factor model means that an inclusion of additional factors is necessary to explain the risk-return relationship in order to accept the null hypothesis. Mackinlay results showed that additional risk factors did not support the risk-based category as suggested by Fama and French (1993). In the view that when Fama and French increased the number of risk factors to three, the test statistic of the intercept vector reduces marginally in significance. This implies that the deviation from the CAPM cannot wholly be explained by the missing risk factors alone.

The results show that the whole story created by Fama and French and their supporters cannot be underpinned by the risk-based missing factors. The *p-value* for test statistic distribution for monthly data was found to be 0.03 and less than 0.001 for weekly data which support the view that deviations are completely not explained by missing risk factors. However, he found some evidence to support the nonrisk-based hypothesis – that is, nonrisk-based alternatives could likewise explain the anomalies detected by the multifactor test. The evidence provided by MacKinlay suggests that it is haste to conclude that multifactor asset pricing model is an alternative to the Sharpe-Lintner-Black (SLB) single factor CAPM. His results can be concluded that multifactor asset pricing models on their own cannot explain the asset pricing deviations from the CAPM and went on to suggest that various empirical results should be examined under differing specific economic models. This study attempts to contribute to the literature by conducting an empirical test in African emerging stock markets with distinct economic and financial variables from the developed markets. The finding will provide additional knowledge outside the U.S and developed markets evidences with important implication for both finance literature and practice.

3.4 Review of Multifactor Tests in Developed Markets

The most prominent asset pricing anomalies in contemporary finance literature are those related to size of the firm (that is, market capitalisation-ME) and ratio of book-to-market equity updated and synthesizes by Fama and French(1992, 1993 and 1996). Fama and French (1992) evaluated the combined roles of market beta, firm size (ME) and book-to-market ratio (BE/ME) in the cross-section of average equity returns on the NYSE, AMEX, and NASDAQ stocks. They adopt Fama and MacBeth (1973) regressions of the cross-section of the equity returns on beta, size and book-to-market equity. In June of every year *t*, ten portfolios were formed based on size using NYSE breakpoints. When size portfolios were subdivided based on ranking betas, Fama and French found a strong relationship between average return and size but no relationship is established for beta and average return. Likewise, at the end of each year *t* they formed twelve portfolios on the basis of ranked book-to-market equity (BE/ME or earning-to-price ratio (E/P). They established a strong relationship between book-to-market equity and average returns. Fama and French further found that the combined roles of size and book-to-market equity absorbed perceptible functions of leverage and earnings-to-price (E/P) in average stock returns. They forcefully concluded that when both size (ME) and value (BE/ME) variables are included in the regression model; the variables have a consistently stronger role in explaining average returns than just the beta. They went on to conclude that the book-to-market relation is stronger than the size effect in explaining realised average returns and as to what the reason could not be substantiated. However, Fama and French model is not based on theory and one should interpret their claim with caution and further tests in both developed and emerging economies are required to substantiate its credibility, especially, its application to practice. A gap this study attempt to fill in African emerging markets.

To advance their argument, Fama and French (1993) adopt Black, Jensen, and Scholes (1972) time series methodology. They performed a regression of market risk premium, BE/ME and size factors on monthly equity returns. Their evidence showed that BE/ME and size have stronger explanatory powers in the return generating process and this provides additional evidence to support their earlier claim that BE/ME and size represent sensitivity to asset risk.

Fama and French also found that high book-to-market equities have low earnings on assets as compare to low book-to-market equities for four years earlier and at least five years after book-to-market equity is measured and therefore conclude that high book-to-market equities are comparatively distressed (providing a low market share price relative to book value) and low book-to-market equities are comparatively strong. They went on to document small capitalisation firms have low earnings compare to large capitalisation firms. Therefore small capitalisation equities are comparatively distressed and large capitalisation equities are comparatively strong. In times of adverse events such as credit and liquidity crunch or recession, shares in financial distress will under-perform and returns to investors holding such shares should be compensated for high sensitivities accordingly. Thus, investors can only be motivated to hold these shares if the prices are low or giving them a high equivalent returns. This is why Fama and French use the *HML* (High minus Low) portfolio returns to proxy the excess return for systematic risk relating to book-to-market equity and the *SMB*

(Small minus Big) portfolio returns to proxy the excess returns to the systematic risk factor relating to market capitalisation. Given their own evidence per above, they appear to suggest that the excess return required by investors for holding small and value stocks as a result of their response to perceived risk or potential failure of underlying firms. This could be construed to mean that the size and value variables identified by Fama and French are actually not risk factors that affect returns but a response by rational investors in an efficient market. Therefore, any deviation generated by a test of an asset pricing theory underpinned by efficient market theory is due to abnormal returns which cannot be explained by fundamental risk factors.

However, Fama and French (1996) further stated that most of the abnormal return patterns found in the 1980s and early 1990s are in reality not abnormal patterns altogether. They concluded that these abnormal patterns were as a result of misspecification of the expected-returns model (see also Basu, 1983).These anomalies are related and unlike the CAPM can be captured by one single model which includes not only the market risk but also other risk factors relating to the *HML* and *SMB*. Mathematically, the testable version of the Fama-French three factor model for portfolio is defined as,

$$R_{\rho t} - R_{ft} = \alpha_{\rho t} + \beta_{\rho t}(R_{Mt} - R_{ft}) + s_{\rho} SMB_t + h_{\rho} HML_t + \varepsilon_{pt} \qquad (3.11)$$

Following the regression of empirical data using equation (3.10), Fama and French concluded that CAPM did not appear to help in explaining cross-section of average portfolio returns and that the extension of the market model to include size (ME) and book-to-market (BE/ME) factors capture most of cross-sectional risks and better explain average asset returns. In their 1992 and 1993 evidence, Fama and French suggested that CAPM had no important role in explaining asset returns, however, in this paper, they appear to suggest that beta has a significant role to play in predicting returns and therefore, should be included in a single model with size and BE/ME. It is becoming obvious with their inconsistent findings that beta is still alive and well in many respects but requires extensive testing in other markets such Africa and this is what this study is aimed to achieve.

Kothari *et al*. (1995) re-examined Fama and French (1992) evidence, which found that beta is flat in explaining stock returns over the period of 1941 – 1990. However, book-to-market equity (BE/ME) and firm size explain returns better than the market during the 1963-1990 period. Besides, Kothari *et al.* began by examining whether there is a weak relationship between beta and average return from 1926 to 1990 period. They employed annual returns to estimate beta and re-investigate the relation between average return and beta during the post 1926 and post 1940 periods. Two reasons inspired their choice of time horizon in evaluating whether or not beta can explain cross sectional variation in returns.

Firstly, the CAPM does not provide any particular guidance on the choice of time horizon, the choice of monthly returns is often due to data availability and they suggested that exploring the robustness of results with alternative time horizon is important. They pointed out that return measurement interval used to estimate betas influence the conclusions drawn from cross sectional regressions of average returns on betas because the true betas systematically and nonlinearly vary with time horizon used to measure returns (see for example, Handa *et al.,* 1989).

Secondly, there is a biased beta estimate due to nonrisk-based factors such as trading frictions and non-synchronous trading (see Amihud and Mendelson, 1986; Scholes and Williams, 1977). Such biases can be minimised by using observations with longer return interval. A variety of aggregation procedures were used to form portfolios which in turn used in cross sectional regression of average monthly returns on annual betas. In spite of the aggregation procedure (either Fama-French approach of ranking equities on size and then on beta or vice versa) and choice of market index (either equally-weighted or value-weighted), there is economically significant coefficient of beta for both post 1926 and post 1940 periods.

Evidence showed that during the 1927 – 1990 periods, contrary to Fama-French evidence, considerable ex-post reward for beta risk was found when annual returns are employed. They argued that the effect of the book-to-market equity (BE/ME) ratio is due to a combination of survivorship or selection bias (that is, dropping poor performing assets, resulting in overestimating past returns or an error in selecting data used for empirical study) in the COMPUSTAT data files influencing the performance of high BE/ME equities and time specific performance of low BE/ME (past winner equities) and high BE/ME (past loser equities).

Kothari *et al.* identified two potential sources of this bias. First, COMPUSTAT include historical information prior to the 1978 as part of a major database expansion project and for most companies, five years of data ‘‘back fill’’ going back to 1973. For example, consider in 1973, if a firm has substantial book assets (that is, high BE/ME) but performing poorly with earnings lower than expected and negative equity returns for the next five years, will not be included in the COMPUSTAT database because of either delisting or inability to meet minimum asset or market value requirements. However, if this high BE/ME firm performs unexpectedly well during the five year period it may well be included in the 1978 database. This can lead to positive relation between BE/ME and expected returns due to the high ex-post returns over this period and high initial BE/ME ratio even when such relation is non-existent. Second, it is obvious that COMPUSTAT procedure for adding financial data favour surviving firms. There is high tendency that firms experiencing adverse economic performance will delay filing their financial statements with Securities and Exchange Commission (SEC) and the Stock Exchanges. Because of failure to comply with disclosure requirements as well as due to thin trading and financial distress, some of these firms' equities are delisted from the stock exchanges. Financial statement data on these firms during the distress period may be unavailable and hence excluded in the COMPUSTAT database. When some of these firms then get better with their performance, their previously delayed statements are filed and the COMPUSTAT will include these data. For that reason COMPUSTAT selection procedure will induce a dominant bias in average returns, especially the high BE/ME firms.

They further explored the presence of selection bias by using COMPUSTAT data and S&P industry level data. Forming portfolios from COMPUSTAT data Kothari *et al.* found significant relation between BE/ME and average equity return. Similarly, using an alternative source of data, S&P 500 database from 1947 to 1987, they found that BE/ME is feebly related to average equity return. They inferred that past BE/ME ratios using COMPUSTAT data are influenced by selection bias and somehow responsible for the relation between BE/ME and average returns.

The selection bias is echoed in Breen and Korajczyk (1995) study. They investigated the effect of BE/ME using COMPUSTAT database free from selection bias during 1974 to 1992 period. No back filled data are allowed in their portfolio formation. Only firms with actual data on the date of portfolio formation are eligible for inclusion in their tests. They followed

Fama and French (1992) approach in constructing portfolios and apply Fama and MacBeth (1973) method to estimate the parameters of the regression. To adjust for non-synchronous trading, they included contemporaneous and lagged market returns in the regression as follows;

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_{i,0}\left(R_{M,t} - R_{f,t}\right) + \beta_{i,-1}\left(R_{M,t-1} - R_{f,t}\right) + \varepsilon_{i,t} \qquad (3.12)$$

and beta for asset *i* is estimated as:

$$\beta_i = \beta_{i,0} + \beta_{i,-1} \qquad (3.13)$$

Ten size-based portfolios were formed and first, ranked according to size, and then beta, and second, on beta, and then size, and re-rank for each subsequent month. Similarly BE/ME decile portfolios were formed each month with firms with positive book-to-market equity. Analysis was performed using equally-weighted and value-weighted portfolios and the results essentially remain unchanged. It was noticed that mean return declines as market capitalisation increases and beta increases with decline in market capitalisation. They found a stronger relation between size and mean returns than between beta and mean returns. This supports Fama and French (1992 and 1993) evidence. The mean returns increase with increases in BE/ME portfolios and equities with high BE/ME ratios tend to have small market capitalisation. They found that the selection bias is not significant when data is restricted to NYSE and AMEX firms but there is significant difference when NASDAQ firms are included in the standard COMPUSTAT data. This, they interpret as a possibly truly stronger BE/ME effect or a more severe selection bias in latter sample.

Fama and French (1998) advanced their argument by extending their empirical work to cover other capital markets outside USA focusing on explanatory power of value premium identified in their earlier studies in 1992 and 1993. Investment managers define value stocks as firms with high book-to-market equity ratio (B/ME, earnings to price (E/P), or cash flows to price (C/P) and growth stocks as firms with low book-to-market equity (B/ME), earning to price E/P and cash flows to price (C/P). Earlier research using US data showed that high B/ME, E/P and C/P firms earn low returns compare to low book-to-market equity ratio, earnings to price (E/P) and cash flows to price(C/P) (Fama and French, 1995). Some researchers argue that the value stocks demonstrate financial distress and thus, the market undervalue such stocks and overvalue growth stocks (see Lakonishok et al. 1994). Undervaluation means that stock prices are low which eventually lead to higher capital gain rates and dividend yields and overvaluation of growth stocks means low capital gain rates and dividend yields.

Others have argued that the excess return paid on value stocks are sample-specific (see Mackinlay, 1995). This prompted Fama and French (1998) to take a multinational dimension of testing a wide range of data outside US and argued that the value premium is not pricing error per se nor sample-specific but a compensation for risk unable to be captured by the CAPM. Their work was set out to answer two main questions – (1) Whether there is value premium existing in other markets and (2) If (1) is true, does it conforms to a risk model similar to the one that described US returns? They examined the US and 12 other developed capital markets in Europe, Australia and Japan using market returns and value and growth portfolios in the regression model.

The US portfolios were formed using all NYSE, AMEX and NASDAQ stocks with relevant CRSP and COMPUSTAT data from 1975 to 1995. Most of the data for the major international markets were obtained from the electronic version of Morgan Stanley Composite Index (MSCI) database. Unlike the COMPUSTAT data, the MSCI data does not include historical data for newly added firms, and include historical data of firms that disappear, so it's free from backfilling problem and thus free from survivor bias. For markets outside US, value and growth portfolios were formed on B/ME, E/P, C/P and D/P at the end of each year from 1974 to 1994. Similarly, at the end of December of each year, in the US, portfolios were formed using year-end CRSP share prices and accounting data from COMPUSTAT.

Value portfolio includes firms whose B/ME, E/P, C/P and D/P are among the top 30% in the country index and growth portfolio includes firms whose B/ME, E/P, C/P and D/P are in the bottom 30%. Their results show that international returns demonstrate consistent value premium. Global value portfolios have average returns which range from 3.09% to 5.09% per year in excess of global market portfolio and they are 5.56% to 7.65% higher than the average returns on equivalent global growth portfolios. This result means that value premium documented in earlier research using US data is a global phenomenon rather than data and country specific issues. This may also support the argument made by Fama and French (1992 and 1995) that the value premium is not a result of survivor bias or data backfilling.

Fama and French assumed that the world market is integrated and that investors are not concerned with deviations from purchasing power parity. They went on to test whether global average returns are consistent with international CAPM (ICAPM) or a two factor ICAPM or APT. They found that the CAPM intercepts for global value and growth portfolios were above 3.4 from 0.0 which demonstrates that the international version of the CAPM fail to explain realised average returns for global value and growth portfolios. The two-factor ICAPM model included H-LB/M ratio as a second variable. Their evidence with 2-Factor ICAPM showed that the two-factor ICAPM provide a better explanation of returns on global value and growth portfolios formed on E/P, C/P, and D/P than the single factor ICAPM.

Arshanapalli *et al*. (1998) went on to investigate Fama-French three factor model in eighteen countries as an additional out-of-sample evidence in order to test the empirical capability of the model outside U.S. Six monthly value-weighted industry-portfolios were formed from energy, materials, equipment, consumer, services and financial. They adopted Fama-French 1996 time-series regression in the form:

$$R_{pt} - R_{ft} = \alpha_{pt} + \beta_p (R_{Mt} - R_{ft}) + sSMB_t + hHML_t + \varepsilon_{pt} \tag{3.14}$$

They observed that when SMB and HML are included in the regressions with the market, most of the variations in average portfolio returns were captured, thus the SMB and HML price the risks left out by the market risk (beta). They further documented that the three-factor model explain most of the return variations on the industry portfolios they examined. They concluded that the superior performance of investment strategies involving buying high BE/ME (value) shares and selling low BE/ME (growth) shares relate to size and book-to-market effects and this is prevalent in other countries, an evidence consistent with Fama and French (1998).

In an attempt to test whether value (BE/ME) premium is unique to small capitalisation equities, Fama and French (2006) split value-growth (VMG) stocks also known as high-low (HML) into its small and big equity components. That is:

$$HMLS = SH - SL \tag{3.15}$$

$$HMLB = BH - BL \tag{3.16}$$

H = V and L = G

Three sample periods were chosen for this study – July 1926-December 2004; July 1926-june 1963 and July 1963-December 2004.They performed regression analysis on six size-BE/ME portfolios (*SH,SN,SL,BG,BN,BL*) on factor portfolios of *SMB,HML, HMLS* and *HMLB*. The results in this study confirmed earlier evidence by Fama and French (1993) for post 1963 data that the value premium is larger for small capitalisation equities (0.60% per month ($t = 3.97$ as compared to *0.26 %* ($t = 1.87$) for big equities. However, there is little evidence for any significant difference in 1926-63 data between small capitalisation equities and big equities (*0.35%* and *0.36%* per month) respectively. The entire sample period of 1926 – 2004 provide significant evidence that value premium actually exist among big equities (*0.31%* per month $t = 2.23$). It can therefore be concluded that when taken the full sample period into consideration there are value premium in both small and big capitalisation equities in expected returns, however, there seems to be higher returns for small capitalisation equities.

3.5 Asset Pricing Studies in Emerging Markets

The emergence of new stock markets in the developing countries is important for international portfolio diversification. The existence of these stock markets has made it imperative for researchers to investigate their risk-return characteristics. Since the mid-1990s, quite an extensive literature has been documented mostly in the Asian and Eastern European markets with little attention on Africa. This section reviews, firstly, studies in Emerging Markets outside Africa and secondly, those specific to Africa.

3.5.1 Review of Emerging Market Tests of CAPM

Claessens *et al.* (1995) is one of the pioneers in emerging market studies into asset pricing which provided evidence on the nature of asset returns by investigating cross-sectional returns in 19 emerging markets. Using data from IFC emerging markets data base, they examined the effects of other risk factors on asset returns beside the beta. Following a regression similar to that of Fama and French (1992), they found that in addition to beta, size and trading volume have significant influence in explaining asset returns in most of these markets but the signs for some factors are opposite of those found in developed markets. In a fewer markets, dividend yield and earning-price ratios are essential. The relation between beta and returns disappear when size (that is, market capitalisation, ME), earnings-price ratio (E/P) and book-to-market ratio (B/M) are included in a cross sectional model.

This implies that evidence gathered in developed markets alone should not be used to determine the way asset pricing theories are evaluated because there are other classes of market around the world which may provide contradictory evidences. As weak as the relationship between asset returns and beta is, other factors may play significant roles in determining equity market returns. Although tests of the CAPM, APT and other multifactor models have done a lot to increase our understanding of how asset pricing theories are used to price market risk, however, the way in which assets are priced remain unclear. It is important that financial economists and portfolio managers understand the consequences of crossing an international border to another country could affect the asset pricing process due to local or idiosyncratic risk factors.

Akdeniz *et al.* (2000) examined the impact of beta on monthly returns in Turkey from 1992 to 1998. They followed Fama and French (1992) methodology. Beta coefficients were estimated by regressing monthly returns of asset on the contemporaneous and one-month-lagged return on value-weighted Istanbul Stock Exchange (ISE) Composite Index, which is made up of 100 equities. Beta estimate for each month is the sum of contemporaneous and it's lagged values. The sum-beta calculated in this manner is regarded as an adjustment for nonsynchronous trading in the market return (see for example, Dimson, 1979). Evidence shows that the market beta is insignificant in explaining realised asset returns for Turkish stocks. Karacabey (2001) supported this evidence when the unconditional beta-return relationship was investigated in the Istanbul Stock Exchange. However, conditional test based on Pettengill *et al.* (1995) approach shows that beta is still a useful risk measure in Turkey. Lam (2001) studied the risk-return relationship in Hong Kong by following Pettengill *et al.* (1995) methodology and using Fama and MacBeth (1975) regression approach. They found that there is a strong positive as well as negative relationship between beta and return in up markets and down markets respectively. Tang and Shum (2004) further investigated the unconditional risk-return relationship in the Singapore stock market from 1986 to 1998. Their results showed that there is a significant relationship between beta and realised returns, but the explanatory power is low. However, when they applied the conditional model based on up market and down market, the explanatory power increased for more than 100-fold and there was significant positive and negative relationship between beta and returns when the market risk premium is positive and negative respectively. Theriou *et al.* (2005) examined the relationship between beta and returns in Athens Stock Exchange, taking into consideration the difference between positive and negative market risk premium (Pentegill *et al.,* 1995) from 1991 to 2002. Their results show that the unconditional CAPM provides flat relationship between beta and return. However, using the conditional CAPM and cross-sectional regression, their evidence tends to support a significant positive and negative relationship between betas and returns in up and down markets respectively.

Pereira (2005) examined the challenges of applying traditional valuation techniques and asset pricing model(s) adopted by practitioners in emerging capital markets with emphasis on Argentina, an important capital market in Latin America. He interviewed corporate executives, financial advisors, private equity funds, banks and insurance companies using written questionnaire. Pereira found that the capital asset pricing model (CAPM) is the most popularly used asset pricing model to discount cash flows, yet is often adjusted to take account of country risk premium. Country specific risks such as asset expropriation by regimes, fluctuation in exchange rate, political instability etc., need to be considered in calculating cost of capital or discount rate for investment inflows. These country-specific risks may vary with time and from country to country and therefore using a constant risk premium to determine discount rate is inappropriate.

Though it is difficult to determine the impact of country specific risks on investment cash inflows, international investors and fund managers can use a standard and well established method for estimating discount rate and add foreign risk premium to domestic cost of capital. The intention is to reduce or eliminate country specific risks arising from politics and economics. Using the standard method of estimating discount rate without adjusting to local conditions will lead to biased discount rate.

This implies that CAPM (popularly used in emerging capital markets but developed based on U.S conditions) needs to be modified to account for lack of market integration of emerging capital markets. An emerging market is believed to be segmented from world capital market and thus using a local version of the CAPM where all the input variables (that is, risk free rate, beta and excess return) originate from the emerging market is appropriate.

The problem with adopting local CAPM is the temptation of double counting idiosyncratic or country specific risk because part of macroeconomic risk is captured in market risks (see for example, Erb *et al.,* 1995). Also Aggawal *et al.* (1999) contributed to this by examining the impact of local and global events on the volatility of emerging capital markets returns. They found that high volatility in emerging capital markets is associated with important events in each country and that no evidence was found to suggest the impact of global factors. Thus, implementing International CAPM would result in missing country risk factors that are important in generating returns.

Michailidis *et al.* (2006) investigated the validity of the capital asset pricing model (CAPM) in the emerging Greek capital market using weekly and annual data from 100 listed equities on Athens Stock Exchange from January 1998 to December 2002. The results of their study neither supports the CAPM's hypothesis, that, higher risk (beta) associated with higher returns is unfounded in the Greek capital market, nor did it support any alternative model including the Fama-French three factor model. The period of research (1998 – 2002) was short and could have a significant impact on results since most asset pricing tests have been conducted under a relatively longer periods. However, evidence reported by Michailidis *et al.* (2006) in the Greek market further supports the idea of additional country specific investigation into asset price determinants to empirically support a more realistic emerging market discount rate, a gap this study is aimed to fill in emerging African countries.

3.5.2 Emerging Market Evidence of Multi-Factor Model

The multi-factor model has reasonably been tested extensively in emerging markets, mostly in the Asian-Pacific and Eastern European markets over the last fifteen years. Limited studies have been conducted in Africa and Middle East. However, these studies have been conducted at aggregate market level or using portfolios rather than individual equities. A gap this study intends to fill. The following are a review of key studies in emerging markets.

Fama and French (1998) is one of the early studies that tested the multifactor model in emerging markets. They studied sixteen emerging capital markets including Asia, Latin America, Middle East and Africa using returns, book-to-market equity and earnings to price data from International Finance Corporation (IFC) with a sample period of 1987 to 1995. Similar to the MSCI data, the IFC data is free from backfilling when adding new markets. Firms were both equally and value weighted by their market capitalisation in each country portfolios.

They first examined the characteristics of the return data and found that the average dollar returns for equally-weighted emerging market index was 24.4% per annum during 1987 to 1995 periods and recorded 25.93% average return for the same period for value-weighted returns. On average they found that ten out of the sixteen countries have annual standard deviation just above 50% with exception of Argentina with 137% and Venezuela 221% per annum respectively. This is typical of what other empirical studies have revealed in emerging markets, that they exhibit higher returns and volatility (Harvey, 1995; Bekaert *et al.,* 1996; Appiah-Kusi and Menyah, 2003).

On the hand, the US annual return standard deviation is 14.64% and only four of the 12 developed markets have a standard deviation above 30% and Italy has the largest amongst all at 43.9%. It is found that the correlation between individual emerging market returns are weak and average correlation coefficient between excess returns of countries is only 0.07 and mostly negative. On the contrary, the average excess market returns in the developed countries have a higher correlation coefficient of 0.44 and mostly positive. Much of the volatility of emerging market returns disappear when combined into portfolios because they are not very correlated.

Secondly, book-to-market equity (BE/ME) were formed based on value (high BE/ME) and growth (low BE/ME) portfolios and found that the difference between average annual dollar return on high B/ME and low B/ME is 16.91% for value weighted portfolios and 14.13% for equally weighted portfolios. This result suggest that the value premium is not just present in emerging capital markets but also pervasive across markets. Unlike the MSCI data, the IFC data covers small capitalisation equities and therefore, this enable Fama and French to also test the presence of size premium in emerging markets.

At the end of each year *t* they formed portfolios of small and big equities and compare returns between the two. In each country the top 30% by market capitalisation were ranked as big portfolios and the bottom 30% ranked as small portfolios. Similarly to that of value and growth portfolios, small and big stocks in each portfolio were value-weighted. Their results were consistent with what was found in the developed markets literature that average returns on small equities have higher returns than big equities.

Fama and French asserted that indeed size effect exists in some emerging markets as found in developed markets in earlier empirical work (*see* Banz, 1981). The results showed that small and value firms are priced in most of the emerging markets across these countries. Fama and French results could be influenced by short period of data (that is, eight years) where most asset pricing tests have taken longer periods and given the high volatility of emerging market returns, asset pricing in emerging markets may be imprecise and thus additional empirical work needs to be done in these markets. A gap this study intends to fill for Africa's emerging markets.

The only African markets included in Fama-French data base were Nigeria and Zimbabwe which is not adequate representative of African emerging markets and also their study was done at an aggregate country level without examining the individual equities or portfolio of equities. This study is designed to examine whether or not the Fama- French three factor model applies to individual equities in African stock markets.

Chui and Wei (1998) investigated the correlation between equity returns and return factors relating to beta, size and book-to-market equity by adopting Fama -MacBeth (1973) regression procedure for five Pacific Basin emerging capital markets, namely Hong Kong, Korea, Malaysia, Taiwan and Thailand. The evidence reported in all the markets investigated found that the market beta (CAPM factor) is weak in explaining realised equity returns. However, the researchers found that the book-to-market equity can explain the cross-sectional variation of realised equity returns in three countries (namely, Hong Kong, Korea and Malaysia) and the size factor is significant in all except Taiwan. Both the methodology and results did not tell the other factors that could be priced in these markets even though there was still asset pricing anomaly found after employing the three-factor model. However, this study intends to suggest a suitable augmented model for Africa.

Drew and Veeraraghavan (2001) followed Fama and French (1996) regression model to test the robustness of the value premium and the three factor model in Malaysia. The evidence suggest that small and high BE/ME equities offer higher returns than big and low BE/ME equities and further document that the three factor model explains the cross-section variation of average equity returns. Their findings further provided additional out of U.S sample evidence to support the previous findings of Fama and French (1992, 1996) in the US, Europe and Japan. However, Lau *et al*. (2002) investigated the relationship between stock returns and beta, size, E/P ratio, cash flow-to-price ratio, book-to-market ratio and sales growth in Singapore and Malaysian stock markets from 1988 to 1996 and found contrary results. Their evidence showed a conditional relationship between beta and stock returns for both countries. They found significant positive relationship during months of positive market risk premium and significant negative relationship during months of negative market risk premium.

Connor and Sehgal (2001) tested Fama-French three factor model in India by constructing six size-*BE/ME* portfolios *(S/L,S/M,S/H,B/L,B/M,B/H)* from the intersection of two size and three *BE/ME*(see Fama and French (1992)). They calculated monthly equal-weighted returns on the six formed portfolios from the July of year t to June of year t_{+1} and reformed the portfolios in June of year t_{+1} from the period of 1989 to 1998. Ranking of size and *BE/ME* followed that of Fama and French (1992). The sample median was calculated to clearly separate small and big capitalisation equities and the *BE/ME* followed the Fama and French (1996) 30:40:30 principles. The test followed the standard Fama-French multivariate regression framework:

$$R_{it} - R_{ft} = \alpha_{it} + \beta\left(R_{Mt} - R_{ft}\right) + sSMB_t + hHML_t + \varepsilon_{it} \qquad (3.17)$$

For all sampled portfolios, their results showed the ability of the three factor regression capturing a cross-section of average returns not able to do by the standard one factor CAPM by Sharpe (1964) and Lintner (1965). In the Indian market, the test results show that the multifactor model explained realised equity returns better than the single factor CAPM.

Lau *et al.* (2002) investigated the relationship between stock returns and beta, size, E/P ratio, cash flow-to-price ratio, book-to-market ratio and sales growth in Singapore and Malaysian stock markets from 1988 to 1996. Their results showed a conditional relationship between beta and stock returns for both countries. They found significant positive relationship during months of positive market risk premium and significant negative relationship during months of negative market risk premium.

Drew *et al.* (2005) compared the CAPM's performance to that of Fama-French three factor model using equities from Shanghai Stock Exchange. The research methodology followed that of Fama and French (1996) linear regression model for both the CAPM and the three factor model. In line with previous studies, the researchers reported that the three factor model better explained average equity returns than the traditional CAPM on Shanghai Stock Exchange. They also found that small and low book-to-market equities generate higher returns than big and higher book-to-market equities. With respect to small equities, their findings are consistent with that of Fama and French (1992, 1996) who argued that small equities generate higher returns than big equities. However, with respect to book-to-market equity, their findings are different from Fama and French (1993, 1996) in the sense that they found that the mimic portfolio for book-to-market equity generates negative returns. This suggests that high book-to-market equity firms are not riskier than low book-to-market equity firms as documented in US portfolios by Fama and French in earlier studies.

Lin and Hong (2006) mimics Fama and French (1993, 1996) methodology to test the existence of the size and BE/ME on the Chinese stock markets. Firstly, the one factor model of CAPM was introduced and subsequently included the two additional factors of *SIZE* and *BE/ME*. When the latter were introduced into the regression the model maximum likelihood values and goodness of fit were greatly improved, which suggest that the *SIZE* and *BE/ME* better explain average returns on the Chinese Stock Markets than the single factor CAPM.

Rahman and Baten (2006) investigated the risk-return relationship by exploring whether the CAPM is a good measure of asset pricing in Bangladesh for the period of 1999 to 2003. They followed Fama-French 1992 methodology by testing the relationship between stock return and beta, book-to-market value, size (market capitalisation) and size 1 (sales). Their results show that beta is not the only risk factor to determine return but the other variables are significant in explaining return variations in Bangladesh.

Further emerging market evidence was provided by Girard and Sinha (2008) who investigated the risks involved when investing in frontier (less developed emerging) markets by examining 360 equities in 19 emerging markets for the period of 1997 to 2004. Their methodology involved a linear regression of the one factor CAPM and the Fama-French three factor model. They found that multifactor extension of CAPM consisting of fundamental risk factors like beta, price to book, and size, provides a better understanding of frontier market asset returns than a model consisting of only the market factor. Their study also found that the coefficients of size and price to book values are positive, confirming that in frontier markets, the small and value stocks are less risky investment avenues than the large and growth stocks. This is in contrary to what was widely observed in developed and US markets, where large and growth equities are found to be less risky.

Donadelli and Prosperi (2012) investigated the impact of liquidity on emerging market returns in 19 countries, six from Asia (China, India, Indonesia, Malaysia, Philippines and Korea), five from Latin America (Argentina, Brazil, Chile, Colombia and Mexico), three from Africa (Egypt, Morocco and South Africa) and five from Eastern Europe (Czech Rep., Hungary, Poland, Russia and Turkey). They considered local and global movements in liquidity as determinant of stock prices. Their evidence shows that local liquidity factors do not explain realised average excess stock returns. In contrast, they found that global liquidity factors significantly affect asset price of risk in these countries.

3.5.3 Evidence of Asset Pricing Tests in African Stock Markets

The attention of finance researchers into asset pricing was drawn to Emerging African markets not until after the year 2000 and there has been scanty nevertheless contentious evidence documented so far. The contention is largely originated from lack of data availability and the short term periods that these data are available. Decisive asset pricing research requires long period of data such as those found in US and Europe. Adding to this controversy is the suspicion of data quality. There is a possibility of data being massaged or market interference from national authority. For example, the Nigerian government controls maximum price of share per day and Tanzania has a law that enforces dividend payment to shareholders. There is also a problem of weak governance and regulatory framework that affect quality of reported accounting data. All these market frictions affect the efficiency of the capital markets in Africa and hence, quality of data presented by these markets. However, these challenges have not stopped researchers to investigate asset pricing in Africa. For example, Jun *et al.* (2003) investigated the relationship between liquidity risk and stock returns in twenty seven emerging markets including three African countries, Nigeria, South Africa and Zimbabwe from 1992 to 1999. They conducted both cross-sectional and time series analysis. They found that stock returns in these countries are positively correlated with aggregate market liquidity as measured by turnover ratio, trading value and the turnover-volatility multiple. Their results hold both in cross-sectional and time series analysis and quite robust, even after controlling for market beta, market capitalisation and price-to-book ratio.

Omran (2007) analysed the CAPM in the Egyptian stock market during the period of 2001 to 2002 using weekly returns data from Al Ahram newspaper in Egypt. His results show that the market beta and preference for skewness appear to significantly explain the return dynamics in the Egyptian stock market. However, in regard to risk-return balance, his results show that a portfolio formed on consumer staples and financial firms with low betas outperformed a portfolio containing construction, materials, weaving and hotel companies with higher betas.

Bundoo (2008) tested Fama and French three-factor model by taking into account time-variation in betas on the Mauritius capital market. The aim of his methodology was to establish whether the size and book-to-market equity effects may be reduced or disappeared as time-varying risk premium is adjusted for temporal variation in idiosyncratic risk. He constructed six size-BE/ME portfolio mimicking Fama and French (1993) and first, performed regression using Fama-French testable regression model as:

$$R_{it_{it}} - R_{ft} = \alpha_{it} + \beta_i (R_{Mt} - R_{ft}) + sSMB_t + hHML_t + \varepsilon_{it} \qquad (3.18)$$

His findings were consistent with Fama and French (1992 and 1993), that the size and book-to-market effects are present in the stock exchange of Mauritius. To test for the robustness of the Fama-French regression, he allows time variation in beta and the model was adjusted as:

$$R_{it} - R_{ft} = \alpha_{it} + \beta_{iM} (R_{Mt} - R_{ft}) + sSMB_t + hHML_t + \delta \left({R_{Mt}} \big/ {\sigma^2{}_{Mt}} \right) + \varepsilon_t \qquad (3.19)$$

δ captures the time-variation in beta and it was expected that accounting for time-variation in beta, *s* and *h* coefficients should be statistically insignificant. When regressions were performed, the coefficients for the size and book-to-market equity variables were significant and do not fade away. This confirms that Fama and French three-factor model is strong when time-varying betas are considered in Mauritius. This means that the model captures other risk factors not captured by the CAPM in certain emerging market in Africa. This should not be interpreted as a generalised model or phenomenon for other African markets. Bundoo's results can be sample specific and also have a short sample period from 1997 to 2003. Another problem identified with Bundoo's model is the variable used to represent time variation in beta, which is the ratio of the market return and variance. Using the lagged risk premium might be a better proxy for time variation in beta.

Hearn and Bruce (2008) proposed and tested size and liquidity-augmented CAPM focussing on emerging African Markets. Their sample includes Johannesburg Stock Exchange (JSE), Nairobi Stock Exchange (NSE), Swaziland and Mozambique. The first two markets, JSE and NSE are considered most developed and the latter two are less developed. They performed a regression using an ex-post multifactor model with market risk premium, the size premium and illiquidity premium as explanatory variables. The ex-post model is expressed as:

$$R_{it_{it}} - R_{ft} = \alpha_{it} + \beta_i (R_{Mt} \quad - R_{ft}) + sSMB_t + hILLIQ_t + \varepsilon_{it} \qquad (3.20)$$

Their results show that size-illiquidity augmented CAPM performs better than the Sharpe-Lintner CAPM and Fama-French Model as they found that size and illiquidity is a priced factor in South Africa and Kenya but less significant in Swaziland and Mozambique. 'Illiquidity for a given stock on a given day was measured as the ratio of the absolute value of the percentage price change per US$ of trading volume'.

Hearn (2009) investigated size and liquidity augmented CAPM and a time-varying parameter model for Uganda, Tanzania and Kenya together with UK and South Africa. Their evidence shows that size and liquidity premia have little significance in explaining returns in UK and South Africa. There is also a marginal increase in the explanatory power between the application of the classic CAPM and its three factor version in these two markets. However, evidence from the three Eastern African markets suggest that size and illiquidity premia have considerable impact on explaining realised returns. Furthermore, his findings show that size premium drives the Kenyan returns whiles liquidity is a key driver of Ugandan returns. Due to the severe illiquidity problem in Tanzania, CAPM based regression techniques was unable to capture market, size or liquidity effects in the market. Besides, the application of the time-varying techniques produces similar results, that the market risk premium is sufficient to explain realised returns in UK and South Africa. In addition to market risk premium, size premium helps in explaining Kenyan returns and Ugandan returns are dominated by size and, particularly, illiquidity effects. The finding from the estimation of cost of equity shows that Uganda has the highest cost equity followed by Kenya and South Africa and UK has the lowest respectively. This result is expected to a larger degree given that East African markets are illiquid and dominated by smaller firms unlike London and Johannesburg which are relatively liquid and dominated by larger firms. This also means that it is more expensive to raise capital from East African capital markets for expansion and capital project investments.

Furthermore, Hearn and Piesse (2010) investigated size and liquidity augmented CAPM in three West African countries (Cote d'Ivoire, Ghana and Nigeria), two North African markets (Morocco and Tunisia) and compares these with UK and France capital markets. They also contrasted the performance of augmented CAPM with GARCH and simple stochastic drift models. Whiles they estimated cost of equity for the markets using augmented CAPM, the potential for portfolio investment diversification is assessed from contrasting the conditional mean and variance-covriance matrices using GARCH and a stochastic model with drift. Their results show that Nigeria has the highest cost of equity followed by Tunisia and Morocco respectively and finally France and UK. This means that it will be expensive to raise capital from Nigeria domestic capital market to fund projects or expansion as compared to their North African and European counterparts. Despite the relative small size and illiquidity of both Ghanaian and Ivorian capital markets, they found that investors would benefit from diversification by including assets from these markets. This benefit is possible because of lack of integration of these two markets from the rest of Africa and the world markets.

Nonetheless, Hearn *et al.* (2010) proposed and tested size and liquidity augmented CAPM in four African markets, South Africa, Kenya, Egypt and Morocco and included UK as a linked between developed and emerging markets. They followed Fama and French (1993) methodology and found that in addition to market risk premium, size and illiquidity are both priced however; they found that premium associated with size has a greater impact in explaining returns than illiquidity in all the markets. They also concluded that the augmented CAPM renders superior performance than Sharpe –Lintner CAPM and therefore support the multifactor evidence of Fama and French (1992). Furthermore, their results suggest that UK and South Africa markets achieved lowest cost of capital whiles the two North African markets of Morocco and Egypt achieve relatively higher cost of equity followed by Kenya with highest cost of equity. This is expected because cost of equity declines as capital market develops and given that London and Johannesburg have the most developed markets within the sample their corresponding lower cost of equity is consistent with convention. Morocco and Egypt are less advanced but developed than Kenya so their respective costs of equity are also in line with convention.

Al-Rjoub *et al*. (2010) also investigated the cross-sectional behaviour of stock returns in four MENA markets, namely, Egypt, Jordan, Morocco and Saudi Arabia. Their results show that in all four markets beta have significant explanatory powers in predicting stock returns however, other fundamentals namely, P/E, BE/ME and M-CAP failed to account for variations in stock returns. Other studies in Egypt and Morocco have shown that the market risk premium is significant in determining returns (Hearn *et al.,* 2010; Omran, 2007).

Hearn (2011) investigated an augmented CAPM and its time-varying counterpart by including size and liquidity as state variables present within stock returns in four North African Countries, Algeria, Morocco, Tunisia and Egypt. In addition, the time-varying technique was included to model the effects of the 2007/08 global financial crisis on domestic North African markets. The evidence suggests that size and illiquidity effects are least significant in Morocco which reproduced in its low cost of equity while that of Egypt and Tunisia is significantly higher. Neither size nor liquidity influence the way returns are generated in Algeria. The time-varying parameter of liquidity betas provides evidence that the 2007/08 global financial crisis affected Egypt and Morocco while the Tunisian capital market is relatively unaffected.

Nel (2011) conducted a field research with accountants in view to determine the frequency and degree to which CAPM is used to estimate cost of equity by practitioners in South Africa. Accounting practitioners and academics were interviewed and they both agreed that CAPM is the best approach to calculate cost of equity. Surprisingly, all investment practitioners interviewed indicated that they use the CAPM frequently, whiles 74% of academic support its application.

Besides, Reddy and Thomson (2011) investigated the CAPM with the aim of testing whether it provides reasonable basis for actuarial modelling in South Africa. They went on to use data from 2000 to 2009 to separately regress excess returns on sectoral indices and excess return on market portfolio for individual years as well as for all periods combined against their corresponding estimated betas. Unlike this study and numerous others found in the literature, data used by Reddy and Thomson in their study were of yearly interval. Their results show that, with exception of 2001, the CAPM was rejected and the performance of the beta was quite weak for regression on sectoral indices and similar results was produced, except 2003, with regression on the market portfolio. However, it was not possible for them to reject the CAPM for all periods combined because they found inconclusive results in this regard. They also found little evidence of a linear relationship between excess returns on sectorial indices and the betas of those indices. Unlike this study, Reddy & Thomson study was based on portfolios and it is therefore expected that an improved results should have been obtained from beta estimates since combining securities into portfolios reduced estimation errors in beta (Jensen *et al.,* 1972; Fama and French, 1993).

Habib and Mounira (2012) investigated whether Tunisian average stock returns vary with liquidity risk factor by following Amihud (2002) methodology from 2002 to 2007. Their results show that, on Tunisian market, liquidity is not a priced factor even after adjusting for market returns and size factor. However, beta provides significant explanation to realised returns. Also, Coffie and Chukwu-lobelu (2012) investigated the equity return generating process in Ghana using CAPM. Jensen (1968) methodology was adopted and they found that the market beta plays a very significant role in determining equity returns.

3.6 Capital Market Segmentation and Emerging Stock Market Returns

Some financial economists and finance practitioners are of the opinion that global capital markets are significantly integrated and therefore propose the use of a global or international capital asset pricing model, popularly known as the ICAPM (O'Brien, 1999; Stulz, 1995, 1999; Schramm and Wang, 1999). This implies that international investors can enter and leave any market anywhere in the world with reasonable certainty and a minimum transaction costs. A persistent issue in international corporate finance is the degree of capital markets segmentation (Braeley *et al.,* 1999; Eun and Resnick, 1984; Bekaert and Harvey, 1995). This issue of whether global capital market is integrated or segmented appear to be elusive in many respects. The relationship that exists between asset risks and return should be the same regardless of location of capital market if indeed international capital markets are fully integrated (Brealey *et al.,* 1999). It has been documented that market segmentation arises particularly in emerging capital markets as a result of market imperfection, differences in taxes, restriction on the ownership of securities, closed political organisation, soft currency and trade barriers (Eun and Resnick, 1984; Eun and Janakiramanan, 1996).

Agmon (1972) examined the relationship among share price movements in US, UK, Germany and Japan. His results showed that share prices in the two European and Japanese capital markets react instantaneously to price changes in the US market index. This reasonably supports the idea of 'one' market hypothesis that conclude that there is integrated global capital markets. On the other hand, Agmon did not test the segmented market hypothesis and his data was based on the one market hypothesis, thus different data in different context should be tested to establish the validity of either market integration or segmentation hypothesis. In Agmon's study, the capital markets under consideration were all developed and have similarities in economic variables and have strong economic ties after the Second World War and therefore, could have documented a different result should emerging capital market(s) have been included in the sample.

Over the last two decades researchers have reported that different capital markets exhibit different degree of integration to world capital markets and over time, there is varying degree of integration. The implication is that equity cost of capital can differ significantly among segmented capital markets. Recent research papers have paid attention to the extent of emerging market segmentation from world markets and have found low correlations of these markets with the world capital markets, suggesting significant benefits for adding emerging capital markets to global portfolio investments (Bekaert, 1999; De Santis and Imrohoroglu, 1997). Harvey (2000) emphasized that there would be a serious problem in applying International Capital Asset Pricing Model(ICAPM) to emerging capital markets because of the model's assumption of a perfect capital market.

The ICAPM further assume that all international markets are perfectly integrated and the same risky asset carries the same expected return irrespective of location of capital market. Bekaert (1995) found insignificant or no evidence of emerging market returns contributing to global economic risk. He interprets this as evidence of segmentation of emerging capital markets from global capital markets from asset pricing perspective. Bekaert and Harvey (1995) documents that implementing the standard asset pricing model in emerging capital markets is less likely due to the complex abnormal behaviour of asset returns in emerging markets. Therefore, adopting the International CAPM may not work for these markets.

Harvey (1995) investigated whether adding emerging market asset to one's portfolio considerably shifts the investment opportunity set. He found that by including this asset, the mean-variance efficient portfolio considerably decrease variance of the portfolio and raise expected returns. He further explored why emerging markets expected returns are higher. In contrast to asset pricing theory which states that high expected return is associated with high variability, Harvey found that the exposure to commonly used risks variables in emerging markets are low. He went on to investigate time variation in the returns of emerging market equity and contrary to the developed markets literature, emerging markets returns are more predictable and more so, local events have more influence on returns than global factors. His evidence is in support of the hypothesis that emerging markets are segmented from the global markets.

Bekaert *et al.* (1996) examined the behavioural characteristics of emerging market volatility and investigated the relationship between risk variables and expected equity returns by using data from IFC emerging markets and Morgan Stanley Capital International. They performed three normality tests based on Hansen's (1982) generalised method of moments (GMM), Jarque – Bera (1982) test and Kolomogorov-Smirnov. Out of twenty emerging capital markets, GMM test rejects normality in 4, Jarque – Bera rejects 13 and Kolomogorov-Smirnov in 11 countries. The deviation from normality is persistent and has important connotation to emerging market investors and fund managers. This means that the usual mean-variance framework of CAPM is no longer sufficient to characterise investment decisions. For some of the countries such as Argentina, Chile, Portugal, Taiwan etc., the average returns in the first five years after the emergence of the IFC database are higher than the subsequent five years. This implies that mean returns vary with time and could mean that emerging market returns are fairly predictable. A possible explanation as to why returns in emerging market can be more predictable as compare to the developed markets is the slow nature of how these markets absorbed new information. According to the efficient market theory, stock prices are fully and immediately reflect available information. The process and pace of absorption may differ in developed markets (more efficient) and emerging markets (less efficient). They went on to find that generally, emerging markets volatility decrease through time, that is, downward volatility. For example, in 1991 volatility in emerging markets was 28% and dropped to 16% in 1996 using IFC data which in turn mirrors the downward volatility produced by MSCI data of 18% and 10.7% respectively during the same period. Combining the high predictability of emerging market mean returns and downward trend of volatility will mean that emerging capital markets can be very good avenue for international portfolio diversification where investors are somehow guaranteed with predictable good returns and relatively low risk investment.

Measuring risk has always been difficult in emerging capital markets and applying the simple CAPM of Sharpe (1964); Lintner (1965) and Mossin (1966) is problematic. Due to the complex nature of emerging capital markets such as persistent currency fluctuation, weak regulatory framework, political instability, and other financial markets 'shocks' make it notoriously difficult to predict emerging capital markets mean returns and volatility using the traditional form of the CAPM. Also, if average returns and volatility change through time, then, the CAPM is not good framework unless these markets are integrated into the world market. This means that the CAPM will produce misleading results if the risk and return change through time.

A body of evidence has shown that emerging capital markets experience high average returns, high volatility and low correlations across emerging capital markets and with developed markets (see for example, Harvey, 2000; Harvey and Bekaert, 1995). The lack of capital market integration means that the CAPM's beta which measures systematic risk is no longer the only useful variable in explaining asset returns. Instead, the appropriate measure of risk in segmented emerging capital markets is volatility – this is the country variance which is usually considered as idiosyncratic. This could mean that the portfolio allocation process should go beyond the mean-variance analysis in these markets and look into information about volatility, correlation, skewness and kurtosis.

Bekaert and Harvey (2002) identified that the direct and indirect forms of restrictions that apply in emerging capital markets can endanger the benefits of any diversification and such restrictions on capital flows at least make the emerging capital markets slightly segmented from the world markets. Gerard *et al.* (2003) investigated the extent to which five key East Asian capital markets (Hong Kong, Japan, Korea, Malaysia and Thailand) are integrated into or segmented from the world capital markets. Their results however, found little evidence of either partial or total segmentation for the five Asian capital markets from the world capital markets. The world market risk premium was significant for all assets; the prices and the associated premium for local risks were not significant. However, they found significant relationship between excess return and exchange rate, suggesting that exposure to exchange rate risk may underpin cross-country differences in expected returns.

Segot and Lucey (2005) investigated capital market integration in the MENA countries namely Egypt, Jordan, Israel, Lebanon, Morocco, Tunisia and Turkey and also with USA and European Monetary Union (EMU). Four cointegration methodologies were used, namely, Johansen and Juselius cointegration analysis, Gregory-Hansen (1996) residual based cointegration analysis, Harris, McCabe and Leybourne (2002) stochastic cointegration analysis and Bierens (1997) criticism of traditional cointegration methodologies. The evidence produced rejects any stable, long-term bivariate relationship between the MENA markets and EMU, USA and a MENA regional benchmark. This result implies that MENA present an opportunity for international portfolio diversification.

Chaieb and Errunza (2007) analysed the impact of variation caused by the purchasing power parity (PPP) and capital market segmentation on asset prices in four Latin American and four Asian countries. The researchers constructed two sets of securities; those that are traded in the domestic market known as eligible securities and both local and foreign investors can invest in these securities and those that traded in the foreign market and only foreign investors can invest in these securities, known as ineligible securities. It was reported that the eligible securities that can be freely traded by both domestic and foreign investors are priced as if the market were fully integrated. The freely traded securities command world market risk premium and an inflation risk premium, while the ineligible securities that can only be held by foreign investors' command two additional risk premia – conditional market risk premium and 'segflation' risk premium. This suggests that apart from global risk factors, market specific and 'segflation' risks are priced and this underpin the hypothesis that local market factors are still important for equity price determination process in emerging capital markets.

Boyle (2009) studied capital market integration between New Zealand and nations from North America, Western Europe and Asia Pacific. He found that the New Zealand and Australian markets are highly integrated with strongly correlated equity returns. The results also show that aside Australia, New Zealand is more integrated with Asia Pacific nations than North American and Western European nations.

Yabara (2012) investigated capital market integration in the East African Community (EAC) Monetary Union. Evidence shows that EAC countries have been pursuing capital market integration by removing capital regulation and harmonising market infrastructure. For example, Uganda, Kenya and Rwanda have completely liberalised capital transaction across the region, while Tanzania and Burundi are obliged to follow by 2015. However, evidence shows that capital market integration in this region is limited and convergence analysis shows that there is weak financial market integration with some nations even showing signs of increasing divergence.

3.7 Literature Gap (Rationale)

Both the theoretical and empirical literature so far revealed extensive and contradictory evidences for CAPM and the Multifactor model in both developed and emerging markets. However, most of these empirical evidences are concentrated in the developed markets particularly U.S, Japan and Western Europe and have left the Emerging African Markets essentially uninvestigated. Nevertheless, the rapid growth of emerging African markets and increased flow of investment funds into Africa during the last two decades make it imperative for additional evidence on investments rewards and their associated risks.

There are mixed evidences provided in the existing literature on asset pricing. For example, Hawawini and Keim (1999) while summarising their empirical studies state that ‘‘the proposal to displace the CAPM and replace it with multifactor model is premature’’. They went on to assert that many of these anomalies have been in existence for almost a century and there is no evidence to prove their existence in the future and therefore research in the next century may be important to settle this issue. Miller (1999) asserts that ‘although the one factor CAPM has managed to sustain more than three decades of fierce scrutiny and still the most widely used and taught asset pricing model in business schools, the current consensus is that a single risk factor is not enough to describe expected asset returns. Instead a three-factor model has now been shown to describe cross sectional average returns better than the CAPM’. However, this author believes that more work is still needed to establish the legitimacy of the new model particularly in emerging capital markets of Africa. This view is supported by Campbell *et al*. (1997), who documented that the practicality of the multi-factor models will not be entirely acknowledged till enough diverse confirmations are presented outside the US market.

The evidence of CAPM and multifactor model tests in Africa are also mixed and contradictory. For instance, Omran (2007) found that market risk premium provides significant explanation to returns in Egypt. His evidence was supported by Al-Rjoub *et al*. (2010), and Coffie and Chukwolobelu (2012), who found that the market beta has significant and positive relation with returns in MENA markets and Ghana respectively. However, Reddy & Thomson (2011) found very little evidence of the explanatory power of beta in South Africa and even rejected the CAPM when it was tested year by year on portfolios. In spite of this evidence, Nel (2011) found that South African firms considers CAPM as the appropriate model for estimating cost of capital and fund managers used it frequently in pricing assets and for analysing portfolio performance. Bundoo (2008) identified that in addition to beta, book-to-maket and size premia affect return generating process in Mauritius. Hearn *et al.* (2010) found similar results in South Africa, Kenya, Egypt and Morocco. In their results they document that in addition to beta, size and liquidity are priced in these markets, while the augmented CAPM renders superior performance than Sharpet-Lintner CAPM. Hearn (2009) found that beta has significant relationship with returns in South Africa compare to the little significant effect of size and liquidity premia. Nevertheless, in addition to beta they found that size and liquidity have significant explanatory power in Kenya and Uganda. Furthermore, Hearn (2011) found that size and liquidity have significant effect in explaining returns in Egypt and Tunisia and less so in Morocco and questionable in Algeria. Nevertheless, Habib and Mounira (2012) found that liquidity is not priced in Tunisia and this is supported by Danadelli and Prosperi (2012) evidence, that local liquidity factors have no effect on asset pricing in Egypt, Morocco and South Africa. Hearn and Piesse (2010) found that size-liquidity augmented CAPM is useful in estimating cost of capital in Ghana, Cote d'Ivoire, Nigeria, Morocco and Tunisia. Jun *et al.* (2003) found a correlation between stock returns and aggregate market liquidity in Nigeria, South Africa and Zimbabwe.

The literature on asset pricing in Africa is still at its elementary stage with much attempt to find anomalies instead of checking the rigour of the CAPM which has been used widely in estimating cost of capital and pricing of assets on the continent by practitioners. The scanty literature so far is crowded with contradictions with no clear recommendation(s) but this study is designed to fill this gap in the African literature by examining individual securities risk profile and proposes a suitable augmented model for Africa. So far none of the literature suggests such an augmented model. Levy and Roll (2010) reanimated the debate of asset pricing after CAPM has received such an acknowledgement from its star critic (see roll, 1977) that the market portfolio may be mean-variance after all. It feels like the test of CAPM has just begun. This new evidence rejuvenates such a study in Africa.

Two more reasons make this study different and important:
Firstly, voluminous empirical studies of Asset Pricing have focussed on portfolios of which Jensen *et al.,* (1972) are among the pioneers and most of emerging ASMs studies have been conducted at aggregate market levels rather than employing data on individual securities. Although estimation errors are reduced when portfolios are used, I believe that since asset pricing models were developed using data on single security rather than portfolio, accordingly, it is important to establish the performance of the models with regard to individual securities initially before jumping to portfolios in frontier market studies. This will also help individual companies to understand and evaluate the relevance of the asset pricing models on the basis of their firm specific risk profile rather than the risk characteristics of a

combination or portfolio of securities when estimating cost of capital. Investment practitioners in these markets will also price assets and evaluate individual security performances with the view of definitive firm risk profile. In order to avoid spurious regression, the methodology is designed to overcome the problem pose by using single securities.

Secondly, examining these classes of emerging markets is motivated by the degree to which these markets move independently from the developed and industrialised markets (that is, market segmentation, Bekaert and Harvey, 1997). The relative segmentation of the emerging ASMs provides this study an opportunity to investigate the performance of asset pricing models in the African markets (see chapter 6 for choice of markets) and how these markets may differ from the developed markets.

Most previous studies in asset pricing in ASMs have been conducted using cross sectional studies. This means that the beta risk is measured at one particular point in time. This study is designed to measure beta risk across time by following time series approach (see also Jensen, 1968; Jensen *et al.,* 1972; Fama and French, 1993).

3.8 Chapter Summary

This table summarises the empirical studies reviewed in this chapter.

Literature	**Findings**
Developed Market Tests	Early empirical works in the developed market uphold the CAPM's theory, particularly its risk-return relation linearity but identify some deviations (Jensen, 1968;

	Black et al., 1972; Fama and MacBeth, 1973 and Blume, 1975). However, the results of the later tests of the CAPM in the developed market are mixed. There are those who find evidence against the CAPM (Basu, 1977 and 1983; Banz, 1981; Eun, 1994; Fama and French, 2004; Bartholdy and Peare, 2005) and those who are either sceptical or entirely reject the anomalous findings (Lo and MacKinlay, 1990; Kothari, Shanken and Sloan, 1995; DeBondt and Thaler, 1985; etc.)
Emerging Market Tests of CAPM	Evidence from emerging market has also been mixed. Some tests support the existence of linear relation between beta and returns (Claessens, Dasgupta and Glen, 1995; Pereira, 2005 and some report contradictory evidence (Michailidis et al., 2006) Those who view emerging capital markets as segmented from the world market and therefore believe that country specific factors affect asset pricing and returns (Bekaert, 1995; Harvey, 2000; Bekaert and Harvey 2002; Chaieb and Errunza, 2007; etc.)

Multifactor Tests in Developed Markets	Fama-French 3-factor model has widely been tested in the finance literature but with mixed results. There are evidence that support that size and B/M variables are truly fundamental risk factors (Fama and French, 1993, 1996 and 1998) and those who differ (Kothari, Shanken and Sloan, 1995; Breen and Korajczyk, 1995).
Emerging Market Tests of 3-Factor	Emerging market has received a fair share of empirical tests of the 3-factor model and evidences are mostly supportive of the model (Fama and French, 1998; Chui and Wei, 1998; Drew et al., 2005; Bundoo, 2008; etc.). Others have found evidence against the multifactor model (Girard and Sinha, 2008).

Table 2 Summary of Empirical Literature

3.9 Chapter Conclusion

The Sharpe-Lintner version of capital asset pricing model has been widely tested and becomes a dominant orthodoxy in finance. Early empirical work upholds the CAPM by reporting that there is evidence of positive linear relation between return and market beta. However, deviations from the testable CAPM were identified and this led to other versions of the model (example, Black, 1972 and Black, Jensen and Scholes, 1972) mainly based on relaxing one or more of the assumptions upon which the classic CAPM was developed. Later empirical tests criticise the CAPM by identifying serious weaknesses in applying the CAPM.

The CAPM was branded as incapable of capturing all relevant systematic risks assets are exposed to. Emerging market has also seen quite sizeable tests of the CAPM and evidences obtained are mixed, with some supporting the CAPM and others rejecting it. Critics of the CAPM in emerging market believe that these markets are segmented and application of the CAPM needs to recognise country specific risks.

In the last two decades multifactor asset pricing models have been proposed as an alternative to the capital asset pricing model. Looking at other alternative models it is indeed fruitful at least for academic debate however, empirical evidence against multifactor asset pricing models support the fact that multifactor models on their own cannot explain the deviation from CAPM across different capital markets and data. Therefore there is the need for more to be learned by considering different capital markets and data under differing specific economic models. The rationale for the study is spelt out following the identification of literature gaps.

CHAPTER FOUR: ASSET PRICING TESTS AND RETURN VOLATILITY PROBLEMS IN EMERGING STOCK MARKETS

4.1 Introduction

Emerging capital markets are popularly known to be characterised by high volatility. However, majority of research documented on forecasting volatility is focused on the developed and the major capital markets and little evidence is provided about volatility in emerging African capital markets. In view that emerging capital markets provide an alternative avenue for international portfolio diversification which benefits investors in terms of risk reduction and opportunities to gain higher returns, it is important that volatility that supports asset pricing is examined.

There is a clear indication from empirical tests in emerging markets that asset returns are affected by volatility clustering (see for example, Bekaert *et al*. 1996; Harvey, 2000; Appiah-Kusi and Menyah, 2003). The evidence from these studies shows that African markets are prone to these problems. This chapter provides empirical review on this and other unique emerging market problems such as thin and non-synchronous trading. Without accounting for these methodological issues, the results provided in this study will be biased and inconclusive.

4.2 Measuring Volatility in Emerging Stock Markets

Choudhry (1996) conducted empirical study into stock market returns volatility, risk premia and persistence of sudden changes to volatility in six emerging capital markets prior and post 1987 crash of stock markets. GARCH-in the mean (that is, GARCH-M) is used for this investigation since this model has the ability to capture leptokurtosis, skewness and volatility clustering. These are the three most empirical features observed in stock returns data. He used monthly stock returns from IFC database as defined by the difference of the log of monthly stock indices from Argentina, Greece, India, Mexico, Thailand and Zimbabwe during the period of January 1976-August 1994. The total periods was divided into pre 1987 and post 1987 October stock market crash with aim of investigating the changes that occur in volatility, risk premia in the various stock markets and persistence of sudden changes to volatility before and after the 1987 crash.

The results revealed that there were significant changes in the ARCH parameters, risk premia and persistence of sudden changes in volatility in returns of stock markets under study prior and post 1987 October crash. It was found that these changes lack uniformity across markets and that they depend on each market involved. Although the crash might have contributed to these changes, country specific factors such as privatization, market-driven policies, and favorable atmosphere for investment by foreign investors have impacted significantly. Choudhry went on to find that the ARCH effect disappear after the crash for Mexico and India and appear after the crash for Zimbabwe. Volatility persistence was found to be permanent before the crash and transitory after the crash in Mexico and Thailand whereas the opposite was true of Greece and India. His results mostly failed to show a significant presence of time-varying risk premium.

Bekaert and Harvey (1997) thoroughly examined the behaviour of stock index returns volatility in emerging capital markets. They followed both time-series and cross-sectional analysis to attempt to address why volatility is different across emerging capital markets. This is important because in a segmented market, the risk premium may have a direct relation with the volatility of equity returns in that particular market. If volatility is perceived to be high, it implies higher cost of capital and delay of investment will be expensive. Bekaert and Harvey found that it is difficult to model volatility in these markets and each market display a specific behaviour. It was established that volatility is influenced by world factors when capital market is integrated with world market and local events influenced segmented markets.

They constructed a number of factors in order to determine why volatility is different in the various emerging capital markets. The variables included are the number of companies in the country index, asset concentration factors, credit ratings of a country, size of the trade sectors to GDP etc. They found that opening up the economy to world trade has considerably lower volatilities. However, political risk as represented by credit rating explains huge amount of cross sectional variation in volatility. Finally, they tested the effect of capital market liberalisation on volatility and find that liberalisation increased the correlation between local and world market returns but considerably decrease emerging markets volatility.

Aggarwal *et al.* (1999) investigated the events that cause large movements in emerging stock markets volatility. They first examined the time emerging stock market returns experience large movements in volatility and whether local or global events such as social, political or economic play a vital role in causing these shifts in volatility. It was aimed at providing economic significance to these changes in the level of volatility. Shifts in volatility are detected from the data under study and observe the events that occur around that period of time. They went further to use a methodology/procedure known as iterated cumulative sums of squares (ICSS) algorithm developed by Tiao and Inclan (1994) to identify a number of significant sudden movements in return variance in each market, estimate how long the shift persists and magnitude of each identified movement in the variance. This procedure is also capable of identifying both rise and decline in variance. They examined ten of the largest emerging capital markets in Asia and Latin America, plus Hong Kong, Singapore, Japan, UK and US, Morgan Stanley World Index, the Far East Index, the Latin American Index and the Emerging Markets Index.

They found that frequent sudden changes in variance caused high volatility in emerging markets. It was noticed that periods with high volatility were associated with important local events in each country rather than global actions. Important political event, currency fluctuation, hyperinflation tend to be connected with sudden changes in volatility. During the period of 1985-1995, the only global event that causes significant shock in the volatility of several emerging stock markets was the October 1987 crash. Even the Gulf War had only a small impact. Returns in local currency and dollar-adjusted returns tend to explain periods of increased volatility and during the period of increased volatility, the dollar-adjusted returns have higher standard deviations than returns in local currency do, perhaps echoing further volatility in rates of exchange.

Bacmann and Dubois (2001) revisited Aggarwal *et al.* (1999) research but this time with the aim to identify permanent changes in stock market returns volatility in emerging markets. The attempt was to separate conditional heteroscedasticity and permanent changes in the variance of equity returns. Bacmann and Dubois found that when series are conditionally heteroscedastic, the ICSS algorithm is misspecified. In order to separate these two effects on volatility, they proposed a slightly modified version of the ICSS algorithm. They went on to suggest two methods in order to detect structural breaks in the unconditional variance when time series display conditional heteroscedasticity.

The first approach was based on the aggregate property of GARCH (1, 1) models and the ICSS algorithm is applied to the aggregated time series which match up to the aggregation of daily equity returns to monthly returns. The second approach was to estimate the normalized errors of GARCH (1, 1) model and ICSS algorithm was applied to the time series. They eventually applied these two methods to test the volatility of asset returns in ten emerging capital markets. They provided contradictory evidence to that of Aggarwal *et al* (1999) which documented that there were less frequent structural breaks in the unconditional variance but demonstrated that shocks are specific to individual countries. Their results showed that the standard Lagrange Multiplier Test (Engle, 1982) failed to differentiate permanent changes (jumps) in volatility against temporary changes (conditional heteroscedasticity). There are dual financial implications for this results: (1) unconditional variance of asset returns (volatility) is much stable than previously documented; (2) because shocks are country specific and has no synchronous effect, emerging capital markets can be appropriate avenue for international asset diversification.

Ortiz and Arjona (2001) analyzed six major Latin American capital markets characteristics in light of nonlinear dependency and autoregressive conditional heteroscedasticity, particularly variants of generalized ARCH including EGARCH and GARCH-M extensions. Weekly data from the IFC during 1989-1994 was used and found that local currency returns were consistently higher than dollar returns during the period of 1989-1994 and also the standard deviation of the dollar returns was higher than volatility of local currency returns. They went on to discover that none of the GARCH model was capable of describing volatilities in these markets. Instead it was found that alternative models such as Durbin Watson statistic, Akaike Information Criterion, Schwarz Criterion and Log Likelihood function gave a better interpretation. The six Latin American markets were found to be sensitive to bad macro policymaking, capital reversals, speculative attacks and the behaviour of international capital markets with which they have established investment links.

Lee *et al.* (2001) investigated time series characteristics of Chinese stock returns and volatility, including the relation between return and volatility. They first tested the random walk hypothesis using Variance Ratio (VR) Tests by following Lo and Mackinlay (1988) procedure given as:

$$VR(n) = \frac{1\sigma^2(n)}{n\sigma^2(1)} = 1 \tag{4.1}$$

Where $\sigma^2(n)$ represents an unbiased estimator of the variance of the n^{th} difference of returns r_t, and $\sigma(1)$ is the estimator of the variance of the first difference of r_t. using the Dickey –Fuller unit root test and the autocorrelation test, the Variance Ratio test rejected the null hypothesis that stock returns follow random walk. The long-term memory is an alternative econometric tool to random walk and describes the correlation structure of the time series at long lags. In finance theory, the possible existence of long memory in asset returns has significant consequences. To test for long-term dependence in stock returns, they used Geweke and Porter-Hudak (1983) fractional differencing test defined by:

$$\ln\left(I[\xi_\lambda]\right) = \beta_0 + \beta_1 \ln\left(\sin^2\left(\frac{\xi_\lambda}{2}\right)\right) + \eta_\lambda,,,,...\lambda = 1,...,v, \tag{4.2}$$

Where

$$\xi_\lambda = \frac{2\pi\lambda}{T} \tag{4.3}$$

Denotes the harmonic ordinates of the sample, T is the number of observations, and $n = T^{\mu}$ for $0 < \mu < 1$ is the number of low frequency ordinates used in the regression. The evidence underpins long memory of returns in the Chinese stock markets (both Shanghai and Shenzhen). GARCH and EGARCH models were applied to attain the fitting sequence of conditional variances which in turn was used as volatility estimates. The findings render a potent support of time-varying volatility and demonstrate that the Chinese stock markets volatility is highly persistent and predictable. They further employ the GARCH-M to examine the relationship between expected returns and expected conditional variance (risk). Testing capital asset pricing theories using GARCH-M model improves the specification because it permits the conditional variance of returns to be used as a measure of risk. They found no evidence of existing relationship between expected returns and expected risk (volatility) as predicted by capital asset pricing models, suggesting that other than volatility other variables need to be considered when formulating expected returns in China. Finally they investigated the hypothesis that information flow to the market place influence volatility of returns. This was tested using trading volume as a proxy for information flow. Daily trading volume was selected to represent the amount of information that flows into the market and found no evidence that trading volume has any significant effect on the conditional variance (volatility) of daily returns.

Appiah-Kusi and Menyah (2003) examined the weak form pricing efficiency across eleven African capital markets. The issue of thin trading which characterise most of these markets were addressed in the procedure used to compute the weekly asset returns. They also allowed for non-linearity and time-variation in the return generation process. Asymmetric EGARCH-M was used since it allows estimates that do not impose undue restrictions on the parameters of the conditional variance equation like the standard GARCH. They found that investors in these markets require time-varying risk premium and rejected the notion that most of these markets are weak form, which implies that expected returns can be predicted by past information.

Kilic (2004) explored volatility clustering and long memory features in emerging stock markets with evidence from Turkish capital market. His research made use of Braille *et al.* (1996) Fractionally Integrated Generalised Autoregressive Conditional Heteroscedasticity (FIGARCH) model. The FIGARCH model has the ability to modelled very long-term dependencies in conditional volatility. GARCH model was used as a benchmark to compare FIGARCH since the former is capable of accounting for persistence in volatility and this persistence decay fairly faster. In order to measure the presence of long memory in the volatility in equity index returns, Kilic used Geweke and Portar-Hudak (1983) estimator and a local Whittle estimator based on Fox and Taqque (1986) to provide evidence of long memory in Istanbul Stock Exchange (ISE) returns. The evidence supports an existence of long memory in volatility process of ISE stock returns but contrary to other emerging markets evidence such as China the conditional mean returns of ISE 100 failed to possess long memory.

4.3 Volatility and Asset Pricing

Shiller (1981) began the literature on volatility for equity prices. He found that stock market volatility is too high to symbolize rational behaviour. Volatility of equity prices would reflect a dramatic variation in expected future dividends given a constant discount rate over short time periods. In the view of this analysis, it was proposed that high volatility involving equity prices is a proof against the efficient market hypothesis. French *et al.* (1987) conducted empirical investigation into the correlation between equity prices and volatility. Through regression of the market risk premium on expected market volatility, computed by using autoregressive integrated moving average(ARIMA) process and market volatility of the unexpected component(that is, the errors from their ARIMA estimates), they found that there is a strong negative correlation between unexpected volatility and returns.

However, they did not find a statistically significant relationship between returns and expected volatility. In order to authenticate their results, they used generalized autoregressive conditional heteroscedasticity in mean (GARCH-M) to estimate risk premia and volatility and the findings underpin their results documented with the ARIMA model. In light of this Schwert (1989) investigated the reasons behind changes in equity volatility over time. He went on to tests the relations between volatility and variables such industrial production, inflation, monetary variables, recessions measured with a dummy variable, lagged value of volatility, leverage and trading volume. He established that all these variables influence asset volatility, although the relationship with industrial production is found to be feeble. Haugen *et al*. (1991) used an approach that identifies precise days in which shifts in volatility occur. As a result of measuring returns prior and post the shifts, they documented that increase in market volatility drives prices down and decrease in volatility push prices up.

4.4 Effect of Thin Trading on Stock Returns

Not all stocks trade everyday (that is, infrequent trading) and this is even more severe in emerging capital markets. Thin trade also arises when stocks and the market index trade at different levels (that is, the stock market trades every day but some individual stocks do not). Investigating random properties of stocks using market index may be bias since stocks do not trade at the same level of frequency as the market index. This is the 'non-synchronicity' problem. For the long-run empirical study, inaccurate estimate resulting from the use of nonsynchronised and infrequent trade data may be less significant especially when monthly, quarterly or annual data are involved. However, the problem of non-synchronicity should be taken seriously and taken into account when using daily or weekly data since it can be an important source of estimation error in arriving at the results of empirical study.

4.4.1 Early Tests of Thin Trading

The seriousness of thin trading as a problem in empirical studies was first identified by Fama (1965) and Fisher (1966). Fama in his 1965 work replicates Theil and Leenders (1965) methodology to examined short-term predictability of stocks on NYSE, evidence earlier captured by Theil and Leenders for the Amsterdam stock exchange. Fama used the information theory similar to Theil and Leenders to test returns of equities for autocorrelation. Time series of the proportion of total traded equities that *advance, decline and remain unchanged* each day on the stock exchange was used. Fama's result was slightly different from that of Theil and Leenders – proportion of equities that advance and decline one day on the NYSE failed to provide evidence in predicting these components the following day. Fama examined the 'closing price' problem in detail and inferred that the captured difference is due to lack of synchronisation in trading of individual equities. He also inferred that the difference in magnitude of results attained for the Dutch stock exchange and NYSE is likely to be described by non-synchronisation.

Furthermore, Fisher (1966) deemed infrequent trading as an essential feature that influence the market indices to predict 'true' movements of the markets and capture trends in movements of individual equities. The stock indices were calculated based on arithmetic or geometric (log values of data set) average of officially recorded 'closing' prices of the index portfolio. The 'true' value of the average market activity was either overestimated or underestimated due to lack of synchronisation in closing prices and this non-synchronicity influenced the behaviour of the index residuals which in turn affect the sign of the bias. Fisher demonstrated that return variance on the market was downward bias and consequently positive autocorrelation was induced into returns that were computed from the arithmetic index.

Fisher proposed that one way of reducing bias arising from thin trading is to use geometric (that is, log values of a data set) rather than arithmetic values. In order to reduce the autocorrelation induced by irregular trading, Braeley (1970), Officer (1975), Schwartz and Whitcomb (1977) reconstructed the market index. They all aimed at investigating the *"intervaling effect",* that is, the inclination of descriptive power of regression to cause estimated mean value of slopes to increase as the differencing interval increased. Schwartz and Whitcom found intervaling effect to be significant for infrequently traded equities.

4.4.2 Models Arising from the Tests of Thin Trading

4.4.2.1 Schwert and Marsh Model

Schwert (1977) and Marsh (1979) initiated another approach to deal with this problem known as ‘trade-to-trade’ method. Returns are calculated on trade-to-trade basis and then these returns are regressed on market returns computed over the trade-to-trade intervals. The following multiple regression is used to estimate the beta:

$$R_s\left(T_s - T_{s-1}\right)^{-1/2} = \hat{\alpha}\left(T_s - T_{s-1}\right)^{-1/2} + \hat{\beta}_{MS}\left(T_s - T_{s-1}\right)^{-1/2} + \varepsilon_s \qquad (4.4)$$

Where returns are computed from transaction (s) to transaction (s-1) and the term $\left(T_s - T_{s-1}\right)^{-1/2}$ is induced to resolve the problem of heteroscedasticity in the residual. The requirement to time all transaction with exactitude is a major disadvantage of this model. It is impossible to use this method if the intervals of recording share prices are unknown or if no index is available to serve as proxy for continuously recorded data. Scholes and Williams (1977) and Dimson (1979) proposed much clearer mathematical models of the trade arrival process and the implication of these models are investigated for the autocorrelation of returns. They proposed fairly straightforward and smart approaches of measuring systematic risk when stock price data experience problem of infrequent trading.

4.4.2.2 Scholes and Williams Model

Scholes and William (1977) approach renders informative setting to demonstrate the repercussion of non-synchronous trading for serial correlation of returns. Assuming that returns are normally distributed, Scholes and Williams (hereafter, SW) demonstrated that reported returns variances and covariances are different from resultant variances and covariances of 'true' returns. They showed that OLS produces partial and inconsistent estimates of alpha and beta when equities do not trade at the frequency as the market index. Due to the error from non-synchronicity, it is possible to discover bias in direction (that is, sign) and magnitude (that is, size) – alpha is partial upward and beta is partial downward for high frequent and high infrequent equities and the bias for the regularly traded securities has opposite sign.

To account for thin trading, SW proposes that estimators for slope (that is, beta) and intercept (that is, alpha) coefficients including residual errors are adjusted using simple algorithm. Beginning with classical model, SW assumed that the distribution of all securities prices have infinitely divisible lognormal variables. In their econometric model, they use logarithmic form of returns to test for continuously compounded returns $\left[R_{nt} = \ln\left(P_t / P_{t-1}\right)\right]$ computed for intervals $\{t-1,t\}, t=\overline{1,T}$ and assumed that log normality are jointly normally distributed with constant means μ_n, standard deviations σ_n, and constant covariance's $\sigma_{mn}, m \neq n, m, n = \overline{1,N}.$ Market portfolio returns $R_{Mt} = \sum_{n=1}^{N} W_n R_{nt}$ is also normally distributed with constant mean μ_M, standard deviation σ_M and constant covariance's $\sigma_{Mn}, n = \overline{1,N}.$ SW arrived at this classical market model,

$$R_{nt} = \alpha_n + \beta_n R_{Mt} + \varepsilon_{nt} \qquad (4.5)$$

Where $\alpha_n = \mu_n - \beta_n \mu_M$ and $\beta_n = {\sigma_{Mn}}/{\sigma_M{}^2}$ are constant, the residual ε_{nt}, perpendicular (i.e. tangent) to R_{Mt}, is normally distributed with mean zero and have constant variances and covariances. The 'true' returns of equities and market index in the model are R_{nt} and R_{Mt} respectively**.** The SW model proposed that the following adjustment to be made to beta and alpha to account for thin trading:

$$\beta_n = \frac{\beta_n^{s-} + \beta_n^{s} + \beta_n^{s+}}{1 + 2\rho_M^s} \qquad (4.6)$$

$$\alpha_n = \alpha_n^s + \left(\beta_n - \beta_n^s\right)\mu_M \qquad (4.7)$$

Where

$$\alpha_n^s = E\left[R_{nt}^s\right] - \beta_n^s E\left[R_{Mt}^s\right] \qquad (4.8)$$

$$\beta_n^s = Cov\left(R_{nt}^s, R_{Mt}^s\right) / Var\left(R_{Mt}^s\right) \quad (4.9)$$

$$\beta_n^{s-} = Cov\left(R_{nt}^s, R_{Mt-1}^s\right) / Var\left(R_{Mt-1}^s\right) \quad (4.10)$$

$$\beta_n^{s+} = Cov\left(R_{nt}^s, R_{Mt+1}^s\right) / Var\left(R_{Mt+1}^s\right) \quad (4.11)$$

$$\rho_M^s = Cov\left(R_{Mt}^s, R_{Mt-1}^s\right) / SD\left(R_{Mt}^s\right) SD\left(R_{Mt-1}^s\right) \quad (4.12)$$

Equation (4.12) represents coefficient of serial correlation.

Scholes and Williams model made pretty insightful logic to state that,

H_1: Measured beta understates ''true'' beta $\left(\beta n > \beta_n^s\right)$

H_2: Measured alpha overstates ''true'' alpha $\left(\alpha_n < \alpha_n^s\right)$ for both highly frequent and highly infrequent traded equities.

H_3: Regularly but not extremely frequently traded equities *measured beta should overestimate ''true'' beta* $(\beta_n < \beta_n^s)$

H_4: Regularly but not extremely frequently traded equities *measured alpha should overestimate ''true'' alpha* $(\alpha_n < \alpha_n^s)$

The sample serial correlation coefficient can be used as estimator for the ''true'' market variance from the following equation,

$$\rho_M^s = \frac{1}{2}\left[\frac{Var\left(R_{Mt}\right)}{Var\left(R_{Mt}^s\right)} - 1\right] \quad (4.13)$$

H_5: Measured ρ_M^s (estimated by $\hat{\rho}_M$) serial correlation coefficients is different from zero and has a positive sign because $Var(R_{Mt}^s)$ understates $Var(R_{Mt})$

Scholes and Williams tested their model by computing compounded (logarithm) daily returns for NYSE and AMEX equities from January 1963 – December 1975. Using compounded returns is reasonable since market microstructure problems which result in error-in-variable bias is smaller than it appears in simple holding period returns (see Fisher, 1966). They formed five portfolios (20 percentiles) based on ranking equities by volume of traded equities during year *t*, and were recreated every year. Unlike Dimson who used value of trade to represent frequency of trading, Scholes and Williams believe that trading volume in equities serves a better proxy for trading frequency**.** The problem is that large volume of trade does not imply frequent trading because it is common to have large block trades in small capitalisation companies however, it does not mean equity is frequently trading. They eliminated equities with missing data for a given trading from current day and subsequent trading day. The Scholes and Williams model assumes that equities should trade at least once a day and attempt to solve this ''non-trading'' problem by eliminating equity returns for at least two trading days for all that do not meet this assumption. This was an attempt to remove errors that were not captured by their model. But they only remove return from ''non-traded'' and one subsequent ''traded'' day however, cumulative error from ''non-traded'' days will embed in equity returns and return to the portfolio after the following day.

Daily returns for portfolios including the market are computed as $R_{pit} = \ln\left(1 + \frac{1}{N_i}\sum_{k=1}^{Ni} R_{it}\right)$.

By using log returns (that is, compound returns), biases arising from non-synchronous trading, which is fairly large for arithmetic averages is reduced (see Fisher, 1966).

Significant results for betas were documented. ''Measured'' estimates for low-volume portfolios underestimate ''true'' betas and it was partially in consonance with H_1 but opposite results were documented for large volume portfolios (that is, frequently traded portfolios) and failed to support H_1. The hypothesis that *measured beta* of regularly but not frequently traded equities overstate *true beta* was rejected *(H_3).* It was found that the difference between betas for large-volume portfolios is insignificant and this is in consonance with the hypothesis that *measured* and *true* betas for continuously or extremely frequently traded equities should be the same. Whiles lead betas (β_n^+) is inclined to increase with volume, lagged betas (β_n^-) tend to decrease. Particularly, no significant trends were found for *measured* and *true* betas, but generally estimators for measured and true alphas were bigger for small-volume portfolios and slightly smaller for large-volume portfolios. No clear significant trends for residual errors were found. It was found that generally, estimators for autocorrelation coefficients for market were positive $(\hat{\rho}_M > 0)$. Which implies that measured variance in market returns $(Var[R_{Mt}^s])$ generally underestimates true variance in market returns $(Var[R_{Mt}])$, consistent with *(H_5)* and no evidence to support theoretical deductions of negative autocorrelation *(H_4).*

It can be seen that there are some but not very forceful and apparent support for the hypothesis that the difference between measured and true parameters decreases with rising trade volumes (that is, frequency of trades). The choice of proxy for trading frequency could be the reason why evidence failed to support the parametric hypotheses. Using volume alone as proxy for trades' frequency is not sufficient since large-volumes for low-priced (small) equities do not mean frequent trading.

4.4.2.3 Dimson Method

Dimson (1979) explored Scholes and Williams (1977) study further by expanding the issue of non-synchronisation of trades over multiple trading periods where it is assumed that some securities have traded fairly infrequently, at least once during subsequent *n* periods. Contrary to Scholes and Williams, Dimson did not remove these equities from portfolio but instead extended the computations of ''true'' return over several periods of trading. Dimson proposed an aggregated coefficient (AC) method to compute the slopes (betas) of thin traded securities. For example, if R_{it} *and* R_{Mt} represent equity and market returns respectively and are serially and cross-sectionally uncorrelated, then *n* lagged intervals determine ''true'' asset and market returns and assumed that asset trade at least once during *n* periods. Lagged and lead betas were estimated using aggregated coefficient regression as:

$$\hat{R}_t = \hat{\alpha} + \sum_{k=-n}^{n} \hat{\beta}_{k\,M_{t+k}} + \mu_t \tag{4.14}$$

Then the following equation represents the estimator of ''true'' beta:

$$\hat{\beta} = \sum_{k=-n}^{n} \hat{\beta}_k \tag{4.15}$$

H_1: The estimated $\hat{\beta}$ from simple regression $R_t = \hat{\alpha} + \hat{\beta}_{Mt} + \mu_t$ overestimate the true beta, whereas the bias for infrequently traded equities will have negative sign.

This hypothesis implies that the presence of thin traded equities in sample could lead to negative bias in calculated betas. This result is consistent with that of Scholes and Williams.

Dimson tested his model by constructing four different sets of overlapping samples from London Share Price Database (LSPD). The first group was randomly created to capture all aspects of equities and the other three were based on size. He chose 421 firms with continuous trading throughout 1955 – 1974. He identified that some small firms have up to 50 days trading gaps during this period. Monthly returns were computed as $R_t = \ln(P_t + d_t) - \ln(P_{t-1})$. Five lags and five leads are used. Dimson found that aggregate coefficient increases the efficiency of the model. Range of beta variation declined as betas for regularly traded equities are decreased, whiles infrequently traded firms betas increased. Small firms are undervalued because their betas are underestimated, and large firms are overvalued because their betas are overestimated by the OLS. Evidence provided by Dimson's test is that betas for small infrequently traded firms are smaller than betas of large mature frequently traded firms. This is possibly due to survivorship bias (that is, tendency that poor performing results are removed from the sample).

Scholes and Williams (1977) method is a single period model and at least necessitate one trade during this period. In contrast, the Dimson model is a multiperiod model and requires several lagged periods. Theoretically Dimson's model is efficient for very thin traded equities, whiles the Scholes and Williams model is efficient for relatively frequent traded equities and captures the ''closing'' price asynchrony better. In theory, it is logical to test the effect of intra-day ''closing price'' with Scholes and Williams model and smooth thin trading over relatively long period of time with Dimson's method, principally for estimating systematic risk for equities. Sholes-Williams used trading volume (although unreasonable) as proxy for trades' frequency, value of trades is preferable in Dimson's. One obvious thing is that both model reported bias in OLS estimation for beta when equities are subject to thin trading. Given the illiquidity nature of Emerging African Stock Markets (ASMs), this problem may be more severe and application of either method can provide unidentical results from US and UK due to the fact that small (infrequently traded) equities may be far more liquid than the larger equities on the ASMs.

4.4.3 Recent Emerging Market Test

Diacogiannis and Makri (2008) studied the intervaling-effect bias arising from the market model (OLS) beta estimates using continuously listed firms on the Athens Stock Exchange from January 2001 to December 2004. Sixty equities were sorted on the basis of market capitalisation. Two portfolios were formed consisting of 30 equities with largest market capitalisation and the other 30 consisting of 30 lowest market capitalisations. For every equity in the high capitalisation portfolio and low-capitalisation portfolio its zero mean returns were computed as a percentage of its total daily, biweekly and monthly returns.

Their results revealed that for both portfolios, the estimates of mean beta and mean R^2 increased with increase return measurement interval demonstrating the existence of intervaling – effect bias on the Athens stock market. The reason why beta shifts as return measurement interval extends could be explained by the fact that stock prices do not fully absorb the impact of information immediately and thus price adjustment delays however, the impact of this experience decline as return measurement intervals lengthen because much of the information have been incorporated in stock prices. Applying OLS beta estimates for Athens stock exchange data, the evidence supported the existence of "intervaling-effect" bias.

In particular, the change in mean beta with high – cap portfolio was statistically insignificant as long run return intervals were being used.

However, there was statistically significant difference between mean beta estimate when daily and monthly return intervals were used for low-cap portfolios. They also found that the difference between the estimated mean beta using OLS for equities and the estimated mean beta using Scholes and Williams (1977) model for equities is statistically insignificant for both high and low capitalisation portfolios. The beta coefficients and the *t-tests* of lagged betas decreased and lead betas increased from low-volume portfolios to high-volume portfolios according to Scholes and Williams (1977) method. To confirm whether the effectiveness of Scholes - Williams's model was valid for Athens stock market data; they constructed six high-cap (low-cap) portfolios by dividing 30 equities of high-cap and low cap respectively consisting of five equities in each portfolio. The first group contains the highest capitalisation equities and the last group contains the lowest capitalisation equities. Scholes – Williams's inference as stated above was rejected and invalid with data from Athens Stock Exchange.

4.5 Chapter Summary

This table summarises the key theoretical and empirical findings identified in this chapter.

Literature	**Findings**
Volatility and asset pricing	The literature revealed that volatility risk premium needs to reflect the asset price/return determination process (Shiller (1981; Schwert, 1989 and Haugen et al., 1991).

Volatility in Emerging market	It is found that emerging market experience volatility in returns (Choudhry, 1996; Bekaert and Harvey, 1997; Bacman and Dubois, 2001; Appiah-Kusi and Menyah, 2003).
Thin trading	Thin trading is found to affect the accuracy of calculating asset returns, thus, must be dealt with to avoid spurious results in empirical tests (Fama, 1965; Fisher, 1966; Schwert, 1977; Marsh, 1979; Scholes and Williams, 1977; Dimson, 1979).

Table 3 Summary of Empirical Literature

4.6 Chapter Conclusion

Empirical evidence shows that volatility persists in stock market returns. Therefore, asset pricing tests should take into account effect of volatility in returns. The literature also revealed that there is a predictable component of emerging stock market returns caused by long-memory. Furthermore, thin trading is found to be prevalent and serious in emerging stock markets. It affects the accuracy of calculating asset returns and if not dealt with will lead to spurious results in empirical tests. The methodology for this study is designed to address this problem.

CHAPTER FIVE: OVERVIEW OF EMERGING AFRICAN STOCK MARKETS (ASMs)

5.1 Introduction

The emergence of new financial markets is important for international finance and investments. New markets create both opportunities and challenges and the emergence of African capital markets provide an opportunity for international portfolio diversification and at the same time posing substantial risks. Before 1980, net portfolio investment in emerging African markets was insignificant due to apparent lack of investment instruments available for foreign investors. During the 1980s, investments in these emerging capital markets became important to international portfolio management.

There were only eight stock markets in Africa prior to 1988 and by the end of 2007 Africa had seen twenty two recognised stock exchanges. These markets range from fairly new ones such as Cape Verde (2005) and Libya (2007) to a more established ones like South Africa (1887) and Egypt (1888). Between 1996 and 2007, the total market capitalisation of African stock markets increased from US$320 billion to US$1.125 trillion as a results of these capital markets opening up to international investors. Emerging market funds were channelled into these markets by foreign investors in order to take advantage of its anomalous growth prospects and associated diversification benefits. Subsequently, the market capitalisation of listed companies on Africa capital markets had a mean of 37.43% of GDP in 1996 and by 2007 this proportion had increased to 86.84% of GDP as a result of substantial growth and development of the African markets (all these facts are from IFC emerging market database, official websites for stock markets). These markets are quite significant recently and are experiencing higher growth; however, some are performing better than others hence the need to understand their performance. The rest of this chapter firstly, review the African stock markets and financial system reforms and secondly, explore the characteristics of the five stock markets used for this study.

5.2 African Stock Markets and Financial System Reforms

The development and revival of African stock markets followed a major financial system and economic reforms during the 1990s. These reforms took the nature of financial sector liberation, privatisation of state-own ventures, enhancement of the investment atmosphere, introduction of vigorous legal and regulatory framework and improvements in the essential amenities for capital market operations. (de la Torre and Schmukler, 2005). There was a significant growth in the African stock markets as a result of these reforms. Equity capitalisation, trading volume and value of traded companies increased significantly. For example, the mean market capitalisation increased from US$25.62billion in 1996 to US$101billion in 2007 and turnover ratio increased from 8% in 1996 to17.3 in 2007 for African stock markets.

Table 4 Stock Market Indicators of African Stock Markets in 1996

	Number of listed domestic companies	Market Capitalisation (US$, billions)	Market Capitalisation of listed companies (% of GDP)	Turnover ratio (%)
Botswana	12	0.3	8.0	9.0
Egypt	646	14.2	18.8	22.2
Ghana	21	1.5	19.8	1.1
Kenya	56	1.8	15.4	3.7
Mauritius	40	1.7	20.1	5.4
Morocco	47	8.7	23.8	5.9
Namibia	12	0.5	10.3	12.1
Nigeria	183	3.6	16.7	2.6
South Africa	626	241.6	218.2	10.9
Tunisia	30	4.3	21.9	6.8

Zimbabwe	64	3.6	38.7	8.8
Mean	**158**	**25.62**	**37.43**	**8.0**

Source: IFC Emerging Market Data Base; official websites of stock exchanges.

Table 5 Stock Market Indicators of African Stock Markets in 2007

	Number of listed domestic companies	Market Capitalisation (US$, billions)	Market Capitalisation of listed companies (% of GDP)	Turnover ratio (%)
Botswana	31	5.9	57.01	2.4
Egypt	591	134.9	102.3	46.3
Ghana	32	2.4	18.4	3.4
Kenya	54	13.4	63.2	15.8
Mauritius	94	6.2	87.9	6.0
Morocco	66	18.5	84.1	27.1
Namibia	28	0.7	11.0	4.6
Nigeria	202	86.3	75.3	13.8
South Africa	401	833.5	327.1	50.0
Tunisia	51	5.0	22.5	19.7
Zimbabwe	82	6.1	106.4	1.5
Mean	**148**	**101.0**	**86.8**	**17.3**

Source: IFC Emerging Market Data Base; official websites of stock exchanges.

At the end of 2007, the market capitalisation of the Johannesburg Stock Exchange (JSE) in South Africa had a market capitalisation of US$833.5 billion and is the continent's largest capital market and considered to be anomaly in many respects. Firstly, it represents approximately 75% of total market capitalisation of African stock markets. Secondly, there is some evidence that JSE is integrated with the major international capital markets while the other African capital markets have low correlation with the global capital markets. For example, JSE overall share index declined by 30% in Autumn 1998 financial crisis in line with capital markets in Europe and Asia (Smith *et al*. 2002). Thirdly, JSE is similar in character with major emerging capital markets in Eastern Europe, Asia and Latin America.

Egypt and Nigeria follow as the second and third largest capital markets with market capitalisation of US$134.9 billion and US$86.3 billion, respectively. These three capital markets represent 95% of the entire African market capitalisation and in addition companies trading on these markets dominate the number of listed companies. The other capital markets are relatively small and market capitalisation ranges from US$18.5billion (Morocco) to US$0.7billion (Namibia). There are fairly smaller and newer markets such as Cameroon, Ivory Coast, Libya, Rwanda, Tanzania, Uganda etc. which are not analysed due to data unavailability and inadequacy.

Notwithstanding the obvious differences in the number and size of listed companies, African stock markets share a number of characteristics. For example, there are non-synchronous trading effects in African capital markets which in turn reflect the illiquidity and smaller market size (Yartey and Adjasi, 2007). Smith *et al.* (2002) proposed that the virtual illiquidity of the JSE is a sign of small number of large institutional investors dominating the markets and subsequent cross-shareholdings of these investors. As a consequence of illiquidity, cost of trading is expensive and even makes it harder for investors to undo their positions which in turn may scare further market entrants on both buying and selling sides, which may further the illiquidity cycle (see for example, de la Torre and Schmukler, 2005). Another common characteristic of emerging African stock markets is the industrial composition of the listed equities in which mining and energy, banking and financial services, and telecommunications dominate market capitalisation. For example, mining equities accounted for 69% and 63% of total market capitalisation in Ghana and Botswana respectively; whereas, in Mauritius equities from banking and financial services accounted for almost 72 percent of the total market capitalisation.

Besides, African capital markets provide advantage of portfolio diversification in the sense that these markets are either lowly or negative correlated with major international capital markets of USA and Western Europe. Alagidede (2008) indeed showed on average that the correlation between monthly equity returns of African stock markets and the major international markets is 14%. This demonstrates a weaker relationship. He went on to show that African stock markets are characterised by weaker correlation with one another. Besides, the attractiveness of African stock markets to international investors is the advantage of potential gains from international portfolio diversification. Although table 4 and 5 point out some key indicators of underdeveloped equity markets, African stock markets have been growing at a faster rate hence its attractive to significant number of investors essentially along the lines of its potential benefits of international portfolio diversification. Relatively, African stock markets continue to perform well in terms of return on investment compared to the other emerging markets and the major international capital markets. In 2004, for example, Ghana stock exchange was considered the best performing equity market in the world as it recorded 144% growth in terms of US dollar, compared to the 30% growth by Morgan Stanley Capital International Global index (Databank Group Ghana, 2004). Likewise, the Egyptian market has grown more than five times following the reform of the Egyptian economy since July 2004. Zimbabwe stock exchange was among the best performers in the world even after adjusting for hyperinflation. (Irving, 2005)

5.3 Overview of National Stock Markets

This section examines the characteristics and performance of the five capital markets sampled for this study.

5.3.1 Ghana Stock Exchange (GSE)

As part of government measures to liberalise and deregulate the financial system, GSE was established in 1989 and formally inaugurated in 1990. The market took another step ahead in 2006 when it opened up the domestic capital market to allow foreign investors participation and this has helped to improve the market significantly. The market capitalisation of GSE stood at US$1.5billion with 21 companies in 1996 and this by 2007 has increased to US$2.4billion with 32 listed companies. Yartey and Adjasi (2007) emphasized the significance of the stock market in raising capital for the growth of corporations in Ghana. They showed that between 1995 and 2002, 12% of total growth in listed companies' assets was funded through the stock exchange. Despite its role in raising corporate finance, Ghana Stock exchange has remained small and illiquid given capitalisation of US$2.4billion dollars and 3.4% turnover ratio in 2007. Regardless of the structural difficulties faced by GSE, it delivered an impressive performance in 2008 with a return on investment of 144% in US dollar terms in 2004 compared to MSCI Global Equity Index rendering GSE the best performer in the world in that year.

5.3.2. Nairobi Stock Exchange (NSE) Kenya

The history of Kenyan capital market is dated back to the 1920s, but formally launched in 1954 by the then British colonial government as a regional capital market for Kenya, Tanzania, Uganda and Zanzibar. NSE became the official national stock exchange for Kenya after these countries obtained their respective independence. Market capitalisation at the end of 2007 stood at US$13.4billion compared to its value in 1996 of US$1.8billion, an increase of 644%. The market capitalisation as percentage of GDP increased from 15.4 to 63.2 while, the liquidity as measured by turnover ratio increased from 3.7% to 15.8% in 1996 to 2007 respectively. In disparity, the number of listed companies has just about remained unchanged, 56 in 1996 and 54 in 2007. This could reflect the accelerated pace of mergers and acquisition that has taken place during this period. NSE consists of three tiers: the main market dealing with the whole market, alternative investments market and fixed income market. NSE is planning to launch futures and options market.

5.3.3 Casablanca Stock Exchange (CSE) Morocco

The history of Casablanca stock exchange is dated back in 1929 however, revival did not occur until the 1990s when it listed some 47 equities at the end 1996 and rose to 66 in 2007. It saw a significant market capitalisation growth over this period from US$8.7billion in 1996 to US$18.5billion, representing 113% increase. Likewise, market capitalisation as a proportion of GDP increased from 23.8% to 84.2% and turnover ratio from 5.9% to 27.1% from 1996 to 2007 respectively.

5.3.4 Nigeria Stock Exchange (NSE)

In 1960, the NSE was established and trading activity in most of the time until 1995 has been involved with government bonds. The NSE has seen a significant growth following capital market liberalisation involving development in equities trading and financial market reforms in 1995. Market capitalisation soared from US$3.6billion in 1996 to a record value of US$86.3billion in 2007, representing 2,297% rise. Capitalisation as a proportion of GDP rose from 16.7% to 75.3 in the same period. Although NSE has a large number of listed equities, over 200, its trading activities has been relatively low and illiquid (2.6% turnover in 1996 and 13.8% in 2007).

5.3.5 Johannesburg Securities Exchange (JSE) South Africa

Johannesburg Securities Exchange (JSE) in South Africa was established in 1887 and doubled as the oldest, the largest and the most developed in Africa. JSE underwent a broader reform to enhance its regulatory, institutional and operational efficiency in the spirit of international best practice. This followed a further reform in 1996 which allowed greater participation of foreign investors. JSE represents 85.7% of the total African market capitalisation in 1996 and this fell to 75% in 2007, as a result of other markets being developed in the region. The JSE was ranked the sixteenth largest capital market in the world in 1996 by market capitalisation (US$241.6billion) and by the end of 2007, JSE emerged as the largest emerging capital market in the world with capitalisation of US$833.5billion confirming a momentous flow of foreign capital flight into South Africa and hence the inclusion of JSE in major investable global market index. There was low liquidity of 10.9% in 1996 but this improves significantly in 2007 at 50% turnover ratio. Compared to the major emerging markets in Asia and Latin America which is more than 100% in turnover, liquidity on JSE is low. Furthermore, JSE is only African capital market that actively trades in derivatives such as stock index futures and currency derivatives.

5.4 Summary Statistics

Table 6 Summary statistics for Market Return, R_M

Descriptive statistics *Country*	*Mean*	*Median*	*Max*	*Min*	*S.D*	*Skew*	*Kurt*	*J-B (p-value)*	*Corr(R_M,R_M-R_f)*
GHANA	1.67	0.94	22.35	-28.84	6.65	-0.56	7.93	120.51 (0.00)	0.9943
KENYA	0.56	-0.12	44.41	-26.32	7.45	1.11	9.43	414.55 (0.00)	0.9933
MOROCCO	1.08	0.76	21.39	13.23	5.24	0.35	5.08	18.92 (0.00)	0.9997
NIGERIA	0.81	0.68	30.70	-72.47	14.20	-1.86	10.14	304.98 (0.00)	0.4428

SOUTH AFRICA	1.00	1.54	19.23	-34.72	6.37	-1.00	7.84	197.96 (0.00)	0.4260

Source: Author's own calculations: 1992-2009

Table 7 Summary Statistics for Equity Risk Premium, R_M-R_f

Descriptive statistics / *Country name*	*Mean*	*Median*	*Max*	*Min*	*S.D*	*Skew*	*Kurt*	*J-B (p-value)*	*Corr(R_M-R_f, R_M)*
GHANA	0.065	-0.230	21.014	-30.670	6.692	-0.553	7.999	123.421 (0.000)	0.9943
KENYA	-0.641	-1.371	43.031	-26.878	7.560	0.971	8.872	342.714 (0.000)	0.9933
MOROCCO	0.786	0.476	21.070	-13.557	5.225	0.355	5.082	18.959 (0.000)	0.9997
NIGERIA	0.132	0.046	35.539	-35.517	8.016	-0.389	9.060	175.771 (0.000)	0.4428
SOUTH AFRICA	0.021	0.070	0.462	-1.232	0.291	-0.824	3.984	26.546 (0.000)	0.4260

Source: Author's own calculations: 1992-2009

Table 8 Summary statistics for SIZE and BE/ME for South Africa and Morocco

	Mean	Median	Max	Min	Std Dev.	Skew	Kurt	J-B (*p-val*)
SA_{SMALL}	1.561	2.839	9.654	-21.289	5.241	-1.437	6.317	72.246 (0.000)
SA_{BIG}	0.921	1.047	15.578	-27.091	6.532	-0.941	6.077	48.796 (0.000)
SA_{SMB}	0.640	0.944	9.992	-12.674	4.508	-0.496	3.17	3.800 (0.150)
SA_{HIGH}	0.828	1.436	16.027	-23.808	6.777	-0.444	3.798	8.549 (0.014)
SA_{LOW}	0.583	0.836	26.505	-37.878	7.420	-0.819	7.488	136.934 (0.000)
SA_{HML}	0.245	-0.014	14.070	-15.021	4.700	0.020	4.386	11.528 (0.003)
MOR_{HIGH}	0.508	0.405	23.462	-12.301	4.892	0.589	5.828	52.813 (0.000)
MOR_{LOW}	0.364	-0.018	20.555	-18.421	5.601	0.105	4.812	18.714 (0.000)
MOR_{HML}	0.144	0.119	10.945	-9.076	3.281	0.099	3.926	5.048 (0.080)

Source: Author's own calculations: 1992-2009

5.5 Performance of National Stock Markets

Statistical evidence for the various stock markets point out that raw return carries higher mean returns than excess returns. The highest raw mean returns are recorded in Ghana at 1.668% followed by Morocco and South Africa at 1.083% and 1.001% respectively while the lowest mean returns are found in Nigeria and Kenya at 0.814% and 0.557% respectively. On the contrary, excess mean returns mostly, reveal a different ranking, with the exception of Morocco which at 0.786% records the highest mean followed by Nigeria at 0.132%. Kenya which at -0.641% records the lowest excess mean returns followed by South Africa at 0.021% and Ghana at 0.065%. The lowest mean returns recorded by Kenya for both raw and excess returns data are reinforced by the lowest and negative recorded median returns of -0.116% and -1.371% respectively.

South Africa recorded the highest raw median returns at 1.542% followed by Ghana at 0.942%, Morocco at 0.756% and Nigeria 0.682%. However, excess median returns reveal different ranking with Morocco ranking the highest at 0.476%, second highest ranking is South Africa with 0.070% followed by Nigeria at 0.046% and Ghana generated negative median returns of -0.230%.

Variability as measured by standard deviation varies considerably among Emerging African Stock Markets. For example, Nigeria returns are the most volatile at 14.195% for raw returns and 8.016% for excess returns. In comparison, returns in Morocco and South Africa are the least volatile at 5.236% for raw returns and 0.291% for excess returns respectively. The data show mixed results in terms of risk-return hypothesis (that is, high risks imply high returns). For instance, Nigeria produces the highest level of variability of 14.195% but providing the second lowest raw mean returns while Ghana and Morocco record the highest raw mean returns but relatively lower variability. Similarly, Kenya records the lowest excess mean returns but relatively higher variability in returns whiles Morocco ranks the highest excess mean returns but the second lowest level of variability.

Small capitalisation portfolio records higher mean returns at 1.561% with corresponding higher median returns of 2.839% as compared to the big cap portfolio with a lower mean return of 0.921% and median return of 1.047%. This is consistent with previous literature that small cap stocks generate higher mean returns than big cap equities (Fama and French, 1992 and 1993; Banz, 1981).

Volatility as measured by the standard deviation is low for small cap portfolio and high for big cap portfolio. This contradicts the risk-return hypothesis that high returns correspond to high risks and also evidence against the existing literature that small cap portfolios generate higher residual risks (Banz, 1981). In both countries, that is, South Africa and Morocco, high book to market portfolios generate high mean returns than low book to market portfolios.

All stock markets and portfolios exhibit a very significant Jarque-Bera statistic, skewness and kurtosis, evidence that the index and its traded equities returns violate the normality assumption. Correlation between raw returns and excess returns is significantly high for Ghana, Kenya and Morocco, ranging from 99.33% to 99.97% but quite low for Nigeria (44.28%) and South Africa (42.60%). Bartholdy and Peare (2005) found high correlation (99.9%) between raw returns and excess returns and suggest that either raw returns or excess returns can be used in beta estimation. This study uses excess returns in estimating the coefficient parameters due to high differences documented in some countries.

5.6 Chapter Summary and Conclusion

In summary, capital markets in Africa has seen significant growth since the 1990s, underpinned by financial system liberalisation, sturdy investment flows, improvement in infrastructure in the various capital markets. In spite of this significant effort made by the African markets, evidence shows that liquidity, capitalisation and listed equities are comparatively low.

Within these indicators, there is a great deal of diversity across the continents. For example, in 2007 Egypt has recorded 591 listed companies' whiles Namibia has only 28 listed equities. In the same year, JSE accounted for 75% of the total African market capitalisation whiles Namibia accounted for only 0.063%. Notwithstanding these differences, there are common features shared by the markets, such as low liquidity as measured by turnover ratio – 1.5% in ZSE to 50% in JSE in 2007.

Compared to the major emerging capital markets in Asia and Latin Africa, liquidity is in surplus of 100%. Regardless of the low liquidity and small capitalisation of African capital markets they are amongst the fast growing markets in the world in terms of return on investment. In most respects, African stock markets are not integrated with the global capital market which presents African markets with the benefit of international portfolio diversification. This has encouraged a lot of international investors to seek diversification by exploring and investing in Africa. Mean returns are relatively high in emerging African markets with correspondingly high volatility. This is consistent with existing literature that emerging capital markets exhibit high volatility and earn high returns. Small capitalisation and high book to market portfolios were found to offer higher mean returns than big capitalisation.

CHAPTER SIX: DATA AND METHODOLOGY

6.1 Introduction

This research is designed to investigate whether or not the CAPM and the 3-Factor Model apply in emerging African Stock Markets. The approach used in a research is largely determined by the hypothesis and the information needs of the researcher. Using data relating to stock returns, market return, risk free rate, book-to-market ratio and market capitalisation, a quantitative approach is adopted to test risk – return relationship. The test approach follows an established method of testing both the classic CAPM and Fama-French three factor model to enable comparability as appropriate.

Currently, there is no robust and comprehensive empirical evidence provided by researchers in emerging African markets (EAM) in respect to capital asset prices in such a manner intended in this study. The remainder of the chapter is structured as follows; description of data sources and sample frame, process of return estimates are explained, issues relating to methodological process are addressed, and finally empirical framework for regression estimates are developed.

6.2 Data

6.2.1 Data Sources

All the data used in this research are obtained from Thomson Reuters DataStream. Reuters DataStream is attractive because its price data are adjusted for all capital as well as effects of merger, acquisition and spin offs/demerger. Once any of these actions is closed and finalised, the estimates must fully reflect the effects of the action. Also historical and current data estimates in Reuters DataStream are adjusted for stock splits, right issues and stock dividends. Historical and current adjustments are made for price, shares and earnings. Extraordinary items are excluded from reported figures. Thomson Reuters is recognised for providing accurate and timely data for investment and finance professionals. Non-updated estimates are auto-filtered and consequently auto-stopped. Thomson Reuters have traditionally made error corrections to historical data provided it can be substantiated through published research documentation. This is to ensure highest quality of data.

The Thomson Reuters DataStream market index is value-weighted. The CAPM theory is specific in its recommendation of value - weighted index consisting of all traded assets in the market. The normal practice is that index consisting of exchange traded equities has been used as proxy. These indices are all denominated in local currency and refer to end of month quote. For data collection standpoint, it is convenient. Moreover, the use of single provider for these indices to distinguish cross-market is preferred because it provides standardised framework under which the analysis is conducted. The indices used in this study are the benchmark indices in their respective markets.

The annualised one-month government T-bill rate in the respective countries is taken as a proxy for risk-free interest rate. The T-bill rate is widely considered to be free from default and governments receive tax revenue to settle loans. Sovereign countries are also considered to be immune from bankruptcy and liquidation unlike corporations.

6.2.2 Sample

Monthly observation on stock returns for the following countries: Ghana, Kenya, Nigeria, Morocco and South Africa are used. Although share prices for some countries were available earlier, market indices were not available until the 1990s. For example share prices in South Africa were available as early as the early 1970s but stock indices were not available until

1995. Similarly, records of share price data in Morocco began in 1993 but stock indices became available in 2002. Therefore, the sample period for South Africa is 1995-2009, Morocco is 2002-2009, Kenya is 1992-2009, and Ghana and Nigeria are from 2000-2009. Data on book equities and Market Capitalisation (MCAP) are absent from Thomson Reuters DataStream emerging market database except for South Africa and Morocco. Therefore multifactor asset test is limited to both countries.

The choice of countries cuts across Africa from the West (Ghana, Nigeria) to East (Kenya) and North (Morocco) to South (South Africa) with different levels of capital market developments. This is a fairly representative sample for ASMs. By IFC's definition South Africa and Nigeria are considered to be developing, while Ghana, Kenya and Morocco are frontier markets. The sample is carefully selected to reflect sufficient representation of all industries in the respective capital markets, mainly manufacturing, banking/financial services, real estate, Energy and mining, agriculture and trading. This enhances comparability and reasonable generalisation.

6.2.3 Sample Selection Criteria

Aside the five countries mentioned above, Thomson Reuters DataStream has data on two other markets, which includes Tunisia and Namibia. However, data are not recorded for most companies in these two countries and those with available data are mostly less than three years and this makes it unattractive for studies in asset pricing. Companies included in this study must have at least three years of data in order to provide enough observations for this study. Furthermore, in order to limit the problem pose by infrequent trading, companies must have been traded at least once a month. Some stocks do not trade in these markets for as long as six months and such companies are excluded from this study. Thirdly, firm's stock must be denominated in local currency.

Table 9 Sample Selection

Country	Number of firms denominated in local currency.	Sample Size: Number of companies satisfying the 3 criteria
Ghana	23	19
Kenya	44	19
Morocco	44	29
Nigeria	45	20
South Africa	250	56

The data in column two above represents the number of companies in each market which are denominated in local currency and at the same time satisfying the other two selection criteria. Some firms in the database have no available recorded data.

Table 10 Stock Market Data and Index Profile

COUNTRY	INDEX NAME	INDEX COMPILATION METHOD	CURRENCY	SAMPLE PERIOD
Ghana	All Share Index	Value-weighted	Ghana Cedi	2000 – 2009
Kenya	NSE Index	Price-weighted geometric mean	Shillings	1992 – 2009
Morocco	All Share Index	Value-weighted	Dirham	2002 – 2009
Nigeria	All Share Index	Value- weighted	Naira	2000 – 2009

South Africa	FTSE/JSE All Share Index	Value-weighted	Rand	1995 - 2009

6.2.4 Computation of Returns

Throughout this study, the monthly return of asset, $R_{t,}$ is defined as $R_t = \ln\left({P_t + d_t}\big/{P_{t-1}} \right) \times 100$, and computed for intervals $\{t_{-1,} t\}, t = 1,....,t$ and that log normality are jointly normally distributed with constant means μ_n, standard deviations σ_n, and constant covariance's $\sigma_{mn}, m \neq n, m, n = 1,....., N$, where P_t is the asset price at time t, d_t is the dividend paid at time t and P_{t-1} is the asset price at time t_{-1}. The logarithmic form of returns is taken in order to reduce the problem of thin trading (*see*, Scholes and Williams, 1977) as well as improving normality. Using Schwert (1977) and Marsh (1979) approach to correct for thin trading will be difficult, since one need to calculate asset/market returns on trade-to-trade basis. It is difficult to identify trade-to-trade values for both assets and the market and this is even more problematic with emerging market data. Hence, Scholes and Williams approach is preferable.

Share prices used to calculate returns are available for every month but information about dividend is restricted to dividend yield, defined as the ratio of previous year's dividend to the end-of-month share price. To calculate total monthly returns, the annual dividend is spread across all months of the year thus compounding the monthly returns reproduces the annual return. Monthly annualised dividend yield is calculated as

$$d_t = (1 + r)^{1/12} - 1 \qquad (6.1)$$

6.2.5 Categorizing size and book to market portfolios

This study adapted Fama and French (1993; 1996) approach to construct size and book-to-market equity (*SIZE-BE/ME*) portfolios. Due to data differences, a direct replication of Fama and French approach is impossible.

In the last week of each month from January to December of year *t*, the listed equities are classified according to size and book-to-market indices. In respect to size, JSE indices are classified into CAP40 (top 40 largest companies), Mid CAP (medium sized companies and Small CAP (smaller sized companies). The Mid CAP serves as a breakpoint between the largest and the smallest companies. There is no such categorisation for Ghana, Kenya, Morocco and Nigeria and thus size portfolios are not possible for these countries. In the same month from January to December of each year *t*, the equity indices on JSE and Morocco are categorized into four book-to-market equity *(BE/ME)* groups (value, low growth, medium growth and growth). Low and medium growths serve as a breakpoint between value and growth equities. Again there is no such information on Ghana, Kenya and Nigeria and thus BE/ME portfolios are limited to South Africa and Morocco. Value-weighted monthly returns on each portfolio are calculated for each month *t,* from January to December of each year *t*. *SMB* is the difference between the average returns of the small CAP portfolio and CAP40 portfolio:

$$SMB = R_t SmallCAP - R_t CAP40 \tag{6.2}$$

HML is the difference between the returns on the value portfolio (that is, HB/ME) and growth portfolio (LB/ME).

$$HML = RtV - RtG = HB / ME - LB / ME \tag{6.3}$$

Table 11 Portfolio formation on Size and BE/ME

R_t Small CAP	*R_tCAP40*
R_tV (HB/ME)	*R_tG(LB/ME)*

R_t means returns', V and G represent value and growth respectively, HB/ME is high book to market equity, and LB/ME is low book to market equity

Fama and French (1993; 2005) and Bundoo (2008) calculated median *SIZE* of the sample as a breakpoint to establish the difference between small and big capitalization equities *(ME)*. Firms with market capitalization *(ME* – share price multiply outstanding number of shares) less than the median are classified as small market equity *(S)* and those with values greater than the median size are classified as big market equity *(B)*. Similarly equities are sorted into three independent book-to-market equity ratios (*BE/ME* – the ratio of book value of equity and market value of equity) portfolios as: *L* (low book-to-market equity *BE/ME* comprises the bottom 30% of firms in the sample), *M* (medium book-to-market equity *BE/ME* ratio comprises the middle 40% of firms in the sample) and the final one being of *H* (high *BE/ME* ratio comprises the top 30% of firms in the sample).

The categorization of equity into groups may seem arbitrary. However, Fama and French (1996) and Bundoo (2008) argue that the choice of categorising portfolio should not affect the results and went on to assert that the test results should not be sensitive to the way one chooses to form their portfolios. Thus, the results of this study should not be affected by the choice of size and BE/ME portfolios construction.

6.3 Model Specifications and Hypotheses Tested

This section examines the empirical characteristics of CAPM and the three factor model.

6.3.1 CAPM Specification and Testable Implications

This study follows Jensen (1968) version of the CAPM and adopts Jensen, Black and Scholes (1972) time series regression approach. Firstly, the risk – return relationship of CAPM is defined as;

$$R_i = R_f + \beta_i \left(R_M - R_f \right) \qquad (6.4)$$

This implies that return on asset *i* is equal to the return on riskless security in the portfolio, plus a risk premium which is the *(β)* times the difference between R_M and R_f.

The first parameter, beta *(βi)* is a proxy for systematic risk of asset *i* in the market *(M)* portfolio.

The second parameter, (R_f), is the intercept in equation (6.4), which represents the return on a riskless security whose return has no correlation with the return on the market (R_M) which means the beta *(β)* of this security is zero which implies that this asset contributes nothing to the market risk $\sigma\ (R_M)$.

The test implication of equation (6.4) is in three folds:

F_1: In any efficient portfolio, *M*, the relationship between asset return and its risk is linear.

F_2: Beta *(β)* is a sole measure of the risk of asset *i* in efficient market and no other measure of risk is possible.

F_3: Risk-averse investors will demand higher return for higher risk investments, that is, $R_M - R_f > 0$

The return conditions of $F_1 - F_3$ will be tested by using month-by-month observed average returns (see Fama and MacBeth, 1972). Jensen (1968) version of CAPM identify that an asset's excess return $R_{it} - R_{ft}$ can be explained by the market risk premium, $\beta\ (R_{Mt}$-$R_{ft})$ and a constant.

$$R_{it} - R_{ft} = \alpha_{it} + \beta_{it}\left(RM_t - R_{ft}\right) + \varepsilon_{it} \qquad (6.5)$$

'Jensen's alpha' is zero for every asset. Thus the alpha (intercept) in the regression model predicts factors uncorrelated to the market risk premium and the slope $R_{Mt} - R_{ft}$ represents coefficient of beta and should be greater than zero. In equation 6.5 the intercept defines the difference between the asset return and the return predicted by the CAPM and this should be zero. The error term ε_{it} represents the residual on return with a mean value of zero and assumed to be independent of all other variables in equation 6.5. The beta of the risk free asset uncorrelated to the market should be zero, $\beta(R_{ft}) = 0 \quad \alpha_i = R_{ft}$

6.3.2 Three Factor Model and Testable Implications

Fama and French (1992; 1993) argued that the CAPM's beta is not strong enough to capture all the systematic risks in asset returns. They further identify that small capitalisation equities *(ME)* and high book-to-market equity produce covariances (systematic risks) in asset returns that the market return is unable to capture and therefore, are priced differently from the market beta. Following the time series regression methodology of Fama and French (1993), the joint roles of beta, size, and book-to-market equity effects on asset returns will empirically be examined as;

$$R_{it} - R_{ft} = \alpha_{it} + \beta_{it}\left(R_{Mt} - R_{ft}\right) + \beta_s\left(SMB\right)_t + \beta_h\left(HML\right)_t \quad (6.6)$$

In this equation, *SMB* (small minus big) is the difference between the returns of small and big capitalisation equities, a proxy for the size effect, *HML* (high minus low) is the difference between the returns of high and low book-to-market equity and the betas are the slopes or coefficients (that is, factor sensitivities or loadings) in the multiple regression of $R_{it} - R_{ft}$ on $R_{MKT\,t} - R_{ft}$, SMB_t, HML_t .

Testable Implication

The test implication of the 3-factor regression model is as follows:

T_1: Well diversified risk-averse investors will require compensation for not only systematic risks but also firm specific risks that are uncorrelated to the market returns.

T_2: If the risk premia are captured by the factors specified in the model, the magnitude of the excess return (compensation) that should be given to investors can be measured by the factor sensitivities or loadings (that is, coefficients) of the regression. Thus, if 3-factor asset pricing model *(3-FAPM)* is accurately specified then the regression sensitivity factors $\beta_{iM}, \beta_{size}, \beta_{B/M}$ must significantly differ from zero. Merton (1973) states that if an asset pricing model is accurately specified then it should produce an intercept which is zero or very close to zero. So if the CAPM or 3-factor or any other factor model is able to capture all the risks in average returns, then the intercepts in the equations 6.5 and 6.6 should be equal to zero or not significantly different from zero.

The choice of time-series regression approach has two important benefits; firstly, time-series regression gives direct evidence of the central theme of linear models that if assets are rationally priced, then the variables that relate to average returns such as beta, firm size and book-to-market equity must proxy for sensitivity for shared or common risk factors in returns. Particularly the $R^2/\ \bar{R}^2$ and the slope values should confirm whether risk variables related to size and book-to-market equity capture shared or common variation in equity returns. Secondly, time-series regression uses excess return on equity as dependent variables and excess returns on the market portfolio, SMB and HML as explanatory variables and therefore provides a direct test between the dependent and independent variables.

6.4 Methodological Issues – Corrections for the Violations of the Assumptions of CLR

1. Although there are various methods of obtaining the Sample Regression Function (SRF) as an estimate of the true Population Regression Function (PRF), the OLS is used in this study. OLS method is used because it minimises the residual sum of squares (RSS) otherwise error term by squaring up the difference between actual and the predicted returns. Estimators of OLS have minimum variance amongst a class of linear estimators, that is, they are considered best linear unbiased estimators (BLUE).

2. The empirical asset pricing models in this study takes the form of a classical linear regression (CLR). The CLR is subject to theoretical assumptions that are practically unrealistic. The nature and consequences of these assumptions are outlined below and how violations of these assumptions are dealt with to avoid erroneous conclusions in this study.

6.4.1 Autocorrelation

The CLR in empirical context assumes that there is no ***serial correlation or autocorrelation*** among the error terms or a disturbance entering the PRF. Autocorrelation is defined as correlation between members of observations ordered in time as in time series data or space as in cross-sectional data (Kendall and Buckland, 1971).

Mathematically, no autocorrelation means

$$\operatorname{cov}(u_i u_j) = 0 \ldots\ldots i \neq j \quad . \tag{6.7}$$

This means that the product of the two different errors u_i and u_j has an expected value of zero. This study uses Breuch-Godfrey (BG) LM tests to detect the presence of autocorrelation.

Newey and West (1987) heteroscedasticity and autocorrelation-consistent *(HAC)* standard errors or simply Newey-West *(N-W)* standard errors is used to correct the standard errors. The attractiveness of the Newey-West error correction model is not just its ability to correct the OLS standard errors in situations of autocorrelation but also in cases of heteroscedasticity. Unlike White's method which corrects only heteroscedasticity error, *N-W* model addresses both the problem of heteroscedasticity and autocorrelation.

6.4.2 Heteroscedasticity Problem

In classical linear regression model the conditional variance of the error or disturbance term or residual is assumed to remain constant, that is, ***homoscedasticity*** (constant variance):

$$\operatorname{var}(\varepsilon_t) = \sigma^2 \tag{6.8}$$

The reverse of this is *heteroscedasticity* – when variance of error is not constant. White test is used to detect the presence heteroscedasticity. The Newey-West standard error is used to resolve the heteroscedasticity problem.

6.4.3 Normality Assumption

The residuals or error terms are assumed to be **normally distributed**: $\varepsilon_t \approx N(0, \sigma^2)$.

Regression analysis depends on the assumption that dataset follow Gaussian (or normal) distribution (that is, symmetrical around its mean). In this study, skewness, kurtosis, and Jarque-Bera tests are used to detect normality. This problem is minimised by using lognormal returns in return estimates.

6.4.4 Stationarity

This study uses time series stock market data and empirical study based on time series assumes that the fundamental time series is stationary. If a time series is stationary, its mean, variance and auto covariance at various lags remain the same no matter at what point we measure them; that is, they are time invariant (Gujarati and Porter, 2010). In this study, the Augmented Dickey-Fuller (ADF) test is used to detect the presence of non-stationarity. To avoid spurious regression that may arise from using a nonstationary time series data, nonstationary time series data is transformed by taking the first differences of the time series data to make them stationary.

Test on unit roots are performed on univariate, (that is, single) time series. On the other hand, co-integration deals with the relationship among a group of variables (that is, multivariate time series), where unconditionally each variable has a unit root. To detect co integration in the time series data, Augmented Engle-Granger Dickey-Fuller (AEGDF) tests are performed. To avoid spurious regression, the presence of co integration is resolved by expressing the co-integrated variables as ECM (Error Correction model) in order to correct for short-run dynamics (that is, disequilibrium) between the variables. A good time series modelling should describe both short-run dynamics and the long-run equilibrium simultaneously; hence an error correction model is specified in the Fama-French model to correct for any disequilibrium. ECM is defined as;

$$\Delta y_t = \phi U_{t-1} + \gamma \Delta x_t + \varepsilon_t \tag{6.9}$$

U_{t-1} denotes ECM in the regression model.

6.5 Estimating Time-Varying Beta

Asset price returns exhibit volatility clustering (that is, large fluctuations tend to follow by large changes and small fluctuations by small changes), habitually exhibit leptokurtosis (that is, the distribution of their returns is fat tailed) and show leverage effect (that is, the tendency for volatility to rise more following a large price fall than following a price rise of the same magnitude or in other words changes in stock prices tend to be negatively correlated with changes in volatility). In order to capture the first two characteristics, Engle (1982) proposed to model time-varying conditional variance with the ARCH process that use past error (or disturbances) to model the variance of the series. Previous empirical work demonstrates that a higher ARCH order is required to catch the dynamic of the conditional variance and Bollerslev (1986) GARCH is an answer to this problem.

The classical linear asset pricing models assumes that variance of the errors is constant (that is, homoscedasticity) and it is defined as:

$$Var(\varepsilon_t) = \sigma^2 \tag{6.10}$$

If variance on error is not constant it is called heteroscedasticity. The variance of errors in financial time series is unlikely to be constant over time and thus makes sense to consider an econometric model which describes the structure of how the variance of the errors evolves. Another drive for this class of models is the tendency for the current level of volatility to be correlated with its immediate preceding period. Wide-ranging academic literature has established the existence of non-constant and time-varying volatility in financial assets returns (see, for example, Shiller, 1981; French *et al*., 1987; Kilic, 2004).

The GARCH models clearly take notice of the variation between the Conditional variance (allow to vary over time) and unconditional variance (remains constant). Besides, this study investigates into the volatility properties of equity returns in emerging African capital markets with the position to typify the characteristics of the conditional variance. This is very vital in favour of the fact that the attractiveness and prospective gains from diversification of international portfolio have motivated investors to these markets nevertheless little is known of the African markets volatility or unpredictability profile.

This study will provide market participants with a better awareness of how eventualities (shocks) influence volatility across time and how major economic and/or political changes may play a part in the process. The first (mean) and second (variance) moment's equations are used to define GARCH model. The return process (r_t) is captured by the mean equation which is made up of the conditional mean, μ, which might encompass terms of autoregressive(AR) and moving average(MA) and error term ε_t, that follows a conditional normal distribution with mean of zero and variance, σ^2 (also denoted as, h_t). Additionally, the available information set to investors up to time t_{-1} is represented by I_{t-1}, thus,

$$r_t = \mu + \varepsilon_t \tag{6.11}$$

where $\varepsilon_t | I_{t-1} \approx N(0, h_t)$

The pattern of the conditional volatility is steady with an estimate of the variance at time *t* (h_t) which in turn based on the constant unconditional mean, *ω*, volatility forecast from the previous (h_t) and last period volatility information $(\varepsilon^2{}_{t-1})$:

$$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1} \tag{6.12}$$

The conditional variance is kept strictly positive by imposing the inequality restrictions *ω=0* and $\alpha, \beta \geq 0$. The condition of GARCH (1, 1) has valuable quality that fluctuation in decay in volatility at a constant rate and the pace of decay is measured by the forecast of $\alpha + \beta$. Volatility persistence is also measured by $\alpha + \beta$, that is, the degree at which fluctuation to current volatility remain vital for long-term into the future. The persistence of fluctuations to volatility becomes greater as this sum move towards unity. Nevertheless, when $\alpha + \beta = 1$ then every fluctuation to volatility is permanent. In such situation, the Integrated GARCH (IGARCH, Engle and Bollerslev, 1986) is used to indicate the process. This process means that persistence in volatility is permanent, and therefore, earlier period volatility is important in forecasting future volatility for all finite horizons. Volatility is considered to be explosive when the sum of α and β is greater than 1. This implies that fluctuation to volatility in one period will lead to even a greater volatility in the next period (see, for example, Chou, 1988).

NOTE: *The Coefficients of GARCH (1, 1) specification measures the degree to which shocks to current volatility is important for long periods in predicting future volatility. The sum of α and β measures the volatility persistence. The closer the sum of α and β is to 1 and beyond the more integrated the current and future volatility,*

Table 12: GARCH summary statistics for aggregate stock market returns

	CONSTANT(MEAN)	CONSTANT(VARIANCE)	ARCH(α,1)	GARCH(β,1)
GHANA (*z-statistics)* *[p-value*]	0.6314 (3.7950) [0.0001]	1.2305 (2.0180) [0.0436]	1.9933 (4.1607) [0.000]	0.1113 (2.7865) [0.0053]
KENYA (*z-statistics)* *[p-value*]	0.1245 (0.3638) [0.7160]	4.1717 (1.1525) [0.2491]	0.2634 (1.5681) [0.1169]	0.6865 (3.8767) [0.0001]
MOROCCO (*z-statistics)* *[p-value*]	1.2164 (2.6667) [0.0077]	18.1738 (1.0192) [0.3081]	-0.0723 (-3.5460) [0.0004]	0.4052 (0.5881) [0.5565]
NIGERIA (*z-statistics)* *[p-value*]	1.1115 (0.8589) [0.3904]	27.2780 (2.0941) [0.0362]	0.5392 (1.7754) [0.0758]	0.5068 (3.3061) [0.0009]
SOUTH AFRICA (*z-statistics)* *[p-value*]	1.5030 (4.6368) [0.000]	4.1301 (1.6029) [0.1090)	0.3277 (2.6258) [0.0086]	0.6224 (0.0916) [0.0000]

Source: Author's own calculations.

Table 12 highlights the importance of GARCH effects by presenting the AR (that is, GARCH) and MA (that is, ARCH) terms. GARCH term is statistically significant at 5 percent level or above for all markets except Morocco. However, ARCH effect is significant at 10 percent level or better for all markets except Kenya. Besides evidence of persistence in volatility as measured by the GARCH model is reflected in the magnitude and significance of the ARCH and GARCH terms combined (that is, as this sum approaches 1 (or unity) the greater the degree of volatility persistence). Evidence is in favour of volatility persistence in emerging ASMs.

6.6 Regression Estimation Method

This study adopts Jensen (1968) version of Sharpe-Lintner CAPM and follows time-series methodology (Jensen *et al*., 1972; Fama and French, 1993). Parameters are estimated using OLS. Most empirical research in capital asset pricing theory has been conducted using cross sectional studies. This means that the beta risk is measured at one particular point in time. This study is designed to measure beta risk across time by following time series methodology.

Monthly risk premium is regressed on the excess equity returns (for CAPM test mimicking Jensen *et al.,* 1972 methodology) and regressing market risk premium, proxy portfolios for size and BE/ME on excess equity returns (for the three factor test mimicking Fama and French, 1993 methodology). The coefficient(s) of the regression slopes represent the risk sensitivities for assets.

6.6.1 The CAPM Empirical Framework

The CAPM parameters are estimated using OLS regression as follows:

$$R_{it} - R_{ft} = \hat{\alpha}_{it} + \hat{\beta}_{i,t}\left(R_{Mt} - R_{ft}\right) + \varepsilon_{it} \qquad (6.13)$$

Let

$$R_{it} - R_{ft} = r_{it} \qquad (6.14)$$

And

$$R_{Mt} - R_{ft} = r_{Mt} \qquad (6.15)$$

ADF test shows that the series r_{it} and r_{Mt} are first order integrated, that is, *I (1)* process. First difference of returns is taken of each series to make it stationary, that is, *I (0)* process as follow:

$$\begin{aligned} r_{it} &= r_{it-1} + \varepsilon_t \\ \varepsilon_t &\sim iid\left(0, \sigma_\varepsilon^2\right) \end{aligned} \tag{6.16}$$

$$\begin{aligned} r_{Mt} &= r_{Mt-1} + e_t \\ e_t &\sim iid\left(0, \sigma_e^2\right) \end{aligned} \tag{6.17}$$

ε_t and e_t are independent of each other.

Thus equation 6.13 is rewritten as:

$$r_{it} = \hat{\alpha}_i + \hat{\beta}_i r_{Mt} + \varepsilon_{it} \tag{6.18}$$

The parameters of equation (6.18) are estimated using monthly excess return of equities and the market risk premium.

Equation (6.18) posits that $\alpha_i = 0$ and $\beta_i > 0$. EViews package is used to facilitate the estimation procedure.

6.6.2 The Fama-French Three Factor Empirical Framework

Similarly, the parameters of the three factor model are estimated using OLS regression as follows:

$$R_{it} - R_{ft} = \hat{\alpha}_{it} + \hat{\beta}_M \left(R_{Mt} - R_{ft}\right) + \hat{\beta}_{St}\left(SMB\right)_t + \hat{\beta}_{\mathrm{H}t}\left(HML\right)_t + \varepsilon_{it} \tag{6.19}$$

$$r_{it} = \hat{\alpha}_i + \hat{\beta}_M r_{Mt} + \hat{\beta}_{St}\left(SMB\right)_t + \hat{\beta}_{\mathrm{H}t}\left(HML\right)_t + \varepsilon_{it} \tag{6.20}$$

ADF test shows that the series in equation 6.20 are first order integrated, *I (1),* thus, first difference of returns are taken of each series to make it stationary, *I(0).* The parameters of equation 6.20 are estimated using monthly excess returns of equities and risk premium relating to the market, size and BE/ME. ADF test shows that the variables in equation 6.20 are co integrated, that is, their linear combination is stationary, *I (0).* Given that Fama and French three factor model is not an equilibrium model, disequilibrium caused by cointegrated errors must be detected and corrected. The AEGDF co integration test is carried out as follows:

1. The OLS regression of equation (6.20) is ran and obtain the residuals (U_t *denotes Residual in the regression equation*).

A unit root test is applied to *Residual* by constructing an *AR (1)* regression for U_t as follows:

$$U_t = \phi U_{t-1} + e_t \tag{6.21}$$

That is, perform the ADF *t-test* of H_0*: ø = 1* against H_1*: ø # 1.*

2. To avoid spurious estimates, the regression of stationary variables in equation (6.20) was extended to the co integrating regression. This is achieved by expressing the lagged residual (U_{t-1}) as Error Correction Model (ECM) in equation (6.22) as:

$$r_{it} = \hat{\alpha}_i + \hat{\beta}_M r_{Mt} + \hat{\beta}_S\left(SMB\right)_t + \hat{\beta}_{\mathrm{H}}\left(HML\right)_t + \hat{\phi}U_{t-1} + \varepsilon_{it} \tag{6.22}$$

Ø captures disequilibrium correction each month.

ECM models both long-run equilibrium and short-run dynamics simultaneously. Residual (U_{t-1}) is expressed as ECM to correct for standard error.

Equations 6.18 and 6.20 have adjusted for these violations of OLS model.

6.6.3 GARCH Framework and Augmented Models for ASMs

The time series regression assumes that the variance of error is homoscedastic, that is, remain constant over time. However, white test shows that the variance of error is heteroscedastic, that is, remain inconstant through time. Although Newey-West (1987) HAC standard errors is used to correct these errors in the data, volatility was persistent. This phenomenon is as a consequence of volatility clustering (or loosely put, 'autocorrelation of volatility'). If the error created by volatility persistence is not accounted for, will cause beta estimates to be biased. Thus, to account for time-varying conditional variance, GARCH is used to model volatility in a second moment equation in order to make the beta estimates BLUE (best linear unbiased estimates). The CAPM and three factor model are thus, adjusted as follows:

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_i r_{Mt} + \varepsilon_{it} + \hat{\gamma} h_t + \xi_t \quad (6.23)$$

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_M r_{Mt} + \hat{\beta}_S (SMB)_t + \hat{\beta}_{\mathrm{H}} (HML)_t + \hat{\phi} U_{t-1} + \varepsilon_{it} + \hat{\gamma} h_t + \xi_t \quad (6.24)$$

$$h_t = \hat{\omega} + \hat{\alpha}\varepsilon_{t-1}^2 + \hat{\beta} h_{t-1} \quad (6.25)$$

γ models time-varying conditional variance.

After applying the GARCH model to account for the non-linear characteristics of the regression, volatility still appear prominent in predicting returns. French *et al.* (1987) found similar result and assert that volatility is actually a priced risk factor and not just a data characteristic issue. Therefore, the underlying theory of both equations 6.23 and 6.24 is that investors should be rewarded for taking additional risk by gaining a higher return. To operationalize this, Engle, Lilien and Robins (1987) GARCH-in-Mean (or GARCH-M) model, where conditional variance of error tem enters into the conditional mean equation, is applied to both equations 6.23 and 6.24 as follows:

$$r_{it} = \hat{\alpha}_i + \hat{\beta}_i r_{Mt} + \hat{\delta}\sigma_t^2 + \varepsilon_{it} \tag{6.26}$$

$$r_{it} = \hat{\alpha}_i + \hat{\beta}_M r_{Mt} + \hat{\beta}_S (SMB)_t + \hat{\beta}_{Ht} (HML)_t + \hat{\delta}\sigma_t^2 + \hat{\phi} U_{t-1} + \varepsilon_{it} \tag{6.27}$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \tag{6.28}$$

If δ is positive and statistically significant, then increased risk resulted from an increase in the conditional variance, leads to a rise in the mean return; thus δ can be interpreted as a risk premium. Equations 6.26 and 6.27 are therefore fit into the regression to model the conditional variance in errors and estimate volatility risk premium peculiar to emerging ASMs respectively. The augmented GARCH-M CAPM is applied to firms whose returns exhibit significant ARCH/GARCH term conditional variance.

Bollerslev and Woodridge (1992) heteroscedasticity consistent covariance is used to overcome residuals that are not conditionally normally distributed. The ARCH term, α, indicates the short-run persistence of shocks, while the GARCH term, β, represents the long-run persistence of shocks.

6.7 Chapter summary

The following table summarises data and methodology used.

1. Research method	Quantitative approach
2. Data source	Thomson Reuters DataStream
3. Sample	Ghana, Kenya, Nigeria, Morocco and South Africa
4. Test approach	Time series regression of Jensen *et al*. (1972) and Fama and French (1993) time series approaches.
5. Methodological issues addressed	Autocorrelation, heteroscedasticity, normality, stationarity, multicollinearity, co integration and conditional variance of error.
6. Regression estimation model	Empirical versions of Sharpe-Lintner CAPM and Fama-French three factor model.

Table 13 Chapter summary of methodology

6.8 Chapter Conclusion

The test approaches follow established methods of testing both CAPM and Fama-French three factor model. Data for this study is sourced from Thomson Reuters DataStream and sample is restricted to five countries (Ghana, Kenya, Nigeria, Morocco and South Africa) which have sufficient data to meet selection criteria. Empirical framework is developed to test the data and results are reported in the next chapter.

CHAPTER SEVEN: EMPIRICAL ANALYSIS AND RESULTS - CAPM

7.1 Introduction

These results are produced by adopting time series methodology of Jensen *et al*. (1972). Monthly realised excess returns on equity are regressed on realised excess returns on the market portfolio. The coefficient of the regression slope represents the risk sensitivity for equities. The results are presented in five main sections, one for each country. The results include the analysis of CAPM in its basic form, followed by GARCH adjusted CAPM for volatility risk and finally chapter conclusions are drawn.

7.2 Empirical Evidence from Ghana

7.2.1 CAPM

Beta coefficient, intercept and other key parameters are estimated using time series regression via OLS using monthly returns data. Contemporaneous monthly market risk premium is regressed on monthly excess stock returns. The series are estimated using stationary data at first difference. The aim of this test is to establish the central theme of CAPM which says that the only risk investors care about or compensated for is systematic risk. A result for Accra Brewery is presented in the equation below for demonstrative purposes. Results for the remaining firms are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \varepsilon_{it}$$

$$r_{it} = -0.9088 + 0.0569 r_{Mt} + \varepsilon_{it}$$

$$t = (-0.8143) \quad (0.3397)$$
$$p = [0.4172] \quad [0.7347]$$

Table 14 Time series regression estimates of equation 6.18

Company	***β***	***α***	***R^2***	***AIC***	***SC***
Accra Brewery	0.0569 (0.3397) [***0.7347***]	-0.9088 (-0.8143) [***0.4172***]	*0.0010*	7.8024	7.8506
Aryton Drugs	0.2075 (1.5420) [***0.1316***]	0.3030 (-0.2687) [***0.7897***]	*0.0604*	6.7768	6.8621
Benso Oil	0.5013 (2.5294) [***0.0147***]*	-1.2453 (-0.8548) [***0.3968***]	*0.1155*	7.5440	7.6198
Cal bank	0.8139 (4.5102) [***0.0000***]**	-0.3865 (-0.2566) [***0.7986***]	*0.2241*	0.2082	7.7193
CFAO	-0.0075 (-0.0478) [***0.9620***]	-0.3756 (-0.4220) [***0.6738***]	*0.0000*	7.4090	7.4573
Clydestone	0.0399 (0.4351) [***0.6654***]	-2.0684 (-3.0674) [***0.0035***]**	*0.0038*	6.0034	6.0792
Cocoa Processing	0.1821 (1.0446) [***0.3013***]	-2.3414 (-2.7028) [***0.0094***]**	*0.0553*	6.3222	6.3979
Ecobank	0.7007 (4.0147) [***0.0003***]**	1.7669 (1.2081) [***0.2347***]	*0.3034*	7.2968	7.3822
Enterprise Insurance	0.5277 (2.1134) [***0.0368***]*	0.5303 (0.3187) [***0.7505***]	*0.0387*	8.6009	8.6492
Fan Milk	0.5225 (3.3878) [***0.0010***]**	1.6129 (1.5693) [***0.1194***]	*0.0937*	7.6375	7.6858
GCB	0.7595 (4.8230) [***0.0000***]**	0.2100 (0.2099) [***0.8418***]	*0.1733*	7.6789	7.7272
Guinness	0.79213 (4.8092) [***0.0000***]**	0.6490 (0.5914) [***0.5555***]	*0.1724*	7.7687	7.8170
Mechanical Lloyd	0.7351 (3.1241) [***0.0023***]**	1.0006 (0.6382) [***0.5246***]	*0.0808*	8.4819	8.5302
PBC	0.5374 (3.4901) [***0.0007***]**	-0.5443 (-0.4937) [***0.6227***]	*0.11805*	7.5826	7.6370
PZ	0.1325 (1.2165) [***0.2264***]	0.7080 (0.9754) [***0.3315***]	*0.0132*	6.9419	6.9901
Standard Chartered Bank	0.3366 (3.6948) [***0.0003***]**	0.6874 (1.1322) [***0.2600***]	*0.1095*	6.5848	6.6331
Total Petroleum	0.1681 (2.3098)	-0.4122 (-0.8830)	*0.0459*	6.0593	6.1075

	[***0.0227***]*	[***0.3792***]			
The Trust Bank	0.0049	-2.6735	*0.0000*	7.5292	7.6079
	(0.0248)	(-1.7797)			
	[***0.9803***]	[***0.0819***]			
Unilever	0.3612	0.9768	*0.0930*	6.9075	6.9558
	(3.3733)	(1.3690)			
	[***0.0010***]**	[***0.1738***]			

Source: Author's own calculations

1. There are three fundamental propositions of the CAPM (i) that asset returns are positive (and linear) functions of beta, (ii) that beta is the only determinant of asset returns, therefore, $\beta > 0$ and $\alpha = 0$ and (iii) risk-averse investors will demand higher return for higher risk investments, that is, R_M-$R_f > 0$. As can be seen from Table 14, with the exception of CFAO, which has negative beta, propositions (i) is supported by the results of the remaining eighteen companies. Positive beta coefficients also mean that investors in Ghana, like investors elsewhere, expect to be compensated more, the higher the systematic risk on their investment. This result also support proposition (iii) and the first aspect of proposition (ii) which states that, $\beta > 0$.

2. The CAPM also implies that if an asset beta is greater than 1 (which is the benchmark beta for the entire market portfolio), then this asset is exposed to higher systematic risk than the market portfolio and therefore, should attract higher returns. The reverse is true for companies with asset beta of less than 1. Per evidence in table 14, beta coefficients for all nineteen firms are less than 1, and hence exhibit low variation in returns (i.e. less risky) than the market portfolio. In other words, although by investing in such companies investors will require lower returns in compensation for taking up lower systematic risk than if they invested in an Index Fund (see Sharpe, 1964; Lintner, 1965), they are also exposed to lesser loss in a falling and/or volatile market condition. For portfolio managers, CFAO will be a good asset for hedging as it

moves in opposite direction to other firms and the market portfolio (Markowitz, 1952 & 1959).

3. A fundamental proposition of the CAPM namely, that only systematic risk (as measured by beta, β) determines asset returns since unsystematic can be eliminated through diversification (Markowitz, 1952 & 1959; Sharpe, 1964; Lintner, 1965), is rebutted by the results. Among all the nineteen firms, there is either positive or negative α, violating this aspect of proposition (ii) which asserts that, $\alpha = 0$.

4. However, these results could be spurious or obtained by chance and therefore it is vitally important to analyse the statistical significance of this evidence. The test of significance was set at 1 (*p-value with* **) and 5 (*p-value with* *) per cent levels. As can be seen from table 14; the beta coefficients of twelve firms (63% of sample) are positively significant at 1 and 5 per cent levels. In other words, there is a significant positive linear relationship between these firms return and beta. This indicates that market risk as measured by beta has a significant effect on estimating cost of capital of these firms for investment appraisal purposes, which is consistent with the evidence documented in other emerging and African capital markets (Claessent *et al*., 1995; Bundoo, 2008; Al-Rjoub *et al*., 2010; Coffie and Chukwulobelu, 2012). The statistical evidence also show that only Clydestone and Cocoa Processing exhibit negative significant alpha values.

The coefficient of determination, $R,^2$ ranges from 0.00% to 30.34% for the individual regressions, which are very low, and this is buttressed by high Akaike Information Criterion (AIC) and Schwarz Criterion (SC), which are all well above the critical value of 3. The highest total variation in equity returns in Ghana which can be explained by the CAPM, as measured by, $R,^2$ is only 30.34% (for Ecobank), leaving almost 70 per cent of the variations in returns unexplained by the model. For companies like CFAO, The Trust Bank and Accra Brewery, with R^2 of practically 0.00%, the unexplained variation of 100% in returns renders the appropriateness of CAPM even more problematic. This implies that there are other risk factors other than systematic risk, including perhaps company-specific and industry/economy wide risk factors, which equity investors seek compensations for in the Ghanaian market. This is consistent with Jensen *et al* (1972), Ross (1976), Fama and French (1992) and Carhart (1997).

7.2.2 GARCH Augmented CAPM

Empirical evidence in emerging markets suggests that volatility affect assets return (French et al, 1987; Bekaert et al, 1996; Ortiz and Arjona, 2001; McMillan and Thupayagale, 2009). Besides, initial White test, J-B statistics, kurtosis and skewness, all show that stock returns used in this study exhibit inconstant error variance, volatility clustering and leptokurtosis. Therefore, this study is designed to improve the CAPM by modelling both error term and the conditional variance via GARCH. This is to take into account the non-linear characteristics of the regression in the variance equation created by volatility clustering and leptokurtosis.

The results in table 15 are estimated using equations 6.23 and 6.25 in chapter 6 in order to establish whether there is correlation between returns and volatility. All parameters are estimated through the regression of excess stock return on market risk premium and expected market volatility by using autoregressive integrated moving average (ARIMA). Elsewhere, the volatility literature argues that daily or intra-daily returns data be used in studying the effects of volatility (Scholes and William, 1977). However, some studies in emerging market volatility revealed that using monthly, weekly and daily data does not give significant difference (see for example, Glosten et al., 1993; Choudhry, 1996; Appiah-Kusi and Menyah, 2003). Thus, the frequency of data does not really matter in emerging market studies particularly in Africa where there is severe infrequent trading. A result for Accra Brewery is presented in the equation for demonstrative purposes. Results for the remaining companies are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \varepsilon_{it} + \hat{\gamma} h_t + \xi_t$$

$$r_{it} = -0.9642 + 0.0360 r_{Mt} + \varepsilon_{it} + 88.0455 h_t + \xi_t$$

$$t = (-0.3998) \qquad (0.0510)$$
$$p = [0.6893] \qquad [0.9594]$$

$$h_t = \hat{\omega} + \hat{\alpha}_1 \varepsilon_{t-1}^2 + \hat{\beta}_1 h_{t-1}$$
$$h_t = 87.4822 - 0.0246 \varepsilon_{t-1} + 0.587 h_{t-1}$$

$$t = (0.7149) \qquad (-1.1153) \qquad (1.0071)$$
$$p = [0.4746] \qquad [0.2647] \qquad [0.3139]$$

The ***ω*** *is the constant variance,* ***α*** *captures the ARCH effect (i.e. information about last period volatility and* ***β*** *captures that of GARCH effect (i.e. the volatility forecast from the previous period).*

Table 15: Time series regression of equation 6.23 & 6.25

Company	***β***	***α***	***Ω***	***α_1***	***β_1***	***$\alpha_1+\beta_1$***	***R^2***	***AIC***	***SC***
ACCRA BREWERY	0.0360 (0.0510) [***0.9594***]	-0.9642 (-0.3998) [***0.6893***]	87.4822 (0.7149) [***0.4746***]	-0.0246 (-1.1153) [***0.2647***]	0.5879 (1.0071) [***0.3139***]	***0.5633***	*0.0009*	7.8689	7.9895
ARYTON DRUGS	0.1093 (0.7226) [***0.4699***]	-1.0628 (0.5706) [***0.5683***]	-0.3678 (-0.2406) [***0.8099***]	-0.1148 (-46.717) [***0.0000***]**	1.1470 (33.115) [***0.0000***]**	***1.0322***	*0.0380*	6.3052	6.5184
BENSO OIL	0.1683 (1.8580) [***0.0632***]	1.9126 (-4.8783) [***0.0000***]**	2.3774 (1.0564) [***0.2908***]	1.6240 (3.0593) [***0.0022***]**	0.2544 (3.0922) [***0.0020***]**	***1.8784***	*0.0634*	6.5013	6.6907

CLYDESTONE	0.0332	-1.9272	8.3949	-0.0505	0.6389	0.5884	0.0028	5.8515	6.0409
	(0.0603)	(-0.8471)	(3.7337)	(-63.5606)	(8.7783)				
	[0.9519]	[0.3969]	[0.0002]**	[0.0000]**	[0.0000]**				
CAL BANK	0.7499	-0.5684	8.9006	-0.1520	1.1094	0.9574	0.2226	7.3567	7.5461
	(3.9164)	(-0.3257)	(1.7401)	(-209.855)	(20.950)				
	[0.0001]**	[0.7446]	[0.0818]	[0.0000]**	[0.0000]**				
CFAO	-0.0361	-0.5389	54.1348	-0.0270	0.5735	0.5465	0.0007	7.4361	7.5568
	(-0.1796)	(-0.3250)	(1.9627)	(-0.8729)	(2.5123)				
	[0.8575]	[0.7452]	[0.0497]*	[0.3827]	[0.0120]*				
COCOA PROCESSING	0.1236	-2.0801	-0.4783	4.4133	0.4405	4.8538	0.0464	5.6818	5.8712
	(6.0568)	(-10.4904)	(-2.8537)	(1.8200)	(2.6852)				
	[0.0000]**	[0.0000]**	[0.0043]**	[0.0688]	[0.0072]**				
ECOBANK	0.7953	0.5711	1.2112	1.8805	0.1058	1.9863	0.1987	6.6699	6.8832
	(10.9186)	(1.1488)	(0.5006)	(1.8434)	(1.1610)				
	[0.0000]**	[0.2506]	[0.6166]	[0.0653]	[0.2456]				
ENTERPRISE INSURANCE	0.5579	1.6400	-0.6350	-0.0164	1.0690	1.0526	0.0347	7.9913	8.1120
	(5.7591)	(1.9629)	(-198.62)	(-156.293)	(2835.1)				
	[0.0000]**	[0.0497]*	[0.0000]**	[0.0000]**	[0.0000]**				
FANMILK	0.5426	0.2953	31.8648	1.4172	-0.0132	1.4040	0.0802	7.1846	7.3053
	(8.7826)	(0.4789)	(6.9263)	(4.7124)	(-0.8190)				
	[0.0000]**	[0.6320]	[0.0000]**	[0.0000]**	[0.4128]				
GCB	0.9593	-0.0143	35.6338	0.2729	0.4424	0.7153	0.1610	7.5535	7.6742
	(5.3414)	(-0.0141)	(2.3861)	(2.2258)	(2.1028)				
	[0.0000]**	[0.9888]	[0.0170]*	[0.0260]*	[0.0355]*				
GUINNESS	0.7926	0.7080	18.8537	3.6177	0.0205	3.6382	0.1724	7.4784	7.5991
	(0.7925	(2.5415)	(3.3416)	(5.6700)	(0.7045)				
	[0.0000]**	[0.0110]*	[0.0008]**	[0.0000]**	[0.4811]				
MECHANICAL LLOYD	0.3480	0.5329	15.9700	0.2470	0.7903	1.0373	0.0575	8.2309	8.3516
	(2.3606)	(0.2300)	(3.0533)	(3.5304)	(22.126)				
	[0.0182]*	[0.7642]	[0.0023]**	[0.0004]**	[0.0000]**				
PBC	0.3109	-1.2034	8.2889	2.2387	-0.0002	2.2385	0.0923	6.2759	6.2751
	(7.0739)	(-4.8323)	(4.2614)	(2.4926)	(-0.0055)				
	[0.0000]**	[0.0000]**	[0.0000]**	[0.0127]*	[0.9956]				
PZ	0.0784	0.4511	0.3511	-0.0530	1.0182	0.9652	0.0098	6.0640	6.1847
	(0.0783)	(1.8086)	(5.4405)	(-31.2377)	(253.90)				
	[0.0783]	[0.8086]	[0.4404]	[0.0000]**	[0.0000]**				
STANCHART BANK	0.2968	0.0151	23.9079	0.7073	-0.0579	0.6494	0.0981	6.4002	6.5209
	(0.2968)	(0.0338)	(8.6535)	(4.3368)	(-0.0578)				
	[0.0000]**	[0.9731]	[0.0000]**	[0.0000]**	[0.0005]**				
TOTAL PETROLEUM	0.1759	-0.3468	14.7727	-0.0283	0.5761	0.5478	0.0453	6.0982	6.2189
	(1.7638)	(-0.3728)	(0.8349)	(-1.8172)	(1.1092)				
	[0.0778]	[0.7093]	[0.4038]	[0.0692]	[0.2673]				
THE TRUST BANK	-0.0121	-2.3488	63.6276	-0.0330	0.5919	0.5589	0.0013	7.6044	7.8012
	(-0.0040)	(-0.6883)	(0.6949)	(-0.5376)	(0.9621)				
	[0.9968]	[0.4912]	[0.4871]	[0.5909]	[0.3360]				
UNILEVER	0.3745	1.1753	9.2442	-0.0445	0.8459	0.8014	0.0922	6.8400	6.9606
	(3.8338)	(1.5033)	(2.0496)	(-1.5867)	(10.461)				
	[0.0001]**	[0.1328]	[0.0404]*	[0.1126]	[0.0000]**				

Source: Author's own calculations

The GARCH model is characterized by the following three fundamental propositions; (i) that *ω=0* and $\alpha, \beta \geq 0$ to ensure that the conditional variance is sternly positive in relation to expected excess stock return. However, reported empirical evidences are contradictory. For example, French et al. (1987) and Campbell and Hentschel (1992) found positive relationship between excess return and conditional variance, while Fama and Schwert (1977), Campbell

(1987), Breen et al. (1989), Turner et al. (1989), Pagan and Hong (1991) and Nelson (1991) found a negative relation; (ii) that shocks to volatility decay at constant rate and the speed of decay is measured by the estimate of *α+β;* (iii) that the sum of α and β measures volatility persistence (i.e. the degree to which shocks to current volatility remain important for long-periods into the future). The persistence of shocks to volatility becomes greater as the sum approaches 1 (or unity) and shock to volatility is considered to be permanent if the sum is equal to 1 (Engle and Bollerslev, 1986). As this sum becomes greater than 1, then volatility is explosive, i.e. shock to volatility in one period will result in even a greater volatility in the subsequent period (Chou, 1988).

1. By summing up α (ARCH term) and β (GARCH term), as can be seen from table 15, proposition (i) is supported by the results. The sum of α and β for all the firms in Ghana are positive which is consistent with French et al. (1987) and Campbell and Hentschel (1992). However, by disaggregating the model, ten firms exhibit negative coefficients of the conditional (ARCH) variance term and the GARCH is negative in three firms. Although, according to ARCH/GARCH theory, this negative relationship between returns and conditional variance should not exist, the estimated coefficients of these firms violate the positive parameter restriction as the ARCH/GARCH models unduly restrict the dynamics of the conditional variance process (see Nelson, 1991). Previous tests of the relation between excess return and conditional variance using ARCH and GARCH models have documented negative relationships (Fama and Schwert, 1977; Campbell, 1987; Breen et al., 1989; Turner et al., 1989; Pagan and Hong, 1991 and Nelson, 1991). This negative relation between return and conditional variance is buttressed by Black (1976), who found a negative correlation between current returns and future returns volatility. Furthermore, Nelson (1991) and Engle

and Ng (1993) argue that the time series properties of monthly returns data are to some extent different from daily returns data and therefore more likely to find a negative relation between returns and conditional variance with low level of data frequency. However, Glosten et al. (1993) argue that there is no theoretical grounding to support the differences in time series properties.

2. Moreover, it is vitally important to analyse the statistical significance of the ARCH and GARCH coefficients in relation to returns since the results obtained could have happened out of chance. The test of significance was set at 1 (*p-value with* **) and 5 (*p-value with* *) per cent levels and the results, as in table 15, shows that the ARCH term exhibits statistically significant coefficients in twelve firms at 1 and 5 per cent levels with either positive or negative sign. However, out of these twelve firms, five exhibit statistically significant negative relationship between returns and (ARCH term) conditional variance at 1 per cent level and seven show statistically significant positive relationship between return and (ARCH term) conditional variance at 1 and 5 per cent levels. Similarly, the results, as in table 15 show that the GARCH term is statistically significant in twelve firms at 1 and 5 per cent levels with either positive or negative sign. However, eleven, with the exception of Standard Chartered Bank, show statistically significant positive relation between return and (GARCH term) conditional variance at 1 and 5 per cent level.

3. The persistence of volatility as measured by the sum of $\alpha+\beta$ varies considerably for the nineteen companies in Ghana. For example, in Aryton, Benso Oil, Cocoa Processing, Ecobank, Enterprise Insurance, Fan Milk, Guinness, Mechanical Lloyd and PBC, volatility persistence is explosive and $\alpha + \beta > 1$ for these firms. A similar

result was documented in McMillan and Thupayagale (2009), where explosive volatility was found in stock returns in Nigeria and Zimbabwe. Explosive volatility means that persistence of shocks to volatility in one period will result in even a greater volatility in the subsequent period since the sum of α and β are greater than 1 or unity (Chou, 1988). For all other firms $\alpha + \beta < 1$. For instance, among all firms, only Cal Bank and PZ exhibit the greatest persistence, although not permanent, at 0.9574 and 0.9652 respectively since the sum of α and β is close to 1. This implies that a shock to volatility in the past will be significant in predicting future volatility over a prolonged period.

Meanwhile, evidence of low volatility is found in Accra Brewery, Clydestone, CFAO, GCB, Standard Chartered Bank, Total Petroleum, The Trust Bank and Unilever. Among these eight firms, the sum of α and β ranges from 0.5465 (CFAO) to 0.8014 (Unilever). This does not insinuate that volatility is not present in these firms however; shocks to volatility diminish so quickly. McMillan and Thupayagale (2009) found similar evidence in nine African Stock Markets (Botswana, Egypt, Ghana, Kenya, Mauritius, Morocco, Namibia, South Africa and Tunisia) that shocks to volatility in these markets taper off fairly quickly in comparison with UK and US markets. Also, Glosten et al. (1993), using monthly excess return on US stocks found that the conditional volatility is not highly persistent.

4. Per GARCH restriction, the variance constant, ω, should be 0. As in table 15, this condition is violated by the evidence. The coefficients of the variance constant, ω, for sixteen firms are greater than 0 and three firms (i.e. Aryton, Cocoa Processing and Enterprise Insurance) are less than 0 or with negative value. However, these results

could be spurious or occurred out of chance and it is appropriate to examine the statistical significance of the coefficients. Per the evidence in table 15, coefficients of eleven firms are statistically significant at 1 and 5 per cent levels with either negative or positive sign. Nonetheless, only two firms (i.e. Cocoa Processing and Enterprise Insurance) exhibit statistically significant negative constant variance at 1 per cent level, while, the remaining nine exhibit statistically significant positive constant variance at 1 and 5 per cent levels.

As can be seen from the results in table 15, with the exception of CFAO and Trust Bank, which has negative beta, the beta coefficients of the remaining seventeen firms are positive, in support of a fundamental proposition of the CAPM which state that asset returns are positive (and linear) functions of beta. However, only eleven of the firms have their beta coefficients statistically significant at 1 and 5 per cent levels. According to the Augmented CAPM the mean intercept should be 0 or close to 0. Nonetheless, this proposition is violated per the results in table 15. The evidence shows that intercepts for ten firms are negative or with values less than 0 and the intercepts for the remaining nine are positive or with values greater than 0. Statistically it is found that the intercepts of only five firms (i.e. Benso Oil, Cocoa Processing, Enterprise Insurance, Guinness and PBC) are positively or negatively significant at 1 and 5 per cent levels.

The coefficient of determination, R^2 ranges from 0.07 per cent to 22.26 per cent and this is a summary measure of how well CAPM explains the return generating process in Ghana in the presence of GARCH. These figures are statistically low and demonstrate that the GARCH augmented CAPM is unable to fully explain the asset return generating process in Ghana. The highest total variation in equity returns in Ghana which can be explained by the GARCH augmented CAPM, as measured by R^2, is only 22.26% (for Cal Bank). This is further buttressed by high Akaike Information Criterion (AIC) and Schwarz Criterion (SC), which are all well above the critical value of 3.

7.2.3 GARCH-M Augmented CAPM

Following the evidence in table 15, shocks to volatility is highly persistent or explosive in ten firms and in many instances a significant relationship between excess stock return and conditional variance are found (see also Black 1976; Shiller, 1981 and French *et al*. 1987). French *et al.* (1987) assert that volatility is actually a priced risk factor and not just a data characteristic issue. Therefore, the underlying theory following the results in table 15 is that investors should be rewarded for taking up additional risk. According to Engle, Lilien and Robins (1987), GARCH-in-Mean (or GARCH-M) is a better model to operationalize this type of risk.

The results in table 16 are estimated using equation 6.26, where the regression process allows the conditional variance to enter the conditional mean process. The GARCH-M is basically motivated by Merton's (1973) ICAPM which suggests that the conditional expected excess return on the stock market should vary positively and proportionately with the conditional market variance. A result for Aryton Drugs Manufacturing is presented in the equation for demonstrative purposes. Results for the remaining companies are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \hat{\delta}\sigma_t^2 + \varepsilon_{it}$$

$$r_{it} = -3.635 + 0.0864 r_{Mt} + 0.3189\sigma_t^2 + \varepsilon_{it}$$

$$t = (-0.3702) \quad (0.5749) \quad (0.1991)$$
$$p = [0.7113] \quad [0.5654] \quad [0.8422]$$

Table 16: time series regression estimates of equation 6.26

Company	***β***	***α***	δ	R^2	***AIC***	***SC***
ARYTON DRUGS	0.0864 (0.5749) [***0.5654***]	-3.3635 (-0.3702) [***0.7113***]	0.3189 (0.1991) [***0.8422***]	*0.06174*	6.6857	6.9416
BENSO OIL	0.0468 (0.3396) [***0.7342***]	-1.4202 (-1.5556) [***0.1198***]	-0.0799 (-0.2791) [***0.7802***]	*0.0154*	6.5859	6.8132
CAL BANK	0.8960 (2.1424) [***0.0322***]*	4.8210 (0.4153) [***0.6779***]	-0.4438 (-0.4096) [***0.6821***]	*0.2295*	7.8362	8.0634
CLYDESTONE	0.0768 (0.3597) [**0.7191**]	-1.6438 (-0.4942) [**0.6212**]	-0.0025 (-0.0094) [**0.9925**]	*0.1159*	5.5388	5.7660
COCOA PROCESSING	0.0723 (10.4681) [***0.0000***]**	-1.2731 (-27.9135) [***0.0000***]**	-0.0566 (-1.9420) [***0.0521***]	*0.1241*	5.6752	5.9024
ECOBANK	0.8005 (6.1169) [***0.0000***]**	-0.1728 (-0.2083) [***0.8350***]	0.2141 (1.0899) [***0.2757***]	*0.2886*	6.7038	6.9597
FANMILK	0.7631 (16.0119) [***0.0000***]**	-0.1472 (-0.3069) [***0.7589***]	0.1245 (1.5582) [***0.1192***]	*0.0825*	7.0189	7.1638
GCB	0.9964 (5.5684) [***0.0000***]**	-7.0650 (-1.1244) [***0.2608***]	0.7202 (1.0943) [***0.2738***]	*0.1882*	7.5595	7.70435
GUINNESS	0.7472 (3.1582) [***0.0016***]**	-2865.548 (-0.0288) [***0.9770***]	569.3259 (0.0288) ***[0.9770]***	*0.1610*	7.8256	7.9946
MECHANICAL LLOYD	0.0518 (1.2099) [***0.2263***]	-2.8408 (-2.9956) [***0.0027***]**	0.5623 (4.7251) [***0.0000***]**	*0.0760*	7.6826	7.8275
PBC	0.2713 (1.6331) [***0.1024***]	-5.2825 (-1.6058) [***0.1083***]	0.5121 (1.5888) [***0.1121***]	*0.1928*	6.8648	7.0282
PZ	0.2029 (2.2595) [***0.0239***]*	-2.7661 (-2.1001) [***0.0357***]*	0.7226 (5.4507) [***0.0000***]**	*0.2654*	6.6979	6.8427
STANCHART BANK	0.3816 (6.7228) [***0.0000***]**	-5.2323 (-1.8289) [***0.0674***]	0.9397 (1.6950) [***0.0901***]	*0.1238*	6.4211	6.5659
UNILEVER	0.3836 (3.0539) **[*0.0023*]****	17.1539 (1.9525) [***0.0509***]	-2.1581 (-1.8182) [***0.0690***]	*0.1097*	0.10969	7.09268

Source: Author's own calculations

The GARCH-M model is characterized by two fundamental propositions; (i) that , $\delta > 0$, is imposed to ensure that the conditional variance is interpreted as risk premium which requires compensation; (ii) investors should be rewarded if, δ, is positive.

1. Per evidence in table 16, proposition (i) is not entirely supported. The results show that the coefficient of Benso Oil, Cal Bank, Clydestone, Cocoa Processing and Unilever are negative, in violation of proposition (i). This means that there is a negative correlation between the return of these three firms and their conditional variance. This result is consistent with existing literature. For example, Nelson (1991) and Glosten et al. (1993) applied ARCH/GARCH-M and EGARCH-M to daily and monthly return data respectively and found negative relation between return and conditional variance in the US. However, the remaining nine firms exhibit positive relation between return and conditional variance in line with French et al. (1987), Campbell and Hentschel (1992), Guo and Neely (2006) results.

2. The positive sign suggests that investors in these eight firms are rewarded for taking up additional volatility risks. The negative relations violate the central theme of the GARCH-M which suggests that the conditional expected excess return on asset should vary positively and proportionately with the conditional variance. As argued strongly by Nelson (1991) that standard GARCH/GARCH-M models lack the properties to capture the dynamics of the conditional variance process and went ahead to propose an alternative model that remedy this weakness. This study is limited to standard GARCH-M and not extended to Nelson's model. Intuitively, assets with negative, δ, would be good instrument for hedging (see Merton, 1973) and therefore portfolio/fund managers will look out for firms with negative, δ.

3. However, these results could be spurious or occurred out of chance and it is appropriate to examine the statistical significance of the coefficients. Per the results in table 16, only Mechanical Lloyd and PZ exhibit positive statistically significant relation between return and conditional variance at 1 per cent level.

Per the evidence in table 16, the beta for all fourteen firms exhibit positive signs in support of a fundamental proposition of the CAPM which state that asset returns are positive (and linear) functions of beta. However, only nine of the firms have their beta coefficients statistically significant at 1 and 5 per cent levels. According to the Augmented CAPM the mean intercept should be 0 or close to 0. Nonetheless, this proposition is violated per the results in table 16. The evidence shows that intercepts for twelve firms are negative and thus, less than 0, while the intercepts for Cal Bank and Unilever are positive and therefore, greater than 0. Statistically it is found that the intercepts of only three firms (i.e. Cocoa Processing, Mechanical Lloyd and PZ) are negatively significant at 1 and 5 per cent levels. The highest total variation in equity returns in Ghana which can be explained by the augmented CAPM, as measured by R^2, is only 28.86% (for Ecobank).

7.3 Empirical Evidence from Kenya

7.3.1 CAPM

Beta coefficient, intercept and other key parameters are estimated using time series regression. Contemporaneous monthly market risk premium of price-weighted geometric mean of All Share index is regressed on contemporaneous equity excess return. The aim of this test is to establish the central theme of CAPM which says that the only risk investors care about or compensated for is systematic risk. A result for Bamburi Cement is presented in the equation below for demonstrative purposes. Results for the remaining companies are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \varepsilon_{it}$$

$$r_{it} = 10.5834 + 0.9094 r_{Mt} + \varepsilon_{it}$$

$t = (13.2410) \quad (7.8035)$
$p = [0.0000] \quad [0.0000]$

Table 17: time series regression estimates of equation 6.18

Company	***β***	***α***	***R^2***	***AIC***	***SC***
Bamburi Cement	0.9094 (7.8035) ***[0.0000]*****	10.5834 (13.2410) ***[0.0000]*****	*0.1893*	8.1621	8.1934
Barclays Bank	1.0547 (13.8460) ***[0.0000]*****	10.1781 (14.7726) ***[0.0000]*****	*0.3863*	7.4670	7.4983
BAT Kenya	0.8246 (5.8892) ***[0.0000]*****	9.1162 (14.7088) ***[0.0000]*****	*0.2861*	7.4260	7.4574
Centum Investment	1.1998 (8.8327) ***[0.0000]*****	9.6488 (12.8331) ***[0.0000]*****	*0.3839*	7.7347	7.7660
Stanbic Bank	1.2542 (3.6800) ***[0.0003]*****	9.6755 (8.3632) ***[0.0000]*****	*0.1398*	9.1674	9.1988
East African Cables	0.8240 (4.3091) ***[0.0000]*****	9.8477 (10.1706) ***[0.0000]*****	*0.0754*	9.0185	9.0499
East African Breweries	1.0063 (7.8231) ***[0.0000]*****	10.2297 (20.9174) ***[0.0000]*****	*0.4395*	7.1532	7.1846
Kenya Commercial Bank	1.2797 (10.7467) ***[0.0000]*****	5.8479 (6.6273) ***[0.0000]*****	*0.4404*	7.6301	7.6614
Kenya Airways	0.9733 (5.3139) ***[0.0000]*****	9.6290 (9.4266) ***[0.0000]*****	*0.2839*	7.4246	7.4643
Kenya Power & Lightening	1.5814 (8.6943) ***[0.0000]*****	10.2955 (10.1498) ***[0.0000]*****	*0.4549*	7.9949	8.0262
Mumias Sugar Co	1.4178 (6.0026) ***[0.0000]*****	8.9792 (5.7881) ***[0.0000]*****	*0.3498*	8.1292	8.1826
National Industrial Credit	0.8886 (6.3583) ***[0.0000]*****	9.6050 (15.7780) ***[0.0000]*****	*0.2619*	7.6976	7.7290
National Media Group	0.8505 (8.1869) ***[0.0000]*****	10.2324 (13.7504) ***[0.0000]*****	*0.2176*	7.8531	7.8847
National Bank of Kenya	1.2354 (5.9057) ***[0.0000]*****	3.0534 (3.4306) ***[0.0007]*****	*0.2883*	7.9497	7.9852
Pan African Insurance	0.3229 (2.7215) ***[0.0070]*****	8.2839 (9.6032) ***[0.0000]*****	*0.0381*	7.8668	7.8982
Standard Chartered Bank	0.7833 (9.2139) ***[0.0000]*****	9.5588 (15.1462) ***[0.0000]*****	*0.1616*	8.0552	8.0865
Total Kenya	-19595.26 (1.4491)	378097.8 (1.7301)	*0.0085*	31.4273	31.4587

	[0.1488]	***[0.0851]***			
TPS Eastern Africa	1.0612 (6.5769) ***[0.0000]*****	9.1911 (12.374) ***[0.0000]*****	*0.3336*	7.3759	7.4160
UNGA Group	1.1012 (5.5673) ***[0.0000]*****	4.2171 (2.9041) ***[0.0041]*****	*0.1374*	8.9277	8.9591

Source: Author's own calculations

1. Again, there are three fundamental propositions of the CAPM (i) that asset returns are positive (and linear) functions of beta, (ii) that beta is the only determinant of asset returns, therefore, $\beta > 0$ and $\alpha = 0$ and (iii) risk-averse investors will demand higher return for higher risk investments, that is, $R_M-R_f > 0$. As can be seen from Table 17, with the exception of Total Kenya, which has an unusually high negative beta, proposition (i) is supported by the results. Positive beta coefficients also mean that investors in Kenya, like investors elsewhere, expect to be compensated more, the higher the systematic risk on their investment. This result also support proposition (iii) and the first aspect of proposition (ii) which states that, $\beta > 0$.

2. The CAPM also implies that if an asset beta is greater than 1 (which is the benchmark beta for the entire market portfolio), then this asset is exposed to higher systematic risk than the market portfolio and therefore, should attract higher returns. The reverse is true for companies with asset beta of less than 1. Per the evidence in table 17, ten of the companies have beta coefficients which are greater than 1, and hence exhibit high variation in returns (i.e. more risky) than the market portfolio. In other words, although by investing in such companies investors will require higher returns in compensation for taking up higher systematic risk than if they invested in an Index Fund (see Sharpe, 1964; Lintner, 1965), they are also exposed to greater loss in a falling and/or volatile market

condition. The reverse is true for the eight companies with equity beta of less than 1. The result for Total Kenya is a statistical oddity or quirk and have no explanation for the very high negative beta, but have included it for completeness.

3. Fundamental proposition of the CAPM namely, that only systematic risk (as measured by beta, β) determines asset returns since unsystematic can be eliminated through diversification (Markowitz, 1952 & 1959; Sharpe, 1964; Lintner, 1965), is rebutted by the Kenyan evidence as all nineteen firms show positive, α, violating the aspect of proposition (ii) which asserts that, $\alpha = 0$.

4. However, these results could be spurious or obtained by chance and therefore it is vitally important to analyse the statistical significance of this evidence. The test of significance was set at 1 (*p-value with* **) and 5 (*p-value with* *) per cent levels. As can be seen from table 17; the beta coefficients for eighteen firms, with the exception of Total Kenya, which result is a statistical oddity, are positively significant at 1 per cent level. In other words, there is a significant positive linear relationship between firms return and beta. This indicates that market risk as measured by beta has a significant effect on estimating cost of capital for these firms for investment appraisal purposes. The statistical evidence also shows that all firms, with the exception Total Kenya, exhibit significant positive relation between returns and alpha (i.e. intercept).

The coefficient of determination, $R,^2$ for the individual regressions are very low, and this is buttressed by high Akaike Information Criterion (AIC) and Schwarz Criterion (SC), which are all well above the critical value of 3. The highest total variation in equity returns in Kenya which can be explained by the CAPM, as measured by R^2, is only 45.49% (for Kenya Power & Lightening), leaving more than 50 per cent of the variations in the company's equity returns unexplained by the model. For a company like Pan African Insurance, with R^2 of 3.81%, the unexplained variation of 96.19% renders the appropriateness of CAPM even more suspect. This implies that there are other risk factors other than systematic risk, including perhaps company-specific and industry/economy wide risk factors, which equity investors seek compensations for in the Kenyan market. This is consistent with Jensen *et al* (1972) Ross (1976) and Fama and French (1992).

7.3.2 GARCH Augmented CAPM

The evidence documented in the preceding section shows beta is not able to fully explain the return generating process in Kenya. Like Ghana, the test is designed to improve the CAPM by modelling both error term and the conditional variance via GARCH. This is to take into account the non-linear characteristics of the regression in the variance equation created by volatility clustering and leptokurtosis.

The results in table 18 are estimated using equations 6.23 and 6.25 to establish the correlation between return and volatility. Parameters are estimated by regressing the excess stock return on market risk premium and expected market volatility using autoregressive integrated moving average (ARIMA) process. A result for Bamburi Cement is presented in the equation for demonstrative purposes. Results for the remaining firms are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \varepsilon_{it} + \hat{\gamma} h_t + \xi_t$$

$$r_{it} = 10.9485 + 0.9263 r_{Mt} + \varepsilon_{it} + 183.1996 h_t + \xi_t$$

$$t = (8.5329) \qquad (8.4557)$$
$$p = [0.0000] \qquad [0.0000]$$

$$h_t = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1}$$
$$h_t = 183.1319 + (0.0906)\varepsilon_{t-1} + (-0.0229)h_{t-1}$$
$$t = (1.5790) \qquad (0.7115) \qquad (0.0352)$$
$$p = [0.1143] \qquad [0.4768] \qquad [0.9719]$$

Table 18: time series regression of equations 6.23 and 6.25

Company	β	α	ω	α_1	β_1	$\alpha_1+\beta_1$	R^2	AIC	SC
Bamburi Cement	0.9263 (8.4557) [0.0000]**	10.9485 (8.5329) [0.0000]**	183.1319 (1.5790) [0.1143]	0.0906 (0.7115) [0.4768]	-0.0229 (0.0352) [0.9719]	**0.0677**	0.1887	8.1341	8.2125
Barclays Bank	0.9843 (15.2489) [0.0000]**	9.0459 (17.1029) [0.0000]**	8.3979 (1.2585) [0.2082]	0.7852 (2.7399) [0.0061]**	0.4378 (5.5031) [0.0000]**	**1.223**	0.3774	7.1450	7.2233
BAT Kenya	0.8730 (8.9470) [0.0000]**	8.9470 (16.8816) [0.0000]**	64.1812 (5.5359) [0.0000]**	0.3639 (3.1587) [0.0000]**	-0.0248 (-0.2415) [0.0000]**	**0.3391**	0.2849	7.3212	7.3995
Centum Investment	1.1758 (17.5174) [0.0000]**	9.4121 (14.1193) [0.0000]**	30.8159 (2.6670) [0.0077]**	0.2480 (3.3697) [0.0008]**	0.5458 (4.3966) [0.0000]**	**0.7938**	0.3836	7.6684	7.7468
Stanbic Bank	1.0526 (15.4361) [0.0000]**	6.1749 (4.5785) [0.0000]**	183.6213 (12.2715) [0.0000]**	1.9303 (6.2044) [0.0000]**	0.0407 (1.6529) [0.0984]	**1.9710**	0.1184	8.8524	8.9308
East African Cables	1.1269 (11.2410) [0.0000]**	8.8349 (13.2442) [0.0000]**	140.3651 (7.3541) [0.0000]**	0.9741 (7.0328) [0.0000]**	0.9740 (1.7889) [0.0000]**	**1.9481**	0.0623	8.5491	8.6275
East African Breweries	0.8909 (23.7643) [0.0000]**	10.3790 (25.6493) [0.0000]**	13.5885 (3.3606) [0.0008]**	0.3269 (4.0681) [0.0000]**	0.4672 (4.9150) [0.0000]**	**0.7941**	0.4334	6.8849	6.9633
KCB	1.3574 (16.2162) [0.0000]**	5.5563 (8.1457) [0.0000]**	126.5801 (2.4563) [0.0896]	-0.1076 (-3.6167) [0.0003]**	0.0394 (0.0896) [0.9286]	**-0.0682**	0.4382	7.6432	7.7216
Kenya Airways	0.8134 (6.7085) [0.0000]**	9.0266 (10.6534) [0.0000]**	2.0057 (1.0347) [0.0000]**	-0.0486 (-193.626) [0.0000]**	1.0346 (983.5899) [0.0000]**	**0.986**	0.2748	7.3115	7.4106
Kenya Power & Lightening	1.5284 (16.6267) [0.0000]**	9.9937 (13.4973) [0.0000]**	183.3846 (5.9009) [0.0000]**	0.2932 (3.9935) [0.0001]**	-0.3074 (-2.4434) [0.0146]*	**-0.0142**	0.4542	7.9054	7.9838
Mumias Sugar Co	1.1951 (6.6870) [0.0000]**	9.5119 (8.3678) [0.0000]**	179.7704 (3.0285) [0.0025]**	0.3482 (2.8144) [0.0049]**	-0.2553 (-1.1492) [0.2505]	**0.0929**	0.3404	8.0672	8.2008
National Industrial Credit	0.8049 (11.8065) [0.0000]**	8.7735 (13.9562) [0.0000]**	50.9796 (4.7611) [0.0000]**	0.5055 (3.6463) [0.0003]**	0.2239 (2.0492) [0.0404]*	**0.7294**	0.2560	7.6524	7.7307
National Media Group	1.1190 (27.6348) [0.0000]**	9.7361 (14.5123) [0.0000]**	46.7824 (5.5018) [0.0000]**	0.6377 (5.1834) [0.0000]**	0.1916 (2.4670) [0.0136]*	**0.8293**	0.1936	7.5521	7.6305
National Bank of Kenya	1.1050 (10.6365) [0.0000]**	3.8039 (4.5169) [0.0000]**	11.2893 (1.9065) [0.0566]	0.1657 (2.6364) [0.0084]**	0.7738 (10.9322) [0.0000]**	**0.9395**	0.2817	7.8228	7.9115
Pan African Insurance	0.3124 (4.4341) [0.0000]**	8.1006 (10.1774) [0.0000]**	125.3432 (8.7906) [0.0000]**	0.2697 (3.6838) [0.0002]**	-0.0811 (-0.8104) [0.4177]	**0.1886**	0.0378	7.7916	7.8700
Standard Chartered Bank	0.5198 (5.0321) [0.0000]**	7.9728 (12.5676) [0.0000]**	32.2627 (5.2339) [0.0000]**	0.5418 (4.0725) [0.0000]**	0.4314 (6.1895) [0.0000]**	**0.9732**	0.1340	7.6905	7.7689

Total Kenya	1.0907 (15.7651) [***0.0000***]**	10.1093 (12.2084) [***0.0000***]**	5.5367 (1.2638) [***0.2063***]	0.0924 (1.9322) [***0.0533***]	0.8445 (12.1740) [***0.0000***]**	**0.9369**	*0.3276*	7.3625	7.4629
TPS Eastern Africa	1332.834 (-0.0388) [***0.9690***]	352498.3 (0.38274) [***0.7019***]	1.66E+12 (1.8720) [***0.0612***]	0.3602 (2.5340) [***0.0113***]*	-0.1028 (-1.4360) [***0.1510***]	**0.2574**	*0.0006*	30.4266	30.5050
UNGA Group	1.2926 (13.7075) [***0.0000***]**	2.9254 (2.7933) [***0.0052***]**	138.0567 (6.2544) [***0.0000***]**	0.6157 (6.4582) [***0.0000***]**	0.2292 (4.2559) [***0.0000***]**	**0.8449**	*0.1292*	8.7496	8.8279

Source: Author's own calculations

The GARCH model is characterized by the following three fundamental propositions; (i) that *ω=0* and $\alpha, \beta \geq 0$ to ensure that the conditional variance is strictly positive in relation to expected excess stock return. However, reported empirical evidences are contradictory. For example, French et al. (1987) and Campbell and Hentschel (1992) found positive relationship between excess return and conditional variance, while Fama and Schwert (1977), Campbell (1987), Breen et al. (1989), Turner et al. (1989), Pagan and Hong (1991) and Nelson (1991) found a negative relation; (ii) that shocks to volatility decay at constant rate and the speed of decay is measured by the estimate of $\alpha+\beta$; (iii) that the sum of α and β measures volatility persistence (i.e. the degree to which shocks to current volatility remain important for long-periods into the future). The persistence of shocks to volatility becomes greater as the sum approaches 1 (or unity) and shock to volatility is considered to be permanent if the sum is equal to 1 (Engle and Bollerslev, 1986). As this sum becomes greater than 1, then volatility is explosive, i.e. shock to volatility in one period will result in even a greater volatility in the subsequent period (Chou, 1988).

1. By summing up α (ARCH term) and β (GARCH term), as can be seen from table 18, proposition (i) is supported by seventeen companies. The sum of α and β for these seventeen firms in Kenya are positive which is consistent with French et al. (1987) and Campbell and Hentschel (1992). However, the sum of α and β for Kenya Commercial Bank (KCB) and Kenya Power & Lightening violates this proposition of

the model. Besides, by disaggregating the model, KCB and Kenyan Airways exhibit negative coefficients of the conditional (ARCH) variance term and the GARCH term is negative in Bamburi, BAT, Kenya Power & Lightening, Mumias, Pan African Insurance and TPS Kenya. Although, according to ARCH/GARCH theory, this negative relationship between returns and conditional variance should not exist, the estimated coefficients of these firms as can be seen from table 18 violate the restriction of this positive parameter as the ARCH/GARCH models unduly restrict the dynamics of the conditional variance process (see also Nelson, 1991). Similarly, previous tests of the relation between excess return and conditional variance using ARCH and GARCH models have documented negative relationships (Fama and Schwert, 1977; Campbell, 1987; Breen et al., 1989; Turner et al., 1989; Pagan and Hong, 1991 and Nelson, 1991). This negative relation between return and conditional variance is buttressed by Black (1976) results, which found a negative correlation between current returns and future returns volatility. Furthermore, Nelson (1991) and Engle and Ng (1993) argue that the time series properties of monthly returns data are to some extent different from daily returns data and therefore more likely to find a negative relation between returns and conditional variance with low level of data frequency such as monthly returns. However, Glosten et al. (1993) argue that there is no theoretical grounding to support the differences in time series properties.

2. Moreover, it is vitally important to analyse the statistical significance of the ARCH and GARCH coefficients in relation to returns since the results obtained could have happened out of chance. The test of significance was set at 1 (*p-value with* **) and 5 (*p-value with* *) per cent levels and the results, as in table 18, shows that the ARCH term exhibits statistically significant effect in seventeen firms at 1 and 5 per cent

levels. However, out of these seventeen firms, only KCB and Kenya Airways exhibit statistically significant negative relationship between returns and (ARCH term) conditional variance at 1 per cent level and the remaining fifteen show statistically significant positive relationship between return and (ARCH term) conditional variance at 1 and 5 per cent levels. Similarly, the results, as in table 18 show that the GARCH term is statistically significant in thirteen firms at 1 and 5 per cent levels. However, only BAT and Kenya Power & Lightening show statistically significant negative relation between return and (GARCH term) conditional variance at 1 and 5 per cent levels respectively. The remaining eleven show statistically significant positive relations between return and (GARCH term) conditional variance at 1 and 5 per cent levels.

3. The persistence of volatility as measured by the sum of $\alpha+\beta$ varies considerably for the nineteen companies in Kenya. For example, in Barclays, Stanbic Bank and East Africa Cables, volatility persistence is explosive and $\alpha + \beta > 1$ for these firms. Explosive volatility means that persistence of shocks to volatility in one period will result in even a greater volatility in the subsequent period since the sum of α and β are greater than 1 or unity (Chou, 1988). For all other firms $\alpha + \beta < 1$. For example, Kenya Airways, National Bank of Kenya, Standard Chartered Bank and Total Kenya has the greatest persistence, although not permanent, at 0.9860, 0.9395, 0.9732 and 0.9369 respectively as the sum of α and β is close to 1. This implies that a shock to volatility in the past will be significant in predicting future volatility over a prolonged period. Meanwhile, evidence of low volatility is found in Bamburi, BAT, Centum, East African Breweries, Mumias, National Industrial Credit, National Media Group, Pan African Insurance, TPS and UNGA. Among these eight firms, the sum of α and β

ranges from 0.0677 (Bamburi) to 0.8449 (UNGA). This does not imply that volatility is not present in these firms however; shocks to volatility taper off quickly. McMillan and Thupayagale (2009) found similar evidence in nine African Stock Markets (Botswana, Egypt, Ghana, Kenya, Mauritius, Morocco, Namibia, South Africa and Tunisia) that shocks to volatility in these markets taper off fairly quickly in comparison with UK and US markets. Also, Glosten et al. (1993), using monthly excess return on US stocks found that the conditional volatility is not highly persistent.

4. Per GARCH restriction, the variance constant, ω, should be 0. As in table 18, this condition is violated by the evidence. The coefficients of the variance constant, ω, for eighteen firms are greater than 0. However, this result could be spurious or occurred out of chance and it is appropriate to examine the statistical significance of the coefficients. Per the evidence in table 18, ω, of thirteen firms are statistically positive significant at 1 per cent level.

As can be seen from table 18, beta coefficients for all nineteen firms reveal positive signs in support of a fundamental proposition of the CAPM which state that asset returns are positive (and linear) functions of beta. However, statistically, eighteen firms have significant betas at 1 per cent level. According to the Augmented CAPM the mean intercept should be 0 or close to 0. Nonetheless, this proposition is violated per the results in table 18. The evidence shows that intercepts for all nineteen firms are positive and therefore, greater than 0. However, statistically, it is found that the intercepts of eighteen firms are positively significant at 1 per cent level.

r_{it}

The coefficient of determination, R^2 ranges from 0.06 per cent to 45.42 per cent and this is a summary measure of how well GARCH augmented CAPM explains the return generating process in Kenya. These figures are statistically low and demonstrate that the GARCH augmented CAPM is unable to fully explain the asset return generating process in Kenya. The highest total variation in equity returns in Kenya which can be explained by the GARCH augmented CAPM, as measured by R^2, is only 45.42% (for Kenya Power & Lightening). This is further buttressed by high Akaike Information Criterion (AIC) and Schwarz Criterion (SC), which are all well above the critical value of 3.

7.3.3 GARCH-M Augmented CAPM

Following the evidence from table 18, it is found that shocks to volatility exist in Kenya. French *et al.* (1987) assert that volatility is actually a priced risk factor and not just a data characteristic issue. Therefore, the underlying theory following the results from table 18 is that investors should be rewarded for taking up additional risk. According to Engle, Lilien and Robins (1987), GARCH-in-Mean (or GARCH-M) is a better model to operationalize this type of risk.

The results in table 19 are estimated using equation (6.26) where the regression process allows the conditional variance to enter the conditional mean process (French *et al.,* 1987; Lee *et al.,* 2001). A result for Barclays Bank is presented in the equation for demonstrative purposes. Results for the remaining companies are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \hat{\delta}\sigma_t^2 + \varepsilon_{it}$$

$$r_{it} = 9.0976 + 0.9845 r_{Mt} - 0.0081\sigma_t^2 + \varepsilon_{it}$$

$$t = (7.0263) \quad (18.6825) \quad (-0.0400)$$
$$p = [0.0000] \quad [0.0000] \quad [0.9681]$$

Table 19: time series regression estimates of equation 6.26

Company	***β***	***α***	δ	R^2	***AIC***	***SC***
Barclays Bank	0.9845	9.0976	-0.0081	*0.3770*	7.1542	7.2483
	(18.6825)	(7.0263)	(-0.0400)			
	[0.0000]**	[0.0000]**	[0.9681]			
BAT Kenya	0.8767	9.4908	-0.0598	*0.2860*	7.3315	7.4256
	(12.5923)	(3.2733)	(-0.1821)			
	[0.0000]**	[0.0011]**	[0.8555]			
Centum Investment	1.1576	12.3556	-0.2931	*0.3730*	7.6788	7.7729
	(16.7699)	(3.7441)	(-0.9451)			
	[0.0000]**	[0.0002]**	[0.3446]			
Stanbic Bank	1.1035	12.5910	-0.2844	*0.1417*	8.8279	8.9220
	(13.4494)	(7.3460)	(-4.4057)			
	[0.0000]**	[0.0000]**	[0.0000]**			
East African Cables	1.0330	17.8507	-0.6033	*0.2421*	8.4882	8.5822
	(11.2019)	(6.9957)	(-3.5440)			
	[0.0000]**	[0.0000]**	[0.0004]**			
East African Breweries	0.9002	11.5429	-0.1632	*0.4350*	6.9020	6.9961
	(23.2404)	(6.63028)	(-0.6664)			
	[0.0000]**	[0.0000]**	[0.5052]			
Kenya Commercial Bank	1.3181	-101.8003	9.7706	*0.4809*	7.6096	7.7036
	(15.6589)	(-5.6722)	(5.4839)			
	[0.0000]**	[0.0000]**	[0.0000]**			
Kenya Airways	0.8751	-54.8454	6.6124	*0.3154*	7.4292	7.5480
	(8.1352)	(-0.5264)	(0.6083)			
	[0.0000]**	[0.5986]	[0.5430]			
Kenya Power & Lightening	1.4077	6.2481	0.2850	*0.4610*	7.8985	7.9926
	(6.2481)	(2.6417)	(1.4662)			
	[0.0000]**	[0.0082]**	[0.1426]			
Mumias Sugar Co	1.2127	10.2782	-0.0777	*0.0032*	8.08819	8.2485
	(6.5658)	(5.2585)	(-0.5105)			
	[0.0000]**	[0.0000]**	[0.6097]			
National Industrial Credit	0.7296	3.2907	0.5593	*0.2363*	7.6457	7.7397
	(12.8345)	(12.8346)	(1.5481)			
	[0.0000]**	[0.3552]	[0.1216]			
National Media Group	1.1103	6.6909	0.3131	*0.1872*	7.5552	7.6493
	(25.1101)	(3.4921)	(1.6192)			
	[0.0000]**	[0.0005]**	[0.1054]			
National Bank of Kenya	1.1845	8.1184	-0.3831	*0.2992*	7.8406	7.9470
	(10.9748)	(2.0607)	(-1.1094)			
	[0.0000]**	[0.0000]**	[0.2673]			
Pan African Insurance	0.3333	4.5605	0.3502	*0.0290*	7.8025	7.8966
	(4.4759)	(0.6855)	(0.6487)			
	[0.0000]**	[0.4930]	[0.5166]			
Standard Chartered Bank	0.5177	16.0122	-0.8110	*0.0527*	7.6655	7.75961
	(5.9652)	(19.6088)	(-7.9954)			
	[0.0000]**	[0.0000]**	[0.0000]**			
TPS Eastern Africa	1.1815	20.2413	-1.1763	*0.3565*	7.3435	7.4640
	(16.6347)	(3.0195)	(-1.5441)			
	[0.0000]**	[0.0025]**	[0.1226]			
UNGA Group	1.2160	-9.7373	0.7783	*0.1347*	8.6961	8.7902
	(16.8479)	(4.5645)	(6.2806)			
	[0.0000]**	[0.0000]**	[0.0000]**			

Source: Author's own calculations

Again, the GARCH-M model is characterized by two fundamental propositions; (i) that, $\delta > 0$, to ensure that the conditional variance is interpreted as risk premium which requires compensation; (ii) investors should be rewarded if, δ, is positive.

1. Per evidence in table 19, the coefficients of ten firms are negative, in violation of proposition (i). This means that there is a negative correlation between the return of these three firms and their conditional variance. Similar results have been found elsewhere. For example, Nelson (1991) and Glosten *et al*. (1993) applied ARCH/GARCH-M and EGARCH-M to daily and monthly return data respectively and found negative relation between return and conditional variance in the US. However, the remaining seven firms exhibit positive relation between return and conditional variance in line with French et al. (1987), Campbell and Hentschel (1992), Guo and Neely (2006) results.

2. The positive sign suggests that investors in these ten firms are rewarded for taking up additional volatility risks. However, the negative relations violate the central theme of the GARCH-M which suggests that the conditional expected excess return on asset should vary positively and proportionately with the conditional variance. As argued strongly by Nelson (1991) that standard GARCH/GARCH-M models lack the properties to capture the dynamics of the conditional variance process and went ahead to propose an alternative model that remedy this weakness. This study is limited to standard GARCH-M and not extended to Nelson's model. Intuitively, assets with negative, δ, would be good instruments for hedging (see Merton, 1973) and therefore portfolio/fund managers will look out for assets with negative δ.

4. However, these results could be spurious or occurred out of chance and it is appropriate to examine the statistical significance of the coefficients. Given the results in table 19, only East African Cables and Standard Chartered Bank exhibit negative statistically significant relation between return and conditional variance at 1 per cent level. With 1 per cent level of significance, Kenya Commercial Bank and UNGA Group show positive relation between return and conditional variance.

Per the evidence from table 19, beta coefficients for all seventeen firms exhibit statistically significant positive coefficient in support of a fundamental proposition of the CAPM which state that asset returns are positive (and linear) functions of beta. According to the Augmented CAPM the mean intercept should be 0 or close to 0. Nonetheless, this proposition is violated per the results in table 19. The evidence shows that intercepts for fifteen firms are greater than 0 or of positive values and the intercepts for remaining three firms (Kenya Commercial Bank, Kenya Airways and UNGA) are less than 0 or of negative values. Statistically it is found that the intercepts for fourteen firms are significant at 1 per cent level with either positive or negative sign. The highest total variation in equity returns in Kenya which can be explained by the augmented CAPM, as measured by, R^2 is only 48.09% (for Kenya Commercial Bank).

7.4 Empirical Evidence from Morocco

7.4.1 CAPM

Beta coefficient, intercept and other key parameters are estimated using time series regression via OLS using monthly data. Contemporaneous monthly market risk premium is regressed on monthly excess stock returns. The series are estimated using stationary data at first difference level. The aim of this test is to establish the central theme of CAPM in Morocco which says that the only risk investors care about or compensated for is systematic risk. A result for

Acred is presented in the equation below for demonstrative purposes. Results for the remaining firms are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \varepsilon_{it}$$

$$r_{it} = 9.3613 + 0.1517 r_{Mt} + \varepsilon_{it}$$

$$t = (6.3752) \qquad (0.4014)$$
$$p = [0.0000] \qquad [0.6891]$$

Table 20: time series regression estimates of equation 6.18

Company	***β***	***α***	R^2	***AIC***	***SC***
Acred	0.1517 (0.4014) [***0.6891***]	9.3613 (6.3752) [***0.0000***]**	*0.0034*	8.0839	8.1380
Afriquia Gaz	0.9877 (6.3634) [***0.0000***]**	0.9876 (15.0106) [***0.0000***]**	*0.3332*	6.8455	6.8996
Attijariwafa Bank	1.0126 (12.9662) [***0.0000***]**	8.7030 (32.3597) [***0.0000***] **	*0.6775*	5.4593	5.5134
Auto Hall	2.26136 (6.10835) [***0.0000***]**	9.9277 (14.6520) [***0.0000***]**	*0.2513*	6.7588	6.8129
Auto Nejma	0.2834 (1.7399) [***0.0852***]	10.0910 (9.1817) [***0.0000***]**	*0.0206*	7.5154	7.5695
BMCE Bank	0.8371 (5.0528) [***0.0000***]**	9.3427 (14.1645) [***0.0000***]**	*0.3802*	6.3095	6.3636
BQ. Maroc. Du Com. Etdl.	0.6494 (4.9042) [***0.0000***]**	8.7608 (17.3577) [***0.0000***]**	*0.2680*	6.3180	6.3721
Branoma	0.2114 (1.4384) [***0.1537***]	9.7627 (15.4039) [***0.1537***]	*0.0304*	6.5320	6.5862
Brasseries Du Maroc	0.6459 (4.4445) [***0.0000***]**	9.4983 (11.7411) [***0.0000***]**	*0.1667*	6.9119	6.9660
CDM Credit Du Maroc	0.8447 (3.770) [***0.0003***]**	8.1403 (17.3443) [***0.0003***]**	*0.3373*	6.5144	6.5685
Centrale Laitiere	0.5706 (3.2817) [***0.0015***]**	9.4959 (12.4560) [***0.0000***]**	*0.1279*	6.9744	7.0285
Ciment Du Maroc	0.9317 (7.0149) [***0.0000***]**	8.3496 (11.5636) [***0.0000***]**	*0.3366*	6.7136	6.7677

Consumar	0.2165 (1.4976) [***0.1376***]	9.9961 (13.8235) [***0.0000***]**	*0.0228*	6.8725	6.9266
Cr. Immobil. Et Hotelier	0.9206 (5.0137) [***0.0000***]**	2.0196 (1.5186) [***0.1323***]	*0.1528*	7.7240	7.7781
Eqdom	0.8369 (8.7979) [***0.0000***]**	8.7980 (15.4948) [***0.0000***]**	*0.3589*	6.4007	6.4547
Holcim Maroc	1.1706 (11.9815) [***0.0000***]**	8.4062 (16.0050) [***0.0000***]**	*0.5761*	6.1847	6.2389
Lafarge Ciments	0.9992 (8.9136) [***0.0000***]**	9.1949 (16.5508) [***0.0000***]**	*0.5083*	6.1421	6.1961
Lesieur Cristal	0.4736 (2.8288) [***0.0057***]**	8.2830 (8.9467) [***0.0000***]**	*0.1020*	6.8572	6.9113
Managem	1.5020 (5.5187) [***0.0000***]**	6.1679 (5.6317) [***0.0000***]**	*0.3755*	7.4989	7.5530
Maroc Leasing	1.0967 (3.7003) [***0.0004***]**	5.4719 (3.2234) [***0.0018***]**	*0.0683*	8.9747	9.0288
Nexans Maroc	-0.0048 (-1.4630) [***0.1469***]	8.3058 (219.7072) [***0.0000***]**	*0.0059*	0.6315	0.6856
Rebab	0.1696 (0.6918) [***0.4908***]	9.2550 (6.8845) [***0.0000***]**	*0.0051*	7.9032	7.9573
Samir	0.8911 (3.0435) [***0.0030***]**	8.0063 (10.0494) [***0.0000***]**	*0.2210*	7.1545	7.2086
Sc. Mtg. D'imiter	0.8785 (3.6343) [***0.0005***]**	5.4884 (4.2578) [***0.0000***]**	*0.1133*	7.9752	8.0293
Sonasid	0.9307 (7.5912) [***0.0000***]**	9.3630 (14.6155) [***0.0000***]**	*0.3244*	6.7663	6.8204
Taslif	0.3672 (0.9635) [***0.3378***]	6.0051 (4.0393) [***0.0001***]**	*0.0214*	7.9955	8.0496
Unimer	0.0610 (0.5412) [***0.5896***]	9.1834 (18.2127) [***0.0000***]**	*0.0041*	6.0801	6.1342
Wafa Assurance	0.9852 (5.3123) [***0.0000***]**	6.9112 (8.2053) [***0.0000***] **	*0.2843*	7.0701	7.1242
Zellidja	0.1200 (0.4453) [***0.6572***]	9.9469 (7.6056) [***0.0000***]**	*0.0022*	8.0598	8.1139

Source: Author's own calculations

1. There are three fundamental propositions of the CAPM (i) that asset returns are positive (and linear) functions of beta, (ii) that beta is the only determinant of asset returns, therefore, $\beta > 0$ and $\alpha = 0$ and (iii) risk-averse investors will demand higher return for higher risk investments, that is, $R_M - R_f > 0$. As can be seen from Table 20, with the exception of Nexans, which has a negative beta, propositions (i) is supported by twenty eight firms. This result also support proposition (iii) and the first aspect of proposition (ii) which states that, $\beta > 0$, as positive beta coefficients mean that investors in Morocco, like investors elsewhere, expect to be compensated more, the higher the systematic risk on their investment.

2. The CAPM also implies that if an asset beta is greater than 1 (which is the benchmark beta for the entire market portfolio), then this asset is exposed to higher systematic risk than the market portfolio and therefore, should attract higher returns. The reverse is true for companies with asset beta less than 1. Per evidence in table 20, beta coefficients for twenty four firms are less than 1, however, beta coefficients for Attijariwafa Bank, Auto Hall, Holcim Maroc, Managem and Maroc Leasing are greater than 1. Therefore, firms with beta less than 1 are expected to exhibit low variation in returns (i.e. less risky) than the market portfolio and reverse is true for firms with beta greater than 1. It is expected that by investing in low beta companies investors will require lower returns in compensation for taking up lower systematic risk than if they invested in an Index Fund (see Sharpe, 1964; Lintner, 1965), as they are also exposed to lesser loss in a falling and/or volatile market condition. The reverse is true for investors who will invest in the high beta firms. For portfolio

managers, Nexans Maroc will be a good asset for hedging as it moves in opposite direction to other firms and the market, although insignificantly.

3. Fundamental proposition of the CAPM namely, that only systematic risk (as measured by beta, *β*) determines asset returns since unsystematic can be eliminated through diversification (Markowitz, 1952 & 1959; Sharpe, 1964; Lintner, 1965), is rebutted by the results. There is positive, α, for all twenty nine firms violating the aspect of proposition (ii) which asserts that, α = 0.

4. However, these results could be spurious or obtained by chance and therefore it is vitally important to analyse the statistical significance of this evidence. The test of significance was set at 1 (*p-value with* **) and 5 (*p-value with* *) per cent levels. As can be seen from table 20; the beta coefficients of twenty firms (68.97% of sample) are statistically positive significant at 1 per cent level. In other words, there is a significant positive linear relationship between firms return and beta. This indicates that market risk as measured by beta has a significant effect on estimating cost of capital for these firms for investment appraisal purposes, which is consistent with the evidence documented in other emerging and African capital markets (Claessent *et al*., 1995; Bundoo, 2008; Al-Rjoub *et al*., 2010; Coffie and Chukwulobelu, 2012). The statistical results also show that twenty seven firms exhibit a significant positive relation between returns and alpha at 1 per cent level.

The R^2 for the individual regressions are very low, with the exception of Attijariwafa and this is buttressed by high Akaike Information Criterion (AIC) and Schwarz Criterion (SC), which are all well above the critical value of 3. The highest total variation in equity returns in

Morocco which can be explained by the CAPM, as measured by R^2 , is 67.75% (for Attijariwafa Bank), leaving more than 30 per cent of the variations in the company's equity returns unexplained by the model. For a company like Zellidja, with R^2 of 0.22%, the unexplained variation of 99.88% renders the appropriateness of CAPM even more questionable. These implies that there are other risk factors other than systematic risk, including perhaps company-specific and industry/economy wide risk factors, which equity investors seek compensations for in the Moroccan market. This is consistent with Jensen *et al* (1972) Ross (1976) and Fama and French (1992).

7.4.2 GARCH Augmented CAPM

The evidence documented in the preceding section shows beta is not able to fully explain the return generating process in Morocco. Like Ghana and Kenya, the test is designed to improve the CAPM by modelling both error term and the conditional variance via GARCH. This is to take into account the non-linear characteristics of the regression in the variance equation created by volatility clustering and leptokurtosis.

The results in table 21 are estimated using equations 6.23 and 6.25 to establish the correlation between return and volatility. Parameters are estimated by regressing excess stock return on the market risk premium and expected market volatility using autoregressive integrated moving average (ARIMA) process. A result for Acred is presented in the equation for demonstrative purposes. Results for the remaining firms are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \varepsilon_{it} + \hat{\gamma} h_t + \xi_t$$

$$r_{it} = 6.9996 + 0.1156 r_{Mt} + 111.3067 h_t + \varepsilon_{it}$$

$t = (4.5007) \qquad (0.3840)$
$p = [0.0000] \qquad [0.7009]$

$$h_t = \hat{\omega} + \hat{\alpha}_1 \varepsilon_{t-1} + \hat{\beta}_1 h_{t-1}$$
$$h_t = 110.7349 + 0.5986\varepsilon_{t-1}^2 - 0.0268 h_{t-1}$$

$t = (8.8286) \qquad (3.8227) \qquad (-0.5108)$
$p = [0.0000] \qquad [0.0001] \qquad [0.6095]$

Table 21: time series regression estimates of equation 6.23 and 6.25

Company	B	A	ω	α_1	β_1	$\alpha_1+\beta_1$	R^2	AIC	SC
Acred	0.1156	6.9996	110.7349	0.5986	-0.0268	**0.5718**	*0.0281*	7.9228	8.0580
	(0.3840)	(4.5007)	(8.8286)	(3.8227)	(-0.5108)				
	[0.7009]	[0.0000]**	[0.0000]**	[0.0001]**	[0.6095]				
Afriquia Gaz	0.9823	9.6108	19.1972	0.1256	0.5189	**0.6445**	*0.3332*	6.8970	7.0323
	(8.2566)	(11.6358)	(0.6521)	(0.7098)	(0.7823)				
	[0.0000] **	[0.0000]**	[0.5143]	[0.4779]	[0.4341]				
Attijariwafa Bank	1.0251	8.3762	3.1447	-0.1071	0.8702	**0.7631**	*0.6750*	5.4436	5.5789
	(15.383)	(23.6128)	(2.4429)	(-3.9833)	(10.1975)				
	[0.0000] **	[0.0000]**	[0.0146]*	[0.0001]**	[0.0000]**				
Auto Hall	0.7983	9.8824	42.7788	0.2691	-0.1734	**0.0957**	*0.2510*	6.7401	6.8754
	(5.4743)	(13.2755)	(2.7577)	(1.6545)	(-0.5066)				
	[0.0000]**	[0.0000]**	[0.0058]**	[0.0980]	[0.6124]				
Auto Nejma	0.2615	9.8938	59.2495	-0.0424	0.5475	**0.5051**	*0.0201*	7.5237	7.6590
	(0.9283)	(6.4034)	(0.7039)	(-8.8363)	(0.8161)				
	[0.3533]	[0.0000]**	[0.4815]	[0.0000]**	[0.4144]				
BMCE Bank	0.7946	8.7667	9.4680	0.4379	0.3047	**0.7426**	*0.3718*	6.2194	6.3546
	(10.622)	(18.0275)	(1.3871)	(3.2790)	(1.1273)				
	[0.0000] **	[0.0000]**	[0.1654]	[0.0010]**	[0.2596]				
BQ. Maroc. Du Com. Etdl.	0.8239	8.2118	11.4746	0.7747	0.0560	**0.8307**	*0.2447*	6.1370	6.2723
	(11.651)	(17.9754)	(2.6900)	(2.8114)	(0.2543)				
	[0.0000]**	[0.0000]**	[0.0071]**	[0.0049]**	[0.7992]				
Branoma	0.2014	9.7326	3.9667	-0.1340	1.0376	**0.9036**	*0.0303*	6.4762	6.6115
	(1.4094)	(14.0260)	(2.6715)	(-3.1321)	(81.188)				
	[0.1587]	[0.0000]**	[0.0076]**	[0.0017]**	[0.0000]**				
Brasseries Du Maroc	0.6859	8.9926	8.8894	0.1262	0.7388	**0.8650**	*0.1627*	6.9142	7.0495
	(4.5073)	(10.5245)	(0.8429)	(1.1280)	(3.1199)				
	[0.0000]**	[0.0000]**	[0.3993]	[0.2593]	[0.0018]**				
CDM Credit Du Maroc	0.8159	8.2979	31.3802	1.3905	0.1644	**1.5549**	*0.3366*	6.5427	6.6780
	(9.7802)	(12.5426)	(0.1985)	(1.4942)	(0.1351)				
	[0.0000] **	[0.0000]**	[0.1644]	[0.1351]	[0.9872]				
Centrale Laitiere	0.4232	9.7814	5.9376	0.1295	0.7764	**0.9059**	*0.1189*	6.9283	7.0636
	(2.9434)	(11.3473)	(2.1269)	(1.6390)	(7.7630)				
	[0.0032] **	[0.0000]**	[0.0334]*	[0.1012]	[0.0000]**				
Ciment Du Maroc	0.8718	9.1992	-0.1670	-0.0545	1.0847	**1.0302**	*0.3260*	6.4414	6.5767
	(6.8826)	(31.1296)	(-0.3262)	(-1.6307)	(21.8074)				
	[0.0000]**	[0.0000]**	[0.7443]	[0.1029]	[0.0000]**				
Consumar	0.2207	9.8897	17.6517	0.0759	0.6007	**0.6766**	*0.0226*	6.9231	7.0584
	(1.4446)	(12.2021)	(0.4511)	(0.5820)	(0.7442)				

	[0.1486]	[0.0000]**	[0.6520]	[0.5606]	[0.4568)				
Cr. Immobil.	0.7903 (6.8738) [0.0000] **	1.4002 (1.9653) [0.0494]*	41.7251 (2.1618) [0.0306]*	0.9263 (3.3876) [0.0007]**	-0.0133 (-0.1176) [0.9062]	**0.913**	*0.1463*	7.5280	7.6633
Eqdom	1.0419 (18.644) [0.0000] **	7.7959 (16.0874) [0.0000]**	8.6812 (4.4224) [0.0000]**	-0.2063 (-4.7624) [0.0000]**	0.9303 (39.6450) [0.0000]**	**0.724**	*0.3240*	6.3017	6.4370
Holcim Maroc	1.1825 (13.553) [0.0000] **	8.6811 (17.7875) [0.0000] **	5.8444 (1.0795) [0.2804]	0.4151 (2.0575) [0.0396]*	0.4568 (2.0228) [0.0431]*	**0.8719**	*0.5748*	6.1933	6.3286
Lafarge Ciments	0.9996 (11.869) [0.0000] **	9.5747 (20.2336) [0.0000]**	17.3558 (1.8158) [0.0694]	0.4253 (2.2791) [0.0227]*	-0.0844 (-0.2091) [0.8344]	**0.3409**	*0.5055*	6.0825	6.2178
Lesieur Cristal	0.4892 (3.2179) [0.0013] **	8.0688 (10.4818) [0.0000]**	3.1428 (16.0505) [0.0000]**	-0.1021 (-18.9804) [0.0000]**	1.0594 (115.5810) [0.0000]**	**0.9573**	*0.1012*	6.7848	6.9201
Managem	1.3527 (8.9569) [0.0000]**	6.0571 (7.3509) [0.0000]**	10.8238 (1.2588) [0.2081]	0.2597 (2.0387) [0.0415]*	0.6734 (4.3654) [0.0000]**	**0.9331**	*0.3715*	7.4448	7.5801
Maroc Leasing	0.6227 (2.2659) [0.0235]*	9.6129 (8.1331) [0.0000]**	120.5087 (3.3230) [0.0009]**	1.4736 (3.2174) [0.0013]**	-0.0362 (-0.6730) [0.5009]	**1.4374**	*0.0257*	8.5541	8.6894
Nexans Maroc	0.0001 (0.322) [0.7468]	8.2544 (2579.937) [0.0000]**	2.79E-05 (0.7817) [0.4344]	0.9713 (3.9826) [0.0001]**	0.3219 (5.5673) [0.0000]**	**1.2932**	*0.0217*	-1.9005	- 1.7652
Rebab	0.4068 (1.9461) [0.0516]	8.5572 (7.8472) [0.0000]**	30.4022 (3.2750) [0.0011]**	0.3729 (3.9908) [0.0001]**	0.4829 (4.8947) [0.0000]**	**0.8558**	*0.0066*	7.7575	7.8928
Samir	0.7015 (3.9963) [0.0001] **	7.6712 (7.6145) [0.0000]**	14.3891 (1.4423) [0.1492]	-0.0678 (-4.3704) [0.0000]**	0.8800 (6.6181) [0.0000]**	**0.8122**	*0.2171*	7.1714	7.3067
Sc. Mtg. D'imiter	0.5563 (2.6690) [0.0076] **	3.9525 (2.8230) [0.0048]**	72.8293 (2.2188) [0.0265]*	0.5179 (1.8501) [0.0643]	0.1583 (0.9377) [0.3484]	**0.6762**	*0.0807*	7.9671	8.1024
Sonasid	0.8799 (6.1333) [0.0000]**	10.0572 (14.7245) [0.0000]**	-0.1177 (-0.7791) [0.4359]	-0.03501 (-5.9005) [0.0000]**	1.0546 (489.1225) [0.0000]**	**1.0196**	*0.3175*	6.6689	6.8041
Taslif	-0.0832 (-0.4343) [0.6640]	5.6109 (7.4594) [0.0000]**	42.6730 (3.1042) [0.0019]**	1.5295 (4.3728) [0.0000]**	-0.0066 (-0.0506) [0.9596]	**1.5229**	*0.0141*	7.7262	7.8615
Unimer	0.0846 (0.8800) [0.3789]	9.2253 (18.7483) [0.0000]**	5.6897 (1.5892) [0.1120]	0.2126 (1.4301) [0.1527]	0.5549 (2.6481) [0.0081]**	**0.7675**	*0.0033*	6.0820	6.2173
Wafa Assurance	0.9986 (7.5453) [0.0000]**	7.3686 (7.4712) [0.0000]**	9.1864 (1.0280) [0.3039]	0.1222 (1.9451) [0.0518]	0.7506 (4.4585) [0.0000]**	**0.8728**	*0.2819*	7.1120	7.2473
Zellidja	0.1899 (0.6345) [0.5257]	9.0670 (6.5406) [0.0000]**	9.7603 (2.5755) [0.0100]**	0.1528 (2.5857) [0.0097]**	0.8229 (18.0378) [0.0000]**	**0.9757**	*0.0024*	8.0402	8.1755

Source: Author's own calculations

The GARCH model is characterized by the following three fundamental propositions; (i) that, ω=0 and $\alpha, \beta \geq 0$ to ensure that the conditional variance is sternly positive in relation to expected excess stock return. However, reported empirical evidences are contradictory. For example, French et al. (1987) and Campbell and Hentschel (1992) found positive relationship between excess return and conditional variance, while Fama and Schwert (1977), Campbell (1987), Breen et al. (1989), Turner et al. (1989), Pagan and Hong (1991) and Nelson (1991) found a negative relation; (ii) that shocks to volatility decay at constant rate and the speed of decay is measured by the estimate of $\alpha+\beta$; (iii) that the sum of α and β measures volatility persistence (i.e. the degree to which shocks to current volatility remain important for long-periods into the future). The persistence of shocks to volatility becomes greater as the sum approaches 1 (or unity) and shock to volatility is considered to be permanent if the sum is equal to 1 (Engle and Bollerslev, 1986). As this sum becomes greater than 1, then volatility is explosive, i.e. shock to volatility in one period will result in even a greater volatility in the subsequent period (Chou, 1988).

1. By summing up α (ARCH term) and β (GARCH term), as can be seen from table 21, proposition (i) is supported by the results for all twenty nine firms. The sum of α and β for all the twenty nine firms in Morocco are positive which is consistent with French et al. (1987) and Campbell and Hentschel (1992). However, by disaggregating the model, eight firms exhibit negative coefficients of the conditional (ARCH) variance term and the GARCH term is negative in six firms. Although, according to ARCH/GARCH theory, this negative relationship between returns and conditional variance should not exist, the estimated coefficients of the firms with negative conditional variance violate the imposition of the positive parameter restriction as the ARCH/GARCH models unduly restrict the dynamics of the conditional variance process (see also Nelson, 1991). Previous tests of the relation between excess return and conditional variance using ARCH and GARCH models have documented

negative relationships (Fama and Schwert (1977), Campbell (1987), Breen et al. (1989), Turner et al. (1989), Pagan and Hong (1991) and Nelson (1991). This negative relation between return and conditional variance is buttressed by Black (1976), who found a negative correlation between current returns and future returns volatility. Furthermore, Nelson (1991) and Engle and Ng (1993) argue that the time series properties of monthly returns data are to some extent different from daily returns data and therefore more likely to find a negative relation between returns and conditional variance with low level of data frequency such as monthly returns.

2. Moreover, it is vitally important to analyse the statistical significance of the ARCH and GARCH coefficients in relation to returns since the results obtained could have happened out of chance. The test of significance was set at 1 (*p-value with* **) and 5 (*p-value with* *) per cent levels and the results, as in table 21, shows that the ARCH term exhibits statistically significant coefficients in nineteen firms at 1 and 5 per cent levels. However, out of these nineteen firms, seven exhibit statistically significant negative relationship between returns and (ARCH term) conditional variance at 1 per cent level and twelve show statistically significant positive relationship between return and (ARCH term) conditional variance at 1 and 5 per cent levels. Similarly, the results, as in table 21 show that the GARCH term is statistically positive significant in sixteen firms at 1 and 5 per cent levels.
3. The persistence of volatility as measured by the sum of $\alpha+\beta$ varies considerably for the twenty nine companies in Morocco. For example, in CDM, Ciment, Maroc Leasing, Nexan, Sonasid and Taslif, volatility persistence is explosive and therefore, $\alpha + \beta > 1$ for these firms. Explosive volatility means that persistence of shocks to volatility in one period will result in even a greater volatility in the subsequent period

since the sum of α and β are greater than 1 or unity (Chou, 1988). For all other firms $\alpha + \beta < 1$. For instance, among all firms, only Branoma, Centrale Laitiere, Cr Immobil, Lesieur Cristal, Managem and Zellidja exhibit the greatest persistence, as the sum of α and β is close to 1. This implies that a shock to volatility in the past will be significant in predicting future volatility over a prolonged period.

Meanwhile, evidence of low volatility is found in the remaining seventeen companies return. Among these seventeen firms, the sum of α and β ranges from 0.0957 (Auto Hall) to 0.8728 (Wafa Assurance). This does not suggest that volatility is not present in these firms; however, shocks to volatility diminish so quickly. McMillan and Thupayagale (2009) found similar evidence in nine African Stock Markets (Botswana, Egypt, Ghana, Kenya, Mauritius, Morocco, Namibia, South Africa and Tunisia) that shocks to volatility in these markets taper off fairly quickly in comparison with UK and US markets. Also, Glosten et al. (1993), using monthly excess return on US stocks found that the conditional volatility is not highly persistent.

4. Per GARCH restriction, the variance constant, ω, should be 0. As in table 21, this condition is violated by the evidence. The coefficients of the variance constant, ω, for twenty seven firms are greater than 0 and only Ciment and Sonasid have a negative, ω. However, these results could be spurious or occurred out of chance and it is appropriate to examine the statistical significance of the coefficients. Per the evidence in table 18, fourteen firms have statistically positive significant, ω, at 1 and 5 per cent levels.

The results from table 21, show that beta for twenty eight firms exhibit positive coefficients in support of a fundamental proposition of the CAPM which state that asset returns are positive (and linear) functions of beta. However, only twenty firms have their beta coefficients statistically significant at 1 and 5 per cent levels. According to the Augmented CAPM the mean intercept should be 0 or close to 0. Nonetheless, this proposition is violated per the evidence in table 21. The evidence shows that the mean intercepts for all twenty nine firms are positive and statistically significant at 1 and 5 per cent levels.

The coefficient of determination, R^2 ranges from 0.24 per cent to 67.50 per cent and this is a summary measure of how well GARCH augmented CAPM explains the return generating process in Morocco. These figures are statistically low and demonstrate that the GARCH augmented CAPM is unable to fully explain the asset return generating process in Morocco. The highest total variation in equity returns in Morocco which can be explained by the GARCH augmented CAPM, as measured by R^2, is only 67.50% (for Attijariwafa Bank) and this is just exceptional. This is further buttressed by high Akaike Information Criterion (AIC) and Schwarz Criterion (SC), which are all well above the critical value of 3.

7.4.3 GARCH-M Augmented CAPM

Following the evidence in table 21, it was found that there is a correlation between excess stock return and conditional variance. French *et al.* (1987) assert that volatility is actually a priced risk factor and not just a data characteristic issue. Therefore, the underlying theory following the results in table 21 is that investors should be rewarded for taking up additional risk. According to Engle, Lilien and Robins (1987), GARCH-in-Mean (or GARCH-M) is a better model to operationalize this type of risk.

The results in table 22 are estimated using equation 6.26 where the regression process allows the conditional variance to enter the conditional mean process. The GARCH-M is basically motivated by Merton's (1973) ICAPM which suggests that the conditional expected excess return on the stock market should vary positively and proportionately with the conditional market variance. A result for Acred is presented in the equation for demonstrative purposes. Results for the remaining companies are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \hat{\delta}\sigma_t^2 + \varepsilon_{it}$$

$$r_{it} = -1.3357 - 0.0498 r_{Mt} + 0.8428\sigma_t^2 + \varepsilon_{it}$$

$$t = (-0.1527) \quad (0.1657) \quad (1.1623)$$
$$p = [0.8786] \quad [0.8684] \quad [0.2451]$$

Table22: time series regression estimates of equation 6.26

Company	***β***	***α***	***Δ***	***R^2***	***AIC***	***SC***
Acred	-0.0498 (0.1657) [***0.8684***]	-1.3357 (-0.1527) [***0.8786***]	0.8428 (1.1623) [***0.2451***]	*0.0011*	7.9544	8.1168
Afriquia Gaz	0.8965 (8.9247) [***0.0000***]**	9.7686 (2.4080) [***0.0160***]*	-0.0236 (-0.0364) [***0.9709***]	*0.3303*	6.8544	7.0167
Attijariwafa Bank	1.0211 (13.2425) [***0.0000***]**	229.5932 (60.5984) [***0.0000***]**	-60.7783 (-60.0391) [***0.0000***]**	*0.6872*	5.5165	5.6788
Auto Hall	0.8375 (5.9723) [***0.0000***]**	6.6540 (5.4504) [***0.0000***] **	0.4671 (2.0308) [***0.0423***]*	*0.2397*	6.7105	6.8728
Auto Nejma	0.2977 (1.0548) [***0.2915***]	9.0420 (0.5182) [***0.6043***]	0.0798 (0.0501) [***0.9600***]	*0.0211*	7.5384	7.7007
BMCE Bank	1.0236 (7.8773) [***0.0000***]**	-3.2881 (-8.2646) [***0.0000***]**	3.0962 (62.8395) [***0.0000***] **	*0.0000*	40.1597	40.3220
BQ. Maroc. Du Com. Etdl.	0.8272 (11.6929) [***0.0000***]**	7.9511 (6.7541) [***0.0000***]**	0.0455 (0.2198) [***0.8260***]	*0.2452*	6.1611	6.3234
Branoma	0.1611 (12.0740) [***0.2494***]	12.0741 (1.4169) [***0.1565***]	-0.4033 (-0.2882) [***0.7732***]	*0.0244*	6.6062	6.7685
CDM Credit Du Maroc	0.8473 (10.3418) [***0.0000***]**	2.5587 (1.1398) [***0.2544***]	0.9736 (2.6062) [***0.0092***]**	*0.3147*	6.5182	6.5183
Centrale Laitiere	0.4384 (3.0413) [***0.0024***]	13.2815 (3.4342) [***0.0006***]	-0.4873 (-0.9064) [***0.3647***]	*0.1134*	6.9722	7.1345
Ciment Du	0.8537	415.7196	-61.7128	*0.3955*	6.7066	6.8689

Maroc	(5.9912) [***0.0000***] **	(0.1488) [***0.8817***]	(-0.1453) [***0.8845***]			
Consumar	0.2207 (1.3158) [***0.1882***]	-1.7246 (-0.1069) [***0.9148***]	1.8659 (0.7072) [***0.4794***]	*0.0339*	6.9356	7.0979
Cr. Immobil. Et Hotelier	0.8717 (7.1197) [***0.0000***]**	-3.0308 (-1.5022) [***0.1330***]	0.4695 (2.0206) [***0.0433***]*	*0.1641*	7.4973	7.6596
Holcim Maroc	1.1747 (14.2258) [***0.0000***]**	6.0077 (1.6992) [***0.0893***]	0.5763 (0.7820) [***0.4342***]	*0.5731*	6.2003	6.3627
Lafarge Ciments	1.0005 (11.5696) [***0.0000***]**	10.1527 (3.9128) [***0.0001***] **	-0.1261 (-0.2216) [***0.8246***]	*0.5058*	6.1059	6.2682
Lesieur Cristal	0.6047 (3.6760) [***0.0002***]**	-82.7503 (-8.2535) [***0.0000***] **	12.4159 (6.6258) [***0.0000***] **	*0.1491*	6.8912	7.0536
Managem	1.3305 (7.8116) [***0.0000***]**	-9.8528 (-7.3628) [***0.0000***] **	1.5149 (92.3818) [***0.0000***] **	*0.0875*	9.3912	9.5535
Maroc Leasing	0.7050 (2.9748) [***0.0029***] **	18.4353 (5.3571) [***0.0000***] **	-0.6730 (-3.3833) [***0.0007***] **	*0.3305*	8.4597	8.6221
Nexans Maroc	-0.2407 (-8.8935) [***0.0000***]**	12.9179 (215.7036) [***0.0000***] **	-0.0845 (-1.8457) [***0.0649***]	*0.0000*	104.2211	104.3835
Rebab	0.4123 (1.9991) [***0.0456***]*	13.0423 (1.9992) [***0.0001***] **	-0.4646 (-1.3740) [***0.1694***]	*0.0125*	7.7654	7.9277
Samir	0.6915 (4.5470) [***0.0000***]**	0.6914 (4.2357) [***0.0000***] **	0.1460 (0.6493) [***0.5161***]	*0.2210*	7.0368	7.1991
Sc. Mtg. D'imiter	0.5461 (2.4645) [***0.0137***]*	1.9923 (0.3347) [***0.7379***]	0.1821 (0.3518) [***0.7250***]	*0.0915*	7.9948	8.1571
Sonasid	0.9201 (5.6189) [***0.0000***]**	26.2101 (1.1399) [***0.2543***]	-2.2535 (-0.7301) [***0.4653***]	*0.3440*	6.7987	6.9610
Taslif	-0.0919 (-0.8328) [***0.4050***]	13.0567 (10.8755) [***0.0000***]**	-0.7965 (-12.0444) [***0.0000***] **	*0.8635*	7.5505	7.7129
Unimer	0.08461 (0.8642) [***0.3875***]	7.8840 (2.6095) [***0.0091***] **	0.3026 (0.4620) [***0.6441***]	*0.0059*	6.1127	6.2750
Wafa Assurance	0.73034 (7656.866) [***0.0000***]**	22.9556 (22.9555) [***0.0000***] **	-2.9537 (-78923.63) [***0.0000***] **	*0.0000*	26.6675	26.8299
Zellidja	0.1973 (0.6809) [***0.4960***]	15.9441 (4.9636) [***0.0000***]**	-0.4770 (-1.7998) [***0.0719***]	*0.0190*	-0.0189	8.2150

Source: Author's own calculations

The GARCH-M model is characterized by two fundamental propositions; (i) that, $\delta > 0$, to ensure that the conditional variance is interpreted as risk premium which requires compensation; (ii) investors should be rewarded if, δ, is positive.

1. Per evidence in table 22, proposition (i) is not entirely supported. The results show that the coefficients of thirteen firms are negative, in violation of proposition (i). This means that there is a negative correlation between the return of these thirteen firms and their conditional variance. This result is consistent with literature elsewhere. For example, Nelson (1991) and Glosten et al. (1993) applied ARCH/GARCH-M and EGARCH-M to daily and monthly return data respectively and found negative relation between return and conditional variance in the US. However, the remaining fourteen firms exhibit positive relation between return and conditional variance in line with French et al. (1987), Campbell and Hentschel (1992), Guo and Neely (2006) results.

2. The positive sign suggests that investors in these fourteen firms are rewarded for taking up additional volatility risks (see also French *et al.*, 1987; Campbell and Hentschel, 1992; Li, 2003, Guo and Neely, 2006). Investors investing in these firms will expect additional compensation for volatility risk and corporations that use CAPM to determine cost of equity must capture the volatility risk premium. The negative relations violate the central theme of the GARCH-M which suggests that the conditional expected excess return on asset should vary positively and proportionately with the conditional variance. As argued strongly by Nelson (1991) that standard GARCH/GARCH-M models lack the properties to capture the dynamics of the conditional variance process and went ahead to propose an alternative model that

remedy this weakness. This study is limited to standard GARCH-M and not extended to Nelson's model. Intuitively, assets with negative, δ, would be good for hedging (see Merton, 1973) and therefore portfolio/fund managers will look out for firms with such negative δ.

3. However, these results could be spurious or occurred out of chance and it is appropriate to examine the statistical significance of the coefficients. Per the results in table 22, Auto Hall, BMCE Bank, CDM Credit, Cr Immobil, Lesieur Cristal and Managem exhibit positive statistically significant relation between return and conditional variance at 1 and 5 per cent levels. Nonetheless, Attijariwafa Bank, Maroc Leasing, Taslif and Wafa Assurance show statistically significant negative relation between return and conditional variance at 1 per cent level.

4. As can be seen from the evidence in table 22, beta for twenty four firms exhibit positive signs in support of a fundamental proposition of the CAPM which state that asset returns are positive (and linear) functions of beta. However, seventeen out of these twenty four firms exhibit statistically positive significant beta at 1 and 5 per cent levels. Only Nexans exhibit statistically negative significant beta at 1 per cent level. According to the Augmented CAPM the mean intercept should be 0 or close to 0. Nonetheless, this proposition is violated per the results in table 22. The evidence shows that intercepts for six firms are lower than 0 or of negative values and twenty one with values greater than zero or positive. Statistically it is found that the intercepts for thirteen firms are significant at 1 and 5 per cent levels with positive signs and intercepts for three of the firms' exhibit negative statistical significance at 1 per cent level. The highest total variation in equity returns in Morocco which can be

explained by the augmented CAPM, as measured by R^2, is 68.72% (for Attijariwafa Bank).

7.5 Empirical Evidence from Nigeria

7.5.1 CAPM

Beta coefficient, intercept and other key parameters are estimated using time series regression. Contemporaneous monthly market risk premium of value-weighted NSE All Share index is regressed on monthly contemporaneous excess stock return. The aim of this test is to establish the central theme of CAPM which says that the only risk investors care about or compensated for is the systematic risk. A result for Access Bank is presented in the equation below for demonstrative purposes. Results for the remaining firms are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \varepsilon_{it}$$

$$r_{it} = 1.0245 + 1.4481 r_{Mt} + \varepsilon_{it}$$

$$t = (0.8689) \quad (8.8733)$$
$$p = [0.3869] \quad [0.0000]$$

Table 23: time series regression estimates of equation 6.18

Company	***β***	***α***	R^2	***AIC***	***SC***
Access Bank	1.4481	1.0245	*0.3963*	8.2217	8.2722
	(8.8733)	(0.8689)			
	[0.0000]*	***[0.3869]***			
Afribank Nigeria	1.0417	-1.0079	*0.2522*	8.2053	8.2550
	(4.9675)	(-0.7883)			
	[0.0000]*	***[0.4323]***			
Ashaka Cement	1.2970	-0.7465	*0.3145*	8.3363	8.3860
	(5.3415)	(-0.5558)			
	[0.0000]*	***[0.5795]***			
Bank PHB	1.7300	0.0722	*0.3790*	9.3080	9.3899
	(6.0818)	(0.0169)			
	[0.0000]*	***[0.9866]***			
Cement Co Nigeria	0.76026	0.8484	*0.0964*	8.7605	8.8113
	(3.1018)	(0.5218)			

	[0.0025]*	***[0.6029]***			
Cornerstone Insurance	1.2239	-1.9446	*0.2434*	8.6084	8.6592
	(6.2788)	(-1.3444)			
	[0.0000]*	***[0.1818]***			
Dunlop Nigeria	1.0705	-2.9860	*0.2271*	8.3885	8.4367
	(4.5956)	(-2.2561)			
	[0.0000]*	***[0.0260]****			
Enpee Industries	-0.0318	-1.3118	*0.0175*	4.2034	4.2542
	(-1.4984)	(-4.4839)			
	[0.1371]	***[0.0000]****			
Flour Mills Nigeria	1.4863	0.2527	*0.4629*	8.0112	8.0621
	(6.8658)	(0.1989)			
	[0.0000]*	***[0.8427]***			
Glaxo Nigeria	0.6485	1.0565	*0.1453*	7.9331	7.9814
	(4.0358)	(0.9292)			
	[0.0001]*	***[0.3548]***			
Julius Berger Nigeria	0.9005	-0.8442	*0.1492*	8.5588	8.6071
	(4.8228)	(-0.6417)			
	[0.0000]*	***[0.5224]***			
Lafarge CMT Wapco	1.7762	-0.7941	*0.0921*	10.4644	10.5127
	(2.9490)	(-0.3508)			
	[0.0039]*	***[0.7264]***			
Livestock Feeds	1.3365	-2.6292	*0.2772*	8.6087	8.6595
	(5.6819)	(-1.4202)			
	[0.0000]*	***[0.1586]***			
Nigerian Bottling Company	0.8859	-0.6537	*0.2761*	7.7492	7.7975
	(7.3166)	(-0.7112)			
	[0.0000]*	***[0.4785]***			
Nigeria Breweries	0.7801	-0.1888	*0.19381*	7.9562	8.0045
	(4.6639)	(-0.1663)			
	[0.0000]*	***[0.8683]***			
PZ Cussons	0.6590	0.2096	*0.1213*	8.1739	8.2222
	(3.9009)	(0.2041)			
	[0.0002]*	***[0.8387]***			
Scoa Nigeria	0.4063	0.6594	*0.0253*	8.9296	8.9807
	(1.5577)	(0.2756)			
	[0.1224]	***[0.7834]***			
University Press	0.7284	-0.4991	*0.0910*	8.7467	8.7980
	(4.2460)	(-0.2657)			
	[0.0000]*	***[0.7910]***			
Wema Bank	0.9691	-1.5815	*0.1611*	8.6663	8.7174
	(2.9052)	(-0.7817)			
	[0.0045]*	***[0.4362]***			
Zenith Bank	1.6073	0.1636	*0.6918*	7.5605	7.6303
	(9.3044)	(0.1326)			
	[0.0000]*	***[0.8950]***			

Source: Author's own calculations

1. There are three fundamental propositions of the CAPM (i) that asset returns are positive (and linear) functions of beta, (ii) that beta is the only determinant of asset returns, therefore, $\beta > 0$ and $\alpha = 0$ and (iii) risk-averse investors will demand higher return for higher risk investments, that is, R_M-$R_f > 0$. As can be seen from table 23,

with the exception of Enpee Industries, which has a negative beta, propositions (i) is supported by the results of nineteen firms. This result also support proposition (iii) and the first aspect of proposition (ii) which states that, $\beta > 0$. In that, positive beta coefficients also mean investors in Nigeria, like investors elsewhere, expect to be compensated more, the higher the systematic risk on their investment.

2. The CAPM also implies that if an asset beta is greater than 1, then this asset is exposed to higher systematic risk than the market portfolio and therefore, should attract higher returns. The reverse is true for the companies with asset betas of less than 1. Per evidence in table 23, beta coefficients for ten firms are greater than 1 and the remaining ten have their beta coefficients less than 1. Therefore, firms with beta less than 1 are expected to exhibit low variation in returns (i.e. less risky) than the market portfolio and reverse is true for firms with beta greater than 1. It is expected that by investing in low beta companies investors will require lower returns in compensation for taking up lower systematic risk than if they invested in an Index Fund (see Sharpe, 1964; Lintner, 1965), they are also exposed to lesser loss in a falling and/or volatile market condition. The reverse is true for investors who will invest in the high beta firms. For portfolio managers, Enpee Industries will be a good asset for hedging as it moves in opposite direction to other firms and the market, although insignificantly.

3. Fundamental proposition of the CAPM namely, that only systematic risk (as measured by beta, β) determines asset returns since unsystematic can be eliminated through diversification (Markowitz, 1952 & 1959; Sharpe, 1964; Lintner, 1965), is rebutted by

the results. Among all the twenty firms, there is either positive or negative α, violating the aspect of proposition (ii) which asserts that, $\alpha = 0$.

4. However, these results could be spurious or obtained by chance and therefore it is vitally important to analyse the statistical significance of this evidence. The test of significance was set at 1 (*p-value with* **) and 5 (*p-value with* *) per cent levels. As can be seen from table 23; the beta coefficients of eighteen firms (90% of sample) exhibit statistically positive significance at 1 per cent level. In other words, there is a significant positive linear relationship between firms return and beta. This indicates that market risk as measured by beta has a significant effect on estimating cost of capital for these firms for investment appraisal purposes, which is consistent with the evidence documented in other emerging and African capital markets (Claessent *et al*., 1995; Bundoo, 2008; Al-Rjoub *et al*., 2010; Coffie and Chukwulobelu, 2012). The statistical evidence also shows that only Enpee and Dunlop exhibit negative significant alpha values at 1 and 5 per cent levels respectively.

The R^2 for the individual regressions are very low, with the exception of Attijariwafa and this is buttressed by high Akaike Information Criterion (AIC) and Schwarz Criterion (SC), which are all well above the critical value of 3. The highest total variation in equity returns in Nigeria which can be explained by the CAPM, as measured by R^2 , is 69.18% (for Zenith Bank), leaving almost 30 per cent of the variations in the company's equity returns unexplained by the model. For a company like Enpee Industries, with R^2 of 1.75%, the unexplained variation of 98.25% renders the appropriateness of CAPM even more uncertain. These implies that there are other risk factors other than systematic risk, including perhaps company-specific and industry/economy wide risk factors, which equity investors seek compensations for in the Nigerian market. This is consistent with Jensen *et al* (1972), Ross (1976) and Fama and French (1992).

7.5.2 GARCH Augmented CAPM

Empirical evidence in emerging markets suggests that volatility affect assets return (French *et al*., 1987; Bekaert *et al*., 1996; Ortiz and Arjona, 2001 and Thupayagale, 2010). Also, initial White test, J-B statistics, kurtosis and skewness, all show that stock returns used in this study exhibit inconstant error variance, volatility clustering and leptokurtosis. Therefore, this study is designed to improve the CAPM by modelling both error term and the conditional variance via GARCH. This is to take into account the non-linear characteristics of the regression in the variance equation created by volatility clustering and leptokurtosis. A result for Access Bank is presented in the equation below for demonstrative purposes. Results for the remaining firms are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \varepsilon_{it} + \hat{\gamma} h_t + \xi_t$$

$$r_{it} = 0.0125 + 1.3256 r_{Mt} + 8.5043 h_t + \varepsilon_{it}$$

$$t = (0.0116) \quad (9.7715)$$
$$p = [0.9907] \quad [0.0000]$$

$$h_t = \hat{\omega} + \hat{\alpha}_1 \varepsilon_{t-1}^2 + \hat{\beta}_1 h_{t-1}$$
$$h_t = 7.5192 + 0.0779 \varepsilon_{t-1} + 1.0630 h_{t-1}$$

$$t = (1.7683) \quad (-1.0289) \quad (17.8515)$$
$$p = [0.0770] \quad [0.3035] \quad [0.0000]$$

Table 24: time series regression estimates of equations 6.23 & 6.25

Company	***β***	***α***	***ω***	***α_1***	***β_1***	***$\alpha_{1+\beta 1}$***	***R^2***	***AIC***	***SC***
Access Bank	1.3256 (9.7715) [***0.0000***] **	0.0125 (0.0116) [***0.9907***]	7.5192 (1.7683) [***0.0770***]	-0.0779 (-1.0289) [***0.3035***]	1.0630 (17.8515) [***0.0000***] **	**0.9851**	*0.3907*	7.9966	8.1229

Afribank Nigeria	1.0364 (5.7901) [0.0000] **	-1.1056 (-0.7800) [0.4354]	138.178 (0.5398) [0.5894]	0.0404 (0.5456) [0.5853]	0.2917 (0.2284) [0.8193]	**0.3321**	*0.2522*	8.2530	8.3771
Ashaka Cement	1.2562 (4.7723) [0.0000] **	-0.4914 (-0.3593) [0.7193]	47.6130 (0.5176) [0.6047]	-0.0258 (-0.5728) [0.5668]	0.8271 (2.4598) [0.0139]*	**0.8013**	*0.3140*	8.3718	8.4960
Bank PHB	1.4060 (8.3250) [0.0000] **	-0.2567 (-0.0829) [0.9339]	0.3187 (0.0024) [0.9981]	-0.0433 (0.2526) [0.8006]	1.0699 (1.8165) [0.0693]	**1.0266**	*0.3657*	9.2377	9.4424
Cement Co Nigeria	0.5629 (2.4453) [0.0145]*	0.4953 (0.3985) [0.6902]	15.9031 (2.0645) [0.0390]*	-0.0767 (-1.3438) [0.1790]	1.0455 28.5126 [0.0000] **	**0.9688**	*0.0895*	8.6153	8.7424
Cornerstone Insurance	1.0923 (5.8607) [0.0000] **	-2.6392 (-1.9357) [0.0529]	-5.3227 (-0.5746) [0.5656]	-0.0290 (-0.2428) [0.8081]	1.0582 (7.5345) [0.0000] **	**1.0292**	*0.2394*	8.5527	8.6798
Dunlop Nigeria	0.8695 (4.9073) [0.0000]**	-3.9535 (-3.3858) [0.0007] **	-2.9967 (-0.3831) [0.7016]	0.0077 (-0.0734) [0.9415]	1.0369 (7.5876) [0.0000] **	**1.0446**	*0.2160*	8.2817	8.4024
Enpee Industries	-0.0014 (-2.214) [0.0268]*	-0.5500 (-61.405) [0.0000]**	0.0013 (1.5431) [0.1228]	1.7634 (3.2397) [0.0012]**	0.0738 (1.2451) [0.2131]	**1.8372**	*0.1487*	1.4771	1.6042
Flour Mills Nigeria	1.1879 (4.7961) [0.0000] **	-0.0053 (-0.0053) [0.9957]	12.2325 (0.4223) [0.6728]	0.1944 (.7019) [0.0888]	0.7629 (2.7742) [0.0055]**	**0.9573**	*0.4441*	7.9316	8.0589
Glaxo Nigeria	0.6499 (4.1252) [0.0000] **	1.0495 (0.9095) [0.3631]	131.7119 (0.5596) [0.5757]	-0.0368 (-0.4946) [0.6209]	0.2026 (0.1360) [0.8918]	**0.1658**	*0.1453*	7.9841	8.1047
Julius Berger Nigeria	0.6714 (5.0431) [-0.3006]	-0.4088 (-0.3006) [0.7637]	22.0333 (7.2671) [0.0000]**	-0.0988 (5.3065) [0.0000] **	1.0307 (5.3065) [0.0000] **	**0.9319**	*0.1390*	8.3389	8.4595
Lafarge CMT Wapco	1.1821 (7.8708) [0.0000] **	0.0257 (0.0255) [0.9797]	6.3607 (0.7614) [0.4464]	-0.0634 (-2.1942) [0.0282]*	1.0164 (13.4354) [0.0000] **	**0.9530**	*0.0816*	8.3187	8.4393
Livestock Feeds	0.1442 (2.4497) [0.0143]*	-1.9561 (-7.8875) [0.0000] **	-0.0853 (-0.7244) [0.4688]	-0.0497 (-0.8813) [0.3781]	1.1275 (25.2168) [0.0000] **	**1.0778**	*0.0552*	7.4610	7.5881
Nigerian Bottling Company	0.8784 (8.6954) [0.0000] **	-0.4483 (-0.6600) [0.5092]	4.8738 (2.3271) [0.0200]*	-0.0795 (-5.3836) [0.0000] **	1.0603 (66.7222) [0.0000] **	**0.9808**	*0.2758*	7.6217	7.6216
Nigeria Breweries	0.6042 (4.0148) [0.0001] **	-0.8110 (-0.5649) [0.5722]	41.9430 (2.5641) [0.0103]*	0.4105 (1.1783) [0.2387]	0.4504 (2.3527) [0.0186]*	**0.8609**	*0.1819*	7.9102	8.0309
PZ Cussons	0.8742 (3.2759) [0.0011]**	-0.1174 (-0.0809) [0.9356]	94.2804 (1.3549) [0.1754]	0.2078 (1.0694) [0.2849]	0.3636 (0.8709) [0.3838]	**0.5714**	*0.1079*	8.2104	8.3311
Scoa Nigeria	0.0437 (0.9417) [0.3464]	-4.1503 (-5.3869) [0.0000]**	13.8452 (1.5734) [0.1156]	1.3117 (2.0772) [0.0378]*	0.3166 (2.2143) [0.0268]*	**1.6283**	*0.0469*	8.4314	8.5593
University Press	0.7075 (4.6415) [0.0000]**	-2.3649 (-1.5093) [0.0000]**	0.1359 (0.0115) [0.9908]	-0.0509 (-0.4960) [0.6199]	1.0628 (7.6777) [0.0000]**	**1.0119**	*0.0820*	8.6365	8.7644
Wema Bank	0.7571 (3.0736) [0.0021]**	0.7790 (0.7307) [0.4649]	102.584 (1.3943) [0.1632]	0.3676 (1.7074) [0.0877]	0.2901 (0.9186) [0.3583]	**0.6577**	*0.1388*	8.3822	8.5101
Zenith Bank	1.3559 (11.657) [0.0000]**	-0.4064 (-0.5251) [0.5995]	-1.2160 (-0.8090) [0.4185]	-0.0793 (-0.5121) [0.6086]	1.1421 (7.8053) [0.0000]**	**1.0628**	*0.6744*	7.2739	7.4484

Source: Author's own calculation

The GARCH model is characterized by the following three fundamental propositions; (i) that, ω=0 and $\alpha, \beta \geq 0$ to ensure that the conditional variance is strictly positive in relation to expected excess stock return. However, reported empirical evidences are contradictory. For example, French et al. (1987) and Campbell and Hentschel (1992) found positive relationship between excess return and conditional variance, while Fama and Schwert (1977), Campbell (1987), Breen et al. (1989), Turner et al. (1989), Pagan and Hong (1991) and Nelson (1991) found a negative relation; (ii) that shocks to volatility decay at constant rate and the speed of decay is measured by the estimate of $\alpha+\beta$; (iii) that the sum of α and β measures volatility persistence (i.e. the degree to which shocks to current volatility remain important for long-periods into the future). The persistence of shocks to volatility becomes greater as the sum approaches 1 (or unity) and shock to volatility is considered to be permanent if the sum is equal to 1 (Engle and Bollerslev, 1986). As this sum becomes greater than 1, then volatility is explosive, i.e. shock to volatility in one period will result in even a greater volatility in the subsequent period (Chou, 1988).

1. By summing up α (ARCH term) and β (GARCH term), as can be seen from table 24, proposition (i) is supported by the results of all twenty companies. The sum of α and β for all the twenty firms in Nigeria are positive which is consistent with French et al. (1987) and Campbell and Hentschel (1992). However, by disaggregating the model, twelve firms exhibit negative coefficients of the conditional (ARCH) variance term, while the GARCH term for twenty firms is positive in line with the models prediction. Previous tests of the relation between excess return and conditional variance using ARCH model have documented negative relationships (Fama and Schwert (1977), Campbell (1987), Breen et al. (1989), Turner et al. (1989), Pagan and Hong (1991) and Nelson (1991). This negative relation between return and conditional variance is

buttressed by Black (1976), who found a negative correlation between current returns and future returns volatility. Furthermore, Nelson (1991) and Engle and Ng (1993) argue that the time series properties of monthly returns data are to some extent different from daily returns data and therefore more likely to find a negative relation between returns and conditional variance with low level of data frequency such as monthly returns.

2. Moreover, it is vitally important to analyse the statistical significance of the ARCH and GARCH coefficients in relation to returns since the results obtained could have occurred out of chance. The test of significance was set at 1 (*p-value with* **) and 5 (*p-value with* *) per cent levels and the results, as in table 24, shows that the ARCH term exhibits statistically significant negative relationship between returns of Julius Berger(**), Lafarge(*), Nigerian Bottling Company(**) and (ARCH term) conditional variance. However, Enpee and Scoa show statistically significant positive relationship between return and (ARCH term) conditional variance at 1 and 5 per cent level respectively. Similarly, the results, as in table 24, show that the GARCH term is statistically positive significant in fourteen firms at 1 and 5 per cent levels.

3. The persistence of volatility as measured by the sum of $\alpha+\beta$ varies considerably for the twenty companies in Nigeria. For example, in Bank PHB, Cornerstone Insurance, Dunlop, Enpee, Livestock, Scoa, University Press and Zenith Bank, volatility persistence is explosive and therefore, $\alpha + \beta > 1$ for these firms. Explosive volatility means that persistence of shocks to volatility in one period will result in even a greater volatility in the subsequent period since the sum of α and β are greater than 1

or unity (Chou, 1988). For all other firms $\alpha + \beta < 1$. For instance, among the remaining firms, Access Bank, Ashaka, Cement Co, Flour Mills, Julius Berger, Lafarge, Nigerian Bottling and Nigeria Breweries exhibit the greatest persistence, as the sum of α and β is close to 1. This implies that a shock to volatility in the past will be significant in predicting future volatility over a prolonged period. Meanwhile, evidence of low volatility is found in the returns of Afribank, Glaxo, PZ and Wema. This does not suggest that volatility is not present in these firms however; shocks to volatility diminish so quickly. McMillan and Thupayagale (2009) found similar evidence in nine African Stock Markets (Botswana, Egypt, Ghana, Kenya, Mauritius, Morocco, Namibia, South Africa and Tunisia) that shocks to volatility in these markets taper off fairly quickly in comparison with UK and US markets. Also, Glosten et al. (1993), using monthly excess return on US stocks found that the conditional volatility is not highly persistent.

4. Per GARCH restriction, the variance constant, ω, should be 0. As in table 24, this condition is violated by the evidence. The coefficients of the variance constant, ω, for sixteen firms are greater than 0 and thus, positive and the remaining four (i.e. Connerstone, Dunlop, Livestock and Zenith) have negative constant variance, ω. However, these results could be spurious or occurred out of chance and it is appropriate to examine the statistical significance of the coefficients. Per the evidence in table 24, only Cement Co, Julius Berger, Nigerian Bottling and Nigeria Breweries have statistically positive significant, ω, at 1 and 5 per cent levels.

The results from table 24, show that beta for nineteen firms exhibit positive coefficient in support of a fundamental proposition of the CAPM which state that asset returns are positive (and linear) functions of beta. However, eighteen firms have their beta coefficients statistically significant at 1 and 5 per cent levels. According to the Augmented CAPM the mean intercept should be 0 or close to 0. Nonetheless, this proposition is violated per the evidence in table 24. The evidence shows that the mean intercepts for all twenty firms are either greater or less than 0, however, only Dunlop, Enpee, Livestock, Scoa and University Press have statistically negative significant coefficients at 1 per cent level.

The coefficient of determination, R^2 ranges from 4.69 per cent to 67.44 per cent and this is a summary measure of how well GARCH augmented CAPM explains the return generating process in Nigeria. These figures are statistically low and demonstrate that the GARCH augmented CAPM is unable to fully explain the asset return generating process in Nigeria. The highest total variation in equity returns in Nigeria which can be explained by the GARCH augmented CAPM, as measured by R^2, is only 67.44% (for Zenith Bank) and this is just exceptional. The weak performance of GARCH Augmented CAPM is further buttressed by high Akaike Information Criterion (AIC) and Schwarz Criterion (SC), which are all well above the critical value of 3.

7.5.3 GARCH-M Augmented CAPM

Following the evidence from table 24, it was found that shocks to volatility are present in Nigeria. French *et al.* (1987) assert that volatility is actually a priced risk factor and not just a data characteristic issue. Therefore, the underlying theory following the results from table 24 is that investors should be rewarded for taking up additional risk. According to Engle, Lilien and Robins (1987), GARCH-in-Mean (or GARCH-M) is a better model to operationalize this type of risk.

The results in table 25 are estimated using equation 6.26 where the regression process allows the conditional variance to enter the conditional mean process. The GARCH-M is basically motivated by Merton's (1973) ICAPM which suggests that the conditional expected excess return on the stock market should vary positively and proportionately with the conditional market variance. A result for Afribank is presented in the equation for demonstrative purposes. Results for the remaining companies are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \hat{\delta}\sigma_t^2 + \varepsilon_{it}$$

$$r_{it} = -2.1125 + 0.4991 r_{Mt} + 0.1189\sigma_t^2 + \varepsilon_{it}$$

$$t = (-2.9231) \quad (2.7736) \quad (1.1728)$$
$$p = [0.0035] \quad [0.0055] \quad [0.2409]$$

Table 25: time series regression estimates of equation 6.26

Company	***β***	***α***	***δ***	***R^2***	***AIC***	***SC***
Access Bank	1.1047 (9.7613) [***0.0000***]**	15.7515 (1.4027) [***0.1607***]	-0.0806 (-1.4599) [***0.1443***]	*0.3277*	7.9727	8.1496
Afribank Nigeria	0.4991 (2.7736) [***0.0055***]**	-2.1125 (-2.9231) [***0.0035***]**	0.1189 (1.1728) [***0.2409***]	*0.1861*	7.8040	7.9530
Ashaka Cement	1.3385 (5.1629) [***0.0000***]**	21.2387 (8.7017) [***0.0000***]**	-1.3311 (-5.1690) [***0.0000***]**	*0.3158*	8.3693	8.5183
Bank PHB	1.7433 (7.0803) [***0.0000***]**	40.5577 (3.3199) [***0.0009***]**	-1.4956 (-2.0338) [***0.0420***]*	*0.3890*	9.4095	9.6552
Cement Co Nigeria	0.7750 (4.1291) [***0.0000***]**	-1132.460 (-0.0690) [***0.9450***]	60.5747 (0.0691) [***0.9449***]	*0.1068*	8.8261	8.9786
Dunlop Nigeria	0.9829 (5.0458) [***0.0000***]**	8.4299 (0.6790) [***0.4971***]	-0.7385 (-0.8977) [***0.3693***]	*0.2412*	8.3881	8.5329
Enpee Industries	-0.0041 (-1.0388) [***0.2989***]	-0.1560 (-0.6996) [***0.4842***]	-0.9586 (-1.5399) [***0.1236***]	*0.4395*	1.8921	2.0447
Flour Mills Nigeria	1.19810 (4.7012) [***0.0000***]**	2.9399 (0.6176) [***0.5369***]	-0.2629 (-0.6571) [***0.5111***]	*0.4426*	7.9492	8.1017
Julius Berger Nigeria	0.9111 (4.2623) [***0.0000***]**	2.4731 (0.2229) [***0.8236***]	-0.2123 (-0.3273) [***0.7435***]	*0.1465*	8.6278	8.7726
Lafarge CMT Wapco	1.2945 (6.6162) [***0.0000***]**	-90.3729 (-0.8943) [***0.3711***]	2.4937 (1.1926) [***0.2330***]	*0.4452*	9.9955	10.1403
Livestock Feeds	1.1022 (1.4453) [***0.1484***]	3.8160 (1.1046) [***0.2693***]	-0.4126 (-0.6531) [***0.5137***]	*0.2556*	8.5087	8.6613

Nigeria Bottling	0.9026 (5.8101) [***0.0000***]**	-63.9649 (-0.8040) [***0.4214***]	13.0789 (0.8007) [***0.4233***]	*0.2483*	7.8079	8.3989
Nigeria Breweries	0.6001 (3.9938) [***0.0001***]**	6.6988 (1.8621) [***0.0626***]	-0.6849 (-2.2247) [***0.0261***]*	*0.1575*	7.9092	8.0540
PZ Cussons	0.8734 (3.3972) [***0.0007***]**	-2.5336 (-0.3297) [***0.7416***]	0.1801 (0.3094) [***0.7570***]	*0.1099*	8.2264	8.3713
Scoa Nigeria	0.1002 (1.7452) [***0.0810***]	-8.3299 (-6.1828) [***0.0000***]**	0.4467 (4.5297) [***0.0000***]**	*0.0458*	8.4062	8.5597
University Press	0.7342 (4.3869) [***0.0000***]**	76.9097 (0.3140) [***0.7536***]	-4.1526 (-0.3220) [***0.7475***]	*0.0964*	8.8172	8.9707
Wema Bank	0.8160 (3.2298) [***0.0012***]**	11.9801 (1.8251) [***0.0680***]	-0.7916 (-1.8276) [***0.0676***]	*0.2074*	8.3709	8.5244
Zenith Bank	1.21723 (14.8323) [***0.0000***]**	1.0269 (0.4629) [***0.6434***]	-0.3541 (-1.0614) [***0.2885***]	*0.6275*	7.5763	7.7857

Source: Author's own calculation

The GARCH-M model is characterized by two fundamental propositions; (i) that, $\delta > 0$, to ensure that the conditional variance is interpreted as risk premium which requires compensation; (ii) investors should be rewarded if, δ, is positive.

1. Per evidence in table 25, proposition (i) is not wholly supported. The results show that the coefficients of twelve firms are negative, in violation of proposition (i). This means that there is a negative correlation between the return of these firms and their conditional variance. This result is consistent with existing literature. For example, Nelson (1991) and Glosten et al. (1993) applied ARCH/GARCH-M and EGARCH-M to daily and monthly return data respectively and found negative relation between return and conditional variance in the US. However, the remaining five firms exhibit positive relation between return and conditional variance in line with French et al. (1987), Campbell and Hentschel (1992), Guo and Neely (2006) results.

2. The positive sign suggests that investors in these five firms are rewarded for taking up additional volatility risks (see also French *et al*., 1987; Campbell and Hentschel, 1992; Li, 2003, Guo and Neely, 2006). Investors investing in these firms will expect

additional compensation for volatility risk and corporations that use CAPM to determine cost of equity must capture the volatility risk premium. The negative relations violate the central theme of the GARCH-M, which suggests that the conditional expected excess return on asset should vary positively and proportionately with the conditional variance. As argued strongly by Nelson (1991) that standard GARCH/GARCH-M models lack the properties to capture the dynamics of the conditional variance process and went ahead to propose an alternative model that remedy this weakness. This study is limited to standard GARCH-M and not extended to Nelson's model. Intuitively, assets with negative, δ, would be good instruments for hedging (see Merton, 1973) and therefore portfolio/fund managers will look out for firms with negative, δ.

3. However, these results could be spurious or occurred out of chance and it is appropriate to examine the statistical significance of the coefficients. Per the results in table 16, only Scoa exhibits positive statistically significant relation between return and conditional variance at 1 per cent level. Statistically, Ashaka, Bank PHB and Nigeria Breweries show negative significant relation between return and their conditional variance at 1 and 5 per cent levels.

4. Per the evidence from table 25, the beta for seventeen firms, with the exception of Enpee, which shows negative beta, support the fundamental proposition of the CAPM which state that asset returns are positive (and linear) functions of beta. However, fifteen firms have positive significant beta coefficients at 1 per cent level. According to the Augmented CAPM the mean intercept should be 0 or close to 0. Nonetheless, this proposition is violated per the results in table 25. The evidence shows that the intercepts for all the firms are either greater (i.e. positive) or less (i.e. negative) than 0.

However, statistically it is found that the intercepts of Afribank, Ashaka, Bank PHB, and Scoa are significant at 1 per cent level and with either negative or positive sign. The highest total variation in equity returns in Nigeria which can be explained by the augmented CAPM, as measured by R^2, is 62.75% (for Zenith Bank).

7.6 Empirical Evidence from South Africa

7.6.1 CAPM

Beta coefficient, intercept and other key parameters are estimated using time series regression. Contemporaneous monthly market risk premium of value-weighted FTSE/JSE All Share index is regressed on monthly contemporaneous excess stock returns. The aim of this test is to establish the central theme of CAPM which says that the only risk investors care about or compensated for is the systematic risk. A result for ABSA is presented in the equation below for demonstrative purposes. Results for the remaining firms are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \varepsilon_{it}$$

$$r_{it} = 8.5822 - 0.0028 r_{Mt} + \varepsilon_{it}$$

$$t = (13.1675) \quad (-0.3194)$$
$$p = [0.000] \quad [0.7498]$$

Table 26: time series regression estimates of equation 6.18

Company	***β***	***α***	***R^2***	***AIC***	***SC***
ABSA Group	-0.0028 (-0.3194) [***0.7498***]	8.5823 (13.1675) [***0.0000***]**	*0.0006*	7.1465	7.1830
Acucap Properties	0.1535 (1.2008) [***0.2330***]	9.1434 (14.1805) [***0.0000***] **	*0.0224*	6.4121	6.4669
AECI	-0.0002 (-0.0302) [***0.9759***]	8.2729 (8.8847) [***0.0000***] **	*0.0000*	7.6613	7.6977
African Rainbow	0.0138 (1.8939)	7.9617 (7.1915)	*0.0060*	7.9985	8.0349

	[***0.0599***]	[***0.0000***] **			
African Oxygen	0.0032	8.1170	*0.0008*	7.1813	7.2178
	(0.3629)	(12.2388)			
	[***0.7171***]	[***0.0000***] **			
AG Industries	0.6212	8.9618	*0.0106*	9.9835	10.0290
	(1.1449)	(2.8181)			
	[***0.2545***]	[***0.0056***] **			
Allied Technologies	0.0091	0.3206	*0.0039*	7.5998	7.6362
	(1.4636)	(0.4338)			
	[***0.1451***]	[***0.6650***]			
AngloGold Ashanti	0.0050	8.4727	*0.0010*	7.8139	7.8504
	(0.8458)	(10.8121)			
	[***0.3988***]	[***0.0000***] **			
Anglo Platinum	0.0161	9.1565	*0.0087*	7.9344	7.9708
	(1.8308)	(9.5210)			
	[***0.0689***]	[***0.0000***] **			
Aspen	0.0009	10.0468	*0.0000*	8.3587	8.3951
Pharmaceutical	(0.1190)	(7.6894)			
Holdings	[***0.9054***]	[***0.0000***] **			
	0.7665	8.3784	*0.1858*	7.3482	7.3937
Aveng	(4.5496)	(8.6009)			
	[***0.0000***] **	[***0.0000***] **			
Basil Read	0.0047	8.6888	*0.0004*	8.6384	8.6749
	(0.8567)	(5.3609)			
	[***0.3928***]	[***0.0000***]**			
Ceramic Industries	-0.0086	9.3272	*0.0051*	7.2657	7.3035
	(-2.6776)	(10.7636)			
	[***0.0082***] **	[***0.0000***] **			
City Lodge Hotels	0.0038	8.6479	*0.0007*	7.6372	7.6737
	(0.6634)	(10.8529)			
	[***0.5080***]	[***0.0000***] **			
COM AIR	0.8278	7.5604	*0.1435*	8.1037	8.1465
	(4.7383)	(6.3762)			
	[***0.0000***] **	[***0.0000***] **			
Cullinan	-0.0242	2.4816	*0.0074*	8.9188	8.9553
	(-2.6257)	(1.3234)			
	[***0.0094***] **	[***0.1875***]			
Delta EMD	0.0165	7.6972	*0.0116*	7.6899	7.7263
	(1.4148)	(9.0000)			
	[***0.1590***]	[***0.0000***] **			
Discovery	0.3493	3.1681	*0.0615*	7.0449	7.0911
	(2.7931)	(4.2778)			
	[***0.0061***] **	[***0.0000***] **			
Distell Group	0.0124	-1.1890	*0.0023*	8.7419	8.7784
	(2.5357)	(-0.7796)			
	[***0.0121***]	[***0.4367***]			
DRD Gold	0.0124	-1.1890	*0.0023*	8.7419	8.7784
	(0.6320)	(-0.8216)			
	[***0.5282***]	[***0.4125***]			
DS&WHSG Network	0.0144	3.5144	*0.0028*	8.8663	8.9028
	(1.5783)	(2.0668)			
	[***0.1163***]	[***0.0403***]*			
First Rand Bank	-0.0086	9.1399	*0.0038*	7.5137	7.5501
	(-0.9872)	(12.8689)			
	[***0.3249***]	[***0.0000***] **			
Glenrand M I B	0.0610	6.1599	*0.0126*	5.4602	5.5028
	(1.1058)	(8.9767)			
	[***0.2708***]	[***0.0000***] **			
Gold Reef Resorts	0.0165	7.6397	*0.0080*	8.1385	8.1765
	(3.2072)	(6.3998)			

	[***0.0016***] **	[***0.0000***] **			
Gold Fields	0.0296	8.1435	*0.0290*	7.9219	7.9584
	(5.0920)	(8.7318)			
	[***0.0000***] **	[***0.0000***] **			
Group Five	0.0066	8.7531	*0.0014*	8.0501	8.0873
	(1.1115)	(7.9644)			
	[***0.2680***]	[***0.0000***] **			
Growthpoint Properties	-0.0122	8.5675	*0.0067*	7.6429	7.6793
	(-6.1910)	(9.1838)			
	[***0.0000***] **	[***0.0000***] **			
Harmony Gold Mining	0.0150	5.3297	*0.0044*	5.3318	8.4626
	(1.3854)	(3.7816)			
	[***0.1677***]	[***0.0002***] **			
Impala Platinum	0.0176	9.3971	*0.0099*	7.9806	8.0171
	(2.1411)	(9.6873)			
	[***0.0337***]*	[***0.0000***] **			
Liberty Holdings	-0.0050	8.1363	*0.0022*	8.1356	7.0135
	(-0.9299)	(13.4469)			
	[***0.3537***]	[***0.0000***] **			
Masonite Africa	0.0035	7.0940	*0.0006*	7.5809	7.6174
	(2.0035)	(7.5568)			
	[***0.0467***]*	[***0.0000***] **			
Merafe Resources	0.0123	0.2901	*0.0023*	8.7446	8.7810
	(0.9526)	(0.1822)			
	[***0.3421***]	[***0.8556***]			
Merchant & Industrial Properties	-2.0843	5.8962	*0.0001*	22.8186	22.8551
	(-0.4283)	(1.7282)			
	[***0.6689***]	[***0.0858***]			
MMI Holdings	-0.0081	8.5963	*0.0033*	7.5617	7.5982
	(-1.1130)	(11.2869)			
	[***0.2673***]	[***0.0000***] **			
MTN Group	0.0081	9.4026	*0.0023*	7.9325	7.9700
	(0.9251)	(8.7416)			
	[***0.3563***]	[***0.0000***] **			
Murray & Roberts	0.0017	8.3722	*0.0001*	7.8947	7.9311
	(0.3254)	(7.6049)			
	[***0.7453***]	[***0.0000***] **			
NED Bank Group	0.0038	3.8343	*0.0008*	7.4290	7.4654
	(0.6170)	(3.8410)			
	[***0.5381***]	[***0.0002***] **			
Octodec Investments	0.0034	9.5089	*0.0009*	7.1594	7.1959
	(0.8649)	(15.6382)			
	[***0.3883***]	[***0.0000***] **			
Omnia	0.0049	8.3863	*0.0010*	7.6868	7.7233
	(0.8585)	(10.3157)			
	[***0.3918***]	[***0.0000***] **			
Pangbourne Properties	-0.0052	9.4523	*0.0037*	6.5648	6.6012
	(-2.5106)	(20.2173)			
	[***0.0130***]*	[***0.0000***] **			
Premium Properties	-0.0032	9.7695	*0.0007*	7.2330	7.2695
	(-1.0142)	(14.7617)			
	[***0.3119***]	[***0.0000***] **			
Pretoria Port CMT	-0.0118	8.6959	*0.0094*	7.2370	7.2734
	(-3.3341)	(13.3217)			
	[***0.0010***] **	[***0.0000***] **			
RMB Bank	-0.004518	8.997639	*0.0011*	7.4858	7.5223
	(-0.5599)	(12.1575)			
	[***0.5763***]	[***0.0000***] **			
SABLE	0.0061	7.3722	*0.0009*	8.2555	8.2919
	(1.8694)	(6.4856)			

	[***0.0633***]	[***0.0000***] **			
SACOIL Holdings	-0.0590 (-3.2688) [***0.0013***] **	-2.7555 (-1.4583) [***0.1466***]	*0.0180*	9.7872	9.8237
Saambou Bank	0.0115 (2.1740) [***0.0311***]*	8.0079 (8.7840) [***0.0000***] **	*0.0075*	7.4175	7.4539
Sanlam	0.518799 (5.0974) [***0.0000***] **	8.254811 (14.0726) [***0.0000***] **	*0.1568*	6.7597	6.8034
SASOL	0.0096 (1.1906) [***0.2355***]	9.0265 (11.1217) [***0.0000***] **	*0.0046*	7.5571	7.5936
Spanjaard	0.0016 (0.4862) [***0.6274***]	8.6080 (9.5818) [***0.0000***] **	*0.0001*	7.8046	7.8410
Standard Bank Group	-0.0019 (-0.2402) [***0.8104***]	8.9102 (13.4163) [***0.0000***] **	*0.0002*	7.4869	7.5234
Sun International	0.0012 (0.2291) [***0.8191***]	8.2680 910.9313) [***0.0000***] **	*0.0001*	7.3767	7.4132
TELKOM	0.4122 (1.9503) [***0.0547***]	8.9186 (9.7636) [***0.0000***] **	*0.0687*	7.1610	7.2206
VOX Telecom	0.0074 (0.0096) [***0.9923***]	-0.9965 (-0.3486) [***0.7280***]	*0.0000*	10.2621	10.3053
White Water Resources	-0.0059 (-2.0923) [***0.0379***]*	-1.6953 (-1.1240) [***0.2626***]	*0.0003*	9.2740	9.3104
WLSN Bayly Holmes-Ovcon	-0.0122 (-2.4256) [***0.0163***]*	10.0162 (10.3671) [***0.0000***] **	*0.0058*	7.7845	7.8210
Zurich Insurance	-0.0028 (-0.5927) [***0.5541***]	8.5823 (13.6270) [***0.0000***] **	*0.0006*	7.1465	7.1830

Source: Author's own calculation

1. The CAPM test is aimed at achieving three fundamental propositions as follows: (i) that asset returns are positive (and linear) functions of beta, (ii) that beta is the only determinant of asset returns, therefore, $\beta > 0$ and $\alpha = 0$ and (iii) risk-averse investors will demand higher return for higher risk investments, that is, R_M-$R_f > 0$. As can be seen from Table 26, eighteen firms with negative beta coefficients violate propositions (i). These eighteen firms also violate the first aspect of proposition (ii) which states that, $\beta > 0$ to compensate for any systematic risk. In practice, portfolio and hedge fund managers will look out for such firms to form a balanced portfolio (see Merton, 1973). In other words, these firms return moves in

opposite direction to the market portfolio and other firms and therefore, considered as good instruments for portfolio hedge. However, thirty eight firms with positive beta coefficient support proposition (i) per the results in table 26. Positive beta coefficients also mean investors in these firms, like investors elsewhere, expect to be compensated more, the higher the systematic risk on their investment.

2. The CAPM also implies that if an asset beta is greater than 1, then this asset is exposed to higher systematic risk than the market portfolio and therefore, should attract higher returns. The reverse is true for the companies with asset betas of less than 1. Per evidence in table 26, beta coefficients for all fifty six firms are less than 1, and hence, expected to experience low variation in returns (i.e. less risky) than the market portfolio. It is expected that by investing in South Africa companies investors will require lower returns in compensation for taking up lower systematic risk than if they invested in an Index Fund (see Sharpe, 1964; Lintner, 1965), they are also exposed to lesser loss in a falling and/or volatile market condition.

3. Fundamental proposition of the CAPM namely, that only systematic risk (as measured by beta, β) determines asset returns since unsystematic can be eliminated through diversification (Markowitz, 1952 & 1959; Sharpe, 1964; Lintner, 1965), is rebutted by the results. Among all the fifty six firms, there is either positive or negative α, violating that aspect of proposition (ii) which asserts that, $\alpha = 0$.

4. However, these results could be spurious or obtained by chance and therefore it is vitally important to analyse the statistical significance of this evidence. The test of significance was set at 1 (*p-value with* **) and 5 (*p-value with* *) per cent levels. As can be seen from table 26; beta of only nine firms exhibit statistically positive significance at 1 and 5 per cent levels. In

other words, there is a significant positive linear relationship between these firms return and beta. This indicates that market risk as measured by beta has a significant effect on estimating cost of capital for these firms for investment appraisal purposes, which is consistent with the evidence documented in other emerging and African capital markets (Claessent *et al*., 1995; Bundoo, 2008; Al-Rjoub *et al*., 2010; Coffie and Chukwulobelu, 2012). The statistical evidence also shows that eight firms exhibit negative significant beta values at 1 and 5 per cent levels. The individual regressions show forty six firms exhibit statistically significant positive alpha values at 1 per cent level, while DS & WHSG is significant at 5 per cent level.

The R^2 for the individual regressions are very low and this is buttressed by high Akaike Information Criterion (AIC) and Schwarz Criterion (SC), which are all well above the critical value of 3. The highest total variation in equity returns in South Africa which can be explained by the CAPM, as measured by R^2 , is only 18.58% (for Aveng), leaving more than 80 per cent of the variations in the company's equity returns unexplained by the model. For companies like Vox Telecom, Aspen Pharmaceutical and AECI, with R^2 of 0.00%, the unexplained variation of 100% renders the appropriateness of CAPM even more suspicious. These implies that there are other risk factors other than systematic risk, including perhaps company-specific and industry/economy wide risk factors, which equity investors seek compensations for in the South African market. This is consistent with Jensen *et al* (1972) Ross (1976) and Fama and French (1992).

The abysmal performance of the CAPM in estimating returns and the inability of the beta to explain most variations in the return generating process in South Africa turned out to be worrying to the researcher. This is because JSE is the most developed capital market in Africa and it is expected that as capital market develops its market microstructure also advances and become more correlated to the world market (O'Brien, 1999; Stulz, 1995). As the impact of these market microstructures such as illiquidity, thin trading, and marketability diminishes systematic risk factor becomes more relevant in explaining the return generating process (Amihud and Mendelson, 1986). As a consequence, the researcher revisited his data used to estimate the parameters for South African firms to check for errors in the data. In fact, there was none. All the series are first difference stationary since Augmented Dickey-Fuller (ADF) test revealed that some series were non-stationary at level. Newey-West standard error was used to correct for both heteroscedasticity and auto correlation and this was confirmed by acceptable range of Durbin-Watson (DW) statistic across firms. In order to normalise returns used in the estimation lognormal returns of asset prices and indices were calculated. However, comparable empirical evidence on CAPM tests in South Africa by Reddy and Thomson (2011) shows that the beta is unable to explain realised asset returns.

7.6.2 GARCH Augmented CAPM

Empirical evidence in emerging markets suggests that volatility affect assets return (French *et al*., 1987; Bekaert *et al*., 1996; Ortiz and Arjona, 2001 and Thupayagale, 2010). Again, initial White test, J-B statistics, kurtosis and skewness, all show that stock returns used in this study exhibit inconstant error variance, volatility clustering and leptokurtosis. Therefore, this study is designed to improve the CAPM by modelling both error term and the conditional variance via GARCH. This is to take into account the non-linear characteristics of the regression in the variance equation created by volatility clustering and leptokurtosis. A result for ABSA is presented in the equation for demonstrative purposes. Results for the remaining firms are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \varepsilon_{it} + \hat{\gamma} h_t + \xi_t$$

$$r_{it} = -21.6880 - 0.0097 r_{Mt} + 46.4060 h_t + \varepsilon_{it}$$

$$t = (-.2.3032) \quad (-2.2711)$$
$$p = [0.0213] \quad [0.0231]$$

$$h_t = \hat{\omega} + \hat{\alpha}_1 \varepsilon_{t-1} + \hat{\beta}_1 h_{t-1}$$
$$h_t = 45.9912 + 0.4394 \varepsilon_{t-1} - 0.0246 h_{t-1}$$
$$t = (3.4712) \quad (1.6102) \quad (-0.4968)$$
$$p = [0.0005] \quad [0.1073] \quad [0.6193]$$

Table 27: time series regression estimates of equations 6.23 and 6.25

Company	β	α	ω	α_1	β_1	$\alpha_1+\beta_1$	R^2	AIC	SC
ABSA Group	-0.0097 (-2.2711) [0.0231]*	-21.6880 (-2.3032) [0.0213]*	45.9912 (3.4712) [0.0005] **	0.4394 (1.6102) [0.1073]	-0.0246 (-0.4968) [0.6193]	**0.4148**	0.0003	7.0311	7.1409
Acucap Properties	0.2224 (2.0407) [0.0413]*	0.6830 (0.1363) [0.8915]	19.5277 (3.8855) [0.0001] **	0.6280 (1.9073) [0.0565]	-0.0207 (-0.7741) [0.4389]	**0.6073**	0.0120	6.3879	6.5535
AECI	0.0033 (0.6180) [0.5366]	542.1819 (1.9892) [0.0467]*	3.8443 (1.0718) [0.2838]	0.1813 (1.8127) [0.0699]	0.7904 (9.1286) [0.0000] **	**0.9717**	0.0022	7.4333	7.5431
African Rainbow	0.0098 (2.8761) [0.0040] **	9.0342 (3.4646) [0.0005] **	11.5442 (1.8021) [0.0715]	0.1333 (1.4571) [0.1451]	0.8005 (7.3624) [0.0000] **	**0.9338**	0.0001	7.8415	7.9513
African Oxygen	0.0027 (0.6042) [0.5457]	8.5332 (15.6318) [0.0000] **	6.5444 (1.0240) [0.3059]	0.1122 (1.5086) [0.1314]	0.8048 (5.9918) [0.0000] **	**0.917**	0.0019	7.1319	7.2417
AG Industries	0.6800 (4.7911) [0.0000] **	2.7427 (2.6651) [0.0077] **	91.062 (1.8275) [0.0676]	3.1014 (1.4465) [0.1480]	-0.0312 (-0.9095) [0.3631]	**3.0702**	0.0059	8.7133	8.8504
Allied Technologies	0.0112 (1.1198) [0.2628]	0.4173 (0.4855) [0.6273]	6.4806 (1.0349) [0.3007]	0.1323 (2.0140) [0.0440]*	0.8213 (8.1421) [0.0000] **	**0.9536**	0.0037	7.5305	7.6403
AngloGold Ashanti	-0.0006 (-0.0810) [0.9354]	22.6728 (1.5263) [0.1269]	1.0401 (0.3152) [0.7526]	-0.0302 (-0.7373) [0.4609]	1.0202 (14.544) [0.0000] **	**0.99**	0.0024	7.7905	7.9003
Anglo Platinum	0.0118 (1.4862) [0.1372]	12.1788 (1.8706) [0.0614]	40.1384 (1.2942) [0.1956]	0.0951 (0.8344) [0.4041]	0.6537 (3.0374) [0.0024] **	**0.7488**	0.0074	7.9524	8.0622
Aspen Pharmaceutical Holdings	0.0120 (0.7549) [0.4503]	-130.6736 (-0.6447) [0.5191]	3.1916 (0.5886) [0.5561]	0.2266 (1.0329) [0.3017]	0.8038 (8.6408) [0.0000] **	**1.0304**	0.0002	8.0667	8.1765
Aveng	0.5799 (5.1370) [0.0000]**	8.1591 (4.3420) [0.0000]**	32.2789 (2.4938) [0.0126]	0.3782 (1.7271) [0.0842]	0.2475 (1.3335) [0.1824]	**0.6257**	0.1787	7.2479	7.3851
Basil Read	0.0096 (1.1528) [0.2490]	-10.0425 (-0.6452) [0.5188]	389.6541 (0.5603) [0.5753]	-0.02496 (-0.6483) [0.5168]	-0.1886 (-0.0863) [0.9312]	**-0.2136**	0.0011	8.6784	8.7881
Ceramic Industries	0.1635 (1.8335) [0.0667]	-1.4821 (-1.6164) [0.1060]	2.3646 (15.8051) [0.0000] **	-0.0507 (-783.92) [0.0000] **	0.9798 (9111.5) [0.0000] **	**0.9291**	0.0033	6.9925	7.1064

City Lodge Hotels	0.0059	32.0904	6.6462	0.1996	0.7215	**0.9211**	*0.0036*	7.1958	7.3056
	(0.4780)	(0.8280)	(1.9534)	(1.9605)	(8.9357)				
	[0.6327]	[0.4077]	[0.0508]	[0.0499]*	[0.0000] **				
Com Air	0.6794	7.6668	154.3089	0.1990	-0.0427	**0.1563**	*0.0723*	8.1022	8.2313
	(3.7996)	(6.8782)	(1.9137)	(1.8550)	(-0.0428)				
	[0.0001] **	[0.0000] **	[0.0557]	[0.0636]	[0.9209]				
Cullinan	-0.0154	6.5808	18.0717	0.1695	0.8144	**0.9839**	*0.0163*	8.8956	9.0054
	(-0.8280)	(2.4976)	(1.0266)	(2.0987)	(8.5135)				
	[0.4077]	[0.0125]	[0.3046]	[0.0358]*	[0.0000] **				
Delta EMD	0.0159	7.7867	11.5438	0.0152	0.8966	**0.9118**	*0.0164*	7.7017	7.8115
	(0.8210)	(8.3443)	(1.2019)	(0.9166)	(10.701)				
	[0.4117]	[0.0000] **	[0.2294]	[0.3594]	[0.0000] **				
Discovery	0.3227	3.1321	33.3677	-0.0855	0.5373	**0.4518**	*0.0835*	7.0415	7.1809
	(3.0440)	(4.5739)	(1.1035)	(-1.8418)	(1.1097)				
	[0.0023] **	[0.0000] **	[0.2698]	[0.0655]	[0.2671]				
Distell Group	0.0073	-1.5338	41.4923	0.1386	0.7532	**0.8918**	*0.0024*	8.7393	8.8491
	(2.2387)	(-1.1348)	(0.9687)	(2.2199)	(4.5085)				
	[0.0252]*	[0.2565]	[0.3327]	[0.0264]*	[0.0000] **				
DRD Gold	0.0103	-0.8995	41.5006	0.1348	0.7565	**0.8913**	*0.0034*	8.7384	8.8482
	(0.0993)	(-0.6250)	(1.6424)	(1.5634)	(6.7518)				
	[0.9209]	[0.5320]	[0.1005]	[0.1179]	[0.0000] **				
DS&W HSG Network	0.0521	-2.5936	6.8556	0.1698	0.8010	**0.9708**	*0.0269*	8.4528	8.5626
	(2.6533)	(-0.3284)	(1.2695)	(2.0830)	(13.973)				
	[0.0080]**	[0.7426]	[0.2043]	[0.0373]*	[0.0000] **				
First Rand Bank	-0.0040	4.3599	2.7358	0.1099	0.8746	**0.9845**	*0.0030*	7.4730	7.582
	(-0.2202)	(0.4660)	(1.0194)	(2.0412)	(21.658)				
	[0.8257]	[0.6412]	[0.3080]	[0.0412]*	[0.0000] **				
Glenrand M I B	0.0061	7.4876	0.0013	4.4887	-0.0186	**4.4701**	*0.3220*	1.8687	1.9972
	(13.0674)	(192.8003)	(1.3593)	(1.5761)	(-1.328)				
	[0.0000] **	[0.0000] **	[0.1740]	[0.1150]	[0.1843]				
Gold Reef Resorts	0.0073	16.6554	7.3084	0.1425	0.8144	**0.9569**	*0.0074*	7.8724	7.9867
	(1.2342)	(4.2005)	(0.9244)	(2.0896)	(9.8425)				
	[0.2171]	[0.0000] **	[0.3553]	[0.0366]*	[0.0000] **				
Gold Fields	0.0186	12.6084	32.8983	0.2093	0.58926	**0.79856**	*0.0356*	7.9242	8.0339
	(4.4829)	(7.5255)	(1.2761)	(2.0622)	(2.6194)				
	[0.0000] **	[0.0000] **	[0.2019]	[0.0392]*	[0.0088] **				
Group Five	0.0059	11.2475	199.4106	-0.0535	-0.0614	**-0.1149**	*0.0013*	8.0914	8.2034
	(0.7232)	(0.6319)	(1.0624)	(-1.4012)	(-0.0580)				
	[0.4695]	[0.5275]	[0.2881]	[0.1612]	[0.9538]				
Growthpoint Properties	0.0220	-11.8941	3.5928	0.2381	0.7758	**1.0139**	*0.1402*	7.3496	7.4594
	(0.6315)	(-0.2162)	(0.7619)	(1.1948)	(7.1477)				
	[0.5277]	[0.8288]	[0.4461]	[0.2321]	[0.0000] **				
Harmony Gold Mining	0.0242	-1.3523	38.0726	0.0163	0.8453	**0.8616**	*0.0095*	8.4884	8.5982
	(1.6765)	(-0.1985)	(0.8946)	(0.3538)	(4.7943)				
	[0.0936]	[0.8426]	[0.3710]	[0.7235]	[0.0000] **				
Impala Platinum	0.0163	11.2090	41.2745	0.1699	0.5832	**0.7531**	*0.0098*	7.9718	8.0816
	(1.8818)	(1.7656)	(1.6000)	(1.6037)	(3.4629)				
	[0.0599]	[0.0775]	[0.1096]	[0.1088]	[0.0005] **				
Liberty Holdings	-0.0081	5.5621	3.9111	0.0724	0.8656	**0.938**	*0.0010*	6.9565	7.0663
	(-1.5357)	(0.4351)	(0.9662)	(0.9318)	(7.1563)				
	[0.1246]	[0.6635]	[0.3339]	[0.3515]	[0.0000] **				
Masonite Africa	0.0032	7.6578	8.3839	-0.0114	0.9416	**0.9302**	*0.0004*	7.5912	7.7009
	(1.2283)	(0.8752)	(1.4607)	(-0.4294)	(20.7293)				
	[0.2193]	[0.3815]	[0.1441]	[0.6676]	[0.0000] **				
Merafe Resources	-0.0104	0.9583	58.5609	0.3028	0.5617	**0.8645**	*0.0012*	8.6682	8.7779
	(-0.7483)	(0.7967)	(2.2260)	(2.7227)	(5.3435)				
	[0.4543]	[0.4257]	[0.0260]*	[0.0065] **	[0.0000] **				
Merchant & Industrial Properties	-30.2528	-7778.35	3.04E+08	0.8923	-0.0480	**0.8443**	*0.0705*	21.8092	21.9190
	(-1.2658)	(-0.0464)	(6.8712)	(0.5481)	(-0.3349)				
	[0.2056]	[0.9630]	[0.0000] **	[0.5836]	[0.7377]				

MMI Holdings	-0.0145	-3.5506	6.1298	0.1294	0.8242	**0.9536**	*0.0040*	7.4914	7.6011
	(-1.9234)	(-0.4703)	(1.6448)	(1.2802)	(9.9353)				
	[***0.0544***]	[***0.6382***]	[***0.1000***]	[***0.2005***]	[***0.0000***]**				
MTN Group	0.0088	2.9775	67.5667	0.1096	0.4492	**0.5588**	*0.0026*	7.9264	8.0394
	(1.4406)	(0.3938)	(1.0964)	(0.8384)	(1.0212)				
	[***0.1497***]	[***0.6937***]	[***0.2729***]	[***0.4018***]	[***0.3072***]				
Murray & Roberts	-0.0109	124.8868	21.7657	0.1479	0.7079	**0.8558**	*0.0114*	7.8296	7.9394
	(-0.9774)	(1.5348)	(1.5040)	(1.7977)	(5.7088)				
	[***0.3284***]	[***0.1248***]	[***0.1326***]	[***0.0722***]	[***0.0000***] **				
NED Bank Group	0.0015	6.5979	6.7902	-0.0073	0.94048	**0.93318**	*0.0006*	7.4676	7.5774
	(0.3030)	(1.1426)	(0.7816)	(-0.2838)	(13.736)				
	[***0.7619***]	[***0.2532***]	[***0.4344***]	[***0.7766***]	[***0.0000***] **				
Octodec Investments	-0.0014	21.2598	6.4746	0.1894	0.7382	**0.9276**	*0.0007*	7.0420	7.1518
	(-0.4351)	(2.2030)	(1.6956)	(1.9937)	(9.1678)				
	[***0.6635***]	[***0.0276***]*	[***0.0900***]	[***0.0462***]*	[***0.0000***] **				
Omnia	0.0079	-12.3392	11.7376	0.1885	0.7222	**0.9107**	*0.0000*	7.5860	7.6958
	(1.5515)	(-2.1301)	(1.4009)	(1.8152)	(5.9960)				
	[***0.1208***]	[***0.0332***]*	[***0.1613***]	[***0.0695***]	[***0.0000***] **				
Pangbourne Properties	-0.005518	7.712898	76.71763	-0.05760	-0.81887	**-0.8765**	*0.0039*	6.6067	6.7165
	(-1.6636)	(0.7472)	(7.7470)	(-1.8570)	(-4.9339)				
	[***0.0962***]	[***0.4550***]	*[****0.0000***] **	[***0.0633***]	[***0.0000***] **				
Premium Properties	-0.0032	10.69140	120.6403	-0.0376	-0.4809	**-0.5185**	*0.0006*	7.2795	7.3893
	(-0.5322)	(0.4410)	(1.5690)	(-1.0375)	(-0.4797)				
	[***0.5946***]	[***0.6592***]	[***0.1166***]	[***0.2995***]	[***0.6314***]				
Pretoria Port CMT	-0.0186	-0.5448	10.5594	0.0764	0.79045	**0.8669**	*0.0156*	7.2459	7.3557
	(-3.2026)	(-0.0851)	(1.0590)	(1.0173)	(4.9353)				
	[***0.0014***] **	[***0.9322***]	[***0.2896***]	[***0.3090***]	[***0.0000***] **				
RMB Bank	-0.0072	2.7311	4.8381	0.1428	0.8158	**0.9586**	*0.0045*	7.3411	7.4509
	(-0.8194)	(0.3427)	(1.3088)	(1.6460)	(14.3687)				
	[***0.4125***]	[***0.7318***]	[***0.1906***]	[***0.0998***]	[***0.0000***]**				
SABLE	0.0019	13.5023	44.0404	0.3153	0.4902	**0.8055**	*0.0091*	8.0319	8.141
	(0.4799)	(2.2306)	(1.7506)	(1.9596)	(2.7818)				
	[***0.6313***]	[***0.0257***]*	[***0.0800***]	[***0.0500***]*	[***0.0054***] **				
SACOIL Holdings	-0.0726	-2.5542	13.3769	-0.0305	1.0258	**0.9953**	*0.0184*	9.7213	9.8311
	(-2.0178)	(-0.9871)	(2.6134)	(-1.3475)	(49.1192)				
	[***0.0436***]*	[***0.3236***]	[***0.0090***] **	[***0.1778***]	[***0.0000***] **				
Saambou Bank	0.0036	7.4088	-2.21E-06	1.1808	0.3818	**1.5626**	*0.0007*	3.1743	3.2841
	(4.4211)	(12.2873)	(-0.0339)	(5.2525)	(5.9975)				
	[***0.0000***] **	[***0.0000***] **	[***0.9729***]	[***0.0000***]**	[***0.0000***] **				
Sanlam	0.6165	7.7746	19.0002	0.1128	0.4026	**0.5154**	*0.1470*	6.6514	6.7831
	(6.0997)	(4.7803)	(1.7656)	(0.9368)	(1.3320)				
	[***0.0000***] **	[***0.0000***] **	[***0.0775***]	[***0.3489***]	[***0.1828***]				
SASOL	0.0060	11.1174	7.8175	0.1045	0.8239	**0.9284**	*0.0025*	7.5319	7.6417
	(1.0408)	(3.6061)	(0.8867)	(1.5764)	(6.0096)				
	[***0.2980***]	[***0.0003***] **	[***0.3752***]	[***0.1149***]	[***0.0000***] **				
Spanjaard	-0.0165	22.2399	156.2180	0.3699	-0.0716	**0.2983**	*0.0127*	7.7291	7.8389
	(-0.8563)	(0.4038)	(5.4696)	(1.0621)	(-1.1560)				
	[***0.3919***]	[***0.6863***]	[***0.0000***]**	[***0.2882***]	[***0.2477***]				
Standard Bank	-0.0113	-15.63908	9.4133	0.4577	0.5565	**1.0142**	*0.0121*	7.2606	7.3704
	(-4.3498)	(-1.2493)	(1.0369)	(1.8505)	(6.5717)				
	[***0.0000***]	[***0.2115***]	[***0.2998***]	[***0.0642***]	[***0.0000***]**				
Sun Int	-0.0011	39.7391	178.4694	0.0057	-0.9277	**-0.9220**	*0.0009*	7.4245	7.5343
	(-0.2168)	(0.8124)	(4.0863)	(0.1789)	(-2.3727)				
	[***0.8283***]	[***0.4166***]	[***0.0000***]**	[***0.8580***]	[***0.0177***]*				
Telkom	0.3839	3.7270	3.8023	-0.1250	1.0601	**0.9351**	*0.0774*	7.1113	7.2913
	(2.8713)	(1.1991)	(1.5945)	(-4.1126)	(16.727)				
	[***0.0041***] **	[***0.2305***]	[***0.1108***]	[***0.0000***]**	[***0.0000***]**				
Vox Telecom	1.1487	113.2315	34.6684	0.2506	0.7838	**1.0344**	*0.0539*	9.8406	9.9710
	(3.0061)	(2.8821)	(1.0981)	(2.0587)	(10.5154)				
	[***0.0026***]**	[***0.0039***]**	[***0.2721***]	[***0.0395***]*	[***0.0000***]**				

White Water Resources	-0.0061 (-1.1796) [***0.2381***]	-2.2841 (-1.0911) [***0.2752***]	633.4285 (2.5943) [***0.0095***] **	0.1901 (1.7931) [***0.0730***]	-0.2154 (-1.2759) [***0.2020***]	**-0.0253**	*0.0008*	9.2908	9.4006
Bayly Holmes-Ovcon	0.0035 (0.1641) [***0.8697***]	13.3509 (0.6759) [***0.4991***]	4.0732 (1.3583) [***0.1744***]	0.1602 (2.0001) [***0.0455***]*	0.8067 (10.3160) [***0.0000***]**	**0.9669**	*0.0132*	7.5507	7.6605
Zurich Insurance	-0.0098 (-2.2711) [***0.0231***]*	-21.6880 (-2.3033) [***0.0213***]*	45.9912 (3.4712) [***0.0005***]**	0.4394 (1.6103) [***0.1073***]	-0.0246 (-0.4968) [***0.6193***]	**0.4148**	*0.0004*	7.0311	7.1409

Source: Author's own calculation

The GARCH model is characterized by the following three fundamental propositions; (i) that, $\omega=0$ and $\alpha, \beta \geq 0$ to ensure that the conditional variance is sternly positive in relation to expected excess stock return. However, reported empirical evidences are contradictory. For example, French et al. (1987) and Campbell and Hentschel (1992) found positive relationship between excess return and conditional variance, while Fama and Schwert (1977), Campbell (1987), Breen et al. (1989), Turner et al. (1989), Pagan and Hong (1991) and Nelson (1991) found a negative relation; (ii) that shocks to volatility decay at constant rate and the speed of decay is measured by the estimate of $\alpha+\beta$; (iii) that the sum of α and β measures volatility persistence (i.e. the degree to which shocks to current volatility remain important for long-periods into the future). The persistence of shocks to volatility becomes greater as the sum approaches 1 (or unity) and shock to volatility is considered to be permanent if the sum is equal to 1 (Engle and Bollerslev, 1986). As this sum becomes greater than 1, then volatility is explosive, i.e. shock to volatility in one period will result in even a greater volatility in the subsequent period (Chou, 1988).

1. By summing up α (ARCH term) and β (GARCH term), as can be seen from the table 27, proposition (i) is supported by fifty firms result. The sum of α and β for all these fifty firms in South Africa are positive which is consistent with French et al. (1987) and Campbell and Hentschel (1992). However, the sum of α and β for Basil, Group

Five, Pangbourne, Premium, Sun International and White Water Resourses violates the fundamental proposition of the model. Besides, by disaggregating the model, eleven firms exhibit negative coefficients of the conditional (ARCH) variance term and the GARCH term for twelve firms is also negative as documented elsewhere. For example, previous tests of the relation between excess return and conditional variance using ARCH model have documented negative relationships (Fama and Schwert (1977), Campbell (1987), Breen et al. (1989), Turner et al. (1989), Pagan and Hong (1991) and Nelson (1991). This negative relation between return and conditional variance is buttressed by Black (1976), who found a negative correlation between current returns and future returns volatility. Furthermore, Nelson (1991) and Engle and Ng (1993) argue that the time series properties of monthly returns data are to some extent different from daily returns data and therefore more likely to find a negative relation between returns and conditional variance with low level of data frequency such as monthly returns.

2. Moreover, it is vitally important to analyse the statistical significance of the ARCH and GARCH coefficients in relation to returns since the results obtained could have occurred out of chance. The test of significance was set at 1 (*p-value with* **) and 5 (*p-value with* *) per cent levels and the results, as in table 27, shows that the ARCH term exhibits statistically significant coefficient in sixteen firms at 1 and 5 per cent levels of which Ceramic and Telkom are negative. Similarly, the results show that the GARCH term is statistically positive significant in thirty eight firms at 1 per cent level, while Pangbourne and Sun International show statistically negative significant coefficients at 1 and 5 per cent level respectively.

3. The persistence of volatility as measured by the sum of $\alpha+\beta$ varies considerably for the companies in South Africa. For example, in AG Industries, Aspen Pharmaceutical, Glenrand, Growthpoint, Saambou, Standard Bank and Vox Telecom, volatility persistence is explosive and therefore, $\alpha + \beta > 1$ for these firms. Explosive volatility means that persistence of shocks to volatility in one period will result in even a greater volatility in the subsequent period since the sum of α and β are greater than 1 or unity (Chou, 1988). For all other firms $\alpha + \beta < 1$. For example, thirty one firms exhibit the greatest persistence, as the sum of α and β is above 0.8 and close to 1. This implies that a shock to volatility in the past will be significant in predicting future volatility over a prolonged period. Meanwhile, evidence of low volatility is found in the returns of the remaining eighteen firms. This does not suggest that volatility is not present in these firms return however; shocks to volatility diminish so quickly. McMillan and Thupayagale (2009) found similar evidence in nine African Stock Markets (Botswana, Egypt, Ghana, Kenya, Mauritius, Morocco, Namibia, South Africa and Tunisia) that shocks to volatility in these markets taper off fairly quickly in comparison with UK and US markets. Also, Glosten et al. (1993), using monthly excess return on US stocks found that the conditional volatility is not highly persistent.

4. Per GARCH restriction, the variance constant, ω, should be 0. As in table 27, this condition is violated by the evidence. The coefficients of the variance constant, ω, for fifty five firms are greater than 0 and thus, positive and only Saambou have negative constant variance, ω. However, as from the results in table 27, only eleven firms have statistically positive significant, ω, at 1 and 5 per cent levels.

The results from table 27, show that beta for thirty six firms exhibit positive coefficient in support of the fundamental proposition of the CAPM which state that asset returns are positive (and linear) functions of beta. However, eighteen firms have their beta statistically significant at 1 and 5 per cent levels with either positive or negative coefficient. According to the Augmented CAPM the mean intercept should be 0 or close to 0. Nonetheless, this proposition is also violated per the evidence in table 27. The evidence shows that the mean intercepts for all fifty six firms are either greater or less than 0, however, only twenty have statistically significant values at 1 and 5 per cent levels with either positive or negative sign.

The coefficient of determination, R^2 ranges from 0.00 per cent to 32.20 per cent and this is a summary measure of how well GARCH augmented CAPM explains the return generating process in South Africa. These figures are statistically low and demonstrate that the GARCH augmented CAPM is unable to fully explain the asset return generating process in South Africa. The highest total variation in equity returns in South Africa which can be explained by the GARCH augmented CAPM, as measured by R^2, is only 32.20% (for Glenrand). This is further buttressed by high Akaike Information Criterion (AIC) and Schwarz Criterion (SC), which are all well above the critical value of 3.

7.6.3 GARCH-M Augmented CAPM

Following the evidence from table 27, it was found that relationship between return and volatility exists in South Africa. French *et al.* (1987) assert that volatility is actually a priced risk factor and not just a data characteristic issue. Therefore, the underlying theory following the results in table 27 is that investors should be rewarded for taking up additional risk.

According to Engle, Lilien and Robins (1987), GARCH-in-Mean (or GARCH-M) is a better model to operationalize this type of risk.

The results in table 28 are estimated using equation 6.26 where the regression process allows the conditional variance to enter the conditional mean process. The GARCH-M is basically motivated by Merton's (1973) ICAPM which suggests that the conditional expected excess return on the stock market should vary positively and proportionately with the conditional market variance. A result for ABSA is presented in the equation for demonstrative purposes. Results for the remaining companies are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \hat{\delta}\sigma_t^2 + \varepsilon_{it}$$

$$r_{it} = -6.1590 - 0.0081 r_{Mt} - 0.1870\sigma_t^2 + \varepsilon_{it}$$

$$t = (-0.4287) \quad (-1.5140) \quad (-1.5480)$$
$$p = [0.6681] \quad [0.1300] \quad [0.1216]$$

Table 28: time series regression estimates of equation 6.26

Company	δ	***β***	***α***	R^2	***AIC***	***SC***
ABSA Group	-0.1869 (-1.5480) [***0.1216***]	-0.0081 (-1.5140) [***0.1300***]	-6.1590 (-0.4287) [***0.6681***]	*0.0253*	7.0344	7.1625
Acucap Properties	0.4008 (2.9025) [***0.0037***] **	0.2383 (5.2963) [***0.0000***] **	-2.1873 (-0.4817) [***0.6300***]	*0.0721*	6.3766	6.5698
AECI	-0.3937 (-1.4570) [***0.1451***]	0.0039 (0.6322) [***0.5273***]	605.310 (1.9684) [***0.0490***]*	*0.0091*	7.4338	7.5619
African Rainbow	-0.1134 (-0.2847) [***0.7759***]	0.0098 (2.6785) [***0.0074***] **	10.3338 (2.0323) [***0.0421***]*	*0.0104*	7.8758	8.0039
African Oxygen	-0.2604 (-0.6808) [***0.4960***]	0.0028 (0.6102) [***0.5417***]	10.5123 (3.4124) [***0.0006***] **	*0.0069*	7.1467	7.2748
Allied Technologies	-0.7797 (-1.1897) [***0.2342***]	0.0054 (0.5849) [***0.5586***]	8.2597 (1.2549) [***0.2095***]	*0.0332*	7.5617	7.6898
AngloGold Ashanti	0.3121 (2.7685) [***0.0056***] **	0.0023 (0.3518) [***0.7250***]	17.2284 (1.0521) [***0.2927***]	*0.0028*	7.8614	7.9895
Anglo Platinum	0.0522 (0.0645) [***0.9486***]	0.0118 (1.4847) [***0.1376***]	11.5051 (0.9488) [***0.3427***]	*0.0072*	7.9640	8.0921

Aspen Pharmaceutical Holdings	0.0034 (0.0239) [***0.9809***]	0.0119 (0.7494) [***0.4536***]	-130.036 (-0.6421) [***0.5208***]	*0.0004*	8.0768	8.2049
Aveng	-0.6795 (-1.7286) [***0.0839***]	0.6388 (5.2109) [***0.0000***] **	13.4805 (3.1984) [***0.0014***] **	*0.2128*	7.2874	7.4474
Ceramic Industries	-0.5447 (-1.2827) [***0.1996***]	0.0056 (0.4487) [***0.6537***]	41.3934 (4.6925) [***0.0000***] **	*0.0389*	7.2569	7.3898
City Lodge Hotels	0.1250 (0.4295) [***0.6675***]	0.0021 (0.1905) [***0.8489***]	36.1452 (1.0048) [***0.3150***]	*0.0052*	7.2062	7.3343
COM AIR	1.8567 (1.5011) [***0.1333***]	0.6397 (4.1791) [***0.0000***] **	-16.5811 (-1.0241) [***0.3058***]	*0.1099*	8.0822	8.2329
Cullinan	-0.2918 (-0.9068) [***0.3645***]	-0.0132 (-0.2674) [***0.7892***]	12.1314 (1.7829) [***0.0746***]	*0.0015*	8.9004	9.0285
Discovery	-0.612309 (-1.4012) [***0.1612***]	0.319849 (2.9287) [***0.0034***] **	7.689655 (2.2096) [***0.0271***]*	*0.092639*	7.062802	7.225405
Distell Group	0.5964 (1.5063) [***0.1320***]	0.0073 (2.7725) [***0.0056***] **	-11.8563 (-1.6950) [***0.0901***]	*0.0023*	8.7443	8.8724
DRD Gold	0.5964 (1.5063) [***0.1320***]	0.0073 (2.7725) [***0.0056***] **	-11.8563 (-1.6949) [***0.0901***]	*0.0023*	8.7443	8.8724
DS&WHSG Network	-0.4696 (-1.8467) [***0.0648***]	0.0523 (2.3922) [***0.0167***]*	3.5137 (0.4660) [***0.6412***]	*0.0120*	8.4396	8.5677
First Rand Bank	-0.2586 (-0.9232) [***0.3559***]	-0.0039 (-0.2090) [***0.8345***]	6.2304 (0.6411) [***0.5214***]	*0.0019*	7.4762	7.6043
Gold Reef Resorts	0.3896 (2.5607) [***0.0104***]*	0.0099 (1.5637) [***0.1179***]	7.4062 (1.4401) [***0.1498***]	*0.0413*	7.9765	8.1099
Gold Fields	0.8553 (1.8262) [***0.0678***]	0.0174 (6.0283) [***0.0000***] **	2.9041 (0.4947) [***0.6208***]	*0.0624*	7.9128	8.0409
Group Five	-0.7359 (-1.9436) [***0.0519***]	0.0057 (0.5820) [***0.5606***]	22.8046 (1.2081) [***0.2270***]	*0.0209*	8.0449	8.1756
Growthpoint Properties	0.7100 (22.3349) [***0.0000***]**	-0.0208 (-3.6802) [***0.0002***]**	-4.2671 (-1.0327) [***0.3017***]	*0.8374*	7.6430	7.7711
Harmony Gold Mining	1.8360 (0.2800) [***0.7794***]	0.0235 (1.7296) [***0.0837***]	-31.6345 (-0.2943) [***0.7685***]	*0.0107*	8.5103	8.6384
Impala Platinum	0.1388 (0.2776) [***0.7813***]	0.0163 (1.8643) [***0.0623***]	9.5011 (1.0242) [***0.3058***]	*0.0112*	7.9830	8.1111
Liberty Holdings	-0.7481 (-1.5357) [***0.1246***]	-0.0088 (-1.5485) [***0.1215***]	9.6949 (0.7607) [***0.4469***]	*0.0218*	6.9636	7.0917
Masonite Africa	-0.7139 (-4.4866) [***0.0000***] **	0.0020 (0.6594) [***0.5097***]	13.5588 (1.4146) [***0.1572***]	*0.0021*	7.6064	7.7344
Merafe Resources	-0.2654 (-0.9737) [***0.3302***]	-0.0111 (-0.8230) [***0.4105***]	5.2709 (1.1009) [***0.2709***]	*0.0220*	8.6769	8.8050

MMI Holdings	-0.2258	-0.0151	-2.2373	*0.0137*	7.5020	7.6301
	(-0.6023)	(-2.1403)	(-0.2935)			
	[***0.5470***]	[***0.0323***]*	[***0.7692***]			
Murray & Roberts	-0.6831	-0.0112	132.942	*0.0328*	7.8362	7.9643
	(-1.4345)	(-0.9934)	(1.8403)			
	[***0.1514***]	[***0.3205***]	[***0.0657***]			
NED Bank Group	4.6754	0.0019	-40.5139	*0.0144*	7.4746	7.6027
	(0.8769)	(0.3738)	(-0.7551)			
	[***0.3805***]	[***0.7086***]	[***0.4502***]			
Octodec Investments	0.2595	-0.0011	17.5136	*0.0067*	7.0683	7.1964
	(0.9360)	(-0.3392)	(1.6480)			
	[***0.3493***]	[***0.7345***]	[***0.0993***]			
Omnia	-0.4299	0.0072	-7.1519	*0.0155*	7.5982	7.7263
	(-1.2680)	(1.6465)	(-1.1384)			
	[***0.2048***]	[***0.0997***]	[***0.2550***]			
Pangbourne Properties	8.5344	-0.0052	-47.9156	*0.0311*	6.6019	6.7300
	(0.4376)	(-1.4253)	(-0.3871)			
	[***0.6617***]	[***0.1541***]	[***0.6987***]			
Pretoria Port CMT	-1.8375	-0.0217	12.6667	*0.0551*	7.2280	7.3561
	(-1.3706)	(-3.7736)	(1.0575)			
	[***0.1705***]	[***0.0002***] **	[***0.2903***]			
RMB Bank	-0.3375	-0.0064	5.8752	*0.0144*	7.3444	7.4725
	(-0.9858)	(-0.6746)	(0.6431)			
	[***0.3242***]	[***0.5000***]	[***0.5201***]			
SABLE	-0.0881	0.0019	14.6163	*0.0025*	8.0557	8.1838
	(-0.3562)	(0.4841)	(2.2989)			
	[***0.7217***]	[***0.6283***]	[***0.0215***]*			
SACOIL Holdings	0.4158	-0.0674	-15.2953	*0.0221*	9.8121	9.9402
	(0.9357)	(-1.7376)	(-1.0932)			
	[***0.3494***]	[***0.0823***]	[***0.2743***]			
Saambou Bank	-0.3733	0.0023	7.3514	*0.0847*	2.9771	3.1052
	(-6.4058)	(2.3044)	(11.5111)			
	[***0.0000***] **	[***0.0212***]*	[***0.0000***] **			
Sanlam	1.4036	0.5250	-1.0323	*0.1428*	6.7597	6.9133
	(1.7418)	(6.3059)	(-0.1976)			
	[***0.0815***]	[***0.0000***] **	[***0.8434***]			
SASOL	-0.4462	0.0065	15.3908	*0.0098*	7.5405	7.6686
	(-0.9746)	(1.0568)	(2.5797)			
	[***0.3298***]	[***0.2906***]	[***0.0099***] **			
Spanjaard	1.440933	0.001343	1.269738	*0.0038*	7.6027	7.7308
	(2.1936)	(0.1932)	(0.0318)			
	[***0.0283***]*	[***0.8468***]	[***0.9747***]			
Standard Bank Group	0.853548	-0.010385	-14.31050	*0.1941*	7.2407	7.3688
	(3.9124)	(-5.0495)	(-1.4008)			
	[***0.0001***] **	[***0.0000***] **	[***0.1613***]			
Sun International	-0.822811	1.88E-05	42.71688	*0.0067*	7.4038	7.5319
	(-1.4107)	(0.0030)	(0.7268)			
	[***0.1583***]	[***0.9976***]	[***0.4673***]			
TELKOM	-0.1712	40.1507	-1410.692	*0.000*	104.3919	104.6019
	NA	NA	NA			
	NA	NA	NA			
VOX Telecom	0.4535	0.6379	7.0050	*0.0319*	9.8868	10.0390
	(1.1128)	(1.6408)	(0.1193)			
	[***0.2658***]	[***0.1008***]	[***0.9050***]			
White Water Resources	0.5578	-0.0012	-17.6244	*0.0063*	9.2902	9.4183
	(2.7758)	(-0.2277)	(-3.4931)			
	[***0.0055***]**	[***0.8199***]	[***0.0005***] **			
WLSN Bayly Holmes-Ovcon	-0.1828	0.0026	14.8546	*0.0007*	7.5661	7.6942
	(-0.6878)	(0.1230)	(0.7923)			
	[***0.4916***]	[***0.9021***]	[***0.4282***]			

Zurich Insurance	-0.1869 (-1.5480) [***0.1216***]	-0.0080 (-1.5140) [***0.1300***]	-6.1590 (-0.4287) [***0.6681***]	*0.0253*	7.0344	7.1626

Source: Author's own calculations

The GARCH-M model is characterized by two fundamental propositions; (i) that, $\delta > 0$, to ensure that the conditional variance is interpreted as risk premium which requires compensation; (ii) investors should be rewarded if, δ, is positive.

1. Per evidence in table 28, proposition (i) is not wholly supported. The results show that the coefficients of twenty seven firms are negative, in violation of proposition (i). This means that there is a negative correlation between the return of these firms and their conditional variance. This result is consistent with literature elsewhere. For example, Nelson (1991) and Glosten et al. (1993) applied ARCH/GARCH-M and EGARCH-M to daily and monthly return data respectively and found negative relation between return and conditional variance in the US. However, the remaining twenty two firms exhibit positive relation between return and conditional variance in line with French et al. (1987), Campbell and Hentschel (1992), Guo and Neely (2006) results, and in support of proposition (i).

2. The positive sign suggests that in these twenty two firms investors are rewarded for taking up additional volatility risks (see also French *et al*., 1987; Campbell and Hentschel, 1992; Li, 2003, Guo and Neely, 2006). Investors investing in these firms will expect additional compensation for volatility risk and corporations that use CAPM to determine cost of equity must capture the volatility risk premium. The negative relations violate the central theme of the GARCH-M, which suggests that the conditional expected excess return on asset should vary positively and proportionately with the conditional variance. As argued strongly by Nelson (1991) that standard GARCH/GARCH-M models lack the properties to capture the dynamics of the

conditional variance process and went ahead to propose an alternative model that remedy this weakness. This study is limited to standard GARCH-M and not extended to Nelson's model. Intuitively, assets with negative, δ, would be a good instruments for hedging (see Merton, 1973) and therefore portfolio/fund managers will look out for assets with negative, δ.

3. However, these results could be spurious or occurred out of chance and it is appropriate to examine the statistical significance of the coefficients. Per the results in table 28, only seven firms, i.e. Acucap, AngloGold, Gold Reef, Growthpoint, Standard Bank, Spanjaard and White Water Resources exhibit positive statistically significant relation between return and conditional variance at 1 and 5 per cent levels. Statistically, Masonite and Saambou Bank show negative significant relation between return and their conditional variance at 1 per cent level.

Per the evidence from table 28, the beta for sixteen firms, which shows negative beta, violate the fundamental proposition of the CAPM which state that asset returns are positive (and linear) functions of beta. However, the remaining thirty three have positive beta, in support, of the CAPM fundamental proposition. Eleven of the firms exhibit positive significant beta coefficients at 1 and 5 per cent levels. However, Growthpoint, MMI, Pretoria and Standard Bank show negative significant beta coefficients at 1 and 5 per cent levels. According to the Augmented CAPM the mean intercept should be 0 or close to 0. Nonetheless, this proposition is violated per the results in table 28. The evidence shows that the intercepts for all the forty nine firms are either greater (i.e. positive) or less (i.e. negative) than 0. However, statistically it is found that the intercepts for only ten firms are significant at 1 and 5 per cent levels with either negative or positive sign. The highest total variation in equity returns in South Africa which can be explained by the augmented CAPM, as measured by R^2 , is 83.74% (for

Growthpoint). The R^2*, t-test and p-value* results for Telkom is a statistical oddity or quirk and have no explanation for this, but is included for completeness.

7.7 Chapter Conclusion

Key statistical estimates provide varying results across ASMs. For example, in Ghana evidence shows that the fundamental proposition of the CAPM was supported by the evidence in table 14. In Ghana, the beta coefficients for twelve firms which represent 63% of the total sample are positively significant at 1 and 5 per cent. It is however observed that beta alone does not fully explain the return generating process in Ghana as demonstrated by low R-squared in the individual regressions. Volatility is found to exist in Ghana but in varying degrees. It is highly persistent and explosive in some firms' return, while in others low and even negative conditional variance was found.

In Kenya, systematic risk as measured by beta dominates asset prices and returns. Beta risk is positively significant in 18 firms representing almost 95% of the total sample at 1 per cent level. More than 50% of these assets show higher beta than the market making them more risky to invest than investing in the market index. However, there exist certain risk factors that influence asset prices and returns that are not captured by the market beta. The ARCH and GARCH terms are found to be significant in seventeen and thirteen firms respectively.

Evidence from Morocco shows that beta risk is significant in twenty firms return. These findings support the market beta's ability to explain patterns of these assets return in Morocco. Meanwhile, the evidence shows that beta risk alone is not able to fully explain the return generating process in Morocco. The ARCH term was found to be significant in nineteen firms and the GARCH is significant in sixteen firms. Statistical evidence shows that beta risk is significant in eighteen firms return in Nigeria. The ARCH term was less significant; however the GARCH term was statistically significant in fourteen firms return in Nigeria.

Unlike the preceding countries, South Africa provides contrary results. The market beta failed to explain majority of firms return generating process. For example, the results show that beta risk is positively significant in only nine out of fifty six firms return, while negatively significant in eight firms return. It was found that the ARCH term was significant in sixteen firms' return of which two are negative, while the GARCH term is significant in forty firms' returns with, also, two firms return negatively related to the conditional variance.

CHAPTER EIGHT: EMPIRICAL ANALYSIS AND RESULTS – 3 FACTOR MODEL

8.1 Introduction

These results are produced by adopting time series methodology of Fama and French (1993). Monthly excess stock returns is regressed on market risk premium and portfolios for size and BE/ME premium. The coefficients of the regression slopes represent the risk sensitivities for stocks. The variables are said to be fallen into two categories, those important to capture common risk (systematic) in asset returns and those likely to capture unique risk (unsystematic, but not eliminated by diversification). Segmenting the explanatory variables in such a manner sets up an interesting test of whether systematic risk or unique risk factors are more important in asset return generating process. If the latter become relevant in pricing risk, then it is only fair to say that size and BE/ME proxy for a common risk or shared risk in asset returns just as the market portfolio. By testing the Fama-French three factor model, this study is challenged by data availability for size and BE/ME premia. Data on size and BE/ME are only available in two out of five stock markets under study, that is, Morocco and South Africa however, the Moroccan data is limited to BE/ME and thus, unable to test for the size premium in this market. The results are presented in two main sections, one for each country and finally the chapter conclusion is drawn.

8.2 Empirical Evidence from Morocco

8.2.1 Fama-French Model

Beta coefficient, intercept and other key parameters are estimated using time series regression via OLS. The series are estimated using stationary data at first difference but assume to be free from co integration. The aim of this test is to establish whether in addition to beta firm fundamentals such as BE/ME affect returns as posited in Fama-French model. Due to unavailability of size data (that is, SMB), the only stylised fact included in the model is

BE/ME (that is, HML). A result for Acred is presented in the equation below for demonstrative purposes. Results for the remaining firms are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \hat{\beta}_{\mathrm{H}t}\left(HML\right)_t + \varepsilon_{it}$$

$$r_{it} = 9.3514 + 0.0655 r_{Mt} - 0.4177 HML_t + \varepsilon_{it}$$

$$t = (6.0557) \quad (0.2273) \quad (-0.9283)$$
$$p = [0.0000] \quad [0.8208] \quad [0.3560]$$

Table 29: time series regression estimates of equation 6.20

Company	***α***	***β***	***HML***	$\overline{R}^2$	***F-Statistics*** *(p-value)*	***AIC***	***SC***
Acred	9.3514 (6.0557) [***0.0000***]**	0.0655 (0.2273) [***0.8208***]	-0.4177 (-0.9283) [***0.3560***]	*0.0132*	-0.4540 [***0.6367***]	8.1484	8.2346
Afriquia Gaz	9.4603 (11.3055) [***0.0000***] **	1.0332 (6.6165) [***0.0000***] **	-0.2674 (-1.0967) [***0.2760***]	*0.3375*	22.3984 [***0.0000***] **	6.9229	7.0091
Attijariwa fa Bank	8.7884 (22.1652) [***0.0000***] **	1.0114 (13.6699) [***0.0000***] **	0.0443 (0.3836) [***0.7023***]	*0.6879*	93.5928 [***0.0000*** **	5.4291	5.5153
Auto Hall	10.2193 (13.2449) [***0.0000***] **	0.70444 (4.8927) [***0.0000***] **	-0.3886 (-1.7287) [***0.0876***]	*0.2273*	13.3543 [***0.0000***] **	6.7606	6.8468
Auto Nejma	10.5345 (8.9666) [***0.0000***] **	0.2837 (1.2943) [***0.1992***]	-0.0353 (-0.1032) [***0.9180***]	*0.0038*	0.8413 [***0.4348***]	7.6016	7.6877
BMCE Bank	9.5301 (14.9326) [***0.0000***] **	0.7771 (6.5254) [***0.0000***] **	-0.0441 (-0.2374) [***0.8129***]	*0.3259*	21.3020 [***0.0000***] **	6.3812	6.4673
BQ. Maroc.	8.4352 (13.7384) [***0.0000***] **	0.7014 (6.1220) [***0.0000***] **	0.3375 (1.8863) [***0.0628***]	*0.3190*	20.6742 [***0.0000***] **	6.3037	6.3899
Branoma	9.5180 (13.5143) [***0.0000***] **	0.2820 (2.1464) [***0.0348***]*	-0.1350 (-0.6583) [***0.5122***]	*0.0345*	2.5020 [***0.0882***]	6.5782	6.6644
Brasseries Du Maroc	8.7689 (12.2038) [***0.0000***] **	0.7628 (5.6892) [***0.0000***] **	-0.2648 (-1.2649) [***0.2581***]	*0.2745*	16.8915 [***0.0000***] **	6.6182	6.7044
CDM Credit	8.0729 (12.1809) [***0.0000***] **	0.8859 (3.7223) [***0.0000***] **	0.2581 (1.0028) [***0.3189***]	*0.3582*	24.4376 [***0.0000***] **	6.5445	6.6307
Centrale Laitiere	9.0318 (10.1876) [***0.0000***] **	0.6384 (3.5593) [***0.0002***] **	-0.2733 (-1.0582) [***0.2931***]	*0.1421*	7.9545 [***0.0007***] **	7.0384	7.1247

Ciment Du Maroc	8.0147 (10.9534) [0.0000] **	1.0105 (7.4015) [0.0000] **	0.2292 (1.0752) [0.28454]	0.3920	28.0772 [0.0000]**	6.6545	6.7408
Consumar	10.1108 (11.7713) [0.0000] **	0.1874 (1.1698) [0.2455]	-0.0605 (-0.2420) [0.8094]	0.0070	0.7099 [0.4947]	6.9752	7.0614
Cr. Immobil. Et Hotelier	1.5437 (1.2029) [0.2325]	0.8769 (3.6621) [0.0004] **	-0.3424 (-0.9158) [0.3625]	0.1265	7.0819 [0.0015] **	7.7782	7.8644
Eqdom	0.2325 (8.7360) [12.8993]	0.8777 (6.9457) [0.0000] **	-0.0552 (-0.2801) [0.7801]	0.3552	24.1389 [0.0000] **	6.4998	6.5860
Holcim Maroc	8.14094 (14.2332) [0.0000] **	1.2225 (11.4541) [0.0000] **	0.1051 (0.6310) [0.5298]	0.6071	65.9039 [0.0000] **	6.6193	6.2481
Lafarge Ciments	9.1828 (15.4462) [0.0000] **	1.0188 (9.1841) [0.0000] **	-0.1159 (-0.6661) [0.5072]	0.4959	42.3223 [0.0000] **	6.2392	6.3254
Lesieur Cristal	8.0483 (9.6284) [0.0000] **	0.4930 (3.1610) [0.0022] **	-0.2794 (-1.1472) [0.2546]	0.0989	5.6073 [0.0052] **	6.9208	7.0070
Managem	5.5570 (5.2753) [0.0000] **	1.4523 (7.3884) [0.0000] **	-0.2587 (-0.8430) [0.4017]	0.3875	27.5573 [0.0000] **	7.3833	7.4695
Maroc Leasing	4.6555 (1.8910) [0.0622]	1.1726 (2.5525) [0.0126]*	-0.2043 (-0.2849) [0.7764]	0.0519	3.2891 [0.0423]*	9.0812	9.1674
Nexans Maroc	8.2896 (221.4524) [0.0000] **	-0.0040 (-0.5729) [0.5683]	0.0091 (0.8417) [0.4024]	0.0118	0.5121 [0.6011]	0.7089	0.7951
Rebab	9.4009 (6.5168) [0.0000] **	0.1152 (0.4283) [0.6695]	0.2264 (0.5388) [0.5915]	0.0184	0.2400 [0.7872]	8.0121	8.0983
Samir	8.1753 (9.0915) [0.0000] **	0.8222 (2.5358) [0.0131]*	0.1681 (0.6832) [0.4964]	0.1878	10.7128 [0.0001] **	7.2013	7.2875
Sc. Mtg. D'imiter	5.8909 (4.2250) [0.0001] **	0.8362 (3.2140) [0.0019] **	-0.1561 (-0.3844) [0.7017]	0.0914	5.2234 [0.0073] **	7.9441	8.0303
Sonasid	9.7322 (12.4936) [0.0000] **	0.9125 (6.2781) [0.0000] **	0.1987 (0.8755) [0.3838]	0.3133	20.1663 [0.0000] **	6.7797	6.8659
Taslif	5.6412 (3.7132) [0.0004] **	0.4083 (1.4405) [0.1535]	-0.0073 (-0.0166) [0.9868]	0.0009	1.0375 [0.3590]	8.1157	8.2019
Unimer	9.0783 (16.835) [0.0000] **	0.0978 (-0.9726) [0.3336]	-0.0696 (-0.4430) [0.6589]	0.0105	0.5655 [0.5703]	6.0442	6.1304

Wafa Assurance	6.6211 (6.9861) [***0.0000***] **	1.1866 (5.7598) [***0.0000***] **	-0.0151 (-0.0549) [***0.9563***]	*0.2707*	16.5880 [***0.0000***] **	7.1720	7.2582
Zellidja	10.3264 (6.7428) [***0.0000***] **	0.1548 (0.5416) [***0.5896***]	-0.5869 (-1.3152) [***0.1921***]	*0.0001*	1.0024 [***0.3715***]	8.1318	8.2180

Source: Author’s own calculations

There are three fundamental propositions of the Fama-French model (i) that the coefficients of the market, size and BE/ME proxies must be positive, (ii) that in order to contribute to return generating process, the respective coefficients must be statistically significant, (iii) that the impact of size and BE/ME factors to return variation is greater than that of the systematic risk (i.e. the market risk premium as measured by beta). As can be seen from table 29, with the exception of Nexans, which has negative beta, proposition (i) is supported by the remaining twenty eight firms which have positive beta coefficients. However, only twenty one firms are statistically significant at 1 and 5 per cent levels. With respect to BE/ME (HML), the coefficients of only nine firms are positive and satisfy the condition of proposition (i) and none of the twenty nine firms exhibit significant coefficient. In other words, per Fama-French model’s prediction BE/ME (HML) premium does not contribute to return variation in Morocco. These findings are similar to those documented elsewhere in both the developed and emerging markets. For example, Kothari *et al*. (1995) found that in the US the market beta dominant the return generating process however, other fundamentals identified in Fama and French (1992 & 1993) failed their test. Al-Rjoub *et al*. (2010) results also show that in four MENA (Middle East and North Africa) markets beta have significant explanatory powers in predicting stock returns however, other fundamentals namely, price-earnings ratio (P/E), BE/ME (i.e. HML) and M-CAP (i.e. SMB) failed to account for variations in stock returns. According to the testable implication of Fama-French model the intercept (or alpha value) should be zero. However, this prediction is violated per the evidence as the intercepts for all twenty nine firms are positive and thus, greater than zero. With the exception of Cr. Immobil, Eqdom and Maroc Leasing, the remaining twenty six firms' exhibit significant intercepts at 1 per cent level indicating deviations from the model even after adjusting for BE/ME risk premium.

The R^2 for the individual regressions are very low and this is buttressed by high Akaike Information Criterion (AIC) and Schwarz Criterion (SC), which are all well above the critical value of 3. The highest total variation in equity returns in Morocco which can be explained by the Fama-French model, as measured by adjusted R^2, is only 60.71% (for Holcim), leaving almost 40 per cent of the variations in the company's equity returns unexplained by the model. For a company like Zellidja with adjusted R^2 of 0.01%, the unexplained variation of 99.99% renders the appropriateness of Fama-French model even more problematic. These implies that there are other risk factors other than systematic and BE/ME risks, including perhaps other company-specific and industry/economy wide risk factors, which equity investors seek compensations for in the Moroccan market. A similar result was reported in Morocco by Hearn *et al*. (2008) that although the market beta was dominant the adjusted R^2 for the Fama-French model was low (0.1030 or 10.30 per cent). However, according to the *F*-statistics, the combined role of beta and value premium is statistically significant in twenty firms at 1 and 5 per cent levels.

8.2.2 ECM Augmented Fama-French model

As Fama-French model is not underpinned by equilibrium theory, error correction is necessary to avoid any cointegrated error which may render the regressions spurious. Trace test and Max-eigenvalue test indicate that the series are cointegrated at 0.05 levels and if this is not corrected will lead into spurious regression. This study specifies Error Correction Mechanism (ECM) in the mean equation to correct for co integration. The co integrated residual is expressed as ECM. A result for Acred is presented in the equation below for demonstrative purposes. Results for the remaining companies are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \hat{\beta}_{\mathrm{H}t} (HML)_t + \hat{\phi} U_{t-1} + \varepsilon_{it}$$

$$r_{it} = 0.9253 + 0.0899 r_{Mt} - 0.3969 HML_t + 0.8970 U_{t-1} + \varepsilon_{it}$$

$$t = (0.0874) \quad (0.3071) \quad (-0.3969) \qquad (0.8079)$$
$$p = [0.9305] \quad [0.7596] \quad [0.3879] \qquad [0.4215]$$

Table 30: time series regression estimates of equation 6.22

Company	***A***	***β***	***HML***	ϕ	$\overline{R}^2$	***F-Statistic*** *(p-value)*	***AIC***	***SC***
Acred	0.9253	0.0899	-0.3969	0.8970	*0.0176*	0.5219	8.1764	8.2921
	(0.0874)	(0.3071)	(-0.8682)	(0.8079)		[***0.6685***]		
	[***0.9305***]	[***0.7596***]	[***0.3879***]	[***0.4215***]				
Afriquia Gaz	8.1059	1.0215	-0.2436	0.1302	*0.3351*	14.9419	6.9504	7.0661
	(4.4687)	(6.4510)	(-0.9823)	(0.8342)		[***0.0000***] **		
	[***0.0000***] **	[***0.0000***] **	[***0.3289***]	[***0.0000***] **				
Attijari wafa Bank	8.4789	1.0069	0.04676	0.0327	*0.6839*	60.8677	5.4632	5.5789
	(10.1917)	(13.3346)	(0.4044)	(0.4304)		[***0.0000***] **		
	[***0.0000***] **	[***0.0000***] **	[***0.6870***]	[***0.6681***]				

Auto Hall	5.6421	0.6778	-0.3561	0.4305	*0.2615*	10.7966	6.7332	6.8494
	(2.4892)	(4.7836)	(-1.5996)	(2.1745)		[0.0000] **		
	[0.0149]*	[0.0000] **	[0.1136]	[0.0326]*				
Auto Nejma	-11.0562	0.2125	0.0162	2.0178	*0.0627*	2.8507	7.5481	7.6639
	(-1.3205)	(0.9943)	(0.0484)	(2.6163)		[0.0425]*		
	[0.1904]	[0.3231]	[0.9615]	[0.0106]*				
BMCE Bank	7.0846	-0.7559	-0.0180	0.2410	*0.3363*	15.0180	6.3888	6.5045
	(4.1148)	(6.3081)	(-0.0963)	(1.5277)		[0.0000] **		
	[0.0001] **	[0.0000] **	[0.9236]	[0.1305]				
BQ. Maroc. Du Com. Etdl.	9.2393	0.7151	0.3396	-0.0938	*0.3154*	13.7465	6.3328	6.4485
	(5.9076)	(6.1035)	(1.8690)	(-0.5858)		[0.0000] **		
	[0.0000] **	[0.0000] **	[0.0653]	[0.5597]				
Branoma	7.8465	0.2795	-0.1239	0.1700	*0.0239*	1.6787	6.6162	6.7284
	(1.6891)	(2.0945)	(-0.5912)	(0.3610)		[0.1782]		
	[0.0951]	[0.0394]*	[0.5561]	[0.7191]				
Brasseries Du Maroc	11.9518	0.7815	-0.3152	-0.3344	*0.2963*	12.6493	6.6066	6.7223
	(6.6290)	(5.8664)	(-1.5092)	(-1.8932)		[0.0000] **		
	[0.0000] **	[0.0000] **	[0.1352]	[0.0620]				
CDM Credit Du Maroc	9.3559	0.9041	0.2410	-0.1458	*0.3562*	16.3074	6.5687	6.6845
	(6.5116)	(3.7370)	(0.9362)	(-1.0179)		[0.0000] **		
	[0.0000] **	[0.0003] **	[0.3520]	[0.3118]				
Centrale Laitiere	11.5654	0.6520	-0.3001	-0.2653	*0.1419*	5.5757	7.0622	7.1780
	(4.3482)	(3.8998)	(-1.1440)	(-1.0107)		[0.0016] **		
	[0.0000] **	[0.0002] **	[0.2561]	[0.3152]				
Ciment Du Maroc	8.1254	1.0203	0.2471	-0.0219	*0.3905*	18.7233	6.6791	6.7949
	(5.7304)	(7.3418)	(1.1430)	(-0.1597)		[0.0000] **		
	[0.0000] **	[0.0000] **	[0.2564]	[0.8736]				
Consumar	12.0563	0.1895	-0.0695	-0.1882	*0.0194*	0.4735	7.0108	7.1266
	(1.3264)	(1.6189)	(-0.2720)	(-0.2134)		[0.7016]		
	[0.1885]	[0.2487]	[0.7864]	[0.8316]				

Cr. Immobil . Et Hotelier	1.1212	0.8517	-0.3358	0.2327	*0.1225*	4.8628	7.8007	7.9164
	(0.7789)	(3.5205)	(-0.8848)	(0.8378)		[***0.0037***] **		
	[***0.4383***]	[***0.0007***] **	[***0.3789***]	[***0.4046***]				
Eqdom	8.7720	0.9025	0.0078	-0.0322	*0.3967*	19.1891	6.3821	6.4978
	(6.0175)	(7.5576)	(0.0419)	(-0.0232)		[***0.0000***] **		
	[***0.0000***] **	[***0.0000***] **	[***0.9667***]	[***0.8173***]				
Holcim Maroc	9.0404	1.2400	0.0947	-0.1014	*0.6086*	44.0177	6.1814	6.2972
	(9.0420)	(11.4611)	(0.5614)	(1.1280)		[***0.0000***] **		
	[***0.0000***] **	[***0.0000***] **	[***0.5761***]	[***0.0000***] **				
Lafarge Ciments	10.965	1.0371	-0.1449	-0.1768	*0.5040*	29.1168	6.2440	6.3597
	(8.6677)	(9.3103)	(-0.8324)	(-1.5803)		[***0.0000***] **		
	[***0.0000***] **	[***0.0000***] **	[***0.4077***]	[***0.1180***]				
Lesieur Cristal	9.6822	0.50041	-0.2926	-0.1946	*0.0917*	3.7942	6.9524	7.0682
	(3.4697)	(3.1652)	(-0.1178)	(-0.6181)		[***0.0134***]*		
	[***0.0008***] **	[***0.0002***] **	[***0.2423***]	[***0.5383***]				
Manage m	4.5604	1.4333	-0.2206	0.1438	*0.3884*	18.5668	7.4057	7.5215
	(3.2141)	(7.2032)	(-0.7087)	(1.0269)		[***0.0000***] **		
	[***0.0019***] **	[***0.0000***] **	[***0.4806***]	[***0.3075***]				
Maroc Leasing	0.7282	1.1920	-0.3219	-0.3265	*0.0460*	2.3348	9.0997	9.2154
	(2.0053)	(2.5681)	(-0.4433)	(-0.8065)		[***0.0800***]		
	[***0.0483***]*	[***0.0121***]*	[***0.6587***]	[***0.4223***]				
Nexans Maroc	5.3384	-0.0070	-0.0003	0.3605	*0.0619*	2.8270	**-1.3171**	**-1.2014**
	(1.7103)	(-2.7961)	(-0.0841)	(0.9572)		[***0.0438***]*		
	[***0.0911***]	[***0.0065***] **	[***0.9332***]	[***0.3413***]				
Rebab	1.21813	0.0861	0.2303	0.8629	*0.0271*	0.2689	8.0444	8.1601
	(0.0860)	(0.3110)	(0.5397)	(0.5805)		[***0.8476***]		
	[***0.9317***]	[***0.7567***]	[***0.5909***]	[***0.5632***]				
Samir	10.3828	0.8504	0.1425	-0.2506	*0.1894*	7.4652	7.2220	7.3378
	(6.4325)	(2.6064)	(0.5765)	(-1.5668)		[***0.0002***] **		
	[***0.0000***] **	[***0.0109***]*	[***0.5659***]	[***0.1211***]				

Sc. Mtg. D'imiter	4.1150	0.8110	-0.1284	0.2743	*0.0876*	3.6550	7.9714	8.0872
	(1.6195)	(3.0718)	(-0.3109)	(0.8500)		[***0.0159***]*		
	[***0.1093***]	[***0.0029***] **	[***0.7567***]	[***0.3978***]				
Sonasid	8.6691	0.9052	0.2246	0.0960	*0.3111*	13.4960	6.8061	6.9218
	(4.6352)	(6.1140)	(0.9748)	(0.5906)		[***0.0000***] **		
	[***0.0000***] **	[***0.0000***] **	[***0.3326***]	[***0.5565***]				
Taslif	2.6115	0.3781	0.0048	0.5194	*0.0060*	0.8350	8.1441	8.2599
	(0.5720)	(1.3113)	(0.0107)	(0.7197)		[***0.4786***]		
	[***0.5689***]	[***0.1935***]	[***0.9915***]	[***0.4738***]				
Unimer	10.2283	0.0996	-0.0685	-0.1269	*0.0231*	0.3743	6.0799	6.1957
	(1.1192)	(0.9751)	(0.4269)	(-0.1274)		[***0.7718***]		
	[***0.2664***]	[***0.3323***]	[***0.6706***]	[***0.8989***]				
Wafa Assurance	5.7924	1.0083	0.0076	0.1074	*0.2654*	10.9975	7.2029	7.3187
	(3.5142)	(5.5984)	(0.0271)	(0.5945)		[***0.0000***] **		
	[***0.0007***] **	[***0.0000***] **	[***0.9785***]	[***0.5539***]				
Zellidja	-4.27237	0.1990	-0.5255	**1.3975**	*0.03140*	1.8970	8.1234	8.2392
	(-0.5431)	(0.7000)	(-1.1795)	**(1.8977)**		[***0.1368***]		
	[***0.5886***]	[***0.4860***]	[***0.2417***]	***[0.41272]***				

Source: Author's own calculations

The fundamental aim of this test is to establish whether correction for cointegrated error improves the performance of the model. As can be seen from the results in table 30, although ECM corrects equilibrium discrepancies they are not statistically significant at either 1 or 5 per cent levels, with the exception of Auto Hall(*), Holcim(**), Auto Nejma(*) and Afriquia Gaz(**), implying that the cointegrated error does not affect return generating process in Morocco. The beta coefficients for twenty two firms is significant at 1 and 5 per cent levels confirming that the market risk premium is still influential in explaining returns in Morocco even when ECM is included in the mean equation. However, the BE/ME which was expected to dominate significantly per the model's prediction after adjusting for cointegrated error is still insignificant. None of the coefficients of BE/ME (HML) for all the twenty nine firms is statistically significant at either 1 or 5 per cent level.

In spite of the error correction, the fitness of the model to the data is not in any way improved as demonstrated by low R^2, and high AIC and SC which are all well above the critical value of 3. The highest total variation in equity returns in Morocco which can be explained by the augmented Fama-French model, as measured by adjusted R^2 , is 60.86% (for Holcim), leaving almost 40 per cent of the variations in the company's equity returns unexplained by the model. For a company like Taslif with adjusted R^2 of 0.6%, the unexplained variation of 99.40% renders the appropriateness of Fama-French model with a difficulty. However, as can be seen from table 30, the combined role of beta and value premium is statistically significant in twenty one firms at 1 and 5 per cent levels as prescribed by the *F*-statistics.

8.2.3 GARCH Augmented Fama-French model

ECM augmented Fama-French model still exhibit significant deviations as the market risk premium and value premium failed to account for majority of variations in returns. Empirical evidence in emerging markets suggests that volatility affect assets return (French *et al*., 1987; Bekaert *et al*., 1996; Ortiz and Arjona, 2001 and McMillan and Thupayagale, 2009). Again, initial White test, J-B statistic, kurtosis and skewness, all show that stock returns used in this study exhibit inconstant error variance, volatility clustering and leptokurtosis. Therefore, this study is designed to improve the Fama-French model by modelling both error term and the conditional variance via GARCH. This is to take into account the non-linear characteristics of the regression in the variance equation created by volatility clustering and leptokurtosis. A result for Acred is presented in the equation for demonstrative purposes. Results for the remaining firms are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \hat{\beta}_{\mathrm{H}t} \left(HML\right)_t + \varepsilon_{it} + \hat{\gamma} h_t + \xi_t$$

$$r_{it} = -9.2388 + 0.2120 r_{Mt} - 0.2128 HML + \varepsilon_{it} + 2.2801 h_t + \xi_{it}$$

$$t = (-2.3113) \qquad (0.9666) \qquad (-1.1165)$$
$$p = [0.0208] \qquad [0.3338] \qquad [0.2642]$$

$$h_t = \hat{\omega} + \hat{\alpha}_1 \varepsilon_{t-1} + \hat{\beta}_1 h_{t-1}$$
$$h_t = 42.9426 + 2.2830 \varepsilon_{t-1}^2 - 0.0029 h_{t-1}$$

$$t = (1.9300) \qquad (3.1294) \qquad (-0.3815)$$
$$p = [0.0536] \qquad [0.0018] \qquad [0.7028]$$

Table 31: time series regression estimates of equations 6.24 and 6.25

Company	*α*	*ω*	*B*	*HML*	*$α_1$*	*$β_1$*	*$α_1$+$β_1$*	$\overline{R}^2$	*F-Statistic (prob)*	*AIC*	*SC*
Acred	-9.2388 (-2.3113) [0.0208] *	42.9426 (1.9299) [0.0536]	0.2119 (0.9666) [0.3338]	-0.2128 (-1.1165) [0.2642]	2.2830 (3.1294) [0.0018] **	-0.0029 (-0.3815) [0.7028]	**2.2801**	*0.1619*	8.7149 [0.0000]**	7.9140	8.1166
Afriquia Gaz	8.1347 (4.4789) [0.0000] **	25.9200 (0.1624) [0.8710]	1.0219 (7.4945) [0.0000] **	-0.2368 (-0.9696) [0.3322]	0.0337 (0.1752) [0.8609]	0.5025 (0.1689) [0.8658]	**0.5362**	*0.3351*	9.6894 [0.0000]**	7.0198	7.2224
Attijariwafa Bank	7.9912 (9.1622) [0.0000] **	11.8360 (2.0978) [0.0359]*	0.7186 (4.0899) [0.0000] **	0.0312 (0.2352) [0.8140]	-0.1189 (-6.4543) [0.0000] **	0.1713 (0.3639) [0.7159]	**0.0524**	*0.6802*	33.9177 [0.0000]**	5.4672	5.6697
Auto Hall	7.254180 (2.5251) [0.0116]*	40.2645 (2.1357) [0.0327]*	0.1618 (0.6197) [0.5354]	-0.3845 (-1.724) [0.0845]	0.3688 (1.4922) [0.1356]	-0.2395 (-0.6293) [0.5291]	**0.1293**	*0.2222*	4.9523 (0.0002) **	6.7217	6.9243
Auto Nejma	-12.1930 (-1.2631) [0.2065]	47.8718 (0.5804) [0.5616]	0.7001 (9.7897) [0.0000] **	0.0916 (0.2405) [0.8099]	-0.0440 (-0.6380) [0.5234]	0.6129 (0.8917) [0.3725]	**0.5689**	*0.0224*	1.3173 [0.2596]	7.5709	7.7735
BMCE Bank	7.7263 (5.4343) [0.0000] **	9.0530 (1.4801) [0.1388]	08461 (11.0194) [0.0000] **	0.2031 (1.3888) [0.1649]	0.5840 (3.1197) [0.0018] **	0.2363 (1.0335) [0.3013]	**0.8203**	*0.2816*	6.4225 [0.0000] **	6.2855	6.4881
BQ. Maroc. Du Com. Etdl.	6.5021 (5.1918) [0.0000] **	11.0126 (2.7518) [0.0059] **	0.2455 (1.7588) [0.0786]	0.1340 (0.8513) [0.3946]	0.7951 (2.6248) [0.0087] **	0.0261 (0.1560) [0.8760]	**0.8212**	*0.2346*	5.2402 [0.0001] **	6.1692	6.3718
Branoma	7.6901 (1.5593) [0.1189]	2.8493 (39.3142) [0.0000] **	0.7446 (5.3499) [0.0000] **	-0.1029 (-0.4832) [0.6829]	-0.1209 (-14.4123) [0.0000] **	1.0556 (5.4444) [0.0000] **	**0.9347**	*0.0150*	0.7951 [0.5966]	6.5615	6.7641
Brasseries Du Maroc	11.6058 (7.6257) [0.0000] **	1.3430 (1.5766) [0.1149]	1.1108 (11.0074) [0.0000] **	-0.1170 (-1.7671) [0.0772]	-0.0881 (-4.7339) [0.0000] **	1.0770 (2.1566) [0.0000] **	**0.9889**	*0.2592*	5.8409 [0.0000] **	6.5415	6.7441
CDM Credit Du Maroc	8.7825 (10.2709) [0.0000] **	6.8833 (4.3913) [0.0000] **	1.1108 (11.0074) [0.0000] **	0.1206 (-0.6338) [0.5262]	-0.1007 (-4.1376) [0.0000] **	0.894974 (11.5598) [0.0000] **	**0.7942**	*0.2999*	6.9283 [0.0000] **	6.4437	6.6463

Centrale Laitiere	10.5881 (3.4651) [***0.0005***] **	8.0242 (1.4340) [***0.1516***]	0.5193 (3.3164) [***0.0009***] **	-0.2482 (-0.7625) [***0.4457***]	0.1048 (1.2141) [***0.2247***]	0.769 (5.3060) [***0.0000***] **	**0.8738**	*0.0997*	2.5321 [***0.0273***]*	7.0628	7.2654
Ciment Du Maroc	9.0280 (7.2520) [***0.0000***] **	0.1694 (2.8662) [***0.0042***] **	0.9395 (7.2413) [***0.0000***] **	0.0556 (-0.3082) [***0.7579***]	-0.0765 (-11.7677) [***0.0000***] **	1.1006 (8.3729) [***0.0000***] **	**1.0241**	*0.3494*	8.4305 [***0.0000***]**	6.3805	6.5830
Consumar	11.4691 (1.4259) [***0.1539***]	10.3797 (3.0979) [***0.0019***] **	0.2056 (1.0443) [***0.2963***]	-0.1012 (-0.3134) [***0.7539***]	0.0677 (0.6495) [***0.5160***]	-0.8237 (-1.6609) [***0.0967***]	**-0.7560**	*0.0598*	0.2196 [***0.0000***] **	7.0673	7.2699
Cr. Immobil. Et Hotelier	0.7840 (0.9689) [***0.3326***]	28.6550 (2.0872) [***0.0369***]*	0.7999 (6.2413) [***0.0000***] **	0.2960 (1.3368) [***0.1813***]	1.1866 (3.0791) [***0.0021***] **	0.0121 (0.1346) [***0.8929***]	**1.1987**	*0.0548*	1.8024 [***0.1096***]	7.55684	7.7594
Eqdom	9.3030 (8.1747) [***0.0000***] **	17.0940 (1.5471) [***0.1218***]	0.9916 (16.4346) [***0.0000***]**	-0.0382 (-0.2426) [***0.8083***]	-0.2355 (-2.5608) [***0.0104***]*	0.6889 (2.1069) [***0.0351***]*	**0.4534**	*0.3626*	8.8707 [***0.0000***] **	6.2735	6.4761
Holcim Maroc	8.5724 (12.1408) [***0.0000***] **	5.2229 (1.172329) [***0.2411***]	1.2777 (12.20407) [***0.0000***] **	0.1755 (1.1528) [***0.2490***]	0.4976 (1.9968) [***0.0458***]*	0.4032 (1.6450) [***0.1000***]	**0.9008**	*0.5885*	20.78067 [***0.0000***] **	6.1662	6.3687
Lafarge Ciments	12.1042 (7.6406) [***0.0000***] **	0.4213 (1.2453) [***0.2130***]	0.9858 (8.9564) [***0.0000***] **	-0.0412 (-0.2895) [***0.7722***]	-0.0572 (-0.8081) [***0.4919***]	1.0592 (14.9494) [***0.0000***] **	**1.0020**	*0.4726*	13.3957 [***0.0000***] **	6.1212	6.3238
Lesieur Cristal	9.3509 (7.1456) [***0.0000***] **	61.8725 (1.9381) [***0.0526***]	0.5652 (3.8977) [***0.0000***] **	-0.4088 (-1.4844) [***0.3177***]	-0.1756 (-4.6989) [***0.0000***] **	0.1130 (0.2113) [***0.8326***]	**-0.0630**	*0.0331*	1.4738 [***0.1983***]	6.9780	7.1806
Managem	5.2118 (4.0678) [***0.0000***] **	11.0277 (1.0998) [***0.0000***] **	1.4027 (8.1662) [***0.0000***] **	-0.0847 (-0.3002) [***0.7640***]	0.1814 (1.4468) [***0.1479***]	0.7127 (4.0230) [***0.0000***] **	**0.8941**	*0.3582*	8.7314 [***0.0000***] **	7.3917	7.5943
Maroc Leasing	8.7469 (1.9559) [***0.0505***]*	4.7482 (3.546747) [***0.0004***] **	0.9663 (1.108577) [***0.2676***]	-0.7764 (-0.8564) [***0.3918***]	0.2576 (1.3222) [***0.1861***]	-0.1623 (-0.5669) [***0.5708***]	**0.0953**	*0.0092*	0.8733 [***0.5185***]	8.8695	9.0721
Nexans Maroc	6.3227 (5.868173) [***0.0000***] **	3.1SE-05 (0.2924) [***0.7699***]	-0.0019 (-3.9016) [***0.0001***] **	0.0008 (0.6428) [***0.5203***]	0.7011 (1.6160) [***0.1061***]	-0.4051 (2.9699) [***0.0030***] **	**0.2960**	*0.1776*	0.2835 [***0.9435***]	7.3178	7.1153
Rebab	-2.5998 (-0.1665) [***0.8677***]	43.0717 (3.1255) [***0.0018***]**	0.3618 (1.6109) [***0.1072***]	0.0817 (0.2259) [***0.8212***]	0.5120 (3.2762) [***0.0011***]**	-0.3476 (2.8490) [***0.0044***]**	**0.1644**	*0.0852*	0.0386 [***0.9997***]	7.9427	81.4527
Samir	8.6976 (4.9489) [***0.0000***] **	13.6859 (1.1637) [***0.2445***]	0.6575 (3.6414) [***0.0003***] **	0.0759 (0.2015) [***0.8403***]	-0.0644 (-3.2064) [***0.0013***] **	0.8816 (5.7679) [***0.0000***] **	**0.8172**	*0.1393*	3.23958 [***0.0068***] **	7.2366	7.4392
Sc. Mtg. D'imiter	5.9847 (2.8489) [***0.0044***] **	1.5234 (1.2089) [***0.2267***]	0.7282 (3.5488) [***0.0004***] **	-0.3077 (-0.7573) [***0.4488***]	-0.0761 (-4.2962) [***0.0000***] **	1.0936 (63.0696) [***0.0000***] **	**1.0175**	*0.0421*	1.6090 [***0.1560***]	7.7242	7.9268
Sonasid	10.59449 (4.9232) [***0.0000***] **	-0.6242 (-2.1721) [***0.0298***]*	0.9266 (5.3752) [***0.0000***] **	0.0375 (0.1909) [***0.8486***]	-0.0416 (-17.0770) [***0.0000***] **	1.0747 (7.3240) [***0.0000***] **	**1.0331**	*0.2698*	6.1109 [***0.0000***] **	6.6844	6.8873
Taslif	8.7413 (3.2993) [***0.0010***] **	5.9934 (2.3802) [***0.0173***]*	0.0194 (0.0916) [***0.9270***]	0.692006 (2.4502) [***0.0143***]*	1.3012 (5.2520) [***0.0000***] **	-0.0594 (1.0068) [***0.3140***]	**1.2418**	*0.1703*	0.4229 [***0.8617***]	7.8440	8.0466
Unimer	7.4872 (0.7298) [***0.4655***]	4.2038 (1.1572) [***0.2472***]	0.1356 (1.5227) [***0.1278***]	-0.0691 (-0.3644) [***0.7155***]	0.1833 (1.1023) [***0.2703***]	0.6153 (2.3797) [***0.0172***]*	**0.7986**	*0.0066*	0.1434 [***0.9898***]	6.0495	6.25
Wafa Assurance	5.7001 (2.4215) [***0.0155***]*	19.8727 (0.2883) [***0.7731***]	1.0152 (5.4796) [***0.0000***] **	0.0008 (0.0042) [***0.9980***]	0.0298 (0.3743) [***0.7081***]	0.6958 (0.6939) [***0.4877***]	**0.7256**	*0.2367*	5.2904 [***0.0001***] **	7.2700	7.4472
Zellidja	6.1485 (0.8320) [***0.4054***]	15.3406 (17.2134) [***0.0000***]**	0.1375 (1.7601) [***0.0784***]	-0.2689 (-0.5537) [***0.5797***]	-0.1175 (-4.4119) [***0.0000***] **	1.0715 (31.7656) [***0.0000***] **	**0.9540**	*0.0364*	0.5139 [***0.7961***]	8.0176	8.2202

Source: Author's own calculations

The GARCH model is characterized by the following three fundamental propositions; (i) that, $\omega=0$ and $\alpha, \beta \geq 0$ to ensure that the conditional variance is sternly positive in relation to expected excess stock return. However, reported empirical evidences are contradictory. For example, French et al. (1987) and Campbell and Hentschel (1992) found positive relationship between excess return and conditional variance, while Fama and Schwert (1977), Campbell (1987), Breen et al. (1989), Turner et al. (1989), Pagan and Hong (1991) and Nelson (1991) found a negative relation; (ii) that shocks to volatility decay at constant rate and the speed of decay is measured by the estimate of $\alpha+\beta$; (iii) that the sum of α and β measures volatility persistence (i.e. the degree to which shocks to current volatility remain important for long-periods into the future). The persistence of shocks to volatility becomes greater as the sum approaches 1 (or unity) and shock to volatility is considered to be permanent if the sum is equal to 1 (Engle and Bollerslev, 1986). As this sum becomes greater than 1, then volatility is explosive, i.e. shock to volatility in one period will result in even a greater volatility in the subsequent period (Chou, 1988).

1. By summing up α (ARCH term) and β (GARCH term), as can be seen from the table 18, proposition (i) is supported by twenty seven companies. The sum of α and β for these twenty seven firms in Morocco are positive which is consistent with French et al. (1987) and Campbell and Hentschel (1992). However, the sum of α and β for Consumar (*-0.7560*) and Lesieur Cristal (*-0.0630*) violates this proposition of the model. Besides, by disaggregating the model, thirteen firms exhibit negative coefficients of the conditional (ARCH) variance term and the GARCH term is negative in seven firms in Morocco. Although, according to ARCH/GARCH theory, this negative relationships between returns and conditional variance should not exist, the estimated coefficients of these firms from table 31 violate the imposition of this

positive parameter restriction as the ARCH/GARCH models unduly restrict the dynamics of the conditional variance process (see also Nelson, 1991). Similarly, previous tests of the relation between excess return and conditional variance using ARCH and GARCH models have documented negative relationships (Fama and Schwert, 1977; Campbell, 1987; Breen et al., 1989; Turner et al., 1989; Pagan and Hong, 1991 and Nelson, 1991). This negative relation between return and conditional variance is buttressed by Black (1976) results, which found a negative correlation between current returns and future returns volatility. Furthermore, Nelson (1991) and Engle and Ng (1993) argue that the time series properties of monthly returns data are to some extent different from daily returns data and therefore, more likely to find a negative relation between returns and conditional variance with low level of data frequency. However, Glosten et al. (1993) argue that there is no theoretical grounding to support the differences in time series properties which should affect the outcome of the results.

2. Besides, it is vitally important to analyse the statistical significance of the ARCH and GARCH coefficients in relation to returns since the results obtained could have happened out of chance. The test of significance was set at 1 (*p-value with* **) and 5 (*p-value with* *) per cent levels and the results, as in table 31, shows that the ARCH term exhibits statistically significant coefficients in eighteen firms at 1 and 5 per cent levels. However, out of these eighteen firms, eleven exhibit statistically significant negative relationship between returns and (ARCH term) conditional variance, while the remaining seven show statistically significant positive relationship between return and (ARCH term) conditional variance at 1 and 5 per cent levels. Similarly, the results, as in table 31, show that the GARCH term is statistically significant in fifteen

firms at 1 and 5 per cent levels of which twelve are with positive coefficients, while the remaining two are negative.

3. The persistence of volatility as measured by the sum of $\alpha+\beta$ varies considerably for the nineteen companies in Ghana. For example, in Acred (*2.2801*), Ciment Du Maroc (*1.0241*), Cr Immobil (*1.1987*), Lafarge (*1.0020*), Sc. Mtg (*1.0175*), Sonasid (*1.0331*) and Taslif (*1.2418*), volatility persistence is explosive and $\alpha + \beta > 1$ for these firms. A similar result was documented in Nigeria and Zimbabwe by McMillan and Thupayagale (2009). Explosive volatility means that persistence of shocks to volatility in one period will result in even a greater volatility in the subsequent period since the sum of α and β are greater than 1 or unity (Chou, 1988). For all other firms $\alpha + \beta < 1$. For instance, among remaining firms, only Branoma (*0.9347*), Brasseries (*0.9889*), Holcim (*0.9008*) and Zellidja (*0.9540*) exhibit the greatest persistence, as the sum of α and β is close to 1. This implies that a shock to volatility in the past will be significant in predicting future volatility over a prolonged period. Meanwhile, evidence of low volatility is found in the remaining sixteen firms. Among these thirteen firms, the sum of α and β ranges from 0.0524 (Attijariwafa) to 0.8941 (Managem). This does not insinuate that volatility is not present in these firms; however, shocks to volatility diminish so quickly. McMillan and Thupayagale (2009) found similar evidence in nine African Stock Markets (Botswana, Egypt, Ghana, Kenya, Mauritius, Morocco, Namibia, South Africa and Tunisia) that shocks to volatility in these markets taper off fairly quickly in comparison with UK and US markets. Also, Glosten et al. (1993), using monthly excess return on US stocks found that the conditional volatility is not highly persistent.

4. Per GARCH restriction, the variance constant, ω, should be 0. As in table 31, this condition is violated by the evidence. The coefficients of the variance constant, ω, for twenty eight firms are greater than 0, while the variance constant for Sonasid (-0.6242) is less than 0. However, only fourteen firms show statistical significant constant variance at 1 and 5 per cent levels of which thirteen are positive and only Sonasid is negatively significant.

Per the results in table 31, beta for twenty eight firms (with exception of Nexans which show negative statistical coefficient at 1 per cent level) exhibit positive coefficients in support of a fundamental proposition of the beta which state that asset returns are positive (and linear) functions of its systematic risk. However, only nineteen firms exhibit statistical significant positive relationship between beta and asset return at 1 per cent level, while Nexans show negative relation at the same level of significance. According to the Augmented Fama-French model, the mean intercept should be 0. Nonetheless, this proposition is violated per the results in table 31. The evidence shows that intercepts for Acred, Auto Nejma and Rebab are negative and thus, less than 0, while the intercepts for the remaining twenty six are positive and thus, greater than 0. Statistically it is found that the intercepts of twenty one firms are positively significant at 1 and 5 per cent levels, while Acred exhibit statistically negative significance at 5 per cent level.

The coefficient of determination, R^2 ranges from 0.66 per cent to 68.02 per cent and this is a summary measure of how well Augmented Fama-French model explains the return generating process in Morocco. The highest total variation in equity in Morocco which can be explained by the GARCH augmented Fama-French, as measured by adjusted R^2, is only 68.02% (Attijariwafa) which is exceptionally high compare to others. The weak explanatory power of the model is further buttressed by high Akaike Information Criterion (AIC) and Schwarz Criterion (SC), which are all well above the critical value of 3. The combined role of beta and BE/ME as measured by *F*-statistic is significant in eighteen firms at 1 and 5 per cent levels.

8.2.4 GARCH-M Augmented Fama-French model

Following the evidence in table 31, it is found that there is correlation between excess stock return and conditional variance in Morocco. French *et al.* (1987) assert that volatility is actually a priced risk factor and not just a data characteristic issue. Therefore, the underlying theory following the results in table 31 is that investors should be rewarded for taking up additional risk. According to Engle, Lilien and Robins (1987), GARCH-in-Mean (or GARCH-M) is a better model to operationalize this type of risk. The results in table 32 are estimated using equation 6.27 where the regression process allows the conditional variance to enter the conditional mean process. A result for Acred is presented in the equation for demonstrative purposes. Results for the remaining companies are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \hat{\beta}_{Ht}(HML)_t + \hat{\delta}\sigma_t^2 + \varepsilon_{it}$$

$$r_{it} = -11.0643 + 0.0325 r_{Mt} + 0.0547 + 0.5852\sigma_t^2 + \varepsilon_{it}$$

$$t = (-0.8117) \quad (0.0879) \quad (0.1009) \quad (0.8400)$$
$$p = [0.4170] \quad [0.9299] \quad [0.9196] \quad [0.4009]$$

Table 32: time series regression estimates of equation 6.27

Company	***α***	***B***	***HML***	***δ***	$\overline{R}$	***F-Statistic (p-value)***	***AIC***	***SC***
Acred	-11.0643 (- 0.8117) [***0.4170***]	0.0325 (0.0879) [***0.9299***]	0.0547 (0.1009) [***0.9196***]	0.5852 (0.8400) [***0.4009***]	*0.0427*	1.0158 [***0.4215***]	7.9766	8.2081

Attijariwa fa Bank	12.9717 (0.9156) [***0.3599***]	1.0100 (13.3929) [***0.0000***] **	0.0514 (0.3748) [***0.7078***]	-1.2880 (-0.3219) [***0.7476***]	*0.6821*	0.8351 [***0.5466***]	5.5405	5.7720
Auto Hall	23.6661 (4.5194) [***0.0000***] **	0.5691 (3.1121) [***0.0019***] **	-0.2131 (-0.8728) [***0.3828***]	-2.9062 (-4.5196) [***0.0000***] **	*0.2733*	5.4583 (***0.0000***) **	6.6841	6.9156
BMCE Bank	-878.5788 (-0.0713) [***0.9431***]	-490.035 (-0.1379) [***0.8903***]	47.6569 (0.4422) [***0.6583***]	-0.8610 (-0.1639) [***0.8697***]	*0.0000*	7.1566 [***0.0000***]**	174.8373	175.0688
BQ. Maroc.	6.6839 (4.7063) [***0.0000***] **	0.8478 (10.5347) [***0.0000***] **	0.1338 (0.8428) [***0.3993***]	-0.0495 (-0.1511) [***0.8799***]	*0.2190*	4.3254 [***0.0004***] **	6.1925	6.4240
Branoma	35.6710 (47.6633) [***0.0000***] **	0.1774 (1.7814) [***0.0748***]	-0.1359 (-1.0124) [***0.3113***]	-3.6993 (-347.6266) [***0.0000***] **	*0.0958*	2.2572 [***0.0384***]*	6.7033	6.9348
Brasseries	13.9506 (2.2039) [***0.0275***]*	0.6445 (4.8996) [***0.0000***]**	-0.3739 (-2.2699) [***0.0232***]*	-0.9170 (-0.8548) [***0.3927***]	*0.2156*	4.8029 [***0.0003***]**	6.5785	6.7811
CDM Credit	5.0482 (0.8894) [***0.3738***]	0.9683 (11.1227) [***0.0000***] **	0.1143 (0.5706) [***0.5683***]	0.7643 (0.8107) [***0.4176***]	*0.3022*	6.1348 [***0.0000***] **	6.5449	6.7765
Centrale Laitiere	6.8749 (0.9016) [***0.3673***]	0.5300 (3.3701) [***0.0008***] **	-0.2312 (-0.6632) [***0.5072***]	0.4977 (0.5673) [***0.5705***]	*0.0942*	2.2325 [***0.0405***] *	7.1037	7.3352
Cr. Immobil.	-3.8675 (-1.8287) [***0.0674***]	0.8926 (6.6949) [***0.0000***] **	0.1002 (0.4251) [***0.6707***]	0.5509 (2.4646) [***0.0137***] *	*0.0597*	1.7525 [***0.1095***]	7.5601	7.7916
Eqdom	4.7942 (1.3620) [***0.1732***]	0.9076 (13.0426) [***0.0000***] **	-0.1168 (-0.6612) [***0.5085***]	0.5567 (0.7861) [***0.4318***]	*0.3682*	7.9109 [***0.0000***] **	6.3056	6.5371
Holcim Maroc	5.6841 (1.7124) [***0.0868***]	1.2322 (12.1787) [***0.0000***] **	0.1727 (1.0817) [***0.2794***]	0.6572 (0.9152) [***0.3601***]	*0.5859*	17.7831 [***0.0000***] **	6.1735	6.4049
Lafarge Ciments	13.1312 (6.9765) [***0.0000***] **	1.0627 (10.1333) [***0.0000***] **	-0.1181 (-0.8963) [***0.3701***]	0.0202 (0.0527) [***0.9580***]	*0.4501*	10.7033 [***0.0000***] **	6.1892	6.4207
Lesieur Cristal	8.4634 (2.8762) [***0.0040***] **	0.6637 (4.0306) [***0.0001***] **	-0.4628 (-2.4083) [***0.0160***] *	0.5277 (1.7635) [***0.0778***]	*0.0271*	1.3307 [***0.2477***]	6.9366	7.1681
Managem	6.0503 (1.1607) [***0.2457***]	1.4015 (8.1017) [***0.0000***] **	-0.1378 (-0.4859) [***0.6270***]	-0.1085 (-0.1909) [***0.8486***]	*0.3482*	7.3336 [***0.0000***] **	7.4224	7.6539
Nexans	6.5643 (20.2069) [***0.0000***] **	-0.0011 (-3.9315) [***0.0001***] **	0.0023 (3.3017) [***0.0010***] **	0.7874 (3.4372) [***0.0006***] **	*0.2617*	5.2030 [***0.0001***] **	**-2.6675**	**-2.4359**
Rebab	7.9226 (0.4865) [***0.6266***]	0.3259 (1.3649) [***0.1723***]	0.0499 (0.1335) [***0.8938***]	-0.6233 (-1.7692) [***0.0769***]	*0.1274*	0.0386 [**0.9997**]	7.9477	8.1792
Samir	19.0729 (2.9022) [***0.0037***] **	0.8536 (5.3493) [***0.0000***] **	0.0877 (0.2083) [***0.8350***]	-0.8855 (-1.6428) [***0.1004***]	*0.1548*	3.1714 [***0.0054***] **	7.2588	7.4903
Sc. Mtg. D'imiter	-3.6088 (-0.3827) [***0.7020***]	0.4813 (2.0231) [***0.0431***]*	-0.2335 (-0.4786) [***0.6322***]	0.8359 (1.0019) [***0.3164***]	*0.0074*	0.9132 [***0.5011***]	8.0078	8.2393

Sonasid	17.538 (1.9963) [***0.0459***]*	1.0048 (5.9006) [***0.0000***] **	0.2369 (0.8273) [***0.4081***]	-0.9655 (-0.8532) [***0.3936***]	*0.2683*	5.3471 [***0.000***] **	6.8554	7.0869
Taslif	8.8002 (2.7328) [***0.0063***] **	0.2061 (1.4773) [***0.1396***]	0.7984 (2.9391) [***0.0033***] **	0.0275 (0.1658) [***0.8683***]	*0.1893*	0.8351 [***0.5466***]	7.8573	8.0888
Unimer	3.0761 (0.3036) [***0.7614***]	0.2080 (2.4949) [***0.0126***]*	-0.0694 (-0.3767) [***0.7064***]	0.7496 (1.3964) [***0.1626***]	*0.0797*	0.1248 [***0.9963***]	6.0709	6.3024
Zellidja	6.2764 (0.6613) [***0.5084***]	0.2631 (0.7899) [***0.4296***]	-0.5435 (-1.1096) [***0.2672***]	-0.6231 (-1.8756) [***0.0607***]	*0.0351*	0.5976 [***0.7559***]	8.1690	8.4005

Source: Author's own calculations

The GARCH-M model is characterized by two fundamental propositions; (i) that, $\delta > 0$, to ensure that the conditional variance is interpreted as risk premium which requires compensation; (ii) investors should be rewarded if, δ, is positive.

1. Per evidence in table 32, proposition (i) is not exclusively supported. The results show that the coefficients for Attijariwafa, Auto Hall, BMCE, BQ Maroc, Branoma, Brasseries, Managem, Rebab, Samir, Sonasid and Zellidja are negative, in violation of proposition (i). This means that there is a negative correlation between the return of these eleven firms and their conditional variance. This result is consistent with existing literature elsewhere. For example, Nelson (1991) and Glosten et al. (1993) applied ARCH/GARCH-M and EGARCH-M to daily and monthly return data respectively and found negative relation between return and conditional variance in the US. However, the remaining twelve firms exhibit positive relation between return and conditional variance in line with French et al. (1987), Campbell and Hentschel (1992), Guo and Neely (2006) results.

2. The positive sign suggests that investors in these twelve firms are rewarded for taking up additional volatility risks. The negative relations violate the central theme of the GARCH-M which suggests that the conditional expected excess return on asset

should vary positively and proportionately with the conditional variance. As argued strongly by Nelson (1991) that standard GARCH/GARCH-M models lack the properties to capture the dynamics of the conditional variance process and went ahead to propose an alternative model that remedy this weakness. This study is limited to standard GARCH-M and not extended to Nelson's model. Intuitively, assets with negative, δ, would be good instruments for hedging (see Merton, 1973) and therefore portfolio/fund managers will look out for firms with negative, δ.

3. However, these results could be spurious or occurred out of chance and it is appropriate to examine the statistical significance of the coefficients. As can be seen from the results in table 32, only Nexans and Cr Immobil show positive statistically significant relation between return and conditional variance at 1 and 5 per cent levels respectively, while Auto Hall and Branoma indicate negative significant relation between return and conditional variance at 1 per cent level. The value (HML) premium is significant in only Brasseries (* and negative), Lesieur Cristal (* and negative), Nexans (** and positive) and Taslif (** and positive).

4. The beta coefficients for twenty one firms are positive in support of a fundamental proposition of the CAPM which state that asset returns are positive (and linear) functions of beta. However, the coefficients of sixteen are positively significant at 1 and 5 per cent levels, while the coefficient of Nexans is negatively significant at 1 per cent level. According to the Augmented CAPM the mean intercept should be 0 or close to 0. Nonetheless, this proposition is violated per the results in table 32. The evidence shows that intercepts for all twenty three firms are either lower or higher than 0. Statistically it is found that the intercepts for only ten firms are positively

significant at 1 and 5 per cent levels. The highest total variation in equity returns in Morocco which can be explained by the augmented Fama-French model, as measured by R^2, is 68.21% (for Attijariwafa). The combined role of beta and BE/ME as measured by F-statistic is significant in fourteen firms at 1 and 5 per cent levels.

8.3 Empirical Evidence from South Africa

8.3.1 Fama-French Model

Beta coefficient, intercept and other key parameters are estimated using time series regression via OLS. The series are estimated using stationary data at first difference but assume to be free from co integration. The aim of this test is to establish whether (1) size (SMB) and BE/ME (HML) contribute to returns generation in South Africa and (2) the Fama-French three factor model performs better in explaining returns than the single factor CAPM in South Africa. A result for ABSA is presented in the equation below for demonstrative purposes. Results for the remaining firms are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \hat{\beta}_{St}\left(SMB\right)_t + \hat{\beta}_{Ht}\left(HML\right)_t + \varepsilon_{it}$$

$$r_{it} = 8.3249 - 0.0032 r_{Mt} + 0.0514 SMB + 0.1180 HML + \varepsilon_{it}$$

$$\begin{array}{lllll} t = (8.0484) & (-0.3716) & (0.3091) & (0.4906) \\ p = [0.000] & [-0.7111] & [0.7580] & [0.6250] \end{array}$$

Table 33: time series regression estimates of equation 6.20

Company	***α***	***β***	***SMB***	***HML***	$\overline{R}$	***F-Statistic (p-value)***	***AIC***	***SC***
ABSA Group	8.3249 (8.0484) [***0.000***]**	-0.0032 (-0.3716) [***0.7111***]	0.0514 (0.3091) [***0.7580***]	0.1180 (0.4906) [***0.6250***]	0.0288	0.1705 [***0.9160***]	7.3564	7.4675
Acucap Properties	8.9548 (13.4033) [***0.0000***] **	0.1928 (1.4432) [***0.1526***]	0.3390 (1.9043) [***0.0602***]	0.2161 (1.9145) [***0.0589***]	0.0674	3.1435 [***0.0293***]*	6.3965	6.5076
AECI	7.5822 (4.6601) [***0.0000***] **	-0.0019 (-0.4365) [***0.6635***]	0.0507 (0.1682) [***0.8668***]	0.0492 (0.2412) [***0.8100***]	0.0341	0.0226 [***0.9954***]	8.1197	8.2308
African Rainbow	6.4618 (4.3479)	0.0119 (0.8032)	0.2853 (0.8156	0.0778 (0.2801)	0.02197	0.3621 [***0.7805***]	8.1500	8.2611

	[***0.0000***] **	[***0.4241***]	[***0.4170***]	[***0.7801***]				
African	7.7213	0.0029	0.1771	0.1930	0.0198	0.4230	7.4174	7.5285
Oxygen	(7.4930)	(0.2789)	(0.7300)	(1.0025)		[***0.7363***]		
	[***0.0000***] **	[***0.7810***]	[***0.4674***]	[***0.3189***]				
AG Industries	8.9142	0.1668	0.2611	-0.2084	0.0105	1.3164	7.5376	7.6487
	(8.0893)	(0.8627)	(1.0372)	(-1.0187)		[***0.2743***]		
	[***0.0000***] **	[***0.3907***]	[***0.3025***]	[***0.3112***]				
Allied	0.0548	0.0057	-0.2809	-0.1828	0.0177	0.4845	7.9159	7.9159
Technologies	(0.0415)	(0.4335)	(-0.9027)	(-0.7401)		[***0.6939***]		
	[***0.9670***]	[***0.6658***]	[***0.3692***]	[***0.4612***]				
AngloGold	8.9284	0.0005	-0.1482	0.1014	0.0291	0.1623	8.0818	8.1929
Ashanti	(6.2163)	(0.0323)	(-0.4382)	(0.3779)		[***0.9214***]		
	[***0.0000***] **	[***0.9743***]	[***0.6624***]	[***0.7064***]				
Anglo	9.5080	0.0075	-0.3919	-0.1329	0.0020	0.9110	7.7657	7.8768
Platinum	(7.7531)	(0.6085)	(-1.3575)	-0.5790		[***0.4387***]		
	[***0.0000***] **	[***0.5444***]	[***0.1782***]	[***0.5635***]				
Aspen	9.8794	-0.0015	-0.2474	-0.3296	0.0261	0.2445	8.9130	9.0241
Pharmaceutical	(4.5393)	(-0.0691)	(-0.4828)	(-0.8103)		[***0.8650***]		
Holdings	[***0.0000***] **	[***0.9451***]	[***0.6305***]	[***0.4200***]				
Aveng	8.5024	0.5960	0.0782	0.1103	0.1145	4.8346	7.1542	7.2653
	(9.3459)	(3.7404)	(0.3766)	(0.6529)		[***0.0037***] **		
	[***0.0000***] **	[***0.0003***] **	[***0.7074***]	[***0.5156***]				
Basil Read	6.4086	-0.0034	-0.3016	0.3718	0.0132	0.6146	8.7629	8.8740
	(3.1740)	(-0.1683)	(-0.6348)	(0.9854)		[***0.6074***]		
	[***0.0021***] **	[***0.8667***]	[***0.5274***]	[***0.3272***]				
Ceramic	9.7826	-0.0077	0.0556	-0.1987	0.0097	0.7130	7.4296	7.5407
Industries	(9.4380)	(-0.7458)	(0.2298)	(-1.0252)		[***0.5463***]		
	[***0.0000***] **	[***0.4578***]	[***0.8188***]	[***0.3081***]				
City Lodge	7.7526	-0.0030	-0.4693	0.1004	0.0076	0.7771	8.1718	8.2829
Hotels	(5.1601)	(-0.2015)	(-1.3260)	(0.3576)		[***0.5099***]		
	[***0.0000***] **	[***0.8408***]	[***0.1880***]	[***0.7215***]				
COM AIR	7.5315	0.8794	-0.3612	-0.4674	0.1529	6.3565	8.2636	8.3747
	(4.7854)	(3.9922)	(-0.9865)	(-1.5889)		[***0.0006***] **		
	[***0.0000***] **	[***0.0001***] **	[***0.3267***]	[***0.1158***]				
Cullinan	-3.3898	-0.0221	-0.0279	-0.8805	0.0227	1.6890	9.1572	9.2683
	(-1.3404)	(-2.5342)	(-0.0416)	(-1.7780)		[***0.1754***]		
	[***0.1837***]	[***0.0131***] *	[***0.9669***]	[***0.0788***]				
Delta EMD	8.9445	0.0172	0.0021	-0.1891	0.0001	1.0025	7.6222	7.7333
	(7.8364)	(1.5048)	(0.0078)	(-0.8865)		[***0.3958***]		
	[***0.0000***] **	[***0.1360***]	[***0.9938***]	[***0.3778***]				
Discovery	1.6855	0.3636	-0.2667	-0.0030	0.0624	2.9737	7.0309	7.1410
	(1.9562)	(2.4020)	(-1.3495)	(-0.0249)		[***0.0361***]*		
	[***0.0537***]	[***0.0185***] *	[***0.1807***]	[***0.9802***]				
Distell Group	-0.1582	-0.0008	-0.4761	0.0909	0.0202	1.6118	7.4765	7.5876
	(-0.1491)	(-0.0755)	(-1.9058)	(0.4586)		[***0.1925***]		
	[***0.8818***]	[***0.9400***]	[***0.0600***]	[***0.6477***]				
DRD Gold	-0.8961	0.0096	-0.1414	-0.0915	0.0300	0.1082	8.9945	9.1056
	(-0.3953)	(0.4210)	(-0.2650)	(-0.2150)		[***0.9551***]		
	[***0.6936***]	[***0.6748***]	[***0.7916***]	[***0.8295***]				
DS&WHSG	-0.8859	0.0178	0.5770	0.1122	0.0230	0.3315	9.3930	9.5041
Network	(-0.3202)	(0.6405)	(0.8873)	(0.2170)		[***0.8026***]		
	[***0.7496***]	[***0.5235***]	[***0.3774***]	[***0.8287***]				

First Rand Bank	9.2497 (6.9716) [***0.0000***] **	-0.0125 -(0.9408) [***0.3494***]	-0.1280 (-0.4120) [***0.6806***]	0.1965 (0.7927) [***0.4302***]	0.0151	0.5597 [***0.6430***]	7.9231	8.0342
Glenrand M I B	8.1401 (124.0538) [***0.0000***] **	0.0086 (1.2805) [***0.2038***]	-0.0015 -(0.1206) [***0.9042***]	0.0061 (1.1391) [***0.2578***]	0.0163	1.4904 [***0.2229***]	0.6297	0.7408
Gold Reef Resorts	5.9298 (3.2199) [***0.0018***] **	0.0148 (0.8221) [***0.4133***]	-0.0702 (-0.1654) [***0.8691***]	-0.1273 (-0.3696) [***0.7126***]	0.0249	0.2799 [***0.8397***]	8.5795	8.6906
Gold Fields	8.5889 (5.8943) [***0.0000***] **	0.0257 (1.7577) [***0.0824***]	-0.0546 (-0.1591) [***0.8739***]	0.1549 (0.5689) [***0.5709***]	0.0115	1.3454 [***0.2650***]	8.1106	8.2217
Group Five	7.5133 (4.5499) [***0.0000***] **	0.0042 (0.2602) [***0.7953***]	-0.1750 (-0.4635) [***0.6442***]	-0.1089 (-0.3526) [***0.7253***]	0.0308	0.1139 [***0.9517***]	8.3617	8.4728
Growthpoint Properties	7.4498 (5.2891) [***0.0000***] **	-0.0136 (-2.5376) [***0.0130***]*	0.3938 (1.7497) [***0.0837***]	1.0573 (2.0930) [***0.0393***]*	0.1380	5.7881 [***0.0012***] **	8.0234	8.1345
Harmony Gold Mining	7.3656 (4.0437) [***0.0001***] **	0.0069 (0.3775) [***0.7068***]	-0.4714 (-1.0993) [***0.2747***]	-0.0253 (-0.0744) [***0.9408***]	0.0149	0.5648 [***0.6397***]	8.5569	8.6681
Impala Platinum	9.7789 (6.7997) [***0.0000***] **	0.0094 (0.6555) [***0.5139***]	-0.2629 (-0.7764) [***0.4396***]	0.2216 (0.8244) [***0.4120***]	0.0041	0.8794 [***0.4551***]	8.0843	8.1954
Liberty Holdings	7.7919 (7.6580) [***0.0000***] **	-0.0063 (-1.2642) [***0.2096***]	-0.0197 (-0.0982) [***0.9220***]	0.0082 (0.0510) [***0.9594***]	0.0301	0.1327 [***0.9404***]	7.3649	7.4760
Masonite Africa	7.5399 (5.9860) [***0.0000***] **	-0.0006 (-0.0507) [***0.9597***]	-0.3418 (-1.1520) [***0.2521***]	-0.0811 (-0.3444) [***0.7314***]	0.0186	0.4581 [***0.7123***]	7.8189	7.9290
Merafe Resources	0.5507 (0.2462) [***0.8061***]	0.0084 (0.3735) [***0.7097***]	0.3659 (0.6951) [***0.4889***]	0.5392 (1.2904) [***0.2004***]	0.0125	0.6340 [***0.5951***]	8.9672	9.0783
Merchant & Industrial Properties	11632.93 (1.9462) [***0.0549***]	-6.2813 (-0.7123) [***0.4782***]	-479.0101 (-0.9780) [***0.3308***]	-71.7310 (-0.1414) [***0.8879***]	0.0298	0.1418 [***0.9347***]	23.4618	23.5729
MMI Holdings	8.1613 (5.7813) [***0.0000***] **	-0.0109 (-1.4415) [***0.1531***]	-0.0684 (-0.2397) [***0.8111***]	0.1525 (0.6131) [***0.5414***]	0.0235	0.3195 [***0.8113***]	8.0421	8.1532
MTN Group	8.3184 (5.0487) [***0.0000***] **	0.0052 (0.8305) [***0.4086***]	0.4456 (1.2127) [***0.2286***]	0.0997 (0.4487) [***0.6548***]	0.0171	0.5006 [***0.6828***]	8.3743	8.4854
Murray & Roberts	7.6089 (5.0344) [***0.0000***] **	-0.0042 (-0.2793) [***0.7807***]	-0.4535 (-1.2745) [***0.2059***]	-0.2216 (-0.7846) [***0.4348***]	0.0132	0.6128 [***0.6085***]	8.1837	8.2948
NED Bank Group	-0.0494 (-0.0462) [***0.9633***]	0.0024 (0.4275) [***0.6701***]	0.1068 (0.5156) [***0.6074***]	0.1896 (0.9497) [***0.3449***]	0.0226	0.3441 [***0.7935***]	7.4342	7.5453

Octodec Investments	8.6131 (8.7785) [***0.0000***] **	0.0031 (0.9127) [***0.3639***]	0.1168 (0.6748) [***0.5016***]	0.2326 (1.0575) [***0.2933***]	0.0146	0.5718 [***0.6351***]	7.3296	7.4407
Omnia	7.0674 (5.0863) [***0.0000***] **	0.0086 (0.6156) [***0.5398***]	0.6276 (1.9186) [***0.0583***]	0.1524 (0.5868) [***0.5589***]	0.0081	1.2426 [***0.2993***]	8.0155	8.1266
Pangbourne Properties	9.0901 (13.6743) [***0.0000***] **	-0.0093 (-1.3887) [***0.1685***]	-0.1803 (-1.1521) [***0.2525***]	0.2918 (2.3489) [***0.0211***] *	0.0709	3.2641 [***0.0252***]*	6.5400	6.6521
Premium Properties	8.9249 (8.6528) [***0.0000***] **	-0.0051 (-0.4966) [***0.6207***]	-0.0912 (-0.3758) [***0.7080***]	0.1395 (0.7237) [***0.4712***]	0.0230	0.3322 [***0.8021***]	7.4196	7.5307
Pretoria Port CMT	8.1633 (8.1205) [***0.0000***] **	-0.0162 (-5.0287) [***0.0000***] **	-0.3082 (-1.6592) [***0.1007***]	-0.0248 (-0.1248) [***0.9009***]	0.0018	1.0552 [***0.3725***]	7.4782	7.5893
RMB Bank	8.8630 (6.5196) [***0.0000***] **	-0.0082 (-1.0239) [***0.3088***]	-0.1488 (-0.5882) [***0.5580***]	0.0801 (0.2799) [***0.7802***]	0.0269	0.2229 [***0.8803***]	7.9368	8.0479
SABLE	5.6533 (3.0674) [***0.0029***] **	0.0093 (0.5038) [***0.6157***]	0.4609 (1.0623) [***0.2911***]	0.2404 (0.6970) [***0.4871***]	0.0182	0.4703 [***0.7037***]	8.5804	8.6916
SACOIL Holdings	-3.6313 (-1.2398) [***0.2184***]	-0.0618 (-2.1039) [***0.0383***]*	0.0064 (0.0094) [***0.9926***]	0.0884 (0.1614) [***0.8721***]	0.0184	1.5552 [***0.2062***]	9.5068	9.6179
Saambou Bank	7.5188 (5.1021) [***0.0000***] **	0.0116 (0.7850) [***0.4341***]	0.0439 (0.1265) [***0.8996***]	0.0882 (0.3201) [***0.7496***]	0.0259	0.2509 [***0.8604***]	8.1331	8.2442
Sanlam	7.8313 (10.2469) [***0.0000***] **	0.5862 (4.4666) [***0.0000***] **	0.1053 (0.6024) [***0.5485***]	0.1957 (1.3804) [***0.1710***]	0.1779	7.4207 [***0.0002***] **	6.8055	6.9166
SASOL	8.9554 (7.0777) [***0.0000***] **	0.0071 (0.5569) [***0.5791***]	-0.0867 (-0.2910) [***0.7717***]	-0.3646 (-1.5419) [***0.1268***]	0.0039	0.8846 [***0.4525***]	7.8282	7.9393
Spanjaard	8.2972 (6.2221) [***0.0000***] **	0.0009 (0.0687) [***0.9454***]	-0.3237 (-1.0310) [***0.3054***]	-0.4005 (-1.6070) [***0.1117***]	0.0001	1.0029 [***0.3956***]	7.9333	8.0444
Standard Bank Group	8.4274 (6.1671) [***0.0000***] **	-0.0038 (-0.6897) [***0.4923***]	0.0166 (0.0749) [***0.9405***]	0.0391 (0.1472) [***0.8833***]	0.0335	0.0379 [***0.9900***]	7.9130	8.0241
Sun International	7.3278 (6.3067) [***0.0000***] **	0.0008 (0.0683) [***0.9457***]	0.1684 (0.6156) [***0.5398***]	0.0978 (0.4504) [***0.6536***]	0.0293	0.1564 [***0.9253***]	7.6577	7.7688
Telkom	8.8491 (8.8786) [***0.0000***] **	0.4189 (2.3616) [***0.0208***]*	0.0727 (0.3105) [***0.7570***]	-0.0449 (-0.2491) [***0.8039***]	0.0348	1.9505 [***0.1286***]	7.2081	7.3272
VOX Telecom	1.0792 (0.1808) [***0.8570***]	-0.8673 (-0.6618) [***0.5098***]	-2.1689 (-2.0822) [***0.0403***]*	0.1179 (0.1761) [***0.8606***]	0.0167	1.5044 [***0.2192***]	10.5967	10.7078
White Water Resources	-1.2280 (-0.4058) [***0.6859***]	-0.0099 (-0.3265) [***0.7448***]	-0.4336 (-0.6086) [***0.5444***]	-0.0364 (-0.0644) [***0.9488***]	0.0299	0.1387 [***0.9366***]	9.5724	9.6835

Bayly Holmes-Ovcon	9.6371 (6.2659) [***0.0000***] **	-0.0180 (-1.1684) [***0.2459***]	-0.2604 (-0.7191) [***0.4740***]	0.2912 (1.0130) [***0.3139***]	0.0006	0.9829 [***0.4048***]	8.2186	8.3297
Zurich Insurance	8.3249 (8.0484) [***0.0000***] **	-0.0032 (-0.3716) [***0.7111***]	0.0514 (0.3090) [***0.7580***]	0.1170 (0.4906) [***0.6250***]	0.0288	0.1705 [***0.9160***]	7.3564	7.4675

Source: Author's own calculation

There are three fundamental propositions of the Fama-French model: (i) that the coefficients of the market, size and BE/ME proxies must be positive, (ii) that in order to contribute to return generation, the respective coefficients must be statistically significant, (iii) that the impact of size and BE/ME factors to return variation is greater than that of the systematic risk (i.e. the market risk premium). As can be seen from table 33, proposition (i) is supported by thirty one firms which have positive beta coefficients. However, only Aveng, Com Air, Discovery, Sanlam and Telkom are positively significant at 1 and 5 per cent levels. The beta coefficient for the remaining twenty five firms are negative, however, only Cullinan, Growthpoint, Pretoria and Sacoil exhibit statistically negative coefficients at 1 and 5 per cent levels.

With respect to BE/ME (HML), the coefficients of thirty five firms are positive and satisfy the condition of proposition (i) however, only Growthpoint and Pangbourne exhibit significant coefficient at 5 per cent. The size (SMB) premium is positive in twenty four firms, while none of the fifty six firms' exhibit significant size coefficient. In other words, per Fama-French model's prediction BE/ME (HML) and size (SMB) premia do not contribute to return variations in Morocco as claimed (see Fama and French, 1992 & 1993). These findings are similar to those documented elsewhere in both the developed and emerging markets. For example, Kothari *et al*. (1995) found that in the US the market beta dominant the return generating process, however, other fundamentals identified in Fama and French (1992 & 1993) failed. Al-Rjoub *et al*. (2010) results also show that in four MENA (Middle East and

North Africa) markets beta have significant explanatory powers in predicting stock returns however, other fundamentals namely, P/E, BE/ME and M-CAP failed to account for variations in stock returns.

According to the testable implication of Fama-French model the intercept (or alpha value) should be zero. However, this prediction is violated per the evidence as the intercepts for all the fifty six firms is either positive and thus, greater than zero or negative and thus, less than zero. Statistically, intercept for forty four firms are positively significant at 1 per cent level. This finding contradicts evidences documented by Fama and French (1992, 1993, and 1996), Ashanapalli (1998), Bundoo (2008) etc. This means that there are still significant unidentified risk factors that affect assets return and price in South Africa but they are simply not size (i.e. SMB premium) and value (i.e BE/ME premium). Michailidis *et al.* (2006) document similar results in Greece which rejects the Fama-French three factor model and went on to say that the size premium and BE/ME premium play no significant role in explaining asset returns. Further evidence found in Hearn *et al.* (2008) shows that the impact of size premium on asset returns is both small and statistically insignificant in certain African countries.

The R^2 for the individual regressions are very low and this is buttressed by high Akaike Information Criterion (AIC) and Schwarz Criterion (SC), which are all well above the critical value of 3. The highest total variation in equity returns in South Africa which can be explained by the Fama-French model, as measured by adjusted R^2 , is only 17.79% (for Sanlam), leaving more than 80 per cent of the variations in the company's returns unexplained by the model. For companies like Delta and Spanjaard with adjusted R^2 of 0.01%, the unexplained variation of 99.99% renders the appropriateness of Fama-French model more problematic. The adjusted R^2 measures the amount of risk contained in the total variation in returns but the combined factors of market risk, size and BE/ME explain very small amount of return variation across South African firms, rendering the Fama-French three factor model unimportant in predicting assets return or pricing equities or estimating cost of capital in this market. This implies that there are other risk factors other than systematic, size (SMB) and BE/ME risks, including perhaps other company-specific and industry/economy wide risk factors, which equity investors seek compensations for in South Africa. A similar result was reported in Morocco by Hearn *et al*. (2008) that although the market beta was significant, the adjusted R^2 for the Fama-French model was low (0.1030 or 10.30 per cent). However, as can be seen from table 33, the combined role of beta, size (SMB) and value premia (HML) is statistically significant in only seven firms at 1 and 5 per cent levels as prescribed by *F*-statistics. This again contradicts some established literature elsewhere which states that the combined role of these fundamentals is compelling in determining risk-return relationship (Fama and French, 1992, 1993, 1996 & 2004; Breen & Korajczyk, 1995; Drew *et al*., 2005; Hearn *et al.,* 2008).

8.3.2 ECM Augmented Fama-French model

As Fama-French model is not underpinned by equilibrium theory, error correction is necessary to avoid any cointegrated error which may render the regressions spurious. Trace test and Max-eigenvalue test indicate that the series are cointegrated at 0.05 levels and if this is not corrected will lead into spurious regression. This study specifies Error Correction Mechanism (ECM) in the mean equation to correct for co integration. The co integrated residual is expressed as ECM. A result for ABSA is presented in the equation below for demonstrative purposes. Results for the remaining companies are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \hat{\beta}_{St}(SMB)_t + \hat{\beta}_{Ht}(HML)_t + \hat{\phi}U_{t-1} + \varepsilon_{it}$$

$$r_{it} = -5.7093 - 0.0079 r_{Mt} + 0.0699 SMB + 0.0956 HML + 1.6782 U_{t-1} + \varepsilon_{it}$$

$$t = (-0.4017) \quad (-0.8870) \quad (0.3503) \quad (0.4256) \quad (1.0350)$$
$$p = [0.6890] \quad [0.3776] \quad [0.7270] \quad [0.6715] \quad [0.3036]$$

Table34: time series regression estimates of equation 6.22

Company	***α***	***β***	***SMB***	***HML***	ϕ	$\overline{R}$	***F-Statistic (p-value)***	***AIC***	***SC***
ABSA	-5.7093	-0.0079	0.0699	0.0956	1.6782		0.4075		
Group	(-0.4017)	(-0.8870)	(0.3503)	(0.4256)	(1.0350)	0.0277	[***0.8028***]	7.3776	705174
	[***0.6890***]	[***0.3776***]	[***0.7270***]	[***0.6715***]	[***0.3036***]				
Acucap	9.4269	0.1786	0.2422	0.2089	-0.0291		1.6935		
Properties	(2.7860)	(1.3869)	(1.6107)	(2.0179)	(-0.0876)	0.0305	[***0.151***]	6.3817	6.5215
	[***0.0066***]**	[***0.1691***]	[***0.1110***]	[***0.0468***]*	[***0.9304***]				
AECI	-79.2777	-0.0177	0.1186	-0.0579	11.3996		1.9086		
	(-2.0691)	(-2.8565)	(0.3840)	(-0.3349)	(2.3004)	0.0397	[***0.1165***]	8.0681	8.2079
	[***0.0416***]*	[***0.0054***]**	[***0.7019***]	[***0.7386***]	[***0.0239***]*				
African	7.3274	0.0113	0.2895	0.0775	-0.1299		0.2486		
Rainbow	(1.0249)	(0.7093)	(0.7616)	(0.2757)	(-0.1227)	0.0354	[***0.9097***]	8.1845	8.3243
	[***0.3084***]	[***0.4801***]	[***0.4484***]	[***0.7835***]	[***0.9027***]				
African	10.5406	0.0034	0.2119	0.1999	-0.3679		0.3781		
Oxygen	(1.4786)	(0.3271)	(0.8175)	(1.0254)	(-0.4080)	0.0291	(***0.8237***)	7.4487	7.5885
	[***0.1430***]	[***0.7444***]	[***0.4159***]	[***0.3081***]	[***0.6842***]				
AG	10.6786	0.1479	0.1846	-0.2156	-0.1715		0.7695		
Industries	(2.1766)	(0.7482)	(0.6919)	(-1.0475)	(-0.3318)	0.0106	[***0.5481***]	7.5592	7.6989
	[***0.0323***]*	[***0.4565***]	[***0.4909***]	[***0.2979***]	[***0.7408***]				
Allied Tech	-0.0021	-0.0032	-0.3561	-0.2636	-1.8224	0.0269	1.6092		
	(-0.0016)	(-0.2358)	(-1.1036)	(-1.0759)	(-2.1063)		[***0.1795***]	7.8893	8.0291
	[***0.9987***]	[***0.8142***]	[***0.2729***]	[***0.2850***]	[***0.0382***]*				
AngloGold	28.6849	0.0028	-0.1799	0.0719	-2.2342		0.7134		
Ashanti	(2.2229)	(0.1921)	(-0.5046)	(0.2674)	(-1.5395)	0.0132	[***0.5851***]	8.0885	8.2283
	[***0.0289***]*	[***0.8482***]	[***0.6151***]	[***0.7898***]	[***0.1274***]				
Anglo	17.5577	0.0031	-0.4309	-0.1825	-0.8607		1.2092		
Platinum	(2.9450)	(0.2478)	(-1.4141)	(-0.7879)	(-1.3638)	0.0094	[***0.3130***]	7.7757	7.9155
	[***0.0042***]**	[***0.8049***]	[***0.1610***]	[***0.4330***]	[***0.1763***]				
Aspen	19.0002	-0.0029	-0.1320	-0.3414	-0.9634		0.3149		
Pharma	(1.6052)	(-0.1335)	(-0.2427)	(-0.8328)	(-0.8065)	0.0321	[***0.8673***]	8.9338	9.0736
	[***0.1122***]	[***0.8941***]	[***0.8088***]	[***0.4073***]	[***0.4222***]				
	6.3683	0.5997	0.1685	0.1259	0.2172		3.9909		
Aveng	(2.5035)	(3.7566)	(0.7709)	(0.7441)	(0.8246)	0.1197	[***0.0052***]**	7.1637	7.3035
	[***0.0142***]*	[***0.0003***]**	[***0.4429***]	[***0.4589***]	[***0.4119***]				
Basil Read	1.2406	-0.0112	-0.4959	0.3657	0.9052		1.0517		
	(0.2409)	(-0.5414)	(-0.9946)	(0.9769)	(1.1925)	0.0023	(***0.3857***)	8.7558	8.8957
	[***0.8102***]	[***0.5897***]	[***0.3228***]	[***0.3314***]	[***0.2364***]				
Ceramic	9.5267	-0.0079	0.0376	-0.2004	0.0296		0.5070		
Industries	(1.2968)	(-0.7158)	(0.1443)	(-1.0208)	(0.0399)	0.0229	[***0.7307***]	7.4637	7.6035
	[***0.1982***]	[***0.4761***]	[***0.8856***]	[***0.3103***]	[***0.9682***]				
City Lodge	12.5849	-0.0026	-0.6341	0.0682	-0.6093		1.0246		
Hotels	(2.4144)	(-0.1712)	(-1.6935)	(0.2420)	(-0.9135)	0.0011	[***0.3995***]	8.1813	8.3211
	[***0.0179***]*	[***0.8645***]	[***0.0941***]	[***0.8093***]	[***0.3636***]				
COM AIR	9.0699	0.5653	-0.6062	-0.5177	-0.0978		2.5599		
	(3.8873)	(2.2359)	(-1.6304)	(-1.7952)	(-0.4342)	0.0662	[***0.0444***]*	8.2297	8.3695
	[***0.002***]**	[***0.0280***]*	[***0.1068***]	[***0.0762***]	[***0.6652***]				
Cullinan	-2.0292	-0.02185	0.0252	-0.8927	0.4245	0.0212	1.4764	9.1811	9.3209
	(-0.6948)	(-0.8779)	(0.0409)	(-1.9279)	(0.9422)		[***0.2166***]		
	[***0.4891***]	[***0.3825***]	[***0.9675***]	[***0.0572***]	[***0.3488***]				
Delta EMD	6.0962	0.0203	-0.0317	-0.1771	0.3227		0.7818		
	(0.9201)	(1.4854)	(-0.1083)	(-0.8138)	(0.4395)	0.0100	[***0.5401***]	7.6543	7.7942
	[***0.3601***]	[***0.1412***]	[***0.9140***]	[***0.4181***]	[***0.6614***]				
Discovery	1.3125	0.3576	-0.2211	-0.0070	0.1612		1.9476		
	(1.2155)	(2.3391)	(-1.0543)	(-0.0434)	(0.4729)	0.0413	[***0.1101***]	7.0587	7.1985
	[***0.2276***]	[***0.0217***]*	[***0.2948***]	[***0.9655***]	[***0.6375***]				
Distell	0.0076	-0.0016 (-	-0.5695	0.0815	-0.0449		1.4578		
Group	(0.0069)	0.1515)	(2.1438)	(0.4071)	(-0.0971)	0.0204	[***0.2224***]	7.4974	7.6372
	[***0.9945***]	[***0.8800***]	[***0.0349***]*	[***0.6850***]	[***0.9229***]				
DRD Gold	-2.6787	0.0013	-0.0461	-0.1459	-1.6733		0.2399		
	(-0.8616)	(0.0496)	(-0.0807)	(-0.3372)	(-0.8201)	0.0358	[***0.9149***]	9.0206	9.1603
	[***0.3914***]	[***0.9606***]	[***0.9359***]	[***0.7368***]	[***0.4145***]				
DS&WHSG	-3.4771	0.0243	0.8206	0.1537	0.5859		0.4548		
Network	(-0.4223)	(0.7735)	(1.1687)	(0.2937)	(0.2621)	0.0254	[***0.7686***]	9.4083	9.5481
	[***0.6739***]	[***0.4414***]	[***0.2458***]	[***0.7697***]	[***0.7939***]				

First Rand	1.4897	-0.0192	-0.0695	0.1817	0.8412		0.6032		
Bank	(0.1701)	(-1.2468)	(-0.2057)	(0.7256)	(0.8957)	0.0184	[0.6614]	7.9483	8.0881
	[0.8654]	[0.2159]	[0.8376]	[0.4701]	[0.3730]				
Glenrand M	1.7746	0.0091	-0.0093	0.0062	0.7841		2.6825		
I B	(0.4294)	(1.2360)	(-1.1775)	(1.1713)	(1.5548)	0.0710	[0.0369]*	0.4749	0.6148
	[0.6687]	[0.2199]	[0.2423]	[0.2448]	[0.1238]				
Gold Reef	8.2912	0.0117	-0.0558 (-	-0.1267	-0.4114		0.2302		
Resorts	(1.0865)	(0.5731)	0.1224)	(-0.3634)	(-0.3289)	0.0363	[0.9207]	8.6122	8.7520
	[0.2804]	[0.5681]	[0.9029]	[0.7172]	[0.7431]				
Gold Fields	13.52892.7423	0.0201	0.0145	0.1217	**-0.5866**		1.2713		
	()	(1.2799)	(0.0394)	(0.4412)	(-1.0550)	0.0122	[0.2878]	8.1319	8.2718
	[0.0075]**	[0.2041]	[0.9686]	[0.6602]	[0.2945]				
Group Five	11.9034	0.0034	-0.0461	-0.1021	-0.6296	0.0439	0.0748	8.3831	8.5229
	(0.9119)	(0.2067)	(-0.1146)	(-0.3283)	(-0.3594)		[0.9897]		
	[0.3644]	[0.8367]	[0.9090]	[0.7435]	[0.7202]				
Growthpoint	8.4620	-0.0109	0.4118	1.0704	-0.1378		4.3411		
Properties	(1.9562)	(-1.0603)	(1.7374)	(1.9927)	(-0.2382)	0.1318	[0.0031]**	8.0541	8.1939
	[0.0538]	[0.2921]	[0.0860]	[0.0495]*	[0.8123]				
Harmony	4.6805	0.0090	-0.3627	0.0038	0.3496		0.3209		
Gold	(0.7977)	(0.4838)	(-0.7949)	(0.0109)	(0.4429)	0.0319	[0.8632]	8.5828	8.7226
	[0.4273]	[0.6298]	[0.4289]	[0.9913]	[0.6590]				
Impala	9.8837	0.0096	-0.2488	0.2222	-0.0139		0.6045		
Platinum	(1.5876)	(0.6524)	(-0.6875)	(0.8127)	(-0.0219)	0.0183	[0.6605]	8.1188	8.2586
	[0.1161]	[0.5159]	[0.4936]	[0.4186]	[0.9825]				
Liberty	6.0756	-0.0072	-0.0369	0.0035	0.2260		0.1066		
Holdings	(0.5636)	(-1.2783)	(-0.1611)	(0.0213)	(0.1633)	0.0423	[0.9799]	7.3984	7.5383
	[0.5745]	[0.2047]	[0.8724]	[0.9830]	[0.8707]				
Masonite	2.1069	4.02E-05	-0.2803	-0.0552	0.7283		0.4105		
Africa	(0.3258)	(0.00316)	(-0.8880)	(-0.2315)	(0.8426)	0.0275	[0.8006]	7.8427	7.9825
	[0.7454]	[0.9975]	[0.3771]	[0.8175]	[0.4019]				
Merafe	1.0713	0.0074	0.2255	0.5328	-0.2853		0.4555		
Resources	(0.4568)	(0.3278)	(0.4025)	(1.2648)	(-0.3881)	0.0254	[0.7681]	8.9916	9.1314
	[0.6490]	[0.7439]	[0.6883]	[0.2094]	[0.6989]				
Merchant &	1136.468	-10.1867	-586.1490	-56.1436	0.9522		0.2579		
Industrial	(0.0626)	(-0.3178)	(-0.7410)	(-0.0946)	(0.6053)	0.0349	[0.9041]	23.4875	23.6273
	[0.9502]	[0.7514]	[0.4607]	[0.9249]	[0.5466]				
MMI	-1.6399	-0.0189	-0.0020	0.1293	1.2010		0.4559		
Holdings	(-0.2181)	(-2.2359)	(-0.0060)	(0.5226)	(1.3526)	0.0254	[0.7678]	8.0662	8.2059
	[0.8279]	[0.0280]*	[0.9952]	[0.6026]	[0.1798]				
MTN Group	4.2270	0.0063	0.3658	0.0769	0.4931		0.3391		
	(0.7259)	(1.0813)	(0.9156)	(0.3350)	(0.7382)	0.0309	[0.8509]	8.4013	8.5411
	[0.4699]	[0.2827]	[0.3625]	[0.7385]	[0.4624]				
Murray &	8.0421	-0.0047	-0.5034	-0.2272	-0.0457		0.4895		
Roberts	(1.4057)	(-0.3069)	(-1.3214)	(-0.7920)	(-0.0609)	0.0238	[0.7434]	8.2164	8.3563
	[0.1635]	[0.7597]	[0.1900]	[0.4306]	[0.9515]				
NED Bank	-0.0816	0.0005	0.0932	0.1762	2.0559		1.3687		
Group	(-0.0756)	(0.0621)	(0.4027)	(0.9766)	(1.9573)	0.0165	[0.2517]	7.4176	7.5574
	[0.9399]	[0.9506]	[0.6882]	[0.3316]	[0.0536]				
Octodec	10.9409	0.0034	0.1252	0.2349	-0.2696		0.4500		
Investments	(1.4253)	(0.9496)	(0.6547)	(1.0791)	(-0.3254)	0.0256	[0.7721]	7.3627	7.5026
	[0.1578]	[0.3450]	[0.5144]	[0.2836]	[0.7457]				
Omnia	8.9729	0.0086	0.7203	0.1694	-0.2767		1.0932		
	(2.1463)	(0.6041)	(2.0577)	(0.6451)	(-0.5223)	0.0042	[0.3653]	8.0418	8.1816
	[0.0347]*	[0.5474]	[0.0427]*	[0.5206]	[0.6028]				
Pangbourne	9.6227	-0.0087	-0.1738	0.2931	-0.614		2.2904		
Properties	(2.8998)	(-1.1904)	(-1.0316)	(2.3307)	(-0.1703)	0.0554	[0.0664]	6.5749	6.7147
	[0.0048]**	[0.2372]	[0.3052]	[0.0222]*	[0.8652]				
Premium	20.6813	-0.0002	-0.1575	0.1437	-1.3171		0.6030		
Properties	(2.0385)	(-0.0139)	(-0.6062)	(0.7421)	(-1.1599)	0.0184	[0.6615]	7.4373	7.5771
	[0.0447]*	[0.9890]	[0.5460]	[0.4601]	[0.2493]				
Pretoria Port	4.5428	-0.0197	-0.2887	-0.0297	0.4556		0.9053		
CMT	(1.0532)	(-3.2983)	(-1.4259)	(-0.1483)	(0.8829)	0.0043	[0.4647]	7.5064	7.6462
	[0.2953]	[0.0014]**	[0.1576]	[0.8825]	[0.3798]				
RMB Bank	-0.6986	-0.0136	-0.1322	0.0715	1.0941		0.3269		
	(-0.0737)	(-1.4599)	(-0.4595)	(0.2458)	(1.0000)	0.0316	[0.8592]	7.9636	8.1034
	[0.9415]	[0.1481]	[0.6470]	[0.8065]	[0.3202]				
SABLE	6.9597	0.0095	0.5394	0.2516	-0.2433		0.4095		
	(1.2827)	(0.5045)	(1.1581)	(0.7214)	(-0.2823)	0.0276	[0.8013]	8.6119	8.7518
	[0.2031]	[0.6153]	[0.2501]	[0.4727]	[0.7784]				

SACOIL	-2.6927	-0.0699	0.1029	0.0512	0.2889		1.2075		
Holdings	(-0.7546)	(-2.0577)	(0.1372)	(0.0916)	(0.5078)	0.0093	[0.3138]	9.5383	9.6781
	[0.4526]	[0.0427]*	[0.8912]	[0.9272]	[0.6129]				
Saambou	3.4872	0.0146	0.0984	0.1051	0.5159		0.2440		
Bank	(0.3553)	(0.9164)	(0.2626)	(0.3766)	(0.3991)	0.0356	[0.9125]	8.1606	8.3004
	[0.7233]	[0.3621]	[0.7935]	[0.7074]	[0.6909]				
Sanlam	6.9487	0.5872	0.0526	0.1979	0.1163		5.4685		
	(3.5341)	(4.4416)	(0.2817)	(1.3808)	(0.5358)	0.1688	[0.0006]**	6.8310	6.9709
	[0.0007]**	[0.0000]**	[0.7789]	[0.1710]	[0.5953]				
SASOL	12.9413	0.0029	-0.1863	-0.3859	-0.4229		0.7989		
	(2.1086)	(0.2111)	(-0.5895)	(-1.6226)	(-0.6255)	0.0092	[0.5292]	7.8432	7.9830
	[0.0380]*	[0.8333]	[0.5571]	[0.1084]	[0.5334]				
Spanjaard	3.8431	0.0032	-0.3570	-0.3832	0.5591		0.9889		
	(0.7647)	(0.2293)	(-1.0705)	(-1.5221)	(0.9356)	0.0005	[0.4182]	7.9562	8.0961
	[0.4466]	[0.8192]	[0.2875]	[0.1317]	[0.3522]				
Standard	-29.5412	-0.0139	0.0519	-0.0101	4.5013		0.4042		
Bank Group	(-1.5818)	(-2.3499)	(0.1992)	(-0.0394)	(2.0843)	0.0278	[0.8051]	7.9286	8.0684
	[0.1174]	[0.0211]**	[0.8426]	[0.9686]	[0.0402]*				
Sun	3.2468	0.0002	0.1386	0.0877	0.5559		0.1218		
International	(0.2921)	(0.0195)	(0.4739)	(0.3974)	(0.3737)	0.0416	[0.9743]	7.6899	7.8298
	[0.7709]	[0.9845]	[0.6367]	[0.6921]	[0.7096]				
TELKOM	3.3851	0.4461	0.0359	-0.6668	0.5911		1.9071		
	(0.8422)	(2.4862)	(0.1438)	(-0.3692)	(1.4084)	0.0445	[0.1182]	7.2208	7.3707
	[0.4024]	[0.0152]*	[0.8860]	[0.7130]	[0.1632]				
VOX	1.7909	-0.5754	-2.5225	0.0477	0.1469		1.2956		
Telecom	(0.2994)	(-0.4189)	(-2.4045)	(0.0708)	(0.4469)	0.0133	[0.2784]	10.6186	10.7584
	[0.7654]	[0.6764]	[0.0184]*	[0.9437]	[0.6561]				
White Water	-5.9144	0.0046	-0.5913	-0.0882	-3.1389	0.0012	1.0267	9.5622	
Resources	(-1.5419)	(0.1471)	(-0.7860)	(-0.1572)	(-1.9502)		[0.3983]		
	[0.1269]	[0.8834]	[0.4341]	[0.8754]	[0.0545]				
Bayly	3.1655	-0.0275	-0.3198	0.2667	0.7058		1.1579		
Holmes-	(0.4689)	(-1.5808)	(-0.8239)	(0.9271)	(1.0253)	0.0071	[0.3353]	8.2277	8.3675
Ovcon	[0.6403]	[0.1177]	[0.4123]	[0.3565]	[0.3081]				
Zurich	-5.7093	-0.0079	0.0699	0.0956	1.6782		0.4075		
Insurance	(-0.4307)	(-0.7162)	(0.2789)	(0.5058)	(1.0625)	0.0277	[0.8028]	7.3776	**7.5174**
	[0.6678]	[0.4759]	[0.7810]	[0.6143]	[0.2910]				

Source: Author's own calculation

The fundamental aim of this test is to establish whether correction for cointegrated error improves the performance of the model. As can be seen from table 34, although ECM corrects equilibrium discrepancies they are not statistically significant at either 1 or 5 per cent levels, with the exception of AECI, Allied Technologies and Standard Bank, which show significance at 5 per cent level. This indicates that the cointegrated error does not affect return generating process in majority of South African firms return. The beta coefficients are significant in only ten firms at 1 and 5 per cent levels having adjusted for cointegrated error. Meanwhile, the SMB and BE/ME which were expected to dominate significantly per the model's prediction after adjusting for cointegrated errors performed badly. For example, only Distell, Omnia and Vox show statistical significant size (SMB) coefficients at 5 per cent level with only Omnia which has positive coefficient. Furthermore, only Acucap, Growthpoint, and Pangbourne show statistically significant positive BE/ME (HML) coefficients at 5 per cent level.

In spite of the error correction, the fitness of the model to the data is not in any way improved as demonstrated by low R^2, and high AIC and SC which are all well above the critical value of 3. The highest total variation in equity returns in South Africa which can be explained by the augmented Fama-French model, as measured by adjusted R^2 , is 16.88% (for Sanlam), leaving more than 80 per cent of the variations in the company's returns unexplained by the model. The weakness of the model is buttressed by the *F-statistic*, as can be seen from table 34, that the combined role of beta, size and value premia is statistically significant in only Aveng (**), Com Air (*), Glenrand (*), Growthpoint (**) and Sanlam (**). Therefore, the poor performance of the model is not caused by cointegrated errors.

8.3.3 GARCH Augmented Fama-French model

Empirical evidence in emerging markets suggests that volatility affect assets return (French *et al*., 1987; Bekaert *et al*., 1996; Ortiz and Arjona, 2001; MacMillan and Thupayagale, 2009). Again, initial White test, J-B statistics, kurtosis and skewness, show that stock returns used in this study exhibit inconstant error variance, volatility clustering and leptokurtosis. Therefore, this study is designed to improve the Fama-French model by modelling both error term and the conditional variance via GARCH. This is to take into account the non-linear characteristics of the regression in the variance equation created by volatility clustering and leptokurtosis. A result for ABSA is presented in the equation for demonstrative purposes. Results for the remaining firms are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \hat{\beta}_{St}(SMB)_t + \hat{\beta}_{Ht}(HML)_t + \varepsilon_{it} + \hat{\gamma} h_t + \xi_t$$

$$r_{it} = 10.8316 - 0.0064 r_{Mt} - 0.1117 SMB_t - 0.1310 HML_t + \varepsilon_{it} + 36.2954 h_t + \xi_{it}$$

$$t = (1.3503) \quad (-1.0042) \quad (-0.7176) \quad (-1.2310)$$
$$p = [0.1769] \quad [0.3135] \quad [0.4730] \quad [0.2183]$$

$$h_t = \hat{\omega} + \hat{\alpha}_1 \varepsilon_{t-1}^2 + \hat{\beta}_1 h_{t-1}$$
$$h_t = 36.1373 + 0.6151 \varepsilon_{t-1} - 0.0070 h_{t-1}$$
$$t = (2.9829) \quad (1.5129) \quad (-0.2074)$$
$$p = [0.0029] \quad [0.1303] \quad [0.8357]$$

Table 35: time series regression estimates of equation 6.24 and 6.25

Company	β	α	ω	SMB	HML	α_1	β_1	$\alpha_1+\beta_1$	$\bar{R}^2$	AIC	SC
ABSA Group	-0.0064 (-1.0042) [***0.3153***]	10.8316 (1.3503) [***0.1769***]	36.1373 (2.9829) [***0.0029***]**	-0.1117 (-0.7176) [***0.4730***]	-0.1310 (-1.2310) [***0.2183***]	0.6151 (1.5129) [***0.1303***]	-0.0070 (-0.2074) [***0.8357***]	**0.6081**	*0.1174*	7.1295	7.3532
Acucap	0.2809 (2.4694) [***0.0135***]*	7.1348 (2.0108) [***0.0443***]*	11.0126 (2.3343) [***0.0196***]*	0.2118 (1.4129) [***0.1577***]	0.3219 (3.5051) [***0.0005***]**	0.5592 (1.5053) [***0.1322***]	0.2171 (1.0749) [***0.2824***]	**0.7763**	*0.0603*	6.3639	6.5876
AECI	-0.0143 (2.1457) [***0.0319***]*	-42.4370 (-1.9082) [***0.0564***]	3.9019 (0.6206) [***0.5349***]	-0.0184 (-0.0819) [***0.9348***]	-0.0826 (-0.5118) [***0.6088***]	0.2154 (1.4383) [***0.1504***]	0.7731 (6.3711) [***0.0000***] **	**0.9885**	*0.0248*	7.9067	8.1304
African Rainbow	0.2809 (2.9826) [***0.0029***] **	7.1348 (3.7381) [***0.0002***] **	11.0126 (1.9160) [***0.0554***]	0.2118 (1.8330) [***0.0668***]	0.3219 (3.0167) [***0.0026***]**	0.5592 (2.4502) [***0.0143***]*	0.2171 (1.2066) [***0.2276***]	**0.7763**	*0.0603*	6.3639	6.5876
African Oxygen	-0.0033 (-0.1521) [***0.8791***]	11.0465 (1.9903) [***0.0466***]*	4.8746 (1.2026) [***0.2291***]	-0.2268 (-0.9981) [***0.3182***]	0.1780 (1.2138) [***0.2248***]	0.2716 (2.0828) [***0.0373***]*	0.6967 (5.5534) [***0.0000***] **	**0.9683**	*0.1080*	7.3402	7.5639
AG Ind	0.2350 (1.0487) [***0.2943***]	7.8382 (1.4739) [***0.1405***]	11.1934 (1.4304) [***0.1526***]	0.1609 (0.7222) [***0.4702***]	-0.1742 (-0.9719) [***0.3311***]	-0.0203 (-0.3526) [***0.7244***]	0.8735 (7.9112) [***0.0000***] **	**0.8532**	*0.0549*	7.5163	7.7399
Allied Tech	3.67E-1 (0.0019) [***0.9985***]	-0.6780 (-0.5045) [***0.6139***]	9.8318 (1.1306) [***0.2582***]	-0.2077 (-0.6478) [***0.5171***]	-0.2577 (-1.1063) [***0.2686***]	0.1313 (1.4913) [***0.1359***]	0.8130 (7.9365) [***0.0000***] **	**0.9443**	*0.0172*	7.8819	8.1056
AngloGold	0.0060 (0.2430) [***0.8080***]	28.1423 (2.2169) [***0.0266***]*	62.7713 (1.0194) [***0.3080***]	0.0519 (0.1213) [***0.9035***]	0.1480 (0.5866) [***0.5575***]	0.1045 (-2.3153) [***0.0206***]*	0.7357 (2.2014) [***0.0277***]*	**0.8402**	*0.0578*	8.0786	8.3023
Anglo Platinum	0.0005 (0.0196) [***0.9844***]	14.1986 (1.8390) [***0.0659***]	206.4596 (4.3549) [***0.0000***] **	-0.4130 (-1.3162) [***0.1881***]	-0.3425 (-1.6416) [***0.1007***]	0.2122 (1.3467) [***0.1781***]	-0.7664 (-3.6432) [***0.0003***] **	**-0.5540**	*0.0419*	7.8003	8.0240
Aspen Pharma	-0.0047 (-0.1430) [***0.8863***]	14.9859 (1.5844) [***0.1131***]	-4.5491 (-0.6373) [***0.5239***]	-0.0556 (-0.1793) [***0.8577***]	0.3191 (0.9293) [***0.3527***]	0.3689 (4.8773) [***0.0000***]**	0.7669 (14.8638) [***0.0000***] **	**1.1358**	*0.1137*	8.8114	9.0351
Aveng	0.4526 (3.7764) [***0.0002***] **	11.0086 (4.9804) [***0.0000***]	5.1629 (16.2894) [***0.0000***]**	0.04789 (0.3528) [***0.7243***]	-0.1224 (-1.1004) [***0.2712***]	-0.1588 (-90.1557) [***0.0000***]**	1.0576 (240.3275) [***0.0000***] **	**0.8988**	*0.0186*	6.8972	7.1209

		**									
Basil Read	-0.0094 (-0.0510) [***0.9593***]	2.4401 (0.4304) [***0.6669***]	19.4578 (0.5968) [***0.5507***]	-0.3377 (-0.4989) [***0.6179***]	0.3373 (0.9418) [***0.3463***]	0.0993 (0.7992) [***0.4242***]	0.8441 (4.0780) [***0.0000***] **	**0.9434**	*0.0387*	8.7451	8.9688
Ceramic Ind	-0.0042 (-0.0891) [***0.9290***]	10.2808 (1.5353) [***0.1247***]	0.5263 (1.7431) [***0.0813***]	0.1043 (0.5063) [***0.6127***]	-0.3693 (-1.8367) [***0.0663***]	-0.0477 (-2.4774) [***0.0132***]*	1.0256 (48.3580) [***0.0000***] **	**0.9779**	*0.0751*	7.2250	7.4487
City Lodge Hotels	-0.0012 (-0.0372) [***0.9703***]	10.5822 (2.5194) [***0.0118***]*	27.0137 (1.2277) [***0.2196***]	-0.3821 (-1.2322) [***0.2179***]	0.0757 (0.2834) [***0.7769***]	0.3121 (1.7885) [***0.0737***]	0.5114 (1.8483) [***0.0646***]	**0.8235**	*0.0449*	7.8659	8.0896
COM AIR	0.6268 (2.2860) [***0.0223***]*	9.3004 (4.6492) [***0.0000***] **	201.6889 (1.1234) [***0.2613***]	-0.5133 (-1.2795) [***0.2007***]	-0.5738 (-1.9137) [***0.0557***]	0.1553 (0.7623) [***0.4459***]	-0.1801 (-0.2127) [***0.8316***]	**-0.0250**	*0.0287*	8.2808	8.5045
Cullinan	-0.0278 (-0.7764) [***0.4375***]	-4.6290 (-2.1940) [***0.0282***]*	15.7413 (11.7195) [***0.0000***]**	-0.2887 (-0.6546) [***0.5127***]	-1.0465 (-3.2150) [***0.0013***]**	-0.0902 (-425.776) [***0.0000***]**	1.0908 (225.4499) [***0.0000***] **	**1.0006**	*0.0348*	9.0348	9.2585
Delta EMD	0.0156 (0.6974) [***0.4856***]	10.2190 (1.2146) [***0.2245***]	6.2178 (1.0300) [***0.3030***]	-0.0339 (-0.1047) [***0.9166***]	-0.1624 (-0.8751) [***0.3815***]	0.1757 (1.3467) [***0.1781***]	0.7801 (5.1815) [***0.0000***] **	**0.9558**	*0.0542*	7.5420	7.7657
Discovery	0.3680 (2.1062) [***0.0352***]*	1.5236 (1.2318) [***0.2180***]	33.4616 (0.8526) [***0.3939***]	-0.3253 (-1.6175) [***0.1058***]	-0.0014 (-0.0072) [***0.9943***]	-0.0924 (-1.1330) [***0.2572***]	0.5346 (0.8580) [***0.3909***]	**0.4422**	*0.0013*	7.0846	7.3083
Distell Group	-0.0015 (-0.0402) [***0.9679***]	0.0563 (0.0474) [***0.9622***]	77.7493 (0.8658) [***0.3866***]	-0.5755 (-1.5134) [***0.1302***]	0.1392 (0.7774) [***0.4369***]	-0.1052 (-0.8744) [***0.3819***]	0.2888 (0.3064) [***0.7593***]	**0.1836**	*0.0171*	7.5405	7.7642
DRD Gold	0.0039 (0.0490) [***0.9609***]	-2.2121 (-0.4824) [***0.6295***]	678.8184 (2.8597) [***0.0042***]**	0.0902 (0.2309) [***0.8174***]	-0.0583 (-0.1415) [***0.8875***]	0.1376 (1.0762) [***0.2818***]	-0.6920 (-1.9543) [***0.0507***]	**-0.5540**	*0.0757*	9.0152 2	9.2389
DS&WH SG Network	0.0243 (0.3617) [***0.7175***]	-6.8017 (-1.2157) [***0.2241***]	30.9199 (0.9815) [***0.3263***]	-0.1419 (-0.2883) [***0.7731***]	0.2372 (0.4848) [***0.6279***}	0.2454 (2.6062) [***0.0092***] **	0.7126 (6.1583) [***0.0000***] **	**0.9580**	*0.0916*	9.2405	9.4642
First Rand	-0.0263 (-1.4450) [***0.1485***]	1.6659 (0.1964) [***0.8443***]	273.4271 (5.9572) [***0.0000***] **	-0.2901 (-1.1108) [***0.2666***]	0.0151 (0.0640) [***0.9490***]	0.0317 (3.8049) [***0.0001***] **	-1.0635 (-25.5350) [***0.0000***] **	**-1.0320**	*0.0690*	7.7745	7.9982
Glenrand M I B	0.0006 (2.0886) [***0.0367***]*	7.3759 (23.5936) [***0.0000***] **	0.0001 (2.3201) [***0.0203***]*	0.0008 (1.1608) [***0.2457***]	0.0008 (2.5244) [***0.0116***]*	1.1280 (11.7544) [***0.0000***] **	-0.0086 (-0.5448) [***0.5859***]	**1.1194**	*0.2580*	- 1.5135	- 1.2898
Gold Reef Resorts	0.0027 (0.0208) [***0.9834***]	10.8745 (1.2470) [***0.2124***]	102.6487 (2.1646) [***0.0304***]*	0.4374 (1.1575) [***0.2471***]	-0.0349 (-0.1242) [***0.9012***]	0.8141 (3.4337) [***0.0006***] **	0.0283 (0.1647) [***0.8692***]	**0.8424**	*0.0988*	8.4296	8.6533
Gold Fields	0.0172 (0.6507) [***0.5153***]	12.1330 (2.8809) [***0.0040***] **	19.2968 (0.8538) [***0.3932***]	-0.2173 (-0.7076) [***0.4792***]	0.0791 (0.3172) [***0.7511***]	0.4944 (2.0321) [***0.0421***]*	0.4876 (2.8905) [***0.0038***] **	**0.9820**	*0.0319*	8.1199	8.3436
Group Five	0.0026 (0.0508) [***0.9594***]	11.1060 (0.8339) [***0.4043***]	152.1827 (1.6505) [***0.0988***]	-0.4109 (-0.9096) [***0.3631***]	-0.3398 (-1.2656) [***0.2057***]	-0.1234 (-1.6133) [***0.1067***]	0.4496 (1.0640) [***0.2873***]	**0.3262**	*0.1030*	8.4000	8.6237
Growthpoint Prop	-0.0103 (-0.7531) [***0.4514***]	10.0133 (4.1127) [***0.0000***] **	14.4014 (0.9084) [***0.3637***]	0.3869 (1.3978) [***0.1622***]	1.2822 (6.8857) [***0.0000***] **	0.4087 (1.7136) [***0.0866***]	0.5736 (2.9565) [***0.0031***] **	**0.9823**	*0.0634*	7.7908	8.0145
Harmony Gold Mining	0.0101 (0.8647) [***0.3872***]	18.7642 (1.0163) [***0.3095***]	25.7296 (0.6235) [***0.5330***]	-0.2159 (-0.5186) [***0.6041***]	0.0872 (0.3067) [***0.7591***]	0.0961 (1.0962) [***0.2730***]	0.8181 (4.2533) [***0.0000***] **	**0.9142**	*0.0745*	8.6278	8.8795
Impala Platinum	0.0088 (0.1839) [***0.8541***]	7.9629 (1.0822) [***0.2792***]	287.5293 (2.5857) [***0.0097***]**	-0.2317 (-0.6585) [***0.5102***]	0.2051 (0.8486) [***0.3961***]	0.0948 (0.6277) [***0.5302***]	-0.7370 (-1.2288) [***0.2191***]	**-0.6420**	*0.0579*	8.1652	8.3889
Liberty Holdings	-0.0105 (-1.9172) [***0.0552***]	3.6540 (0.3880) [***0.6980***]	21.8486 (1.4503) [***0.1470***]	-0.0479 (-0.2259) [***0.8212***]	-0.0958 (-0.7825) [***0.4339***]	0.2048 (1.6552) [***0.0979***]	0.5530 (2.6549) [***0.0079***] **	**0.7578**	*0.0879*	7.3934	7.6171
Masonite Africa	-0.0011 (-0.0388) [***0.9691***]	3.0490 (0.6393) [***0.5226***]	5.3063 (9.9593) [***0.0000***]**	-0.1158 (-0.4774) [***0.6331***]	-0.0547 (-0.2190) [***0.8267***]	-0.0723 (-6.7014) [***0.0000***]**	1.0455 (69.0521) [***0.0000***] **	**0.9732**	*0.0725*	7.5797	7.8034

Merafe	0.0027	0.8293	111.1618	0.0593	0.2837	0.2718	0.4791	**0.7509**	*0.0690*	8.9827	9.2064
Resources	(0.1743)	(0.3596)	(1.0624)	(0.1027)	(0.6832)	(0.9178)	(1.1737)				
	[0.8616]	[0.7191]	[0.2881]	[0.9182]	[0.4945]	[0.3587]	[0.2405]				
Merch &	-5.1876	1082.757	5.40E+08	-461.527	-194.7101	0.7557	-0.0992	**0.6565**	*0.1963*	22.663	22.886
Indust	(-0.0274)	(0.0160)	(1.2603)	(-0.2455)	(-0.1154)	(0.6096)	(-0.1213)				
	[0.9781]	[0.9872]	[0.2075]	[0.8061]	[0.9081]	[0.5421]	[0.9034]				
MMI	-0.0207	-3.1602	57.6665	0.1670	0.1375	0.1009	0.5455	**0.6464**	*0.0699*	8.0727	8.2964
Holdings	(-2.9248)	(-0.4826)	(1.6606)	(0.5641)	(0.6013)	(0.8269)	(1.7920)				
	[0.0034] **	[0.6294]	[0.0968]	[0.5727]	[0.5476]	[0.4083]	[0.0731]				
MTN	0.0052	0.9631	138.0473	0.2865	-0.0182	0.1522	0.2535	**0.4057**	*0.0770*	8.4312	8.6549
Group	(1.2335)	(0.1823)	(0.7795)	(0.7875)	(-0.0882)	(0.9823)	(0.3535)				
	[0.2174]	[0.8554]	[0.4357]	[0.4310]	[0.9297]	[0.3260]	[0.7237]				
Murray	0.0033	8.6753	14.7257	-0.8326	-0.2001	0.2013	0.7289		*0.0899*	8.1600	8.3837
&	(0.3395)	(1.6756)	(0.8034)	(-2.3971)	(-0.7786)	(0.8800)	(2.9028)	**0.9302**			
Roberts	[0.7343]	[0.0938]	[0.4218]	[0.0165*	[0.4362]	[0.3789]	[0.0037] **				
NED	-0.0003	-0.0235	17.2850	0.1312	0.1804	0.0574	0.7449	**0.8023**	*0.0206*	7.4602	7.6839
Bank	(-0.0427)	(-0.0248)	(0.7695)	(0.5571)	(1.0603)	(0.7069)	(2.6116)				
	[0.9660]	[0.9802]	[0.4416]	[0.5774]	[0.2890]	[0.4796]	[0.0090] **				
Octodec	-0.0007	15.7777	2.4951	-0.0762	0.1890	0.3274	0.7130	**1.0404**	*0.0796*	7.0662	7.2899
Invest	(-0.2202)	(4.0943)	(0.7708)	(-0.6063)	(1.4393)	(1.3882)	(6.2536)				
	[0.8257]	[0.0000] **	[0.4408]	[0.5443]	[0.1501]	[0.1651]	[0.0000] **				
Omnia	0.0063	8.9961	41.0214	0.6810	0.1001	0.3488	0.4304	**0.7792**	*0.0356*	7.9697	8.1934
	(0.1823)	(1.9162)	(1.4801)	(1.9832)	(0.4704)	(1.9115)	(1.7443)				
	[0.8553]	[0.0553]	[0.1389]	[0.0473*	[0.6381]	[0.0559]	[0.0811]				
Pangbourne Prop	-0.0082	10.4759	7.4246	-0.1147	0.3792	-0.0980	0.9071	**0.8091**	*0.0135*	6.6226	6.8463
	(-0.8244)	(3.4254)	(0.6483)	(-0.5947)	(3.2141)	(-1.0045)	(3.7370)				
	[0.4097]	[0.0006] **	[0.5168]	[0.5520]	[0.0013]**	[0.3151]	[0.0002]**				
Premium	0.0019	23.1565	2.3238	-0.0755	0.0770	-0.0828	1.0695	**0.9867**	*0.0758*	7.3062	7.5299
Prop	(0.1071)	(2.5537)	(2.5077)	(-0.2872)	(0.4111)	(-4.0931)	(134.1849)				
	[0.9147]	[0.0107]*	[0.0122]*	[0.7739]	[0.6810]	[0.0000]**	[0.0000] **				
Pretoria	-0.0232	1.8153	8.5662	-0.2717	-0.0812	0.1332	0.7801		*0.0512*	7.5070	7.7307
Port	(-4.0210)	(0.4140)	(1.1147)	(-1.3128)	(-0.4513)	(1.1315)	(5.7857)	**0.9133**			
CMT	[0.0001] **	[0.6789]	[0.2650]	[0.1892]	[0.6518]	[0.2579]	[0.0000] **				
RMB	-0.0107	3.2686	12.5143	0.2451	0.0517	0.1413	0.7882	**0.9295**	*0.0975*	7.9041	8.1278
Bank	(-1.3301)	(0.3686)	(1.1115)	(0.9186)	(0.2140)	(1.1731)	(10.1009)				
	[0.1835]	[0.7124]	[0.2663]	[0.3583]	[0.8306]	[0.2408]	[0.0000] **				
SABLE	0.0032	8.8447	34.3670	0.0029	-0.1650	0.5966	0.3908	**0.9874**	*0.1030*	8.1753	8.3990
	(0.0252)	(2.3201)	(2.0211)	(0.0076)	(-0.7855)	(2.5369)	(2.9232)				
	[0.9799]	[0.0203]*	[0.0433]*	[0.9940]	[0.4323]	[0.0112]*	[0.0035] **				
SACOIL	-0.0717	-3.2234	410.5202	0.0962	0.0072	0.1620	0.2796	**0.4416**	*0.0282*	9.5634	9.7871
Holdings	(-2.40480)	(-0.8904)	(1.2242)	(0.1184)	(0.0109)	(1.1489)	(0.5179)				
	[0.0162]*	[0.3732]	[0.2209]	[0.9057]	[0.9913]	[0.2506]	[0.6045]				
Saambou	0.0040	12.0818	46.5843	0.2499	0.4828	1.6403	-0.0335	**1.6068**	*0.1129*	7.9567	8.1804
Bank	(0.0870)	(1.7998)	(2.4243)	(1.2997)	(4.7305)	(3.5556)	(-0.8847)				
	[0.9307]	[0.0719]	[0.0153]*	[0.1937]	[0.0000]**	[0.0004]**	[0.3763]				
Sanlam	0.6617	7.3749	16.6901	-0.0313	0.1451	0.0209	0.4942	**0.5151**	*0.1275*	6.6571	6.8808
	(5.0270)	(3.9686)	(1.9084)	(-0.1874)	(1.0261)	(0.3125)	(1.8750)				
	[0.0000] **	[0.0001] **	[0.0563]	[0.8514]	[0.3048]	[0.7547]	[0.0608]				
SASOL	0.0035	11.2231	188.9834	-0.1918	-0.3629	0.1271	-0.5519	**-0.4250**	*0.0478*	7.8906	8.1143
	(0.1300)	(1.9921)	(2.2215)	(-0.5169)	(-1.3728)	(0.9898)	(-0.9317)				
	[0.8965]	[0.0464]*	[0.0263]*	[0.6052]	[0.1698]	[0.3223]	[0.3515]				
Spanjaard	0.0020	4.5805	73.2202	-0.2574	-0.1588	0.6175	-0.0224	**0.5951**	*0.0674*	7.6151	7.8388
	(0.0978)	(1.0883)	(5.3685)	(-0.9172)	(-0.8623)	(4.2082)	(-0.3406)				
	[0.9221]	[0.2765]	[0.0000]**	[0.3591]	[0.3885]	[0.0000]**	[0.7334]				
Standard	-0.0170	-17.6629	4.7171	-0.1123	-0.3220	0.8759	0.4727	**1.3486**	*0.1042*	7.6008	7.8245
Bank	(-0.6668)	(-0.7031)	(0.4809)	(-0.7097)	(-2.2761)	(2.2252)	(2.9575)				
	[0.5049]	[0.4820]	[0.6306]	[0.4779]	[0.0228]*	[0.0261]*	[0.0031] **				
Sun Int	-0.0006	1.1454	14.3482	0.1338	0.0367	0.0626	0.8116	**0.8742**	*0.0814*	7.7477	7.9714
	(-0.0142)	(0.0943)	(0.4970)	(0.4777)	(0.1416)	(0.6708)	(2.7987)				
	[0.9887]	[0.9249]	[0.6192]	[0.6329]	[0.8874]	[0.5024]	[0.0051] **				
Telkom	0.4688	3.6910	4.6341	-0.1362	-0.1833	-0.1408	1.0699	**0.9291**	*0.0103*	7.1186	7.3585
	(2.9327)	(1.2039)	(3.0762)	(-0.4694)	(-1.0125)	(-6.7868)	(24.8964)				
	[0.0034] **	[0.2286]	[0.0021]**	[0.6388]	[0.3113]	[0.0000]**	[0.0000] **				
VOX	-0.4624	-1.0813	495.8000	-1.6173	0.8045	0.3292	0.4123	**0.7415**	*0.0373*	10.2762	10.4999
Telecom	(-0.6309)	(-0.2389)	(1.8259)	(-1.0702)	(0.8454)	(2.1531)	(1.8069)				
	[0.5281]	[0.8112]	[0.0679]	[0.2845]	[0.3979]	[0.0313]*	[0.0708]				
White	-0.0015	-5.7967	775.633	-1.0992	0.1438	0.3644	-0.3955	**-0.0310**	*0.0468*	9.5814	9.8051
Water	(-0.0108)	(-1.5720)	(2.1335)	(-1.2715)	(0.2450)	(0.9676)	(-1.0454)				
Resource	[0.9914]	[0.1159]	[0.0329]*	[0.2035]	[0.8064]	[0.3333]	[0.2959]				

Bayly Holmes-Ovcon	-0.0464 (3.5694) [***0.0004***]**	10.1806 (1.6473) [***0.0995***]	-0.8058 (-0.2048) [***0.8378***]	-0.5054 (-2.2400) [***0.0251***] *	0.1421 (0.4699) [***0.6384***]	0.1879 (2.3822) [***0.0172***]*	0.8240 (13.2705) [***0.0000***] **	**1.0119**	*0.0833*	8.0983	8.3220
Zurich Insur	-0.0064 (-0.8403) [***0.4007***]	10.8316 (13.2593) [***0.4140***]	36.1373 (2.8544) [***0.0043***]**	-0.1117 (-0.5234) [***0.6007***]	-0.1310 (-0.72470 [***0.4686***]	0.6151 (3.5321) [***0.0004***]**	-0.0070 (-0.0506) [***0.9596***]	**0.6081**	*0.1174*	7.1295	7.3532

Source: Author's own calculation

The GARCH model is characterized by the following three fundamental propositions; (i) that, *ω=0* and $\alpha, \beta \geq 0$ to ensure that the conditional variance is strictly positive in relation to expected excess stock return. However, reported empirical evidences are contradictory. For example, French et al. (1987) and Campbell and Hentschel (1992) found positive relationship between excess return and conditional variance, while Fama and Schwert (1977), Campbell (1987), Breen et al. (1989), Turner et al. (1989), Pagan and Hong (1991) and Nelson (1991) found a negative relation; (ii) that shocks to volatility decay at constant rate and the speed of decay is measured by the estimate of *α+β;* (iii) that the sum of α and β measures volatility persistence (i.e. the degree to which shocks to current volatility remain important for long-periods into the future). The persistence of shocks to volatility becomes greater as the sum approaches 1 (or unity) and shock to volatility is considered to be permanent if the sum is equal to 1 (Engle and Bollerslev, 1986). As this sum becomes greater than 1, then volatility is explosive, i.e. shock to volatility in one period will result in even a greater volatility in the subsequent period (Chou, 1988).

1. By summing up α (ARCH term) and β (GARCH term), as can be seen from table 35, proposition (i) is supported by forty nine companies. The sum of α and β for these forty nine firms are positive which is consistent with French et al. (1987) and Campbell and Hentschel (1992). However, the sum of α and β for Anglo Platinum (-*0.5540*), Com Air (-*0.0250*), DRD Gold (-*0.5540*), First Rand (-*1.0320*), Impala Platinum (-*0.6420*), Sasol (-*0.4250*) and White Water Resources (-*0.0310*) violates

this proposition of the model as they all show negative values. Besides, by disaggregating the model, eleven firms exhibit negative coefficients of the conditional (ARCH) variance term and the GARCH term is negative in thirteen firms. Although, according to ARCH/GARCH theory, this negative relationships between returns and conditional variance should not exist, the estimated coefficients of these firms from table 35 violate the imposition of this positive parameter restriction as the ARCH/GARCH models unduly restrict the dynamics of the conditional variance process (see also Nelson, 1991). Similarly, previous tests of the relation between excess return and conditional variance using ARCH and GARCH models have documented negative relationships (Fama and Schwert, 1977; Campbell, 1987; Breen et al., 1989; Turner et al., 1989; Pagan and Hong, 1991 and Nelson, 1991). This negative relation between return and conditional variance is buttressed by Black (1976) results, which found a negative correlation between current returns and future returns volatility. Furthermore, Nelson (1991) and Engle and Ng (1993) argue that the time series properties of monthly returns data are to some extent different from daily returns data and therefore more likely to find a negative relation between returns and conditional variance with a low level data frequency. However, Glosten et al. (1993) argue that there is no theoretical grounding to support the differences in time series properties that should warrant the changes in results.

2. Besides, it is vitally important to analyse the statistical significance of the ARCH and GARCH coefficients in relation to returns since the results obtained could have happened out of chance. The test of significance was set at 1 (*p-value with* **) and 5 (*p-value with* *) per cent levels and the results, as in table 35, shows that the ARCH term exhibits statistically significant coefficients in twenty two firms at 1 and 5 per

cent levels. However, out of these twenty two firms, only six exhibit statistically significant negative relationship between returns and (ARCH term) conditional variance, while the remaining sixteen show statistically significant positive relationship between return and (ARCH term) conditional variance at 1 and 5 per cent levels. Similarly, the results also show that the GARCH term is statistically significant in thirty one firms at 1 and 5 per cent levels of which twenty nine are positive, while the other two are negatively related to return.

3. The persistence of volatility as measured by the sum of $\alpha+\beta$ varies considerably for the companies in South Africa. For example, in Aspen Pharmaceuticals (1.1358), Cullinan (1.0006), Glenrand(1.1194), Octodec (1.0404), Saambou (1.6068), Standard Bank (1.3486) and Balyly Holmes Ovcon (1.0119), volatility persistence is explosive as, $\alpha + \beta > 1$. Explosive volatility means that persistence of shocks to volatility in one period will result in even a greater volatility in the subsequent period as the sum of α and β are greater than 1 or unity (Chou, 1988). For all other firms $\alpha + \beta < 1$. For instance, among remaining firms, seventeen exhibits the greatest persistence, as the sum of α and β is above 0.9 and therefore, close to 1. This implies that a shock to volatility in the past will be significant in predicting future volatility over a prolonged period. Meanwhile, evidence of low volatility is found in the remaining twenty five firms. Among these twenty five firms, the sum of α and β ranges from 0.1836 (Distell) to 0.8988 (Aveng). This does not insinuate that volatility is not present in these firms however; shocks to volatility diminish fairly quickly. McMillan and Thupayagale (2009) found similar evidence in nine African Stock Markets (Botswana, Egypt, Ghana, Kenya, Mauritius, Morocco, Namibia, South Africa and Tunisia) that shocks to volatility in these markets taper off fairly quickly in

comparison with UK and US markets. Also, Glosten et al. (1993), using monthly excess return on US stocks found that the conditional volatility is not highly persistent.

4. Per GARCH restriction, the variance constant, ω, should be 0. As in table 35, this condition is violated by the evidence. The coefficients of the variance constant, ω, for fifty four firms are greater than 0 (i.e. positive) and that of Aspen and Bayly Holmes-Ovcon are less than 0 (i.e. negative). However, only nineteen firms show positive significant coefficient at 1 and 5 per cent levels.

As can be seen from table 35, beta coefficients for only twenty nine firms show positive coefficients in support of a fundamental proposition of the beta which state that asset returns are positive (and linear) function of its systematic risk. The remaining twenty seven show negative coefficients and these assets could be considered as instrument for portfolio hedging as they move in opposite direction of the market portfolio and other firms trading on the market (see Markowitz, 1952 & 1959; Merton, 1973). However, only eight firms exhibit significant positive relationship between beta and return at 1 and 5 per cent levels, while five firms show negative relation at the same levels of significance. According to the Augmented Fama-French model, the mean intercept should be 0. Nonetheless, this proposition is violated per the results in table 35. The evidence shows that mean intercepts for all the fifty six firms is either positive (greater than 0) or negative (less than zero). Statistically it is found that the intercept for seventeen firms is significant of which sixteen are positive at 1 and 5 per cent levels, while Cullinan is negative at 5 per cent level.

The coefficient of determination, R^2 ranges from 0.13 per cent to 19.63 per cent and this is a summary measure of how well Augmented Fama-French model explains the return generating process in South Africa. The highest total variation in equity in South Africa which can be explained by the GARCH augmented Fama-French, as measured by adjusted R^2, is only 19.63% (Merch & Ind Properties). The weak explanatory power of the model is further buttressed by high Akaike Information Criterion (AIC) and Schwarz Criterion (SC), which are all well above the critical value of 3.

8.3.4 GARCH-M Augmented Fama-French model

Following the evidence in table 35, it is found that there is a correlation between return and conditional variance. French *et al.* (1987) assert that volatility is actually a priced risk factor and not just a data characteristic issue. Therefore, the underlying theory following the results in table 35 is that investors should be rewarded for taking up additional risk. According to Engle, Lilien and Robins (1987), GARCH-in-Mean (or GARCH-M) is a better model to operationalize this type of risk. The results in table 36 are estimated using equation 6.27 where the regression process allows the conditional variance to enter the conditional mean process. A result for AECI is presented in the equation for demonstrative purposes. Results for the remaining companies are presented in the table below.

$$r_{it} = \hat{\alpha}_{it} + \hat{\beta}_{it} r_{Mt} + \hat{\beta}_{St}(SMB)_t + \hat{\beta}_{Ht}(HML)_t + \hat{\delta}\sigma_t^2 + \varepsilon_{it}$$

$$r_{it} = -45.7270 + -0.0154 r_{Mt} + 0.0271 SMB - 0.0935 HML - 0.4375\sigma_t^2 + \varepsilon_{it}$$

$$\begin{array}{llllll} t = (-2.1529) & (-2.2334) & (0.1312) & (-0.5866) & (-1.4921) \\ p = [0.0313] & [0.0255] & [0.8956] & [0.5574] & [0.1357] \end{array}$$

Table 36: time series regression estimates of equation 6.27

Company	***δ***	***β***	***α***	***SMB***	***HML***	$\overline{R}^2$	***F-Statistic (p-value)***	***AIC***	***SC***
AECI	-0.4375 (-1.4921) [***0.1357***]	-0.0154 (-2.2334) [***0.0255***]*	-45.7270 (-2.1529) [***0.0313***]*	0.0271 (0.1312) [***0.8956***]	-0.0935 (-0.5866) [***0.5574***]	*0.0230*	0.7529 [***0.6448***]	7.8945	8.1461
African Rainbow	0.266438 (0.566169)	0.0068 (1.7856)	6.2252 (0.9051)	0.0731 (0.3139)	0.0121 (0.0473)	*0.1260*	0.2648 [***0.1948***]	8.0118	8.2635

	[0.5713]	[0.0742]	[0.3654]	[0.7536]	[0.9623]				
African	-0.0781	-0.0037	12.3405	-0.2701	0.1733	*0.1244*	1.9101	7.3568	7.6084
Oxygen	(-0.2278)	(-0.1697)	(2.1511)	(-1.3434)	(1.4583)		[0.6125]		
	[0.8197]	[0.8652]	[0.0315]*	[0.1791]	[0.1448]				
AG Ind	-0.5340	0.2409	14.4762	0.2038	-0.2394	*0.0741*	0.2415	7.5973	7.8489
	(-0.6604)	(1.0452)	(1.6867)	(0.8720)	(-1.4524)		[0.9816]		
	[0.5089]	[0.2959]	[0.0917]	[0.3832]	[0.1464]				
Allied	-7.8247	-0.0018	88.6074	-0.0833	-0.1253	*0.0694*	1.8202	7.8866	8.1382
Tech	(-0.3499)	(-0.1375)	(0.3526)	(-0.2689)	(-0.4930)		[0.0853]		
	[0.7264]	[0.8906]	[0.7243]	[0.7880]	[0.6220]				
AngloGo	0.0135	0.0012	6.1767	-0.0613	0.0569	*0.0047*	0.0477	8.1120	8.3618
ld Ash	(1.5799)	(0.2505)	(6.1162)	(-0.2071)	(0.2453)		[0.9999]		
	[0.1141]	[0.8022]	[0.0000]**	[0.8360]	[0.8062]				
Anglo	0.2827	-137.2369	306.0957	25.6676	39.9001	*0.0254*	4.5792	7.6210	7.8710
Platinum	(0.0231)	(-0.0311)	(0.0116)	(0.087015)	(0.3331)		[0.0918]		
	[0.9815]	[0.9751]	[0.9907]	[0.9307]	[0.7391]				
Aspen	0.0755	-0.0045	14.3188	-0.0526	0.3033	*0.1124*	0.7845	8.8170	9.0686
Pharm	(0.2760)	(-0.1443)	(1.5061)	(-0.1430)	(0.8935)		[0.4566]		
	[0.7825]	[0.8852]	[0.1320]	[0.8863]	[0.3716]				
Aveng	-7.2593	0.4979	58.2066	0.2787	-0.0071	*0.2307*	4.297897	7.0278	7.2795
	(-18.1376)	(3.3404)	(74.4420)	(1.5541)	(-0.0466)		[0.0002] **		
	[0.0000] **	[0.0008] **	[0.0000] **	[0.1201]	[0.9628]				
Basil	0.3501	71.6959	106.9652	124.1921	163.7911	*0.0652*	0.2219	75.3956	75.6472
Read	(NA)	(NA)	(NA)	(NA)	(NA)		[0.9792]		
	[NA]	[NA]	[NA]	[NA]	[NA]				
Ceramic	0.3587	-0.0031	7.0821	0.0447	-0.2980	*0.0775*	0.2085	7.4306	7.6823
Ind	(0.7050)	(-0.1217)	(0.8294)	(0.1712)	(-1.1759)		[0.9886]		
	[0.4808]	[0.9031]	[0.4068]	[0.8640]	[0.2396]				
Cullinan	-1.6112	-0.0155	34.4798	0.3434	-1.3648	*0.0457*	1.5265	9.1329	9.3845
	(-2.8820)	(-0.2416)	(2.7357)	(0.8218)	(-2.6430)		[0.1612]		
	[0.0040] **	[0.8090]	[0.0062] **	[0.4112]	[0.0082] **				
Delta	-0.0682	0.0165	11.3577	-0.0017	-0.1916	*0.0668*	0.3107	7.5971	7.8488
EMD	(-0.1740)	(0.7369)	(1.2139)	(-0.0055)	(-1.0202)		[0.9599]		
	[0.8618]	[0.4611]	[0.2248]	[0.9956]	[0.3077]				
DS&WH	0.3272	0.1047	-22.3796	4.3026	-0.1405	*0.0014*	0.0161	10.1899	10.4416
SG	(0.5897)	(4.1178)	(-1.4684)	(10.1877)	(-0.1684)		[0.9999]		
Network	[0.5554]	[0.0000] **	[0.1420]	[0.0000] **	[0.8662]				
First	0.9223	-0.0235	-10.1333	-0.0933	0.0663	*0.0133*	0.8559	7.8716	8.1233
Rand	(1.8868)	(-0.8215)	(-0.6216)	(-0.2587)	(0.1975)		[0.5570]		
	[0.0592]	[0.4113]	[0.5341]	[0.7959]	[0.8434]				
Gold	0.4931	0.0061	0.3552	0.5108	-0.0399	*0.0133*	0.8557	8.3992	8.6508
Reef	(1.6249)	(0.1577)	(0.0556)	(1.5360)	(-0.1740)		[0.5572]		
	[0.1042]	[0.8747]	[0.9557]	[0.1245]	[0.8618]				
Gold	1.6421	0.0162	-5.9333	-0.0605	-0.1351	*0.0620*	1.7266	8.0612	8.3129
Fields	(1.4779)	(0.1827)	(-0.3695)	(-0.2783)	(-0.4335)		[0.1049]		
	[0.1394]	[0.8550]	[0.7117]	[0.7808]	[0.6646]				
Group	0.6445	0.0058	3.7171	-0.0288	0.0091	*0.0919*	0.074365	8.35796	8.60962
Five	(1.0543)	(0.1502)	(0.2247)	(-0.0595)	(0.0262)		[0.9997]	9	9
	[0.2917]	[0.8806]	[0.8221]	[0.9525]	[0.9790]				
Growthp	-0.3133	-0.0099	13.6318	0.2980	1.3117	*0.1282*	2.6181	7.8111	8.0627
oint Prop	(-0.6001)	(-0.8198)	(2.3469)	(1.0412)	(7.2711)		[0.0134]*		
	[0.5484]	[0.4124]	[0.0189]*	[0.2978]	[0.0000]**				
Harmon	-0.8476	0.0100	18.7642	-0.21585	0.0872	*0.0745*	0.2373	8.6278	8.8794
y Gold	(-0.8712)	(0.8647)	(1.0162)	(-0.5185)	(0.3067)		[0.9826]		
	[0.3837]	[0.3872]	[0.3095]	[0.6041]	[0.7591]				
Liberty	-0.9605	-0.0126	10.7529	-0.1689	-0.0987	*0.0620*	0.3570	7.3807	7.6323
Holdings	(-1.5719)	(-2.0264)	(1.1367)	(-0.7893)	(-0.8932)		[0.9398]		
	[0.1160]	[0.0427]*	[0.2557]	[0.4299]	[0.3717]				
Masonite	-0.2916	-0.0021	2.1613	-0.2790	0.1710	*0.0972*	0.0250	7.8850	8.1367
Africa	(-0.8201)	(-0.0430)	(0.2117)	(-0.9085)	(0.5329)		[0.9999]		
	[0.4122]	[0.9657]	[0.8323]	[0.3636]	[0.5940]				
Murray	-0.0601	0.0042	9.9868	-0.8569	-0.1953	*0.1027*	0.2024	8.2086	8.4603
& Rob	(-0.1206)	(0.4513)	(1.2286)	(-2.3656)	(-0.7686)		[0.9897]		
	[0.9040]	[0.6517]	[0.2192]	[0.0180]*	[0.4421]				
NED	-0.3384	-4.0931	134.1944	-17.0375	-55.0188	*0.0091*	0.0934	117.903	118.154
Bank	(-8.2779)	(-0.1336)	(10.1751)	(-53.0906)	(-0.8708)		[0.9993]		

	[0.0000] **	[0.8936]	[0.0000] **	[0.0000] **	[0.3838]				
Octodec	0.2710	-0.0011	13.7149	-0.1246	0.1922	*0.0720*	0.2602	7.1015	7.3532
Invest	(1.0822)	(-0.3091)	(3.2619)	(-0.9981)	(1.46018)		[0.9767]		
	[0.2792]	[0.7572]	[0.0011] **	[0.3183]	[0.1442]				
Pangbou	-0.1868	0.6682	-31.3977	-13.7673	-5.1458	*0.0839*	2.0195	85.9184	86.1701
rne Prop	(NA)	(NA)	(NA)	(NA)	(NA)		[0.0542]		
	[NA]	[NA]	[NA]	[NA]	[NA]				
Premium	5.2930	0.0012	-28.5251	-0.1313	0.0840	*0.0126*	0.8621	7.4719	7.7236
Prop	(0.4184)	(0.0288)	(-0.2342)	(-0.3956)	(0.3607)		[0.5519]		
	[0.6756]	[0.9770]	[0.8148]	[0.6924]	[0.7183]				
Pretoria	-35.3749	-0.0260	310.4124	-0.4026	-0.3510	*0.1076*	2.3266	7.4257	7.6774
Port	(-1.3818)	(-2.1486)	(1.2722)	(-1.7338)	(-2.8850)		[0.0267]*		
	[0.1670]	[0.0317] *	[0.2033]	[0.0830]	[0.0039] **				
RMB	-0.3330	-0.0128	3.9320	0.2234	0.0820	*0.0847*	0.1409	7.9448	8.1965
Bank	(-0.5115)	(-1.5883)	(0.3649)	(0.8147)	(0.3355)		[0.9970]		
	[0.6090]	[0.1122]	[0.7151]	[0.4152]	[0.7372]				
SABLE	0.0395	0.0024	10.9621	-0.0283	-0.1738	*0.1399*	0.056	8.2267	8.4783
	(0.1567)	(0.0720)	(2.5885)	(-0.0816)	(-0.8832)		[0.9998]		
	[0.8755]	[0.9425]	[0.0096] **	[0.9349]	[0.3771]				
Saambou	-0.7499	0.0092	20.7125	0.3926	0.2380	*0.0536*	0.4394	7.9709	8.2225
Bank	(-2.0018)	(0.2227)	(1.5493)	(1.5295)	(1.0774)		[0.893]		
	[0.0453]*	[0.8237]	[0.1213]	[0.1261]	[0.2813]				
Spanjaar	1.1671	-0.0063	-1.9333	-0.1766	0.1477	*0.1411*	1.0967	7.5238	7.7755
d	(2.3449)	(-0.3159)	(-0.3914)	(-0.6823)	(0.6885)		[0.5734]		
	[0.0190]*	[0.7520]	[0.6955]	[0.4950]	[0.4911]				
Standard	0.6012	-0.0175	-23.3462	-0.2167	-0.2326	*0.3140*	2.0758	7.5435	7.7951
Bank	(1.9154)	(-0.6498)	(-1.4967)	(-1.7940)	(-1.7611)		[0.0975]		
	[0.0554]	[0.5158]	[0.1345]	[0.0728]	[0.0782]				
Sun Inter	0.6895	-0.0015	-8.6084	0.1144	0.0138	*0.1039*	0.0749	7.7643	8.0159
	(0.6983)	(-0.0415)	(-0.5067)	(0.4194)	(0.0550)		[0.9993]		
	[0.4850]	[0.9668]	[0.6124]	[0.6749]	[0.9561]				
Telkom	-71.1983	0.7165	306.3843	0.0153	0.0117	*0.1527*	3.0341	7.1338	7.5720
	(-1.9819)	(5.3221)	(1.9784)	(0.0976)	(0.0668)		[0.0075]**		
	[0.0475]*	[0.0000]**	[0.0479]*	[0.9222]	[0.9467]				
VOX	0.4552	-0.4209	-16.9260	-1.7393	0.7656	*0.0658*	0.3201	10.3053	10.5569
Telecom	(1.0521)	(-0.5271)	(-1.0098)	(-1.2108)	(0.7681)		[0.9562]		
	[0.2927]	[0.5981]	[0.3126]	[0.2259]	[0.4424]				
Bayly	-1.9202	-0.0473	15.6171	1.0109	0.9666	*0.0513*	0.6334	22.0709	22.3225
Holmes-	(-50.6924)	(-3.4475)	(1.8581)	(1.7062)	(7.7013)		[0.7269]		
Ovcon	[0.0000] **	[0.0006] **	[0.0632]	[0.0880]	[0.0000] **				
Zurich	-0.2589	-0.0063	13.8711	-0.1337	-0.1343	*0.0821*	0.1648	7.1412	7.3929
Insur	(-3.8353)	(-1.0131)	(1.6213)	(-0.8988)	(-1.3598)		[0.9948]		
	[0.0001]**	[0.3110]	[0.1049]	[0.3687]	[0.1739]				

Source: Author's own calculations

The GARCH-M model is characterized by two fundamental propositions; (i) that, $\delta > 0$, to ensure that the conditional variance is interpreted as risk premium which requires compensation; (ii) investors should be rewarded if, δ, is positive.

1. As can be seen from the evidence in table 36, twenty firms with negative, δ, rejected proposition (i), in violation of the imposed restriction. This means that there is a negative correlation between the return of these firms and their conditional variance. This result is consistent with existing literature elsewhere. For example, Nelson

(1991) and Glosten et al. (1993) applied ARCH/GARCH-M and EGARCH-M to daily and monthly return data respectively and found negative relation between return and conditional variance in the US. However, the remaining eighteen firms exhibit positive relation between return and conditional variance in line with French et al. (1987), Campbell and Hentschel (1992), Guo and Neely (2006) results.

2. The positive coefficient suggests that investors in these eighteen firms are rewarded for taking up additional volatility risks. The negative relations violate the central theme of the GARCH-M which suggests that the conditional expected excess return on asset should vary positively and proportionately with the conditional variance. As argued strongly by Nelson (1991) that standard GARCH/GARCH-M models lack the properties to capture the dynamics of the conditional variance process and went ahead to propose an alternative model that remedy this weakness. This study is limited to standard GARCH-M and not extended to Nelson's model. Intuitively, assets with negative, δ, would be good instruments for hedging (see Merton, 1973) and therefore portfolio/fund managers will look out for firms with negative conditional variance.

3. However, these results could be spurious or occurred out of chance and it is appropriate to examine the statistical significance of the coefficients. As can be seen from the results in table 36, only Aveng (** and negative), Cullinan (** and negative), NED Bank(** and negative), Saambou Bank (* and negative), Spanjaard(* and positive), Telkom (* and negative), Bayly-Holmes Ovcon(** and negative) and Zurich (** and negative) show significant relation between return and conditional variance. The size (SMB) premium is significant in only DS & WHSG (** and positive), Murray & Roberts (* and negative), NED Bank (** and negative), while the

value (HML) premium is significant in Cullinan (** and negative), Growthpoint (** and positive), Pretoria (** and negative) and Bayly Holmes-Ovcon (** and positive).

4. The beta coefficients for seventeen firms are positive in support of a fundamental proposition of the CAPM which state that asset returns are positive (and linear) functions of beta. However, only Aveng, DS&WHSG Network and Telkom are positively significant at 1 per cent level, while there is a statistically significant negative beta coefficients for AECI (*), Liberty Holdings(*), Pretoria (*) and Bayly Holmes-Ovcon (**). According to the Augmented CAPM the mean intercept should be 0 or close to 0. Nonetheless, this proposition is violated per the results in table 36. The evidence shows that intercepts for all thirty eight firms are either less or greater than 0. Statistically, it is found that the intercepts for only AECI (* and negative) African Oxygen(* and positive), AngloGold Ashanti (** and positive), Aveng (** and positive), Cullinan(** and positive), Growthpoint (* and positive), NED Bank (** and positive), Octodec (** and positive), Sable (** and positive) and Telkom (* and positive) are significant. The highest total variation in equity returns in South Africa which can be explained by the augmented Fama-French model, as measured by R^2 , is 31.40% (for Standard Bank). The *F*-statistic is significant in only Aveng (**), Growthpoint (*), Pretoria (*) and Telkom (**).

5. The significance test results (i.e. t-statistic and *p-value*) for Basil Read and Pangbourne are a statistical quirk, however included for completeness.

8.4 Chapter Conclusion

Key statistical estimates provide consistent results across both Moroccan and South African markets. In that, for both markets the Fama-French three factor model performs poorly. The joint role of beta, size (M-CAP) premium and BE/ME premium are poor and fail to explain variations in returns even under conditional tests such as GARCH and ECM. On their own the size (SMB) and BE/ME premia are unable to explain realised average monthly returns and the findings contradict existing evidence that these two variables are fundamentally risk factors (see for example, Fama and French, 1992 & 1993; Claessens *et al.,* 1995; Bundoo, 2008 and Hearn *et al.,* 2008).

The market beta rather demonstrate superior performance than expected when SMB and BE/ME are present in the same regression model. These results confirm those documented in US by Kothari *et al.* (1995) and in Egypt, Jordan, Morocco and Saudi Arabia by Al-Rjoub *et al*. (2010). The fitness of the model is poor both in its basic and augmented forms as demonstrated by low adjusted R^2. Results show that volatility affect assets returns in both markets and thus, estimation of asset prices and returns should account for volatility risk premium. Largely, the ability of Sharpe-Lintner CAPM and Fama- French three factor model to fully explain the return generating process are rejected in both markets, however, the beta on its own outperform SIZE (SMB) and BE/ME (HML) fundamentals.

CHAPTER NINE: FINAL CONCLUSIONS

9.1 Summary of Thesis

The aim of this research was to investigate whether or not the capital asset pricing model (CAPM) and the Fama-French three factor model apply in Emerging African Stock Markets (EASM). Previous studies have either implicitly or explicitly supported additional tests of the Sharpe-Lintner-Black Capital Asset Pricing Model and the Fama-French three factor model in other emerging markets [Fama and French, 1998; Drew and Veeraraghavan, 2001; Bundoo, 2008].

The emergence of new financial markets is important for international finance and investments. New markets create both opportunities and challenges and the emergence of African capital markets provide an opportunity for international portfolio diversification and at the same time posing substantial risks. Before 1980, net portfolio investment in emerging markets was insignificant due to apparent lack of investment instruments available for foreign investors. During the 1980s, investments in emerging capital markets became important to international portfolio management.

Capital markets in Africa has seen significant growth since the 1990s, underpinned by financial system liberalisation, sturdy investment flows, improvement in infrastructure in the various capital markets. In spite of this significant effort made by the African markets, evidence shows that liquidity, capitalisation and listed equities are comparatively low. Within these indicators, there is a great deal of diversity across the continents. For example, in 2007 Egypt has recorded 591 listed companies' whiles Namibia has only 28 listed equities. In the same year, JSE accounted for 75% of the total African market capitalisation whiles Namibia accounted for only 0.063%.

Notwithstanding these differences, there are common features shared by the markets, such as low liquidity as measured by turnover ratio; 1.5% in ZSE to 50% in JSE in 2007. Regardless of the low liquidity and small capitalisation of African capital markets, they are among the fast growing markets in the world in terms of return on investment. In many cases, African capital markets are not integrated with the global capital market which presents African markets with the benefit of international portfolio diversification. This has encouraged a lot of international investors to seek diversification by exploring and investing in Africa. Investigation into assets return generating process and associated risks is therefore important to stakeholders and participants of emerging African stock markets.

This study is designed to contribute to the body of empirical literature and evidence by testing the two celebrated asset pricing models in the context of emerging African stock markets. Both unconditional and conditional tests were applied to CAPM and Fama-French model. A volatility augmented CAPM was developed to capture variations in asset returns in emerging African Stock Markets.

9.2 Key Findings

9.2.1 CAPM

There are three fundamental propositions of the CAPM (i) that asset returns are positive (and linear) functions of beta, (ii) that beta is the only determinant of asset returns, therefore, $\beta > 0$ and $\alpha = 0$ and (iii) risk-averse investors will demand higher return for higher risk investments, that is, R_M-$R_f > 0$. From the build-up, the evidence on the CAPM in African emerging markets seems to be mixed. While some studies such as Bundoo (2008), Hearn and Piesse (2009), and Reddy and Thomson (2011) found weak support for the Model, others like (Hearn, Piesse and Strange, 2008), Al-Rjoub et al. (2010), Nel (2011), and (Coffie and Chukwulobelu, 2012) found that beta is very significant in explaining return generating process in certain African countries and/or very commonly used in estimating the cost of equity capital by corporate entities and investment communities alike.

1. The market beta is dominant in Kenya with eighteen (95% of sample) of firms return being able to explain by systematic risk followed by Nigeria with also eighteen firms (representing 90% of total sample of twenty) return generating process being able to explain by systematic risk as measured by beta. In Morocco the systematic risk is able to explain the return of twenty companies (68.97% of sample), while in Ghana the systematic risk is able to explain the return of twelve companies representing 63% of sample. In South Africa, the situation is dire for the CAPM. Out of fifty six companies, the beta is able to explain the return of only nine firms (i.e. 16.07 of sample) per the CAPM's prediction, that asset returns are positive (and linear) functions of its beta. The other eight firms whose return could be explained by the systematic risk however contradict the underlying prediction of the model by exhibiting negative beta coefficients.

2. The CAPM also implies that if an asset beta is greater than 1 (which is the benchmark beta for the entire market portfolio), then this asset is exposed to higher systematic risk than the market portfolio and therefore, should attract higher returns. The reverse is true for companies with asset beta of less than 1. In Ghana and South Africa, beta coefficients

for all nineteen and fifty six firms respectively are less than 1, and hence, expected to experience low variation in returns (i.e. less risky) than the market portfolio. It is expected that by investing in Ghana and South Africa investors will require lower returns in compensation for taking up lower systematic risk than if they invested in an Index Fund or elsewhere (see Sharpe, 1964; Lintner, 1965). They are also exposed to lesser loss in a falling and/or volatile market condition. This is followed by Morocco with twenty four firms (82.76% of sample) showing low systematic risk and, hence, lower variation in returns. Furthermore, there will be expected lower cost of equity capital leading to overall lower weighted average cost of capital (WACC) or discount rate for investment appraisal purposes in these three countries. However, in Kenya, the return of only eight companies (42.11% of sample) reveal low coefficient of system risk, while in Nigeria ten (50% of sample) firms return show lower systematic risk.

3. Largely, evidence in all countries, with the exception of South Africa, demonstrates a positive linear relationship between asset return and beta, inferring that an increase in market risk premium increases asset returns. These findings are consistent with those documented in Jensen *et al*. (1972), Black (1972), Fama and MacBeth (1973), Kothari *et al.* (1995), Hearn *et al* (2008) and Al-Rjoub *et al* (2010). In South Africa, the return of only thirty eight firms (67.86% of sample) show positive linear relationship with beta, while in Ghana (eighteen firms, 94.74%), Kenya (eighteen firms, 94.74%), Morocco (twenty eight firms, 96.55%) and Nigeria (nineteen firms, 95%) show positive linear relationship between excess stock return and beta.

9.2.2 GARCH and GARCH-M

1. The GARCH fundamental proposition that, $\alpha + \beta \geq 0$, to ensure that the conditional variance is strictly positive in relation to expected excess stock return is supported by the results of all nineteen firms in Ghana, twenty nine in Morocco and twenty in Nigeria. While seventeen out of nineteen firms in Kenya and fifty firms out of fifty six in South Africa support this fundamental proposition. The GARCH results show that volatility persists in individual assets return generating process in all five countries. For example, Ghana records the highest number of firms (i.e. nine) with explosive volatility in their returns followed by Nigeria (eight) and South Africa (seven), Morocco (six), while Kenya records the least at three. The significance of the disturbance term and the conditional variance term varies considerably from country to country. For instance, in Ghana, the disturbance term and conditional variance term have equal influence when the model is disaggregated into ARCH and GARCH as both terms are persistent in twelve firms each. In Kenya, the disturbance term dominates return variation in seventeen firms as compared to thirteen by the conditional variance term. Again, in Morocco, the disturbance term is significant in nineteen firms, while the GARCH is significant in sixteen. However, in Nigeria the GARCH dominates the disturbance term in fourteen firms return while the ARCH is significant in only five. Similarly in South Africa the GARCH dominate and it's significant in forty firms, while the disturbance term is significant in only sixteen firms.

2. The preceding evidence demonstrate the importance of volatility in predicting asset returns in African Stock Markets and thus, makes it imperative to estimate this risk by using GARCH-M. The evidence varies considerably across countries. For example, in Ghana and Kenya, only nine firms exhibit positive volatility risk premium as estimated by, δ, then Morocco with fourteen firms, while five and twenty two firms in Nigeria and South Africa

show positive volatility risk premium respectively. Positive risk premium means that an increase in volatility risk increases firm returns and this evidence confirm existing literature that there is positive correlation between returns and volatility (French *et al.,* 1987; Campbell and Hentschel, 1992; Li, 2003; Guo & Neely, 2006).

3. On the other hand, evidence of negative volatility risk premium was documented in the remaining firms in each country. This means that there is a negative correlation between the return of these firms and their conditional variance. This result is consistent with literature elsewhere. For example, Nelson (1991) and Glosten et al. (1993) applied ARCH/GARCH-M and EGARCH-M to daily and monthly return data respectively and found negative relation between return and conditional variance in the US.

9.2.3 Fama-French 3-factor in Morocco and South Africa

1. Available statistical evidence shows that the size and the value premia are priceless in both Morocco and South Africa. There is a body of empirical evidence which support the fact that size (SMB) and value (BE/ME) premia would render market risk premium (i.e. beta) hopeless when all are found in the same regression model (see for example, Claessens *et al,* 1995; Chui & Wei, 1998; Lin & Hong, 2006). However, the evidence documented in Morocco and South Africa contradicts this established literature, where the beta exhibit dominance over the size and value premia.

2. Individually, size and value premia perform badly as demonstrated by largely statistically insignificant t-statistic and p-values for the individual regressions. Furthermore, joint explanatory power of beta, size and BE/ME is weak as shown by very low R^2 and this is buttressed by high AIC and SC statistics, which are all well above the critical value of 3. This

is contradictory to the established anomalous literature which state that the presence of size and BE/ME in a regression model with market risk premium should offer superior explanation to stock returns (Fama and French, 1992, 1993 & 2004; Bundoo, 2008).

3. Co integrated errors were found to exist in the regression model and therefore, ECM was introduced into the mean equation in order to correct for any disequilibrium errors. As stated earlier, the object was to improve the model's explanatory power since Fama-French model was not based on any equilibrium theory. The evidence obtained in chapter eight shows that cointegrated error has no significant effect on the return generating process.

4. Similar to the CAPM test, GARCH was introduced into the 3-factor variance equation in order to model the conditional variance. The evidence shows that ARCH dominates Moroccan firms' returns with eighteen, while the GARCH term is significant in fifteen firms return. In South Africa the disturbance term is significant twenty two firms, while the conditional variance term is significant in thirty one firms. By including GARCH in the mean equation, eighteen firms exhibit positive volatility risk premium, δ, in South Africa, while twelve firms exhibit positive volatility risk premium in Morocco.

6. Some empirical evidence such as Jun *et al.* (2003), Hearn and Bruce (2008), Bundoo (2008), Hearn (2009, 2011), Hearn and Piesse (2010), and Hearn *et al.* (2010) have identified illiquidity, size and BE/ME as pricing factors in Africa. However, African stock markets are characteristically small and illiquid and therefore, constructing portfolios based on size and illiquidity will anyway generate excess return. This phenomenon would fit into the data

snooping criticism since this would mean constructing portfolios using characteristics of the data for variables used in the regression model to test the data. Besides, all these multifactor studies in Africa have arbitrary constructed size, BE/ME and illiquidity portfolios and could be subjected to data snooping bias. The unreliability of these so called stylised facts identified in Africa are even more severe given that these multifactor models are not based on any equilibrium theories. However, volatility is found to exist in all the five countries and therefore, can be more reliable as pricing risk factor as it represents country variance, given that African stock markets are segmented from the world market. This country variance may transmit currency risk, political risk, inflation risk, interest rate risk, business cycle risk etc.

9.3 Summary Results

This table summarises the key findings following the results discussed in the preceding two chapters.

Table 37: Summary results

1. The market beta contributes significantly to majority of firms return generating process but at varying degree in Ghana, Kenya, Morocco and Nigeria.
2. At least the results in these countries upheld Jensen-Black-Scholes (1972), Black (1972) and Jensen (1968) versions of CAPM.
3. The strictest form of Sharpe-Lintner version of CAPM is rejected in these four markets.
4. Beta has far lesser role in contributing to the asset return generating process in South Africa and unlike the other countries partially rejects the CAPM of any form.
5. Size and BE/ME premium have no roles in explaining return generating process in Morocco and South Africa Stock Markets. Both size premium and BE/ME fundamentals are rejected

	across firms and markets.
6.	The Fama-French three factor model is rejected in both Morocco and South Africa.
7.	Volatility risk premium as defined by GARCH-M is priced across the five countries.

9.4 Contributions of This Study to the Literature

A key contribution of this study using the five countries is the emergence of volatility augmented CAPM, a model which has never been proposed or tested in empirical research in asset pricing for both developed and emerging markets.

French *et al.* (1987) and results produced in this study in parts of chapters 7 and 8 using equations 6.23, 6.24 and 6.25 have found that volatility could actually be a priced risk factor rather than just a data characteristic issue. Therefore, the underlying theory of these equations is that investors should be rewarded for taking up additional volatility risk. To operationalize this, conditional variance of error enters into the conditional mean equation as applied to the classic CAPM,

$$r_{it} = \alpha_i + \beta_i r_{Mt} + \psi\sigma_t^2 + \varepsilon_{it} \tag{9.1}$$

Where

$$\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 \tag{9.2}$$

Therefore, the expected return version of equation 9.1 for asset *i* is expressed as:

$$E(r_i) = r_f + \beta(E[r_M]) + \psi(E[\sigma_t^2]) \tag{9.3}$$

Where $E(r_i)$, $E[r_M]$, and $E[\sigma_t^2]$ are expected return on asset *i*, expected market risk premium and expected volatility risk premium respectively, while β and ψ are the coefficients of these risk premia. It will be interesting to know whether this new model is country specifics or being able to explain return generating process in other emerging capital markets with similar economic features by extending the tests in future studies to other countries.

This study provides substantial evidence of the benefits of volatility as augmenting factor in the classic CAPM in explaining asset returns in a new application to Africa and other emerging markets with similar economic characteristics. It was demonstrated that a pricing model that includes both market risk premium and volatility risk premium significantly captures patterns of returns in Africa than the classic CAPM and Fama-French model. Furthermore, this study makes three more important contributions to the literature on emerging African capital markets as follows:

1. That beta on its own cannot fully explain risk in Africa per CAPM's assertion as returns can be related to other non-beta factors.

2. The evidence here produces firm contradiction to the growing literature that size and BE/ME are fundamental risk factors. These two variables are not risk factors and indeed, small and value firms do not attract additional compensation for risk in Africa.

3. Lack of integration of African stock markets with the world market means that country specific risk as measured by volatility is persistent across all five countries and therefore volatility augmented asset pricing model is more appropriate than classic CAPM or multifactor model with size and BE/ME. Unlike Fama-French and liquidity augmented

models, this model is underpinned by theory. Even, in circumstances where volatility risk premium is negative as documented elsewhere and in this study for certain assets in Africa; the model provides useful information for portfolio construction/allocation and hedging in line with Merton (1973) ICAPM.

9.5 Practical Implications

1. Theory suggests that corporate managers should go ahead and invest in capital projects provided there is a proof of maximising corporate value. Subsequently, if some shareholders differ with management decisions, they can sell their shares and be well off as if management have made different decisions. This underpins the theoretical recommendation that managers invest only in those projects that yield positive net present value (NPV). As academics are still busily debating the value of the CAPM, it puts practitioners and companies who use the CAPM in their capital budgeting process into a state of stupor. Although capital budgeting decisions can be made without the CAPM, evidence seems to suggest that those who choose to adopt it presently in spite of the academic debate will actually not receive a worthless advice. For those interested in the strategic view of business, the CAPM still appears to have something to offer in the capital investment decision process.

2. The capital asset pricing model provides a method of assessing the riskiness of cash flows arising from a project and also estimates the relationship between that riskiness and the cost of capital (or the risk premium for investing in that project). The CAPM asserts that the important measure of a project risk is systematic or common risk known as the project’s beta.

According to the CAPM, a project cost of capital is an exact linear function of the rate on risk-free project and the systematic risk (that is, beta) of the project being evaluated.

3. However, test results documented in this study appear to suggest that the risk adjusted one factor CAPM's beta is not sufficient to wholly explain risk in emerging ASMs and that there is other risks factors. Thus, using beta alone as basis of estimating cost of capital may mislead managers into under estimating project risk.

4. It was further documented that volatility risk which serves as a proxy for country specific risk (or country variance) varies considerably in emerging African Stock Markets and evidence produced here show that volatility risk premium is additional pricing risk factor in Africa. Due to segmented emerging ASMs as shown by their respective statistically significant intercepts, the market beta is no longer useful as a sole measure of systematic risk. Instead, volatility must be considered as important measure of risk in emerging African Stock Markets because volatility is seen as the country variance or country idiosyncratic risk. This means in allocating portfolios fund managers and /or investors should go beyond the mean-variance analysis in these markets and look into information about volatility, correlation, skewness and kurtosis (see for example, Bekaert *et al*, 1996). This evidence contradicts the assertion of International CAPM which says that international investors can enter and leave any market anywhere in the world with reasonable certainty and a minimum transaction costs.

5. Cost of equity capital is expected to be high in Africa due to compensation for additional volatility risk. This implies that additional burden is placed on indigenous African companies seeking to raise finance from domestic capital markets to fund expansion and overseas capital investments. Furthermore, the cost of meeting stringent corporate governance and regulatory requirements of developed markets by indigenous African companies, including frequent auditing and disclosure means that these companies are compelled to raise finance on the local markets where the cost of equity is substantially high. It puts these firms at an obvious competent disadvantage and profit margins have to be considerably higher than their international competitors in order to break even given the higher cost of raising equity capital.

6. Given the high predictability of emerging market expected returns, with shocks that are country specific and has no synchronous effect, emerging ASMs can be very good avenue for international portfolio diversification where international investors are somehow guaranteed with predictable good returns. From the viewpoint of international investors there is considerable evidence to show that there is lack of integration among the African stock markets as highlighted by the volatility risk premium (that is, country risk premium). This suggests that investing in these countries would be subject to high and variable levels of transaction costs. Accessing and verifying information from those countries with poor corporate governance regimes and incomplete regulation will incur substantial costs. Nevertheless, significant benefits can be obtained by clearly including volatility risk premium into asset pricing model that would capture the pattern of returns in these markets and improves direct foreign investment flow through equity and stakes in listed companies.

7. It is also important that policy makers direct efforts towards improving corporate governance, regulation and enforcement in order to promote growth in these markets and develop the economy. By so doing cost of raising equity capital in Africa would be reduced and increase the competitiveness of these stock markets and make them cheaper source of business finance than the more established local banking industries.

8. It is also believed that this result is an interesting one which contributes to the growing literature on asset pricing, particularly in Africa and in emerging markets generally among academics and practitioners as it is the first of its kind. It is hoped that the results here will initiate a new dimension for the on-going asset pricing debate in emerging capital markets.

9.6 Direction for Further Research

The poor performance of the CAPM and Fama-French models calls for a reiteration of existing body of evidences that revealed the weaknesses of these two models.

1. One of the earliest criticisms of CAPM is its use of market index as a proxy for efficient market portfolio (Roll, 1977; Ross, 1976; Merton, 1973). Similar criticisms have been levelled against the CAPM by recent researchers such as Eun (1994), Bartholdy & Peare (2005) that the poor performance of the CAPM can be attributed to its emphasis on the use of value-weighted market portfolio. It is therefore suggested that future empirical work in emerging ASMs would explore alternative proxies for the market factor.

2. The central theme of the CAPM suggests that the market beta is able to explain all variations in asset returns. Empirical evidence suggests that this assertion is not wholly true (see for example, Jensen, 1968; Jensen *et al*., 1972; Black, 1972). Moreover, other researchers have found other risk factors not captured by the market beta and termed these as anomalies. Notably, among these are those factors related to P/E ratio (Basu 1977 & 1983), firm size (Banz, 1981; Fama & French, 1992), book-to-market equity ratio (Fama & French, 1992 & 1993) and Momentum (Carhart, 1995 & 1997). In this study, both size and book-to-market ratio were tested in Morocco and South Africa and evidence produced suggests that these two factors are indeed not risk factors or do not contribute to asset risk.

3. Therefore, future studies will extend both size and BE/ME fundamentals to other African markets and factors relating to P/E ratio and momentum will also be tested. Others have also identified liquidity as risk factor in asset pricing (Liu, 2006, 2008; Hearn *et al*, 2008, 2011). Future research will as well explore this further in emerging ASMs.

4. Alternative asset pricing models such APT, ICAPM, C-CAPM will be tested in these markets and the volatility augmented CAPM discovered in this study will be extended into other emerging markets.

REFERENCES

Al-Rjoub, S.A.M, Al Yousef, A and Ananzeh, I. E. N. (2010) ‘‘Beta wins Again: Case of four Emerging Markets’’, *Journal of Economic Co-operation and Development*, vol. 31, no. 1, pp. 1-16

Aggarwal, R., Inclan, C. and Leal, R. (1999) "Volatility in Emerging Stock Markets", *Journal of Financial and Quantitative Analysis,* vol. 34, pp. 33-55.

Agmon, T. (1972) "The Relations among Equity Markets: A Study of Share Price Co Movement in the United States, United Kingdom, Germany and Japan", *The Journal of Finance,* vol. 27, no. 4, pp. 839-855.

Akdenniz, L., Atlay-Salih, A. and Aydogan, K. (2000) ‘‘Cross Section of Expected Stock Returns in ISE’’, *Russian and Eastern European Finance and Trade,* vol. 36, no. 5, pp 6-26.

Alagidede, P. (2008) ‘‘Day of the week seasonality in African stock markets’’, *Applied Financial Economics Letters*, vol.4, no.2, pp.115-120

Alagidede, P. and Panagiotidis, T. (2006) Calender Anomalies in an Emerging African Market: Evidence from the Ghana Stock Exchange. Department of Economics, Loughborough University.

Amihud, Y. (2002) ‘‘Illiquidity and stock returns: cross-section and time series effects’’, *Journal of Financial Markets*, vol.5, pp.31-56

Amihud, Y. and Mendelson, H. (1986) "Asset Pricing and the Bid-Ask Spread”, *Journal of Financial Economics,* vol. 17, pp. 223-249.

Amihud, Y., Christensen, B. J. and Mendelson, H. (1992) *Further Evidence on the Risk-Return Relationship.*, Research Paper Series edn, Graduate School of Business, Stanford University, USA.

Appiah-Kusi, J and Menyah, K (2003) ‘’Return predictability in African stock markets’’, *Review of Financial Economics*, vol.12, pp. 247 – 270

Arshanapalli, B., Coggin, T. D. and Doukas, J. (1998) ‘‘Multifactor asset pricing analysis of international value investment strategies’’*, Journal of Portfolio Management*, vl.24, pp.10-23

Asness, C.S. (1997) "The Interaction of Value and Momentum Strategies.", *Financial Analyst Journal,* , pp. 29-36.

Atchison, M. D. and Butler, K. C. and Simonds, R. R. (1987) "Nonsynchronous Security Trading and Market Index Autocorrelation", *Journal of Finance,* vol. 42, no. 1, pp. 111-118.

Avramov, D. and Chordia, T. (2006) ‘‘Asset pricing models and Financial Market Anomalies’’, *The Review of Financial Studies*, vol. 19, no. 3, pp. 1001-1040

Bacmann, J. and Dubois, M. (2002) ‘‘Volatility in emerging stock markets revisited’’, Manuscript presented at the European Financial Management Association (EFMA) 2002 London Meeting

Baek, Y. (1987) "A Modified Version of Breeden's Capital Asset Pricing Model.", *Journal of Economic Development,* vol. 12, no. 1, pp. 137-147.

Banz, R.W. (1981) ‘‘The Relationship between Return and Market Value of Common Stock’’, *Journal of Financial Economics*, vol.9, pp.3-18

Bartholdy, J. and Peare, P. (2005) ‘‘Estimation of Expected Return: CAPM vs. Fama and French’’, *International Review of Financial Analysis*, vol.14, no.4, pp.407-427

Basu, S. (1977) ‘‘Investment Performance of Common Stocks in Relation to their Price-Earnings Ratio: A test of the Efficient Market Hypothesis’’, *Journal of Finance*, vol.32, pp.663-682

Basu, S. (1983) ‘‘The Relationship between Earning’s Yield, Market Value and the Returns for NYSE Common Stocks: Further Evidence’’, *Journal of Financial Economics*, vol.12, pp.129-56

Bekaert, G. (1995) ‘‘Market Integration and Investment Barriers in Emerging Equity Markets’’, World Bank Economic Review, vol. 9, pp. 75 - 107

Bekaert, G. and Harvey, C. R. (1995) "Time-Varying World Market Integration", *The Journal of Finance,* vol. 50, no. 2, 403 -445

Bekaert, G. and Harvey, C. R. (1997) "Emerging Equity Market Volatility", *Journal of Financial Economics*, vol. 43, pp. 29-77.

Bekaert, G. and Harvey, C. R. (2002) ‘‘Research in Emerging Markets Finance: Looking to the Future’’, *Emerging Markets Review*, vol. 3, pp. 429-448

Bekaert, G., Erb, C. B., Harvey, C. R. and Viskanta, T. E. (1996) The Behaviour of Emerging Market Returns, Conference on the future of Emerging capital flows, New York.

Berk, J.B. (1995) "A Critique of Size-Related Anomalies", *The Review of Financial Studies,* vol. 8, no. 2, pp. 275-286.

Bierens, H.J. (1997a) ‘‘Cointegration analysis’’, in C. Heij, J. M. Schumacher, B. Hanzon and C. Praagman eds, *System Dynamics in Economic and Financial Model*, John Wiley, pp. 217-246

Bierens, H.J. (1997a) ‘‘Nonparametric cointegration analysis’’, *Journal of Econometrics*, vol.77, pp.379-404

Bird, R. and Whitaker, J. (2004) "The Performance of Value and Momentum Investment Portfolios: Recent Experience in the Major European Markets Part 2", *Journal of Asset Management,* vol. 5, no. 3, pp. 157-175.

Black, F. (1976) ‘Studies of stock price volatility changes’, *Proceedings of the 1976 Meetings of the American Statistical Association, Business and Economics Statistics Section*, pp.177-181

Black, F. (1972) "Capital Market Equilibrium with Restricted Borrowing", *The Journal of Business,* vol. 45, no. 3, pp.444-455

Blume, M. E. (1975) ‘‘Betas and Their Regression Tendencies’’, *The Journal of Finance*, vol.30, no.3, pp.785-795.

Bollerslev, T. (1986) Generalised Autoregressive Conditional Heteroscedasticity, *Journal of Econometrics*, Vol. 31, pp. 307-27.

Bollerslev, T. and Woodridge, J. M. (1992) ‘‘Quasi-Maximum Likelihood Estimation and Inference in Dynamic Models with Time Varying Covariances’’, *Econometric Reviews,* vol. 11, pp. 143-172

Bollerslev, T.R., Chou, Y. and Kroner, K.F. (1992) ARCH Modelling in Finance: A Review of the Theory and Empirical Evidence, *Journal of Econometrics*, Vol. 52, pp. 5-59.

Boyle, G. (2009) Capital market Integration: A Review of the Issues and An Assessment of New Zealand’s Position, University of Canterbury, Christchurch, *unpublished*.

Brealey, R. A. (1970) ‘‘The distribution and independence of successive rates of return from the British Equity Market’’, *Journal of Business Finance*, vol. 2, pp.29-40

Brealey, R. A., Cooper, I. C. and Kaplanis, E. (1999) ‘‘What is the international dimension of international finance?’’, *European Finance Review*, vol.3, no.3, pp.103-119

Breen, W., Glosten, L. R. and Jagannathan, R. (1989) ‘‘Economic significance of predictable variations in stock index returns’’, *Journal of Finance*, vol.44, no. 5, pp.1177-1189

Breeden, D.(1979) "An Intertemporal Asset Pricing Model with Stochastic Consumption and Investment Opportunities.", *Journal of Financial Economics,* vol. 7, pp. 265-296.

Breen, W. J. and Korajczyk, R. A. (1995) *On Selection Biases in Book-to-Market Based Tests of Asset Pricing Models*, Kellogg Graduate School of Management, Northwestern University, USA.

Brennan, M. J. and Xia, Y. (2000) *Assessing Asset Pricing Anomalies.*, Seminar edn, The Anderson School of Management, UCLA, USA.

Bruner, F. R., Conroy, R. M., Li, W., O'Halloran, E. F. and Lleras, M. P. (2003) *Investing in Emerging Markets,* The Research Foundation of AIMR, Virginia, USA.

Bundoo, S.K. (2008) An Augmented Fama and French Three-Factor Model: New Evidence From An Emerging Stock Market, The Stock Exchange of Mauritius, *Applied Economics Letters,* vol 15, no. 15, pp. 1213-1218

Campbell, J. Y. (1987) ‘‘Stock returns and the Term Structure’’, *Journal of Financial Economics*, vol.18, pp.373-399

Campbell, J.Y. and Hentschel, L. (1992) "No News is Good News: An Asymmetric Model of Changing Volatility in Stock Returns.", *Journal of Financial Economics,* vol. vol. 31, pp.281-318

Carhart, M.M. (1995) "Survivor Bias and Mutual Fund Performance", *Working Paper, School of Business Administration, University of Southern Carolina, Los Angeles.*

Carhart, M.M. (1997) "On Persistence in Mutual Fund Performance", *The Journal of Finance*, vol.52, no.1, pp.57-82.

Chaieb, I. and Errunza, V. (2007) "International Asset Pricing under Segmentation and PPP Deviations", *Journal of Financial Economics,* vol. 86, pp. 543-578.

Chan, K.C. and Nai-Fu Chen (1988) ‘‘An Unconditional Asset Pricing Test and the Role of Firm Size as an instrumental Variable for Risk’’, *Journal of Finance,* vol.43, no.2, pp.309-325

Chou, R.Y. (1988) ‘‘Persistent Volatility and Stock Returns – Some Empirical Evidence Using ARCH’’, *Journal of Applied Econometrics*, Vol.3, pp. 279-294

Choudhry, T. (1996) ‘‘Stock Market Volatility and the Crash of 1987: Evidence from six Emerging Markets’’, *Journal of International Money and Finance*, vol.12, no.6, pp.969-981.

Chui, A. C. W. and Wei, K. C. J. (1998) "Book-to-Market, Firm Size and The Turn-of-the-year Effect: Evidence from Pacific-Basin Emerging Markets.", *Pacific-Basin Finance Journal,* vol. 6, no. 3-4, pp. 275-293.

Claessens, S. (1995) "The Emergence of Equity Investment in Developing Countries: Overview", *The World Bank Economic Review,* vol. 9, no. 1, pp. 1-17.

Claessens, S., Dasgupta, S. and Glen, J. (1995) The Cross-Section of Stock Returns: Evidence from Emerging Markets, working paper, WP 1505, World Bank, New York.

Coffie, W. and Chukwulobelu, O. (2012) The Application of Capital Asset Pricing Model (CAPM) to Individual Securities on Ghana Stock Exchange, *Research in Accounting in Emerging Economies,Vol 12B, pp. 121 – 147.*

Connor, G. and Korajczyk, R.A. (1993) *The Arbitrage Pricing Theory and Multifactor Models of Asset Returns*, Working Paper no. 139 edn, Kellogg Graduate School of Management, Northwestern University, USA.

Connor, G. and Seghal, S. (2001) *Tests of the Fama and French Model in India*, Discussion Paper edn, London School of Economics.

Conrad, C. and Mammen, E. (2006) "A Specification Test for a Class of GARCH-in-Mean Models", the Annual Meeting of the Verein fur Socialpolitik, 2006, in Bayreuth.

Databank (2004) ‘‘African Stock Markets Consolidate Gains’’, Databank Research, Accra, Ghana, Databank.

Davis, J. L., Fama, E. F. and French, K.R. (2000) "Characteristics, Covariances and Average Returns", *The Journal of Finance,* vol. 65, no. 1, pp. 389-406.

Davis, J.L. (2001) Explaining Stock Returns: A Literature Survey, *Dimensional Fund Advisors Inc, USA,* .

De Bondt, W. F. and Thaler, R. H. (1985) ‘‘Does the Stock Market Overreact?’’ *Journal of Finance*, vol. 40, pp. 793-805

De Bondt, W. F. and Thaler, R. H. (1987) ‘‘Further Evidence on Investor Overreactions and Stock Market Seasonality’’, *Journal of Finance*, vol. 42, pp. 557-81

De Goeij, P., Pungulescu, C. and de Roon, F. (2007) Market Size Effects and Integration in Developed and Emerging Markets, *Social Science Research Network Working Paper Series.*

De la Torre, A. and Schmukler, S. (2005) ‘‘Small Fish, Big Pond. What is the future for domestic capital markets in a Globalised Economy?’’, *Finance and Development*, vol.42, no.2, pp.47-49

De Santis, G. and Imrohoroglu, S. (1997) ‘‘Stock returns and volatility in emerging financial markets’’, *Journal of International Money and Finance*, vol.16, pp.561-579

Diacogiannis, G. and Makri, P. (2008) "Estimating Betas in Thinner Markets: The Case of the Athens Stock Exchange", *International Research Journal of Finance and Economics,* vol.13. pp.108-122

Dickey D.A. and Fuller, W.A. (1979) ‘‘Distribution of Estimators in Autoregressive Time Series with a Unit Root’’, *Journal of American Statistical Association*, vol.74, pp.427-31

Duffie, D. and Zame, W. (1989) "The Consumption-Based Capital Asset Pricing Model", *Econometrica,* vol. 57, no. 6, pp. 1279-1297.

Dimson, E. (1979) "Risk Measurement When Shares are Subject to Infrequent Trading", *Journal of Financial Economics,* vol. 7, pp. 197-226.

Dimson, E. and Marsh, P. (1983) "The Stability of UK Risk Measures and the Problem of Thin Trading", *Journal of Finance,* , pp. 753-783.

Donadelli, M. and Prosperi, L. (2012) ‘‘On the role of liquidity in emerging markets stock prices’’, Research in Economics, vol. 66, pp. 320-348

Drew, M.E. and Veeraraghavan, M. (2002) On the Value Premium in Malaysia, *unpublished*

Drew, M.E., Naughton, T. and Veeraraghavan, M. (2005) ‘‘Pricing of Equities in China: Evidence from Shanghai Stock Exchange’’, *Managerial Finance*, vol.31, no.12, pp.46-57

Drobetz, W., Sturmer, S. and Zimmermann, H. (2002) "Conditional Asset Pricing in Emerging Stock Markets", *Swiss Journal of Economics and Statistics,* vol. 138, no. 4, pp. 507-526.

Elsas, R., El-Shaer, M. and Theissen, E. (2003) ‘‘Beta and returns revisited: evidence from the German stock market, *Journal of International Financial Market, Institution and Money,* vol. 13, pp. 1-18

Engle, R. F. (1982) ‘‘Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation’’, *Econometrica*, vol.50, pp.987-1007

Engle, R. F. and Bollerslev, T. (1986) ‘‘Modelling the persistence of conditional variances’’, *Econometric Reviews’’*, vol.5, pp.1-50

Engle, R.F., D. M. Lilien and R. P. Robins (1987) ‘‘Estimating Time Varying Risk Premia in the Term Structure: The ARCH-M Model’’, *Econometrica,* vol.55, no.2, pp 391-407

Engle, R. F. and Ng, V. K. (1993) ‘‘Measuring and Testing the Impact of News on Volatility’’, *Journal of Finance*, vol. 48, pp.1749-1778

Erb, C. B., Harvey, C. R. and Viskanta, T. E. (1995) Country Risk and Global Equity Selection, the Journal of Portfolio Management, pp. 74-83.

Errunza, V. and Losq, E. (1985) "International Asset Pricing under Mild Segmentation: Theory and Test", *Journal of Finance,* vol. 40, pp. 104-124.

Eun, C. and Janakiramanan, S. (1986) ‘‘A model of international asset pricing with a constraint on the foreign equity ownership’’, *Journal of Finance*, vol.41, pp.897-913

Eun, C.S. (1994) "The Benchmark Beta, CAPM and Pricing Anomalies", *Oxford Economic Papers,* vol. 46, no. 2, pp. 330-343.

Eun, C.S. and Resnick, B. G. (1984) ‘‘Estimating the correlation structure of international share prices’’, Journal of Finance, vol. 39, no.5, pp.1311-1324

Faff, R. (2001) ‘‘An Examination of the Fama and French Three-Factor Model Using Commercially available Factors’’, *Australian Journal of Management,* vol. 26, pp,1-17.

Faff, R.(2000) *An Examination of the Fama and French Three-Factor Model Using Commercially Available Factors.*, School of Economics and Finance, RMIT, Australia.

Fama, E. F. and French, K.R. (1996) "The CAPM is Wanted, Dead or Alive", *Journal of Finance,* vol. 51, no. 5, pp. 1947-1958.

Fama, E. F. and French, K.R. (2004) "The Capital Asset Pricing Model: Theory and Evidence", *Journal of Economic Perspectives,* vol. 18, no. 3, pp. 25-46.

Fama, E. F. and French, K.R. (2005) "The Value Premium and the CAPM", *Journal of Finance,* vol. 61, no. 5, pp. 2163-2185.

Fama, E. F. and MacBeth, J. D. (1973) "Risk, Return and Equilibrium: Empirical Tests", *The Journal of Political Economy,* vol. 81, no. 3, pp. 607-636.

Fama, E.F. (1965) "The Behaviour of Stock Market Prices", *Journal of Business,* vol. 38, pp. 34-105.

Fama, E.F. (1965). "Tomorrow on the New York Stock Exchange," *Journal of Business,* vol. 38, no. 3, pp. 285-299.

Fama, E.F. and French K.R. (1992) the Cross Section of Expected Stock Returns, Journal of Finance 47, *427-465*.

Fama, E.F. and French, K.R. (1993) ‘‘Common Risk Factors in the returns on Stocks and Bonds’’, *Journal of Financial Economics*, vol.33, pp.3-56

Fama, E.F. and French, K.R. (1995) ‘‘Size and Book-to-Market Factors in Earnings and Returns’’, *Journal of Finance*, vol.50, pp.131-155

Fama, E.F. and French, K.R. (1996) ‘‘Multifactor Explanations of Asset Pricing Anomalies’’, *Journal of Finance*, vol.51, no.1, pp. 55-84

Fama, E.F. and French, K.R. (1998) ‘‘Value versus Growth: The International Evidence’’, *Journal of Finance*, vol.53, pp.1975-1979

Fama, E.F.(1970) "Efficient Capital Markets: A Review of Theory and Empirical Work.", *Journal of Finance,* vol. 25, pp. 383-417.

Fama, E.F.(1991) "Efficient Capital Markets: II.", *The Journal of Finance,* vol. 46, no. 5, pp. 1575-1617.

Fama, E. F. and Schwert, G. W. (1977) ‘‘Asset Returns and Inflation’’, Journal of Financial Economics, vol. 5, pp.115-146

Fisher, L. (1966) "Some New Stock-Market Indexes", *The Journal of Business,* vol. 39, no. 1, pp. 191-225.

Fletcher, J. (1997) ‘‘An examination of the cross-sectional relationship of beta and return: UK evidence’’, *Journal of Economics and Business*, vol.49, no.3, pp.211-221

Fox, R. and Taqqu, M.S. (1986) ‘‘Large-sample properties of parameter estimates for strongly dependent stationary Gaussian time series’’, *Annals of Statistics*, vol.14, no.2, pp.517-532

French, K. R, Schwert, G.W. and Stambaugh, R. F. (1987) ‘‘Expected Stock Returns and Volatility’’, *Journal of Financial Economics*, vol.19, pp.3-29

Galagedera, D.U.A. (undated) A Review of Capital Asset Pricing Models, *Monash University, Australia, unpublished*.

Garbade, K. and Rentzler, J. (1981) "Testing the Hypothesis of Beta Stationarity", *International Economic Review,* vol. 22, no. 3, pp. 577-587.

Gaunt, C. (2004) ‘‘Size and Book to Market Effects and the Fama-French Three-Factor Asset Pricing Model: Evidence from the Australian Stock Market’’, *Accounting and Finance,* vol.44, pp.27-44

Gerard, B., Thanyalakpark, K. and Batten, J. A. (2003) "Are the East Asian Markets Integrated? Evidence from the ICAPM", *Journal of Economics and Business,* vol. 55, pp. 585-607.

Geweke, J. and Porter-Hudak, S. (1983) ‘‘The estimation and application of long memory time series models’’, *Journal of Time Series Analysis*, vol.4, no.4, pp.221-238

Girard, E. and Sinha, A. (2008) "Risk and Return in the Next Frontier", *Journal of Emerging Market Finance,* vol. 7, pp. 43-80.

Girard, E. and Sinha, A. (2008) Risk and Return in the Next Frontier, *Journal of Emerging Market Finance, 7*: 43-80

Glosten, L. R., Jagannathan, R. and Runkle, D. E. (1993) ‘‘On the Relations between the Expected Value and the Volatility of the Nominal Excess Returns on Stocks’’, *Journal of Finance*, vol.48, no.5, pp.1779 - 1801

Goyal, A. (2000) "Predictability of Stock Return Volatility from GARCH Models", *Anderson Graduate School of Management, UCLA.*

Gregory, A.W. and Hansen, B.E. (1996a) ‘‘Residual-based tests for cointegration in models with regime shifts’’, *Journal of Econometrics*, vol.70, pp.99-126

Gregory, A.W. and Hansen, B.E. (1996b) ‘‘Tests for cointegration in models with regime and trend shifts’’, *Oxford Bulletin of Economics and Statistics*, vol.58, pp.555-559

Gujarati, D. N, and Porter, D. C. (2010) *Essentials of Econometrics, 4th edition,* McGraw Hill, New York.

Gujarati, D. N, and Porter, D. C. (2009) *Basic Econometrics, 5th edition,* McGraw Hill, New York.

Guo, H. and Neely, C. J. (2006) "Investigating the Intertemporal risk-return relation in International Stock Markets with the Component GARCH Model", *Federal Reserve Bank of St Louis, Working Paper 2006-006A., .*

Gutierrez, R.C.(2001) *Book-to-Market Equity, Size and the Segmentation of the Stock and Bond Markets.*, Lowry Mays College and Graduate School of Business, Texas A&M University, USA.

Habib, H. and Mounira, B. A. (2012) ‘‘Asset pricing and liquidity risk interrelation: an empirical investigation of the Tunisian stock market*, Journal of Research in International Business and Management*, vol. 2, no. 12, pp. 312-322

Handa, P., Kothari, S. P. and Wasley, C. (1989) ‘‘The relation between the return interval and betas: implication for the size effect’’*, Journal of Financial Economics*, vol.23, no.1, pp.79-100

Hansen, L. P. (1982) ‘‘Large sample properties of Generalised Method of Moments Estimators’’, *Econometrica*, vol.50, no.4, pp.1029-1054

Harris, D., McCabe, B. and Leybourne, S. (2002) ‘‘Stochastic cointegration estimation and inference’’, *Journal of Econometrics*, vol.111, no.2, pp.363-384

Harvey, C. R. (1995) ‘‘Predictable Risk and Returns in Emerging Markets’’, *Review of Financial Studies*, vol. 9, pp.75-107

Harvey, C. R. (2000) The Drivers of Expected Returns in International Markets, *Working paper,* Fuqua School of Business School & NBER, USA.

Haugen, R.A, Talmor, E. and Torous, W.N. (1991): The Effect of Volatility Changes on The Level of Stock Prices and Subsequent Expected Returns. The Journal of Finance, 46, 3, pp. 985-1007

Hawawini, G. and Keim, D. B. (1998) *The Cross Section of Common Stock Returns: A Review of the Evidence and Some New Findings.*, Seminar Paper edn, Wharton School, University of Pennsylvania, USA.

Hearn, B. (2009) ‘‘Liquidity and valuation in East African Securities Markets, *South African Journal of Economics,* vol. 77, no. 4, pp. 553-576

Hearn, B. (2011) ‘‘Modelling size and liquidity in North African industrial sectors’’, *Emerging Markets Review*, vol. 12, pp. 21-46

Hearn, B. and Piesse, J. (2008) ‘‘Opportunities and costs of portfolio diversification in SADC’s smallest equity markets’’, *South African Journal of Economics*, vol.76, no.3, pp.399-426

Hearn, B. and Piesse, J. (2009) "An Augmented Capital Asset Pricing Model: Liquidity and Stock Size in African Emerging Financial Markets’’, *African Finance Journal*, special edition, pp. 27-57

Hearn, B. and Piesse, J. (2010) "Modeling Size and Illiquidity in West African Equity Markets", *Applied Financial Economics,* vol.25, no.2, pp.157-181

Hearn, B. and Piesse, J. (2010) ‘‘Modelling size and illiquidity in West African equity markets’’, Applied Financial Economics, vol. 20, pp.1011-1030

Hearn, B., Piesse, J. and Strange, R. (2010) "Market liquidity and Stock Size Premia in Emerging Markets: Implications for Foreign investment, *International Business Review*, vol. 19, no. 5, pp. 489-501

Herbison, B. J. (2003) Notes on the Translation of Don Quixote, Available at <www.herbison.com>

Hodoshima, J., Garza-Gormez, X. and Kunimura, M. (2000) ‘‘Cross-sectional regression analysis of return and beta in Japan, *Journal of Economics and Business*, vol. 52, pp. 515-533

Hwang, S and Satchell, S (2005) "GARCH Model with Cross-sectional Volatility; GARCHX Models", *Applied Financial Economics,* vol. 15, no. 3. pp.203-216

Inclan, C. and Tiao, G. C. (1994) ‘‘Use of cumulative sums of squares for retrospective detetction of changes of variance’’, *Journal of American Statistical Association*, vol.89, pp.913-923

Irving, J. (2005) ‘‘Regional integration of stock exchanges in Eastern and Southern Africa: progress and prospects’’, IMF Working Paper, WP/05/122

Isakov, D. (1999) "Is Beta Still Alive? Conclusive Evidence from the Swiss Stock Market", *The European Journal of Finance,* vol. 5, no. 3, pp. 202-212.

Jagannathan, R. and Wang, Z. (1996) "The Conditional CAPM and the Cross-Section of Expected Returns", *Journal of Finance,* vol. 51, pp. 3-53.

Jarques, C. and Bera, A. (1987) ‘‘A test for normality of observations and regression residuals’’, *International Statistical Review*, vol.55, pp.163-172

Jegadeesh, N. and Titman, S. (1993) "Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency", *The Journal of Finance,* vol. 48, no. 1, pp. 65-91.

Jensen, M. C. (1968) ‘‘The Performance of Mutual Funds in the Period 1945 – 1964’’, *The Journal of Finance*, vol.23, no. 2, pp. 398 - 416

Jensen, M. C., Black, F. and Scholes, M. (1972) The Capital Asset Pricing Model: Some Empirical Tests, in *Studies in the Theory of Capital Markets*. Michael C. Jensen, Ed. New York: Praeger, pp. 79–121

Jun, S-G., Marathe, A. and Shawky H. A. (2003) ‘‘Liquidity and stock returns in emerging equity markets, *Emerging Markets Review*, vol. 4, pp. 1-24

Karacebey, A. (2001) ‘‘Beta and return: Istanbul Stock Exchange Evidence’’, Working Paper Series, SSRN.

Kehl, J.R.(2007) "Emerging Markets in Africa", *African Journal of Political Science and International Relations,* vol. 1, no. 1, pp. 1-8.

Kendall, M. G. and Buckland, W. R. (1971) A dictionary of statistical terms, Hafner, New York.

Kilic, R. (2004) "On the Long Memory Properties of Emerging Capital Markets: Evidence from Istanbul Stock Exchange", *Applied Financial Economics,* vol. 14, pp. 915-922.

Kothari, S.P; Shanken, J. and Sloan, R.G. (1995) ''Another Look at the Cross-section of Expected Returns'', *Journal of Finance,* vol. 50, pp.*185-224*

Lagoarde-Segot, T. and Lucey B. M. (2005) Capital Market Integration in the Middle East and North Africa and its Implication for International Portfolio Allocation, Institute for International Integration Studies, Trinity College Dublin, *Discussion Paper No. 71.*

Lakonishok, J. and Shapiro, A. C. (1986) ''Systematic risk, total risk and size as determinants of stock market returns'', *Journal of Banking and Finance*, vol.10, pp.115-132

Lakonishok, J; Shleifer, A. and Vishny, R.W. (1994) Contrarian Investment, Extrapolation and Risk, Journal of Finance 49, 1541-1578.

Lam, K., Liu, T. and Wong, W. K. (2008) ''The magnitude effect in the over-and-underreaction in international markets'', *International Journal of Finance*, vol.20, no.3, pp.4833-4862

Lam, S. K. K. (2001) ''The conditional relation between and returns in the Hong Kong stock market, Applied Financial Economics, vol. 11, pp. 669-680

Lau, S. T., Lee, C. T. and McInish, T. H. (2002) ''Stock returns and beta, firm size, E/P, CF/P, book-to-market and sales growth: Evidence from Singapore and Malaysia, *Journal of Multinational Financial Management*, vol. 12, pp. 207-222

Lee, C. F., Chen, G. and Rui, R. M. (2001) "Stock Returns and Volatility on China's Stock Markets", *The Journal of Financial Research,* vol. 24, no. 4, pp. 523-543.

Levy, M. and Roll, R. (2010) ''The market portfolio may be mean-variance efficient after all'', *Review of Financial Studies,* vol. 23, pp. 2464-2491

L'Her, J., Masmoudi, T and Suret, J. (2003) ''Evidence to Support the Four-Factor Pricing Model from the Canadian Stock Market''. *Journal of International Financial Markets, Institutions and Money,* vol. 14, pp.313-328

Li, H. (2003) Mean/Variance relation and the Conditional Distribution, *Working Paper, Swedish School of Economics and Business Administration.*

Li, H. and Hong, Y. (2006) New test of Asset Pricing Models in China, WISE Working Paper Series, WISEWP0610

Lintner, J. (1965) "Security Prices, Risk and Maximal Gains from Diversification", *The Journal of Finance,* vol. 20, no. 4, pp. 587-615.

Lintner, J. (1965) ‘‘The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets’’, *Review of Economics and Statistics*, 47(1): 13–37

Lo, A. and Mackinlay, A. (1988) "Stock Market Prices do not Follow Random Walk: Evidence from a Simple Specification Test", *Review of Financial Studies,* vol. 1, pp. 41-66.

Lo, A. and Mackinlay, A. (1990) "An Econometric Analysis of Infrequent Trading", *Journal of Econometrics,* vol. 45, pp. 181-211.

Lo, A. and Mackinlay, A. (1990) "Data-Snooping Biases in Tests of Financial Asset Pricing Models", *Review of Financial Studies,* vol. 3, pp. 431-467.

Lyn, E. and Zychowicz, E. (2004) ‘‘Predicting Stock Returns in The Developing Markets of Eastern Europe,’’ *the Journal of Investing*, spring, pp. 34–48

MacKinlay, A.C. (1995) Multifactor Models do not Explain Deviations from the CAPM, *Journal of Financial Economics*, vol.38, pp.3-28

Markowitz, H. (1952) "Portfolio Selection", *The Journal of Finance,* vol. 12, pp. 77-91.

Markowitz, H. (1959) *Portfolio Selection: Efficient Diversification of Investments,* Wiley, New York.

Markowitz, H. (1952) "Portfolio Selection.", *The Journal of Finance,* vol. 12, pp. 77-91.

Maroney, N. and Protopapadakis, A. (2002) The Book-to-Market and Size Effects in a general Asset Pricing Model: Evidence from Seven National Markets, European Finance Review 6,189-221

Marsh, P.R. (1979) "Equity Rights Issues and the Efficiency of the UK Stock Market", *Journal of Finance,* pp. 839-862.

Mauboussin, M.J. (2002) "Revisiting Market Efficiency: The Stock Market as a Complex Adaptive System", *Journal of Applied Corporate Finance,* vol. 14, no. 4, pp. 8-16.

McMillan, D. G. and Thupayagale, P. (2009) ‘‘Measuring Volatility Persistence and Long Memory in the Presence of Structural Breaks: Evidence from African Stock Markets’’, Managerial Finance, vol. 37, no. 3, pp. 219-241

Merton, R. (1973) "An Intertemporal Capital Asset Pricing Model", *Econometrica,* vol. 41, pp. 867-888.

Michailidis, G., Tsopoglou, S., Papanastasiou, D. and Mariola, E. (2006) "Testing the Capital Asset Pricing Model (CAPM): The Case of the Emerging Greek Securities Market", *International Research Journal of Finance and Economics,* no. 4, pp. 78-91.

Mossin, J. (1966) Equilibrium in a Capital Asset Market, Econometrica, vol 35, pp. 768-83.

Nel, W. (2011) "The Application of the Capital Asset Pricing Model (CAPM): A South African Perspective", *African Journal of Business Management,* vol. 5, no. 13.

Nelson, D.B. (1991) "Conditional Heteroscedasticity in Asset Returns: A New Approach", *Econometrica,* vol. 59, pp. 347-370.

Newey, W. and West, K. (1987) ‘‘A simple positive semi-definitive heteroscedastic and autocorrelation consistent covariance matrix’’, *Econometric*, vol.55, pp.703-708

O'Brien, J. (1999) "The Global CAPM and a firm's Cost of Capital in Different Currencies", *Journal of Applied Corporate Finance,* vol. 12, no. 3, pp. 73-79.

Officer, L. H. (1976) ‘‘The purchasing power parity theory of exchange rates: A review article’’, *International Monetary Fund (IMF) Staff Papers*, vol.83, pp.1-60

Omran, M. F. (2007) ‘‘A0n analysis of the capital asset pricing model in the Egyptian stock market’’, *Quarterly Review of Economics and Finance*, vol. 46, pp. 801-812

Ortiz, E. and Arjona, E. (2001) "Heteroscedastic Behaviour of the Latin American Emerging Stock Markets", *International Review of Financial Analysis,* vol. 10, pp. 287-305.

Pagan, A. R. and Hong, Y. S. (1991) ‘‘Non-parametric estimation and the risk premium’’, in N. Barnett, J Powell, and G. Tauchen eds., *Semiparametric and nonparametric methods in econometrics and statistics*, Cambridge University Press, pp.51-75

Patel, S. and Sarkar, A. (1998) ‘‘Crises in Developed and Emerging Stock Markets’’, *Financial Analyst Journal,* vol. 54, no.6, pp.50-59

Pereira, L.E. (2005) "The Practice of Investment Valuation in Emerging Markets: Evidence from Argentina", *Journal of Multinational Financial Management,* vol. 16, pp. 160-183.

Perold, A.F. (2004) "The Capital Asset Pricing Model", *Journal of Economic Perspectives,* vol. 18, no. 3, pp. 3-24

Pettengill, G. N., Sundaram, S. and Mathur, I. (1995) ‘‘The conditional relation between beta and returns, *Journal of Quantitative Analysis*, vol. 30, no. 1, pp. 101-116.

Rahman, M. and Baten, A. (2006) ‘‘An empirical testing of capital asset pricing model in Bangladesh’’, *Journal of Research Science*, vol. 17, no. 4, pp. 225-234

Ramcharran, H. (2004) Returns and Pricing in Emerging Markets, The Journal of Investing, vol 3, Issue 1, pp. 45 – 55

Reddy, T. L and Thomson, R.J. (2011) "The Capital Asset Pricing Model: The Case of South Africa", *South African Actuarial Journal,* vol. 11.

Reinganum, M. R. (1981) A New Empirical Perspective on the CAPM, Journal of Financial and Quantitative Analysis, vol 16, 439-462

Reinganum, M.R. (1981) "Empirical Tests of Multi-factor Pricing Model, The Arbitrage Pricing Theory: Some Empirical Results", *The Journal of Finance,* vol. 36, no. 2, pp. 313-321.

Roll, R. (1977) "A Critique of the Asset Pricing Theory's Tests: Part I", *Journal of Financial Economics,* vol. 4, pp. 120-176.

Roll, R. and Ross, S. A. (1980) "An Empirical Investigation of the Arbitrage Pricing Theory", *The Journal of Finance,* vol. 45, no. 5, pp. 1073-1103.

Ross, S. A. (1976) "The arbitrage theory of capital asset pricing," *Journal of Economic Theory,* vol. 13, pp. 341-360.

Ross, S.A. (1978) "The Current Status of the Capital Asset Pricing Model (CAPM)", *The Journal of Finance,* vol. 33, no. 3, pp. 885-901.

Rouwenhorst, K. G. (1999) ‘‘Local Returns Factors and Turnover in Emerging Stock Markets’’, *The Journal of Finance*, vol. 54, no. 4, pp. 1439-1464

Russel, P. S. and Sankaran, K. (2008) "Value and Momentum Strategies: Returns from Risk-Controlled Portfolios", *Journal of Business and Economic Studies,* vol. 14, no. 2, pp. 25-118.

Schiereck, D., De Bondt, W. and Weber, M. (1999) "Contrarian and Momentum Strategies in Germany", *Financial Analyst Journal,* pp. 104-116.

Scholes, M. and Williams, J. (1977) "Estimating Betas from Non-Synchronous Data", *Journal of Financial Economics,* vol. 5, pp. 309-327.

Schramm, R. M. and Wang, H. N. (1999) "Measuring the Cost of Capital in an International CAPM Framework", *Journal of Applied Corporate Finance,* vol. 12, pp. 63-72.

Schramm, R. M. and Wang, H. N. (1999) Measuring the Cost of Capital in an International CAPM Framework, *Journal of Applied Corporate Finance,* vol. 12, pp. 63-72

Schwartz, R. A. and Whitcomb, D.K. (1977) "Evidence on the Presence and Causes of Serial Correlation in Market Model Residuals", *Journal of Financial and Quantitative Analysis,* vol. 12, pp. 291-313.

Schwert, G. W. (1990) Stock Volatility and the Crash of 87, The Review of Financial Studies, vol 3, no. 1, pp.77-102

Schwert, G.W. (1977) "Stock Exchange Seats as Capital Assets", *Journal of Financial Economics,* vol. 4, pp. 51-78.

Schwert, G.W. (1983) "Size and Stock Returns, and Other Empirical Regularities", *Journal of Financial Economics,* vol. 12, pp. 3-12.

Sehgal, S. (2001) Investor behaviour in Indian Capital Markets, working paper, University of Delhi. Series with a Unit Root, *Journal of American Statistical Association*, Vol. 74, pp. 427-31

Shanken, J. (1982) "The Arbitrage Pricing Theory: Is it Testable?" *The Journal of Finance,* vol. 37, no. 5, pp. 1129-1140.

Sharpe, W.F. (1963) "A Simplified Model for Portfolio Analysis", *Management Science,* vol. 9, no. 2, pp. 277-293.

Sharpe, W.F. (1964) ‘‘Capital Asset Prices: A Theory of Market Equilibrium under conditions of Risk’’, *Journal of Finance*, vol. 19, no. 3, pp. 425-442

Sharpe, W.F.(1990) *Capital Asset Prices with and Without Negative Holdings*, Nobel Lecture edn, Stanford University Graduate School of Business, Stanford, California, USA.

Shiller, R. J. (1981) Do Stock Prices Move Too Much to be justified by Subsequent Changes in Dividends? *American Economic Review*, vol. 71, pp. 197-210

Smith, G., Jefferis, K. and Ryoos, H. (2002) ‘‘African stock markets: multiple variance ratio tests of Random Walks’’, *Applied Financial Economics*, vol.12, pp.475-484

Stulz, R.M. (1995)"International Portfolio Choice and Asset Pricing: An Integrative Survey." in *The Handbook of Modern Finance*, V. Maksimovic and W. Ziemba edn, North Holland.

Stulz, R.M. (1999) *Globalization and the cost of equity capital,* Working paper edn, New Your Stock Exchange, NY.

Stulz, R.M. (1999) *Globalization and the cost of equity capital,* Working paper edn, New

Stulz, R.M. (1999) *International Portfolio Flows and Security Markets.*, Working paper, no. 99-3 edn, Ohio State University and NBER, USA.

Stulz, R.M.(1995 International Portfolio Choice and Asset Pricing: An Integrative Survey, in *The Handbook of Modern Finance*, V. Maksimovic and W. Ziemba edn, North Holland.

Tang, G. Y. N. and Shum, W. C. (2003) ‘‘The conditional relationship between beta and returns: recent evidence from international stock markets’’, *International Business Review*, vol. 12, pp. 109-126

Tang, G. Y. N. and Shum, W. C. (2004) ‘‘The risk-return relations in the Singapore stock market, Pacific-Basin Finance Journal, vol. 12, pp. 179-195

Theil, H. and Leenders, C. T. (1965) "Tomorrow on the New Amsterdam Exchange", *Journal of Business,* vol. 38, no. 3, pp. 277-284.

Theriou, N. G., Maditinos, D. I., Aggelidis, V. C. and Theriou, G. N. (2005) Testing the relation between beta and returns in the Athens Stock Exchange: A Second Attempt, *3rd International Conference on Accounting and Finance in Transition,* Greenwich, London, July

Thupayagale, P (2010) Essays in long memory: evidence from African stock markets, PhD Thesis, University of St Andrews

Turner, C. M., Startz, R. and Nelson, C. R. (1989) ‘‘A Markov Model of Heteroskedasticity, Risk and Learning on the Stock Market’’, *Journal of Financial Economics*, vol. 25, pp. 3-22

Whitelaw, R.F. (2000) "Stock Market Risk and Return: An Equilibrium Approach", *The Review of Financial Studies,* vol. 13, pp. 521-547.

Yabara, M. (2012) Capital Market Integration: Progress Ahead of the East African Community Monetary Union, *IMF Working Paper* WP/12/18.

Yartey, C. O. and Adjasi, C. K. (2007) Stock Market Development in Sub-Saharan Africa: Critical Issues and Challenges, *IMF Working Paper* WP/07/20, Washington D.C.

Publications

Coffie, W. (2009) Capital Asset Pricing Model and the Three Factor Model – Evidence from Emerging Capital Markets, *18th School Research Conference, University of Wolverhampton Business School, UK, January.*

Coffie, W. and Chukwulobelu, O. (2011) The Unconditional Capital Asset Pricing Model (CAPM) – Preliminary Evidence from an Emerging African Stock Market**,** *1st International Conference in Accounting and Finance on Africa, Accra, Ghana, September. Peer Reviewed Conference*

Coffie, W. and Chukwulobelu, O. (2012) The Application of Capital Asset Pricing Model (CAPM) to Individual Securities on Ghana Stock Exchange, *Research in Accounting in Emerging Economies,Vol 12B, pp. 121 – 147.*

Coffie, W. (2012) Capital Asset Pricing Model and the Three Factor Model: Empirical Evidence from Emerging African Stock Markets, PhD Thesis submitted to Birmingham City University.

Coffie, W. (2012) Asset Prices, Cointegration and Volatility, *25th UWBS Research Conference,* University of Wolverhampton, UK*, May*

.

Coffie, W. (2012) Asset Prices, Cointegration and Volatility, *Time Varying Correlation and Volatility Symposium,* University of Wolverhampton Business School, *May.*

Coffie, W. and Chukwulobelu, O. (2012) CAPM and Time Varying Conditional Variance – Emerging Market Evidence, 2nd *International Conference in Accounting and Finance on Africa, Abuja, Nigeria, September. Peer Reviewed Conference*

Coffie, W. and Chukwulobelu, O. (2013) The Cost of Equity Capital in Emerging Market – The Case of Kenya, *GSTF International Journal on Business Review, vol. 4, no. 2.*

Coffie, W. and Chukwulobelu, O. (2013) Significance of Beta in Estimating Cost of Capital in an Emerging Economy – The Nigerian Evidence, *forthcoming, International Journal of Management Practice.*

Coffie, W. and Chukwulobelu, O. (2013) Evaluating the performance of CAPM to Individual securities on Nairobi Stock Exchange, 3nd *International Conference in Accounting and Finance on Africa, Makerere University, Kampala, Uganda, September. Peer reviewed conference.*

Coffie, W. (2013) Analysing Security Performance in Morocco and South Africa, *Afro-Asia Journal of Finance & Accounting (in review).*

Coffie, W (2013) Measuring the persistence of volatility in Southern and East Africa, *International Journal of Economic and Business Research (in review)*