BACK TESTING EQUITY RISK PREMIUM IN THE KENYAN STOCK MARKET

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DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the Research Proposal contains no material previously published or written by another person except where due reference is made in the Research Proposal itself.

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This Research Proposal has been submitted for examination with my approval as the Supervisor.

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Table of Contents

List of Figures

List of Abbreviations

ERP	Equity Risk Premium
NSE	Nairobi Securities Exchange
CAPM	Capital Asset Pricing Model
ARIMA	AutoRegressive Integrated Moving Average model
GARCH	Generalized Autoregressive Conditional Heteroskedasticity
DDM	Dividend Discount Model

Abstract

This study focuses on the estimation of the Equity Risk Premium (ERP) in the Kenyan market, with a specific focus on the Nairobi Securities Exchange (NSE) 20 Share Index. The ERP is a critical component in asset pricing models, used to gauge the extra return that investors demand for taking on the higher risk of equity investments compared to risk-free assets. However, the estimation of ERP in emerging markets like Kenya presents unique challenges, including market inefficiencies, limited data availability, and heightened economic volatility. This research addresses these challenges by employing a dual approach, back-testing ERP using historical excess returns over the 90-day Treasury bill rate and forward-looking projections using ARIMA and GARCH models. The ARIMA struggled to model monthly ERP due to its volatility and predominantly negative values, but the GARCH model effectively captured volatility of the ERP over the observed period. The findings reveal that risk-free rates in most cases exceed stock returns in the Kenyan market, emphasizing the need for tailored risk management strategies. This study bridges a critical gap in the literature and provides actionable insights for enhancing investment strategies and policy development in Kenya.

Chapter 1: Introduction

1.1 Background

The expectation of every investor is to make a return higher than the risk-free rate in their investment, in the long run. Equity Risk Premium(ERP) is the excess return from investing in the stock market over the risk-free rate. It reflects the compensation investors seek for accepting the higher risk associated with equity investments versus risk-free assets. The risk-free rate is normally the yield on government bonds such as treasury bills. This is because the government is not expected to default in paying the borrowing that they have done by issuing bonds, therefore they are considered a low-risk investment. There are other issuers of bonds such as cooperate bonds which have a higher yield compared to government bonds since they are more risker to the investor. When evaluating assets, the risk-free rate of return serves as a benchmark. It helps you decide whether they're worth pursuing. It is also essential since it allows us to compare various investments to one another. It is an essential component of financial models for asset pricing, portfolio management, and capital budgeting.

In developed markets, ERP is a well-studied and extensively utilized metric that provides useful information to investors, financial analysts, and policymakers. Several studies have been done on that market than on emerging markets. (Damodaran, 2006) conducted groundbreaking research that extensively examined ERP, emphasizing its fluctuation in different markets and over time. Damodaran's thorough research demonstrates that ERP estimates can vary considerably depending on the methodology, time frame, and market circumstances chosen. Different periods of historical data yield varying ERP estimates, longer periods might average out anomalies but could include outdated market conditions. Shorter periods may reflect current conditions but can be skewed by recent anomalies. Furthermore, changes in the economic cycle affects return on an investment. During recessions, ERP tends to be higher due to increased risk aversion, whereas in booms, it’s lower due to higher investor confidence. The researcher highlights that fluctuations in interest rates impact the risk-free rate, altering ERP estimates. He stresses the significance of employing various methods to determine a reliable ERP estimate.

The average risk premium of the American market for the last 10 years has been between 5.3% and 5.7%. Studies done have shown that emerging markets are likely to have a higher ERP than developed markets. Supported by (Salomons, 2003), the ERP of emerging markets are significantly higher and the reward for investors in emerging stock markets changes over time. The researcher finds that the ERP of emerging markets can range from 3% to 5% higher. Since the market is very risky and exhibits a high level of volatility, there is need for the investor to be compensated for the additional risk.

Over many years, equities have been making a higher return than the risk-free rate, which has been hard to explain. This is the equity risk puzzle. According to (Mehra & Prescott, 1985), the U.S. equity premium is typically around 6% , which traditional models based on realistic levels of risk aversion could not support. This equity premium puzzle indicated that traditional models might be missing important components and underlined the need for more research into the variables influencing ERP.

Kenya's stock market is still growing and still experiencing many challenges related to its growth. Some of these challenges are; rising interest rates, increase in expenses, inflation, depreciation of the Kenyan Shilling, high debt and exchange rate pressure, causing foreign investors to reallocate money and resulting in price erosion across listed assets. The NSE has been underperforming recently due to the political instability that has been ongoing which has increased market volatility, and regulatory changes have also affected their performance. There are 69 companies that are publicly listed in the stock exchange.

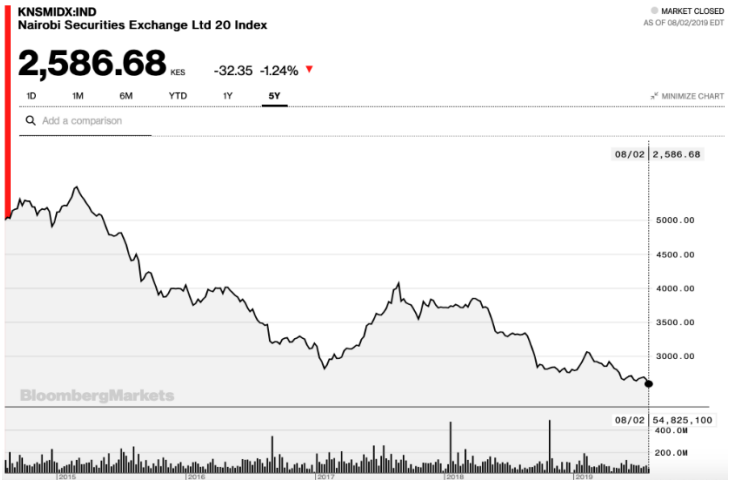

Fig 1: NSE 20 Share Index over a 10 year period

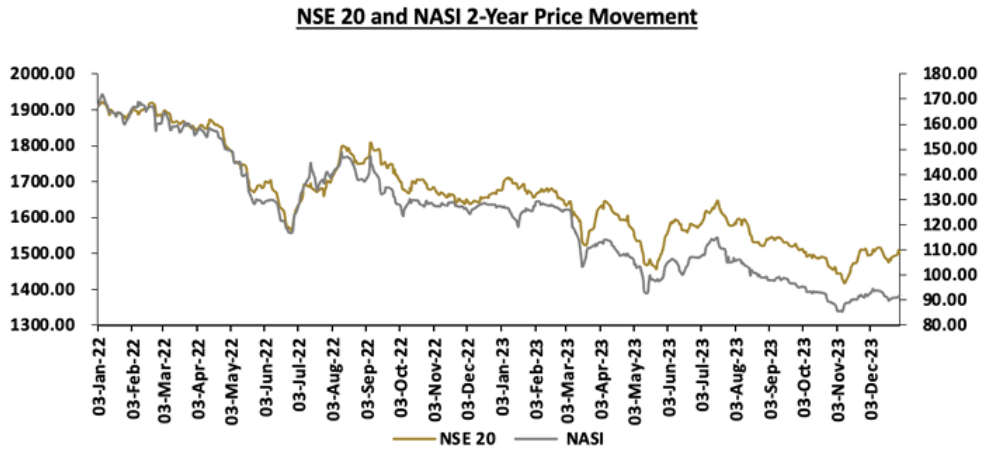

Fig 2: NSE 2O Share Index and NASI over the last two years(2022 – 2023)

The estimation and application of ERP face particular difficulties in developing markets such as Kenya because of market inefficiencies, restricted data availability, and increased economic volatility. Developing countries often exhibit high levels of market inefficiency due to information asymmetry. Efficient Market Hypothesis(EMH) states in an efficient market, all stock prices reflect all available information. It also highlights that stocks trade at their fair value in the stock market. This is never the case in an inefficient market since the stock price does not fully reflect all information due to some traders having more information than others. Moreover, information of companies listed in the NSE are not easy to access, therefore, getting relevant data could also be hard to find.

For investors hoping to make wise choices in this market, it is imperative that they comprehend the ERP in relation to the Nairobi Securities Exchange (NSE). Prior research by (W, Ngugi, Nyamongo, & Muriuki, 2003) and (Kithinji & Ngugi, 2010) emphasizes the importance of localized ERP estimates by identifying the unique traits and risks associated with the Kenyan financial market. (W, Ngugi, Nyamongo, & Muriuki, 2003) investigate the determinants of interest rate spreads in Kenya and find that high operating costs, the prevalence of non-performing loans (NPLs), and variations in return on assets (ROA) significantly influence financial market dynamics. These factors increase risk perceptions and contribute to higher interest rate spreads, underscoring the need for ERP estimates that reflect the specific economic and regulatory conditions in Kenya.

(Kithinji & Ngugi, 2010) further explore the relationship between credit risk management and bank profitability in Kenya, revealing that non-performing loans and loan loss provisions are critical determinants of profitability. This highlights the elevated risk environment in the Kenyan banking sector, which can impact ERP by influencing investor expectations of risk and return. The unique financial challenges and institutional factors present in the Kenyan market, such as weak legal protections and inconsistent regulatory frameworks, necessitate a localized approach to ERP estimation. Such an approach would better account for the distinct financial risks inherent in the Kenyan context, leading to more accurate and relevant ERP estimates.

1.2 Problem Statement

Estimating the Equity Risk Premium (ERP) in frontier markets like Kenya remains a contentious issue due to unique risks such as political instability, economic volatility, and liquidity constraints. Traditional models, such as the Capital Asset Pricing Model (CAPM) have been widely used but are often criticized for their inability to accurately reflect the dynamic and volatile nature of these markets. These methods struggle with market inefficiencies, volatility clustering, and the absence of robust historical data, leading to inconsistent and less reliable ERP estimates. For instance, ERP estimation is particularly challenging due to the time-varying nature of risk factors, the influence of market volatility, and the scarcity of reliable historical data (Othieno, F, & Biekpe, 2018). The researchers concluded that traditional models also fail to adequately capture the forward-looking nature of ERP, especially in volatile markets like those in Africa. To address these gaps, advanced time-series models like ARIMA, which can be used to forecast ERP, and GARCH, which captures volatility, offer a robust approach to estimate and back-test the ERP.

Additionally, emerging markets, including Kenya, present unique challenges for ERP estimation due to their heightened economic volatility, political instability, and liquidity constraints. Traditional models assume market efficiency and stationarity, which rarely hold true in these environments. Moreover, existing studies such as (William, Coffie, & Chukwulobelu, 2013) on ERP estimation in Kenya have primarily focused on static models or outdated methodologies, failing to capture the evolving dynamics of the Nairobi Securities Exchange (NSE). These limitations create a gap in the literature and practical applications, as they inadequately reflect the risks and returns associated with the Kenyan market.

This study addresses this gap by employing advanced econometric techniques, specifically ARIMA and GARCH models, to back-test and forecast ERP directly. The ARIMA model captures time-dependent trends and patterns in ERP, while the GARCH model accounts for volatility and time-varying risk. By applying these models, this research aims to provide a more accurate and robust approach to ERP estimation, tailored to the unique characteristics of emerging markets. Bridging this gap is essential for improving investment strategies, enhancing financial stability, and contributing to the broader understanding of ERP dynamics in frontier markets like Kenya.

1.3 Research Objectives

1. Estimation and analysis of ERP in the Kenyan stock market using historical data.
2. Applying the ARIMA and GARCH model in modeling and forecasting the ERP.

1.4 Research Questions

The research questions that should be answered to achieve that stated research objectives.

1. What is the ERP estimates each month?
2. How adequate does the ARIMA model and the GARCH model be used to explain ERP?
3. What is the forecasted ERP over a one-year period using the ARIMA model and the GARCH model?

1.5 Significance of the Research

This study is important to investors who want to invest in the Kenyan Stock market because it will provide a clear understanding on the expected equity returns in the future and aid in making investment decisions such as asset allocation. ERP helps investors gauge the level of risk they are taking on and whether the potential returns justify that risk. Understanding the ERP allows portfolio managers to define return expectations and decide the best asset allocation. A higher ERP may result in a larger stock allocation, whilst a lower ERP may indicate a more conservative approach. Additionally, changes in the ERP can indicate economic developments. For instance, a rising ERP may signal increased market risk or investor uncertainty, whereas a dropping ERP may signify improved economic stability.

Given the unique characteristics of the NSE, including its volatility, liquidity constraints, and the broader economic environment, this study offers a tailored approach to ERP estimation that better aligns with the local market conditions. This, in turn, will help investors in developing more effective risk management strategies and optimizing their portfolios to maximize returns while mitigating potential risks.

For academic researchers, it will contribute to the existing body of knowledge on ERP in emerging markets. By providing an updated and localized estimate of the ERP, this study advances the theoretical understanding of risk premiums in frontier markets, contributing new knowledge that reflects the current economic realities of Kenya.

In addition to its academic and practical contributions, the study also holds substantial significance for policymakers and regulatory bodies. It can guide the formulation of policies aimed at enhancing market efficiency, transparency, and investor confidence by highlighting the specific risks and opportunities associated with investing in the NSE. Moreover, the research outcomes may provide insights into the broader economic policies that impact the financial market, helping to create a more conducive environment for both domestic and international investors.

Chapter 2: Literature Review

2.1 Introduction

The Equity Risk Premium (ERP) is a fundamental concept in finance, representing the excess return, above risk-free rate, an investor expects from investing in stocks. Equity is a risky investment hence investors require compensation for taking on more risk by investing in stocks rather than in risk-free government bonds. The uncertainty in the return of equity, and the volatility of the stock market contributes to the riskiness of equities. Given its importance in asset pricing, portfolio management, and investment decision-making, understanding the ERP in the context of the Nairobi Securities Exchange (NSE) is crucial.

There is only one stock market in Kenya, the Nairobi Securities Exchange(NSE). According to (Nyasha, 2014), the NSE is one of the most developed stocks markets in Eastern and Central Africa, established in 1954, with 66 listed companies as of 2021. Over the years, the stock market has made significant developments such as the formation of a regulatory body, Capital Markets Authorities (CMA) in 1989. Despite these developments, the NSE faces several challenges such as inflation, depreciation of the Kenyan Shilling and market volatility. These factors significantly impact the stability of the stock market and hence, the estimation of the ERP.

The estimation of ERP has been widely studied across different markets, developed and emerging, using a range of methodologies. Intuitively, ERP is calculated as the difference between the expected return on the market portfolio and the risk-free rate, often estimated using historical stock and bond returns. However, practical estimation involves several considerations, including the time horizon, market conditions, and availability of historical data.

This literature review aims to explore the historical estimation of the ERP in the different stock markets, examining various theoretical frameworks and empirical studies to provide a comprehensive understanding of the factors influencing ERP and its estimation methodologies.

2.2 Theoretical Framework

2.2.1 Risk and Return Trade-off

The most fundamental concept underlying ERP is the risk-return trade-off. The basic principle is the with higher risks, investors demand higher return. Different investors have different risk appetites: some are risk seekers/lovers, others are neutral, and others risk averse. Equities are inherently riskier than risk-free assets like government bonds, and therefore, the excess return (ERP) compensates investors for this additional risk.

In Modern Portfolio Theory is a practical method used by most investors where they select investments to maximize their overall return for a given level of risk. It highlights the importance of diversification which is investing in a variety of assets to reduce the overall risk of the portfolio. The choice in the different assets to invest in depends on the risk associated with it, the volatility in returns. (Markowitz, 1952) argued that for an investor to achieve high returns they need to accept high risk, this is demonstrated by the efficient frontier. It is a graphical representation of a set of optimal portfolios that offer the highest expected return for a given level of risk, or the lowest risk for a given level of expected return.

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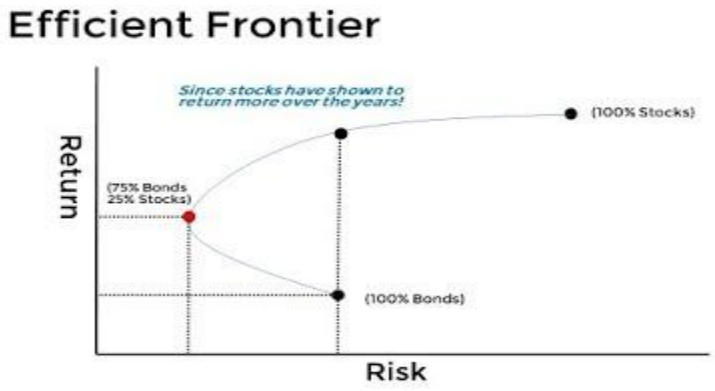


[redacted]

While MPT provides a foundation for understanding the risk-return trade-off, it assumes that investors are rational and markets are efficient. These assumptions often do not hold true, particularly in emerging markets like Kenya. This is because there is information asymmetry

caused by gaps in information provided. Additionally, the Nairobi Securities Exchange (NSE) is less liquid compared to developed markets. Lower liquidity means that it is harder to buy or sell assets without causing significant price changes, which can lead to price inefficiencies. It is dominated by a few large players, including institutional investors, which can also distort prices and lead to inefficiencies.

2.2.2 Capital Asset Pricing Model (CAPM)

It describes the relationship between systematic risk and expected return for assets, particularly stocks. The model posits that the expected return on an investment is proportional to its beta (the measure of its risk relative to the market). The model is a combination of three theories:

According to (Sharpe, 1964), the expected return should compensate investors for the time value of money and the systematic risk of the asset relative to the market. Systematic risk is defined by Sharpe as the risk that cannot be eliminated through diversification by holding a diversified portfolio. The risk is measured by Beta (β). which is the sensitivity of an asset's return to the return of the overall market.

(Lintner, 1965) extended the work of Markowitz and Sharpe by suggesting that the expected return on an asset is linearly related to its risk, as measured by Beta (β). This builds on the idea that investors require compensation for taking on additional risk. Lintner added a risk-free rate to the model, establishing that investors can borrow or lend at a risk-free rate, which influences their investment decisions and the capital market line (CML). CML represents the risk-return tradeoff in a market where investors can lend and borrow at the risk-free rate. It shows the optimal portfolios that best combines risk and return.

(Mossin, 1966) considered the behavior of all investors in the market and their impact on asset prices. This helped in understanding how equilibrium prices of assets are determined in the market. The paper emphasizes the assumption of the homogeneous expectation of investors, where all investors have the same beliefs on the expected return, variance and covariance of assets.

Sharpe, Lintner and Mossin all made significate contributions to the Capital Asset Pricing Model(CAPM) formula:

$$E(R_i) = R_f + \beta_i\left(E[R_m] - R_f\right)$$

$$where: E(R_i)\ is\ the\ expected\ return\ of\ asset\ i$$

$$R_f\ is\ the\ risk-free\ rate$$

$$\beta_i\ is\ the\ Beta\ for\ asset\ i$$

$$E[R_m]\ is\ the\ expected\ return\ of\ the\ market\ portfolio$$

The CAPM is instrumental in understanding the relationship between risk and return, yet it simplifies the complexities of financial markets since it only accounts for the market factor. The Fama and French Three-Factor Model enhances CAPM by incorporating size and value factors, providing a more comprehensive risk assessment framework

2.2.3 Fama and French Three-factor Model

(French, Fama, & R., 1992) came up with a better model that extended the knowledge of CAPM by adding two more factors. The three factors are:

Market Risk factor which is represented by the Beta (β). It is similar to that one in CAPM

Size factor (SMB – Small Minus Big), this component measures the difference in return between large- and small-cap stocks. The size effect describes how small-cap stocks typically perform better than large-cap stocks. Market capitalization is the most recent market value of a company's outstanding shares.

Value Factor (HML- High Minus Low), this factor represents the difference in return between high book-to-market stocks(value) and low book-to-market stocks(growth). The value effect refers to the tendency for value stocks to perform better than growth stocks.

The highlighted three factors are significant determiners of stock return as proven by this paper. The equation for this model is:

$$R_i - R_f = \alpha_i + \beta_{iM}(R_M - R_f) + \beta_{iSMB}SMB + \beta_{iHML}HML$$

$$Where: R_i\ is\ the\ return\ on\ assset\ i$$

$$R_f\ is\ the\ risk-free\ rate$$

$$\alpha_i\ \ is\ the\ intercept$$

$$\beta_{iM} \; is \; the \; sensitvity \; of \; asset \; i \; to \; the \; market \; factor$$

$$\beta_{iSMB} \; is \; the \; sensitivity \; of \; asset \; i \; to \; the \; size \; factor$$

$$\beta_{iHML} \; is \; the \; sensitivity \; of \; asset \; i \; to \; the \; value \; factor$$

Recent studies suggest that even the Three-Factor Model may not fully capture all dimensions of risk, leading to the development of multi-factor models that include momentum, profitability, and investment factors.

2.2.4 AutoRegressive Moving Average Model (ARIMA)

It is employed in the analysis of time series data. The model is a popular and powerful statistical method used for time series forecasting. It combines three key components: Autoregression (AR), Integration (I), and Moving Average (MA), to model and predict future values based on past data. The ARIMA model (p, d, q) is typically specified with three parameters:

p: The number of lag observations included in the model (AR component).

d: The number of times that the raw observations are differenced to make the series stationary (Integration component).

q: The size of the moving average window (MA component).

The ARIMA model is particularly suited for financial data, such as forecasting the Equity Risk Premium (ERP), as it accounts for both the historical values and the noise in the data. Its flexibility in modeling different types of time series data makes it a valuable tool in financial forecasting, where past patterns can be used to predict future trends.

2.3 Empirical Literature

There are several studies that have been done on Equity Risk Premium(ERP) to further understand it by employing different methodologies and datasets. (Damodaran, 2015) groundbreaking study offers a thorough analysis of the factors that influence ERP and its estimation techniques. Damodaran highlights that the economic factors that influence ERP are: investor risk aversion, information uncertainty, macroeconomic variables and market conditions. The author emphasizes the importance of using historical returns to estimate ERP, which is the difference between annual

stock returns and bonds over a long period of time. The shortcomings of this approach, especially in emerging markets, is the unavailability of historical data and its volatility. The paper employs two approaches: implied approach, where current equity prices or risk premium are used to estimate the forward-looking estimate of the premium in a non-equity market, and the survey approach, where investors are asked their view on ERP.

(Harris & Marston, 2001) estimated ERP using historical data and noted the variability and sensitivity of the premium estimated based on the method used and the period considered. In conventional approaches, the ERP is usually estimated using long-term historical averages of stock returns less bond returns. Nevertheless, the authors point out that the historical era chosen may have an impact on these estimations. Harris and Marston noted several biases that can affect historical ERP estimates, including survivorship bias, where only successful companies are included in the data, and the changing risk environment over time. They concluded that accounting for only one risk, like the Beta for CAPM), does not fully capture changes in investor return requirements.

The ERP of each country tends to be different since the market conditions are different and the macroeconomic variables, over different time periods, supported by the study done by (Dimson, Marsh, & Staunton, 2005). The researchers estimated ERP using historical data dated up to 103 years back and of 16 countries. They observed that historical data might not be a reliable indicator of the future ERP, since market volatility may be lower and new technological advancements presenting investors increasing diversification opportunities. Although historical data is not an accurate indicator of future stock return, it serves as a foundational starting point for understanding the relationship between risk and return in equity markets. It can be used to identify trends, patterns and cycles that may influence investment decisions and may be used to forecast future expectations.

The difference between developed markets and emerging markets play a role in the estimation of ERP. Emerging markets exhibits a higher ERP as compared to developed markets due to the riskiness of their market, supported by (Salomons, 2003). This necessitates the need to use a more efficient and objective approach in estimating the ERP of frontier countries. (Othieno, F, & Biekpe, 2018) explores ERP estimation in African frontier markets, using a conditional approach that adjusts for time-varying risk factors such as market volatility, liquidity constrains and political

instability. The findings suggest that traditional methods may underestimate ERP in these markets due to their failure to account for these conditions. This study is highly relevant as it supports the use of dynamic models like ARIMA to better estimate ERP in the NSE.

Most researchers have used a traditional method, which is the CAPM formula, however, this model has been criticized by many. Critics argue that it oversimplifies the multifaceted nature of risk in financial markets, ignoring other important factors that influence asset prices. Fama and French(1992) came up with the Three-Factor Model which solves this problem by introducing two additional factors to the model; the size factor(SML) and the value factor(HML). The study done by (Achola & Muriu, 2016) tested whether the three-factor model holds on NSE where they noted that the three factor model's predictions hold true for the NSE, particularly after thin trading is considered, but the premium is not statistically significant.

In emerging markets like Kenya, the estimation of the cost of equity capital is particularly challenging due to unique market characteristics such as higher volatility, political instability, and liquidity constraints. The study done by (William, Coffie, & Chukwulobelu, 2013) provides crucial insights into these challenges by examining the specific factors that influence the cost of equity in the Kenyan market. The research highlights the inadequacy of traditional models such as CAPM in capturing the true risk premium in such markets, which are often characterized by higher levels of economic and political risk compared to developed markets.

Although many studies have estimated the ERP in advanced economies, there is a lack of extensive research regarding ERP estimation in emerging markets like Kenya. The Kenyan stock market presents a unique case for studying ERP due to its status as a developing market with distinctive economic and regulatory challenges. In emerging markets, the estimation of ERP is complicated by factors such as political instability, market liquidity issues, and limited historical data. Additionally, forward-looking ERP estimates are rarely determined leaving a gap in the literature on predictive analysis in the context of the Nairobi Securities Exchange (NSE).

The studies reviewed highlight the complexity of ERP estimation, with many factors influencing its calculation, including market inefficiencies, economic volatility, and the availability of reliable data. It is evident that traditional models, such as the CAPM, often fall short in fully capturing the unique risks present in markets like the Nairobi Securities Exchange (NSE). This review has also underscored the importance of localized ERP estimates, as the financial dynamics of the Kenyan

market differ significantly from those of more developed economies. The literature further points to the need for advanced modeling techniques, such as ARIMA, to provide forward-looking estimates that can better account for the evolving nature of these markets. Overall, the empirical evidence supports the notion that a nuanced and context-specific approach is essential for accurate ERP estimation in the Kenyan market, thereby guiding the methodological choices and analytical techniques for this study.

Chapter 3: Methodology

3.1 Introduction

This section outlines the research design, population and sampling, data collection, and data analysis techniques used to achieve the research objectives. It uses a quantitative approach, combining historical analysis with predictive modeling. The approach is crafted to offer a strong structure for examining past data and comprehending the elements that affect ERP within the Kenyan stock market. Given the importance of ERP in financial decision-making, it is crucial to adopt robust methods that integrate both historical data and forward-looking models.

3.2 Research Design

The study adopts a quantitative research design, which is appropriate for analyzing numerical data and deriving patterns that can be generalized across similar contexts. This design is justified as the research aims to quantify the ERP in the Kenyan market using historical financial data and stochastic forecasting models. The quantitative approach facilitates the comparison of ERP estimates derived from historical and forward-looking methods, providing a comprehensive view of market expectations.

Specifically, the study employs a descriptive and predictive research designs that incorporates the ARIMA model which is used to model and forecast ERP by identifying patterns in its historical data, such as trends, seasonality, or autoregressive relationships. The focus is on leveraging past ERP values to predict future values, enabling back-testing and performance evaluation. The historical analysis allows for an understanding of the ERP's evolution over time within the NSE 20 Index share. The paper employs the use of GARCH model which captures the volatility dynamics of ERP, addressing its tendency for volatility clustering, periods of high fluctuations followed by calmer periods. This is particularly important for ERP, as market risks can vary significantly over time. The choice of these methods is justified by their widespread use in financial research and their ability to account for the time-varying nature of financial markets, as supported by (Othieno, F, & Biekpe, 2018).

3.3 Population and Sampling

The population of interest includes all companies listed on the NSE over the period between 2009 – 2019.

Given the study's focus on ERP estimation, the sample will consist of firms that have been list as part of the NSE 20 Index share from 2009 to 2019 . This period is selected to ensure sufficient data availability for both historical analysis and ARIMA modeling. The NSE 20 Share Index is a key benchmark that tracks the performance of the top 20 companies on the NSE, representing a significant portion of the market capitalization and providing a broad overview of market performance. This focus on the NSE 20 Share Index ensures that the study captures the most liquid and actively traded stocks, which are crucial for an accurate estimation of the ERP.

This non-probability sampling method is justified because it allows the researcher to focus on companies that are most relevant to the study's objectives, particularly those with long-term, consistent data on stock prices, dividend payouts, and other financial metrics. By concentrating on the NSE 20 Share Index, the sample is representative of the most significant and influential companies in the Kenyan stock market.

3.3 Data Sources

This study will use secondary data sourced from reliable financial databases, and market data providers. The types of data collected will include:

1. Market Indices: Historical data on the NSE 20 Share Index, which will provide a benchmark for market performance. This can be gotten from a data vendor known as Refinitiv Eikon.
2. 90-day Treasury bills: the yields of the 90-days treasury bills can be gotten from the Central Bank of Kenya.

The dataset will cover a period of 10–15 years to ensure a robust analysis and accurate back-testing of ERP estimates.

3.5 Analysis Technique

The data analysis will involve two primary phases:

Back-Testing and Forecasting ERP:

The historical ERP will be calculated by comparing the historical returns of the NSE 20 Share Index with the risk-free rate, typically proxied by the yield on 90-day treasury bills. The data on

the index performance is daily, every working day, as well as the yield of the T-Bills. Daily return on the NSE 20 index will be calculated as:

$$R_d = \frac{P_t - P_{t-1}}{P_{t-1}}$$

Where: R_d is the daily market return

P_t is the price at time t

P_{t-1} is the price at time t-1

The daily return will be averaged into monthly return using a geometric mean then this will be compared to the geometric mean of T-Bill yields.

$$ERP_M = R_m - R_f$$

Where: ERP_M is the monthly Equity Risk Premium, R_m is the monthly market return, and R_f is the monthly risk-free rates.

Monthly data is more efficient since investors do not actively trade every day, they might be trading monthly in the case of active portfolio management.

To fit the ARIMA model, the ERP data must be stationary, thus stationarity check is the first step. Stationarity check ensures that the mean and the variance does not change over time. If the ERP is non-stationary, differencing will be applied appropriately. The next step is identifying the model parameters to use, Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) plots will guide the selection of ARIMA(p,d,q) parameters. After the parameters are stated, the historical ERP data will be fitted to the ARIMA model and the model's fit will be validated by analyzing residuals to ensure they behave as white noise. The ARIMA model will forecast ERP for a specified horizon. These forecasts will be back-tested against actual historical ERP values to assess accuracy.

Residual Analysis from ARIMA:

After fitting the ARIMA model, the volatility is going to be explained. These residuals are analyzed for volatility clustering, which is common in financial data like ERP. The GARCH(1,1) model will be used:

- ARCH term (α1) captures the impact of past shocks (squared residuals).
- GARCH term (β1) captures the persistence of past volatility.

The conditional variance is modeled as:

$$\sigma^2{}_t = \omega + \alpha_1 \varepsilon^2{}_{t-1} + \beta_1 \sigma^2{}_{t-1}$$

where $\sigma^2{}_t$ is the forecasted variance (volatility) at time t, $\varepsilon^2{}_{t-1}$ is the previous period's squared residual, and $\sigma^2{}_{t-1}$ is the previous period's variance.

The GARCH model will forecast the conditional variance (volatility) of ERP for the same test period as ARIMA. This provides insights into the risk dynamics of ERP over time.

3.6 Conclusion

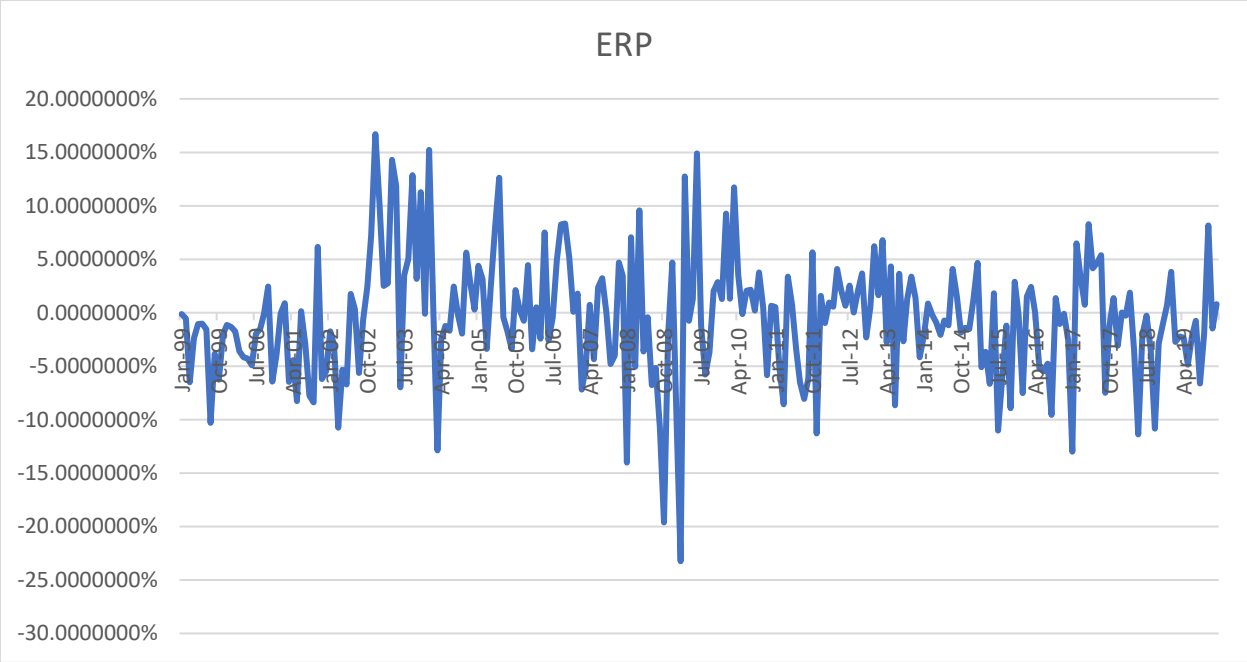
This research employs a methodical approach to estimating the Equity Risk Premium (ERP) for the Kenyan market, specifically focusing on the NSE 20 Share Index. The chosen methodology integrates both historical data analysis and forward-looking approaches, ensuring a comprehensive understanding of ERP in the Kenyan context. By employing a quantitative research design, this study aligns with established academic standards, facilitating a robust examination of ERP trends over time.

The historical analysis, using past market data, provides a baseline ERP estimate that reflects the performance of the NSE 20 Share Index over period of time, it shows the extent of stocks outperformed bonds over the investigation period. Meanwhile, the ARIMA model introduces a forward-looking perspective, allowing for the projection of future ERP values based on observed trends and patterns. The GARCH model is used to explain the risk aspect of the ERP.

The sampling technique, focused on the NSE 20 Share Index, ensures that the study's findings are representative of the most actively traded and influential companies on the Nairobi Securities Exchange. This enhances the relevance of the study's results for policymakers, investors, and other stakeholders interested in understanding the risk-return dynamics of the Kenyan market.

Chapter 4: Findings

This chapter presents the results of the study, focusing on the back-testing and forecasting of the Equity Risk Premium (ERP) on the Nairobi Securities Exchange (NSE). The findings address the key research objectives, including the estimation of ERP using daily data, the forecasting of returns with the ARIMA model, and the assessment of volatility using the GARCH model.



The key finding is that the historical ERP was characterized by high volatility, with approximately 55% of the values being negative. This anomaly is due to the fact that the risk-free rates exceeds the stock returns during most of the observed period. The pattern is unusual in an efficient and booming stock markets, where equity returns typically surpass risk-free rates to compensate investors for the additional risk associated with equities.

The average monthly ERP was -0.56%, reflecting a challenging investment environment in the Kenyan market over the analyzed period. This persistent negative ERP indicates that investors are not adequately compensated for the risks they assume when investing in equities. Instead, they would achieve higher returns by opting for risk-free investments like government bonds, which offer assured and comparatively better returns. This scenario discourages equity investments and may lead to reduced market participation and liquidity in the NSE.

The implication of the risk-free rate exceeding the stock return can be due to poor performance of the listed companies in the NSE or investors lacking confidence in the Kenyan stock market. Additionally, high inflation rates, political instability, and macroeconomic challenges contribute to increase in risk-free rates, making bonds more attractive to investors. This anomaly emphasizes the importance of robust modeling strategies that account for these distinct market dynamics. The high volatility and unpredictability of ERP render traditional trend-based models such as ARIMA ineffective for accurate ERP forecasting.

The high volatility and predominantly negative values of ERP made it impossible to identify clear patterns and trends for effective modeling using the ARIMA approach.

The study opted to fit a volatility model (GARCH) better suited for capturing the volatility of the difference between the stock returns and the risk-free rate over the observation period.

The GARCH(1,1) model effectively captured the dynamic nature of ERP volatility, with a high beta coefficient of 0.728 confirmed that volatility from market shocks persisted over time, reflecting the long-lasting effects of economic uncertainty and market inefficiencies. A log-likelihood of 380.5159 which indicates the goodness of fit of the model; a higher value generally suggests a better fit. Additionally, the GARCH model successfully forecasted conditional volatility over a 12-month horizon. The forecast showed gradual increasing volatility, signaling rising market uncertainty, highlighting the need for effective risk management strategies in long-term financial planning. There is a constant mean forecast reflecting the assumption of no significant shocks in the forecast horizon.

In conclusion, the findings demonstrate that while the ARIMA model is inadequate for modeling ERP due to its high volatility and negative trends, the GARCH model effectively captures the volatility dynamics. The consistent outperformance of risk-free rates over stock returns in the NSE reflects considerable market inefficiencies, emphasizing the significance of implementing robust models and policy measures to enhance the Kenyan stock market's attractiveness and functionality.

Chapter 5: Conclusion

This research explored the estimation of Equity Risk Premium (ERP) in the Kenyan stock market using ARIMA and GARCH models. The analysis revealed that the historical ERP in the NSE was characterized by high volatility, with risk-free rates frequently exceeding stock returns. This anomaly, indicative of market inefficiencies, discouraged equity investments as investors were not adequately compensated for taking on additional risk. The study found that:

The ARIMA model was unable to effectively model ERP due to its high volatility and lack of identifiable trends. This limitation underscored the need for a more robust model capable of addressing time-varying volatility.

The GARCH(1,1) model successfully captured the volatility of the ERP, confirming persistent market shocks and the lasting impact of risk on ERP. Forecasts revealed rising conditional volatility over a 12-month horizon, emphasizing increasing market uncertainty.

Despite the constant mean forecast ($\mu = -0.009$), the gradually increasing standard deviations (σ) highlighted the growing unpredictability of ERP. Residual diagnostics confirmed the adequacy of the GARCH model, strengthening its reliability for volatility forecasting.

The results align with studies indicating that financial markets exhibit volatility clustering. Persistent shocks are a hallmark of equity markets in emerging markets, supporting the relevance of GARCH models for capturing such dynamics.

This study demonstrates the inadequacy of ARIMA models in high-volatility environments like the NSE and highlights the suitability of GARCH models for volatility modeling and forecasting. By applying GARCH directly to ERP, the research provides a nuanced understanding of the risk-return dynamics specific to frontier markets.

Investors and portfolio managers can leverage the insights from this study to explore sophisticated tools to manage risks and predict returns in volatile markets like Kenya's NSE. They should consider the market inefficiencies while making investment decisions. Moreover, the study offers critical insights into the Kenyan stock market inefficiencies, including the frequent dominance of risk-free rates over stock returns. Policymakers can leverage these findings to implement regulatory reforms and policies that enhance equity market performance and investor confidence.

However, there are several limitations that were experienced such as;

1. The use of historical data may not fully capture some of the rare events that may affect the ERP.
2. Both ARIMA and GARCH models rely on specific assumptions, such as stationarity and normality of residuals. Any violations of these assumptions may influence the results.
3. The models did not incorporate external macroeconomic variables, such as interest rates or inflation, which may overlook critical influences on ERP.

Recommendations

1. Perform ERP analysis using the survey methodology since the practical ERP was decreasing over the observation period. A survey may be conducted on investors, such as fund managers and banks, on what they would expect their premium should be for them to invest in the stock market. A comparison should be done between the practical ERP (historical data estimates) and the survey ERP (based on investors' expectations), so as to provide insights into market sentiment and identify discrepancies between observed and expected returns. An analysis of this discrepancy should be investigated.
2. Use hybrid models for instance combining GARCH with machine learning techniques, such as Long Short-Term Memory (LSTM) networks, could be explored for better understanding of ERP.

This study demonstrates that the Equity Risk Premium in the Kenyan stock market is characterized by persistent volatility and market inefficiencies, underscoring the need for tailored econometric approaches. The findings validate the effectiveness of GARCH models in capturing volatility and rising uncertainty, providing valuable insights for investors, policymakers, and researchers. By addressing gaps in existing literature, this research paves the way for improved investment strategies and policy frameworks in emerging markets like Kenya

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APPENDIX : ERP Working

Date	Stock Monthly Returns	Rf monthly rate	ERP
Jan-99	0.7231454%	0.850940%	-0.1277943%
Feb-99	0.1809967%	0.716881%	-0.5358847%
Mar-99	-5.8078611%	0.708774%	-6.5166347%
Apr-99	-1.6836631%	0.722907%	-2.4065706%
May-99	-0.2832483%	0.768825%	-1.0520737%
Jun-99	-0.1311570%	0.906890%	-1.0380474%
Jul-99	-0.4309923%	1.132682%	-1.5636748%
Aug-99	-9.1472190%	1.162378%	-10.3095971%
Sep-99	-2.6232204%	1.228316%	-3.8515368%
Oct-99	-4.8910872%	1.362133%	-6.2532197%
Nov-99	-0.6586326%	1.398533%	-2.0571655%
Dec-99	0.3949227%	1.529149%	-1.1342263%
Jan-00	0.2331559%	1.551723%	-1.3185675%
Feb-00	-0.5891144%	1.160048%	-1.7491622%
Mar-00	-2.6915619%	0.894507%	-3.5860692%
Apr-00	-3.1784272%	0.982037%	-4.1604642%
May-00	-3.4007030%	0.890271%	-4.2909743%
Jun-00	-4.0968655%	0.833538%	-4.9304037%
Jul-00	-1.1646947%	0.790111%	-1.9548057%
Aug-00	-0.8076696%	0.739598%	-1.5472676%
Sep-00	0.7261506%	0.824882%	-0.0987315%
Oct-00	3.3078199%	0.847189%	2.4606312%
Nov-00	-5.5689587%	0.886117%	-6.4550753%
Dec-00	-2.9492089%	1.016306%	-3.9655148%
Jan-01	1.0919712%	1.153557%	-0.0615854%
Feb-01	2.0937984%	1.193258%	0.9005403%
Mar-01	-5.2937372%	1.169420%	-6.4631576%
Apr-01	-3.4219598%	1.016172%	-4.4381314%

May-01	-7.4337204%	0.836789%	-8.2705097%
Jun-01	1.0858739%	0.954098%	0.1317759%
Jul-01	-1.8975481%	1.014233%	-2.9117809%
Aug-01	-6.7621777%	1.011663%	-7.7738409%
Sep-01	-7.4178348%	0.978369%	-8.3962040%
Oct-01	7.0805999%	0.920941%	6.1596592%
Nov-01	-5.3071210%	0.911058%	-6.2181793%
Dec-01	-4.6041747%	0.874398%	-5.4785731%
Jan-02	-0.8863142%	0.862453%	-1.7487670%
Feb-02	-2.1808732%	0.843953%	-3.0248259%
Mar-02	-9.9448145%	0.808404%	-10.7532180%
Apr-02	-4.5448398%	0.798178%	-5.3430175%
May-02	-5.9823081%	0.723793%	-6.7061008%
Jun-02	2.3404315%	0.591849%	1.7485824%
Jul-02	1.0224365%	0.692475%	0.3299619%
Aug-02	-4.9511264%	0.669730%	-5.6208561%
Sep-02	0.0019168%	0.612350%	-0.6104329%
Oct-02	3.0918152%	0.648469%	2.4433465%
Nov-02	7.9448896%	0.666554%	7.2783354%
Dec-02	17.3737426%	0.672679%	16.7010632%
Jan-03	10.8434531%	0.673175%	10.1702783%
Feb-03	3.1185664%	0.625816%	2.4927502%
Mar-03	3.2482956%	0.505648%	2.7426477%
Apr-03	14.8158971%	0.506779%	14.3091180%
May-03	12.3489817%	0.474364%	11.8746181%
Jun-03	-6.7340830%	0.246481%	-6.9805640%
Jul-03	3.6238475%	0.127190%	3.4966577%
Aug-03	5.1045345%	0.097867%	5.0066672%
Sep-03	12.9294923%	0.068872%	12.8606205%
Oct-03	3.2480220%	0.083408%	3.1646140%
Nov-03	11.3856773%	0.106046%	11.2796313%

Dec-03	0.0222873%	0.120712%	-0.0984247%
Jan-04	15.3525546%	0.130723%	15.2218319%
Feb-04	0.5535359%	0.130004%	0.4235320%
Mar-04	-12.7469011%	0.131676%	-12.8785767%
Apr-04	-2.2738757%	0.174155%	-2.4480311%
May-04	-0.9916531%	0.236093%	-1.2277465%
Jun-04	-1.5294227%	0.166365%	-1.6957878%
Jul-04	2.5866086%	0.141108%	2.4455005%
Aug-04	0.0306496%	0.186998%	-0.1563485%
Sep-04	-1.7229007%	0.226206%	-1.9491068%
Oct-04	5.9520199%	0.323354%	5.6286663%
Nov-04	3.1343099%	0.412304%	2.7220060%
Dec-04	0.9334073%	0.646768%	0.2866398%
Jan-05	5.0516367%	0.663494%	4.3881426%
Feb-05	3.8272610%	0.688874%	3.1383866%
Mar-05	-2.6998173%	0.692197%	-3.3920139%
Apr-05	3.2475280%	0.696097%	2.5514315%
May-05	8.6070412%	0.694498%	7.9125430%
Jun-05	13.3154941%	0.682304%	12.6331901%
Jul-05	0.2479765%	0.688874%	-0.4408979%
Aug-05	-1.0873933%	0.694158%	-1.7815516%
Sep-05	-2.6914972%	0.688121%	-3.3796182%
Oct-05	2.7855110%	0.658006%	2.1275046%
Nov-05	0.8800721%	0.631222%	0.2488499%
Dec-05	-0.1187684%	0.648818%	-0.7675864%
Jan-06	5.0990074%	0.661495%	4.4375127%
Feb-06	-2.7606788%	0.645325%	-3.4060037%
Mar-06	1.1095417%	0.612599%	0.4969426%
Apr-06	-1.8634010%	0.566648%	-2.4300490%
May-06	8.0626849%	0.566542%	7.4961426%
Jun-06	-2.0520720%	0.533737%	-2.5858092%

Jul-06	-0.0457694%	0.478425%	-0.5241941%
Aug-06	5.3429110%	0.483219%	4.8596918%
Sep-06	8.7780619%	0.522472%	8.2555902%
Oct-06	8.9039440%	0.551808%	8.3521362%
Nov-06	5.6608886%	0.519343%	5.1415454%
Dec-06	0.5422781%	0.465202%	0.0770757%
Jan-07	2.2782142%	0.486723%	1.7914907%
Feb-07	-6.7019727%	0.504394%	-7.2063670%
Mar-07	-4.7075704%	0.511645%	-5.2192157%
Apr-07	1.2811497%	0.537631%	0.7435190%
May-07	-3.8017556%	0.547677%	-4.3494326%
Jun-07	2.8981740%	0.528195%	2.3699794%
Jul-07	3.7567543%	0.528057%	3.2286972%
Aug-07	0.5925005%	0.588490%	0.0040101%
Sep-07	-4.1934427%	0.592513%	-4.7859556%
Oct-07	-3.4085566%	0.608422%	-4.0169782%
Nov-07	5.3007017%	0.605993%	4.6947086%
Dec-07	4.0173540%	0.555051%	3.4623034%
Jan-08	-13.4461498%	0.561517%	-14.0076670%
Feb-08	7.6325511%	0.587279%	7.0452718%
Mar-08	-4.5193508%	0.556936%	-5.0762869%
Apr-08	10.1763927%	0.592474%	9.5839189%
May-08	-3.0022320%	0.624941%	-3.6271729%
Jun-08	0.1879892%	0.622116%	-0.4341266%
Jul-08	-6.1187220%	0.645810%	-6.7645320%
Aug-08	-4.5085831%	0.644723%	-5.1533062%
Sep-08	-10.0753316%	0.619656%	-10.6949874%
Oct-08	-18.9874175%	0.624085%	-19.6115024%
Nov-08	-1.3340617%	0.673910%	-2.0079718%
Dec-08	5.3781719%	0.688952%	4.6892201%
Jan-09	-9.1526136%	0.679384%	-9.8319980%

Feb-09	-22.6374691%	0.608274%	-23.2457427%
Mar-09	13.3459945%	0.589506%	12.7564886%
Apr-09	-0.1757557%	0.591771%	-0.7675267%
May-09	1.8738616%	0.600494%	1.2733675%
Jun-09	15.4944489%	0.591349%	14.9030996%
Jul-09	-0.6513768%	0.582707%	-1.2340841%
Aug-09	-5.2066848%	0.584896%	-5.7915807%
Sep-09	-3.1350317%	0.587904%	-3.7229361%
Oct-09	2.6026399%	0.585443%	2.0171969%
Nov-09	3.4349127%	0.582238%	2.8526745%
Dec-09	1.8149896%	0.551580%	1.2634093%
Jan-10	9.7874018%	0.530652%	9.2567499%
Feb-10	1.7987367%	0.503527%	1.2952098%
Mar-10	12.2201680%	0.484938%	11.7352301%
Apr-10	3.9359871%	0.420671%	3.5153162%
May-10	0.2024454%	0.344441%	-0.1419956%
Jun-10	2.2978398%	0.245126%	2.0527134%
Jul-10	2.2883981%	0.132160%	2.1562380%
Aug-10	0.3607009%	0.151318%	0.2093833%
Sep-10	3.9332464%	0.167981%	3.7652654%
Oct-10	0.6427923%	0.175014%	0.4677785%
Nov-10	-5.6741409%	0.182409%	-5.8565497%
Dec-10	0.8516167%	0.187716%	0.6639002%
Jan-11	0.7291432%	0.200687%	0.5284565%
Feb-11	-5.0334608%	0.213008%	-5.2464684%
Mar-11	-8.3277125%	0.227872%	-8.5555848%
Apr-11	3.6572534%	0.269531%	3.3877226%
May-11	1.2128868%	0.435134%	0.7777531%
Jun-11	-2.6968441%	0.717170%	-3.4140143%
Jul-11	-5.7876274%	0.719673%	-6.5073009%
Aug-11	-7.3142417%	0.738211%	-8.0524526%

Sep-11	-5.2224807%	0.943789%	-6.1662698%
Oct-11	6.7989014%	1.156494%	5.6424070%
Nov-11	-10.0326743%	1.254400%	-11.2870745%
Dec-11	1.5706109%	0.000000%	1.5706109%
Jan-12	0.5978122%	1.574602%	-0.9767903%
Feb-12	2.4679143%	1.504384%	0.9635304%
Mar-12	1.9111616%	1.356323%	0.5548385%
Apr-12	5.3393488%	1.239728%	4.0996205%
May-12	2.9376935%	0.871288%	2.0664053%
Jun-12	1.4541819%	0.812260%	0.6419221%
Jul-12	3.4687387%	0.945439%	2.5233001%
Aug-12	0.8699464%	0.844358%	0.0255885%
Sep-12	2.7490067%	0.736530%	2.0124766%
Oct-12	4.4121016%	0.726369%	3.6857326%
Nov-12	-1.5373932%	0.781957%	-2.3193500%
Dec-12	1.2121895%	0.662611%	0.5495788%
Jan-13	6.8613266%	0.650252%	6.2110751%
Feb-13	2.3092424%	0.684778%	1.6244643%
Mar-13	7.5740441%	0.798932%	6.7751125%
Apr-13	-1.9667423%	0.823546%	-2.7902882%
May-13	5.0727877%	0.749223%	4.3235644%
Jun-13	-8.1646348%	0.503014%	-8.6676492%
Jul-13	4.1190389%	0.480212%	3.6388273%
Aug-13	-1.8759034%	0.799705%	-2.6756080%
Sep-13	2.0318237%	0.763544%	1.2682796%
Oct-13	4.1659017%	0.779659%	3.3862426%
Nov-13	2.1630802%	0.791609%	1.3714715%
Dec-13	-3.4094117%	0.759119%	-4.1685311%
Jan-14	-1.4373946%	0.740040%	-2.1774345%
Feb-14	1.5909723%	0.732726%	0.8582462%
Mar-14	0.5381673%	0.717981%	-0.1798135%

Apr-14	-0.2215744%	0.705065%	-0.9266396%
May-14	-1.3621016%	0.706793%	-2.0688942%
Jun-14	0.0712887%	0.791422%	-0.7201332%
Jul-14	-0.4013512%	0.769210%	-1.1705614%
Aug-14	4.7553143%	0.663893%	4.0914217%
Sep-14	2.2615524%	0.672803%	1.5887492%
Oct-14	-1.1555249%	0.694996%	-1.8505212%
Nov-14	-0.7082461%	0.692875%	-1.4011207%
Dec-14	-0.8471141%	0.687754%	-1.5348681%
Jan-15	1.9453708%	0.689437%	1.2559334%
Feb-15	5.3579069%	0.689048%	4.6688585%
Mar-15	-4.4289494%	0.681067%	-5.1100161%
Apr-15	-2.9863800%	0.675806%	-3.6621862%
May-15	-5.9843698%	0.663300%	-6.6476702%
Jun-15	2.4929284%	0.663401%	1.8295273%
Jul-15	-10.2189736%	0.817170%	-11.0361440%
Aug-15	-5.1792168%	0.913082%	-6.0922987%
Sep-15	-0.0735049%	1.143094%	-1.2165992%
Oct-15	-7.3005521%	1.629917%	-8.9304687%
Nov-15	3.8086450%	0.914439%	2.8942059%
Dec-15	0.6117754%	0.782836%	-0.1710611%
Jan-16	-6.6220380%	0.900550%	-7.5225879%
Feb-16	2.3606145%	0.845426%	1.5151881%
Mar-16	3.1031215%	0.699030%	2.4040914%
Apr-16	0.6823050%	0.714531%	-0.0322264%
May-16	-4.5260223%	0.655990%	-5.1820126%
Jun-16	-4.8902764%	0.584974%	-5.4752505%
Jul-16	-4.1734764%	0.597470%	-4.7709467%
Aug-16	-8.8813215%	0.680587%	-9.5619087%
Sep-16	2.0252734%	0.647693%	1.3775809%
Oct-16	-0.4313628%	0.628170%	-1.0595323%

Nov-16	0.5564811%	0.658301%	-0.1018199%
Dec-16	-1.8779314%	0.677624%	-2.5555559%
Jan-17	-12.3011352%	0.691053%	-12.9921885%
Feb-17	7.1668092%	0.692583%	6.4742264%
Mar-17	3.9401843%	0.692042%	3.2481422%
Apr-17	1.4477015%	0.702946%	0.7447551%
May-17	8.9774448%	0.698312%	8.2791325%
Jun-17	4.8278868%	0.673779%	4.1541083%
Jul-17	5.2769754%	0.660735%	4.6162402%
Aug-17	6.0457719%	0.656905%	5.3888665%
Sep-17	-6.8450903%	0.653726%	-7.4988158%
Oct-17	-0.5821733%	0.650312%	-1.2324852%
Nov-17	2.0128056%	0.644354%	1.3684513%
Dec-17	-2.4377807%	0.643947%	-3.0817273%
Jan-18	0.6823925%	0.646773%	0.0356198%
Feb-18	0.3606911%	0.645635%	-0.2849443%
Mar-18	2.5218956%	0.645014%	1.8768814%
Apr-18	-2.8678868%	0.643496%	-3.5113830%
May-18	-10.7548473%	0.640102%	-11.3949493%
Jun-18	-1.4288886%	0.630464%	-2.0593526%
Jul-18	0.3332593%	0.618877%	-0.2856179%
Aug-18	-2.8295133%	0.615345%	-3.4448586%
Sep-18	-10.2356871%	0.615540%	-10.8512271%
Oct-18	-2.2670761%	0.609232%	-2.8763084%
Nov-18	-0.4583108%	0.593274%	-1.0515851%
Dec-18	1.3011897%	0.592255%	0.7089345%
Jan-19	4.3940378%	0.580518%	3.8135196%
Feb-19	-2.1687692%	0.566981%	-2.7357500%
Mar-19	-1.6533066%	0.571346%	-2.2246521%
Apr-19	-1.7394207%	0.595816%	-2.3352362%
May-19	-4.2876961%	0.578935%	-4.8666308%

Jun-19	-1.6287375%	0.557951%	-2.1866888%
Jul-19	-0.2092416%	0.535808%	-0.7450495%
Aug-19	-6.0936674%	0.521232%	-6.6148996%
Sep-19	-1.4471082%	0.514363%	-1.9614712%
Oct-19	8.6933638%	0.516981%	8.1763824%
Nov-19	-0.9370543%	0.537784%	-1.4748382%
Dec-19	1.3659867%	0.578751%	0.7872358%
Mean	0.1080577%	0.6641307%	-0.5560730%
Standard Dev	5.5737%	0.2761%	5.6240%