UNIVERSITY OF NAIROBI

DEPARTMENT OF ECONOMICS

"TIME-VARYING RISK PREMIA" AN EMPIRICAL INVESTIGATION ON THE NAIROBI STOCK EXCHANGE:

BY

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9TH, SEPTEMBER, 2005

DECLARATION:

This is my original work and has never been presented for any degree in any other university.

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To my dear parents *JENIFFER AND MASAKATI*

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I wish to state the views expressed in this study are my own and thus do not represent the views of the University of Nairobi or any other quarters; I'm responsible for any errors and shortcoming of this study.

ABSTRACT:

In this study, the price of risk on the Nairobi stock market was estimated using a conditional asset pricing model that allows for time variation in the risk. Two different GARCH (1, 1)-M models are used in the econometric specification. The estimates of the price of risk are invariably positive and insignificant, and conclude that there exists an insignificant time-varying risk premium in the Nairobi stock market. The well known day of the week effect reflected in insignificant positive Friday and negative Monday, does not seem to be present in the market. Also entry of foreign investors and change of trading system increases volatility contrary to the fact the volatility should decline.

LIST OF CONTENTS:

ABBREVIATIONS:

AR - Autoregressive

CAPM - Capital asset pricing model

CDS - Central depository and Settlement Corporation limited

CRRA - Constant relative risk aversion

DvP - Delivery versus Payment

EGARCH- Exponential generalized autoregressive Conditional heteroskedasticity

EMH - Efficient market hypothesis

GARCH - Generalized autoregressive conditional Heteroskedasticity

GARCH-M - Generalized autoregressive conditional Heteroskedasticity-mean

GJR - Glosten, jaannathan and runkle

HPR - Holding period return

NSE- Nairobi Stock Exchange

NYSE- New York stock exchange

LSE - London stock exchange

R_t - Returns at time t

StSE - Sweden stock exchange

TSE - Taiwan stock exchange

QML- Quantitative maximum likelihood

1 CHAPTER ONE:

1.0 INTRODUCTION:

1.1 BACKGROUND

Some empirical investigations have been done on large stock markets that show risk premium vary over time. The U.S. and U.K., for example, have a large home market, which implies that there is ample scope for diversification in the domestic stock markets. While these markets are well studied, there is little research done on small emerging stock markets economies with less room for diversification. Thus, little is known about the differences in the relation between risk and return in large economies compared with smaller markets. In this paper we study the case of the Nairobi stock exchange market, which is considered to be representative of small market economies.

The most widely used theoretical model for specifying the relation between risk and return is the Capital Assets Pricing Model (CAPM), which gives the risk premium of an asset as the market price of risk times the amount of non- diversifiable risk. In a conditional version of the CAPM, the risk may vary over time, which means that the risk premium is time varying as well. We estimate the changing risk on the Nairobi stock exchange market using the GARCH approach of Engle (1982) and Bollerslev (1986), as well as the price of risk using a conditional asset-pricing model that allows for time variation in the risk and the risk premium. This enables a comparison of price of risk in a small export-oriented economy like Kenya with the price of risk found in large economies such as the U.S., U.K and Sweden.

A number of studies have been performed using this technique to estimate the risk premium. In an early study, French, Schwert and Stambaugh (1987) found a positive and significant price of risk[2] on the U.S. stock market for monthly data from 1928 to 1984.Poon and Taylor (1992) also obtained positive, albeit insignificant, reward to risk parameters for U.K. data of different periodicity. Recently, Glosten *et al.* (1993) reported a negative and significant estimate of the price of risk for U.S. monthly stock returns. Hence, the empirical evidence provides little agreement about the study this relationship using data from a smaller market.

The result regarding the price of risk in this study makes it possible to contrast characteristics of the representative investor from different countries. These characteristics may depend on factors such as investment opportunities or diversification possibilities for investors, the degree of regulation of the domestic capital market, entry of foreign investors and change of trading system (see Ngugi *et al*, 2001).Estimates of time varying risk enable a comparison of features of the return-generating processes across markets, such as seasonal effects and persistence in conditional variance. We study the problems above using GARCH-M type models on daily excess returns for the Kenyan market portfolio.

Seasonal effects in the conditional volatility are taken care of the following the procedure Glosten *et al.* (1993). All inference and hypothesis testing are preformed with methods which are robust to departures from normality.

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[2] Price of risk = $\partial = \dfrac{ER_m - r_f}{\sigma^2}$

1.1.1 NAIROBI STOCK EXCHANGE

The Nairobi Stock Exchange (NSE) is a small stock market compared with giants such as the NYSE, LSE, and TSE or StSE. The Nairobi stock exchange is a market, which deals in exchange of shares of public quoted companies and Government and Municipal gilt edged stocks for money. NSE was established in 1954; presently it has 56 listed companies. These 56 listed companies offer a total 48 ordinary shares and 9 Preference Shares. The NSE is made up of 18 stock broking firms. The introduction of capital market authority and a trading floor at the NSE can be expected to result in an increased awareness of its working of the stock exchange and the benefits of investing in stocks. The power of the Internet and the World Wide Web is set to change the world in the next 50 years.

Central depository and Settlement Corporation limited (CDS) was introduced in 1995. The introduction of the CDS has created new business standards for our capital markets, which will have significant benefits to the domestic and international attractiveness of the market. The CDS will shorten the registration process, boost liquidity in the market, increase market activity, reduce market risk, attain international standards and deliver NSE mission statement. In recognition of this, the NSE will create an electronic trading platform in conjunction with CDS. This will allow us to reap the full benefits of technology in one leap forward. This would have further facilitated electronic transfer of ownership without the physical movements of the certificates thereby minimizing systematic risk. Further the delivery versus payment (DvP) was introduced in 1st August 2000.The market therefore faced the challenges of settling transactions within five days of settlement and registry. This would further enhance investor confidence and liquidity by making the settlement period shorter and safer.

In November 1991 share trading moved from coffee house to floor based open outcry system. The open outcry system was adopted to enhance transparency by enabling all brokers to have an equal opportunity to bid for securities and also enhance handling of the growing trading activity.[3]Foreigner's investors were allowed to participate in the NSE as from January 1995.However, their participation was limited to 2.5% for individual investors and 20% in aggregate of each stock. This was later revised to 5% and 40% respectively in July 1995.

Besides being rather small, the NSE has the following salient features common to exchanges in most small open economies. It is the domestic base for a number of multinational companies, which represent a large proportion of the market capitalization and trading value. The big firms are almost always highly export oriented and Kenya is rarely their main market. This factor implies an international diversification effect, which might constitute a partial substitute for a large and relatively stable home market. Big export orientation also means that there is an exchange rate risk, which would lead to us to believe that the variations in the net cash flows of Kenya multinationals are larger than for U.S or U.K.or Sweden firms. Furthermore, the NSE lists a number of important firms in the manufacturing resource (industrial & allied), financial and agricultural sectors with wide swings in earnings, and there are also very few public utilities and retail companies. All in all, the Kenyan market may be expected to be more volatile than, for example, the

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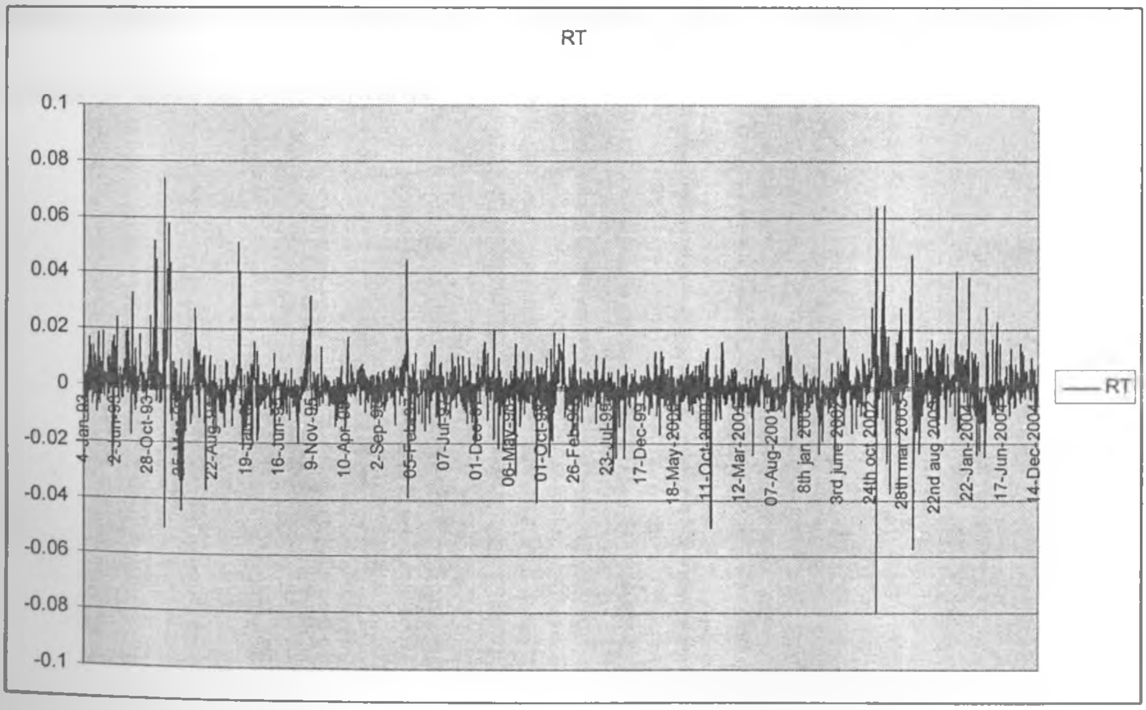
[3] See Ngugi (2003) for detailed literature on the development of the Nairobi Stock Exchange: A historical perspective, Kenya institute of public policy and research analysis.

U.S. market, which implies that there may be differences in the conditional variance process *per se*.

Like in most other countries, Kenyan capital markets were highly regulated until the late 1980's.For instance, unlimited investment in foreign securities was not possible. Thus the set of investment opportunities was quite limited for Kenyan agents as compared to U.S. or U.K. investors. As a consequence, the compensation for risk demanded by Kenyan investors might have been lower during the period of capital regulation. A priori, the observed price of risk would therefore be expected to increase when the Kenyan markets were deregulated, and to become similar to the price of risk in larger economies

The figure 1 shows a time series plot of daily returns. A visual inspection of the suggest that the volatility of returns display volatility clustering (the series is oscillating around the mean.



In the year 1993/94 there was an upward surge is evident hitting a record high and an accompanying sharp fall. The volatility observed, could be due to microstructure changes vs. policy changes related to dividends, entry of foreign investors and improved efficiency of trading system. Policy changes may be perceived by investors as a disincentive to investment reducing trading volume and liquidity thus increasing volatility in the market. Improved efficiency in trading system would shorten the registration process, boost liquidity and increase market activity thereby reducing market risk and volatility. Entry of foreign investors would increase trading volume, but withdrawal of investment due to perceived idiosyncratic risk too often, would increase volatility in the market. It's also evident that there was downward trend during the period since 1999 to the last general elections 2002 this was due political climate in which the investor lost confidence in the financial markets and also presidential election outcome; this caused an increase in volatility of the NSE stock market. The political information affects volatility by influencing the reservation price of traders. Improvement was evidenced again on 2003 onwards.

1.2 STATEMENT OF THE PROBLEM:

The investor makes the decision depending on the amount of returns he is looking for, the period of investment and the risks associated with particular forms of investment. Central problem in financial economic theory is the valuation of claims to uncertain future cash flows.

In the CAPM, which is a one-period equilibrium model, the valuation of an asset is a function of the market price of risk and the amount of non-diversifiable risk of the asset. The price of risk is related to individual preferences and it is positive and the same for all assets. The non-diversifiable risk is related to stochastic characteristics of the asset and, in particular, its amount of market risk. In CAPM, this amount is represented by the covariance of the asset's return with the market portfolio return. In the unconditional version of the model, it is assumed that the amounts of risk as well as the price of the risk remain constant over time, which implies a constant risk premium. On the other hand, in the conditional CAPM and multi-period models, the price of risk as well as the amount of risk may be time varying. From an empirical point of view, it is a well-known fact that for most assets the variance is not constant over time, but there are no clear-cut results on time-varying preferences towards risk. Thus, a fundamental challenge to empirical asset pricing has been to model a time-varying risk premium where the quantity of risk varies over time but the price of risk is presumed to stay the same.

1.3 OBJECTIVES OF THE STUDY:

(i)To examine whether the market risk is priced on the Nairobi stock exchange.

(ii)To examine the time-varying risk premium on the Nairobi stock exchange.

(iii)To draw policy recommendation of the study.

1.4 HYPOTHESIS OF THE STUDY:

Selecting the order of the GARCH models with seasonal correction will do estimation results. A GARCH (1, 1)-M model will be estimated for each sample and perform robust LM-tests, of Bollerslev and Wool ridge (1992), with this model as the null hypothesis.

(i)To test whether market risk is priced in the model as measured by significant positive Values of $\bar{c}$.

H$_0$: ∂. The market price is not priced.

H$_1$: ∂. Reject the hypothesis that price of the market risk varies overtime. The return to bearing market risk increases with the market returns conditional volatility.

(ii) To test the time variation of the risk premium (price of risk).

H$_0$: $\bar{c}_{t0} = \partial_{t1} = \partial_{tn}$ There is no time-varying risk premium.

H$_1$: $\partial_{t0} \neq \partial_{t1} \neq \partial_{tn}$ Reject the hypothesis. That there is time varying risk premium.

1.5 SIGNIFICANCE OF THE STUDY:

The result regarding the price of risk in this study makes it possible to contrast characteristics of the representative investor. These characteristics may depend on factors such as investment opportunities or diversification possibilities for investors and the degree of regulation of the domestic capital markets. This helps individual investors and firms decide on investment options or choice of return of their assets and diversify their assets in terms of risk and return.

This study may also help investors make predictable choices. Since predictability is due to time varying expected returns caused by changes in time-varying risk premia.Investors are able to adjustment. So predictability is essentially due to changes in real returns overtime caused by persistence of real shocks. Investors may adjust in temporal consumption plans based on anticipated real returns, but there is no reason that the adjustment would cause predictable changes in returns to fully disappear.

Empirically, the risk premium contributes a leading portion of stock momentum profits. Furthermore, the risk premium helps identify stocks that are likely to generate more momentum profit. The study will also be of importance to the academician who needs the information for market based research.

2. CHAPTER TWO

2.0 LITERATURE REVIEW:

(2.10) Theoretical Background.

The behavior of asset prices has always been at the centre of academic, media and business attention. One issue it attracts the attention of financial analysts and policy makers is where the emerging stock markets exhibits similar general characteristics, regarding the distribution behaviour of stock returns as developed stock market Hypothesis (EMH)[4] EMH predicts that expected return is unpredictable from the past returns or other past proxy Variables. It is argued that the best forecast of returns is the historical mean; and the deviations of the expected value of return are equal to zero, Fama (1991). Several studies have concluded that predictability due to time-varying expected return is consistent with efficient stock market hypothesis.

Stock prices respond asymmetrically to shocks due to stock prices decline (bad news) more than stock price increase (good news) which influence the sign in returns which influences the stock return influences the future volatility being negatively correlated with direction of actual price changes. Black (1976) and Christie (1982) point out that stock returns tend to be negatively correlated with changes volatility so that a reduction in the equity value of the firm raises its debt to equity ratio, hence raising the risk ness of the firm, as manifested by an increase in future volatility. The "leverage effect" posits that a firm's stock price decline raises the firm's financial leverage resulting in an increase in the volatility of equity. Others have suggested that the

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[4] Market efficiency is defined at three levels: weak form efficiency, semi-strong efficiency and strong form efficiency.

negative relationship between returns and return volatility to stems from natural time variation in the risk premium on stock prices. That is an expected volatility and therefore upward revisions of the risk premium, which compensates them for greater risk. But, a higher risks premium lead to a greater discounting of future expected cash flows (holding those cash flows constant) and therefore lowers stock prices or negative returns to day.

Ngugi *et al* (2001) observes that factors such as entry of foreign investors and change of trading system on opportunity investment may have impact on stock market microstructure (volatility, efficiency and liquidity) hence have a significant effect on the risk premium meaning that positive effect investors are risk averse while a negative effect investors are risk lovers.

Glosten *et al.* (1993) observes that investors may not require a high risk premium if the risky time periods coincide with periods when investors are better able to bear particular types of risk. Again, if the future seems risky the investor may want to save more in the present thus lowering demand for larger premium. If transferring income to the future is risky and the opportunity of investment in a risk free asset is absent the price of a risky asset may be raised considerably, reducing the risk premium. Thus, it is possible to have a positive and negative relationship, between current returns and current variance. The versions of GARCH that are used to capture asymmetric response of conditional variance to different shocks, for example the exponential GARCH (or EGARCH) by Nelson (1991), generalized quadratic ARCH or QGARCH by Sentena (1992) and the Glosten, Jagannathan & Runkle (GJR) model as in Glosten et al. (1993).

Ryden *et al* (1998) show that the markov switching model can explain the temporal and distributional properties of stock returns. The model has drawn a lot of attention in modeling structural changes in dependent data. In economics, it has been used to identity business fluctuations see Hamilton (1989) to study the changes in real interest rates, Garcia (1998). Recently, the model has been used extensively in finance area especially to model the non linear structure in time series data. Turner *et al.* (1989) has the model to explain the time varying risk premium in stock returns. Methodologically, they consider a markov switching model which allows either the mean or the variance or both to differ between the two regimes. However, Hamilton (1989) first order markov switching model would not capture duration dependence in states. Ignoring duration dependence, results in a failure to capture important properties of stock returns.

Hamilton & Lin (1996) adapt the Hamilton (1989) model to capture the non linear dynamics between the stock market and business cycle. Their model, unlike Hamilton (1989) model explains volatility clustering, mean reversion and non linear cyclical features in returns. Schaller & van Norden (1997) use the Markov Switching Model to distinguish between fads and bubbles in stock returns. Gordon & St Amour (2000) use a two state Markov Process to model risk aversion, called as preference regimes and link this model with the cyclical pattern of asset prices.

(2.1.1) Risk and return theoretical background.

The relationship between risk and return is important in a portfolio context since these two parameters are considered the main objects of choice. The risk and return relationship is based in the mean variance framework of portfolio selection. Theoretical expectations are that there should be a positive risk –return relationship for the simple reason that investors need to be compensated via the provision of a risk premium if they take additional risks. The theoretical risk-return relationship is based on the premise of risk aversion, Markowitz, (1952) and Sharpe, (1965).

Expectations have however been noted to thin general conclusion. Bowman (1980), for example discovered within most industries, risk and return were negatively correlated, fiegenbaun & Thomas, (1988) also discovered a negative relationship between risk and return. Various explanations have been advanced to explain this apparent contribution. Some scholars have questioned the premise of risk aversion arguing that its not universally applicable, Markowitz, (1952) and Swalm, (1966).

Langhbaum *et al*, (1980) established that individuals are not uniformly risk averse, but adopt a mixture of risk–seeking and risk–averse levels behaviors. They further, established that target levels or prospects are important in determining this behaviour. Thus when returns have been below target, most investors will portray a risk seeking behaviour, and when returns have been above target, most investors will be risk – averters. This "prospects theory" explanations for negative risk-return, relationships have also received support in a corporate context from Fiegenbaun and Thomas, (1988) and Bowman (1980) who established that troubled firms whose returns are below prospect returns are more risk seeking than healthy firms.

Many earlier empirical studies are based on the direct association of variance with risk and the fundamental trade off between risk and return. According to the theories of Sharpe (1964), Litner (1965), Mossin (1966) and Black and Scholes (1974), change in asset price is directly related to its own variance or to the covariance between its return and the return on the market portfolio.

(2.1.2) Risk

There are two schools of thought can be discerned from contemporary literature. The variability school and the volatility school. In the variability school, March and Shapiro (1987) perceive risk as the variation in the distribution of possible outcomes, their distribution and their of possible outcomes, their distribution and their subjecting values. Thus perception of risk being the possibility those actual returns may vary from the expected returns. Risk as measured as the variability of returns has received widespread acknowledgement in the decision theory (see for example, Thierauf & Klekamp, (1984), Gallagher & Watson, (1980) viewed thus as the variability of returns, risk in quantified in terms of variability measures e.g. range, standard deviations, variances, semi-variances and coefficient of variation.

The volatility school of thought perceives risk in terms of the volatility of returns in relation to the market returns. Thus a stock whose returns are highly correlated with the market returns in said to have low volatility where as a stock whose returns have little correlation with the market returns is said to be highly volatile.

A measure of risk based on the volatility concept quantities only that portion of total variation which is associated with the market variation (Systematic risk) and ignores any unsystematic variation, Bower & wippern, (1969).

Despite the variety of definitions and concepts about risk and meaningful definition and hence quantification of risk should incorporate both variability and volatility. One such framework for defining and quantifying risk is the (CAPM) which considered both the variability of asset returns and the volatility of such returns resulting in the quantification of risk into component namely diversifiable risk and non-diversifiable risk.

From a managerial perspective, risk in seen as the possible of loss (March and Eugene, 1969) or the potentiality of a hazard March and Shapira, (1987).

This perception of risk is different from the decision theory perspective in three different ways;

(i) Those managers do not perceive positive outcomes as risky but do perceive negative outcomes as risky. This is not possible when there exists only the potentialities for gain.

(ii) That risk is not in the minds of managers, primarily a probability concept. It is the magnitude of possible bad outcomes rather than the uncertainty whose is more important.

(iii) Quantifying risk is not a priority for managers. Rather it is the feeling or the acknowledgement of risk and its multi-dimensional phenomena that is important rather it numerical proxies.

(2.1.3) Classic Rule of Risk Premium

Yet another classic investment principle is under attack. Bulls say they have debunked an investment superstition, fueling their view that stocks are on their way to more levels once thought impossible. Bears see the trampling of another basic rule as just one more sign of a stock market gone mad and in for trouble. The rule in question is a simple one. It holds that stocks don't offer the safe, guaranteed returns of government bonds, and hence investors need to be offered extra returns to make it worth their while to put money into stocks instead of bonds. Stock gains, after all, come mainly from the unpredictable advances of the market; stock prices can go up 20% one year and down 20% the next. So investors will put money into stocks only if they expect that stock returns, over time, will outpace bond returns by some amount that compensates them for the added **risk** of owning stocks.

This extra return from stocks long has been called the "**risk premium**" -- literally, the **premium** you receive in exchange for owning a riskier, more volatile instrument. The idea that stocks should return significantly more than bonds is "a long-term principle" of finance, says Robert Bissell, president of Wells Capital Management, Wells Fargo's money management arm.Ivo Welch, a professor at the Anderson School of Management of the University of California at Los Angeles who has been studying the phenomenon, goes further. "It is the single most important number for anybody in finance, either academic or practitioner," he maintains. Trouble is, by some interpretations, this fundamental rule is beginning to flash a big red warning light about the future direction of the stock market. Big stocks have gained so much since 1994 that the typical forecast of additional stock-market gains, based on expected gains in company earnings, now indicates that investors could get almost the same return from bonds. The **risk premium** that can be forecast today for stocks has shrunk to two percentage points or less far below the four to eight points that analysts typically use as a benchmark. That, according to classic thinking, heralds bad news for the stock market.

William Dudley, director of U.S. economic research at Goldman Sachs, worries that some investors, who now consider 20% annual stock-market gains normal, don't understand that mathematical limits may be closing in. Those investors could be in for a shock." Investors may already be too optimistic in their assessment of future expected returns," he cautions in a report this month. But revisionists scoff at such worries; the old math, they say, no longer applies. James Glassman, a resident fellow at the American Enterprise Institute in Washington, maintains that, based on studies of long-term investing over the past century, stocks actually have been no riskier than bonds. Over long periods, he says, their returns have been more steadily up than those of bonds." If you define **risk** as volatility," which is what most analysts do, Mr. Glassman says, "history has shown that stocks are no more volatile than bonds" over the long term. Stocks can be more volatile over short periods, however. In an opinion article published in The Wall Street Journal in March, he and Kevin Hassett, an American Enterprise Institute resident scholar, argued that long-term investors should demand no extra **premium** for holding stocks. And if investors didn't expect any extra **premium**, the two authors add, stocks still would look like highly attractive investments today as many forecasts show them likely to gain more than bonds in the future.

In fact, Messrs. Glassman and Hassett calculate that, if you eliminate the expectation of a **risk premium** and forecast low inflation and strong earnings growth, the Dow Jones Industrial Average still is far short of where it should be. In theory, at least, they figure that its price-earnings ratio could hit 100, four times the current level, although they acknowledge that it might in practice stay lower. In an interview, Mr. Glassman says traditional-style market analysts didn't foresee the stock markets recent gains in part because they thought investors require a higher **risk premium** than they actually expect. But to the traditionalists, the Glassman analysis amounts to nothing less than changing the rules to fit the game, which they see as a recipe for disaster. Who is right? One reason for the disagreement is that the experts all agree that no one has the tools to forecast what the **risk premium** will be in the future. There is some agreement on what it has been in the past. Since about 1926, stocks have returned about five percentage points to eight percentage points more than Treasury's, depending on which Treasury instruments you use and how you compare them. In the past year, the gap has been enormous -- a 32% gain in the Standard & Poor's 500-stock index, not counting dividends, has dwarfed Treasury yields (for buy-and-hold investors) of less than 7%.

Another way to look at the **risk premium** is to calculate how volatile stocks have been compared with bonds over recent periods. The more volatile stocks are, the higher the **premium** should be because the **risk** of a sudden change in fortune for a stockholder is greater. But looking backward doesn't necessarily help analysts forecast how much if any stocks will beat bonds in the future -- or what kind of expectations investors will have for the **risk premium**. Most analysts try to do that through a formula based on the consensus earnings forecasts for the S&P 500. The idea is that a stock's price is simply the present value of its expected future earnings. One measure of the expected return on a stock's price is to take the per-share forecast earnings for the current or coming year, and divide by the stock price. That figure is called the "earnings yield," and for the S&P 500 it currently is less than 5%. That is barely above the inflation-adjusted Treasury yield, which is 3% to 4%, depending on your estimate of coming inflation.

Little wonder that Morgan Stanley Dean Witter strategist Byron Wien recently wrote an article entitled "**Risk** Premium-R.I.P." He figures that, even using a **risk**

premium of 2%, his models show the S&P 500 17% overvalued compared with bonds. He would have to cut the **risk premium** to 1% in order to make the S&P 500 look slightly below fair value, he says.Messrs. Wien and Dudley worry that stock investors could be in for disappointments if they expect continuing double-digit stock gains; so does Prof. Welch, who himself thinks, based in part on a survey he has done of other academics, that the **risk premium** probably ought to be calculated at something closer to 4%. Many other academics think it should be 5% or 6%.

Much of the basic research suggesting that the **risk premium** should be zero was done by Jeremy Siegel of the University of Pennsylvania's Wharton School of Business. But Prof. Siegel took the trouble to write a letter to the editor of The Wall Street Journal contesting the Glassman-Hassett thesis that the price of the Dow industrials could hit 100 times earnings. Prof. Siegel says that stocks have gained so much that they already are priced at fair value.

(2.2) Empirical Evidence:

A number of studies have performed using this technique to estimate the risk premium. In a early study, French, Schwert and Stambaugh, (1987) found a positive and significant price of risk on U.S. stock market for monthly data form 1928 to 1984.

Poon and Taylor (1992) also obtained positive albeit insignificant, reward to risk parameters for U.K. data of different periodicity.

Recently, Glosten *et al* (1993) reported a negative and significant estimate of the price for U.S monthly stock returns. Recently again Björn Hanson & Peter Hördahl

(1997) using GARCH-M models found that the estimates of the price or risk are invariably positive and significant and conclude that there exists a time–varying risk premium in the Swedish stock market, this study was monthly data from 1919 to 1992 and daily data for the period 1977 to 1990.

Others studies show evidence of time varying risk premium. Fraser & Power, (1997) find a significant negatively coefficient for Malaysia investors, which they interpret as showing that investors in Malaysia are predominantly risk lovers. Chondhry (1996) using GARCH-M Model confirms no time varying risk premium in several emerging markets and where it is significant, the sign is negative, indicating risk averse investors.

Song *et al.* (1998) use GARCH models to analyze the relationship between returns and volatility in Shangai and Shenzen stock exchange market in China and found that there exists volatility transmission between the two markets (the volatility spill over effect). Similarly, Booth *et al* (1997) show evidence of price and volatility spill over among the Danish, Norwegian, Swedish and finish stock markets. The input of good news (market advances) and bad news (market retreats) is described by an EGARCH model. Volatility transmission is asymmetric spill over being price more pronounced for bad their good news. Significant price and volatility spill over exist but they are few in number of studies that have looked at the chaotic response of stock returns show weak support for both, the developed and developing markets an indication that stock returns are generated by a stochastic process (see Barkololas & Trawlos, (1998) and Yadav *et al* (1999).

Generally, various factors are identified to influence the distributional characteristics of returns. Fama & French, (1988) observe that the slowly decaying price component could be explained by models of irrational market in stock prices take long temporary swings away from fundamental values and time- varying equilibrium expected returns generated by rational pricing in an efficient market. But as noted by Fama (1991), factors behind the predictability of returns are not conclusive as to whether predictability indicates irrational bubbles in price or large rational swings in expected returns.

Ferson & Harvey, (1991) attribute predictability to economic variables. They use a multi-beta asset pricing model with macro economic variables, including unexpected inflation consumer expenditure and interest rates that proxy for risk factor in the stock market. Their results indicate that most predictable variation in assets returns can be explained by shifts in the asset risk exposure (beta) and by shifts in the market's component for holding these exposures (risk premium). Both beta's and risk premiums change predictably overtime. The stock market risk premium is however, found to be the most important for capturing predictable variation of stock portfolios. The evidence suggests that investors rationally update their assessments of expected return. Thus predictability is associated with sensitivity to economic variables.

Reichenstein and Rich (1993) show a more consistent relationship between risk premium and S&p stock returns than either dividend yield or earning price ratio. They conclude that risk premium predicts long horizon stock returns more than other variables as it mirrors movement in the unobservable market risk premium.

Flannery *et a,l*(1997) using sub-period GARCH-M model found a positive and significant effect of stock market risk on NYSE-AMEX security returns for weekly data from 1973 to 1990.

Ngugi *et al*,(2001) on the study of revitalization of African stock market using GARCH-M Model confirms time varying risk premium in several African stock markets and where it is significant, the sign is positive, indicating risk averse investors.

Murinde *et at*,(1999) while investigating the nature of stock market volatility in the emerging East European markets of Hungary and Poland report that volatility can be best be specified as a process of conditional heteroskedasticity in both markets. Volatility seemed to be persistent of nature while daily returns exhibited non linearly. They reject the hypothesis that conditional volatility is priced.

Muriu,(1999) investigating the stock market volatility in the Nairobi Stock Exchange using GARCH models using a daily data from 1992 to 2003 found the volatility is priced.

In conclusion, the above studies we find most stock markets the market risk is priced and time-varying as well.

3 CHAPTER THREE:

3.0 METHODOLOGY:

3.1 EMPIRICAL MODEL OF TIME-VARYING PRICE OF RISK (RISK PREMIUM):

Assuming a constant price of risk over time, the following relation for the risk premium of the market portfolio *m* is given by the conditional CAPM from equation (1):

$$E\,[R_{i,t}/\Phi_{t-1}] = \partial var\,[R_{i,t}/\Phi_{t-1}] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where R_{it} is the return on the market portfolio in excess of the one period risk free rate, $E\,[.|\Phi_{t-1}]$ is the mathematical expectation conditioned on the information set available at time *t-1*, and ∂ is the price of risk, which is assumed constant. This relation between the market's conditional variance and expected return is a one-period static model, which is assumed to hold period. However, Merton (1980) shows that, under certain conditions, it can be interpreted as a close approximation of the intertemporal CAPM of Merton (1973). Thus, model (1) is consistent with Merton's findings that for a representative investor with constant market equilibrium, approximately proportional to the *ex ante* variance of the market return. If the agents are risk averse then the reward to risk parameter should be positive.

The next step is to formulate an empirical model that is dynamically show time varying risk premium over time, this we use the dynamics of the market-index returns and we specify the hypothesis to be tested.

Typically, most asset pricing models postulate a relation between expected returns and some measure of risk. For example, in the static version of the Capital Asset Pricing

Model (CAPM) the expected return on any asset is a linear function of the covariance between the return on that asset and the return on the market portfolio.

In order to determine whether investors are rewarded for their exposure to market risk we use the following variation of the CAPM from equation (2)

$$E_{t-1}(R_{i,t}) = \mu_i + b_i R_{i,t-1} + \partial h_{im,t} \quad \ldots\ldots(2)$$

Where $h_{im,t}$ indicates the conditional covariance between the return on the index i and the return on the market portfolio. Equation (2) differs from the traditional CAPM in one respect. First, it includes an autoregressive component to take into account the effect of non-synchronous trading. Second; it is inspired by Black's (1972) version of the CAPM, which does not include the risk-free rate. In order to test the model, we complete the specification by assuming that the conditional second moments follow a GARCH process.

The objective of this part of the analysis is to determine whether risk is priced First, we consider a scenario in which assets are priced. In this case, the version of the CAPM can be applied and the market portfolio can be approximated with the market index. In general, the system of equations in (2) can be applied to any assets within the market portfolio. However, since we study the market index the equation is reduced to a single equation. In practice, we estimate the following model

$$R_{i,t} = \mu_i + b_i R_{i,t-1} + \partial h_{im,t} + \varepsilon_{i,t} \qquad \varepsilon_{i,t}|\Phi_{t-1} \sim N(0, h_{i,t}) \quad \ldots\ldots(3)$$

and

$$h_{i,t} = \omega_i + \alpha_i \varepsilon^2_{i,t-1} + \beta_i h_{i,t-1} \quad \ldots\ldots(4)$$

Where Φ_{t-1} is the set of information available at the beginning of time t and the conditional density function is modeled as a Normal Distribution.

Where R_{it} is the return on the market portfolio in excess of the one period risk free rate, The $b_iR_{i,t-1}$ component is included in the mean equation to account for the autocorrelation potentially induced by non-synchronous trading in the assets that make up a market index.

The parameter ∂ determines the reward to risk in the model. Expected returns increase with market risk, the coefficient ∂ in equation (3) should be positive and statistically significant.

The $h_{im\,t}$ is the conditional variance of the market portfolio and the univariate GARCH process for the conditional variance is described in (4). The conditional variance, h_t is a linear function of past squared errors and past conditional variances. To ensure that the process in (4) is well behaved and that the conditional variance of ε_t is stationary, α_0, α_i and β_i are required to be non-negative, and α_i and β_i must sum to less than one.

According to Bollerslev *et al* (1992,p.25) the GARCH-M model provides a natural tool to investigate the linear relationship between the return and variance of the market portfolio provided by Merton's (1973,1980) intertemporal CAPM.The use of the GARCH (p, q)-M in testing for stock market volatility is also advocated by Engle (1990). The GARCH model has the advantage of incorporating heteroscedasticity into the estimation procedure.[5]According to Bollerslev *et al.* (1992) the GARCH (p, q) model can be viewed as a reduced form of a more complicated dynamic structure for the time varying conditional second moments.[6]All GARCH models are martingale[7] difference implying

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[6]This feature of the GARCH model is desirable because Hodrick and Srivastava (1984) provide evidence that the forecast error is heteroscedastic.

[7] Bera and Higgins (1993) provide an excellent analysis of the ARCH, GARCH and related models.Bolerslev *et al.* (1992) provide a survey of the application of the GARCH and related models in finance.

that all expectations are unbiased.GARCH models capture the tendency for volatility clustering in financial data. Volatility clustering in stock returns implies that large (small) price changes follow large (small) price changes of either signs.

According to Engle and Bollerslev (1986) if $\alpha_i + \beta_i = 1$ in a GARCH (1, 1)-M model, this implies two things: persistence of a forecast of the conditional variance over all finite horizons, and an infinite variance for the unconditional distribution of ε_t. In other words, when $\alpha_i + \beta_i = 1$ a current shock persists indefinitely in conditioning the future variance. In a GARCH (1, 1)-M model the ε_t is the covariance stationary if the sum of α_i and β_i is significantly less than unity. As the sum of α_i and β_i approaches unity the persistence of shocks to volatility is greater. A significant impact of volatility on the stock prices can only take place if shocks to volatility are not persists over a long time (porteba and summers, 1986). The market will not make an adjustment of the future discount rate if shocks to volatility are not permanent. Since the sum of $\alpha_i + \beta_i$ represents the change in the response function of shocks to volatility per period, a value greater than unity implies that the response function of volatility increases with time and a value less than unity implies that shocks decay with time (Chou, 1988). The closer to unity the value of the persistence measure, the slower is the decay rate.

We also add dummy variables to the models in order to capture seasonal effects in the conditional volatility, following the style adopted by Glosten *et al* (1993).It is assumed that the return shock ε_t in any weekday or calendar month is a scale multiple of

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[8] Martingale hypothesis states that tomorrow's price is expected to be equal to today's price given asset's entire price history's $[P_{t+1} | P_t, P_{t-1}] = P_t$

some underlying fundamental innovation $\acute{\eta}_t$ that does not display any deterministic seasonal behavior :

$$\partial_t = \left(1 + \sum_{i=1}^{n} \lambda_i D_{i,t}\right)\eta_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$

Where $D_{i,t}$ is a seasonal dummy and λ_i is a parameter to be estimated.

Furthermore, to take account of serial correlation, which may be caused by non-synchronous trading in the stock index, moving average terms are included in the conditional mean. Thus, the models which are finally estimated are as follows:

$$R_{i,t} = \mu_i + b_i R_{i,t-1} + \partial_1 h_{im,t} + \partial_2 Dmon + \partial_3 Dtue + \partial_4 Dwed + \partial_5 Dthur + \partial_6 Dfri$$

$$+ \partial_7 1995 + \partial_8 2000 + \varepsilon_t + \theta\varepsilon_{t-1} + \theta\varepsilon_{t-2} \qquad \varepsilon_{i,t}|\Phi_{t-1} \sim N(0, h_{i,t}) \ldots\ldots\ldots(6)$$

And

$$h_{i,t} = \omega_i + \alpha_i\varepsilon^2_{i,t-1} + \beta_i h_{i,t-1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(7)$$

The method of estimating this time-varying risk premium will be sub-period GARCH (1, 1)-M model. The estimation will be done in different time sub- periods (periodicity), for instance, periods before and entry of foreign investors, period after the entry of foreign investors and no change in trading system and periods before and after change of trading system t+7 to t+5. Then estimates of the value of ∂'s are obtained. Then analysis is done on those obtained estimates.

3.2. DATA.

The analysis uses a secondary time series data. The data will consist of the continuously compounded returns, defined as the first difference of the log stock indices, calculated as $R_t = \log(P_t/P_{t-1})$ where P_t represent the value of the NSE-20 share index at time t.In order to investigate time-varying risk premium, a market index is required obtained from the NSE.This market index will be the NSE-share index closing value.

This study utilizes the the NSE-20 share index as a proxy for market returns which is the barometer of the market. Price index is a measure of the relative changes in price between various points in time given no change in volume. The NSE-20 share index comprise of blue chip companies seen to represent the general market performance and form bulk of the market capitalization.

The daily data will cover the period from 4th January 1993 to 30th December 2004 with 2970 observations.

3.3. METHOD OF CALCULATION OF RETURN.

Returns can be capital gains log differences (continuously compounded return).

$$Rt = \Delta ln\ P_t = lnP_t - lnP_{t-1}$$

Where

P_t – Current Market Index.

P_{t-1} = Previous Market Index.

4 CHAPTER FOUR:

4.0 EMPIRICAL ESTIMATIONS.

4.1 DESCRIPTIVE STATISTICS.

TABLE 1:
Summary statistics for stock returns

	Period before the entry of foreign investors. 04/01/1993-30/12/1994	Period after the entry of foreign investors. 03/01/1995-31/07/2004	Period after the entry of foreign investors with no change of trading system t+7 to t+5. 03/01/1995-31/07/2000	Period change of trading system from t+7 to t+5. 04/01/1993-31/07/2000	Period after change of trading system from t+7 to t+5. 01/08/2000-30/12/2004	Period of the entire sample. 04/01/1993-30/12/2004
Mean	0.002498	-0.000187	-0.000620	-0.000201	0.000368	0.000262
Median	0.001188	-0.000262	-0.000494	-7.06E-05	-5.02E-05	-6.20E-05
Maximum	0.073912	0.064476	0.044543	0.0739212	0.064476	0.073912
Minimum	-0.050100	-0.080078	-0.040729	-0.050100	-0.080078	-0.080078
Std-Dev.	0.011789	0.007641	0.006254	0.008200	0.009091	0.008535
Skewness	1.228052	0.093408	-0.261586	1.206564	0.139588	0.744305
Kurtosis	10.88067	17.90250	9.482569	15.95981	17.61594	16.88211
Jarque-Bera	1411.011	22878.30	2449.725	13663.44	9634.472	24114.32
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Observations	497	2472	1390	1887	1082	2969

Mean stock returns decline after the entry of foreign investors from 0.002498 to -0.00019.But declined further to -0.00062 after entry of foreign investors because of foreign investor participation induce dampening effect of order flow, but before change of trading system t +5.The mean stock returns rose to-0.000201 after change of trading system t+5.After the change of trading system from t+7 to t+5 the mean returns also increased to 0.000368 due to increased efficiency and liquidity in stock returns. The entire average stock returns were 0.000262.

From the daily standard deviation it is evident that the daily stock returns are less volatile after the entry of foreign investors declining from 0.011789 to0.007641implies that small changes in volatility are frequent, but the stock return became more volatile after the change of trading system from t+7 to t+5 that is evident by the increase of standard deviation from 0.006254 to 0.008200 with no change in trading system then increased further to 0.009091,implies that large changes in volatility are more frequent.

The stock returns exhibit positive skew ness and high kurtosis evidence of fat tails. The right tail becomes thicker after the entrance of foreign investors which implies that the returns were higher prior to the entry of foreign investors. From the Jarque-Bera values shows that the stock returns in those periods are normally distributed because the p-values are zero.

TABLE 2

Summary statistics of weekdays stock returns.

	Monday	Tuesday	Wednesday	Thursday	Friday
Mean	-0.000135	0.000627	0.000351	-0.000113	0.000570
Median	-0.000631	9.95E-06	-5.53E-05	-0.000220	0.000145
Maximum	0.043634	0.063599	0.057451	0.073912	0.064476
Minimum	-0.040729	-0.043989	-0.080078	-0.056977	-0.050100
Std. Dev.	0.007660	0.008220	0.009127	0.008653	0.008908
Skew ness	0.588186	1.503525	-0.409290	1.298659	0.951948
Kurtosis	9.914586	15.12440	19.51163	20.79470	14.52768
Jarque-Bera	1186.838	3920.591	6866.764	8044.507	3338.863
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Observations	579	603	603	597	587

Weekdays Paired mean difference

Day of the week	Paired mean difference			t- value
	Mean	Lower 95% confidence interval of the difference	Upper 95% confidence interval of the difference	
MON -TUE	- 7.5E-04	-1.7E-03	1.79E-04	-1.586
TUE - WED	2.76E-04	-5.4E-04	1.10E-03	0.661
WED- THUR	4.52E-04	-5.2E-04	1.42E-03	0.918
THUR -FRI	-7.1E-04	-1.7E-03	2.86E-04	-1.401
FRI -MON	-7.2E-04	-1.7E-03	2.42E-04	-1.469

From the above table, Tuesdays have the highest mean returns followed by Fridays. Thursdays have the lowest average returns. Mondays have negative mean returns, this conform with the fact that the first day of the week returns are low, pick up on Tuesdays and also on Fridays we expect to be high. From the standard deviation is evident that on Wednesdays the returns are more volatile than any other days, being least on Mondays meaning that investors are rewarded in terms of high risk premium. Only Wednesdays the returns are negatively skewed. Both days have high kurtcsis. From the jarque-Bera shows that both weekdays are normally distributed because the p-values are zero.

The *t*- statistics test for the mean difference shows insignificant mean returns between the weekdays at 5%.Confirms that the mean returns does not differ significantly across weekdays.

TABLE 3

Augmented Dickey Fuller (ADF) test Statistic

	With intercept		With intercept and Trend	
	Calculated values	Critical values	Calculated values	Critical values
ADF Test Statistic	-40.2236	1% -3.4356 5% -2.863 10% -2.5676	-40.2428	1% -3.9666 5% -3.414 10% -3.128
AR1	-63.4982	1% -3.4356 5% -2.863 10% -2.5676	-63.4875	1% -3.9666 5% -3.414 10% -3.128

From the unit root test that Augmented Dickey Fuller (ADF) Statistic is significant in both intercept and trend indicating that the series is not integrated therefore stationary.

4.2 VOLATILITY ANALYSIS:

Before estimating GARCH models the daily returns and squared returns have to be tested for the presence of autocorrelation (serial correlation) and heteroskedasticity by performing robust LM-tests and stationality.Testing for serial correlation is because the stock returns have high kurtosis and variance clustering(shown by high standard deviation).And testing for heteroskedasticity is because of uncorrelated squared returns. Stationarity testing is for identifying whether the stock return model is changing over time.

TABLE 4
Panel A
Autocorrelations of stock returns.

	Period before entry of foreign investors. 04/01/1993-30/12/1994	Period after entry of foreign investors, but no change in trading system. 03/01/1995-31/07/2000	Period after entry of foreign investors with no change of trading system. 03/01/1995-31/07/2000	Period before change in trading system from t+5. 04/01/1993-31/07/2000	Period after change of trading system from t+7 to t+5. 01/08/2000-30/12/2004	Period of th sample 04/01/1993-30/12/2004
Q(1)	0.393(0.0000)	0.232(0.0000)	0.170(0.0000)	0.315(0.0000)	0.265(0.0000)	0.294(0.000
Q(12)	0.074(0.0000)	0.053(0.0000)	0.046(0.0000)	0.060(0.0000)	0.052(0.0000)	0.057(0.000
Q(24)	0.023(0.0000)	-0.036(0.0000)	-0.006(0.0000)	0.019(0.0000)	-0.060(0.0000)	-0.014(0.00
Q(36)	-0.050(0.0000)	-0.004(0.0000)	0.044(0.0000)	-0.029(0.0000)	0.012(0.0000)	0.011(0.000

nel B
tocorrelation of squared stock returns.

Q(1)	0.487(0.0000)	0.366(0.0000)	0.172(0.0000)	0.458(0.0000)	0.389(0.0000)	0.425(0.000
Q(12)	0.099(0.0000)	0.044(0.0000)	0.012(0.0000)	0.120(0.0000)	0.039(0.0000)	0.082(0.000
Q(24)	-0.032(0.0000)	0.178(0.0000)	-0.015(0.0000)	-0.001(0.0000)	0.199(0.0000)	0.098(0.000
Q(36)	0.024(0.0000)	-0.035(0.0000)	-0.002(0.0000)	0.049(0.0000)	0.030(0.0000)	0.041(0.000

The table includes periods before and after entry of foreign investors, the period after the entry of foreign investors but no change in trading system and the period before and after change of trading system. *p*-values in bracket.

The returns show autocorrelation with significant coefficients with various lags before and after entry of foreign investors (1995) as well as with change in trading system (2000) leading to the rejection of the null hypothesis of no serial correlation of daily returns. The returns shows evidence of serial correlation as judged by autocorrelations of both the returns and squared returns. Following Die bold (1986), the above characteristics of high kurtosis and variance clustering seen in the autocorrelation coefficients suggest that the ARCH specification provides a good approximation to the structure of conditional variance and is appropriate for capturing time series characteristics of the daily returns.

In comparing the performance of a linear model with its non-linear counterpart we first use ARIMA models .In the sample, significant first order autocorrelation is a common feature in both return series which suggests that ARMA(1,0) would be a good specification to characterize daily returns. In the context of Box and Jenkins (1976),see Gujarati (1995) the series should be stationary before ARIMA models are used and therefore stationarity of the returns series is tested using unit root test of Dickey and Fuller (1976). From the unit root test that Augmented Dickey Fuller (ADF) Statistic is significant in both intercept and trend indicating that the series is not integrated therefore stationary. The Augmented Dickey Fuller (ADF) Statistic in table 3 is significant in both intercept and trend indicating that the series is not integrated therefore stationary.

TABLE 5

ARIMA (1, 1, 0) Estimates

C	4.27E-05
AR1	- 0.3835(0.0000)
Adjusted R-squared	0.1416
Log likelihood	10153.91
ARCH-LM Statistic	0.3519(0.0000)

p-values in brackets

From the above estimation results for the ARIMA (1, 0) model indicate that the coefficient for the first order auto regression is statistically significant, we reject the null hypothesis of no serial correlation. To test for heteroskedasticity, the ARCH-LM test is applied to the residuals. The ARCH-LM statistic above indicates presence of heteroskedasticity suggesting that the ARIMA (1, 0) model does not remove heteroskedasticity.

To take account of serial correlation, which may be caused by non-synchronous trading in the stock index, moving average terms are included in the conditional mean. Thus, the estimated model is ARMA (1, 2) is below:

TABLE 6

OLS estimates.

R_{t-1}	0.7959(0.0000)
Dmon	8.21E-05(0.8386)
Dtue	0.0012(0.0016)
Dwed	0.0002(0.4972)
Dthur	-0.0001(0.7288)
Dfri	0.0010(0.0084)
D1995	-0.0006(0.0023)
D2000	0.0002(0.1731)
MA(1)	-0.6145(0.0000)
MA(2)	0.782(0.0003)
R-squared	0.1603
Adj.R-squared	0.1577
Log-likelihood	10186.31
Skewness	-0.34
Kurtosis	20.53
ARCH- LM TEST	
C	4.08E-05(0.0000)
RESID^2(-1)	0.3333(0.0000)

p- values in brackets

The above return model was found to be free from serial correlation, performing serial correlation LM test was found to be insignificant, thus accept the null hypothesis of no serial correlation. To test for heteroskedasticity, the ARCH-LM test is applied to the residuals. The ARCH-LM statistic above indicates presence of heteroskedasticity suggesting that the ARIMA (1, 2) model does not remove heteroskedasticity.

GARCH (*p, q*) would be a good specification to model the conditional variance of daily stock returns. Where for $p=0$ becomes ARCH (q) process, and for $p=q=0$ the variance of the daily returns is simply a white noise process.

We chose the AR (1, 2) - GARCH (1, 1) parameterization with normal distribution to do the estimations.

TABLE 7
GARCH (1, 1) estimates.

R_{t-1}	0.8306(0.0000)
Dmon	-0.001(0.5896)
Dtue	0.0003(0.1832)
Dwed	0.0003(0.0786)
Dthur	-0.0005(0.099)
Dfri	0.0005(0.0838)
D1995	-0.0027(0.0224)
D2000	6.06E-05(0.4761)
MA(1)	-0.697(0.0000)
MA(2)	0.04188(0.084)
Variance Equation	
C	3.85E-06(0.0000)
ARCH(1)	0.1975(0.0000)
GARCH(1)	0.7605(0.0000)
R-squared	0.1501
Adj.R-squared	0.1467
Log-likelihood	10596.29
Skewness	-0.22
Kurtosis	10.96
ARCH-LM TEST	
C	0.9857(0.0000)
STD RESID^2(-1)	0.0155(0.3973)

p –values in brackets

From the GARCH (1, 1) estimation the lagged variable is positive and significant. Mondays and Thursdays have negative coefficients other days have positive coefficient meaning that investors may not require high risk premium and low risk premium respectively. There is negative effect of entry of foreign investors meaning that investors may not require high risk premium, but a positive effect of change of trading system from t+7 to t+5 meaning that investors are rewarded in terms of high risk premium. All coefficients are not significant except Wednesdays, Thursdays and Fridays and during the entry of foreign investor's at10%significance level. There is also persistence in volatility of 0.96 showing a strong effect of ARCH and GARCH effects. The coefficient of ARCH and GARCH are significant showing that there is presence of heteroskedasticity.The GARCH parameterization is statistically significant in most cases. Second, the β coefficient in the conditional variance equation is considerably larger than α, implying that large market surprises induce relatively small revisions in the future volatility. Third, the persistence of the conditional variance process, measured by $\alpha+\beta$, is high and often close to the Integrated GARCH model of Engle and Bollerslev (1986).This implies that current information is relevant in predicting future volatility, also at a very high horizon. The skewness and kurtosis diagnostic show substantial decline in the GARCH model compared to the OLS counterpart, hence our interpretation is that the GARCH model successfully accounts for the volatility clustering in returns and is superior to the OLS model. The value of the adjusted R^2 is very low in both GARCH model confirming that the daily returns contain ARCH effects (volatility clustering), so GARCH models do not provide sufficient explanation for volatility in the returns. To test for heteroskedasticity, the ARCH-LM test is applied to the residuals. The ARCH-LM statistic above indicates no presence of heteroskedasticity suggesting that the GARCH (1, 1) model does remove heteroskedasticity.

We extend the GARCH model to the "GARCH in mean" (GARCH-M) specification in order to examine the pricing of risk of the NSE market.

TABLE 8

GARCH (1, 1) –M estimates.

GARCH	3.0366(0.2272)
R_{t-1}	0.8047(0.0000)
Dmon	-0.0004(0.2929)
Dtue	0.0002(0.5012)
Dwed	0.00025(0.2330)
Dthur	-0.00061(0.0543)
Dfri	0.00033(0.2754)
D1995	-0.00029(0.0267)
D2000	6.17E-05(0.5094)
MA(1)	-0.6713(0.0000)
MA(2)	0.0527(0.0323)
Variance Equation	
C	4.03E-05(0.0000)
ARCH(1)	0.2030(0.0000)
GARCH(1)	0.7524(0.0000)
R-squared	0.1519
Adj.R-squared	0.1482
Log-likelihood	10596.79
Skewness	-0.24
Kurtosis	10.90
ARCH-LM TEST	
C	0.9864(0.0000)
STD RESID^2(-1)	0.0145(0.4271)

p-values in brackets

From the above estimation the market risk is not priced, though it is positive, it's not significant. From the GARCH (1, 1)-M estimation the lagged variable is positive and significant. Mondays and Thursdays have negative coefficients and also have lower conditional variance of excess return, while other days have positive coefficients and higher conditional variance of excess returns, suggesting that the conditional variance during these days differs systematically from the average conditional variance of other days. There is negative effect of entry of foreign investors showing that investors were not rewarded in terms of high risk premium. A positive effect of change of trading system from t+7 to t+5 investors shows that investors were not rewarded in terms of high risk premium. All coefficients are not significant except Thursday and during the entry of foreign investors at also 10% significance level. Overall, it is confirmed that the well known day of the week anomaly, in the form of negative Monday returns and higher positive Friday returns is not present. There is high degree of persistence in volatility; the value is 0.96 showing a strong effect of ARCH and GARCH effects and less than one indicating shocks are not explosive and have a slow decaying rate. The coefficient of ARCH and GARCH are highly significant showing that there is presence of heteroskedasticity.The value of the adjusted R^2 is very low in both GARCH models confirming that the daily returns contain ARCH effects(volatility clustering).

We also extend analysis using "GARCH in mean" (GARCH-M) to different periods to examine whether entry of foreign investors and change of trading system had any influence on the pricing of risk. New investors broaden the market, dampening the effect of order flow shocks on prices and may also make prices more efficient of order flow shocks on public information regarding fundamental values and change in trading system. Here the only difference is that we omit the dummies of entry of foreign investors (D1995) and change of trading system (D2000) because the period's specifications are under study.

TABLE 9
GARCH (1, 1)-M PERIODS Estimates

Periods	Period before entry of foreign investors. 04/01/1993-30/12/1994.	Period after entry of foreign investors.	Period after entry of foreign investors with no change of trading system. 03/01/1995-31/07/2000.	Period before change in trading system from t+7 to t+5. 04/01/1993-31/07/2000.	Period after change of trading system from t+7 to t+5. 01/08/2000-30/12/2004.
GARCH	3.0658(0.6400)	3.1065(0.2296)	2.4517(0.5208)	3.3138(0.3118)	3.8330(0.4004)
R_{t-1}	0.7014(0.0000)	0.8464(0.0000)	0.8120(0.0000)	0.8328(0.0000)	0.7803(0.0000)
Dmon	-0.0012(0.2032)	-0.0005(0.0707)	-0.0013(0.0018)	-0.0009(0.0112)	-0.0011(0.0183)
Dtue	-0.0008(0.4651)	-0.0002(0.5075)	-5.71E-05(0.8953)	-3.13E-05(0.9346)	-0.0005(0.2651)
Dwed	0.0025(0.0028)	8.14E-05(0.7898)	0.0005(0.2694)	0.0003(0.2777)	0.0.005(0.2143)
Dthur	-0.0016(0.0930)	-0.0008(0.0073)	-0.0009(0.0510)	-0.0009(0.0175)	-0.0008(0.1080)
Dfri	0.0013(0.2087)	0.0002(0.4859)	0.0007(0.1087)	0.0001(0.6369)	0.0003(0.4116)
MA(1)	-0.4438(0.0000)	-0.7552(0.0000)	-0.6519(0.0000)	-0.7141(0.0000)	-0.5671(0.0000)
MA(2)	0.1079(0.1237)	0.0664(0.0101)	0.0391(0.3088)	0.0509(0.0893	0.0454(0.3145)
	Variance equation				
C	1.33E-05(0.0000)	4.72E-06(0.0000)	5.38E-06(0.0000)	5.47E-06(0.0000)	4.53E-06(0.0000)
ARCH(1)	0.3664(0.0000)	0.2097(0.0000)	0.2708(0.0000)	0.2308(0.0000)	0.2984(0.0000)
GARCH(1)	0.5893(0.0000)	0.7261(0.0000)	0.6824(0.0000)	0.6956(0.0000)	0.6923(0.0000)
R-squared	0.2654	0.1527	0.2196	0.1929	0.2529
Adj.R-squared	0.2488	0.1489	0.2134	0.1882	0.2452
Log-likelihood	1639.02	8943.33	4956.427	6804.866	3824.425
Skewness	0.8	-0.35	0.28	-0.08	0.408
Kurtosis	11.06	12.10	9.9	10.58	9.699

p-values in brackets

The final observation was to analyze the pricing of the market risk of different periods, because liberalization (foreign investor's participation) and change of trading system from t+7 to t+5 were only the pricing factors. From the above factors, mean that before entry of foreign investors (markets were closed for foreign investors) and before change of trading system from t+7 to t+5, if this was the case, domestic assets would not be necessarily be priced prior to this date. From the above estimations, the market risk is not priced and insignificant in both periods. This means there is no significant volatility on expected returns on these periods.

This is confirmed from the above estimates. The periods have different GARCH coefficients so it confirms time-varying risk premium. After the entry of foreign investors the value GARCH coefficient increased from 3.06 to 3.10 and also GARCH coefficient increased to3.31 to 3.83 for the change in trading system from t+7 to t+5. It also means that the above factors, entry of foreign investors and change of trading system had impact this stock market micro structure features (volatility, efficiency and liquidity) hence impact on the risk premium. There are changes in ARCH parameters and high degree of persistence of shocks in volatility increase in both periods meaning the slower the decay rate.

From the above estimates conclude that there is increase of market volatility after the entry of foreign investors (1995) and after change in trading system (2000) contrary to the fact the above factors can induce greater participation which reduces volatility. Hence volatile investment flows would be high volatility in stock prices.

GARCH (1, 1)-M variance series was obtained for above periods to do a mean difference test to find whether the ex-ante volatility differs significantly across the periods.

TABLE 10

GARCH (1, 1)-M Period Paired mean difference test

Periods	Paired differences			t- value
	Mean	Lower 95% confidence interval of the difference	Upper 95% confidence interval of the difference	
Period before entry of foreign investors between Period after entry of foreign investors.	2.505E-05	1.630E-05	3.380E-05	5.627
Period after entry of foreign investors between Period after entry of foreign investors with no change of trading system.	-4.1E-06	-5.4E-06	-2.9E-06	-6.422
Period after entry of foreign investors with no change of trading system between Period before change in trading system.	4.2E-06	3.3E-06	5.1E-06	9.266
Period before change in trading system between Period after change of trading system	- 9.5E-06	- 1.2E-05	-7.0E-06	-7.660

From the above paired mean difference test shows that the Period before the entry of foreign investors and Period after the entry of foreign investors, Period after the entry of foreign investors and Period after entry of foreign investors with no change of trading system t+7 tot+5,Period after entry of foreign investors with no change of trading system t+7 tot+5 and Period before the change of trading system, Period before the change of trading system from and Period after the change of trading system from t+7 tot+5, shows significant mean difference. So the ex-ante volatility differs significantly from periods. Conclude that there is increase of market volatility which increases market risk.

5 CHAPTER FIVE:

(5.1) SUMMARY AND CONCLUSIONS

In this study, the price of risk on the Nairobi stock market was estimated using a conditional asset pricing model that allows for time variation in the risk. Two different specifications for modeling the conditional variance were used: GARCH (1, 1)-M with seasonal correction. The data consisted of daily excess returns covering the period 1993 to 2004.

The slope parameters in the conditional variance equations were significant, which indicates GARCH effects. We also found that there is seasonal variation in the daily conditional variance. In the final evaluation of the two models; we selected the preferred model specification by performing robust LM-tests.

The estimates of the price of risk, interpreted as the relative risk aversion of the representative investor, are positive and insignificant. These results combined with the significant ARCH and GARCH effects confirm the existence of time-varying risk premium which is not significant[8] and also volatility persistence in the Nairobi stock market. The above changes may be due factors such as change of trading system, entry of foreign investors (encouragement of investments by foreign citizens and companies), market oriented policies and also privatization. The parameters values of the price of risk are quite similar to the results found in some of the previous studies on foreign markets. In particular, my results on Kenyan data lend support to those investigations using U.K. data which report insignificant positive price of risk parameters. Hence; we find that there are small differences in the preferences towards risk of representative investors in small and large economies.

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[8] Lack of use of proper definition of risk may be behind the insignificant time-varying risk premium.

The well known day of the week anomaly reflected in form of insignificant positive Friday and negative Monday, does not seem to be present in the market. .Also entry of foreign investors and change of trading system increases volatility contrary to the fact the volatility should decline.

(5.2) POLICY IMPLICATIONS:

To improve the above research there need to include risk-free rate so that excess returns is used instead of market returns. These results advocate further research in the area of risk and return and proper measure of risk in stock markets. Further research attempt could investigate the applicability of models examined in this study to individual stocks. The model can be tested whether investors are rewarded in terms of high risk premium. Also the study can be done to determine the stability of the risk premium over time.

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