THE EFFICIENCY OF TREASURY BILLS MARKET IN KENYA

BY

ODEP SOLOMON OTIENO

REG. NO: D61/P/7072/2004

A project submitted in partial fulfilment of the requirements for the degree of

MASTERS IN BUSINESS ADMINISTRATION

SCHOOL OF BUSINESS
UNIVERSITY OF NAIROBI

2008

OTIENO LUTHER ODHIAMBO
Supervisor

DECLARATION

I, Odep Solomon Otieno hereby certify that;

1. Except where due acknowledgement has been made, this project work is mine alone.

2. The project has not been previously submitted in whole or in part to qualify for any other academic award.

Signed..... Date 25.11.2008.....

Odep Solomon Otieno
D61/P/7072/2004

I, Mr. Otieno Luther Odhiambo hereby certify that this project has been presented for examination with my approval as the University of Nairobi Supervisor.

Signed..... Date 25.11.2008.....

Mr. Otieno Luther Odhiambo

Lecturer, School of Business

University of Nairobi

DEDICATION

This project is dedicated to the memory of my late father Evans Odep and my late brothers Mordecai Oyugi and Enoch Owira (*Best Neighbour*); and sister Risper Achieng'.

ACKNOWLEDGEMENT

I am truly indebted to a number of people, without whom, this project would not have been successfully completed. My most sincere gratitude goes to my family for their patience and understanding during the period of my studies. I also wish to thank the Management and Staff of the School of Business, University of Nairobi, and my student colleagues for their time and encouragement.

Special thanks to my former colleague at KLM, Philip Apiyo, for proof-reading my project and to my Supervisor, Mr. Luther Otieno, whose guidance helped me a lot in developing the project.

MERCI BEAUCOUP

LIST OF ABBREVIATIONS

Analysis of Variance	ANOVA
Central Bank of Kenya	CBK
Efficient Market Hypothesis	EMH
Treasury Bills	T-Bills
Unbiased Expectations Theory	UET

LIST OF TABLES AND GRAPH

TABLE OF CONTENTS

CHAPTER 5

ABSTRACT

This study is purposed to test the efficiency of the Kenyan Treasury Bills Market. It tests how accurate forward rates are in predicting the expected spot rates and is founded on the unbiased expectations theory.

The data used consist of weekly yields on 91-day and 182-day T-Bills over the six year period from 18th February 2002 to 17th March 2008. Using first test of ANOVA we determine whether the 91-day and 182-day Treasury bills are different. We again use ANOVA for 91-Days TB Lag and Forward Rate Lag to test whether the forward rate is equal to the expected spot rate. Finally we run the regression model to find out the change in future spot rate when forward rate changes by 1. This helps determine whether the relationship between future spot rate and forward rate is statistically significant.

We find that 91-day and 182-day T-Bills appear different in line with the theory that assets of longer maturity tend to give higher returns as compensation. We also find that forward rate tends to be higher than the comparable spot rate suggesting the existence of forward premiums. The regression co-efficient, P-value of 0.000, show that the relationship is statistically significant i.e. you can use forward rates to predict future spot rates.

The implication is that market players would not achieve much trying to predict future spot rates using the forward rates alone. The CBK should develop a model that incorporates forward rate and other macro-economic factors to predict more accurately the future spot rate; as we find that the forward rates have incremental information for the future changes in the spot exchange rates, given that they move towards the same direction. This would guide investors in their decision to invest in the Kenya Treasury Bills.

This study will pay attention to the cross-interest rates and cross-maturity term structures of the forward premium to assess if at all they contain information that can be useful in predicting future spot interest rates.

A forward interest rate is the rate one can lock in now for a commitment to buy a one-period bond in the future. This leads naturally to the hypothesis that forward rates forecast future spot (one period) interest rates. Early tests of this hypothesis largely use US Treasury bills, and the results are rather negative.

A market is efficient if nobody can obtain extraordinary profit in the long run by using publicly available information (Fama, 1965). Gross (1983) summarize the conditions to be fulfilled if the market is to be efficient: the market is competitive, information is costless to acquire; the market participants have the capacity to effectively use the information; transaction costs is zero; and no non-random innovation between contract time and actual delivery.

1.1.1 Efficient Market Hypothesis

The weak-form efficiency hypothesis of t-bill market just like foreign exchange markets, presents testable implications for the time series behavior of systems of spot interest rates. Findings of cointegration in systems of spot interest rates just like spot exchange rates (Alexander and Johnson (1992), Lopez (1996) would seem to contradict the market efficiency hypothesis. A cointegrated system would imply the presence of predictability of t-bill interest rate. The t-bill interest rate market efficiency implies that, if the market is efficient, then there are no remaining ex-ante opportunities for making profits through speculation.

Rationally, an efficient Treasury bill market utilizes available information efficiently in forming its expectations about the future yields. Studies on the efficiency of the U. S. Treasury bill market include those by Roll (1970), Sargent (1972), Hamburger and Platt (1975), and Fama (1975, 1976a,b). Studies by Campbell and Shiller (1988), Stock and Watson (1988), and Hall, Anderson and Granger (1992), recognize the nonstationarity of the bill yields and find that their term structure is well modeled as a cointegrated system.

The t-period spot rate is the interest rate on a pure discount bond whose life extends from today through t future periods. Thus for pure-discount bonds with maturities of one, two, and three years, spot rates for one, two, and three years can be determined. This suggests that the spot rate of interest (st) for each t is the bonds market discount rate for a bond's cash flow that is to be received in period t. After the spot rates have been determined, it is a straight forward matter to determine the corresponding set of discount factors. The set of discount factors, also referred to as the market discount function are used to determine the present value of bonds.

The forward rate is the expected yield during some future period - e.g., the forward rate for year three is the one year rate expected to prevail in year three (three years from now). The t-period forward rate t periods in the future is represented by the interest rate, determined today, on a pure discount bond that will come into existence t periods from today and mature t periods after t-1.

1.1.2 Treasury Bills Market

Treasury bills are the most important money instrument. During the first five months of the fiscal year 2007/08, Government domestic debt increased by 5.3 percent from Ksh 404.7 billion in June 2007 to Ksh 426.0 billion in November 2007. The rise in domestic debt during the period reflected increases of Ksh 21.6 billion and Ksh 3.6 billion in Treasury bonds and other domestic debt, respectively. These increases were, however, partly offset by a decrease of Ksh 3.9 billion in Treasury bills.

The amounts tied in Treasury bills show its importance in the money and capital market. Treasury bills (excluding Repos) decreased from Ksh 94.4 billion in June 2007 to Ksh 90.6 billion in November 2007. Consequently, Treasury bills, expressed as a percentage of overall domestic debt, decreased from 23.3 percent to 21.3 percent during the period. Treasury bills held by commercial banks decreased from Ksh 45.1 billion or 47.7 percent in June 2007 to Ksh 36.9 billion or 40.8 percent in November 2007. The share of 91-day Treasury bills in outstanding Government securities increased from 6.0 percent to 8.3 percent while 182-day Treasury bills decreased from 19.7 percent to 15.3 percent during the period.

The importance of efficiency in Treasury bill market is that rational investors will not invest in any risky asset that offer returns that is equal to or less than return on security issued by treasury.

Treasury bills can be transacted readily due to existence of active secondary market and that they enjoy zero default risk and negligible price risk. They represent the obligations of the Government of Kenya which have a primary tenor like 91 and 182 days. They are sold on an auction basis every week in certain minimum denominations by the Central Bank of Kenya. They do not carry an explicit rate or coupon rate. Instead they are sold at a discount rate to be

redeemed at a later date at a value equal to its face value. This means that the implied yield of a treasury bill depends on both the size of the discount and the period of maturity.

1.1.3 Term Structure of Interest Rates

There are four different theories that explain term structure of interest rates. The pure expectations hypothesis asserts that investors are expecting higher short-term rates in the future. In which case, the forward rate curve would be even steeper than the currently prevailing yield curve which is the geometric average of these future short-term rates. The liquidity hypothesis would imply that this upward sloping yield curve is a natural by-product of risk averse investors who require a higher yield to invest in longer term securities because of the higher risk involved - i.e., the greater volatility of longer maturity securities. The assertion under the market segmentation hypothesis is that there is greater demand for short-term securities by those who have an interest in this segment of the market. Therefore, those institutions that tend to invest in the short-term segment of the yield curve have greater funds at the present time compared to those who have an interest in long-term securities. Then there is the preferred habitat hypothesis that is intermediate between the liquidity preference and segmented market hypothesis. The preferred habitat theory holds that various investors and borrowers have segments in the market in which they prefer to operate. However such investors are assumed to be willing to leave their desired maturity segments if there are significant differences in yields between various segments. The theory relied on in this study is the pure expectations hypothesis.

1.2 Statement of the Problem

The base interest rate on securities issued by the Government is the basis for analyzing returns from investment in financial assets such as stocks and bonds, i.e. interest rate on Treasury securities is the benchmark interest rate in modern economies.

Studies on the efficiency of the U. S. Treasury bill market include those by Roll (1970), Sargent (1972), Hamburger and Platt (1975), and Fama (1975, 1976a, b) report that forward rates and spot rates are cointergrated and that the T-bill market is efficient. Campbell and Shiller (1988), Stock and Watson (1988), and Hall, Anderson and Granger 1992),recognize the non-stationarity of the bill yields and report that their term structure is cointegrated. In an earlier study in Canada, Park (1982) found that the weekly bill auction market was efficient.

Various studies in Kenya that have touched on market efficiency have not specifically dealt with the efficiency of the Treasury bill market in Kenya. These studies have found that the foreign exchange and securities markets are largely inefficient.

Langat (1998) for instance carried out a study on the impact of Treasury bills rates volatility on corporate investments and concluded that there is a positive and significant influence of T-bill rates on commercial investment in Kenya.

Thus this study explores this line of research (in Kenya) and provides insight into the Treasury bill market whose efficiency is central to efficiency of money and capital markets. This study

also extends earlier study (elsewhere) by using data in an emerging economy. How accurate are forward rates in predicting the expected spot rate?

1.3 Objective of the study

The objective of this study is to test the efficiency of the Treasury Bills Market.

1.4 Importance of this Study

The study is useful to the following stakeholders:

1. Corporate managers and investment advisors when pricing financial securities.
2. Treasury managers with an interest in forecasting future spot rates.
3. Central Bank of Kenya and Treasury in understanding changes in Treasury bill yield curves.
4. Investors and general public in making decisions about their market expectations.
5. Academic researchers can use the study in conducting further research in related fields.

CHAPTER 2

2.0 Literature review

2.1 Efficient Market Hypothesis

The Efficient Market Hypothesis (EMH) is about informational efficiency. It implies that investors and their agents have the capacity to efficiently discount the available information in the security prices. It has its origins in the rational expectations theory that requires prices to take into account all relevant information disclosed to the market (Jensen, 1978). However, the EMH does not imply that prices will always be "correct"! It simply implies consensus in the market and that there are no free lunches. Furthermore, the EMH does not require every market player to be well-informed. Market prices are formed by the actions of the majority. The presence in the market of several risk-averse, rational agents, who maximize their wealth, is a sufficient condition for prices to contain all relevant information.

In this study the fundamental assumption is that if markets are efficient then spot and forward interest rates will adjust immediately to the arrival of new information. However the arrival of information is unpredictable. The unpredictable movements in spot and forward rates raise the question whether the Treasury bill market is efficient. The theoretical debate on market efficiency started with the famous Fama (1970) definition of market efficiency. That definition put in context of this study would imply that the forward rate should be the best predictor of future spot rate.

Moreover, the Treasury bill market might be judged inefficient either because period to period movements in spot rates are serially correlated, or because forward rates are not unbiased

predictors of future spot exchange rates. Much of the recent evidence on asset market efficiency has been difficult to interpret.

2.2 Efficiency of Treasury Bill Market

The Treasury bill market is said to be efficient if it utilizes available information efficiently in forming its expectations about the future yields. Future yield are important because they are used to discount future cash flow to their present value. This is an important stage in bond valuation. Earlier studies on the efficiency of the U. S. Treasury bill market include those by Roll (1970), Sargent (1972), Hamburger and Platt (1975), and Fama (1975, 1976a, b). More recent studies, including Campbell and Shiller (1988), Stock and Watson (1988), and Hall, Anderson and Granger (1992), recognize the non-stationarity of the bill yields and find that their term structure is well modeled as a co-integrated system.

A forward interest rate is the rate one can contract now for a commitment to buy a one-period bond in the future. One would therefore expect a strong correlation between current one period forward rate and future spot (one period) interest rates.

Early tests of this hypothesis employed US Treasury bills, and the results are that forward rates do not seem to predict spot rates, except perhaps a month or two ahead [Hamburger and Platt (1975), Shiller, Campbell, and Schoenholtz (1983), Fama (1984)]. Fama and Bliss (1987) find, however, that when the forecast horizon is extended, longer term forward rates have strong power to forecast spot rates. They attribute this forecast power to slow mean reversion of the spot rate that only becomes evident over long horizons.

The evidence in Fama and Bliss (1987) that forward interest rates forecast future spot interest rates for horizons beyond a year repeats in the out-of-sample 1986–2004 period. The predictability of the spot rate captured by forward rates seems to be due to mean reversion toward a time-varying expected value that is subject to a sequence of apparently permanent shocks.

2.2.1 Rational Expectation Hypothesis

The rational expectation hypothesis states that in an efficient market participant agents do no expect to earn above normal profit, except by chance, by systematically using available information (Billson, 1981). This definition of the market efficiency hypothesis requires that: the market is competitive; information is costless to acquire and it is used rationally; transaction cost is zero (Goss, 1983). In order to be an efficient market in treasury bills i.e. where current forward rates are equal to expected forward rates, it is necessary that there is no risk-free gain in that market; in which we should not expect significant differences between forward rates and expected forward rates.

In Treasury bill markets, this condition is satisfied through arbitrage by which equilibrium rates across the t-bill of different maturities are established such that no one is making profits by trading one Treasury bill for another at any point in time.

In summary, market efficiency is defined not as well only for a point of time (spot market), but over time (futures and forward market) (Levich, 1979). This interpretation of market efficiency means that the forward rate by itself is the best forecast of the future spot rate. This means that market players cannot make better forecasts than the forward rate. In other words, the available information is already fully utilized and reflected by forward rate. In terms of investment strategy

this means that, in t-bill market, the roll over strategy cannot be replaced by maturity strategy to earn profits because the values are identical.

2.3 Term Structure of Interest Rates

There are four main economic theories attempting to explain how yields vary with maturity. Two of the theories are extreme positions, while the third attempts to find a middle ground between the former two.

2.3.1 Market Expectations (Pure Expectations) Hypothesis

This hypothesis assumes that the various maturities are perfect substitutes and suggests that the shape of the yield curve depends on market participants' expectations of future interest rates.

$$(1 + i_{lt})^n = (1 + i_{st}^{year1})(1 + i_{st}^{year2}) \cdots (1 + i_{st}^{yearn})$$

These expected rates, along with an assumption that arbitrage opportunities will be minimal, is enough information to construct a complete yield curve. For example, if investors have an expectation of what 1-year interest rates will be next year, the 2-year interest rate can be calculated as the compounding of this year's interest rate by next year's interest rate.

More generally, rates on a long-term instrument are equal to the geometric mean of the yield on a series of short-term instruments. This theory perfectly explains the stylized fact that yields tend to move together.

In the early literature, a special importance is given to test the unbiased expectation hypothesis which is the special case of the market efficiency hypothesis. It is based on the assumption of the risk neutrality of the participants.

However, the rejection of the unbiased hypothesis does not lead us to rejection of the market efficiency hypothesis. Forward rates can differ from the future spot rate because of transaction costs and/or risk premium. It is also important to note that interest rate, whether it is a spot or forward rate, reflect current information at the time of quotation. Hence one cannot expect these rates to reflect same information after their quotation. Some events (e.g. government intervention) cannot be reflected in forward interest rate although this can be reflected in future spot rates.

2.3.2 Liquidity Preference Theory

The Liquidity Preference Theory asserts that long-term interest rates not only reflect investors' assumptions about future interest rates but also include a premium for holding long-term bonds, called the term premium or the liquidity premium. This theory is therefore an offshoot of the Pure Expectations Theory. This premium compensates investors for the added risk of having their money tied up for a longer period, including the greater price uncertainty. Because of the term premium, long-term bond yields tend to be higher than short-term yields, and the yield curve slopes upward. Long term yields are also higher not just because of the liquidity premium, but also because of the risk premium added by the risk of default from holding a security for a long term.

2.3.3 Market Segmentation Theory

This theory is also called the segmented market hypothesis. In this theory, financial instruments of different terms are not substitutable. As a result, the supply and demand in the markets for short-term and long-term instruments is determined independently. Prospective investors would

have to decide in advance whether they need short-term or long-term instruments. Due to the fact that investors prefer their portfolio to be liquid, they will prefer short-term instruments to long-term instruments. Therefore, the market for short-term instruments will receive a higher demand. Higher demand for the instrument implies higher prices and lower yield. This explains the stylized fact that short-term yields are usually lower than long-term yields. This theory explains the predominance of the normal yield curve shape. However, because the supply and demand of the two markets are independent, this theory fails to explain the observed fact that yields tend to move together (i.e., upward and downward shifts in the curve).In an empirical study in 2000, Alexandra E. MacKay, Eliezer Z. Prisman, and Yisong S. Tian found segmentation in the market for Canadian government bonds, and attributed it to differential taxation.

For a brief period in the last week of 2005, and again in early 2006, the US Dollar yield curve inverted, with short-term yields actually exceeding long-term yields. Market segmentation theory would attribute this to an investor preference for longer term securities, particularly from pension funds and foreign investors who prefer guaranteed longer term yields.

2.3.4 Preferred Habitat Theory

The Preferred Habitat Theory states that investors have distinct investment horizons and require a meaningful premium to buy bonds with maturities outside their "preferred" maturity, or habitat. Supporters of this theory believe that short-term investors are more prevalent in the capital market and therefore, longer-term rates are normally higher than short-term rates. However, short-term rates can be higher than long-term rates occasionally i.e. the reverse yield. The preferred habitat theory therefore represents a middle ground between the market segmentation theory and the market expectations theory. It seems to explain both the persistence of the normal

yield curve shape and the tendency of the yield curve to shift up and down while basically retaining its shape.

2.4 Market Efficiency Tests in T-Bill Market

From the above formulation, it becomes clear that the market efficiency hypothesis is conditional on the set of information available at the time forward rates are quoted and it is valid under the fulfillment of all conditions. In which case, the difference between forward rate and comparable spot rate could be due to arrival of new information. This make the test of the EMH heavily dependent upon the definition of the information set. According to the level of information, following the work of Fama (1970), the test of market efficiency can be made as a weak form, a semi-strong form or as a strong form efficiency test.

In the weak form of the test, the information set contains only the historical exchange rates of the currency in question. In the case of a semi-strong form test, the set contains all publicly available information in addition to its own historical exchange rates. In the strong form of the test, inside information in addition to publicly, available information is included to the set. The difficulty of obtaining knowledge about the distribution and the level of inside information makes it impossible to test the hypothesis in the strong form.

In this study the market efficiency will be tested in semi-strong form. The semi-strong form of the test can be divided into two sub-groups according to the variables which have been used to construct the information set. The first group may be called "simple semi-strong form and the information set consist of treasury bills of different maturities. The second group information set may contain the information related to other variables such as GNP, money supply, and interest

rates on risky assets. The underlying assumption of the simple semi-strong form is that exchange rates reflect all publicly available information.

2.4.1 Efficient Market, Spot Rate and Forward Rates

Fama and Bliss (1987) present evidence that forward interest rates forecast future spot interest rates for horizons beyond a year and confirms the same in the out-of-sample 1986–2004 period. But their explanation that the forecast power is due to mean reversion of the spot rate toward a constant expected value is no longer valid. Instead, the predictability of the spot rate captured by forward rates seems to be due to mean reversion toward a time-varying expected value that is subject to a sequence of apparently permanent shocks that are on balance positive to mid-1981 and on balance negative thereafter.

A market is efficient if nobody can obtain abnormal profit in the long run by using publicly available information. Hence if a market is efficient, in the long run nobody can make any extraordinary profit, in which case a spot rate has a long run equilibrium relationship with a forward rate.

Recall that in an efficient market nobody can obtain extraordinary profit in the long run by using publicly available information. Hence if a market is efficient, in the long run nobody can make any extraordinary profit: Such that the difference between expected spot rate and forward rate is zero i.e. $E(S_{t+1} - F_t) = 0$. This implies that a spot rate has a long-run equilibrium relationship with a forward rate; which in itself is a testable proposition.

Park (2000) examines if the spot and forward interest rates of the Canadian Treasury bill market are cointegrated and test the bill market efficiency. The data used are monthly average yields of

three- and six-month Treasury bills from July 1962 to February 1996. Both spot and forward rates are found to be I(0) and cointegrated in the Engle-Granger (1987) sense.

2.5 Market Efficiency in Kenya

Various studies in Kenya that have touched on market efficiency have not specifically dealt with the efficiency of the Treasury bill market.

Langat (1998) who studied the impact of Treasury bills rates volatility on corporate investment-the case of commercial banks (using 91-day T-bills) concluded that there exists a positive and significant influence of T-bill rates on commercial investment.

Kiio (2006) found market adjusted excess returns to be significant for the 10 days before and 10 days after dividend announcement for cash dividend paying firms in her research on market efficiency and the effects of cash dividend announcements on share prices of companies listed on the Nairobi Stock Exchange.

Ndunda (2002) examined EMH for the foreign exchange market in Kenya and found out that there exists strong evidence against the simple efficiency hypothesis for the major currencies in his study on testing whether forward exchange rates are predictors of future spot rates in Kenya.

Muhoro (2005) and Kurgat (1998) studied efficiency of the foreign exchange market in Kenya and found the market to be inefficient due to occurrence of huge arbitrage opportunities in the market. Kurgat (1998) found that there exists higher arbitrage opportunity in bureaus than in banks.

2.6 91-Day and 182-Day T-Bill Rates

In finance, differences in expected returns are usually interpreted as rewards for risk and time. This makes it possible ordering and comparing returns across maturities. The liquidity preference hypothesis tells us that expected return always increase with maturity. This is at variance with models that allow for time-varying expected returns. Fama and Bliss (1987) find, however, that when the forecast horizon is extended, longer-term forward rates have strong power to forecast spot rates. They attribute this forecast power to slow mean reversion of the spot rate that only becomes evident over long horizons.

Theoretically we expect the equivalent yield of the six month (182 days) Treasury bill to be at least twice if not more, than that of the three month (91 days). The reason is the effect of compounding the discount of the first three month period over the second 3-month period.

2.7 Summary

There have been various studies on Efficient Markets but none has been conclusive as evidenced in the past literature. EMH theory has been met with a lot of opposition especially from the technical analysts, Goodman (1979). Their argument is that many investors base their expectations on past prices, past earnings, track records and other indicators. Past prices do influence future prices. In Kenya, similar studies have also been carried out but this touch on spot market efficiency of foreign exchange market and volatility of Treasury bill rate. None of the local studies has touched on Efficiency of the Treasury Bill Market.

This study therefore is to try and bridge this gap in research. It will endeavor to establish the relationship between spot and forward T-bill interest rates as well as answer the question as to whether it is possible to use forward rates to forecast future movement of the spot rates in the Kenyan Treasury bill market.

CHAPTER 3

3.0 Research Methodology

This is an empirical study on the relationship between forward rates and future spot rates, using Kenyan Treasury Bill data.

To calculate the forward rate between period's t-1 and t the following formula can be used:

$$(1 + f_{t-1,t}) = (1 + s_t)^t/(1 + s_{t-1})^{t-1}$$

The spot rate for t periods is given by:

$$(1 + s_t)^t = (1 + f_{t-1,t}) \times (1 + s_{t-1})^{t-1}$$

Where:

S is spot rate; f is forward rate; t is years to maturity.

3.1 Population

The population of interest consists of all weekly yields on 91-day and 182-day T-bills for six years, from 18th February 2002 to 17th March 2008. This is current data. This short period is necessary if we assume that spot rates and forward rates are stationary. Appendix 1 gives details of these weekly returns.

3.2 Data Collection Method

The study will use secondary data from The Central Bank of Kenya. This shall be obtained from CBK monthly and yearly Economic Reviews. The data will be limited to 6 years from 2002 to 2008 with the assumption that spot rates and forward rates are stationary.

3.3 Variables of the Study

Three variables will be employed in this study, namely the yield on 91-day, 182-day and forward rates. Relying on the assumption that the yield and spot rate are identical on a pure discount bond, the implied forward rate is:

$$(1+f_{t-1}) = (1+S_t)^t/(1+S_{t-1})^{t-1}$$

$$(1+f_{91,182}) = (1+S_{182})^{182}/(1+S_{91})^{91}$$

If we assume a constant premium (for term, liquidity or risk), then the equation that defines the equilibrium relationship between forward rate and future spot rate, is:

$$f_t = E_t (S_t+3.I) + P$$

Where:

f_t = forward rate implied when we relate the yield on 91 day treasury bills to the yield on 182 day treasury bills.

I = Information set

p = constant premium

The Treasury bill market is efficient if its assessment of future spot rates incorporates all information at month t, such that: St+3 =Et (St+3.It) + Ut+3

Where:

S_{t+3} = the three month spot rate at month t+3,

E_t = is the conditional operator

I_t = is the information set at time t

U_{t+3} = the forecast error or part of S_{t+3} which is unpredictable at month t.

3.4 Data Analysis

The study will use regression analysis to the relationship between forward rates (ft) and future spot rates (S_{t+3}):

Actual Future spot rate = α + ß (forward rate)

The efficient market hypothesis would imply that the coefficient of f_t generated by regression equation is equal to one (1) if S_{t+1} is to be equal to f_t.

CHAPTER FOUR

4.0 Data Analysis and Findings

4.1 Introduction

The results of the analysis are represented in this chapter. The objective of this study is to determine how accurate forward rates are in predicting the expected spot rate ($es_{1,2}$). The Efficient Market Hypothesis (EMH) is related to the concept of informational efficiency, agents' efficient exploitation of the available information set. This study has its foundations on unbiased expectations theory (UET). The UET holds that the forward rate represents average opinion of what expected future spot rate for the period in question will be. In equilibrium the UET states that the expected spot rate is equal to the forward rate:

$$es_{1,2} = f_{1,2}$$

The null hypothesis is that the spot rate is equal to the forward rate.

4.2 Descriptive Statistics

This study employed data for the period 18th February 2002 to 17th March 2008. In the total there were data for 316 weeks. The 91-day and 182-day Treasury bills weekly returns were from issue No.1456 to issue No.1773.

Below is a summary of the descriptive statistics of the 91-day and 182-day T-bills returns employed in this study. The 91-day T-bills have the average return of 6.202% compared to 7.004% for the 182-day T-bills. Theoretically the return on 182-day T-bills should be higher

than the 91-day T-bills because of the longer period i.e. investors are compensated for waiting longer.

Table 1: Descriptive Statistic For Weekly Returns From Treasury Bills Feb 2002 to March 2008

Variable	N	Mean	StDev	Minimum	Maximum	Co-efficient of Variation
91DaysTeasury Bills	316	6.202	2.607	0.783	10.565	0.420
182Days Treasury Bills	316	7.004	2.502	1.329	11.242	0.357

The minimum return is lowest (0.783%) for 91-day T-bills and highest (11.42%) for 182-day Treasury bills. The return per unit of risk (co-efficient of variation) is highest for 91-day T-bills. This implies that in terms of risk, investors are better off holding 182-day T-bills.

4.3 Forward Rates

We calculate 316 forward rates, which effectively are the expected spot rate (e,s $_{1,2}$) using the function:

$$(1+f_{t-1,t})=(1+S_t)^t / (1+S_{t-1})^{t-1}$$

The full results are in appendix 1. The mean forward rate was 7.814%, a standard deviation of 2.484% a minimum of 1.82 and a maximum of 11.92%. The co-efficient of variation is 0.3178, which is lower than that of 91-days Treasury bills.

4.4 Expected Spot Rates and Actual Spot Rates

To compare the actual spot rate with expected forward rates (es) or forward rates, we lag the 8 observed spot rates. The summary of these two variables are as follows:

Table 2: Descriptive Statistic For Weekly Returns From Treasury Bills Lag and Forward Rates Feb 2002 to March 2008

Variable	N	Mean	StDev	Minimum	Maximum	Co-efficient of Variation
91DaysT. Bills	315	6.188	2.599	0.783	10.469	0.420
91 Forward Rate	315	7.811	2.488	1.82	11.923	0.319

The mean forward rate is higher than the comparable spot rate and less variable if we compare their standard deviations. The next question is whether these two variables are different i.e. is the mean of forward rate of 7.811% statistically higher than the actual spot rate of 6.188%? The variability as measured by standard deviation show wider fluctuation in actual spot rate than expected.

4.5 Forward Rates and Actual Spot Rates Test for Equal Variances

We use variance test to perform hypothesis tests for equality or homogeneity of variance between forward rates and actual spot rates. Statistical procedures, including analysis of variance, assume that although different samples may come from populations with different means, they have the same variance.

Analysis of variance (ANOVA) is similar to regression in that it is used to investigate and model the relationship between a response variable and one or more independent variables. However, analysis of variance differs from regression in two ways: the independent variables are qualitative

(categorical), and no assumption is made about the nature of the relationship (that is, the model does not include coefficients for variables). In effect, analysis of variance extends the two-sample t-test for testing the equality of two population means to a more general null hypothesis of comparing the equality of more than two means, versus them not all being equal.

4.6 First Test of ANOVA

This test determines whether the 91-day and 182-day Treasury bills are different. They appear different as the 91-day TB reports a mean of 6% while the 182-day reports a mean of 7%, a difference of 1%. This is in line with the theory that assets of longer maturity tend to give higher returns as compensation. P value of 0.00 confirms this.

Table 3: One-way ANOVA: 91DaysTB, 182DaysTB

```
Analysis of Variance
Source     DF        SS        MS        F        P
Factor      1    101.54    101.54    15.55    0.000
Error     630   4112.66      6.53
Total     631   4214.20

                                  Individual 95% CIs For Mean
                                  Based on Pooled StDev
Level       N      Mean     StDev  --+---------+---------+---------+----
91DaysTB  316     6.202     2.607  (------*------)
182DaysT  316     7.004     2.502                    (------*------)
                                  --+---------+---------+---------+----
Pooled StDev =    2.555            6.00      6.40      6.80      7.20
```

4.7 ANOVA for 91-Days TB Lag and Forward Rate Lag

This test the hypothesis that means of several populations are equal. It is an extension of T-test, specifically for the case where the population variances are assumed to be equal like in the case of expected spot rates and actual spot rates.

This test determines whether the forward rate is equal to the expected spot rate. We find that they are not equal. The forward rate tends to be higher than the comparable spot rate. This suggests

existence of forward premiums. The theory that might explain this phenomenon is the liquidity preference theory as opposed to the unbiased expectations theory.

Table 4: **One-way ANOVA: 91DaysTBlag, ForRatelag**

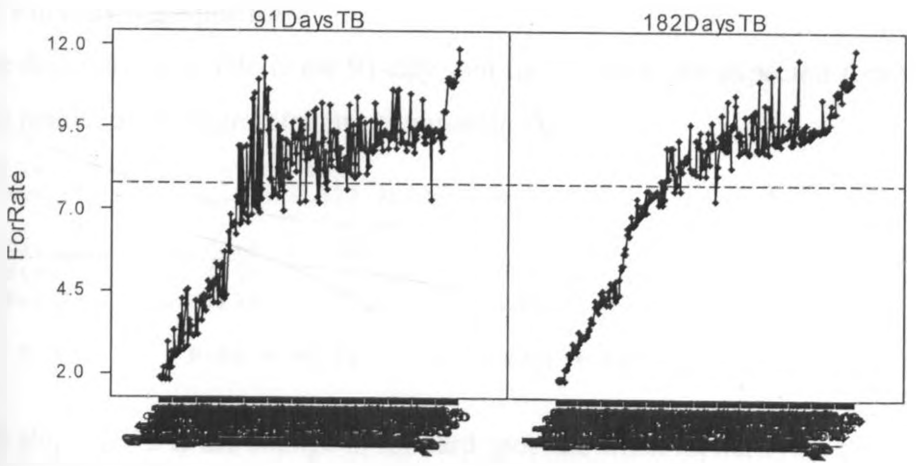
```
Analysis of Variance
Source     DF        SS        MS        F        P
Factor      1    414.80    414.80    64.09    0.000
Error     628   4064.38      6.47
Total     629   4479.18

                                  Individual 95% CIs For Mean
                                  Based on Pooled StDev
Level       N      Mean     StDev  --+---------+---------+---------+----
91DaysTB  315     6.188     2.599  (----*----)
ForRatel  315     7.811     2.488                                (----*----)
                                  --+---------+---------+---------+----
Pooled StDev =    2.544            6.00      6.60      7.20      7.80
```

4.8 The Main Effect Plot

The main effect plot is used to compare the impact of the two Treasury bills on forward rates.

Graph 1 Main Effects Plot - Data Means for Forward Rates and 91 days and 182 Days T Bills



The points in the plot are the means of the response variables at the various levels for each factor, with a reference line drawn at the grand mean of the response data forward rate. The effects are the differences between the means and the reference line. From the graph above we see that the 91-day Treasury bills effects upon forward rate are large compared to the effects of 182-day Treasury bills on forward rates.

Our finding is that the mean and variance of 91-day Treasury bill is different from that of 182-day Treasury bill. The P-value for the ANOVA is 0.000 at a commonly used x-level of 0.05 for the test, and we conclude that there are no significant differences in the return between the two bills.

The same conclusion is reached when we compare the actual spot rate with forward rates.

The P-value of 0.000 confirms no significant differences between mean actual spot rate and expected spot rate.

4.9 Forecasting Spot Rate

The dependent variable is the 91-day spot rate whereas the expected forward rate is the spot rate. The results of the regression are summarized below.

```
The regression equation is
91DaysTBlag = - 1.41 + 0.972 ForRatelag

Predictor        Coef     SE Coef          T        P
Constant      -1.4069      0.1772      -7.94    0.000
ForRatel      0.97236     0.02162      44.97    0.000

S = 0.9530      R-Sq = 86.6%     R-Sq(adj) = 86.6%
```

The slope 0.972 is the change in forward spot rate when forward rate changes by 1 i.e. it is almost one to one. The constant intercept value of – 1.407 is the predicted spot rate when predictor forward rate is zero. The co-efficient P-value tells us whether or not the association between the

response and the prediction is statistically significant. In our case, a P-value of 0.000 show that the relationship is statistically significant i.e. you can use forward rates to predict spot rates. The R^2 represent the proportion of variation in the response data explained by the predictors i.e. 86.6% in our case.

CHAPTER 5

5.0 Conclusions

In this paper we focus mainly on the expectations hypothesis applied to the Treasury bill market to test whether it could be considered efficient in that way. According to our findings presented in chapter four, the estimates provided prove that this market is not efficient.

The basic statistical analysis shows that, there is a relationship between spot and forward exchange rates and that when the time arrives the actual spot rates tend to be lower than the hitherto expected forward rates. This could confirm the view, shared by many authors, that the forward exchange rate contains a risk premium.

However, we find that the forward rates have incremental information for the future changes in the spot exchange rates, given that they move towards the same direction.

5.1 Recommendations for Further Research

This study finds that forward rates are not accurate predictors of future or expected spot rates. The information content of the market players need to be researched to determine which economic variables would exactly predict the future spot rates.

It would also be of interest to carry out further research on the level of cointegration in the Kenyan Treasury Bills market.

5.2 Limitation of this Study

The short period of research made it difficult collecting and analyzing data for earlier periods before the year 2002. If time could allow, other advanced models could be used in similar studies.

REFERENCES

Campbell, J. Y. and R. J. Shiller (1987), Cointegration and Tests of Present Value Models, *Journal of Political Economy* 95, 1062-1088.

Davidson, R. and J. G. MacKinnon (1993), *Estimation and Inference in Econometrics*, NewYork: Oxford University Press.

Engle, R. F. and C. W. J. Granger (1987), A Cointegration and Error Correction: Representation, Estimation, and Testing, *Econometrica* 55, 251-76.

Fama, E (Jan. 1965): "The Behaviour of Stock Market Prices", Journal of Business, 38, pp 34-105.

Fama, E (May, 1970): "Efficient Capital Markets: A Review of Theory and Empirical Work", Journal of Finance, 383-412

Fama, E. F. (1975), Short-Term Interest Rates as Predictors of Inflation, *American Economic Review* 65, 269-282.

Fama, E. F. (1976a), Inflation Uncertainty and the Expected Returns on Treasury Bills, *Journal of Political Economy* 84, 427-448.

Fama, E. F. (1976b), Forward Rates as Predictors of Future Spot Rates, *Journal of Financial Economics* 3, 361-377.

Hall, A. D., H. M. Anderson, and C. W. J. Granger (1991), Cointegration Analysis of Treasury Bill Yields, *Review of Economics and Statistics* 73, 116-126.

Hamburger, M. J. and E. N. Platt (1975), Expectations Hypothesis and the Efficiency of the Treasury Bill Market, *Review of Economics and Statistics* 57, 190-199.

Kiio, Kanini E. (2006): "An Empirical Investigation into Market Efficiency and the effects of cash divided announcements on Share Prices of Compound listed on the Nairobi Stock", (University of Nairobi).

Kurgat, P (1998); "An Empirical study of spot Market Efficiency in Kenya's Foreign Exchange Bureaus" (University of Nairobi).

Langat, Stanley C. (1998): An Empirical study of the Impact of Treasury Bill Rates volatity on Corporate Investment. The case of Commercial Banks in Kenya, (University of Nairobi).

Muhoro Judith W. (2005): Determining the Efficiency of the Forex Market in Kenya, (University of Nairobi).

Ndunda, F.K. (2002): Testing whether Forward Exchange Rates are Predictors of Future Spot Rates in Kenya", (University of Nairobi).

Park, S. (2000): A Test of The Market Efficiency Hypothesis with An Application to Canadian Treasury Bill Yields, Carleton Economic Papers, Carleton University, Department of Economics.

Roll, R. (1970), *The Behavior of Interest Rates: An Application of the Efficient Market Model to U. S. Treasury Bills*, New York: Basic Books.

Sargent, T. (1972), Rational Expectations and the Term Structure of Interest Rates, *Journal of Money, Credit and Banking* 4, 74-97.

Sharpe, W.F., Alexander, G.J., and Bailey, J.V (1999): Investments. Sixth Edition, Prentice Hall.

Stock, J. H., and M. W. Watson (1988), Testing for Common Trends, *Journal of the American Statistical Association* 83, 1097-1107.

Appendix 1

Weekly TB rates

Date	IssueNo	91DaysTB	182DaysTB	Period	ForRate	91DaysTBlag	ForRatelag	Class	Return
18-Feb-02	1457	10.565	11.242	1	11.92	10.47	11.92	0	10.469
25-Feb-02	1458	10.469	10.995	2	11.52	10.33	11.52	0	10.333
4-Mar-02	1459	10.333	10.803	3	11.28	10.15	11.28	0	10.147
11-Mar-02	1460	10.147	10.645	4	11.15	10.05	11.15	0	10.051
18-Mar-02	1461	10.051	10.516	5	10.98	10 05	10 98	0	10.045
25-Mar-02	1462	10 045	10.423	6	10.80	10.08	10.80	0	10.075
1-Apr-02	1463	10.075	10.447	7	10.82	10.10	10 82	0	10.097
8-Apr-02	1464	10.097	10.524	8	10.95	10.08	10.95	0	10.078
15-Apr-02	1465	10.078	10 511	9	10.95	9.98	10.95	0	9 982
22-Apr-02	1466	9.982	10.471	10	10.96	9.82	10.96	0	9.818
29-Apr-02	1467	9.818	10.419	11	11.02	9.65	11.02	0	9 647
6-May-02	1468	9.647	10.347	12	11.05	9 32	11.05	0	9.315
13-May-02	1469	9.315	10.18	13	11.05	8.87	11.05	0	8.868
20-May-02	1470	8.868	9.891	14	10 92	8.33	10.92	0	8.329
27-May-02	1471	8.329	9.499	15	10.68	7.72	10.68	0	7.716
3-Jun-02	1472	7 716	9.07	16	10.44	7.13	10.44	0	7.132
10-Jun-02	1473	7.132	8.651	17	10.19	7.01	10.19	0	7.006
17-Jun-02	1474	7.006	8.632	18	10.28	7.50	10.28	0	7.498
24-Jun-02	1475	7.498	8.859	19	10.24	8.31	10.24	0	8.306
1-Jul-02	1476	8.306	9.127	20	9.95	8.73	9.95	0	8.732
8-Jul-02	1477	8.732	9.377	21	10.03	8.78	10.03	0	8.779
15-Jul-02	1478	8.779	9.41	22	10.04	8.74	10 04	0	8.74
22-Jul-02	1479	8.74	9.395	23	10.05	8.61	10.05	0	8.611
29-Jul-02	1480	8.611	9 503	24	10.40	8.43	10.40	0	8.428
5-Aug-02	1481	8 428	9.495	25	10.57	8.32	10.57	0	8.315
12-Aug-02	1482	8.315	9.468	26	10.63	8.32	10.63	0	8.322
19-Aug-02	1483	8.322	9.5	27	10.69	8.29	10.69	0	8.293
26-Aug-02	1484	8.293	9.49	28	10.70	8.08	10.70	0	8.075
2-Sep-02	1485	8.075	9.163	29	10.26	7.85	10.26	0	7.848
9-Sep-02	1486	7.848	8.852	30	9.87	7.58	9.87	0	7.575
16-Sep-02	1487	7.575	8.443	31	9.32	7.24	9.32	0	7.241
23-Sep-02	1488	7.241	8.324	32	9 42	7.27	9.42	0	7.265
30-Sep-02	1489	7.265	8.32	33	9.39	7.54	9.39	0	7.535
7-Oct-02	1490	7.535	8.353	34	9.18	8.04	9.18	0	8.036
14-Oct-02	1491	8.036	8.494	35	8.95	8.28	8.95	0	8 281
21-Oct-02	1492	8.281	8.578	36	8.88	8.41	8.88	0	8.409
28-Oct-02	1493	8.409	8 75	37	9.09	8.36	9.09	0	8.363
4-Nov-02	1494	8.363	8.75	38	9.14	8.30	9.14	0	8.303
11-Nov-02	1495	8 303	8.742	39	9.18	8.25	9.18	0	8.245
18-Nov-02	1496	8.245	8.715	40	9.19	8.28	9.19	0	8.283
25-Nov-02	1497	8.283	8.827	41	9.37	8.34	9.37	0	8.338
2-Dec-02	1498	8 338	8 885	42	9.43	8.37	9.43	0	8.365
9-Dec-02	1499	8.365	8.857	43	9.35	8.39	9.35	0	8.393
16-Dec-02	1500	8.393	8.722	44	9.05	8 37	9.05	0	8.373
23-Dec-02	1501	8 373	8.715	45	9.06	8.42	9.06	0	8.419
30-Dec-02	1502	8.419	8 75	46	9.08	8.48	9.08	0	8.478
6-Jan-03	1503	8.478	8.75	47	9.02	8.42	9 02	0	8.415
13-Jan-03	1504	8.415	8.75	48	9.09	8.35	9.09	0	8.352
20-Jan-03	1505	8.352	8.713	49	9.08	8.29	9.08	0	8.291
27-Jan-03	1506	8.291	8.7	50	9.11	8.15	9.11	0	8 149
3-Feb-03	1507	8.149	8.643	51	9.14	7.92	9.14	0	7.921
10-Feb-03	1508	7.921	8.349	52	8.78	7.62	8.78	0	7.623
17-Feb-03	1509	7.623	8.029	53	8.44	7.40	8.44	0	7.402
24-Feb-03	1510	7.402	7.532	54	7.66	6.99	7.66	0	6.989
3-Mar-03	1511	6.989	7.106	55	7.22	6.48	7.22	0	6.481
10-Mar-03	1512	6.481	6.715	56	6.95	6.12	6.95	0	6.115
17-Mar-03	1513	6.115	6.505	57	6.90	5.82	6.90	0	5.816

Date	IssueNo	91DaysTB	182DaysTB	Period	ForRate	91DaysTB	ForRatelag	Class	Return
24-Mar-03	1514	5 816	6.499	58	7.19	5.80	7.19	0	5.796
31-Mar-03	1515	5.796	6.366	59	6.94	6.09	6,94	0	6.091
7-Apr-03	1516	6.091	6.571	60	7 05	6.26	7.05	0	6.264
14-Apr-03	1517	6.264	6.833	61	7.41	6.32	7.41	0	6.324
21-Apr-03	1518	6.324	6.985	62	7.65	6.34	7.65	0	6.336
28-Apr-03	1519	6.336	6.938	63	7.54	6.18	7.54	0	6.184
5-May-03	1520	6 184	6.906	64	7.63	6.01	7.63	0	6.008
12-May-03	1521	6 008	6.807	65	7.61	5.78	7.61	0	5.782
19-May-03	1522	5.782	6.696	66	7.62	5.40	7.62	0	5.399
26-May-03	1523	5.399	6.299	67	7.21	4.82	7.21	0	4.823
2-Jun-03	1524	4.823	5.547	68	6.28	3 85	6.28	0	3.854
9-Jun-03	1525	3.854	4.788	69	5.73	2.52	5 73	0	2.524
16-Jun-03	1526	2.524	3.925	70	5.35	2.03	5.35	0	2.027
23-Jun-03	1527	2.027	3.425	71	4.84	1.76	4.84	0	1.763
30-Jun-03	1528	1.763	2.894	72	4.04	1.54	4.04	0	1.537
7-Jul-03	1529	1.537	2.82	73	4.12	1.55	4.12	0	1.547
14-Jul-03	1530	1.547	3.068	74	4.61	1.54	4.61	0	1 542
21-Jul-03	1531	1 542	3.015	75	4.51	1.52	4.51	0	1.522
28-Jul-03	1532	1.522	2.891	76	4 28	1.48	4.28	0	1.48
4-Aug-03	1533	1.48	2.6	77	3.73	1.36	3.73	0	1.364
11-Aug-03	1534	1.364	2.345	78	3.34	1.04	3.34	0	1.036
18-Aug-03	1535	1.036	1.997	79	2.97	0.84	2.97	0	0.843
25-Aug-03	1536	0.843	1.519	80	2.20	0.84	2.20	0	0.844
1-Sep-03	1537	0.844	1.359	81	1.88	0.84	1.88	0	0 84
8-Sep-03	1538	0.84	1.329	82	1.82	0.83	1.82	0	0.832
15-Sep-03	1539	0.832	1.371	83	1.91	0.78	1.91	0	0.783
22-Sep-03	1540	0.783	1.34	84	1.90	0.85	1.90	0	0.849
29-Sep-03	1541	0.849	1.351	85	1.86	0.98	1.86	0	0.98
6-Oct-03	1542	0.98	1.612	86	2.25	0.93	2.25	0	0.93
13-Oct-03	1543	0.93	1.396	87	1.86	1.04	1.86	0	1.038
20-Oct-03	1544	1.038	1.445	88	1.85	1.07	1.85	0	1.074
27-Oct-03	1545	1.074	1.729	89	2.39	1.13	2.39	0	1.133
3-Nov-03	1546	1.133	1.894	90	2.66	1.25	2.66	0	1.249
10-Nov-03	1547	1.249	1.718	91	2.19	1.36	2.19	0	1.357
17-Nov-03	1548	1.357	1.946	92	2.54	1.38	2.54	0	1.381
24-Nov-03	1549	1.381	1.963	93	2.55	1.49	2.55	0	1.488
1-Dec-03	1550	1.488	2.076	94	2.67	1.53	2.67	0	1.526
8-Dec-03	1551	1.526	2.127	95	2.73	1.41	2.73	0	1.412
15-Dec-03	1552	1.412	2.05	96	2.69	1.46	2.69	0	1.46
22-Dec-03	1553	1 46	2.1	97	2.74	1.41	2.74	0	1.405
29-Dec-03	1554	1.405	2.076	98	2.75	1.52	2.75	0	1.515
5-Jan-04	1555	1.515	2.247	99	2.98	1.59	2.98	0	1.59
12-Jan-04	1556	1.59	2.349	100	3.11	1.60	3.11	0	1.601
19-Jan-04	1557	1.601	2.379	101	3.16	1.61	3.16	0	1.614
26-Jan-04	1558	1.614	2.418	102	3.23	1.61	3.23	0	1.606
2-Feb-04	1559	1.606	2.407	103	3.21	1.59	3.21	0	1.591
9-Feb-04	1560	1.591	2.366	104	3.15	1.55	3.15	0	1.554
16-Feb-04	1561	1.554	2.208	105	2.87	1.53	2.87	0	1.534
23-Feb-04	1562	1.534	2.356	106	3.18	1.57	3.18	0	1.574
1-Mar-04	1563	1 574	2.429	107	3.29	1.59	3.29	0	1.59
8-Mar-04	1564	1.59	2.47	108	3.36	1.59	3.36	0	1.589
15-Mar-04	1565	1.589	2.513	109	3.45	1.58	3.45	0	1.582
22-Mar-04	1566	1.582	2.61	110	3.65	1.62	3.65	0	1.623
29-Mar-04	1567	1.623	2.625	111	3.64	1.73	3.64	0	1 732
5-Apr-04	1568	1.732	2.666	112	3.61	1.93	3.61	0	1.927
12-Apr-04	1569	1.927	2.924	113	3.93	2.17	3.93	0	2.17
19-Apr-04	1570	2.17	3.361	114	4.57	2.61	4.57	0	2.611
26-Apr-04	1571	2.611	3.516	115	4.43	2.84	4.43	0	2.838
3-May-04	1572	2.838	3.685	116	4.54	2.98	4.54	0	2.984
10-May-04	1573	2.984	3.684	117	4.39	2.99	4 39	0	2.992
17-May-04	1574	2.992	3.685	118	4.38	2.94	4.38	0	2 937
24-May-04	1575	2.937	3.599	119	4.27	2.60	4.27	0	2.6
31-May-04	1576	2.6	3.381	120	4.17	2.30	4.17	0	2.299

Date	IssueNo	91DaysTB	182DaysTB	Period	ForRate	91DaysTB	ForRatelag	Class	Return
7-Jun-04	1577	2.299	3.23	121	4.17	2.07	4.17	0	2.065
14-Jun-04	1578	2.065	3.203	122	4.35	1.98	4.35	0	1.978
21-Jun-04	1579	1.978	3.121	123	4.28	1.72	4.28	0	1.717
28-Jun-04	1580	1.717	3.029	124	4.36	1.64	4.36	0	1.636
5-Jul-04	1581	1.636	2.931	125	4.24	1.61	4.24	0	1.613
12-Jul-04	1582	1.613	2.911	126	4.23	1.70	4.23	0	1.701
19-Jul-04	1583	1.701	2.935	127	4.18	1.88	4.18	0	1.876
26-Jul-04	1584	1.876	3.128	128	4.40	2.01	4.40	0	2.011
2-Aug-04	1585	2.011	3.291	129	4.59	2.18	4.59	0	2.177
9-Aug-04	1586	2.177	3.437	130	4.71	2.26	4.71	0	2.256
16-Aug-04	1587	2.256	3.497	131	4.75	2.41	4.75	0	2.405
23-Aug-04	1588	2.405	3.548	132	4.70	2.49	4.70	0	2.487
30-Aug-04	1589	2.487	3.674	133	4.87	2.61	4.87	0	2.609
6-Sep-04	1590	2.609	3.783	134	4.97	2.70	4.97	0	2.7
13-Sep-04	1591	2.7	3.968	135	5.25	2.78	5.25	0	2.779
20-Sep-04	1592	2.779	4.064	136	5.37	2.91	5.37	0	2.906
27-Sep-04	1593	2.906	4.292	137	5.70	3.24	5.70	0	3.236
4-Oct-04	1594	3.236	4.568	138	5.92	3.73	5.92	0	3.732
11-Oct-04	1595	3.732	5.006	139	6.30	4.33	6.30	0	4.332
18-Oct-04	1596	4.332	5.577	140	6.84	4.50	6.84	0	4.5
25-Oct-04	1597	4.5	5.5	141	6.51	4.52	6.51	0	4.518
1-Nov-04	1598	4.518	5.534	142	6.56	4.60	6.56	0	4.6
8-Nov-04	1599	4.6	5.565	143	6.54	4.75	6.54	0	4.748
15-Nov-04	1600	4.748	5.692	144	6.64	5.18	6.64	0	5.182
22-Nov-04	1601	5.182	6.27	145	7.37	6.26	7.37	0	6.259
29-Nov-04	1602	6.259	7.088	146	7.92	7.19	7.92	0	7.189
6-Dec-04	1603	7.189	7.776	147	8.37	8.65	8.37	0	8.65
13-Dec-04	1604	8.65	7.998	148	7.35	8.29	7.35	0	8.291
27-Dec-04	1606	8.291	8.795	149	9.30	8.25	9.30	0	8.254
3-Jan-05	1607	8.254	8.781	150	9.31	8.25	9.31	0	8.247
10-Jan-05	1608	8.247	8.761	151	9.28	8.28	9.28	0	8.277
17-Jan-05	1609	8.277	8.771	152	9.27	8.22	9.27	0	8.216
24-Jan-05	1610	8.216	8.634	153	9.05	8.30	9.05	0	8.301
31-Jan-05	1611	8.301	8.839	154	9.38	8.44	9.38	0	8.44
7-Feb-05	1612	8.44	8.998	155	9.56	8.63	9.56	0	8.634
14-Feb-05	1613	8.634	8.984	156	9.34	8.62	9.34	0	8.615
21-Feb-05	1614	8.615	8.937	157	9.26	8.66	9.26	0	8.659
28-Feb-05	1615	8.659	8.94	158	9.22	8.65	9.22	0	8.652
7-Mar-05	1616	8.652	8.969	159	9.29	8.64	9.29	0	8.636
14-Mar-05	1617	8.636	8.97	160	9.31	8.61	9.31	0	8.612
21-Mar-05	1618	8.612	8.853	161	9.09	8.62	9.09	0	8.62
28-Mar-05	1619	8.62	8.854	162	9.09	8.67	9.09	0	8.673
4-Apr-05	1620	8.673	8.959	163	9.25	8.70	9.25	0	8.699
11-Apr-05	1621	8.699	8.973	164	9.25	8.69	9.25	0	8.687
18-Apr-05	1622	8.687	8.75	165	8.81	8.66	8.81	0	8.663
25-Apr-05	1623	8.663	8.981	166	9.30	8.66	9.30	0	8.66
2-May-05	1624	8.66	8.901	167	9.14	8.67	9.14	0	8.67
9-May-05	1625	8.67	9.054	168	9.44	8.67	9.44	0	8.666
16-May-05	1626	8.666	9.05	169	9.44	8.66	9.44	0	8.662
23-May-05	1627	8.662	9.057	170	9.45	8.64	9.45	0	8.641
30-May-05	1628	8.641	9.052	171	9.46	8.56	9.46	0	8.563
6-Jun-05	1629	8.563	9.023	172	9.48	8.50	9.48	0	8.497
13-Jun-05	1630	8.497	8.896	173	9.30	8.49	9.30	0	8.486
20-Jun-05	1631	8.486	8.943	174	9.40	8.46	9.40	0	8.462
27-Jun-05	1632	8.462	8.977	175	9.49	8.59	9.49	0	8.586
4-Jul-05	1633	8.586	9.084	176	9.58	8.57	9.58	0	8.573
11-Jul-05	1634	8.573	9.067	177	9.56	8.60	9.56	0	8.597
18-Jul-05	1635	8.597	9.051	178	9.51	8.59	9.51	0	8.592
25-Jul-05	1636	8.592	9.117	179	9.64	8.63	9.64	0	8.63
1-Aug-05	1637	8.63	9.112	180	9.60	8.63	9.60	0	8.63
8-Aug-05	1638	8.63	9.093	181	9.56	8.66	9.56	0	8.663
15-Aug-05	1639	8.663	9.093	182	9.52	8.66	9.52	0	8.661
22-Aug-05	1640	8.661	9.09	183	9.52	8.69	9.52	0	8.693

Date	IssueNo	91DaysTB	182DaysTB	Period	ForRate	91DaysTB	ForRatelag	Class	Return
29-Aug-05	1641	8.693	9.079	184	9.47	8.66	9.47	0	8.663
5-Sep-05	1642	8.663	9.096	185	9.53	8.62	9.53	0	8.622
12-Sep-05	1643	8.622	8.989	186	9.36	8.54	9.36	0	8.536
19-Sep-05	1644	8.536	8.862	187	9.19	8 49	9.19	0	8.488
26-Sep-05	1645	8.488	8.646	188	8.80	8.41	8.80	0	8.406
3-Oct-05	1646	8.406	8.616	189	8.83	8 32	8.83	0	8.317
10-Oct-05	1647	8.317	8.613	190	8.91	8.22	8.91	0	8.217
17-Oct-05	1648	8.217	8.531	191	8.85	8.06	8.85	0	8.057
24-Oct-05	1649	8.057	8.458	192	8.86	7.94	8.86	0	7.944
31-Oct-05	1650	7.944	8.396	193	8.85	7.85	8.85	0	7.853
7-Nov-05	1651	7.853	8.386	194	8.92	7.81	8.92	0	7.807
14-Nov-05	1652	7.807	8.358	195	8.91	7.86	8.91	0	7.855
21-Nov-05	1653	7.855	8.367	196	8.88	7.86	8.88	0	7.858
28-Nov-05	1654	7.858	8.366	197	8.88	7.96	8.88	0	7.956
5-Dec-05	1655	7.956	8.403	198	8.85	8.04	8.85	0	8.043
12-Dec-05	1656	8.043	8.406	199	8.77	8.14	8.77	0	8.14
19-Dec-05	1657	8.14	8.509	200	8.88	8.14	8.88	0	8.14
26-Dec-05	1658	8.14	8.634	201	9.13	8.16	9.13	0	8.155
2-Jan-06	1659	8.155	8.732	202	9.31	8.26	9.31	0	8.261
9-Jan-06	1660	8.261	8.792	203	9.33	8.26	9.33	0	8.258
16-Jan-06	1661	8.258	8.819	204	9.38	8.25	9.38	0	8.245
23-Jan-06	1662	8.245	8.907	205	9.57	8.25	9.57	0	8.247
30-Jan-06	1663	8.247	8.937	206	9.63	8.21	9.63	0	8.21
6-Feb-06	1664	8.21	8.951	207	9 70	8.09	9.70	0	8.085
13-Feb-06	1665	8.085	8.869	208	9.66	7.95	9.66	0	7.945
20-Feb-06	1666	7.945	8.827	209	9.72	7.86	9.72	0	7 859
27-Feb-06	1667	7.859	8.77	210	9.69	7.76	9.69	0	7.763
6-Mar-06	1668	7.763	8.703	211	9.65	7.69	9.65	0	7.686
13-Mar-06	1669	7.686	8.653	212	9.63	7.62	9.63	0	7.622
20-Mar-06	1670	7.622	8.602	213	9.59	7.35	9.59	0	7.345
27-Mar-06	1671	7.345	8.126	214	8.91	7.23	8.91	0	7.233
3-Apr-06	1672	7.233	7.875	215	8.52	7.09	8.52	0	7.088
10-Apr-06	1673	7.088	7.374	216	7.66	6.95	7.66	0	6.951
17-Apr-06	1674	6.951	7.177	217	7.40	6.79	7.40	0	6.791
24-Apr-06	1675	6.791	7.009	218	7.23	6.84	7.23	0	6.841
1-May-06	1676	6.841	7.045	219	7.25	7.08	7.25	0	7.082
8-May-06	1677	7.082	7.452	220	7.82	7.10	7.82	0	7.099
15-May-06	1678	7.099	7.478	221	7.86	7.08	7.86	0	7.079
22-May-06	1679	7.079	7.661	222	8 25	6.97	8.25	0	6.971
29-May-06	1680	6.971	7.744	223	8.52	6.84	8.52	0	6.84
5-Jun-06	1681	6.84	7.681	224	8.53	6.69	8.53	0	6.686
12-Jun-06	1682	6.686	7.419	225	8.16	6 55	8.16	0	6.547
19-Jun-06	1683	6.547	7.257	226	7.97	6.31	7.97	0	6.312
26-Jun-06	1684	6.312	6.92	227	7.53	6.13	7.53	0	6.129
3-Jul-06	1685	6.129	6.73	228	7.33	6.00	7.33	0	6.001
10-Jul-06	1686	6.001	6.619	229	7.24	5.90	7.24	0	5.895
17-Jul-06	1687	5.895	6.388	230	6.88	5.74	6.88	0	5.74
24-Jul-06	1688	5.74	6.222	231	6.71	5.71	6 71	0	5.708
31-Jul-06	1689	5.708	6.125	232	6.54	5.85	6.54	0	5.845
7-Aug-06	1690	5.845	6.228	233	6.61	5.85	6.61	0	5.849
14-Aug-06	1691	5.849	6.326	234	6.81	5.99	6.81	0	5.993
21-Aug-06	1692	5.993	6.575	235	7.16	6.13	7.16	0	6.134
28-Aug-06	1693	6.134	6.73	236	7.33	6.29	7.33	0	6.293
4-Sep-06	1694	6.293	7.1	237	7.91	6.39	7.91	0	6.388
11-Sep-06	1695	6.388	7.331	238	8.28	6.51	8.28	0	6.511
18-Sep-06	1696	6.511	7.533	239	8.56	6.62	8.56	0	6.62
25-Sep-06	1697	6.62	7.816	240	9.03	6.68	9.03	0	6.681
2-Oct-06	1698	6.681	7.99	241	9.32	6.79	9.32	0	6.79
9-Oct-06	1699	6.79	8.246	242	9.72	6.85	9.72	0	6.849
16-Oct-06	1700	6.849	8.373	243	9.92	6.90	9.92	0	6.898
23-Oct-06	1701	6.898	8.467	244	10.06	6.91	10.06	0	6.914
30-Oct-06	1702	6.914	8.484	245	10.08	6.90	10.08	0	6.898
6-Nov-06	1703	6.898	8.423	246	9.97	6.65	9.97	0	6.648

Date	IssueNo	91DaysTB	182DaysTB	Period	ForRate	91DaysTBlag	ForRatelag	Class	Return
13-Nov-06	1704	6.648	8.159	247	9.69	6.25	9.69	0	6.25
20-Nov-06	1705	6.25	7.838	248	9.45	5.86	9.45	0	5.857
27-Nov-06	1706	5.857	7.525	249	9.22	5.68	9.22	0	5.68
4-Dec-06	1707	5.68	7.312	250	8.97	5 64	8.97	0	5.636
11-Dec-06	1708	5.636	7.282	251	8.95	5.76	8 95	0	5 763
18-Dec-06	1709	5.763	7.328	252	8.92	5.83	8.92	0	5.831
25-Dec-06	1710	5.831	7.372	253	8 94	5.88	8.94	0	5.876
1-Jan-07	1711	5.876	7.772	254	9.70	5.92	9.70	0	5.921
8-Jan-07	1712	5.921	8.123	255	10.37	5.99	10.37	0	5.991
15-Jan-07	1713	5.991	8.27	256	10.60	6.08	10.60	0	6.081
22-Jan-07	1714	6.081	8.51	257	10 99	6.13	10.99	0	6.129
29-Jan-07	1715	6.129	8.736	258	11.41	6.19	11.41	0	6.193
5-Feb-07	1716	6.193	8.873	259	11.62	6.21	11.62	0	6.214
12-Feb-07	1717	6.214	8.67	260	11.18	6.25	11.18	0	6.245
19-Feb-07	1718	6.245	8.458	261	10.72	6.24	10.72	0	6.242
26-Feb-07	1719	6.242	8.253	262	10.30	6.22	10.30	0	6.219
5-Mar-07	1720	6.219	8.067	263	9.95	6.26	9.95	0	6.262
12-Mar-07	1721	6.262	7.979	264	9.72	6.35	9.72	0	6.351
19-Mar-07	1722	6.351	7.927	265	9.53	6.43	9.53	0	6.43
26-Mar-07	1723	6.43	7.921	266	9.43	6.47	9.43	0	6.474
2-Apr-07	1724	6.474	7.814	267	9.17	6.51	9.17	0	6.51
9-Apr-07	1725	6.51	7.822	268	9 15	6.65	9.15	0	6.653
16-Apr-07	1726	6.653	7.918	269	9.20	6.80	9.20	0	6.797
23-Apr-07	1727	6.797	7.985	270	9.19	6.80	9.19	0	6.795
30-Apr-07	1728	6.795	8.101	271	9.42	6.80	9.42	0	6.795
7-May-07	1729	6.795	8.138	272	9.50	6.78	9.50	0	6.782
14-May-07	1730	6.782	8.042	273	9.32	6.77	9.32	0	6.774
21-May-07	1731	6.774	7.99	274	9.22	6.74	9.22	0	6.744
28-May-07	1732	6.744	7.74	275	8.75	6.64	8.75	0	6.643
4-Jun-07	1733	6.643	7.521	276	8.41	6.58	8.41	0	6.575
11-Jun-07	1734	6.575	7.297	277	8.02	6.49	8.02	0	6.487
18-Jun-07	1735	6.487	7.028	278	7.57	6.40	7.57	0	6.398
25-Jun-07	1736	6.398	6.906	279	7.42	6.35	7.42	0	6.345
2-Jul-07	1737	6.345	6.876	280	7.41	6.35	7.41	0	6.345
9-Jul-07	1738	6.345	6.959	281	7.58	6.46	7.58	0	6.463
16-Jul-07	1739	6.463	7.115	282	7.77	6.57	7.77	0	6.565
23-Jul-07	1740	6.565	7.305	283	8.05	6.90	8.05	0	6.902
30-Jul-07	1741	6.902	7.575	284	8.25	7.08	8.25	0	7.084
6-Aug-07	1742	7.084	7.927	285	8.78	7.34	8.78	0	7.342
13-Aug-07	1743	7.342	8.105	286	8.87	7.37	8.87	0	7.37
20-Aug-07	1744	7.37	7.99	287	8.61	7.38	8.61	0	7.384
27-Aug-07	1745	7.384	7.924	288	8.47	7.36	8.47	0	7.361
3-Sep-07	1746	7.361	7.874	289	8.39	7.35	8.39	0	7.352
10-Sep-07	1747	7.352	7.804	290	8.26	7.33	8.26	0	7.332
17-Sep-07	1748	7.332	7.801	291	8.27	7.34	8.27	0	7.341
24-Sep-07	1749	7.341	7.795	292	8.25	7.35	8.25	0	7.346
1-Oct-07	1750	7.346	7.798	293	8 25	7.45	8.25	0	7.452
8-Oct-07	1751	7.452	7.805	294	8.16	7.56	8.16	0	7.556
15-Oct-07	1752	7.556	7.841	295	8.13	7.67	8.13	0	7.674
22-Oct-07	1753	7.674	7.842	296	8.01	7.72	8 01	0	7.724
29-Oct-07	1754	7.724	7.914	297	8.10	7.92	8.10	0	7.922
5-Nov-07	1755	7.922	8.018	298	8.11	7.93	8.11	0	7.932
12-Nov-07	1756	7.932	8.142	299	8.35	7.30	8.35	0	7.298
19-Nov-07	1757	7.298	8.056	300	8.82	6.93	8.82	0	6.925
26-Nov-07	1758	6.925	7.934	301	8.95	6.88	8.95	0	6.875
3-Dec-07	1759	6.875	7.889	302	8.91	6.87	8.91	0	6.865
10-Dec-07	1760	6.865	7.842	303	8.83	6.84	8.83	0	6.839
17-Dec-07	1761	6.839	7.858	304	8.89	6.89	8.89	0	6.892
24-Dec-07	1762	6.892	7.889	305	8.90	6.80	8.90	0	6.796
7-Jan-08	1763	6.796	8.187	306	9.60	6.89	9.60	0	6.891
14-Jan-08	1764	6.891	8.056	307	9.23	7.00	9.23	0	6.999
21-Jan-08	1765	6.999	8.032	308	9.07	7.12	9.07	0	7.115
28-Jan-08	1766	7.115	8.089	309	9.07	7.33	9.07	0	7.334

Date	IssueNo	91DaysTB	182DaysTB	Period	ForRate	91DaysTB	ForRatelag	Class	Return
4-Feb-08	1767	7.334	8.355	310	9.39	7.42	9.39	0	7.424
11-Feb-08	1768	7.424	8.413	311	9.41	7.29	9.41	0	7.291
18-Feb-08	1769	7.291	8.313	312	9.34	7.07	9.34	0	7.069
25-Feb-08	1770	7.069	8.137	313	9 22	6.96	9.22	0	6.956
3-Mar-08	1771	6.956	7.991	314	9.04	6.89	9.04	0	6.894
10-Mar-08	1772	6.894	7.763	315	8 64	6.87	8.64	0	6.868
17-Mar-08	1773	6.868	7.724	315	8.59			1	11 92