ANALYSING THE EFFECT OF TREASURY BILL RATES ON STOCK MARKET RETURNS USING GARCH

BY

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DECLARATION

This research project is my original work and has not been presented for a degree in any other University

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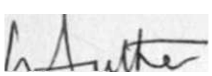
This research project has been submitted for examination with my approval as the University Supervisor.



Signed..."^.:... . . . .^ . a . o o t

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DEDICATION

For my family, who offered unconditional love and support during the course of the entire MBA program and especially during the project period.
I am greatly indebted to my mother Rose Mutoko, who continues to learn, grow and develop and who has been a source of encouragement and inspiration to me throughout my life, a very special thank you for providing me with the encouragement to finish what I had started and for the myriad ways in which you have actively supported me in my determination to find and realize my potential.

To my wonderful son Richard, you remain a constant source ofjoy and I am privileged and humbled at the knowledge that God chose me to be your mother.

To my rock, my salvation, my fortress, may all honour and glory be to God.

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ABSTRACT

This paper examines the relationship between the returns of assets on the Nairobi Stock Exchange (NSE) and the Treasury Bills Rate using GARCH Analysis. Existing studies in Kenya on the relationship of factors affecting the returns of assets in the NSE have used various methods, mostly Ordinary- Least Squares (OLS) Regression and have yielded inconclusive results. This study recognizes the unique characteristic of financial series data that makes common analysis techniques like OLS regression unsuitable for generating effective forecast models. The study systematically examines the returns of the various market segment returns within the NSE for these characteristics so as to build a basis for using GARCH analysis. Finally, it compares the results obtained using OLS regression with the results obtained using GARCH analysis techniques.

The study concluded that in keeping with theory, Treasury Bill Rates have a significant impact on the asset returns of the various market segments, the NSE - 20 Share Price Index and All market returns as a whole. The behaviour of the returns of assets on the NSE can be better explained by considering the volatility of previous periods. The study found that GARCH analysis gives a better explanation for the relationship between Treasury Bill Rates and asset returns than OLS regression in every market segment. Furthermore, the explanatory power becomes stronger as we consider the effect of previous variances on the current observations.

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1.-1 CHAPTER ONE - INTRODUCTION

1.1 BACKGROUND

Over the years financial analysts and investors have been concerned about the impact of Treasury bills rate on the behavior of asset returns. The results of these studies have been captured in the form of the "risk free rate" as depicted in various asset pricing models such as CAPM and APT. In Kenya, the behavior of assets on the Nairobi Stock Exchange (NSE) is due to the fact that investors desire to channel their funds to assets with the most promising investment opportunities. Treasury bills and stocks are competing assets, particularly when their prices are not at equilibrium. Correct choice ensures that the investors are able to reduce their risk and enhance returns by recognizing the underlying direction of the markets and taking positions accordingly.

An investor can decide to purchase any one of a number of different securities many of which represent a different type of claim on a private or government entity. Investors are always in search of assets whose returns are commensurate with risk, Markowitz (1952). This is in line with the assumption that rational investors only assume risk if they will be adequately compensated. The implication is that investors have to rank assets on a risk-return perspective then select the assets to invest in according to their individual risk preferences as noted by Markowitz (1952) in his mean variance paradigm.

Treasury bills are the least risky and most marketable of all of the securities, Elton and Gruber (1995). Treasury bills play a special role in financial theory because they have no risk of default in addition to very short term maturities. In many economies they are considered risk less investments. Ordinary shares issued by private entities represent an ownership claim on the earnings and assets of the firm that issued them, Elton and Gruber (1995). Even with the limited liability that ordinary shares come with, the residual nature of claims (on a firm's assets and earnings) accruing to shareholders, this class of investment is considered the riskiest.

A major assumption of this study is the existence of rational investors who respond in a predictable manner to opportunities for gain and the risk of loss as new information arrives in the market. The classic paradigm of financial theory assumes that investors operating in frictionless markets make rational decisions. If this assumption holds and there are imperfections in the market, then government must compete with the private entities for private savings. As an investment vehicle, treasury bills are issued by the government to raise money. Treasury bills do not pay periodic interest. Instead, they are sold at a discount from their face value i.e. it is a pure discount security issued by the government with a maximum term to maturity of one year. Upon maturity, the investor receives the face value. The difference between the face value and the price at which it was sold is treated as the rate of return for the investor.

The interest on Treasury bills is generally viewed as the representative money market rate. For this reason Treasury bill interest rates are typically used as the index rate for variable rate financial contracts. In particular, the spread between private money rates and Treasury bill interest rates is used as a measure of the default risk premium on private securities. The Treasury bill interest rate is generally used to test various hypotheses about the effect of such economic variables as the rate of inflation or the money supply on the general level of short term interest rates, Cook and Lawyer (1983). Furthermore Treasury bill interest rates are used to test hypotheses about the determinants of money market yield curves. Despite this central role accorded to Treasury bill interest rates, they frequently diverge greatly from other high risk assets of comparable maturity. Furthermore, this differential is subject to abrupt change, Cook and Lawyer, (1983). This study seeks to examine the degree of the impact of Treasury Bills Rate on the return of assets on the NSE.

Students of financial markets and specifically those who focus on the pricing of assets, model the relationship between competing assets such as private stock returns and Treasury Bills using linear regression techniques. However, a significant re-evaluation of statistical basis of econometric models starting in the 1980s suggests that there is a need to balance theory with statistical analysis. Banerjee, Dolado, Galbraith and Hendry,

(1993) Econometric modeling basis has expanded from assumption of stationary to include integrated processes. The effect of the expansion is continuing and is having enormous influence on choice of model forms, statistical inference and interpretation of a number of traditional concepts such as collinearity, forecasting and measurement errors.

Stationary time series data showing fluctuating volatility and, in particular, financial return series have provided the impetus for the study of a whole series of econometric time series models that may be grouped under the general heading of GARCH (Generalized Auto Regressive Conditionally Heteroskedastic) models, Engle (1982), Bollerslev, Chou, and Kroner, (1992) and Shephard, (1996). The hidden variable volatility depends parametrically on lagged values of the process and lagged values of volatility.

GARCH modeling, which builds on advances in the understanding and modeling df volatility in the last decade, has become an important econometric technique. GARCH takes into account excess kurtosis and volatility clustering, two important characteristics of financial time series. It provides accurate forecasts of variances and covariances of asset returns through its ability to model time-varying conditional variances. As a consequence, GARCH models have been applied successfully to such diverse fields as risk management, portfolio management and asset allocation, option pricing, foreign exchange, and the term structure of interest rates. Highly significant GARCH effects have been found in equity markets, not only for individual stocks, but for stock portfolios and indices, and equity futures markets as well, Bollerslev, Chou, Kroner, (1992). These effects are important in such areas as value-at-risk (VaR) and other risk management applications that concern the efficient. This study examines the relationship between Treasury Bills Rate and the return of assets on the Nairobi Stock Exchange using GARCH analysis. The study also carries out OLS linear regression and compares their forecasting capability to those obtained through GARCH analysis.

1.2 EXPECTED POLICY IMPLICATIONS OF THE STUDY

1.2.1 Importance of Public Debt Management

Public debt management is the process of establishing and executing a strategy for managing the government's debt in order to raise the required amount of funding, achieve its risk and cost objectives and meet any other public debt management goals that the government may have set, such as developing and maintaining an efficient market for government securities, IMF/World Bank (2001).

In a broader macroeconomic context for public policy, governments should seek to ensure that both the level and rate of growth in their public debt is fundamentally sustainable, and can be serviced under a wide range of circumstances while meeting cost and risk objectives. Policy makers in Kenya should focus on reforms that strengthen the quality of public debt management and reduce the country's vulnerability to international financial shocks. This will result in an annual budget that can be adhered to in the long run without the need to over stretch domestic resources due to unforeseen events in the international markets.

1.2.2 Coordination with monetary and fiscal policies

Effective coordination of debt management with fiscal and monetary policies while maintaining separate responsibility between the same. Public debt can be managed in various ways. Although the different methods work together to achieve the final target, there is need to separate the various responsibilities so that objectivity is maintained in the entire process. Both of these instruments are critical to maintaining a stable economy and when they are managed by the same body it becomes increasingly easy to compromise the objectives of one policy in order to achieve those of the other.

Debt managers, fiscal policy advisors, and central bankers should share an understanding of the objectives of debt management, fiscal, and monetary policies given the interdependencies between their different policy instruments. Where the level of financial development allows, there should be a separation of debt management and monetary policy objectives and accountabilities. Debt management, fiscal, and monetary authorities should share information on the government's current and future liquidity needs in order to achieve effective planning. Debt managers should inform the government on a timely basis of any emerging debt sustainability problems.

1.2.3 Effective Debt Structuring and Risk Management

Poorly structured debt in terms of maturity, currency, or interest rate composition and large and unfounded contingent liabilities are important factors in inducing economic crises in many countries throughout history. For example, irrespective of the exchange rate regime, or whether domestic or foreign currency debt is involved, crises have often arisen because of an excessive focus by governments on possible cost savings associated with large volumes of short term or floating rate debt. This has left government budgets seriously exposed to changing financial market conditions, including changes in the country's credit worthiness, when this debt has to be rolled over. By reducing the risk that the government's own portfolio management will become a source of instability for the private sector, prudent government debt management, along with sound policies for managing contingent liabilities can improve make a country les susceptible to contagion and financial risk, IMF/World Bank (2001).

A government's debt portfolio is usually the largest financial portfolio in the country. It often contains complex and risky financial structures, and can generate substantial risk to the government's balance sheet and to the country's financial stability. As noted by the Financial Stability Forum's Working Group on Capital Flows, "recent experience has high lighted the need for governments to limit the building of liquidity exposures and other risks that make their economies especially vulnerable to external shocks". Sound debt structures help governments reduce their exposure to interest rate, currency and other risks. Therefore sound risk management by the public sector is also essential for risk management by other sectors of the economy.

1.2.4 Transparency and Accountability

There is a need to establish clarity of roles, responsibilities and objectives of financial agencies responsible for debt management. The allocation of responsibilities among the ministry of finance, the central bank, or a separate debt management agency, for debt management policy advice, and for undertaking primary debt issues, secondary market arrangements, depository facilities, and clearing and settlement arrangements for trade in government securities, should be publicly disclosed. The objectives for debt management should be clearly defined and publicly disclosed, and the measures of cost and risk that are adopted should be explained. Materially important aspects of debt management operations should be publicly disclosed and debt management activities should be audited annually by external auditors.

1.2.5 Institutional Framework

The legal framework should clarify the authority to borrow and to issue new debt, invest, and undertake transactions on the government's behalf. Risks of government losses from inadequate operational controls should be managed according to sound business practices, including well-articulated responsibilities for staff, and clear monitoring and control policies and reporting arrangements. Debt management activities should be supported by an accurate and comprehensive management information system with proper safeguards. Staff involved in debt management should be subject to a code-of-conduct and conflict-of-interest guidelines regarding the management of their personal financial affairs. Sound business recovery procedures should be in place to mitigate the risk that debt management activities might be severely disrupted by natural disasters, social unrest, or acts of terrorism. Debt managers should make sure that they have received appropriate legal advice and that the transactions they undertake incorporate sound legal features.

1.3 STATEMENT OF THE PROBLEM

In Kenya the bearish nature of the stock market before 2002 has been blamed on the excessive borrowing by the Kenya Government. Jiwaji (2004), writing for G21 notes, "Kenyans have paid and continue to pay a very high price, both in budgetary and economic costs, for the financial indiscipline of the 1990s which was characterized by high fiscal deficits, excessive domestic borrowing..." If the preceding assertion holds, then an association exists between government borrowing and stock market performance and must be visible and capable of adversely affecting the levels of private investment. Government borrowing is expressed in various ways including the sale of Treasury Bills through Open Market Operations. The fact that the CBK is willing to expend resources to monitor the performance of the Nairobi Stock Exchange and include this in its monthly economic indicators lends tremendous credence to the fact that the stock market is viewed as a predictor of the economy within Kenya.

Furthermore proponents of the stock market as an indicator of economic activity explain that investors are observant of economic trends and factors impacting the performance of corporations, MacEwan (1990). It is expected that investors sell off their shares before the economy goes into a decline, making it look like the stock market is in conflict with the economy, but in reality the stock market is exhibiting its predictor qualities and signaling that investors are expecting a down turn in corporate profits as the economy enters a recession; and as a result they are liquidating their assets so as to minimize their future losses in the adverse economic climate expected. The opposite happens when investors anticipate expansion (boom) in the economy, Pearce (1983).

Investment is not an event but a process which describes how an investor should go about making decisions with regard to what assets and how extensively to commit his funds to these assets as well as when investments should be made. In summary the investor like a pilot about to land the plane is always looking for signals. Such signals include the adaptive expectations model and the rational expectations model. Adaptive expectations models suggest that expectations are developed through past experience, whereas rational expectations models pose that expectations are formed using all current information that is available, Debondt and Thaler (1985) and Pearce and Roley (1985). The foregoing serves to emphasize the fact that the stock market is forward looking, predicting the performance of the economy and hence, studies aimed at better understanding the factors that dictate stock asset returns, serve not only to improve allocation of funds, but improve performance of the economy as a whole.

Economist Valentino Piana, (2002) tells us that a large and abrupt increase in general interest rates can have devastating effects on crucial real variables, exerting a depressing pressure on Gross Domestic Product (GDP) and the economy at large. Macroeconomic theory suggests it is through interest rates that monetary" policy actions are transmitted to the economy, Roley and Sellon (1995). Furthermore, the CBK 15th Monetary Policy Statement, December (2004), notes that when the CBK increases the money supply, short-term rates drop, which stimulates activity in interest-sensitive sectors. Studies of the determinants of output movements conducted since the early 1980's found that when interest rates are considered, the monetary aggregates lose most of their explanatory power, suggesting that interest rates contain important information about future output, Sims (1980).

However of concern to us is whether the relationship between the returns of assets on the NSE and treasury bills rate is large enough to be relied on by investors as an investment signal. Investors respond to an effective signal by selling off their shares before the economy goes into decline, on account of analyzing the various assets, revising the constitution of the portfolio and the policy in keeping with economic forecasts.

Studies on financial time series confirm that financial series exhibit increased conditional variance and use of Ordinary Least Squares Linear Regression may not be sufficient to fully accommodate these variances and incorporate their impact into current forecast models. It therefore becomes necessary to apply competing modeling approaches on NSE financial time series data. This study seeks to examine the impact of Treasury Bill rates on the return of assets on the NSE.

1.4 OBJECTIVE OF THE STUDY

The first objective of this study is to examine the extent of the relationship between the Treasury Bills rate and the returns of stocks traded on the Nairobi Stock Exchange.
The second objective is to compare Ordinary Least Square (OLS) regression analysis and GARCH analysis in predicting the returns of assets on the NSE using Treasury Bills rate as the independent variable.

1.5 JUSTIFICATION OF THE STUDY

Investors will be able to make informed decisions as to the most profitable portfolio to hold during different periods based on better information. Whether their preference is risk averse, risk seeking or risk neutral, the results of this study will go a long way in providing much needed information as to the investments to hold and those to sell.

Portfolio managers can use this study to counter-check their investment recommendations and provide value maximization for their clients. They can also use this information to investigate anomalies in expected returns that are not explained by the standard economic indicators as a way to better appreciate the dynamics within the economy and improve portfolio returns.

Policy makers within the Government can use the findings within this study to better align their fiscal and monetary policies. This study will provide incentives for greater fiscal discipline so as to provide a stable environment for sustainable development. The ultimate goal of a government is to improve the living conditions of people in their everyday lives. Increasing the gross domestic product is not just a numbers game. Higher incomes mean good food, warm houses, and hot water. They mean safe drinking water and inoculations against the perennial plagues of humanity which in turn help to break the cycle of poverty to produce a wealthy nation.

Financial Intermediaries will appreciate the information contained within this document and utilize it for purposes of planning their financial strategies and the development of financial products that will meet the requirements of their corporate and private customers in the future.

The balance between the value to invest in Treasury bills and the amount of funds to leave available in order to extend credit to the economy is a decision that needs to be made based on an understanding of the national implications and not just monetary gains. The study may also be useful for international organizations (such as the World Bank) and foreign governments who are interested in the development of capital markets in the emerging countries.

Finally, the research will add to the body of knowledge not only in finance but in other areas of specialization and develop a better appreciation of the forces impacting our lives at any given time.

2.0 CHAPTER TWO - LITERATURE REVIEW

2.1 LINK BETWEEN STOCK MARKET AND T-BILL RATE

The interest rate environment has long been recognized as important to the performance of the stock market. Periods of falling interest rates have generally been more favorable for stocks than periods of rising rates. Darrat and Dickens (1999) noted in their study that interest rates lead stock returns. Various studies such as the June 2004 study by the CFA Institute show that stocks in the US averaged greater returns during periods of expansive monetary policy and smaller returns were realized when the policy on interest rates was restrictive. The study found that markets performed poorly, resulting in lower than average returns and higher than average risk. Conversely, periods of expansive monetary policy - when interest rates are falling, generally coincide with strong stock performance including higher than average returns and less risk.

The Central Bank of Kenya's (CBK) management of the country's monetary policy has a strong bearing on the stock market. Changes in the T-Bill rate usually have a large impact on the shilling and interest rate environment as a whole. The CBK also sets monetary policy through its daily market operations. As movements in the general price level are influenced by the amount of money in circulation, the Central Bank of Kenya operates in a way that restricts the growth of the total money stock to a level that is consistent with a predetermined economic growth target, June 2004 - 14th Monetary Policy Statement. One of the major tools the Bank uses to implement monetary policy is Open Market Operations, through which the Bank buys or sells Government of Kenya Treasury Bills in the secondary market in order to achieve a desired level of Bank reserves. The Bank injects money to the economy when it buys Treasury Bills, and drains money when it sells it. As the law of supply and demand takes over in the money market, the cost of loanable funds (interest rates) adjusts itself to the desired level, Central Bank of Kenya Home Page (2005).

The base rate is the interest rate set by banks to determine the cost of borrowing. Kenyan Banks and other financial intermediary institutions usually follow the lead of the CBK by adopting a base rate that is pegged on the Treasury Bill Rate and this in turn affects the price at which funds are made available to institutions and individuals which in turn affects the performance of securities within the NSE. Indeed the East African Newspaper (June 29 - July 7 1998) notes that the reduction in Treasury bill yields, combined with post budget measures introduced to reduce the cash ratio from 16 to 15 per cent - money deposited with the CBK from banks at no interest - contributed to a drop in the base lending rates of most commercial banks. A drop in interest rates favors firms that rely on borrowed funds and ultimately results in improved earnings to shareholders of the affected firms. This is reflected in improved asset returns on the NSE.

2.2 THE CBK AND SETTING TREASURY BILL RATES

While many factors go into setting the myriad interest rates in effect, the one factor that best illustrates the CBK's role is time to maturity. Under normal economic conditions, the longer the period over which one invests or borrows money, the higher the interest rate. We note that there are many different interest rates within the economy, Tharsing (2005). The CBK indirectly controls the interest rate that banks use to set the rate at which they extend credit to customers i.e. called base lending rate. This is done through the sale and purchase of Treasury Bills. Commercial Banks use the prevailing interest rate of the TBills as a bench mark for setting their base lending rate. All of the other interest rates are set in the marketplace by the normal forces of supply and demand. On closer inspection, we find that the CBK does not dictate the base rate but rather sets a target rate. The actual rate is set by and between banks. The CBK helps to steer the actual rate toward its target by buying and selling short-term Treasury bills on the open market.

Consumers use the credit facilities to buy commodities, and the economy grows. Thus the CBK doesn't really set interest rates. It only sets one rate, the Treasury Bill Rate. Since the CBK does this by buying or selling T-bills, we may also conclude that the CBK plays an important role in setting very short-term interest rates within the economy.

2.3 TREASURY BILL RATE AND CROWDING OUT EFFECT

An investor buys Treasury Bills at a discount and receives payment of face value on maturity date. In Kenya, the T-bills on offer are for maturity periods of 91 days (three months) and 182 days (six months). Individuals and corporate bodies, including non-residents are eligible to purchase the bills, although considering the fact that the minimum face value is Kshs 1,000,000 and additional values MUST be in multiples of Kshs. 50,000 makes the T-bills inaccessible to most individuals. As a result, the major purchasers of TBills tend to be financial institutions, Mukherjee (1999). These institutions are responsible for providing credit to individual and corporate consumers. When banks invest their money in the purchase of T-bills it reduces the amount of money available to the economy for expansion and development, Girmens and Guillard (2002), Schenk (2000). Furthermore, the money made available for these activities is at a premium thus increasing the expenses of consumers within the economy, who in turn reduce their spending on commodities. On the other hand, Corporations will pay more for loans they have borrowed. This increases the interest expense on their profit and loss statement, leading to reduced profits.

The crowding out effect is an economic theory explaining an increase in interest rates due to rising government borrowing in the money market, Girmens and Guillard (2002). The problem occurs when government debt 'crowds out' private companies and individuals from the lending market. Increased government borrowing tends to increase market interest rates. This is because the government will issue treasury bills at a high interest rate so as to make them attractive and competitive to potential investors, Ahmed and Miller (1999). The government can always pay the market interest rate, but there comes a point when corporations and individuals can no longer afford to borrow. A high level of government expenditure and borrowing makes it hard for companies and individuals to borrow; this is called the "crowding out" effect.

2.4 FACTORS AFFECTING TREASURY BILL RATES

A number of factors are cited as influencing the trend that Treasury bill rates take. Demand for risk-free fixed-income securities in general, Stanton (2000). For example, a "flight to safety" caused by concerns about default or liquidity risk in other financial markets may cause investors to shift to T-bills to avoid risk, Federal Reserve Bank of San Francisco (2005). Government budget deficits in some years may reduce the supply of some Treasury securities issues. Economic conditions may influence rates. Rose and Peter (1994), note that T-bill rates typically rise during periods of business expansion and fall during recessions. Monetary policy actions by the CBK that affect the base rate likely will influence interest rates for other close substitutes, including short-term T-bills, Federal Reserve Bank of San Francisco (2005). Inflation and inflation expectations also are factors in determining interest rates. For example, periods of relatively high (low) rates of inflation usually are associated with relatively high (low) interest rates on T-bills, American Institute for Economic Research (2000).

2.5 THE ATTRACTIVENESS OF T-BILLS TO INVESTORS

Treasury bill rates are normally the lowest of rates within the economy. They are influenced mainly by the expectations about government budget deficits, government short-term cash-management needs, inflation, as well as overall conditions of demand and supply in the markets for credit, Wagacha (2001), Fleming (1997), Stanton (2000). In some countries e.g. United States, the interest paid on Treasury bills includes an inflation premium for any expected loss of purchasing power, Kopcke and Kimball (1999). These were introduced in 1997 and are officially known as Treasury Inflated Protected Securities (TIPS).

At the same time, however, Treasury bill rates probably have only a small or no liquidity premium for holding bills instead of cash because holders have a ready market in which to sell the bills, should they need cash before the maturity date. Also missing from the interest rate paid on Treasury bills is a credit-risk premium to offset the chance that the issuer might default because of the superior credit standing of the government, Stanton (2000). The real rate of return otherwise called pure time value of money is the price necessary to induce investors to forego consumption and save. The real rate of interest is thus defined within the context of no uncertainty and no inflation. To ascertain this rate, reference is usually made to Treasury bills which are regarded as a risk-free asset, the returns of which normally lag behind risky investments such as equities. The difference between the returns on risk-free assets and risky assets is the risk premium, which compensates investors for the risk taken.

Thus given an opportunity, a risk averse investor will always opt for T-bills rather than private securities whenever TBills offer higher returns. In fact, during turbulent financial times, investors' increased desire for default-free assets tends to produce particularly low interest rates on Treasury bills compared with money market instruments issued by the private sector, Federal Reserve Bank of San Francisco (2005). This is because of the law of supply and demand. As the demand for T-bills increase, their interest rate goes down. As the interest rate of T-bills increases, they become more and more attractive to potential investors this could translate into a reduction for the demand on private securities which could be giving comparable returns but at higher risks.

2.6 STOCK MARKET EFFICIENCY

Stock market efficiency has fundamental implications for stock market investors and analysts who are constantly in search of models and formulas that will predict the future prices of stocks. The random walk theory, Kendall (1953), Malkiel (1973), is a theory that states that the past movement or direction of the price of a stock or overall market cannot be used to predict its future movement i.e. stock price fluctuations are independent of each other and have the same probability distribution. They conclude that over a period of time, prices maintain an upward trend. It assumes that consecutive price changes are independent and identically distributed over time. Investors and analysts are in search for signals that give an indication as to the trend the stock markets will take in the future.

The Efficient Market Hypothesis evolved in from the Ph.D. dissertation of Eugene Fama (1965). Fama persuasively made the argument that in an active market that includes many well-informed and intelligent investors, securities will be appropriately priced and reflect all publicly available information. If a market is efficient, no information or analysis can be expected to result in out performance of an appropriate benchmark. This being the case market performance indicators becomes crucial in forming the body of knowledge from which investors make decisions.

2.7 ASSET PRICING MODELS

Asset pricing models indicate that the price of a security is determined by cash inflows expected by investors and the risk associated with those cash inflows, Markowitz (1952), Sharpe (1964), Fisher (1908) and Hirshleifer (1964). In the case of investment by holding ordinary shares, cash inflows consist of expected dividends during the period the investor holds the share and the capital gains made when the share is sold. Thus we see that the stock market is forward looking, and current prices reflect the future earning potential, or profit of corporations and hence the factors that determine the amount or the risk associated with the cash inflows is important to making informed decisions, Pandey (1999).

The risk component of an asset can be broken down into systematic and unsystematic risk. Unsystematic risk is the risk that arises from the uncertainties which are unique to individual assets and which in turn can be diversified away if a large number of securities are combined to form well-diversified portfolios. Systematic risk also known as market risk is the risk that arises as a result of economy wide uncertainties and the tendency of individual securities to move together with changes in the market. This part of the risk cannot be reduced through diversification. Investors are exposed to this market risk even when they hold well diversified portfolios, Malkiel (1973).

Examples of unsystematic risk include: Workers declaring a strike in a company; A formidable competitor entering the market; The Research and Development expert leaves the firm; The company loses a big contract; The company making a break through in its manufacturing process, etc. Examples of systematic risk include: The Government changing the interest rate policy; the corporate tax rate is increased; the government resorts to massive deficit financing; and The inflation rate increases. In an efficient market these factors are discounted into the share price.

2.7.1 Capital Asset Pricing Model (CAPM)

The CAPM builds on the model of portfolio choice developed by Harry Markowitz (1959). In Markowitz's model, an investor selects a portfolio at time t-1 that produces a stochastic return at time t. The model assumes investors are risk averse and, the absence of transaction costs, so expected return is only related to risk, perfect competition, so an individual investor's decisions have no effect on prices, and homogeneous expectations, so that all investors form the same assessment of assets' market risk, and hence end up desiring the same optimal portfolio. Another important assumption which is often subsumed in practice is that investors only care about assets' risk and expected return. The CAPM turns this algebraic statement into a testable prediction about die relation between risk and expected return by identifying a portfolio that must be efficient if asset prices arc to clear the market of all assets. The CAPM Equation is written as

$$E(R_J) = R_f + (E(R_m) - R_f)\beta_J \qquad \textbf{Equation 2.1}$$

Where

$E(R_j)$ = Expected Rate of Return of asset j

R_f = Risk free rate - usually the prevailing Treasury bill rate

$E(R_m)$= Expected Rate of Return of the market portfolio

β_j = Beta of asset j - undiversifiable risk of security j

Sharpe (1964) and Lintner (1965) add two key assumptions to the Markowitz model to identify a portfolio that must be mean-variance-efficient. The first assumption is complete agreement. Given market clearing asset prices at $t-1$, investors agree on the joint distribution of asset returns from t-1 to And this distribution is the true one, that is, the distribution from which the returns we use to test the model are drawn. The second assumption is that there is borrowing and lending at a risk free rate, which is the same for all investors and does not depend on the amount borrowed or lent.

2.7.2 Arbitrage Pricing Theory (APT)

(APT) holds that the expected return of a financial asset can be modeled as a linear function of various macro-economic factors, where sensitivity to changes in each factor is represented by a factor specific beta coefficient. The model derived rate of return is then used to price the asset correctly - the asset price should equal the expected end of period price discounted at the rate implied by model. If the price diverges arbitrage should bring it back into line. This theory was initiated by the economist Stephen Ross in 1976.

The APT along with the CAPM is one of two influential theories on asset pricing. The APT differs from the CAPM in that it is less restrictive in its assumptions. It allows for an explanatory as opposed to statistical model of asset returns. In some ways, the CAPM can be considered a "special case" of the APT in that the Securities market line represents a single-factor model of the asset price, where Beta is exposure to changes in value of the Market. Additionally, the APT can be seen as a "supply side" model, since its beta coefficients reflect the sensitivity of the underlying asset to economic factors. Thus, factor shocks would cause structural changes in the asset's expected return, or in the case of stocks, in the firm's profitability, Burmeister and Wall (1986), Chen and Ingersoll (1983), Roll, Richard and Ross (1980), and Ross, Stephen (1976). Akwimbi (2003) studied the predictive ability of asset returns on the NSE using CAPM and APT. He concluded that the APT model had far greater explanatory power on the factors he selected which included unexpected changes in foreign exchange reserves, unexpected changes in inflation rates, unexpected changes in the exchange rate of the dollar and changes in the interest rate of loans.

Where UR_S the unexpected component of return arising from the specific factors is related to the firm and UR_m is that component of the unexpected return that arises from the economy wide market related factors. APT assumes that market risk can be caused by economic factors such as changes in gross domestic product, price level, the interest rate of Treasury bills etc. The sensitivity of the asset's return to each factor is estimated. Thus there will be as many betas as the number of factors and equation 1 can be expressed as follows:

$$E\{R_j\}=R_f + p j , + P_2/_2 + \ldots + PnYn \qquad \textbf{Equation 2.2}$$

Taking the case of the relationship of the prices of assets on the Nairobi Stock Exchange and the above equation can be written as

$$E(R \ ) = TreasuryBiUsRate + P j \backslash + \ldots + P j_{n} \qquad \textbf{Equation 2.3}$$

There exists some important systematic risks driving security returns in a linear fashion and investors perceive these risks and can estimate the sensitivity of the security to them. In a world with various sources of risk, the APT can result in a lot of statistical noise, but if examined for a particular factor it provides a clearer explanation of w hat moves stock returns. The two models mentioned above, indicate the Treasury Bill Rate has a key role to play in the evaluation of the returns of an asset. Thus any information that improves our understanding of the impact of T-Bill Rates on the return of assets, improves our knowledge and predictability of asset price movements.

2.8 THE STOCK EXCHANGE AS A PREDICTOR OF THE ECONOMY

2.8.1 Centra] Bank of Kenya Statistics

Central Bank of Kenya's (CBK) monthly economic review reports the performance of the Nairobi Stock Exchange (NSE) as one of the economic indicators. The report includes the movements of the NSE-20 price index as well as percentage (%) trade turnover in securities listed at the Nairobi Stock Exchange (NSE) and the performance of the 91 day Treasury bill. This suggests that the CBK is aware of the importance of the NSE as a "predictor" of the economy and hence to some extent is aware of the association between changes in economy and movements in the NSE 20 share index. LawTence Kudlow, Chief Economist for CNBC, the leading financial news television network in the world, says that "The stock market index signals to the government the 'feel good' factor prevailing in the economy" Kudlow (2001). As much as the finance ministry may want to ignore it, the performance of the stock market right after the introduction of the budget gives an immediate feedback to the Finance Minister about the acceptability of the budget.

This study is based on the premise that the performance of the Nairobi Stock Exchange is indicative of the country's economic performance and that the interest rate of Treasury bills is a significant factor impacting on the pricing of assets on the exchange. The stock market has traditionally been viewed as an indicator or "predictor" of the economy. Many believe that large decreases in stock prices are reflective of a future recession, whereas large increases in stock prices suggest future economic growth.

2.8.2 The NSE -20 Price Index

The NSE - 20 Index is considered effective and representative, Odhiambo (2000). Critics have also expressed doubt in the accuracy of the NSE-20 index itself citing the fact that out of all the business entities registered in the country as at December 2002, only 51 companies are quoted. In countries where over 70 percent (%) of organizations have their stocks traded in the stock exchanges, it is reasonable to assume that performance on the stock exchange mirrors performance of the economy. Thus a fundamental question of the representative nature as well as the effectiveness of the index arises, Odhiambo (2000). Stock market indices are designed to be consistent, transparent and representative.

A good Stock Index captures the movement of the well diversified and highly liquid stocks. For a lay man it is the pulse rate of the economy. Index movements reflect the changing expectations of the stock market about future dividends of the corporate sector. When constructing an effective stock index certain parameters are carefully considered. This includes: Liquidity - liquidity of stocks as measured by the "impact cost" criterion which determines the cost faced when actually trading the index; Diversification - to cancel out stock noise which is essentially the individual stock fluctuations and to reduce investor's risks. An index must thus have a balanced representation of all sectors; Optimum size - More stocks lead to greater diversification but the limiting factor is the size of the index. There exist a number of stocks that if included in an index i.e. from 10 to say 30 contribute to risk reduction; but increasing the number beyond a point does very little in risk reduction. Further it might lead to addition of illiquid stocks; Market Capitalization: The index should include primarily the stocks of companies that have significant market capitalization with respect to the index such that any major change in the price of the stock is reflected in the index;

Averaging - Every stock primarily moves for two reasons: The news about the company and the news about the country. An ideal index is affected only by the latter, that is the news of the economy and the effect of the former is knocked out by proper averaging.
Stock market indices are designed to be consistent, transparent and representative. A good Stock Index captures the movement of the well diversified and highly liquid stocks. For a lay man it is the pulse rate of the economy. Index movements reflect the changing expectations of the stock market about future dividends of the corporate sector, Shah and Thomas, (2000).

The index is calculated by finding the weighted average of the prices of the most actively traded companies in the market, where the weights are generally in proportion to the market capitalization of the company. When constructing an effective stock index certain parameters are carefully considered such as liquidity of stocks as measured by the "impact cost" criterion which determines the cost faced when actually trading the index. By putting stocks of various sectors that reflect the economy, diversification is used to cancel out stock noise which is essentially the individual stock fluctuations and to reduce investor's risks. An index must thus have a balanced representation of all sectors. More stocks lead to greater diversification but the limiting factor is the size of the index. Increasing number of stocks in an index from 3 to say 30 might result in a sharp reduction in risks. However, increasing the number beyond 30 does very little in terms of risk reduction. Further increase in the numbers might lead to addition of illiquid stocks, Evans and Archer (1968).

The index should include primarily the stocks of companies that have significant market capitalization with respect to the index such that any major change in the price of the stock is reflected in the index, Cowles Commission (1939). Every stock primarily moves for two reasons; Firstly, the news about the company and secondly, the news about the country. An ideal index is affected only by the latter, that is the news of the economy and the effect of the former is knocked out by proper averaging Economic Times India (2000). Index revision is done periodically taking into consideration the factors mentioned above. The relevant index body makes clear, researched and publicly documented rules for this purpose. These rules are applied regularly, to obtain changes to the index set. However, it is ensured that the value of the index does not change significantly after the revision of the index set.

In building the foundation for this study, it is important to establish the fact that the performance of the stock exchange is a predictor of the economy, and hence the study of any factor that significantly affects the prices of assets within the exchange is of importance not only at the stock market but at a national level. Theoretical reasons for why stock prices might predict economic activity include traditional valuation model of stock prices and the "wealth effect".

2.8.3 Traditional Valuation Models

The traditional valuation model of stock prices suggests that stock prices reflect expectations about future economy, and can therefore predict the economy Fernandez (1999), Modigliani and Miller (1958) and (1963), Myers (1974), Arditti and Levy (1977), The stock market is forward looking, and current prices reflect the future earning potential, or profit of corporations. The valuation of a share today is a function of cash inflows expected by investors and the risk associated with those cash inflows. Cash inflows consist of expected dividends during the period the investor holds the share and the capital gains made when the share is sold. The risk associated with the asset is measured by the summation of the deviations of the future rate of return against the expected rate of return Pandey (1999). Since stock prices are forward looking and reflect expectations about profitability and profitability is directly linked to economic activity, fluctuations in stock prices are thought to indicate the direction of the economy Comincioli (1996).

Many investors evaluate their stock portfolios on their inherent value. The inherent value is the total expected earnings of the company over a time period, discounted by the fact that a shilling today is not worth as much as a shilling tomorrow (time value of money). If investors believe that a recession is coming, then they will believe that company earnings will be less in the future (since that typically takes place in a recession) which will decrease the inherent value of the stock. When the inherent value of the stock is far below its current price, investors will sell the stock, driving the price of the stock down Comincioli (1996).

If investors believe a boom is coming, they will increase their estimates of the inherent value because future earnings should be higher than they previously expected. Often this will lead to the inherent value being far higher than the current price of the stock, so investors buy the stock. This leads the price of the stock to rise. It is because a large number of investors act on this inherent value principle that the economy tends to follow the stock market. Investors are constantly watching macroeconomic variables to try and determine when the next downturn in the economy will happen. Investors are often right when they predict the future growth rate of the economy Federal Reserve Bank of Dallas (2001).

2.8.4 Wealth Effect

The "wealth effect" holds that stock prices lead economic activity by actually causing what happens to the economy. Dynan and Dean (2001) argue that since fluctuations in stock prices have a direct effect on aggregate spending, the economy can be predicted from the stock market. When the market is rising, investors are wealthier and spend more. As a result, the economy expands. On the other hand, if stock prices are declining, investors are less wealthy and spend less. This results in slower economic growth.

As people get wealthier, they consume more. This wealth effect has important consequences for monetary policy. When there is an interest rate increase, future income from assets such as equities must be discounted at a higher rate than before. As a result their owners feel poorer and spend less. A cut in interest rates has the opposite effect. The stock market as an indicator of economic activity has a lot of controversy associated with it. Opponents of this idea site the case of the strong economic growth that followed the 1987 market crash as solid ground to doubt the stock market as an indicator of future economic performance.

2.8.5 Initial Public Offerings (IPOs)

Another stock market phenomenon that supports the idea of the stock market as a predictor of the economy is traceable to new stock issues or Initial Public Offerings (IPO's). Corporate growth opportunities require fresh or additional capital. IPOs are associated with favorable ***economic windows of opportunity.*** Corwin and Schultz (2005) note that a liquid secondary market is a critical component in a successful initial public offering (IPO). For underwriters, a liquid market can reduce or eliminate the costs of providing stabilization. Initial liquidity may also reduce the costs faced by market makers who act as the trader of last resort. For investors, a liquid market can reduce transaction costs and lower volatility in the immediate aftermarket. Finally, a liquid market can improve the issuing firm's future access to capital markets by attracting analysts or investors.

These windows of opportunity are further enhanced by other factors such as the favorable status of the industry in question. This is almost self-enforcing because an industry not performing well is plagued with employee unrest and unfavorable business policy and thus unattractive in the eye of the investors. A firm in such an industry finds it hard to successfully launch an IPO.

2.8.6 Turning the Corner into Profitability

Investors are interested in corporations that show a trend of improving profits over time. Lowry and Schwert (2002) find that firms tend to file IPOs following periods of high initial returns because the high returns reflect positive information learned during the registration periods. More positive information results in higher initial returns and more companies file IPOs soon thereafter. Thus a loss making organization with no strategies for turning around its performance other than an IPO will not be received favorably by the stock market.

2.8.7 Logical Set of Buyers for Assets

This is difficult to explain but is nonetheless an important concept with respect to the timing of an IPO. Specifically, does the nature of business make the deal appropriate for institutional or retail investors, and is it appropriately sized for the buyers? For example, most biotechnology deals today are bought exclusively by institutional investors. This is because they are far too complex for individual investors to understand. Paul Monica (2005) writing for CNN/Money notes that IPO's are glamorous. Investors craved debuts from companies in hot areas of technology, especially the Internet sector and biotechnology. But this year, being boring is all the rage with investors opting for traditional industries like oil and gas. Thus the timing of IPOs is another phenomenon that reinforces the fact that the stock market is a predictor of economic performance.

2.9 LOCAL STUDIES ON PREDICTING RETURNS OF THE NSE

As mentioned previously in this document students of finance and professionals within the finance and economic sector in Kenya have been interested in the performance of assets on the NSE and the ability to predict the same using various factors. The studies are mainly the unpublished MBA thesis projects presented at the University of Nairobi and a few published articles by professionals in the Institute of Policy and Research (IPAR) Kenya.

Njaramba (1990) carried out a study to determine which of the two figures, earning before extraordinary items and earnings after extraordinary items has a stronger effect on stock prices. Using OLS regression he concluded that there was no significant difference between the strength of the relationship before or after extraordinary items. His study used data spanning 1st January 1978 to 31st December 1988.

Kerandi (1993) examined the predictive ability of the Dividend Valuation Model on ordinary shares on the NSE. He noted the difference between the predicted price using the dividend valuation model and the actual price and subjected the difference to a t-test analysis. He concluded that the dividend model is a poor predictor of share prices on the NSE.

Gathoni (2002) explore the extent to which three valuation ratios, namely price earning ratio, dividend yield, and price sales ratios affected the returns of assets on the NSE during the period 1996 to 2000. She used OLS regression and concluded that the ratios have predictive value only in some cases.

Akwimbi (2003) investigated the relationship of NSE stock returns to selected market and industrial variables. He focused on loans, interest on savings among others and concluded that there is no significant relationship between these factors and the returns of assets on the stock exchange.

Rioba (2003) carried out a study to determine the predictability of ordinary stock returns for selected securities listed on the NSE using recursive least squares regression. He concluded that the predictability evidence for ordinary' shares is weak and not conclusive.

iMutunga (2003) set out to establish whether there is any significant difference in the returns of Low Price/Earnings (P/E) ratio stocks and High P/E ratio stocks for companies quoted on the NSE. He found that there is no statistically significant difference in either of these returns, and concluded that these investment strategies do not apply to the Kenyan market and recommended that investors should use other investment strategies in choosing assets to include in their portfolios.

2.10 UNIQUENESS OF THIS STUDY

The above studies, regardless of accepted theories and principles of finance and a wealth of literature to fall back against have all yielded inconclusive evidence in predicting the returns of assets on the NSE. This clearly indicates that practical considerations on the ground do not necessarily agree with the theory of the day and compels finance scholars and professionals to explain why there is a discrepancy between reality and theory. This study is unique in that it examines the impact of Treasury Bills on NSE asset returns, a factor that has not as yet been investigated by previous projects. It will examine the Kenyan economic setting by examining the trends between T-bill rates and asset returns and compare these results with theory.
The study is also unique in that it utilizes an analysis model other than OLS regression to predict the asset returns. As mentioned previously, GARCH has been gaining huge success and popularity in academic and professional financial circles since its introduction by Engle in 1920 and its significant enhancement by Bollerslev in 1996. The deluge of GARCH material and its ability to capture the volatility inherent in financial data has prompted its use in this study. OLS Regression limits the variance over time to a constant usually referred to as the "error" term. The term itself "error" is a misnomer as it suggests a parameter that is captured as a "by the way", yet statistic theory has shown that residuals in financial data are rich in volatility content.

2.11 GARCH

GARCH stands for Generalized Autoregressive Conditional Heteroskedasticity. Heteroskedasticity is the time-varying variance i.e., volatility. Conditional implies a dependence on the observations of the immediate past, and autoregressive describes a feedback mechanism, by which past observations are incorporated into the present. GARCH then is a mechanism by which past variances are included in the explanation of future variances. More specifically, GARCH is a time series modeling technique by which past variances and past variance forecasts are used to forecast future variances.

ARCH models were introduced by Engle (1982) and generalized as GARCH (Generalized ARCH) by Bollerslev (1986). These models are widely used in various branches of econometrics, especially in financial time series analysis, Bollerslev, Chou, and Kroner (1992) and Bollerslev, Engle, and Nelson (1994). Estimates of asset return volatility are used to assess the risk of many financial products. Accurate measures and reliable forecasts of volatility are crucial for derivative pricing techniques as well as trading and hedging strategies that arise in portfolio allocation problems.

Financial return volatility data is influenced by time dependent information flows which result in pronounced temporal volatility clustering. These time series can be parameterized using Generalized Autoregressive Conditional Heteroskedastic (GARCH) models. It has been found that GARCH models can provide good in-sample parameter estimates and, when the appropriate volatility measure is used, reliable out-of-sample volatility forecasts. Empirical studies on financial time series have shown that they are characterized by increased conditional variance following negative shocks (bad news). The distribution of the shocks has also been found to exhibit considerable leptokurtosis. Since the standard Gaussian GARCH model cannot capture these effects various GARCH model extensions have been developed.

On a purely statistical level, non-constant variance (heteroskedasticity) constitutes a threat to inference as it biases the standard errors of coefficients. The standard approach to heteroskedasticity is to employ a number of "corrections" to overcome the statistical problems involved (e.g., White 1980). However, the presence of heteroskedasticity in a model can also indicate an underlying process that is theoretically interesting. In time series data, the unconditional, or long run, variance from a model may be constant even though there are periods where the variance increases substantially. These eruptions of high variance in some periods can be indicative of contextual volatility often hypothesized to occur in financial markets or public opinion. Mean models often fail to capture this dynamic because increases or decreases in conditional variance do not necessarily imply a change in the expected mean of the data.

2.11.1 The ARCH Specification

In developing an ARCH model, you will have to consider two distinct specifications—one for the conditional mean and one for the conditional variance. In the standard GARCH (1,1) specification:

y, = XJ + E,. . . . . **Equation 2.4**

cr² = *CO* + af,²., + *($<j]A.* . . . . **Equation 2.5**

Where

y_t = mean equation

cr,² = conditional variance equation

a = the mean

£²., = News about volatility from the previous period, measured as the lag of the squared residual from the mean equation i.e. the ARCH term.

cr²., = Last period's forecast variance i.e. the GARCH term

The mean equation given in (4) is written as a function of exogenous variables with an error term. Since cr,² is the one-period ahead forecast variance based on past information, it is called the conditional variance. The conditional variance equation specified in (5) is a function of three terms namely the mean, the ARCH term and the GARCH term. The (1, 1) in GARCH (1,1) refers to the presence of a first-order GARCH term (the first term in parentheses) and a first-order ARCH term (the second term in parentheses). An ordinary ARCH model is a special case of a GARCH specification in which there are no lagged forecast variances in the conditional variance equation.

This specification is often interpreted in a financial context, where an agent or trader predicts this period's variance by forming a weighted average of a long term average (the constant), the forecasted variance from last period (the GARCH term), and information about volatility observed in the previous period (the ARCH term). If the asset return was unexpectedly large in either the upward or the downward direction, then the trader will increase the estimate of the variance for the next period. This model is also consistent with the volatility clustering often seen in financial returns data, where large changes in returns are likely to be followed by further large changes. There are two alternative representations of the variance equation that may aid in the interpretation of the model. If we recursively substitute for the lagged variance on the right-hand side of (2), we can express the conditional variance as a weighted average of all of the lagged squared residuals:

$$cr: = \frac{\quad}{i - p} + a \overset{ao}{\underset{1}{V}} B^{jA} e\} , \qquad \textbf{Equation 2.6}$$

We see that the GARCH (1,1) variance specification is analogous to the sample variance, but that it down-weights more distant lagged squared errors.

The second representation the error in the squared returns is given by v, = ef - erf. Substituting for the variances in the variance equation and rearranging terms we can write our model in terms of the errors:

$$f,^2 = CD + (a + \quad + V, - \quad fiv_{tA} \qquad \textbf{Equation 2.7}$$

Thus, the squared errors follow a heteroskedastic ARMA (1, 1) process. The autoregressive root which governs the persistence of volatility shocks is the sum of a and/?. In many applied settings, this root is very close to unity so that shocks die out rather slowly. To gain theoretical purchase on conditional volatility, it can be useful to model the variance directly by introducing theoretically relevant variables that may account for the heteroskedastic nature of the disturbances. This has the advantage of increasing the efficiency of estimates in the mean model while providing substantive information about the variance process.

2.11.2 The Case for Using GARCH Analysis

One problem with using regular linear regression to evaluate the data of TBills Interest Rate and returns of various stocks on the NSE is that whilst it gives us an idea of the implied volatility taking into account the current view of the market, it does not give us any insight into possible future changes in volatility. Given that the value of a stock is primarily driven by the risk (volatility) and expected return, making predictions is a valuable tool from a practitioner's perspective.

GARCH is well suited to modeling the volatility and adjusting the original modeling equation using the information obtained from the analysis of the variances. The most striking feature is that periods of high volatility tend to cluster together. Therefore, one would expect the volatilities to be correlated to some extent. The other noticeable feature is that the volatility tends to revert to some long-running average - a property commonly known as mean-reversion. The mean-reversion nature of the volatilities helps ensures that the process remains statistically stationary. It is these characteristics of the residuals that lend themselves to the GARCH process. The various graphs for all the market segments reveal a similar trend.

Lubrano (1998) notices that simple GARCH is not effective in describing the transition between two regimes denoted by a threshold. Indeed a cursory examination of time series data shows that there are sharp transitions from positive to negative and from low values of positive to very high values of positive. He introduced a new class of GARCH models that allows for a smooth transition and named it STGARGH - Smooth Transition GARCH. As financial data have very often a high frequency of observation, a smooth transition seems a priori better than an abrupt transition. Engle and Ng (1993) found that the most severe misspecification direction was that the tested models did not take adequately account for the sign asymmetry. The smooth transition model addresses the problem of sign asymmetry. It is more than a simple generalization of the TGARCH as it allows for various transition functions that assure a great flexibility to the skedastic function, taking into account sign but also size effects. Finally the specification retained accepts the simple GARCH as a restriction.

2.11.3 **Modeling** Financial **Returns Volatility**

In this section we take a week as the unit time interval and identify return as the continuously compounded weekly asset return r, expression for r_t is then:

$r, = Logip,) - Log(p,\_\backslash)$ .... **Equation 2.8**

Where Log denotes the natural logarithm and is the asset's (close of trade) value on week *t*. The weekly return volatility on week *t* is then

If a standard GARCH (1,1) model is assumed then a one step-ahead out-of-sample weekly volatility forecast can be constructed as:

$^{a}i*l = {}^{a}o + {}^{a}\backslash {}^{e}i +$ .... **Equation 2.9**

Where

$S_t = y, -b_Q- xjb_x$ .... **Equation 2.10**

And

$°V^2=i = {}^{r}i*\backslash^2$ **Equation2.il**

However, empirical research has shown that GARCH is not good a estimator of r,*, and that much improved volatility forecasts can be obtained if high frequency (daily or intraday) returns data are taken into account.

To be specific, if the asset price is sampled m times per day then the following returns are generated:

$r_{(m),} \quad = L0g(p,) - L0g(p,_{\_Vm})$. . . . . **Equation 2.12**

Where

t - Mm, 2/w,... Etc. and the cumulative squared returns (CSR) for day $t + 1$ are:

$^{CSR}\{m), +l$ = X ^{r} i) ' + l$ (with $\underline{m}$ above) . . . . **Equation 2.13**

If CS7?$_{(m)(+1}$ is used instead of $r,^{2}_{+l}$ then standard GARCH models can provide satisfactory volatility forecasts. In fact the quality of these forecasts has been found to increase monotonically as the sampling frequency (m) increases.

3.0 CHAPTER THREE - METHODOLOGY

3.1 THE POPULATION AND THE SAMPLE

The study uses all the securities listed in the Nairobi Stock Exchange (NSE) as the and their various market segments as the dependent variable and the 30-day treasury bill rate as the independent variable. The securities are divided into various categories in order to get a clearer picture of the impact of Treasury Bill Rate impact on the market as a whole, the companies that constitute the NSE - 20 Share Index, and the companies that make up the various market segments, namely Financial and Investment, Agriculture, Commercial and Services, and Industrial. This data is readily available from the NSE and the Central Bank of Kenya and has been validated as accurate and circulated for use by researchers in other sectors of the economy.

The sample consists of securities comprising the calculation of the NSE 20 share index. The government security is the 90-day Treasury bill. The period of the study is 5th April 1996 to 21st Dec 2001. The stock prices that are captured relate to the firms that are quoted within the NSE. Although these firms cover a broad spectrum of industries, attention is given to those firms that make up the NSE-20 Index based on the assumption that the index is accurate and representative. The sample is further broken down into the various market segments in order to get a clearer understanding of the impact of the TBills interest rate. The study is limited to the period 1996 to 2001 since data is readily available during this period. After 2001, the Alternative Market Segment was introduced which caused the original groupings of companies to be altered.

3.2 DATA COLLECTION

In this study, secondary data sources from the NSE and annual reports of listed companies will be employed. Annual share prices after being adjusted for dividends, seasonal equity offerings and stock splits, if any, will be used in calculating security returns and risk. The data relating to 90-day Treasury bill will be sourced from Central Bank of Kenya database which is available from their web site. These are official keepers of the data to be used in this study. In the empirical analysis below, focus is brought to bear on the behavior of stock prices on the Nairobi Stock Exchange from 1996 to Dec 2001. The trend is compared to that of the interest rate on the 90-day Treasury bill for the same period of time. Although data is available from 2001 until 2005, there is a break in the nature of the data in that the Alternative Market Segment was created, which resulted in the re-distribution of companies from their original market segments to the Alternative Market Segments. Data pertaining to the Treasury Bills is from the Central Bank of Kenya.

3.3 THE VARIABLES AND THEIR MEASUREMENTS

We have two assets whose return and risk we need to compute. These are stocks and the 90-day Treasury bill.

3.3.1 Return on Stocks and Market Index

Annual return R, of an asset is calculated as follows:

$$R_i = \frac{P_t - P_0 + D_t}{P_0} \qquad \textbf{Equation 3.1}$$

Where:

R_i = Return on asset (stock) i

P_t = Price of share (stock) at period t

P_0 = Price of share (stock) at period M

D_t = Dividend paid during the period on stock

The above formulation will be used in calculating return on stocks that constitute NSE 20 share index on a weekly basis. The weekly frequency is dictated by the fact that T-bill interest rates are released in most cases weekly and the fact that a larger time scale, with more intervals of data improves the precision of estimates. The return will then be converted into weekly annual returns to be comparable to Treasury bill rates reported by weekly by Central Bank of Kenya.

3.3.2 Market Return

This will be based on NSE 20 share market index. Market index is a collection of securities whose prices are averaged to reflect the overall investment performance of a particular market for financial assets. The market return R_m for the purpose of this study is a series of average of weekly returns of each firm stock constituting the index:

$$R = \frac{(R_{u}+R_{2l}+R_{ir}..R_{nl})}{n} \quad \text{Equatjon 3 2}$$

Where:

R_m = the market return

R_u = Return on stock of the first company in week t

n = The number of company in the index

3.3.3 Returns 91 Day Treasury Bills

The calculation of returns on treasury bills is different. The treasury bills are issued on a discount basis. All are issued in book entry form i.e. the buyer receives a receipt at the time of the purchase and treasury bills face value at the time of maturity. The return on treasury bills is calculated by solving for r_{lb} in the following function:

$$PP_{lb} = \frac{MV}{(1 + r\ j}$$ **Equation 3.3**

Where:

PP_{lb} = Purchase price of the treasury bills.

MV = Maturity value or face value of treasury bills

r_{tb} = The return on treasury bills.

n = The period to maturity

3.3.4 Risk

Stock returns may be riskier or more volatile than treasury bills. However capturing risk inherent in a financial asset is a difficult. To capture risk we borrow heavily from statistics. The concept we borrow is standard deviation. Standard deviation is a summary measure about the average spread of observations. It is the square root of the variance, which is calculated as:

$$a^2 = \frac{1}{T-1} \; t \; -\bar{R}]^2 \quad \text{..... Equation 3.4}$$

We use standard deviation as a measure of investment risk. We calculate variability in return on assets such as return on shares (stock) and treasury bills

3.4 DATA ANALYSIS

The numbers in both sets of data are converted in their logarithms. This non-linear logarithmic conversion of data is very useful when comparing the interest rate of T-bills with the changes in stock prices. By converting the data into logarithms the variability becomes roughly the same within each group (homoscedasticity) Maestas and Gleditsch (1998). Often groups that tend to have larger values also tend to have greater within-group variability. A logarithmic transformation will often make the within-group variability more similar across groups. This is especially useful for the stock prices. It is also easier to describe the relationship between the variables when it's approximately linear. Logarithmic transformations are helpful when constructing statistical models to describe the relationship between two measurements which in their original form seem to have no linear correlation.

Finally, logarithms also play an important role in analyzing probabilities. Statisticians have developed many techniques for fitting straight-line models to predict a variety of outcomes. There is a problem when using these methods to model probabilities. The estimated probabilities can be less than 0 or greater than 1, which are impossible values. Logistic regression models the log odds (odds = probability/ (1-probability)) are used instead. While probabilities must lie between 0 and 1 (with a neutral value of 1/2), odds are ratios that lie between 0 and infinity (with a neutral value of 1). It follows from the discussion two paragraphs above, that log odds can take on any value, with a neutral value of 0 and the log odds in favor of an event being equal in magnitude and opposite in sign to the same odds against the event.

Earlier studies modeled the relationship between stock returns and TBill returns using regression analysis. Such studies overlooked the possibility that when time series data are used in regression analysis, often the error term is not independent through time. Instead, the errors are serially correlated or autocorrelated. If the error term is autocorrelated, the efficiency of ordinary least-squares (OLS) parameter estimates is adversely affected and standard error estimates are biased.

In this study, it is assumed that the error term is varying or increasing with each observation due to the time series nature of the data. Each set of data represents a different week which introduces its own errors into the data. The use of an autoregressive conditional heteroskedasticity (ARCH) model considers the variance of the current error term to be a function of the variances of the previous time period's error terms. In this particular case an autoregressive moving average model is assumed for the error variance, thus resulting in the use of a generalized autoregressive conditional heteroskedasticity (GARCH) model. The Autoregressive Conditional Heteroskedasticity (ARCH) model introduced by Engle (1982) allows the variance of the error term to vary over time, in contrast to the standard time series regression models which assume a constant variance. Bollerslev (1986) generalized the ARCH process by allowing for a lag structure for the variance. The generalized ARCH models, i.e. the GARCH models, have been found to be valuable in modeling the time series behavior of stock returns Baillie and DeGennaro, (1990), Akgiray (1989), French et al. (1987), Koutmos (1992), Koutmos et al. (1993). Bollerslev (1986) allows the conditional variance to be a function of prior period's squared errors as well as of its past conditional variances. The GARCH model has the advantage of incorporating heteroskedasticity into the estimation Procedure.

3.5 ROAD MAP OF DATA ANALYSIS

The data will be put through basic data analysis to get a feel for the behaviour of the data in its raw format and also in its transformed format.

1. A basic correlation analysis will be carried out on the TBills Interest Rate on an annual basis and that of the stock returns for the various market segments. The purpose of this analysis will be to determine if TBills Rate are independent when compared to the rate of return of stocks. Only then can we make a decision as to whether we are dealing with a dependent and independent variables or dealing with a case of factor analysis.

2. The second step will be to analyze the distribution of TBills Interest Rates and see whether their distribution is linear or non-linear. The results from this step will help us narrow down the type of data transformation that will be required at advanced stages of the analysis.

3. The distribution of the returns of the various market segments will be undertaken to determine if the distribution is normal. The distribution of the various market segments will indicate whether the data needs to undergo a data transformation in order to come up with an appropriate relationship model between rate of return and TBills Interest Rate.

4. A test to determine whether the data is uniformly distributed will be the final descriptive test for the data. Presence of uniform distribution is an important assumption for carry ing out various statistical tests. If the data does not have a uniform distribution it is important that we establish this fact and seek alternative analysis methods or transform it to obtain the desired characteristics.

5. The next step in accordance to the literature review is to establish the presence of autoregression within the residuals of the various market segment returns. This will be done using the Durbin Watson test and the ARCH LM Test. The Durbin-Watson test statistic is designed for detecting errors that follow a first-order autoregressive process. This statistic also fills an important role as a general test of model misspecification.

6. If the tests are positive for GARCH we will run ordinary linear regression and compare the results to GARCH (1, 1) and other higher order GARCH models and test to see if the GARCH estimation has a better "goodness of fit" compared to OLS regression.

7. The graphs of the various returns over time will then be analyzed to examine the behaviour of the market segments when TBills rise and fall. The points for examination will be generated from the TBill Graph's high and low points.

4.0 CHAPTER FOUR - DATA ANALYSIS AIS'D FINDINGS

The process of data analysis is governed by the Road Map that was described in Chapter Three. It starts from basic analysis of the data to determine its properties, these form the basis for the various analysis that the data will be subjected to during the analysis stage. The analysis then graduates to more specific analysis of graphs, which gives us a better feel for the behaviour of the data not only in general but across certain time periods. Finally the data is subjected to OLS Linear Regression and GARCH regression and the results are obtained. The comparison of these two analysis techniques forms the final part of the analysis as we examine the best fit model for each market sector.

LEGEND OF ABBREVIATIONS USED IN THE DATA ANALYSIS	
AllRetnA	Returns for the entire Nairobi Stock Exchange taken on an annual basis
AgrRetA	Returns for the Agricultural Market Segment taken on an annual basis
Com Ret A	Returns for the Commercial and Services Segment taken on an annual basis
FinRetA	Returns for the Financial and Investment Segment taken on an annual basis
IndRetA	Returns for the Industrial and Allied Segment taken on an annual basis
TBills R	Returns for the Treasury Bills taken on an annual basis
NSEIRetA	Returns for the for the NSE - 20 Share Price Index taken on an annual basis

Table 4.1 - LEGEND OF ABBREVIATIONS USED IN THE DATA ANALYSIS

4.1 CORRELATION ANALYSIS

The correlation between two variables reflects the degree to which the variables are related. The most common measure of correlation is the Pearson Product Moment Correlation (p). Pearson's correlation reflects the degree of linear relationship between two variables. It ranges from +1 to -1. A correlation of+1 means that there is a perfect positive linear relationship between variables. A low p-value for

this test (less than 0.05 for example) means that there is evidence to reject the null hypothesis in favor of the alternative hypothesis, or that there is a statistically significant relationship between the two variables. The null hypothesis in this case states that there is no correlation Ho: $\boldsymbol{p} = 0$

And the alternative hypothesis states that there is a correlation Hi: $\boldsymbol{p} <> 0$

p - value < 0.05 there is evidence to support correlation

p - value > 0.05 there is evidence to support no correlation

The purpose of earning out the correlation analysis is to determine whether there is a relationship between any of the dependent and independent variables. If a strong correlation exists, then the analysis shifts to factor analysis as opposed analysis of independent variables. This is important so as to ensure that the analysis technique employed is suitable for the type of data we have.

CORRELATION ANALYSIS OF THE VARIOUS MARKET SEGMENTS

		A	B	C	D	E	F
		NSEIRetA	**AIlRetnA**	**AgrRetA**	**ComRetA**	**FinRetA**	**IndRetA**
1.	**AIlRetnA**	**0.720**	**The p value « 0.05 and hence supports the fact that there is a strong correlation**				
		0.000					
2.	**AgrRetA**	**0.434**	**0.379**	**The p value « 0.05 and indicates there is evidence to support correlation, albeit a weak form of correlation**			
		0.000	**0.000**				
3.	**ComRetA**	**0.256**	**0.506**	**0.052**	**Weak form of correlation for all except C3 which indicates that there is evidence to reject existence of correlation.**		
		0.000	**0.000**	**0.373**			
4.	**FinRetA**	**0.617**	**0.709**	**0.158**	**0.212**	**Weak correlation for all except B4 which indicates strong correlation**	
		0.000	**0.000**	**0.006**	**0.000**		
5.	**IndRetA**	**0.471**	**0.772**	**0.148**	**0.191**	**0.365**	**Weak correlation except for B5 which has strong correlation**
		0.000	**0.000**	**0.000**	**0.000**	**0.000**	
6.	**TBills R**	**0.090**	**0.050**	**0.144**	**0.042**	**-0.006**	**-0.040**
		0.121	**0.389**	**0.013**	**0.472**	**0.924**	**0.491**

The p value » 0.05 and indicates there is no correlation with the exception of C6 which indicates there is evidence to accept the existence of a very weak form of correlation

Table 4. 2 - CORRELATION ANALYSIS OF THE VARIOUS MARKET SEGMENTS

The data above shows that a strong correlation exists between AllRetA and NSEIRetA. This is a good indication because it indicates that the NSEI - 20 Share Price Index is a good estimator of overall market performance. Worthy of note is the strong positive correlation between the Financial and Investment Sector and the Industrial and Allied Sector and the returns of the market in its entirety. This strong positive correlation is made more interesting when one notes the lack of similar correlation between these sectors and the NSEIRetA.

In general, the data shows that there is very little correlation between the Treasury Bill Interest and the various market segments. As such, the Treasury Bills Interest Rate can be used as an independent v ariable in the analysis of the various market segments as well as the entire market. This eliminates the need for factor analysis and allows us to proceed to the next step of our examination.

4.2 IS THE DATA LINEAR?

This stage of the data analysis examines the nature of the data for its linearity purposes. This is because non-linear data will have to be subjected to logarithmic transformation in order to prepare it for analysis via techniques that require the data to be linear. The result of the various graphs - APPENDIX 4 tables 4.3 to 4.9 indicates that all the data is non linear in nature, and may need logarithmic transformation for purposes of further analysis especially when using OLS regression. GARCH analysis does not require the data to be linear in nature in order to give reliable results.

4.3 ANALYSIS OF DISTRIBUTION TRENDS

Kurtosis is a parameter that describes the shape of a random variable's probability density function (PDF). A normal random variable has a kurtosis of 3 irrespective of its mean or standard deviation. If a random variable's kurtosis is greater than 3, it is said to be leptokurtic. If its kurtosis is less than 3, it is said to be platykurtic. The Jarque-Bera is a statistic that shows if a sample could have been drawn from a normal distribution. It relies on the statistics of kurtosis and skewness. The statistic is computed as:

$JB = — - [S^2 + - (* - 3)^2]$. . . . . **Equation 4.1**

6 4

Where S is the skewness, K is the kurtosis, and k represents the number of estimated coefficients used to create the series. Under the null hypothesis of a normal distribution, the Jarque-Bera statistic is distributed as with 2 degrees of freedom. The reported Probability is the probability that a Jarque-Bera statistic exceeds (in absolute value) the observed value under the null—a small probability value leads to the rejection of the null hypothesis of a normal distribution. A Jarque-Bera statistic of 0 indicates that the distribution has a skewness of 0 and a kurtosis of 3, and is therefore judged to come from a normal distribution. Skewness values other than 0 and kurtosis values farther away from 3 lead to increasingly large Jarque-Bera values.

Ho: The distribution is not normal

Hi: The distribution is normal

NORMAL DISTRIBUTION SUMMARY - TABLE A

		A	B	C	D	E	F	G
	Series Name	**Mean**	**Std. Dev**	**Skewness**	**Kurtosis**	**Jarque-Bera**	**Prob.**	**Status**
1.	**TBills Rate**	**17.44**	**005.93**	**0.13**	**01.60**	**25.26**	**0.00**	**REJECT**
2.	**AgrRetA**	**-0.017**	**090.69**	**1.67**	**13.86**	**1610.25**	**0.00**	**REJECT**
3.	**AllRetA**	**0.817**	**076.70**	**2.21**	**13.03**	**1478.53**	**0.00**	**REJECT**
4.	**ComRetA**	**1.815**	**114.97**	**1.06**	**7.288**	**286.15**	**0.00**	**REJECT**
5.	**FinRetA**	**-1.289**	**117.13**	**1.78**	**10.98**	**952.84**	**0.00**	**REJECT**
6.	**IndRetA**	**1.519**	**116.46**	**2.66**	**16.17**	**2517.1**	**0.00**	**REJECT**
7.	**NSElRetA**	**1.584**	**092.09**	**3.07**	**26.13**	**7136.95**	**0.00**	**REJECT**

Table 4.3 - NORMAL DISTRIBUTION SUMMARY - TABLE A

NORMAL DISTRIBUTION SUMMARY - TABLE B								
		A	B	C	D	E	F	G
	Series Name	Mean	Std. Dev	Skewness	Kurtosis	Jarque-Bera	Prob.	Status
1.	Log(TBills Rate)	2.79	0.35	0.17	1.62	25.20	0.003003	REJECT
2.	Log(AgrRetA)	3.42	1.40	-0.70	3.40	14.10	0.000885	REJECT
3.	Log(AIIRetA)	3.48	1.43	-1.12	4.76	40.00	0.000000	REJECT
4.	Log(ComRetA)	3.78	1.24	-0.28	2.89	01.89	0.387173	REJECT
5.	Log(FinRetA)	3.75	1.37	-0.67	3.74	12.94	0.001550	REJECT
6.	Log(IndRetA)	3.65	1.41	-0.51	3.22	05.92	0.051643	REJECT
7.	Log(NSEIRetA)	3.65	1.20	-0.79	4.86	33.00	0.000000	REJECT

Table 4.4- NORMAL DISTRIBUTION SUMMARY - TABLE B

The analysis for normality was carried out on the raw data itself (Table A) as well as on the data that had been transformed using logarithms (Table B). Although Table A above gives very large values for Jarque-Bera the inherent probabilities are very low to the order of 0.00000. This indicates that the distributions of the various market segment returns are normally distributed. Table B gives a better picture with smaller JB statistics ranging from a maximum of 40 for All Returns to 1.89 for Commercial and Services Sector. Further perusal of histograms generated give confirmation to the fact that the data is normally distributed. The above analysis indicates the presence of normally distributed data and hence reassures us that data interpretation using t-statistics, p-values and other methods is acceptable because the data exhibits Gaussian distribution.

The literature review noted that GARCH analysis is well suited to Financial Data Time series due to the unique nature of such data. These properties include "fat tails" - excess kurtosis and volatility clustering, two important characteristics of financial time series. The above test provides information on Kurtosis as well as the presence of the normal distribution of the data. The above analysis confirms that all the market segments depict excess kurtosis whether the analysis is done on the original raw data, or on the data that has undergone logarithmic transformation. It also shows that transformation of data into its logarithmic form gives better results than working on the raw data. The only exception to this rule is TBills data which is not affected by logarithmic transformation. Its Kurtosis and JB Statistic remain consistent across the transformation. This prompts the re-examination of the linear nature of the TBills as obtained in the data analysis of section 4.2 above.

4.4 ONE WAY ANOVA ANALYSIS - SUMMARY DATA

ONE WAY ANOVA ANALYSIS SUMMARY DATA				
Item	**Description**	**F**	**P**	**Conclusion**
1.	NSEIRetA, AllRetA	0.01	0.912	Accept
2.	AllRetA, AgrRetA, ComRetA, FinRetA, IndRetA	0.04	0.996	Accept
3.	AgrRetA, TBills Rate	11.04	0.001	Reject
4.	ComRetA, TBills Rate	5.51	0.019	Reject
5.	FinRetA, TBills Rate	7.63	0.006	Reject
6.	IndRetA, TBills Rate	5.58	0.019	Reject
7.	NSEIRetA, AllRetA, TBills Rate	5.49	0.004	Reject
8.	NSEIRetA, TBills Rate	8.83	0.003	Reject
9.	AllRetA, TBills Rate	13.97	0.000	Reject

Table 4.5 - ONE WAY ANOVA ANALYSIS SUMMARY DATA

The null hypothesis for ANOVA states that the means are equal.

Ho: (xl = \il = ik

The alternative hypothesis for ANOVA states that the means are not equal.

The data above was calculated using a confidence level of 95%. For 1 and 2 above the null hypothesis is accepted indicating that the means of NSEIRetA and AllRetA on an annual basis have equal means with similar dispersion patterns. This is not surprising considering the fact that the NSEI - 20 Share Price is meant to be a proxy for the returns of the entire stock exchange.

The same applies for the means and dispersion patterns of all the different market segments (Financial and Investments, Commercial and Services, Agriculture, Industrial and Allied) matched against the returns of the entire stock market (AllRetA) on an annual basis. Looking at 4 - 10 above, we note that the null hypothesis is rejected, indicating that the Treasury Bills Interest Rate has an impact on the rate

of return of stocks in the various market segments within the Nairobi Stock Exchange as measured on **an** annual basis.

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A	B	C	D	E	F	G
Durbin Watson	D_L	D_U	Type Of Autocorrelation	F Statistic	Prob.	Null Hypothesis

0

4.5 TESTING FOR PRESENCE OF ARCH IN THE VARIABLES

The Durbin Watson statistic is used to test for the presence of first-order autocorrelation in the residuals of a regression equation. The test compares the residual for the time period t with the residual from the time period t-1 and develops a statistic that measures the significance of the correlation between successive comparisons. The statistic is used to test for the presence of both positive and negative correlation in the residuals. The statistic has a range of from 0 to 4, with a midpoint of 2. The Null Hypothesis is that there is no significant correlation. The second part of this analysis will test for conditional heteroskedasticity using White's test. The results will be reflected using the f-statistic and the p-statistic. The Null Hypothesis for Whites test is that there is no Conditional Heteroskedasticity and the alternative hypothesis is that there is presence of conditional heteroskedasticity

Regions of Acceptance and Rejection of the Null Hypothesis				
O-D_l	**D_l** to **Du**	D_L to (4-D_l)	**(4- Dl)** to **(4- DO**	**(4- D_l)** to **4**
0-1.65	1.65-1.69	1.69-2.31	2.31-2.35	2.35-4
Reject Null Ho Positive Autocorrelation	Neither Accept or Reject	Accept the Null Hypothesis	Neither Accept or Reject	Reject Null Ho Negative Autocorrelation

Table 4.6 - Regions of Acceptance and Rejection of the Null Hypothesis

ARCH RESULTS PER MARKET SEGMENT								
		A	B	C	D	E	F	G
Item	**Description**	**Durbin Watson**	**D_l**	**DL**	**Type Of Autocorrelation**	**F Statistic**	**Prob.**	**Null Hypothesis**
1.	**AgrRetA**	**1.58**	**1.65**	**1.69**	**Positive Autocorrelation**	**0.54**	**0.58**	**THERE IS CH**
2.	**AIIRetnA**	**1.36**	**1.65**	**1.69**	**Positive Autocorrelation**	**0.01**	**0.98**	**THERE IS CH**
3.	**IndRetnA**	**1.55**	**1.65**	**1.69**	**Positive Autocorrelation**	**0..23**	**0.79**	**THERE IS CH**
4.	**NSEIRetnA**	**1.49**	**1.65**	**1.69**	**Positive Autocorrelation**	**0.29**	**0.74**	**THERE IS CH**
5.	**ComRetnA**	**1.87**	**1.65**	**1.69**	**No Autocorrelation**	**0.28**	**0.75**	**THERE IS CH**
6.	**FinRetnA**	**1.73**	**1.65**	**1.69**	**No Autocorrelation**	**0.33**	**0.71**	**THERE IS CH**

Table 4.7 - ARCH Results Per Market Segment

The first four columns A, B, C and D give results pertaining to the Durbin Watson Criteria and the last three columns E, F and G give results from White's Test.

The upper and lower limits of the d statistic are given for k=1, and for a confidence interval of 0.05. The null hypothesis states that there is no autocorrelation, otherwise known as ARCH (1)

Ho: There is NO ARCH (1)

Hi: There is ARCH (1)

Interpretation of the results using the upper and lower limits of the Durbin Watson tables for one independent variable and 299 observations, for a confidence level of 0.05 yields a lower limit of 1.65 and an upper limit of 1.69. The residuals of the Commercial and Services Market Segment and the Financial and Investment market Segment, indicate that there is no autocorrelation. The results of 1,2, 3 and 4 indicate that there is positive autocorrelation in the residuals of the returns of stocks in the Agriculture Market Segment and the Industrial and Allied Market Segment. The residuals of the returns of the all the stocks within the market analyzed on an annual basis show that there is autocorrelation present. Autocorrelation is also positive for the residuals of the returns of the stocks of the companies that make up the NSE 20 Index. The results from column E, F and G indicate that all the market segments indicate presence of conditional heteroskedasticity including commercial and services as well as financial and investment segments.

The above result indicates presence of ARCH in the dependent and independent variables and has established the necessary criteria to undertake GARCH analysis.

4.6 ORDINARY LEAST SQUARES ANALYSIS

OLS RESULTS FOR THE DIFFERENT MARKET SEGMENTS						
		A	B		C	D
		F	P	Goodness of Fit	R-Sq	R-Sq (adj)
1.	AllRetnA vs. TBills Rate	0.74	0.389	Reject	0.2%	0.0%
2.	AgrRetA vs. TBills Rate	6.29	0.013	Reject	2.1%	1.7%
3.	ComRetA vs. TBills Rate	0.52	0.472	Reject	0.2%	0.0%
4.	NSEIRetA vs. TBills Rate	0.74	0.455	Reject	0.1%	0.1%
5.	FinRetA vs. TBills Rate	0.01	0.924	Accept	0.0%	0.0%
6.	IndRetA vs. TBills Rate	0.48	0.491	Accept	0.2%	0.0%

Table 4.8 - OLS Results For The Different Market Segments

Ho: Acceptable Goodness of Fit

H1: Unacceptable Goodness of Fit

The above data shows that the summary outputs of subjecting the data to OLS regression. For the sectors indicated in 1, 2, 3, and 4 against TBills Rate there is a poor fit and this yields an adjusted coefficient of determination of 0%, 1.7%, 0%and 0.1% respectively. This means Treasury Bill Rate have a very small impact on the returns of the entire stock exchange as well as the Agriculture, and Commercial and Services sectors. The data shows that for 4, and 5 the goodness of fit is acceptable within a confidence interval of 95%, although the coefficient of determination is very low and yields a 0% explanation between the Treasury Bill Interest Rate and the Financial and Investment Sector and the Industrial and Allied Sector. The number of unusual observations in the various sectors is very high with standardized residuals ranging from 7.10 to -3.48 across the board. This further confirms that fact that T-Bill Rate has an insignificant impact on the return of stocks in the various market segments within the NSE. This is not in keeping with the CAPM model and the APT model which indicate that the T-bill Rate is a key factor in determining the return of an asset.

4.7 GARCH ANALYSIS

The R-squared R^2 statistic measures the success of the regression in predicting the values of the dependent variable within the sample. It is the fraction of the variance of the dependent variable explained by the independent variables. The statistic will equal one if the regression fits perfectly, and zero if it fits no better than the simple mean of the dependent variable. It can be negative if the regression does not have an intercept or constant, or if the estimation method is two-stage least squares. One problem with using R^2 as a measure of goodness of fit is that the R^2 will never decrease as you add more regressors. In the extreme case, you can always obtain an R^2 of one if you include as many independent regressors as there are sample observations. The adjusted/?^{2}, commonly denoted as R^2 , penalizes R^2 for the addition of regressors which do not contribute to the explanatory power of the model. The adjusted R^2 is computed as $R\sim = 1 - (1 - R^2)$——- The Theil inequalitycoefficient

t-k

(TIC) always lies between zero and one, where zero indicates a perfect fit between the forecasted model and the actual terms.

Weak R^2	**0 - 2**	**Weak p statistic**	»	**0.1**
Moderate R^2	**2 - 5**	**Moderate p statistic**	«	**0.1**
Strong R^2	**5 and above**	**Strong p statistic**	«	**0.05**

AgrRetA	Linear Regression	GARCH **(1,1)**	GARCH **(10.1)**
Adj R^2	1.7%	-3.65%	**-8.75%**
f	6.290	(z)-1.6090	**(z)-4.0190**
P	0.013	0.1076	0.0001
Theil IC	0.86	0.88	**0.83**
Goodness of fit	Weak R^2 Strong p-statistic	Moderate R^2 Moderate p-statistic	**Strong** *R~* **Strong p-statistic**
Status	Average Fit	Good Fit	**Excellent Fit**

Table 4.9 - Agricultural Segment - OLS VS GARCH Results

From the above results we observe that the TIC is strong at 0.83 to 0.88 for GARCH (1,1) model. Further analysis into the R^2 statistic, shows that it keeps on improving as we move from linear regression to GARCH (1,1) and gives us the best fit for GARCH (10,1). Thus we can conclude that the GARCH model gives a better fit than the linear regression model across the board when all the statistics are examined.

FinRetA	Linear Regression	GARCH (1,1)	GARCH (5,1)
Adj R^2	0.0%	4.17%	8.1%
f	0.48	(z) 5.4958	3.930
P	0.92	0.000	0.000
TIC	0.987	0.764	0.750
Goodness of fit	Very Weak/?^{2} Poor p-statistic	Moderate R^2 Strong p statistic	Strong *R~* Strong p statistic
Status	Weak Fit	Good Fit	Excellent fit

Table 4.10 - Financial And Investments Segment - OLS VS GARCH Results

The above analysis reveals that the R~ statistic keeps improving as we move from linear regression to GARCH (5, 1) which yields an *R~* of 8.1% compared to 0.0% of Linear Regression. The Theil Inequality Coefficient shows a stronger fit for the linear regression as compared to the GARCH regressions. This is not surprising considering the fact that Annual Returns for the Financial and Services Sector showed no traces of autocorrelation in their residuals.

However, GARCH still gives a better fit when you consider that it gives superior readings for all three parameters.

ComRetA	Linear Regression	GARCH (1,1)	GARCH (10,1)
Adj R^2	-0.16%	-1.54%	**-4.96%**
f	0.5177	0.0922	**(z) 0.1030**
P	0.4723	0.9934	**0.9179**
TIC	0.95	0.907	**0.95**
Goodness of fit	Weak R^2 Weak p-statistic	Weak R^2 Weak p-statistic	Moderate/?^{2} Weak p statistic
Status	Weak Fit	Weak Fit	Average Fit

Table 4.11 - Commercial And Sen ices Segment - OLS VS GARCH Results

The analysis of the annua! returns of the commercial and services sector indicate a strong TIC that ranges from 0.907 to 0.95 for both linear regression as well as GARCH (10, 1). The R^2 statistic keeps improving from -0.16 for the linear regression to -4.96 for GARCH (10, 1). Since the GARCH (10, 1) yields a stronger *R~* than the linear regression equation, and results in similar TICs, the GARCH estimation is deemed superior to the Linear Regression one. Recall, that this market segment tested negative for autocorrelation and this may explain why GARCH and Linear Regression have such strong TIC values.

IndRetA	Linear Regression	GARCH (1,1)	GARCH (10,1)
Adj R2	**0.0%**	**12.80%**	**-3.67%**
f	**0.480**	**9.7800**	**0.1886**
P	**0.491**	0.0000	**0.9992**
TIC	**0.96**	**0.94**	**0.94**
Goodness of fit	Weak R^2 Weak p-statistic	Strong^" Strong p-statistic	Moderate^" Poor p-statistic
Status	Poor fit	Excellent Fit	Average fit

Table 4.12 - Industrial And Allied Segment - OLS VS GARCH Results

The Theil inequality coefficients are very similar ranging from 0.94 for the GARCH models to 0.96 for the linear regression models. However, further analysis shows a marked improvement in the /?' values from 0.00% to 12.8% as well as a p statistic that supports the accuracy of the GARCH (1,1) model at a very high confidence interval. Overall, the GARCH model **presents** a better fit than the linear regression model.

NSEIRetA	Linear Regression	GARCH (1,1)	GARCH (10,1)
Adj R^J	0.47%	-0.49%	-6.91%
f	2.41	0.70851	(z)-1.5280
P	0.12	0.61745	0.1265
TIC	0.91		0.93
Goodness of fit	Weak R^2 Moderate p-statistic	Weak/?^{2} Weak p-statistic	Strong/?" Moderate p-statistic
Status	Poor Fit	Poor Fit	Good Fit

Table 4.13 - NSE - 20 Share Price Index - OLS VS GARCH Results

The *R~* value increases as you move from linear regression to GARCH (10, 1). The TIC statistic also improves as you go to the GARCH (10, 1) model. The GARCH (10, 1) model gives the best fit with a strong adjusted R squared, a moderately strong p statistic and a strong TIC.

AllRetnA	Linear Regression	GARCH (1,1)	GARCH (10,1)
Adj R^2	0.24%	5.77%	-5.15%
f	0.74	4.6528	(z) 0.6560
P	0.39	0.000421	0.5118
TIC	0.95	0.78	0.87
Goodness of fit	Weak/?^{2} Poor p-statistic	Strong/?^{2} Strong p-statistic	Strong R' Poor p-statistic
Status	Poor Fit	Good Fit	Average Fit

Table 4.14- All Market Returns - OLS VS GARCH Results

The Theil Inequality Coefficient deteriorates significantly as you move from the linear regression model to the GARCH model. However the *R~* statistic improves from 0.24% for linear regression to 5.77% for GARCH (1,1). Overall the best model is still the GARCH model.

SUMMARY OF OLS REGRESSION RESULTS AGAINST GARCH RESULTS			
Market Segment	OLS Adj R-Sq	GARCH Adj R-Sq	Technique with superior explanatory power
AllRetnA vs. TBills Rate	0.0%	5.15%	GARCH
AgrRetA vs. TBills Rate	1.7%	-8.75%	GARCH
ComRetA vs. TBills Rate	0.0%	-4.96%	GARCH

NSEIRetA vs. TBills Rate	**0.1%**	**-6.91%**	**GARCH**
FinRetA vs. TBills Rate	**0.0%**	**8.1%**	**GARCH**
IndRetA vs. TBills Rate	**0.0%**	**12.8%**	**GARCH**

Table 4.15 - Summary Of OLS Regression Results Against GARCH Results

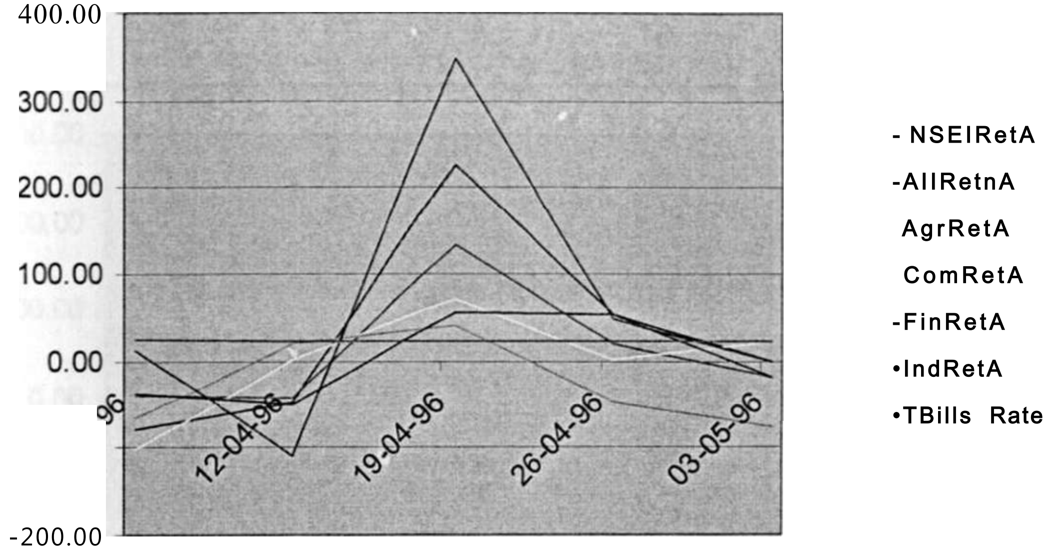
The above results indicate that GARCH has greater explanatory power than OLS linear regression. This is consistent with Asset Pricing Models of CAPM and APT which indicate that the risk free rate, practically interpreted as the prevailing T-Bill Rate of the day is a key factor in the return of assets on the NSE. This is also consistent with the fact that GARCH does not cancel out the "error" term "noise" but fully embraces it to capture the impact of previous volatility and variance into present observations.

4.8 INTERPRETATION OF GRAPHS

Information from the graphs showing the trends of the various market segment returns from the period April 1996 until December 2001 indicate that they respond to the TBill rate in a consistent fashion. The plot of TBills Rate over time was used to isolate key points in time where the TBills Rate was experiencing marked increases or decreases. A period of 4 weeks before and after the high (low) point was then taken as a cut off. These points were then used to analyze the trends of the various market segments to see how they responded.

The increase in the TBills Rate has a greater impact on the market than a decrease in the TBills Rate. Increases are marked with significant drops in the returns of all market segments, which persist for several weeks. Periods where the TBills Rate is steadily increasing are market by dismal performances in most market segments. Periods where the TBills Rate decreases are marked by a short lived increase in market segment returns. Generally the effect on the various market segment returns is instantaneous, but on a few occasions certain market segments take a week to register the change in their overall returns. A few examples showing the nature of the response are illustrated in the graphs below.

Figure 4.1 - Effect of TBills Rate Drops from a High of 24.32 to 22.32 on Other Market Segments



When the TBill Rate experienced a drop from 24.32 to 22.32 all the other market segments as well as the NSEIRetA went up significantly. This response was immediate across all market segments. The same happens when the TBill Rate drops from 21.92 to 21.20 as illustrated in Figure 4.2 below.

Figure 4.2 - Effect of TBills Rate Drops from a High of 21.92 to 21.20 on Other Market Segments

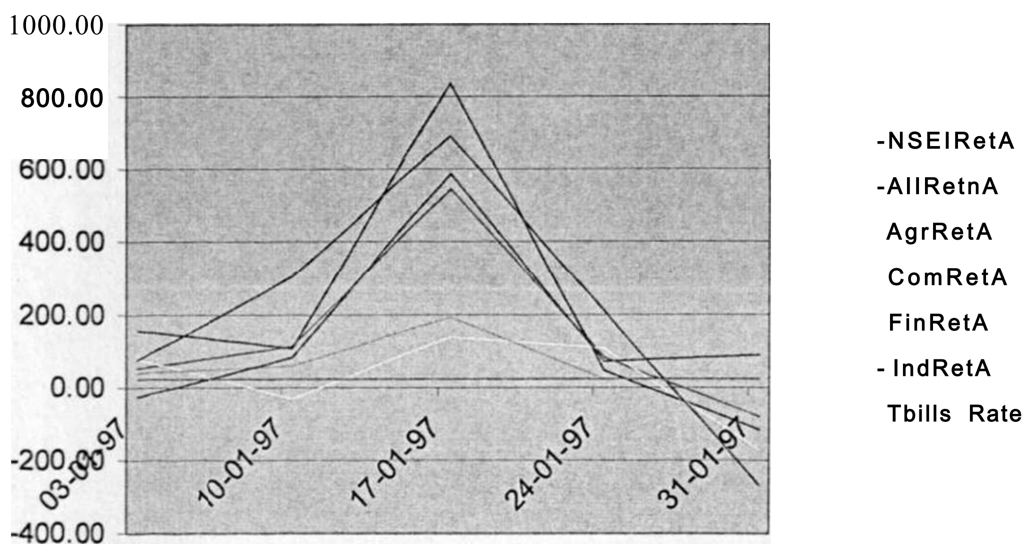
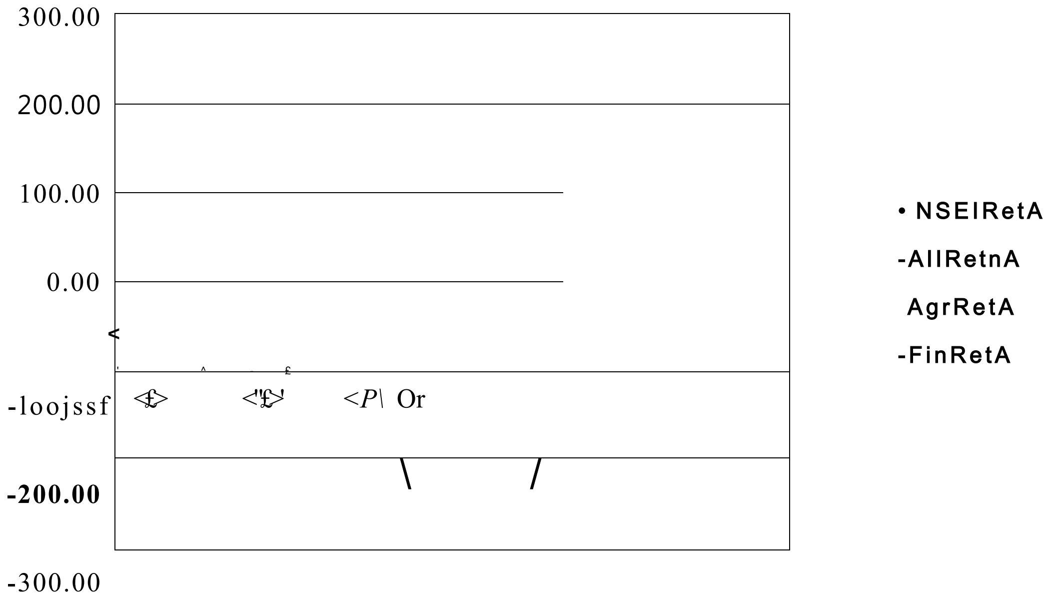


Figure 4.3 - Effect of TBills Rate Increase from a Low of 19.20 to 21.45 on Other Market Segments



In 1997 the TBill Rate increased from 19.20 to 21.45 the various market segments responded by making sharp dips in the opposite direction as shown in the figure above. As noted above periods when the TBills Rate decreases are marked by a short lived increase in market segment returns.

4.9 DATA INTERPRETATION AND ANALYSIS

4.9.1 Restrictive Money Policies and Market Returns

In keeping with finance theory this study finds that there is a relationship between the T-Bill rate and the return of stocks on the NSE. During times of restrictive monetary policy - or rising interest rates - the study found that markets performed poorly, resulting in lower than average returns and higher than average risk. Conversely, periods of expansive monetary policy - when interest rates are falling - generally coincide with strong stock performance including higher than average returns and less risk. One of several examples is the period from 21st June 1996 when the T-Bill rate rose from 21.93 to a maximum of 24.41 on the week of 27th September 1996. During this period the average of the NSE -20 Index dropped from a weekly average of 35.73 to a weekly average of -3.64. The returns of other market segments were equally depressed and are shown in the summary below.

MARKET SEGMENT RETURNS BEFORE AND AFTER A TBILL RATE INCREASE (21" June 1996 to 27th September 1996)				
Item	**Sector**	**Average return before the increase of TBills Rate**	**Average return after the increase of TBills Rate**	**Difference in Average Return over the period**
1.	Agricultural Sector	7.33	3.71	3.62
2.	Financial and Investment Sector	45.33	-26.46	71.79
3.	Industrial and Allied Sector	26.60	-17.68	44.28
4.	Commercial and Services Sector	-4.78	3.90	-8.68
5.	All Market Returns	21.44"	-8.40	29.84

Table 4.16 - MARKET SEGMENT RETURNS BEFORE AND AFTER A TBILL RATE INCREASE

The summary above shows that with the exception of the Commercial and Services Sector, all other sectors reported a decline in returns. In addition, certain sectors are much more sensitive than others to changes in T-Bill rates. The Financial and Investment Sector is more sensitive, reporting a change of approximately 72 points and the agricultural sector is least sensitive reporting a change of 3.62 points. In addition, an upward trend in asset prices is accompanied by an expansion in credit in an economy as it adds to the value of collateral, strengthens the borrowing capacity of investors and the lending propensity of banks. However if this expansion is not based on realistic expectation of future prospects, a financial bubble occurs. During the period from 25th July 1997 to 17^{lh} July 1998, the average T Bill Rate decreased from an average of 25.90 to 13.97 with an all time high of 27.20.

MARKET SEGMENT RETURNS DURING PERIODS OF SUSTAINED TBILL INCREASES AND TBILL RATE DECLINES				
item	**sector**	**Average return during the period of increasing T Bill Rate**	**Average return during the period of declining T Bill Rate**	**Difference in Average Returns**
1.	**Agricultural Sector**	**25.75**	**11.26**	**-14.49**
2.	**Financial and Investment Sector**	**-12.25**	**24.80**	**37.05**
3.	**Industrial and Allied Sector**	**-5.78**	**36.83**	**42.61**
4.	**Commercial and Services Sector**	**4.95**	**28.74**	**23.79**
5.	**All Market Returns**	**7.98**	**31.74**	**23.76**
6.	**NSEIRetA**	**6.47**	**28.05**	**21.58**

Table 4.17 - MARKET SEGMENT RETURNS DURING PERIODS OF SUSTAINED TBILL INCREASES AND TBILL RATE DECLINES

The above table summarizes the returns during these periods and indicates that all sectors with the exception of the agricultural sector showed a marked improvement in performance with the Industrial and Allied Sector showing a marked sensitivity to the rates, closely followed by the Financial and Investment Sector.

4.9.2 Turbulence in the Economy

When financial markets move from normal to turbulent periods, credit and liquidity premiums both tend to increase substantially as potential purchasers of security assets become more averse to risk and seek a "safe haven" in instruments such as Treasury bills, "safe" options may include the commercial and services sector which is offer stability in Fast Moving Consumer Goods (FCMG) e.g. Chum Supermarkets Ltd.

4.9.3 Periods of Stability

In section 4.7 - Interpretation of Graphs, it is noted that increase in TBills Rate has a greater effect on the market than periods of TBills Rate decrease. During these periods, the returns of various market segments tend to exhibit a trend rather than hop from negative to positive, from high to low. Even during periods of steady increase of TBills rates the same is observed. Such periods of continuous TBills Rate increase or decrease can be termed as "stable" circumstances and could probably explain much of the behavior of T-bill interest rates against the prices of assets on the NSE. When monetary policy becomes progressively more stable - the base rate becomes less volatile compared with the past, and the CBK provides more information so that market participants can anticipate changes in policy. With less volatility, overall liquidity and credit-risk premiums may have dropped, thus narrowing the myriad differences in the returns of securities on the NSE.

4.9.4 Changes in Minimum Reserve Requirements

The reserve requirement is the amount of money that a depository institution is obligated to keep in the CBK vaults in order to cover its liabilities against customer deposits. The Board of Governors decides the ratio of reserves that must be held against liabilities that fall under reserve regulations. Thus, the actual shilling amount of reserves held in the vault depends on the amount of the depository institution's liabilities. The Kenya Letter of Intent, Memorandum of Economic and Financial Policies and Technical Memorandum of Understanding from the Kenyan Government to the IMF in December 2004 notes that "The easing of monetary policy in 2003/04 to support economic recovery resulted in declining interest rates and rising inflation. Following the reduction in the legal reserve requirement from 10 percent to 6 percent in July 2003, the reserve money multiplier rose from 4.9 to 5.3, resulting in a 13 percent expansion of broad money in 2003/04 against the 7 percent projected under the program. The consequent rise in liquidity led to negative real yields on money market instruments. In response to the decline in interest rates, bank credit to the private sector grew substantially. This was also the case from September 1997 to June 1998 when the minimum reserve requirement ratio dropped from a minimum of 15% to a minimum of 12%. This also happened in September 1998 when the ratio dropped from a minimum of 14% to 10%. This may account for the lack of consistency in the behaviour of the returns of the assets when examined solely in the light of T-Bills Interest Rate. The table below briefly summarizes the changes in minimum reserve requirements ratio over the years in Kenya.

RESERVE REQUIREMENTS RATIO

1990 to March 1993	Daily minimum	6%	fixed
April and May 1993	Daily minimum	8%	fixed
June - September 1993	Daily minimum	10%	fixed
October -November 1993	Daily minimum	12%	fixed
December 1993 - January 1994	Daily minimum	14%	fixed
February-March 1994	Daily minimum	16%	fixed
April-July 1994	Daily minimum	20%	fixed
August 1994-April 1996	Daily minimum	18%	fixed
May 1996 -September 1997	Minimum 15%	18%	Average over 14 days cycle.
October 1997-June 1998	Minimum 12%	15%	Average over 14 days cycle.
July-September 1998	Minimum 14%	14%	Average over 14 days cycle.
October - November 1998	Minimum 10%	13%	Average over 14 days cycle.
December 1998 - November 2000	Minimum 9%	12%	Average over 14 days cycle.
December 2000 - June 2003	Minimum 8%	10%	Average over 14 days cycle.
June 2003 to date	Daily minimum	6%	Fixed, include foreign currency deposits

Table 4.18 - RESERVE REQUIREMENTS RATIO

Francis M. Mwega (2005), in his article "Financial Sector Reforms in Eastern and Southern Africa" for the International Research Center notes that many financial systems in Africa have been subjected to financial repression characterized by high reserve requirements (sometimes of 20%- 25% compared to 5%-6% in developed countries). This in turn leads to high spreads thereby imposing an implicit tax on financial intermediation. This financial repression gives the government and public sector preference and crowds out the private sector, resulting in inefficient allocation of funds within the economy.

4.9.5 Government Fiscal Policy

When the Government increases rates, it is seeking to restrain the economy. Companies that borrow money pay more when interest rates go up. This reduces their earnings and in turn reduces their attractiveness to potential investors. As a result, the price of securities on the NSE will fall. (See Table 23 and Table 24). Further more consumers also pay more to borrow money, which discourages them from buying cars, houses and everything that goes with them. This hurts companies dependent on the consumer.

4.9.6 Risk Profile of Investors

Since investors care about expected yields and not promised yields, they demand a higher rate of return on private money securities than on Treasury Bills in order to offset the perceived risk of default and to equalize expected returns. The higher the default risk premium is for a particular asset, the less attractive it may be for a conservative investor. During periods when the Treasury bill interest rate is high conservative investors may view this as an attractive investment as opposed to putting their money in private securities. This then would starve the stock market of much needed funds and result in dismal performance within the Nairobi Stock Exchange (See Table 23 and Table 24).

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

This thesis has presented the analysis of TBills Rates and their impact on the return of assets on the Nairobi Stock Exchange using GARCH analysis. The study presented a systematic approach to data analysis that began with basic techniques of Correlation analysis, One Way ANOVA and Distribution Trend Analysis. It then moved to tests for ARCH so as to establish a basis for using GARCH analysis. The ARCH tests were positive and the analysis moved onto GARCH and compared the results with linear regression results. The tests for ARCH were positive for all market segments with the exception of the Financial and Investment Sector and the Commercial and Services Sector. Using a three fold criteria of the adjusted R-Squared R^2 value, the p-value and the Theil Inequality Coefficient, all the data results for GARCH and linear regression were compared. The conclusions drawn are:

1. The Treasury Bill Rate has a significant impact on the asset returns of the various market segments, the NSE - 20 Share Price Index and All market returns as a whole.
2. The behaviour of the returns of assets on the NSE can be better explained by considering the volatility of previous periods. This is modeled using the ARCH term within the GARCH analysis.
3. The study found that GARCH analysis gives a better explanation for the relationship between Treasury Bill Rates and asset returns than linear regression in every market segment.
4. The study found that further iterations using ARCH terms from previous periods produced a better fit than the GARCH (1,1) model.
5. The Industrial Sector is the most sensitive to TBill rates (Adj R-Sq 12.8%) followed by the Financial and Investment Segment, with the Commercial and Services Segment being the least sensitive (Adj R-Sq 4.96%).

In General, GARCH analysis is more effective for explaining the effect of the T-bill Rate on the return of assets on the NSE than Linear regression. Furthermore, the explanatory power becomes stronger as we consider the effect of previous variances on the current observations.

5.2 RECOMMENDATIONS

The Government of Kenya should seek to implement more effective public debt management strategies so as to achieve desired fiscal and monetary objectives without adversely affecting the prices of assets on the NSE. A balance between legislation, control and market forces should be encouraged to ensure that there is effective allocation of resources within the economy to promising companies. The study has shown that the return of assets in the Industrial and Allied Segment can be accounted for by the T-Bill Rate to the extent of 12.8%. If the Government is serious about attaining Industrialization status by 2020 they should put in place structures that create an enabling environment for the Industrial and Allied Segment to thrive. Some of these structures will require the review of T-Bill Rates.

Since GARCH produces more reliable results for a data sample of 1000 and greater, it would be advisable to carry out the same analysis using a longer time period and compare the results with the current ones. The data indicated periods where there was a sharp transition within the data. The use of Smooth Transition GARCH (STGARCH) to analyze the data may offer a model with-stronger explanatory capabilities.

5.3 LIMITATIONS OF THE STUDY

The study used rudimentary GARCH analysis and hence did not take into consideration several options that could be utilized to create a better fit forecasting model. In particular, the study was not able to design mean models and variance models that had been refined using appropriate regressor variables.

GARCH models are useful but only part of a solution. Although GARCH models are usually applied to return series, financial decisions are rarely based solely on expected returns and volatilities. There is a need to map the activity of these returns along side other economic indicators in play during the period under study. These economic indicators would give a better overall picture of the model and would include rate of taxation, inflation, unemployment, the level of foreign exchange reserves, the impact of IMF programs on the country etc. GARCH models have shown greater consistency in results for a range of data greater than 1000. Our study employed a total of 299 data samples and this would probably account for the negative adjusted R squared values.

Previous studies on predicting the returns of assets on the NSE using various factors and OLS regression could benefit from analysis using GARCH. It was observed in the Literature Review Section, that most of these studies yielded results that were statistically insignificant, inconclusive or lacking in explanatory power. The use of GARCH may shed light on the analysis and produce results that better reflect theory.

5.4 RECOMMENDATIONS FOR FURTHER STUDY

GARCH analysis is a relatively new approach to the modeling and examination of financial time series especially within Kenya. Probability distributions for asset returns often exhibit fatter tails than the standard normal distribution. The fat tail phenomenon - excess kurtosis, as well as the characteristic volatility clustering of residuals is found within asset returns and is best modeled by GARCH. Studies to promote the understanding and utilization of the various types of GARCH should be undertaken for clearer interpretation of market data. Other GARCH Models to be utilized in the advanced interpretation of the data include STGARCH - Smooth Transition GARCH, IGARCH - Integrated GARCH, and TGARCH - Threshold GARCH.

The analysis of the relationship between TBills Interest Rate and the return of assets on the NSE could also benefit from analysis using a larger data set of more than 299 observations. This is because GARCH has been shown to be more effective when the data set is greater than 1000.

It would also be beneficial to undertake GARCH analysis on studies that examine more than one independent variable. This would give a clearer picture and help isolate the key variables within the economy that affect prices of assets on the NSE. The more the number of variables analyzed the greater the predictive power of the model. Other variables to be considered would include inflation, exchange rate of the Kenya Shilling against the dollar or Euro, and level of government debt.

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This study focused on the utilization of the ARCH term while holding the GARCH term constant at 1 lag. Future studies would benefit from an examination of the effect of GARCH term as the number of lags is increased. A comparison between the predictability power of using both the ARCH term and the GARCH term should be done against the use of only the ARCH term and a recommendation made for the best analysis criteria.

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APPENDIX 1- LIST OF COMPANIES IN THE NSE

MAIN INVESTMENT MARKET SEGMENTS

AGRICULTURE

UNILEVER TEA KENYA LIMITED
KAKUZI LIMITED
REA VIPINGO PLANTATIONS LTD
SASINI TEA AND COFFEE LIMITED

COMMERCIAL AND SERVICES

CAR AND GENERAL (KENYA) LIMITED
CMC HOLDINGS LIMITED
HUTCHINGS BIEMER LIMITED
KENYA AIRWAYS LIMITED
MARSHALLS (EAST AFRICA) LIMITED
NATION MEDIA GROUP LIMITED
TOURISM PROMOTION SERVICES LIMITED
UCHUMI SUPERMARKETS LIMITED

FINANCE AND INVESTMENT

BARCLAYS BANK OF KENYA LIMITED
CFC BANK
DIAMOND TRUST BANK (KENYA) LIMITED
HOUSING FINANCE COMPANY LIMITED
ICDC INVESTMENT COMPANY LIMITED
JUBILEE INSURANCE COMPANY LIMITED
KENYA COMMERCIAL BANK LIMITED
NATIONAL BANK OF KENYA LIMITED
NIC BANK LIMITED
PAN AFRICA INSURANCE COMPANY LIMITED
STANDARD CHARTERED BANK KENYA LIMITED

INDUSTRIAL AND ALLIED

ATHI-RIVER MINING LIMITED
BAMBURI CEMENT COMPANY LIMITED
BRITISH AMERICAN TOBACCO KENYA LIMITED
BRITISH AMERICAN TOBACCO KENYA LIMITED
BOC KENYA LIMITED
BOC KENYA LIMITED

CARBACID INVESTMENTS LIMITED
CROWN-BERGER KENYA LIMITED
OLYMPIC CAPITAL HOLDINGS LIMITED
EAST AFRICAN CABLES LIMITED
EAST AFRICAN PORTLAND CEMENT COMPANY
EAST AFRICAN BREWERIES LIMITED
FIRESTONE (E.A) LIMITED
KENYA OIL COMPANY LIMITED
MUMIAS SUGAR COMPANY LTD
KENYA POWER AND LIGHTING COMPANY LIMITED
TOTAL KENYA LTD
UNGA GROUP LIMITED

ALTERNATIVE INVESTMENT MARKET SEGMENT

A. BAUMANN & COMPANY LIMITED
EXPRESS KENYA LIMITED
KAPCHORUA TEA COMPANY LIMITED
KENYA ORCHARDS LIMITED
LIMURU TEA COMPANY LIMITED
STANDARD NEWSPAPERS GROUP LIMITED
WILLIAMSON TEA KENYA LIMITED

APPENDIX 2 - COMPANIES THAT CONSTITUTE THE CALCULATION OF NSE 20 SHARE INDEX

Unilever Tea Kenya Limited

Williamson Tea Kenya Limited

Kakuzi

Sasini Tea and Coffee Limited

Chum Supermarket

Kenya Airways Limited

TPS-Serena

Nation Media Group

Barclays Bank (K) Limited

Diamond Trust Bank Kenya Limited

Kenya Commercial Bank Limited

Standard Chartered Bank Limited

Bamburi Cement Limited

British American Tobacco (K) Limited

British Oxygen Company Kenya Limited

National Industrial Credit Bank Limited*

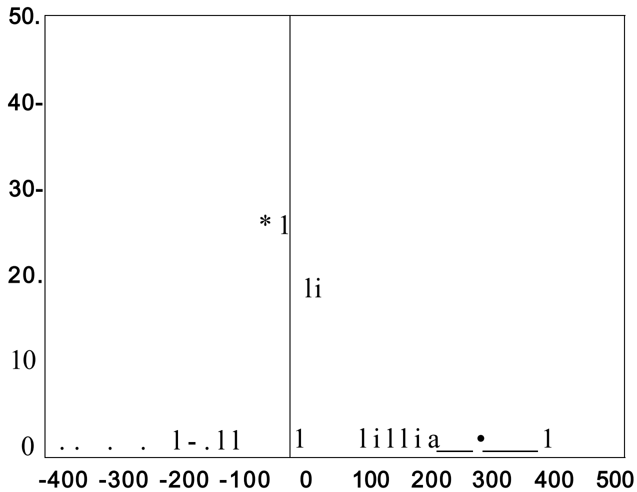
East Africa Breweries Limited

Firestone East Africa Ltd

Kenya Power & Lighting Company Limited

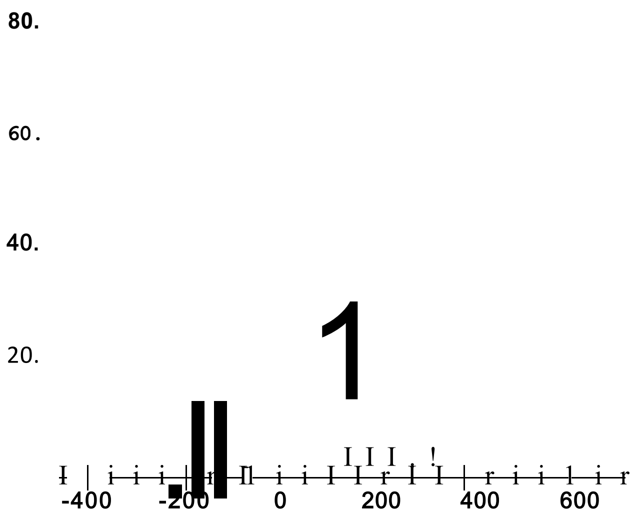
Total Kenya Limited

APPENDIX 3 - NORMAL DISTRIBUTION GRAPHS AND STATISTICS FOR THE VARIOUS MARKET SEGMENTS



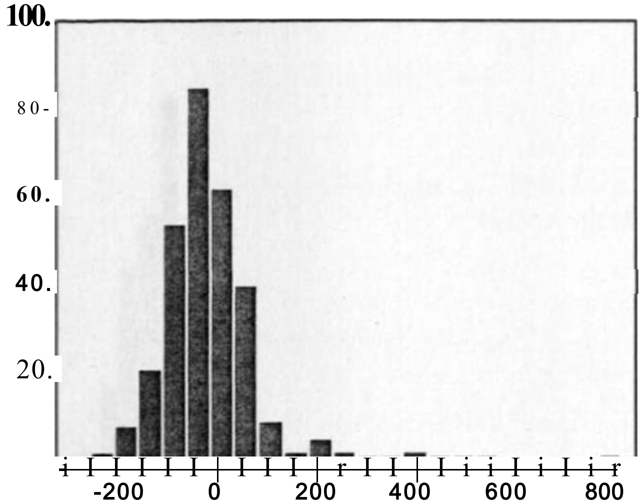
Series: C OMR ETA
Sample 4/05/1996 12/21/2001
Observations 299

Mean	1.815267
Median	9.353431
Maximum	488.6268
Minimum	380.8654
SW.Dev.	114.9723
Skewness	1.069852
Kurtosis	7.288459
Jarque-Bera	286.1581
Probability	0.000000

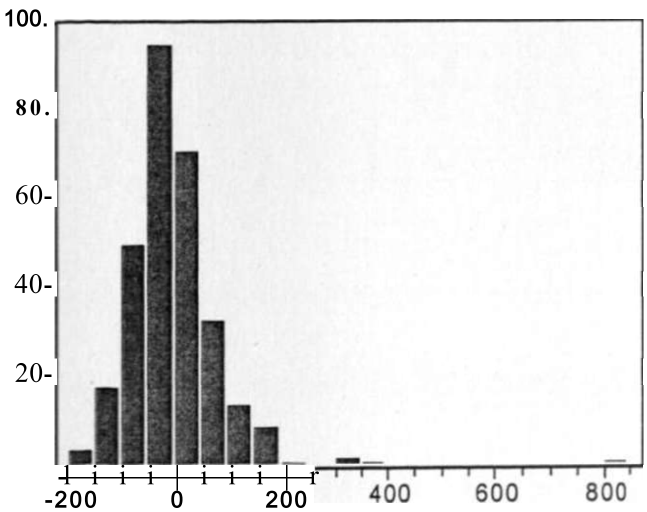


Series: FIN R ETA
Sample 4/05/1996 12/21/2001
Observations 299

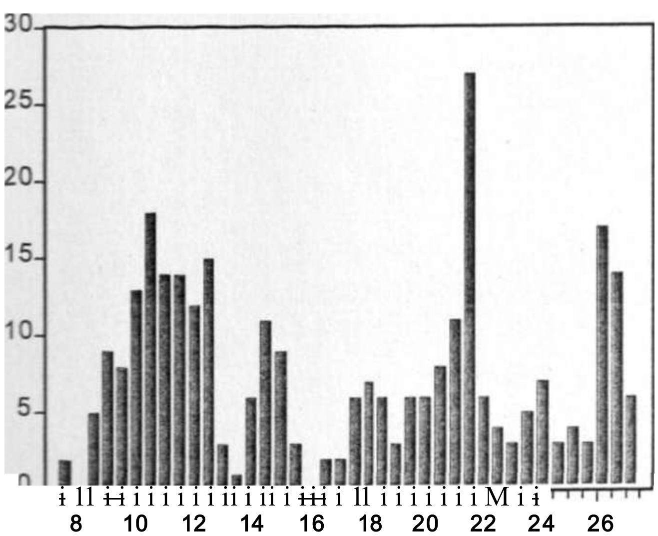
Mean	-1289277
Median	-14.03559
Maximum	6952530
Minimum	-407.8104
Std. Dev.	117.1331
Skewness	1.782437
Kurtosis	10.98585
Jarque-Bera	952.8392
Probability	0.000000



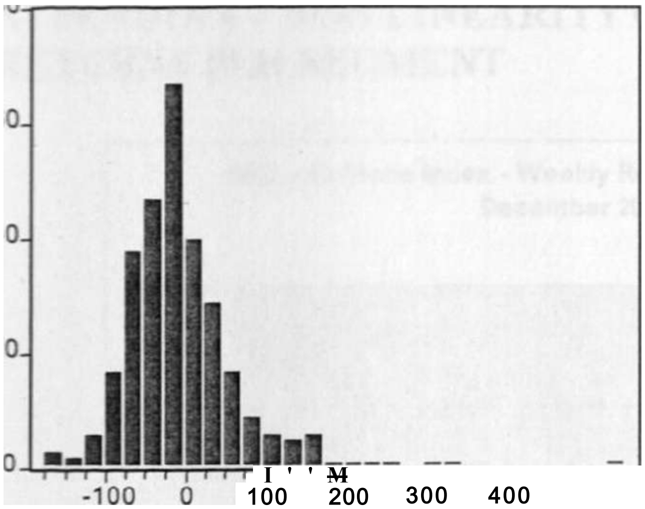
Series: INDRETA	
Sample 4/05/1996 12/21/2001	
Observations 299	
Mean	1.519344
Median	-1420010
Maximum	844.9460
Minimum	-255.8580
Std. Dev.	116.4601
Skewness	2.664184
Kurtosis	16.17761
Jarque-Bera	2517.093
Probability	0.000000



Series: NSEIR ETA	
Sample 4/05/1996 12/21/2001	
Observations 299	
Mean	1.584554
Median	•9.327479
Maximum	839.9460
Minimum	•188.7238
Std. Dev.	92.09799
Skewness	3.067338
Kurtosis	26.13506
Jarque-Bera	7136.948
Probability	0.000000



Series:TBILLS RATE01	
Sample 4/05/1996 12/21/2001	
Observations 299	
Mean	17.44578
Median	17.74000
Maximum	27.20000
Minimum	7.850000
Std. Dev.	5.933928
Skewness	0.131793
Kurtosis	1.600672
Jarque-Bera	25.26049
Probability	0.000003



Series :ALLR ETNA
Sample 4/05/1996 12/21/2001
Observations 299

Mean	0.817498
Median	-8.634041
Maximum	546.6737
Minimum	•169.4625
Std. Dev.	76.70395
Skewness	2.125448
Kurtosis	13.03034
Jarque-Bera	1478.527
Probability	0.000000

t

APPENDIX 4 - NON LINEARITY OF THE WEEKLY ASSET RETURNS PER SEGMENT

NSE - 20 Share Index - Weekly Returns from April 1996 - December 2001

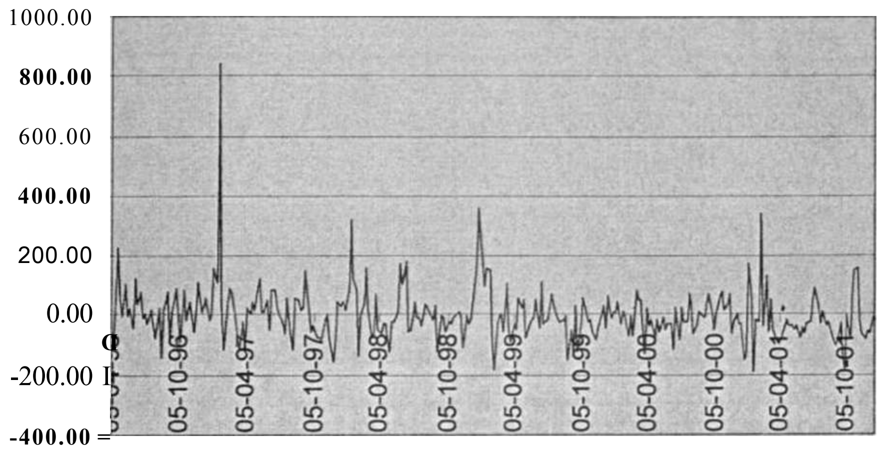


Table 4. 19- NSE -20 SHARE INDEX - WEEKLY RETURNS FROM APRIL 1996-DEC 2001

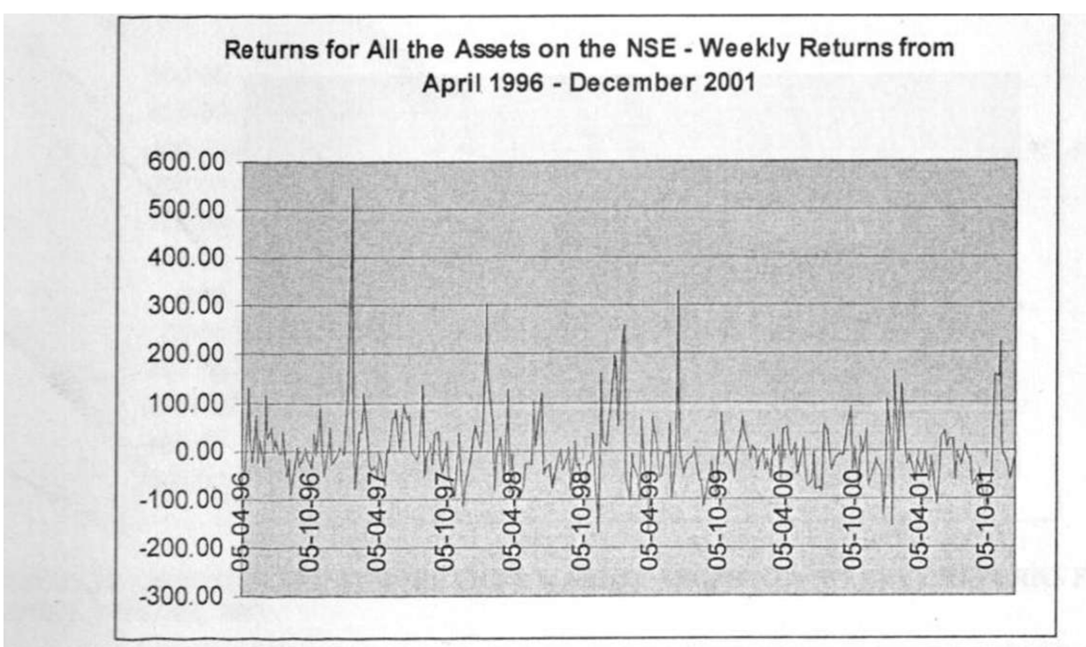


Table 20.4 – ALL ASSETS ON THE NSE – WEEKLY RETURNS FROM APRIL 1996-DEC 2001

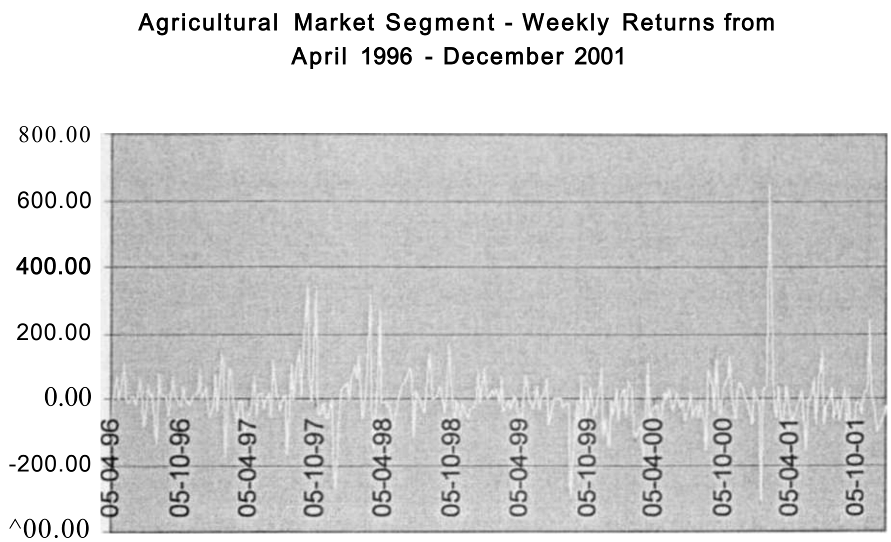


Table 4.21 -AGRICULTURAL MARKET SEGMENT - WEEKLY RETURNS FROM APRIL 1996-DEC 2001

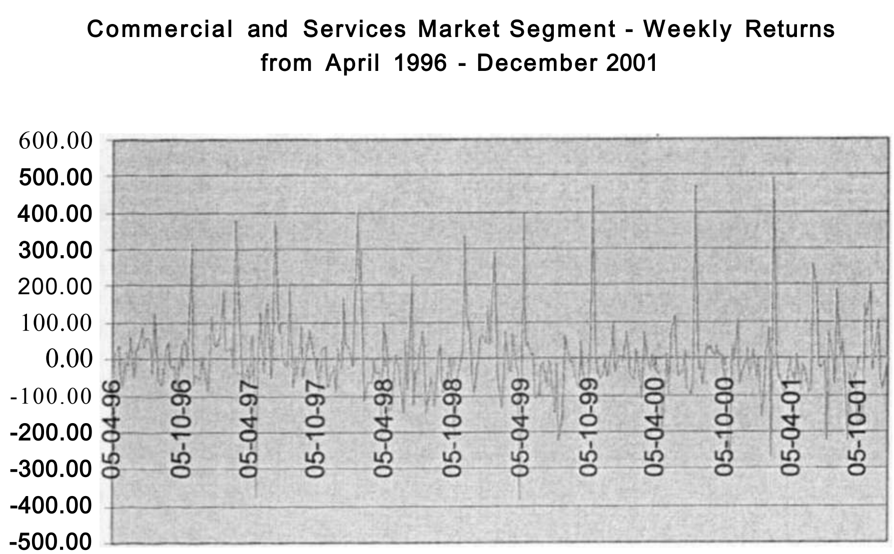


Table 4.22 -COMMERCIAL AND SERVICES MARKET SEGMENT - WEEKLY RETURNS FROM APRIL 1996-DEC 2001

Financial and Investment Market Segment - Weekly Returns
from 1996-2001

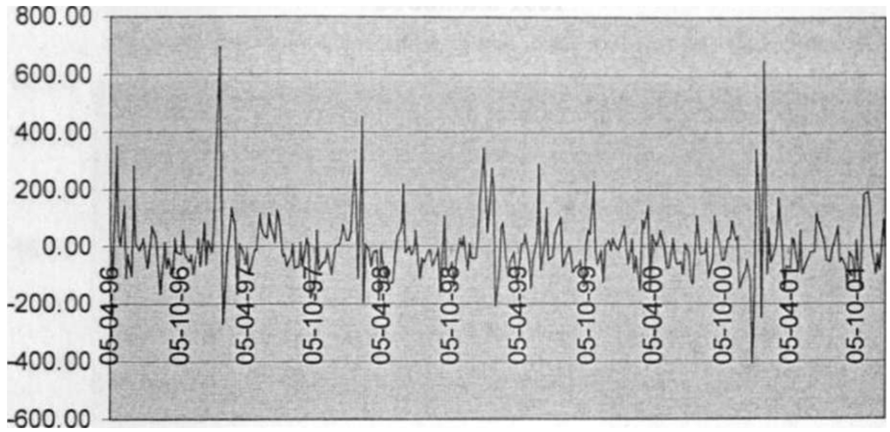


Table 4.23 - FINANCIAL AND INVESTMENT MARKET SEGMENT - WEEKLY RETURNS FROM APRIL 1996-DEC 2001

Industrial and Allied Market Segment - Weekly Returns
from April 1996 - December 2001

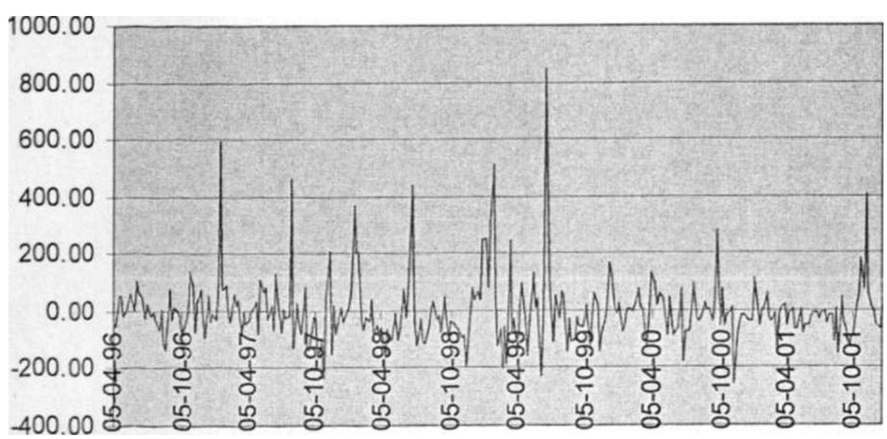


Table 4.24 - INDUSTRIAL AND ALLIED MARKET SEGMENT - WEEKLY RETURNS FROM APRIL 1996-DEC 2001

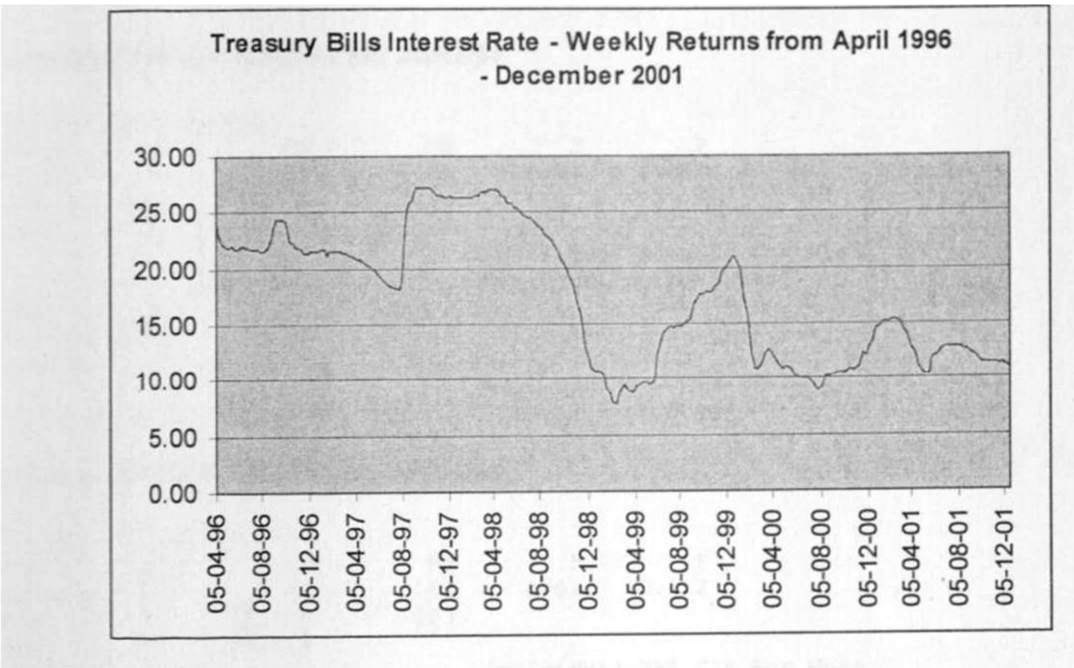


Table 4. 25 – TREASURY BILL RATES – WEEKLY RETURNS FROM APRIL 1996-DEC 2001

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```
welcome to Minitab, press F1 for help.
Retrieving worksheet from file: F:\Students Projects\Regina\Coir.blned Data.xls
```

Results for: Combined Data.xls

One-way ANOVA: NSEIRetW, AIIRetW

```
-.r.alysis of Variance
Source     DF        SS        MS       F       P
Factor      1      0.02      0.02    0.01   0.937
Error     596   1520.25      2.55
Total     597   1520.27
                                Individual 95% CIs For Mean
                                Based on Pooled StDev
-evel       N      Mean     StDev   ----+---------+---------+---------+-
NSEIRetW  299     0.016     1.729   (-----------------*----------------)
AIIRetW   299     0.005     1.454   (                 *                )
                                    ----+---------+---------+---------+-
Pooled StDev =    1.597              -0.12      0.00      0.12      0.24
```

One-way ANOVA: NSEIRetA, AIIRetnA

```
Analysis of Variance
Source     DF        SS        MS       F       P
Factor      1        88        88    0.01   0.912
Error     596   4280930      7183
Total     597   4281018
                                Individual 95% CIs For Mean
                                Based on Pooled StDev
Level       N      Mean     StDev   ----+---------+---------+---------+-
NSEIRetA  299      1.58     92.10   (-----------------*-----------------)
AIIRetnA  299      0.82     76.70   (                 *                )
                                    ----+---------+---------+---------+-
Pooled StDev =    84.75              -6.0       0.0       6.0      12.0
```

One-way ANOVA: NSEIRetA, AIIRetnA, TBills Rate

```
Analysis of Variance
Source     DF        SS        MS       F       P
Factor      2     52690     26345    5.49   0.004
Error     894   4291423      4800
Total     896   4344113
                                Individual 95% CIs For Mean
                                Based on Pooled StDev
Level       N      Mean     StDev   --------+---------+---------+------
NSEIRetA  299      1.58     92.10   (--------*---------)
AIIRetnA  299      0.82     76.70   (        *         )
TBills R  299     17.45      5.93                      (       *       )
                                    --------+---------+---------+------
Pooled StDev =    69.28                     0        10        20
```

One-way ANOVA: NSEIRetA, TBills Rate

```
Analysis of Variance
Source     DF        SS        MS       F       P
Factor      1     37611     37611    8.83   0.003
Error     596   2538141      4259
```

```
total      597    2575752
                                      Individual 95% CIs For Mean
                                      Based on Pooled StDev
l^vel        N       Mean      StDev    ------+-        +         +-
NSEIRetA   299       1.58      92.10   (        * -
TBills R   299      17.45       5.93                     <-
                                                       10
Pooled StDev =      65.26                                        20        30
```

One-way ANOVA: AllRetnA, TBills Rate

```
Analysis of Variance
Source      DF        SS         MS        F        P
Factor       1     41337      41337    13.97    0.000
Error      596   1763775       2959
Total      597   1805112
                                      Individual 95% CIs For Mean
                                      Based on Pooled StDev
Level        N       Mean      StDev    ------+ -------- +        +
AIIRetnA   299       0.82      76.70   (        *        )    --------
TBills R   299      17.45       5.93                           (        * -

Pooled StDev =      54.40                 0.0       8.0      16.0
```

One-way ANOVA: AllRetnA, AgrRetA, ComRetA, FinRetA, IndRetA

```
Analysis of Variance
Source      DF        SS         MS        F        P
                                472     0.04    0.996
Error     1490  16273904      10922
Total     1494  16275792
                                      Individual 95% CIs For Mean
                                      Based on Pooled StDev
Level        N       Mean      StDev
AIIRetnA   299        0.8       76.7
AgrRetA    299       -0.0       90.7
ComRetA    299        1.8      115.0
FinRetA    299       -1.3      117.1   (-
IndRetA    299        1.5      116.5

Pooled StDev =      104.5                -8.0       0.0       8.0
```

One-way ANOVA: AgrRetA, TBills Rate

```
Analysis of Variance
Source      DF        SS         MS        F        P
Factor       1     45592      45592    11.04    0.001
Error      596   2461592       4130
Total      597   2507184
                                      Individual 95% CIs For Mean
                                      Based on Pooled StDev
Level        N       Mean      StDev
AgrRetA    299      -0.02      90.69   <-
TBills R   299      17.45       5.93                       <-
                                                         10
Pooled StDev =      64.27                                          20
```

One-way ANOVA: ComRetA, TBills Rate

```
Analysis of Variance
Source      DF        SS         MS
```

```
•actor       1      36525      36525      5.51     0.019
Error      596    3949644       6627
total      597    3986169
                                          Individual 95% CIs Foe Mean
                                          Based on Pooled StDev
^evel        N       Mean      StDev     ---------+--- ---------+         +
CorRetA    299       1.82     114.97    (         *        --)-------  ----------
TBills R   299      17.45       5.93                      (         *          )

Pooled StDev =      81.41                         0        10        20
```

One-way ANOVA: FinRetA, TBills Rate

```
Analysis of Variance
Source      DF         SS         MS         F        P
Factor       1      52475      52475      7.63    0.006
Error      596    4099104       6878
Total      597    4151579
                                          Individual 95% CIs For Mean
                                          Based on Pooled StDev
Level        N       Mean      StDev    ---------- +-------    +         +
FinRetA    299      -1.29     117.13   (         *        ) --------- -------
TBills R   299      17.45       5.93                       (        *      >

Pooled StDev = 8 2 . 9 3                           0        12        24
```

One-way ANOVA: IndRetA, TBills Rate

```
Analysis of Variance
Source      DF         SS         MS         F        P
Factor       1      37921      37921      5.58    0.019
Error      596    4052254       6799
Total      597    4090175
                                          Individual 95% CIs For Mean
                                          Based on Pooled StDev
Level        N       Mean      StDev     ---------+--- ---------+        +         "
IndRetA    299      1.52-     116.46    (         *        --)-------  ----------
TBills R   299      17.45       5.93                      (         *          >

Pooled StDev = 8 2 . 4 6                          0        10        20
```

Correlations: NSEIRetA, AIIRetnA, AgrRetA, ComRetA, FinRetA, IndRetA, TBills Rat

	NSEIRetA	AIIRetnA	AgrRetA	ComRetA	FinRetA	IndRetA
AIIRetnA	0.720					
	0.000					
AgrRetA	0.434	0.379				
	0.000	0.000				
CocRetA	0.256	0.506	0.052			
	0.000	0.000	0.373			
FinRetA	0.617	0.7C9	0.158	0.212		
	0.000	O.OCO	0.006	0.000		
IndRetA	0.471	0.772	0.148	0.191	0.365	
	0.000	0.000	0.010	0.001	0.000	

Tr-lls R	0.090	0.050	0.144	0.042	-0.006	-0.040
	0.121	0.389	0.013	0.472	0.924	0.491

Zei: Contents: Pearson correlation
P-Value

Regression Analysis: NSEIRetA versus TBills Rate

The regression equation is
NSEIRetA = - 22.7 + 1.39 TBills Rate

Predictor	Coef	SE Coef	T	P
Constant	-22.72	16.53	-1.37	0.170
TBills R	1.3933	0.8970	1.55	0.121

S = 91.88 R-5q = 0.8% R-Sq(adj) - 0.5%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	20370	20370	2.41	0.121
Residual Error	297	2507278	8442		
Total	298	2527648			

Jnusual Observations

Obs	TBills R	NSEIRetA	Fit	SE Fit	Residual	St Resid
3	22.3	226.14	8.38	6.88	217.76	2.38R
42	21.2	839.95	6.82	6.29	833.13	9.09R
94	26..3	320.91	13.85	9.52	307.06	3.36R
143	10..7	358.26	-7.76	8.03	366.01	4 .00R
144	10..8	192.34	-7.70	8.00	200.05	2.19R
251	15.. 1	-188.72	-1.65	5.71	-187.07	-2.04R
254	15..3	339.99	-1.38	5.65	341.37	3.72R

= denotes an observation with a large standardized residual

Regression Analysis: AllRetnA versus TBills Rate

The regression equation is
AIIRetnA = - 10.5 + 0.646 TBills Rate

Predictor	Coef	SE Coef	T	P
Constant	-10.46	13.80	-0.76	0.449
TBills P.	0.6462	0.7491	0.86	0.389

S = 76.74 R-Sq = 0.2% R-Sq(adj) = 0.0%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	4381	4381	0.74	0.389
Residual Error	297	1748901	5889		
Total	298	1753282			

Unus-ial Observations

Obs	TBills R	AIIRetnA	Fit	SE Fit	Residual	St Resid
	21.2	546.67	3.24	5.25	543.43	7.10R
54	26.3	305.64	6.51	7.95	299.14	3.92R

95	26.3	166.10	6.54	7.,98	159..56	2., 09R
137	15.8	-168.71	-0.25	4 .61	-168..45	-2., 20R
138	14.4	160.79	-1.18	5..01	161..98	2.. 12R
143	10.7	196.82	-3.52	6..70	200..34	2.. 62R
144	10.8	173.29	-3.49	6.,68	176.,78	2.. 31R
146	10.0	243.29	-3.99	7..13	247,.29	3.. 24R
147	9.2	261.15	-4.48	7..58	265..63	3.. 48R
157	9.1	-169.46	-4.60	7..69	-164 .86	-2.. 16R
168	14.0	330.63	-1.39	5..12	332,.02	4 . 34R
251	15.1	-154.C4	-0.68	4 ,77	-153,.36	-2.. 00R
252	15.2	162.66	-0.63	4 .74	163..29	2.. 13R
2 91	11.5	155.64	-3.02	6..28	158,.66	2 , 07R
292	11.5	153.C8	-3.01	6..28	156,.10	2., 04R
293	11.5	222.17	-3.01	6..28	225,.18	2.. 94R

R denotes an observation with a large standardized residual

Regression Analysis: AgrRetA versus TBills Rate

The regression equation is
AgrRetA = - 38.4 + 2.20 TBills Rate

Predictor	Coef	SE Coef	T	P
Constant	-38.42	16.17	-2.38	0.018
TBills R	2.2011	0.8776	2.51	0.013

89.90 R-Sq 2.1% R-Sq(adj) = 1.7%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	50836	50836	6.29	0.013
Residual Error	297	2400263	8082		
Total	298	2451099			

-'.-.usual Observations

Obs	TBills R	AgrRetA	Fit	SE 1Fit	Residual	St Resid
44	21.6	-173..54	9.02	6.32	-182..56	-2.04R
76	27.2	341..92	21.36	9. 99	320..56	3.59R
79	27.1	342..57	21.32	9. 97	321..25	3.60R
86	26.4	-196..37	19. 60	9.39	-215.. 97	-2.42R
87	26.3	-267..69	19.45	9.34	-287 . 14	-3.21R
100	26.8	314..38	20.51	9.69	293..88	3.29R
104	27.0	267..56	20. 99	9.86	246..67	2.76R
177	15.2	-284..22	-5.03	5.57	-279.. 19	-3.11R
178	15.3	-192,.19	-4.74	5.53	-187..45	-2.09R
206	11.9	-194 ,47	-12.22	7.12	-182..25	-2.03R
251	15.1	-304 ,32	-5.13	5.58	-299,. 19	-3.33R
254	15.3	642 ,53	-4 .70	5.52	647 .33	7.21R
255	15.4	395,.05	-4.52	5.50	399..57	4 . 45R
293	11.5	236,.95	-13.07	7.36	250..02	2.79R

P denotes an observation with a large standardized residual

Regression Analysis: ComRetA versus TBills Rate

The regression equation is
ComRetA = - 12.3 + 0.81 TBills Rate

Predictor	Coef	SE Coef	T	P
Constant	-12.29	20.70	-0.59	0.553
TBills R	0.808	1.123	0.72	0.472

S - 115.1   R-Sq = 0.2%   R-Sq(adj) - 0.0%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	6855	6855	0.52	0.472
Residual Error	297	3932296	13240		
Total	298	3939151			

Unusual Observations

Obs	TBills R	ComRetA	Fit	SE Fit	Residual	St Resid
30	22.2	315. 02	5,.62	8,.50	309.,40	2.70R
47	21.5	376..12	5 .05	8 .03	371.,06	3.23R
55	20.6	-374 ,63	4 .33	7 .52	-379..01	-3.30R
63	19.0	375.,30	3 .04	6 .87	372..26	3.24R
S4	26.3	399.,25	8 .93	11 .92	390.. 32	3. 41R
96	26.4	293.,82	9 .01	12 .01	284 .81	2. 4 9R
104	27.0	-220.,33	9 .53	12 .62	-229..85	-2.01R
135	17.8	333..37	2 .08	6 .66	331..29	2.88R
146	10.0	289..40	-4 .20	10 .69	293..60	2.56R
157	9.1	-380..87	-4 .96	11 .53	-375..90	-3.28R
158	9.3	399..05	-4 .79	11 .34	403,.84	3.53R
185	17.7	469.. 13	2 .05	6 .66	4 67..07	4.07R
224	9.5	467..28	-4 .59	11 .11	471,. 87	4 .12R
237	10.7	-320..99	-3 . 61	10 .06	-317,.37	-2.77R
254	15.3	-263..45	0 .10	7 .07	-263 .54	-2.29R
255	15.4	488..63	0 .16	7 .04	488 .46	4 .25R
270	12.0	254 . 51	-2 .59	9 .04	257 . 10	2.24R

?. denotes an observation with a large standardized residual

Regression Analysis: FinRetA versus TBills Rate

The regression equation is
FiriRetA = 0.6 - 0.11 TBills Rate

Predictor	Coef	SE Coef	T	P
Constant	0.63	21.10	0.03	0.976
TBills R	-0.110	1.145	-0. 10	0.924

S = 117.3   R-Sq = 0.0%   R-Sq(adj) = 0.0%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	127	127	0.01	0.924
Residual Error	297	4088484	13766		
Total	298	4088611			

Jr.usual Observations

Obs	TBills R	FinRetA	Fit	SE Fit	Residual	St Resid
3	22..3	348.54	-1.82	8.79	350.36	2. 99R
10	21..9	282.06	-1.78	8.51	283.85	2.43R
41	21..6	306.76	-1.75	8.31	308.51	2.64R
42	21..2	695.25	-1.70	8.03	696.95	5.95R

					,,, ,,	-2.27R
44	21.6	-266.97	-1.74	8.25	"265.23	r
	26.3	302.68	-2.26	12.15	304.93	qr
	26.4	452.42	"2.27	12.31	454.69	
143	10.7	343.56	-0.55	10.25	344.11	2
	10.0	273.44	-0.47	0.90	273.91	
165	10.3	289.89	-0.51	10.61	290.39	
247	14.1	-407.81	-0.92	7.82	-406.89	3.4
249	14.9	340.66	-1.01	7.40	341.66	J-
251	15.1	-245.81	-1.03	7.29	-244.78	2.09
252	15.2	650.62	-1.04	7.25	651.6o	5.56K

R denotes an observation with a large standardized residual

Regression Analysis: IndRetA versus TBills Rate

The regression equation is
Ir.dRetA = 15.2 - 0.78 TBills Rate

Predictor	Coef	SE Coef	T	P
Constant	15.21	20.97	0.73	0.469
TBills R	-0.785	1.138	-0.69	0.491

S = 116.6 **R-Sq = 0.2%** R-Sq(adj) =0.0%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	6466	6466	0.48	0.491
Residual Error	297	4035295	13587		
Total	298	4041761			

Unusual Observations

Obs	TBills R	IndRetA	Fit	SE Fit	Residual	St Resid
42	21..2	590.60	-1.43	7 8	592..03	5.09R
70	18..8	462.15	0.47	6.91	461.. 68	3.97R
94	26..3	372.38	-5.39	12.08	377.. 77	3.26R
116	24..9	442.96	-4.35	10.85	447 . 30	3.85R
143	10..7	247.96	6.78	10.18	241.. 18	2.08R
144	10..8	251.15	6.75	10.15	244 ..39	2.10R
146	10..0	313.38	7.36	10.83	306.. 0?	2.64R
147	9.,2	511.33	7.96	11.52	503..36	4.34R
154	9.2	243.03	7.96	11.52	235..07	2.03R
168	14.,0	844.95	4.20	7.78	840..75	7.23R
234	10..6	282.32	6. 92	10.33	275., 40	2.37R
241	11.,1	-255.86	6.49	9 6	-262..34	-2.26R
293	11.,5	403.79	6.17	9.54	397 . 61	3.42R

P denotes an observation with a large standardized residual

Descriptive Statistics: NSEIRetA, AllRetnA, AgrRetA, ComRetA, FinRetA, IndRetA

Variable	N	Mean	Median	TrMean	stDev	c- m
NSEIRetA	299	1.58	-9.33	-4.09	9??n	SE "ear_
AIIRetnA	299	0.82	-8. 63	-4 .94	7fi"™	5"33
AgrRetA	299	-0.02	-5. 11	-3 44	'	
CoaRetA	299	1.82	-9.35			5-24
FinRetA	299	-1.29	-14.04	-9'55		6,6t
IndRetA	299	1.52	-14 .20	-932		6"7
				J/	l-c.46	6.74

TBills R	299	17.446	17.740	17.390

Variable	Minimum	Maximum	Q1	Q3
SSEIRetA	-188.72	839.95	-47.84	37.99
AIlRetnA	-169.46	546.67	-43.37	28.52
AgrRetA	-304.32	642.63	-42.03	32.13
CsmRetA	-380.87	488.63	-55.13	37.74
FinRetA	-407.81	695.25	-67.45	36.84
InaRetA	-255.86	844.95	-59.51	39.36
TBills R	7.850	27.200	11.559	21.930

AeekEnd	NSEIRctA	AllRetnA	AgrRetA	ComRetA	FinRetA	IndRetA	series	TBills Rate	IssueNo.
rS-Apr-96	-79 53	-40 20	-101 61	-64 58	12.68	-37.27	1	24 32	1152
'2-Apr-96	-47 84	-43 03	2 52	1909	-10949	-49 35	2	23.17	1153
'9-Apr-96	226 14	133 21	71.13	39 86	348 54	5591	3	22.32	1154
26-Apr-96	53 47	20 14	047	-46 77	47.65	52 76	4	22.06	1155
."3-May 96	-1 18	-20 08	21 13	-7548	-2.00	-18 27	5	21 87	1156
• :-May-96	102 94	72 43	111.17	21 32	144 29	7 49	6	21.91	1157
VMay-96	-5 00	-22 92	-529	-17.41	-108 33	41.99	7	21.98	1158
24-May-96	25 84	24 13	-12.07	62 33	-2640	5989	8	21 74	1159
3" May-96	-44 77	-30 49	596	-50 35	-104 73	5.29	9	21 74	1160
37-Jun-96	124 28	113 84	6.30	2388	282.06	106.04	10	21.93	1161
•4-Jun-96	38 73	28 88	-1905	35 56	14.31	68.16	11	22.00	1162
7I-Jun-96	78 69	47 56	61 53	90.11	-15.91	50.84	~ 12	21.93	1163
28-Jun-96	-1257	428	2.17	32.57	9 95	-19.44	13	21.89	1164
35-Jul-96	506	21 58	-81.79	58 33	24.91	26.09	- 14	21.64	1165
•2-Ju»-96	-29 05	-7 42	43.62	49.25	-75.13	-17.17	15	21 69	1166
"9-Jui-96	14 39	-4 49	8 50	-36.81	-1345	-3.92	16	21.63	1167
26-JuJ-96	-32 34	38 95	19.13	128 28	68 08	-31.24	17	21.65	1168
j2-Aug-96	-79 31	-5007	-138.99	-60 17	25.39	-62.62	18	21.53	1169
19-Aug-96	24 61	• 1772	78.05	-70 10	-6603	7.06	19	21.57	1170
'5-Aug-96	-144 88	-89 96	15.57	-63.39	-164 10	-114.33	20	21.77	1171
23-Aug-96	15 64	-27 12	761	37.50	16.44	-134.00	21	21 85	1172
30-Aug-96	7849	6 79	7.39	4501	-78 24	73.16	22	22.72	1173
36-Sep-96	-81 86	-31 78	-50.05	-22 43	-39.87	-29.44	23	23.58	1174
'3-Sep-96	12 16	-952	68.78	-19.81	-9631	10.53	24	24.27	1175
20-Sep-96	87 76	707	14.17	-89.37	30 40	0.63	25	24.41	1176
27-Sep-96	863	-14 18	-0 04	-20.52	-2304	-21.32	26	24 39	1177
I4-Oct-96	-87 73	-3261	-26.16	47.82	-24.90	-80.62	27	24 09	1178
' 1-Oct-96	83 90	34 14	34.35	53 57	52.81	-30.01	28	23 42	1179
'8-Oct-96	-1677	-6 15	-2.97	585	-24 91	13.81	29	22.50	1180
25-Oct-96	18 43	8893	-1983	315.02	-52.95	136.99	30	22.15	1181
31-NOV-96	43 73	692	-1.69	-70.75	-27.97	86.72	31	21.92	1182
28-Nov-96	-53 63	-51 10	10.18	-40.15	-97.83	-68.38	32	21.80	1183
;15-Nov-96	8 92	225	18.61	-5507	-14.02	35.67	33	21.69	1184
22-Nov-96	106 70	48 85	89.83	6.02	24 94	74.53	34	21.36	1185
29-Nov-96	7 13	-25 08	1 12	-18 10	-67 83	-17.78	35	21.41	1186
j6-Dec-96	27 16	-1429	36 19	-85.77	81.10	-90 96	36	21.57	1187
'S-Dec-96	58 01	-349	-5 11	-551	-64.31	56.90	37	21.61	1188
20-Dec-96	-1382	6.69	-52.85	115 66	2042	-39.06	38	21.60	1189
27-Dec-96	1 50	-3 88	-26 47	3524	-17.29	-6,68	39	21.58	1190
03-Jar>-97	15514	53 04	77.17	37.74	76.88	-27.44	40	21.63	1191
'O-Jan-97	10614	114 59	-33 74	59.27	306.76	85.10	41	21.63	1192
I7-Jan-97	839 95	546 67	138.76	18841	695.25	590.60	42	21.20	1193
24-Jan-97	45 06	83 18	109.74	24 56	20947	73.21	43	21 45	1194
31-Jai>-97	-11866	-77 27	-173 54	20.64	-266.97	86.50	44	21.55	1195
07-Fet>-97	33 48	40 97	9824	35.18	-22.46	-7.31	45	21.55	1196
:4-Fet>-97	89 00	41 00	86 14	-27.38	56.95	-35.05	46	21.47	1197
2I-Fet>-97	7612	119 58	-902	376 12	135.77	60.15	47	21 45	1198
28-Feb-97	-4 02	3827	-67 62	134 46	67.78	21.80	48	21 40	1199
07-Mar-97	-5483	-30 79	-887	1262	-163 16	39.78	49	21 36	1200
"4-Mar-97	-118 39	-39 38	-6 76	-69 53	8.14	-80.63	50	21 26	1201
21-Mar-97	-22 84	-30 44	-105 22	-15.59	-23.05	-249	51	21.18	1202
28-Mar-97	-114 72	-5324	-44 82	-61.74	-64.05	-42 64	52	20 99	1203
34-Apr-97	2383	-6 50	-5014	62 52	-1820	-32.29	53	20 90	1204
11 -Apc-97	600	-1698	-37 92	66 80	-99 19	8.10	54	20.79	1205

WeekEnd	NSEIRetA	AIIRetnA	AgrRetA	ComRetA	FinRetA	IndRetA	series	TBills Rate	IssueNo.
'8-Apr-97	4399	-73.94	72.68	-374.68	-39.07	2.65	55	20 56	1206
25-Apr-97	17.53	3.14	-45 97	16.36	-16.19	33.00	56	20.40	1207
32-May-97	97.45	-1.23	1475	125.41	-16.55	-77.20	57	20 30	1208
09-May-97	124.36	67.39	18.08	-35.31	115 74	111.59	58	20.15	1209
'5-May-97	6.81	69.08	-29.00	144.31	60 13	72.15	59	19 SO	1210
23-May-97	6.19	84.27	-7.52	150.90	44 67	81.14	60	19 68	1211
30-May-97	48.72	3.42	15 70	-48.73	29.23	-2685	61	19 42	1212
06-Jun-97 _	-50 21	60.70	-53.01	158.29	119 38	1929	62	1925	1213
I3-Jun-97	81.50	98.23	119.42	375.30	69.89	-60.73	63	18 96	1214
20-Jun-97	82.31	63.29	5.48	70.14	15.57	130 58	64	18 72	1215
27-Jun-97	22.08	73.11	3.65	102.95	130.82	59.13	65	18.47	1216
M-Jul-97 ""	5.80	-2.32	-37.57	4.99	109.23	-70.40	66	18.34	1217
11-JU-97	-20.70	-9.14	8.14	-16.76	-33.04	4 08	67	18.27	1218
18 Jul-97	-64.19	-19.04	10.70	-22.53	-29 78	-21.25	68	18.22	1219
25-Jui-97	54.70	-7.45	-165.98	205.28	-68.28	-15.39	69	18.20	1220
:i-Aug-97	-60.67	134.34	107.06	-75.86	-33.79	462.15	70	18.78	1221
D8-Aug-97	-115 56	-49.68	-1.30	6.53	4.94	-129.19	71	23.58	1222
*5-Aug-97	58.45	-7.94	78.94	-40.99	-79.08	29.22	72	25.26	1223
22-Aug-97	48.72	15.60	151.69	89.73	-67.39	-45.93	73	25.69	1224
29-Aug-97	14 05	-26.18	13.18	-45.75	12 94	-75.56	74	26.10	1225
05-Sep-97	23.07	36^88	170.34	-2.65	-70.40	80.83	75	26.76	1226
12-Sep-97	146.15	39.54	341.92	77.84	2599	" -132.06	76	27.16	1227
19-Sep-97	18.79	20.88	74.49	52.30	7.23	-136.58	77	27.15	1228
26-Sep-97	-55.20	-43.69	-5.56	18.14	-176.19	-19.00	78	27.09	1229
03-()ct-97	-39.72	17.37	342.57	-41.91	-140.84	-23 13	79	27.14	1230
10-0ct-97	-79.42	-49.73	-41.44	-87.28	55.95	-155 51	80	27.20	1231
17-0ct-97	-74.84	-58 45	-47.45	25.65	-79.89	-106.26	81	27.15	1232
24-Oct-97	-81.27	-92.50	-13.93	31.53	-54.07	-231.04	82	26.85	1233
31-Oct-97	-14 27	-25 32	-52.80	-74.86	-57.10	52.33	83	26.63	1234
07-NOV-97	-0 41	36.91	-57.69	-60.11	-5.36	210.48	34	26.51	1235
14-Nov-97	-75.44	-111.39	-2.95	-23.01	-97.41	-151 35	85	2648	1236
2[1]-Nov-97	-15342	-76.93	-196.37	-8971	-51.49	21.45	86	26 36	1237
28-Nov-97	-89.04	-57.00	-267.69	2642	-0.84	-77.86	87	25 29	1238
05-Dec-97	44.56	-4.61	-9.98	-26.18	10.25	-16.73	88	26.39	1239
12-Dec-97	29.55	31 55	31.51	163.40	35.65	13.80	89	2627	1240
19-Dec-97	44 88	54.24	37 53	42.83	74.19	-33.00	90	26.27	1241
26-Dec-97 _	37.99	19.02	53.97	27.93	19.69	-3.45	91	26.31	1242
32-Jan-98	15.91	8.37	0.00	-1.37	18.48	10.10	92	26.27	1243
09-Jan-98	79.32	43.77	64.98	-18.58	47.51	62.11	93	2528	1244
16-Jan-98	320.91	305.64	101.44	399.25	302.68	372.38	94	26.25	1245
23-Jan-98	119.60	166.10	6597	206.62	165.47	210.38	95	26.30	1246
30-Jan-98	84.00	129.64	132.34	293.82	-111.28	204.43	96	26.35	1247
06-Feb-98	-134 94	61.78	-60.35	-110.98	452.42	-36.00	97	26.41	1248
13-Feb-98	-3.57	-81.86	-21 54	-78.12	-190.85	-64.39	98	26.51	1249
20-Feb-98	33.56	-3.58	41.57	-65.18	7 57	-22.61	99	26.61	1250
27-Feb-98	154 72	27.26	314 38	-67.01	-10.88	-35.03	100	26.77	1251
06-Mar-98	21.31	-5.03	-22.53	-4.14	-69.63	39 34	101	26.89	1252
13-Mar-98	-77 59	-65.61	-150.68	-37.82	-21.65	-77.66	102	26.90	1253
20-Mar-98	-72.10	127.69	90.94	-38.96	-14 43	-51 53	103	26.98	1254
27-Mar-98	71.49	-84.80	267.66	-220.33	-186.39	-80.91	104	26.99	1255
03-Apr-98	-51.45	-4.82	-11.97	99.13	2.01	-59.51	105	26.99	1256
10-Apr-98	-66.12	-81.36	-10.50	16.32	-100.67	-151.65	106	26.96	1257
17-Apr-98	-31.73	-76.57	-23.48	-139.36	-67.45	-65.14	107	26.77	1258
24-Apr-98	-29.82	-97.72	-23.75	-133.03	-129.20	-92.73	108	26.48	1259

WeekEnd	NSEIRetA	AllRetnA	AgrRetA	ComRetA	FinRetA	IndRetA	series	TBills Rate	IssueNo.
I'-May-98	-120.85	-74 03	-90.14	12.43	-121.18	-98.93	109	2628	1260
•ay-98	-21.44	-25.99	-50.35	-11.10	-36.14	-11.48	110	26.00	1261
•5-May-98	-25.12	-26.79	-13.11	-24.85	37.41	-97.86	111	25.74	1262
[224lay-98	10.37	-25.91	44.70	-144.79	63.04	-64.04	112	25.70	1263
25-May-98	177.27	104.23	45.22	48.45	217.99	76.48	113	25.42	1264
	101.64	9.65	66.61	-81.42	-18.66	-18.92	114	25.40	1265
'Z-Jun-98	182.96	97.26	93.19	231.00	-1.23	80.65	115	25.12	1266
19-Jun-98	-58.98	118.38	66.15	-121.89	-25.39	442.96	116	24.92	1267
25-Jun-98	-48 57	-48.01	-110.91	-32.38	-13.34	-36 40	117	24 74	1268
03-Jut-98	44 65	-34.11	26.83	-27.18	57.28	-117.71	118	24.58	1269
1Q-Jul-98	-7 75	-24.80	-7.04	74.88	-112.79	-28.22	119	24.45	1270
17-Jii-98	-12.67	-74.34	-26.86	34.50	-42.50	-107.10	120	24 17	1271
2i>hi-98	-38.64	-52.40	-42.03	-147.91	-5821	-114.59	121	2399	1272
31-Ju(-98	35.10	-5.35	143.29	-49.77	-10.45	-60.25	122	2380	1273
07-Aug-98	20.47	1.86	88.11	-73.08	-14.29	10.63	123	23.55	1274
•i-Ajg-98	9.85	-37.01	-1.30	-127.62	-70.49	32.23	124	23.20	1275
.'-jg-98	-16.17	-12.81	8.55	21.63	-29.74	-26.29	125	22.93	1276
2&-Aug-98	26.51	5.07	36.41	36.49	-9.11	-12.63	126	22.61	1277
rut-Sep-98	-124.06	-81.49	32.20	-93.62	-157.08	-72 22	127	22.36	1278
11 Sep-98	-4.68	20.01	-41.17	-75.33	112.54	50 33	128	22.00	1279
18-Sep-98	-9.33	-29.96	36.02	1.84	-81.16	-21.27	129	21 41	1280
25-Sep-98	-54.03	-24.63	166.99	-3.08	-88.16	-94.39	130	20.88	1281
02-Oct-98	-26.84	-77.56	0.86	-218.14	-54 30	-35.94	131	20.24	1282
Q9-Oct-98	-31.21	-73.51	-71.11	-61.11	-139.10	-44.63	132	19 82	1283
15-Oct-98	-13.52	-27.03	-5.33	-30.64	-48.02	-56.34	133	19.27	1284
23-Oct-98	6.04	-21.38	-53 74	20.50	24.34	-63.03	134	18.60	1285
3D-Oct-98	7.25	35.87	-8.98	333.37	-3 16	-91.88	135	17.77	1286
C6-Nov-98	-3.49	-27.94	-31.25	128.60	37.74	-82.37	136	16.90	1287
13-Nov-98	-106.32	-168.71	-60.60	58.30	-80.57	-190.81	137	15.79	1288
23-Nov-98	-4.04	160.79	-27.98	-55.13	4.72	-7.57	138	14.35	1289
27 Nov 98	-31.74	19.68	-27.93	-92.17	-39.41	80.64	139	12.96	1290
:<4-Dec-98	-15.18	10.66	-8.50	14.15	-4096	38.34	140	11 88	1291
" Dec-98	103.77	61.33	89.14	58.50	21.88	68.36	141	11.07	1292
15-Dec-98	167.37	95.32	-10.12	68.24	161.91	38.58	142	10.71	1293
25-Deo98	358.26	196.82	92.61	45.06	343.56	247.96	143	10.74	1294
-'•Jan-99	192.34	173.29	45.17	140.50	221.83	251.15	144	10.78	1295
C-S-Jan-99	92.82	51.80	-0.10	39.22	46.01	86.17	145	10.59	1296
15-Jan-99	154.16	243.29	24.70	289.40	27344	313 38	146	10.00	1297
22-Jan-99	145.78	261.15	10.62	155.18	214.18	511.33	147	9.24	1298
29-Jan-99	-99.40	-53.62	31 82	-50.66	-206 72	48.55	148	8.59	1299
C5-Feb-99	-183.42	-100.93	-13.97	-137.67	-91.29	-119.14	149	7.97	1300
12-Feb-99	-32.20	-6.39	69.36	-71.92	68.84	-66.94	150	7.85	1301
19-Feb-99	-2.25	-35.07	-35.94	69.39	79.94	-193.61	151	8.61	1302
25-Feb-99	1.59	-50.05	-15.72	-28.65	-66.91	-58.19	152	9.07	1303
05-Mar-99	-56.43	-99.14	-786	-36.02	-106.39	-185.29	153	9.45	1304
12-Mar-99	103 15	69.76	-2979	64.64	-57.26	243.03	154	9.24	1305
19-War-99	-41.10	-57.02	479	-20.66	-20.72	-73.61	155	8.97	1306
26-Mar-99	-91.26	-41.70	-3 60	-38.38	-83.65	-30.76	156	8.81	1307
02-Apr-99	-30.43	-169.46	-40 26	-380.87	-129.51	-133.80	157	9.06	1308
0&-Apr-99	-52.52	69.77	-92 43	399.05	8.73	19.53	158	9.27	1309
16-Apr-99	53.24	41.42	2004	35.71	3.81	98.31	159	9.46	1310
23-Apr-99	20.10	27.42	72.05	45.98	43.36	-36.48	160	9.67	1311
30-Apr-99	50.49	-56.32	1 95	12.23	-33.84	-155.28	161	9.75	1312
07-May-99	-79.14	-51.23	-15.40	1345	-146.22	-43.46	162	9.67	1313

AeekEnd	NSEIRetA	AllRetnA	AgrRetA	ComRetA	FinRetA	IndRetA	series	TBills Rate	IssueNo.
-Vay-99	-2863	0.27	-3244	-110.46	-44 86	130 20	163	959	1314
;-4lay-99	-19 15	-3.84	44 05	-95.94	21 52	16.22	164	9.78	1315
:3-Mav-99	-1060	58.72	-31.23	-14.99	289 89	40.42	165	10.32	1316
X-Jun-99	50.10	-102.41	2.81	-11.96	-82.97	-223.59	166	1226	1317
"-Jon-99	-40 33	-11.10	26.94	-74 73	23.17	4.37	167	13.40	1318
•3-Jur-99	107.58	330.63	67.33	-240	134.55	844 95	168	1403	1319
:5-Jun-99	-29 21	2.91	-79.26	-21.60	-47 17	109.15	169	14 37	1320
Q2-Jti-99	-19.15	-46.13	-7.83	-145.40	-36.14	-9 38	170	14 68	1321
J 5-Jul-99	23 77	-29.92	2.84	-16.12	31 30	-108.77	171	14.81	1322
•S-Jut-99	67.91	-16.04	0.64	-222.81	59.14	56 92	172	14.71	1323
23-Jui-99	9.38	-14.32	-1.95	-158.18	101.31	-24 04	173	14.79	1324
3Q-Jirt-99	-12.68	6 84	-24.75	62.42	-70.57	71.33	174	14.88	1325
• - .: 39	-25.58	-7.39	-16.20	36.93	-46.76	52 76	175	14.90	1326
"3-Aug-99	-18.94	-59.23	-10.19	-10.56	-2.36	-138.76	176	14.94	1327
20-Aug-99	-2 34	-64 91	-284.22	-8.47	-23.78	-26.57	177	15.17	1328
j27-Aug-99	-147.11	-113.23	-192.19	-42.88	-92.11	-108 65	178	15.30	1329
:Q3-Sep-99	-51.30	-63.38	-3.55	-83.29	-70.79	-99.72	179	15.91	1330
i:-Sep-99	-125.59	-53.11	-130 99	42.05	-68.06	-21.00	180	1674	1331
17-Sep-99	30.89	-23.58	71.09	-25.07	-48.87	-51.21	181	17.38	1332
24-Sep-99	-119.46	-100.95	-136.53	-99.11	-134.72	-54.48	182	17.62	1333
31-OQ-99	-39.45	-20.39	13.89	-53 68	3.82	-26 56	183	17.72	1334
:6-Oct-99	55.05	22.94	-42.26	42.81	57.63	22.20	184	17.79	1335
' 5-Oct-99	26.86	77 40	36.63	469.13	40.09	-118.99	185	17 74	1336
22-Oct-S9	-23 61	-12 90	-47.06	4.86	224.71	-11.83	186	1784	1337
23-Oct 99	-18.37	-1.95	-40.01	-35.80	-14.04	61.85	187	18 09	1338
05-Nov-99	-59.55	-3.62	1.03	-55.50	-59.52	22.74	188	1831	1339
12-NW-99	-86 21	-26 68	97.47	-36.13	-12.16	-142.68	189	18.69	1340
"r-Nov-99	-48.92	-53.61	-104 83	7.03	-121 84	-75.20	190	19.56	1341
25-Nov-99	-19.14	-0.50	-57.99	-48.07	0.62	-19.39	191	19.78	1342
OS-Dec-99	27.36	33.24	-143.26	16.95	21.35	39.36	192	20.09	1343
10-Dec-99	-40.66	70.94	-8.06	99.30	-11.90	166.37	193	20.47	1344
17-Dec-99	60.04	40.42	-47 81	-39.83	24.67	131.94	194	2094	1345
2i-Dec-99	-8.18	12.29	31.42	6 48	-3.92	7.68	195	20 97	1346
31-Dec-99	9.44	-17.71	-63.65	8.40	-15.96	-10.23	196	20.65	1347
C7-Jan-00	10.86	12.27	6.85	-11.74	13.48	28.73	197	2C.00	1348
14-jan-00	42.67	0.20	28.49	74.01	66.85	-72.90	198	18.92	1349
2' - Jan-00	-27.30	-40.05	-54.41	25.06	0.92	-50.66	199	17.27	1350
28-Jan-OO	6.92	-15.51	54 57	-43.57	-63.10	2.61	200	15.71	1351
3A-Feb-00	-2.48	0.78	27.10	-58.07	27.34	4.25	201	14.13	1352
11-Feb-OO	-71.15	-40.38	-101.77	20.46	-92.61	1.33	202	12.27	1353
18-Feb-OO	-1.29	-19.98	-114.30	-9.20	-35.63	19.43	203	10.94	1354
25-Feb-00	-67.05	-56.22	-84.28	-110.19	-150.16	76.39	204	10.91	1355
03-Mar-00	83.82	32.84	-91.69	71.56	97.92	11.80	205	11.36	1356
1 Q-Mar-00	48.10	-10.79	-194.47	36.27	65.03	4 38	206	11.90	1357
17-Mar-00	47.77	10.90	111.29	-29.01	147.65	-122.00	207	12.39	1358
24-Mar-00	-127.60	-62.54	-68.00	12.14	-154.41	-30.97	208	12.76	1359
31-Mar-OO	20.91	42.66	-38.40	-19.50	44 36	128.77	209	12.53	1360
37-Apr-OO	-38.63	49.02	-18.58	-44.87	1.73	98 80	210	12.09	1361
14-Apr-00	-18.31	278	-27.34	-48.84	21.99	22.04	211	11.61	1362
21-Apr-OO	-66.72	-10.05	-83.03	-202.24	55.62	60.49	212	11.28	1363
28-Apr-00	-14.33	15 14	15.08	12.46	-6.12	42.89	213	11.01	1364
05-May-00	-59.38	-48 68	-0.64	-94 58	-77.24	-24.58	214	11.06	1365
12-May-00	-11.58	-3058	32.13	65.58	-73.38	-84 88	215	11.16	1366
19-May-OQ	-47.48	24.61	-37.30	118.21	2840	49.03	216	11.00	1367

WeekEnd	NSEIRetA	AllRetnA	AgrRetA	ComRetA	FinRetA	IndRetA	series	TBills Rate	IssueNo.
26-May-OO	-27 26	-35 03	-9.78	8.79	-26.29	-84.15	217	10.61	1368
32-Jun-OO	-30.91	-72.05	19.14	-48 51	-59.24	-73.22	218	10.28	1369
39-Jun-OO	-116.99	-63 14	-2566	-3049	-57.51	-64.02	219	1001	1370
'6-Jun-OO	2421	-0 54	-8.38	17 54	-95.30	77.79	220	10 06	1371
23-Jun-OO	-84.10	-82.12	-67.13	-81.13	9 31	-172.98	221	10.12	1372
30-Jun-00	23.33	-74.87	-21.84	-98.24	-23.10	-71.24	222	10.00	1373
•7-Jut-OO	-20.54	-84.60	17.26	-64.92	-117.40	-73.45	223	9.82	1374
14-Jul-00	-21.01	52.29	-55.21	467.28	-128.10	0.62	224	9.52	1375
21-Jul-00	69.80	41.93	-17.48	-30.79	109.54	97.27	225	9.22	1376
28-JuMX)	34 66	-10.98	-55.81	-9.35	37.60	-30.30	226	8.96	1377
34-Aug-00	-59.91	-40.55	-11.41	-71.20	-29.31	-36.71	227	9.10	1378
11-Aug-OO	-38.80	-14 57	-60.28	39.40	-23.55	-22.09	228	9.70	1379
18-Aug-OO	8.61	-12.01	-157.38	22.19	28.59	29.34	229	10.15	1380
25-Aug-00	5.50	-6.05	89.13	32.22	-108.39	5.52	230	10.24	1381
01-Sep-00	-7.45	-8.63	48.11	3.93	-47.55	3.97	231	10.34	1382
38-Sep-OO	34.10	16.92	-34 56	32.68	109.94	-37.11	232	10.37	1383
15-Sep-00	69.20	49.53	124.87	14.10	56.32	32.64	233	10.59	1384
22-Sep-OO	9.83	88.76	-49.03	6.43	-5.04	28232	234	10.57	1385
29-Sep-00	-46.99	-40.17	-25.57	-52.16	-48.30	-47.62	235	10.55	1386
06-0ct-00	0.22	7.22	42.71	-29 95	-47.67	73.87	236	10.62	1387
13-Oct-OO	60.15	-73.68	63.37	-320.99	25.02	-49.78	237	10.73	1388
20-0ct-00	>7.23	28 27	126.98	37.29	30.40	-1420	238	10.88	1389
27-Oct-OO	13.92	-5.28	24.70	-5.77	86.23	-3.72	239	10.82	1390
33-Nov-00	37.34	43.32	-59.08	103.16	2063	11.40	240	10.93	1391
1 Q-Nov-00	67.99	-72.39	20.40	-71.91	36.84	-255.86	241	11.12	1392
' "T-Nov-00	-60.50	-60.87	55.22	-40.75	-144 47	-79.08	242	11.80	1393
24-Nov-00	-2428	-33.32	28.00	-11.10	-101.82	-39.39	243	12.41	1394
Ol-Dec-OO	-0.06	-18.58	1.25	25.55	-91.47	-12.00	244	12.14	1395
M-Dec-00	-33 39	-29.29	-4.88	-48.17	-45.28	-12.93	245	12.96	1396
15-Dec-OO	-31.46	-43 37	-49.54	22.32	-118.62	-29.78	246	1347	1397
22-Dec-OO	-147.09	-133.77	-76.76	-2.67	-407.81	-38.07	247	14.06	1398
29-Dec-00	-129.99	-75.38	27.21	-52.42	-208.52	-39.46	248	14.64	1399
05-Jan-01	172 05	107.37	8.35	2.06	340.66	113.21	249	14.87	1400
12-Jan-01	56 64	21.32	-14.36	-155.34	154.33	64.54	250	14.99	1401
19-Jan-01	-188.72	-154.04	-304.32	-95.73	-245.81	-52.76	251	15.12	1402
26-Jan-01	-18.78	162.66	26.61	14.92	650.62	9.17	252	15.21	1403
02-Feb-01	-26.47	-1.40	41.31	82.38	-95.97	2.52	253	15.26	1404
09-Feb-01 ~	339.99	82.45	642.63	-263.45	63.63	60.11	254	15.32	1405
16-Feb-01	-34 43	136.92	39505	488.63	-51.90	-26.71	255	15.40	1406
23-Feb-01	126.91	-3.27	-20.91	-7.47	-12.80	-37.35	256	15 38	1407
02-Mar-01	-54.53	-26.72	-56.65	-47.99	18.86	-5.23	257	15.09	1408
09-Mar-01	50.19	-8.43	39.81	-57.59	171.54	-136.46	258	14.80	1409
16-Mar-01	-52.76	-44.56	-96.80	-95.91	0.75	-18.33	259	14.42	1410
23-Mar-01	-80.98	-62.62	-45.21	-75.58	-150.48	13.87	260	13.92	1411
30-Mar-01	-98.10	-18.19	44.59	-19.86	-72.19	17.48	261	13.43	1412
06-Apr-01	-86.27	-48.51	-41.49	-42.07	-75.54	-46.78	262	12.95	1413
13-Apr-01	-41 19	-29.40	-72.52	-59.19	24.82	-5.88	263	12 40	1414
20-Apr-01	-17.01	0.42	-46.82	10.98	22.56	3.96	264	11.80	1415
27-Apr-01	-37.40	-64.04	-19.43	-88.06	-88.11	-60.53	265	11.15	1416
04-May-01	-36.54	-12.18	4.79	-16.42	55.12	-60.85	266	10.51	1417
11-May-01	-47.29	-34.10	22 68	-25.46	-93.86	6.08	267	10.43	1418
18-May-01	-39.16	-111.04	-158.C6	-89.59	-57.40	-79.93	268	10.34	1419
25-May-01	-75.98	-55.97	-2.54	-89.64	-41.84	-52.30	269	11 56	1420
01-Jun-01	-40 14	28.52	-7.24	254.51	-23.26	-52.56	270	11.99	1421

WeekEnd	NSEIRetA	AllRetnA	AgrRetA	ComRetA	FinRetA	IndRetA	series	TBills Rate	IssueNo.
38-Jun-01	-60.48	38.47	67.36	186.29	-22.97	-20.73	271	12.24	1422
•5-Jun-01	-29.33	7.91	-77.49	-20.97	120.31	-8.97	272	1243	1423
22-Jun-01	-26.43	25.54	50.58	-27.44	91.83	-5.72	273	12.78	1424
29-Jun-01	45.96	22.72	144.41	-4.21	36.83	-26.66	274	12.80	1425
jo-Jul-01	90 78	-58.45	-77.97	-220.78	11.01	-6.27	275	12.90	1426
•3-Jul-OI	32.48	-2.28	-24.78	71.25	-49.72	-003	276	12.94	1427
20-JuW)1	-29 50	-29.16	1.43	12.78	-54 19	-39.76	277	12.94	1428
27-Jut-01	7.37	-9.51	38.14	-67.76	-5.84	-15.83	278	12.94	1429
(B-Aug-01	-39.65	10.69	-59.85	186.09	12.18	-18.08	279	12 84	1430
'O-Aug-OI	-24.31	-17.34	-7.80	2.21	66.64	-104 12	280	12 80	1431
*7-Aug-01	-4347	-13.07	-65.10	52.17	-51.98	7.18	281	12.78	1432
24-Aug-01	-89.12	-72.55	-30.28	-4.97	-38.15	-146.22	282	12.66	1433
31-Aug-01	-103 16	-56.32	34.57	-220.51	-70.35	45.33	283	12.49	1434
07-Sep-01	-91.06	-91.72	-103.24	-45.13	-152.39	-45.38	284	12.28	1435
14-Sep-01	-31.61	-37.03	-2.02	-63.97	-19 59	-54.66	285	12.14	1436
21-Sep-01	-147 54	-95.81	-129.84	-44.37	-44.35	-127.82	286	11.98	1437
28-Sep-01	-179.61	-125.32	-103.17	-166.47	-125.48	-93.28	287	11.70	1438
05-0ct-01~	-0.76	-66.96	-1429	-185.67	18.63	-86.13	288	11.51	1439
12-Oct-O1	-80 02	-69.46	-17.51	-149.81	-145.01	22.95	289	11.45	1440
'5-Oct-OI	71.80	56.79	-46.31	148.31	61.07	44.78	290	11.50	1441
2S-Oct-O1 "	149.81	155 64	11.69	113.90	189.06	182.22	291	11.51	1442
02-NOV-01	157.47	153.08	29.04	204.63	194.42	75.09	292	11.52	1443
I9-NOV-01	-18 32	222.17	236.95	-30.12	145.45	403.79	293	11.52	1444
•5-Nov-01	-6549	-0.15	18.99	18.37	1.34	5909	294	11.45	1445
25-Nov-OI	-81 06	-20.84	-3726	103.53	-95.97	2 70	295	11.28	1446
30-Nov-01 ~	-55 90	-35.20	-102.65	-51.20	-27.43	-6.50	296	11.4	1447
"Dec-01	-65.50	-57.49	-82.91	-81.49	-85.90	-51.12	297	11.3	1448
14-Dec-01	-10.55	-17.50	-51.83	-27.83	99.05	-60.74	298	11.1	1449
21-Dec-OI	-18 78	-4.20	-21.06	1.49	-9.21	1392	299	11.0	1450

Dependent Variable AGRRETA
Method: Least Squares
Date: 11/12/05 Time: 11:15
Sample: 4/05/1996 12/21/2001
Included observations: 299
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TBILLS RATE01	0.226662	0.302810	0.748527	0.4547

R-squared	0.002127	Mean dependent var	-0.017432
Adjusted R-squared	0.002127	S.D. dependentvar	90.69269
S.E. of regression	90.59617	Akaike info criterion	11.85404
Sum squared resid	2445885.	Schwarz criterion	11.86642
Log likelihood	-1771.179	Durbin-Watson stat	1.582741

White Heteroskedasticity Test:

F-statistic	0.542801	Probability	0.581696
Obs*R-squared	1.092598	Probability	0.579089

Test Equation:
Dependent Variable RESID^2
Method: Least Squares
Date: 11/12/05 Time: 11:15
Sample 4/05/1996 12/21/2001
Included observations: 299
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3245.138	17571.05	0.184687	0 8536
TBILLS RATE01	266.5712	2519.749	0.105793	0.9158
TBILLS RATE01^2	0.838230	75.36482	0.011122	0.9911

R-squared	0.003654	Mean dependent var	8180.216
Adjusted R-squared	-0.003078	S.D dependent var	29105.03
S.E. of regression	29149.79	Akaike info criterion	23.40827
Sum squared resid	2.52E+11	Schwarz criterion	23.44539
Log likelihood	-3496.536	F-statistic	0.542801
Durbin-Watson stat	1.533397	Prob(F-statistic)	0.581696

Dependent Variable: COMRETA
Method: Least Squares
Date 11/12/05 Time 11:16
Sample: 4/05/1996 12/21/2001
Included observations: 299
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TBILLS_RATE01	0.176858	0.348157	0.507983	0.6118

R-squared	0.000556	Mean dependent var	1.815267
Adjusted R-squared	0.000556	S.D dependent var	114.9723
S.E of regression	114.9403	Akaike info criterion	12.33004
Sum squared resid	3936961.	Schwarz criterion	12.34242
Log likelihood	-1842.341	Durbin-Watson stat	1.872784

White Heteroskedasticity Test:

F-statistic	0.285714	Probability	0.751685
Obs'R-squared	0.576107	Probability	0.749721

Test Equation:
Dependent Variable RESID^2
Method: Least Squares
Date: 11/12/05 Time: 11:16
Sample: 4/05/1996 12/21/2001
Included observations: 299
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std Error	t-Statistic	Prob.
C	16172.23	26023.58	0.621445	0.5348
TBILLS RATE01	-87.29040	3113.210	-0.028039	0.9777
TBILLS_RATE01^2	-4 366730	84.22542	-0.051846	0.9587

R-squared	0.001927	Mean dependent var	13167.10
Adjusted R-squared	-0.004817	S.D. dependent var	32966.49
S.E. of regression	33045.80	Akaike info criterion	23.65916
Sum squared resid	3 23E+11	Schwarz criterion	23.69629
Log likelihood	-3534.044	F-statistic	0.285714
Durbin-Watson stat	1.836556	Prob(F-statistic)	0.751685

Dependent Variable: FINRETA
Method Least Squares
Date. 11/12/05 Time: 11:16
Sample: 4/05/1996 12/21/2001
Included observations: 299
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TBILLS_RATE01	-0.077616	0.370707	-0.209373	0.8343

R-squared	0.000028	Mean dependent var	-1.289277
Adjusted R-squared	0.000028	S.D.dependent var	117.1331
S.E. of regression	117.1315	Akaike info criterion	12.36781
Sum squared resid	4088497.	Schwarz criterion	12.38019
Log likelihood	-1847.988	Durbin-Watson stat	1.735032

White Heteroskedasticity Test:

F-statistic	0.337706	Probability	0.713680
Obs'R-squared	0.680704	Probability	0.711520

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 11/12/05 Time: 11:16
Sample 4/05/1996 12/21/2001
Included observations: 299
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8921.014	24865 33	-0.358773	0.7200
TBILLS RATE01	2724.728	3305.296	0.824352	04104
TBILLS RATE01^2	-73.47228	92.67357	-0.792807	0.4285

R-squared	0.002277	Mean dependent var	13673.90
Adjusted R-squared	-0.004465	S.D. dependentvar	43309.97
S.E. of regression	43406.55	Akaike info criterion	24.20459
Sum squared resid	5.58E+11	Schwarz criterion	24.24172
Log likelihood	-3615.586	F-statistic	0.337706
Durbin-Watson stat	1.631206	Prob(F-statistic)	0.713680

Dependent Variable INDRETA
Method Least Squares
Date: 11/12/05 Time: 11:16
Sample: 4/05/1996 12/21/2001
Included observations: 299
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TBILLS_RATE01	-0.003071	0.352058	-0.008722	0.9930

R-squared	-0.000171	Mean dependent var	1.519344
Adjusted R-squared	-0.000171	S.D. dependent var	116.4601
S E. of regression	116 4700	Akaike info criterion	12 35648
Sum squared resid	4042451.	Schwarz criterion	12.36886
Log likelihood	-1846.294	Durbin-Watson stat	1.549197

White Heteroskedasticity Test:

F-statistic	0.233657	Probability	0.791779
Obs'R-squared	0471306	Probability	0.790055

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 11/12/05 Time 11:16
Sample: 4/05/1996 12/21/2001
Included observations: 299
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	31204.86	28090.32	1.110876	0.2675
TBILLS RATE01	-1879.898	3646.306	-0.515562	06065
TBILLS RATE01*2	44.51723	102.7807	0.433129	0.6652

R-squared	0.001576	Mean dependent var	13519.90
Adjusted R-squared	-0.005170	S.D. dependentvar	53001.25
S E of regression	53138.08	Akaike info criterion	24.60916
Sum squared resid	8.36E+11	Schwarz criterion	24.64629
Log likelihood	-3676.069	F-statistic	0.233657
Durbin-Watson stat	1.965491	Prob(F-statistic)	0.791779

Dependent Variable NSEIRETA
Method: Least Squares
Date: 11/12/05 Time: 11:16
Sample: 4/05/1996 12/21/2001
Included observations: 299
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TBILLS RATE01	0.225483	0.301556	0.747731	0.4552

R-squared	0.001745	Mean dependent var	I.584554
Adjusted R-squared	0.001745	S.D. dependent var	92.09799
S.E. of regression	92.01762	Akaike info criterion	II.88518
Sum squared resid	2523238.	Schwarz criterion	11.89755
Log likelihood	-1775.834	Durbin-Watson stat	1.487775

White Heteroskedasticity Test:

F-statistic	0.291483	Probability	0.747369
Obs*R-squared	0.587717	Probability	0.745382

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 11/12/05 Time: 11:16
Sample: 4/05/1996 12/21/2001
Included observations 299
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8855.033	25216.81	-0.351156	0.7257
TBILLS RATE01	1901.396	3165.406	0.600680	0.5485
TBILLS_RATE01^2	-46.77400	82.33113	-0.568120	0.5704

R-squared	0.001966	Mean dependent var	8438.924
Adjusted R-squared	-0.004778	S.D. dependent var	42114.40
S.E. of regression	42214.89	Akaike info criterion	24.14892
Sum squared resic	5.28E+11	Schwarz criterion	24.18604
Log likelihood	-3607.263	F-statistic	0.291483
Durbin-Watson stat	1.982511	Prob(F-statistic)	0.747369

Dependent Variable ALLRETNA
Method Least Squares
Date: 11/12/05 Time 11:17
Sample 4/05/1996 12/21/2001
Included observations 299
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TBILLS RATE01	0.108818	0.238858	0455575	0.6490

R-squared	0.000572	Mean dependent var	0.817498
Adjusted R-squared	0.000572	S D dependent var	76.70395
S E of regression	76 68203	Akaike info criterion	11.52055
Sum squared resid	1752280.	Schwarz criterion	11.53293
Log likelihood	-1721.322	Durbin-Watson stat	1.365511

White Heteroskedasticity Test:

F-statistic	0.011455	Probability	0 988611
Obs*R-squared	0.023140	Probability	0 988497

Test Equation:
Dependent Variable: RESIDE
Method: Least Squares
Date: 11/12/05 Time: 11:17
Sample: 4/05/1996 12/21/2001
Included observations: 299
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std Error	t-Statistic	Prob.
C	7246.130	12445.18	0.582244	0.5608
TBILLS RATE01	-143.4405	1547.233	-0.092708	0.9262
TBILLS_RATE01^2	3.289947	41.24350	0.079769	0.9365

R-squared	0.000077	Mean dependent var	5860.468
Adjusted R-squared	-0.006679	S.D.dependent var	20255.44
S.E of regression	20322.97	Akaike info criterion	22.68687
Sum squared resid	1.22E+11	Schwarz criterion	22.72400
Log likelihood	-3388.688	F-statistic	0.011455
Durbin-Watson stat	1 831018	Prob(F-statistic)	0.988611

Dependent Variable AGRRETA
Method ML - ARCH
Date: 11/12/05 Time: 11:19
Sample: 4/05/1996 12/21/2001
Included observations: 299
Convergence achieved after 65 iterations
Bollerslev-Wooldrige robust standard errors & covariance

	Coefficient	Std. Error	z-Statistic	Prob.
SQR(GARCH)	-0.349442	0.156998	-2.225773	0.0260
TBILLS_RATE01	1.529634	0635527	2.406876	0.0161
		Variance Equation		
C	1608.605	1022.747	1.572827	0.1158
ARCH(1)	0.201094	0.100613	1.998685	0.0456
GARCH(1)	0.616075	0.133148	4.626994	0.0000
RESID	-0.596721	39.84319	-0.014977	0.9881

R-squared	-0.019119	Mean dependent var	-0.017432
Adjusted R-squared	-0.036510	S.D. dependent var	90.69269
S E of regression	92.33343	Akaike info criterion	11.74369
Sum squared resid	2497961.	Schwarz criterion	11.81795
Log likelihood	-1749.682	Durbin-Watson stat	1.524386

Dependent Variable. AGRRETA
Method: ML - ARCH
Date 11/12/05 Time 11:19
Sample: 4/05/1996 12/21/2001
Included observations: 299
Convergence achieved after 42 iterations
Bollerslev-Wooldrige robust standard errors & covariance

	Coefficient	Std. Error	z-Statistic	Prob.
SQR(GARCH)	-0.510515	0.192891	-2.646648	0.0081
TBILLS_RATE01	2.479711	0.857240	2.892668	0.0038
		Variance Equation		
C	6676.769	1117.921	5.972488	0.0000
ARCH(1)	0.079241	0.051381	1.542241	0.1230
ARCH(2)	0.098475	0.055056	1.788623	0.0737
ARCH(3)	0.310584	0.219742	1.413403	0.1575
ARCH(4)	0.286444	0.193392	1.481155	0.1386
ARCH(5)	0.033081	0.038121	0.867789	0.3855
ARCH(6)	-0.018817	0.014321	-1.313894	0.1889
ARCH(7)	0.114873	0.095181	1.206882	0.2275
ARCH(8)	0.105032	0.086807	1.209951	0.2263
ARCH(9)	0.039867	0.038806	1.027340	0.3043
GARCH(1)	-0.823822	0.171592	-4.801055	0.0000
RESID	-7.150817	12.70908	-0.562654	0.5737

R-squared	-0 040084	Mean dependent var	-0.017432
Adjusted R-squared	-0087527	S.D.dependent var	90.69269
S.E. of regression	94.57846	Akaike info criterion	11.67771
Sum squared resid	2549349.	Schwarz criterion	11.85097
Log likelihood	-1731.817	Durbin-Watson stat	1.548801

ft

Dependent Variable: COMRETA
Method: ML - ARCH
Date: 11/12/05 Time: 11:20
Sample: 4/05/1996 12/21/2001
Included observations: 299
Convergence achieved after 79 iterations
Bollerslev-Wooldrige robust standard erro's & covariance

	Coefficient	Std. Error	z-Statistic	Prob.
SQR(GARCH)	0.182510	0.128695	1.418160	0.1561
TBILLS_RATE01	-1.602498	0.723611	-2.214584	0.0268
		Variance Equation		
C	14880.94	2733.269	5.444375	0.0000
ARCH(1)	0.151977	0.075702	2.007560	0.0447
GARCH(1)	-0.332049	0.151896	-2.186038	0.0288
RESID	10.11696	49.32908	0.205091	0.8375

R-squared	0.001572	Mean dependent var	1.815267
Adjusted R-squared	-0.015466	S.D. dependent var	114.9723
S.E. of regression	115.8579	Akaike info criterion	12.27896
Sum squared resid	3932957.	Schwarz criterion	12.35322
Log likelihood	-1829.705	F-statistic	0.092285
Durbin-Watson stat	1.857034	Prob(F-statistic)	0.993402

r

Dependent Variable: COMRETA
Method: ML - ARCH
Date: 11/12/05 Time: 11:20
Sample: 4/05/1996 12/21/2001
Included observations: 299
Convergence achieved after 126 iterations
Bollerslev-Wooldrige robust standard errors & covariance

	Coefficient	Std. Error	z-Statistic	Prob.
SQR(GARCH)	0.011575	0.077465	0.149417	0.8812
TBILLS_RATE01	-0.360171	0 213908	-1.683766	0.0922
		Variance Equation		
C	12211.95	3231.200	3.779384	0.0002
ARCH(1)	0.076380	0.055440	1.377701	0.1683
ARCH(2)	-0.030175	0.014925	-2.021727	0.0432
ARCH(3)	-0.038838	0.013006	-2.986167	0 0028
ARCH(4)	-0.022309	0.017356	-1.285398	0.1987
ARCH(5)	-0.027814	0.010263	-2.710193	0.0067
ARCH(6)	-0 008311	0.020851	-0 398614	0.6902
ARCH(7)	-0.056398	0.009560	-5.899618	0.0000
ARCH(8)	0.080833	0.039648	2.038804	0.0415
ARCH(9)	-0.054082	0.016972	-3.186543	0.0014
GARCH(1)	0.044165	0.202202	0.218419	0.8271
RESID	12.70648	34.32852	0.370144	0.7113

R-squared	-0.003822	Mean dependent var	1.815267
Adjusted R-squared	-0.049611	S.D. dependent var	114.9723
S.E. of regression	117.7897	Akaike info criterion	12.19527
Sum squared resid	3954208.	Schwarz criterion	12.36853
Log likelihood	-1809.193	Durbin-Watson stat	1.863061

re

Dependent Variable: FINRETA
Method: ML - ARCH
Date: 11/12/05 Time: 11:20
Sample 4/05/1996 12/21/2001
Included observations: 299
Convergence achieved after 60 iterations
Bollerslev-Wooldrige robust standard errors & covariance

	Coefficient	Std. Error	z-Statistic	Prob.
SQR(GARCH)	0.709968	0.114541	6.198351	0.0000
TBILLS_RATE01	-4.243265	0.617053	-6.876657	0.0000
Variance Equation				
C	3327.694	1155.741	2.879274	0.0040
ARCH(1)	0.589401	0.222438	2.649736	0.0081
GARCH(1)	0.274570	0.087106	3.152145	0.0016
RESID	17.39911	17.53308	0.992359	0.3210

R-squared	0.057748	Mean dependent var	-1.289277
Adjusted R-squared	0.041669	S.D. dependent var	117.1331
S E. of regression	114.6668	Akaike info criterion	12.02491
Sum squared resid	3852501.	Schwarz criterion	12.09917
Log likelihood	-1791.725	F-statistic	3.591453
Durbin-Watson stat	1.832146	Prob(F-statistic)	0.003617

i

Dependent Variable: FINRETA
Method: ML - ARCH
Date: 11/12/05 Time: 11:21
Sample: 4/05/1996 12/21/2001
Included observations: 299
Convergence achieved after 72 iterations
Bollerslev-Wooldrige robust standard errors & covariance

	Coefficient	Std. Frror	z-Statistic	Prob.
SQR(GARCH)	0.929188	0.130107	7.141721	0.0000
TBILLS_RATE01	-5.413340	0.689217	-7.854337	0.0000
		Variance Equation		
C	6375.615	1117.139	5.707094	0.0000
ARCH(1)	0.464317	0.149667	3.102328	0.0019
ARCH(2)	0.155995	0.160851	0.969811	0.3321
ARCH(3)	0.264290	0.064286	4.111182	0.0000
ARCH(4)	0.046040	0 086614	0.531556	0.5950
ARCH(5)	0.031251	0.043295	0.721817	0.4704
GARCH(1)	-0.336358	0.286768	-1.172929	0.2408
RESID	23.22175	12.12511	1.915179	0.0555

R-squared	0.109207	Mean dependent var	-1.289277
Adjusted R-squared	0.081466	S.D. dependent var	117.1331
S E. of regression	112.2606	Akaike info criterion	11.99168
Sum squared resid	3642106.	Schwarz criterion	12.11544
Log likelihood	-1782.756	F-statistic	3.936672
Durbin-Watson stat	1.669978	Prob(F-statistic)	0.000096

Dependent Variable: INDRETA
Method: ML - ARCH
Date: 11/12/05 Time 11:21
Sample: 4/05/1996 12/21/2001
Included observations: 299
Convergence achieved after 41 iterations
Bollerslev-Wooldrige robust standard errors & covariance

	Coefficient	Std Error	z-Statistic	Prob.
SQR(GARCH)	0.992889	0.234280	4.238044	0.0000
TBILLS_RATE01	-6.235589	1.336206	-4.666638	0.0000
		Variance Equation		
C	8284.298	6625.096	1.250442	0.2111
ARCH(1)	0.002420	0.031991	0.075652	0.9397
GARCH(1)	0.145460	0.646520	0.224989	0.8220
RESID	23.71667	29.82876	0.795094	0.4266

R-squared	0.143080	Mean dependent var	1.519344
Adjusted R-squared	0.128457	S.D.dependent var	116.4601
S.E. of regression	108.7231	Akaike info criterion	12.00309
Sum squared resid	3463466.	Schwarz criterion	12.07735
Log likelihood	-1788.462	F-statistic	9.784455
Durbin-Watson stat	1.454165	Prob(F-statistic)	0.000000

Dependent Variable INDRETA
Method ML-ARCH
Date: 11/12/05 Time 11:21
Sample: 4/05/1995 12/21/2001
Included observations: 299
Convergence achieved after 40 iterations
Bollerslev-Wooldrige robust standard errors & covariance

	Coefficient	Std Error	z-Statistic	Prob.
SQR(GARCH)	0.157926	0.144647	1.091804	0.2749
TBILLS_RATE01	-1.206400	1.226370	-0.983716	0.3253
Variance Equation				
C	11118.25	2674.823	4.156632	0.0000
ARCH(1)	0.069267	0.101689	0.681168	0.4958
ARCH(2)	0.034986	0.102880	0.340071	0.7338
ARCH(3)	-0.026592	0.034161	-0.778429	0.4363
ARCH(4)	-0.014392	0.009503	-1.514497	0.1299
ARCH(5)	-0.019182	0.003087	-6.213708	0.0000
ARCH(6)	-0.007361	0.007542	-0.976000	0.3291
ARCH(7)	0.027339	0.047793	0.572026	0.5673
ARCH(8)	-0.020421	0.018826	-1.084742	0.2780
ARCH(9)	-0.018535	0.005606	-3.306311	0.0009
GARCH(1)	0.260404	0.306621	0.849269	0.3957
RESID	1.006759	107.7463	0.009344	0.9925

R-squared	0.008532	Mean dependent var	1.519344
Adjusted R-squared	-0.036693	S.D.dependent var	116.4601
S.E. of regression	118.5775	Akaike info criterion	12.36032
Sum squared resid	4007278.	Schwarz criterion	12.53359
Log likelihood	-1833.869	F-statistic	0.188652
Durbin-Watson stat	1.572262	Prob(F-statistic)	0 999238

Dependent Variable. ALLRETNA
Method ML - ARCH
Date 11/12/05 Time 11:21
Sample 4/05/1995 12/21/2001
Included observations 299
Convergence achieved after 278 iterations
Bollerslev-Wooldrige robust standard errors & covariance

	Coefficient	Std Error	z-Statistic	Prob.
SQR(GARCH)	0.118550	0.096464	1.228951	0.2191
TBILLS_RATE01	-1.054040	0.332477	-3.170262	0.0015
		Variance Equation		
C	4834.371	1222.881	3.953264	0.0001
ARCH(1)	0.299781	0.136796	2.191442	0.0284
ARCH(2)	0.193356	0.125085	1.545801	0.1222
ARCH(3)	0.018014	0.033841	0.532312	0 5945
ARCH(4)	-0.010494	0.008502	-1.234243	0.2171
ARCH(5)	-0.001064	0.020694	-0.051421	0.9590
ARCH(6)	-0.004724	0.020994	-0.225022	0.8220
ARCH(7)	-0.018094	0.009788	-1.848703	0.0645
ARCH(8)	-0.014936	0.001305	-11.44224	0.0000
ARCH(9)	-0.013701	0.006659	-2.057543	0.0396
GARCH(1)	-0 418501	0.419828	-0.996838	0.3188
RESID	10.31729	24.60863	0.419255	0.6750

R-squared	-0.005663	Mean dependent var	0 817498
Adjusted R-squared	-0.051535	S.D.dependent var	76.70395
S.E. of regression	78.65559	Akaike info criterion	11.30387
Sum squared resid	1763210.	Schwarz criterion	11.47713
Log likelihood	-1675.928	Durbin-Watson stat	1.353669

Dependent Variable ALLRETNA
Method: ML - ARCH
Date: 11/12/05 Time 11:21
Sample 4/05/1996 12/21/2001
Included observations 299
Convergence achieved after 10 iterations
Bollerslev-Wooldrige robust standard errors & covariance

	Coefficient	Std. Error	z-Statistic	Prob.
SQR(GARCH)	0.769205	0.224496	3.426372	0 0006
TBILLS_RATE01	-3.402582	0.639438	-5 321209	0.0000
		Variance Equation		
C	3760.660	780 1444	4.820467	0.0000
ARCH(1)	0.219655	0.106500	2.062493	0.0392
GARCH(1)	-0.042366	0.007592	-5.580241	0.0000
RESID	12.73822	12.50167	1.018922	0.3082

R-squared	0.073559	Mean dependent var	0.817498
Adjusted R-squared	0.057749	S.D.dependent var	76.70395
S.E. of regression	74 45622	Akaike info criterion	11.25961
Sum squared resid	1624312.	Schwarz criterion	11.33386
Log likelihood	-1677.311	F-statistic	4.652804
Durbin-Watson stat	1.386829	Prob(F-statistic)	0.000421

Dependent Variable NSEIRETA
Method ML - ARCH
Date 11/12/05 Time: 11:22
Sample 4/05/1996 12/21/2001
Included observations: 299
Convergence achieved after 78 iterations
Bollerslev-Wooldrige robust standard errors & covariance

	Coefficient	Std. Error	z-Statistic	Prob.
SQR(GARCH)	1.937493	0.594592	3.258522	0.0011
TBILLS_RATE01	-9.527181	2.596938	-3.668621	0.0002
Variance Equation				
C	4099.515	885.6212	4.628971	0.0000
ARCH(1)	0.248935	0.078350	3.177217	0.0015
GARCH(1)	0.192306	0.105877	1.816305	0.0693
RESID	20.98142	5.249608	3.996758	0.0001

R-squared	0.011946	Mean dependent var	I.584554
Adjusted R-squared	-0.004915	S.D.dependent var	92.09799
S E. of regression	92.32403	Akaike info criterion	II.48097
Sum squared resid	2497452.	Schwarz criterion	11 55522
Log likelihood	-1710.405	F-statistic	0.708515
Durbin-Watson stat	1.531681	Prob(F-statistic)	0.617449

Dependent Variable: NSEIRETA
Method: ML-ARCH
Date 11/12/05 Time: 11:22
Sample 4/05/1996 12/21/2001
Included observations: 299
Convergence achieved after 157 iterations
Bollerslev-Wooldrige robust standard errors & covariance

	Coefficient	Std. Error	z-Statistic	Prob.
SQR(GARCH)	-0.210723	0.137907	-1.528006	0.1265
TBILLS_RATE01	0.686036	0.535943	1.280056	0.2005
		Variance Equation		
C	6927.356	1676.856	4.131157	0.0000
ARCH(1)	0.155526	0.090431	1.719817	0.0855
ARCH(2)	0.120548	0.165792	0.727105	0.4672
ARCH(3)	0.001343	0.017606	0.076285	0.9392
ARCH(4)	-0.004055	0.013678	-0.296459	0.7669
ARCH(5)	-0.001610	0.011175	-0.144103	0.8854
ARCH(6)	-0.010753	0.001230	-8.739656	0.0000
ARCH(7)	-0.005079	0.005760	-0.881628	0.3780
ARCH(8)	0.004314	0.016585	0.260097	0.7948
ARCH(9)	-0.009754	0.003037	-3.211760	0.0013
GARCH(1)	-0.120573	0.201070	-0.599658	0.5487
RESID	4.157806	90.86475	0.045758	0.9635

R-squared	-0.022512	Mean dependent var	1.584554
Adjusted R-squared	-0.069153	S.D. dependent var	92.09799
S.E. of regression	95.22919	Akaike info criterion	11.76652
Sum squared resid	2584550.	Schwarz criterion	11.93978
Log likelihood	-1745.094	Durbin-Watson stat	1.424058