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DEPARTMENT OF MATHEMATICS AND STATISTICS

AN ANALYSIS OF THE RISK AND RETURN RELATIONSHIP AND TESTING THE VALIDITY OF CAPITAL ASSET PRICING MODEL (CAPM) ON THE ZIMBABWE STOCK EXCHANGE

BY

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE BACHELOR OF SCIENCE HONOURS DEGREE IN STATISTICS AND FINANCIAL MATHEMATICS

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APPROVAL FORM

The undersigned certified that they have supervised and recommended to Bindura University of Science Education for acceptance of dissertation entitled '**An Analysis of the risk and return relationship and testing the validity Capital Asset Pricing Model on Zimbabwe Stock Exchange.'** submitted in partial fulfillment of a Bachelor of Science Honors Degree in Statistics and Financial Mathematics.

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DECLARATION

I hereby declare that the research project entitled "**An analysis of the risk and return relationship and testing the validity of Capital Asset Pricing Model on the Zimbabwe Stock Market.**" submitted to Bindura University of Science Education, Department of Mathematics and Physics is a record of an original work done by me under the guidance and supervision of Mr. K. Basira with all the borrowed information fully acknowledged and this work is submitted in partial fulfilment of the requirements for the award of a Bachelor of Science Honours Degree in Statistics and Financial Mathematics. The results personified in this research have not been submitted to any University or Institute for the award of any degree or diploma.

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Date: 21 December 2021

DEDICATION

I dedicate this project to my family and friends for their unwavering support and for always seeing the best version of me.

ACKNOWLEDGEMENTS

I would like to extend my gratitude to my supervisor Mr. K. Basira for the mentorship and guidance during the period of this research study. I would also give a special thanks to my parents for their support and also to all my friends. I would also like to thank the Almighty for making this whole research a success.

ABSTRACT

The risk-return relationship is one of the most crucial concepts of investment theory and this is also a growing concern for various investors The main purpose of this study was to identify the risk- return relationship. The objectives of study include: to identify the relationship between risk and expected return on the Zimbabwe Stock Exchange, identify whether the expected rate of return and stock beta is linearly related and to establish the validity of Capital Asset Pricing Model on Zimbabwe Stock Exchange (ZSE). The study employed the quantitative descriptive research design.. The study used the monthly stock prices for the ten counters listed on ZSE for the period of January 2014 up to March 2019. The study used the time series regression to test the relationship between risk and return. Results from the study indicate that UNIFREIGHT (P = 0.001), OLDMUTUAL (P = 0.016) and LAFARGE (P = 0.034) were statistically significance at 0.005 significance level. The results of the study indicated that high risk is associated with higher returns therefore there is a positive relationship between risk and expected return thus this do not violate the CAPM assumption. From the research findings it also concluded that the Capital Asset Pricing Model is valid for ZSE. Furthermore, there are other studies that take into consideration other factors like inflation and exchange rates which affects the stock return and these studies had employed advanced models such as GARCH model that were recommended by the researcher.

Key words: Return, Risk, CAPM, Zimbabwe Stock Exchange (ZSE)

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LIST OF ACRONYMS AND ABBREVIATIONS

APT	**:** Arbitrage Pricing Model
COVID-19	**:** Novel Corona virus
CAPM	**:** Capital Asset Pricing Model
GARCH-M	**:** Generalised Autoregressive Conditional Heteroskedasticity Model
ISE	**:** Iraq Stock Exchange
MPT	**:** Modern Portfolio Theory
NYSE	**:** New York Stock Exchange
RBZ	**:** Reserve Bank of Zimbabwe
PSX	**:** Pakistan Stock Exchange
VaR	**:** Value at Risk
ZSE	**:** Zimbabwe Stock Exchange
ZSEINDX	**:** Zimbabwe Stock Exchange Industrial Index

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This section introduces the study being undertaken. The background of the study, statement of the problem, research objective, research question and research hypothesis are also looked at. The significance of the study, scope of the study, assumptions, limitations, definition of terms and conclusion are outlined in this chapter. Generally, it is the laying ground of the project and a map which will direct the researcher in carrying out the project.

The motive of the research is to offer the researcher an intensity clarification on security market overall performance via comparing risk and return hypothesis. One of the greatest documented propositions of funding theory is that traders on average can recognize a higher rate of return through assuming greater risks. A general goal of the majority investors is the maximization of return and lots of accept as true with that manner of yielding more returns is to invest in securities which can be notion to be riskier. Nurwulandari (2021), maximizing returns through investing in low grade securities is primarily based totally on what he or she calls the hypothesis of growing returns.

1.2 Background of the study

The Zimbabwe Stock Exchange (ZSE) was established in 1896 and is a licensed securities exchange in terms of the Securities and Exchange Act (24:25) to provide for the listing and trading of securities. Its core mandate is to facilitate long-term capital raising through listing of securities as well as offering secondary market securities trading and issuer regulation services.

Weakening economic performance, political instability and the bond notes which have been put in circulation has affected the Stock market performance. In the case of Zimbabwe, a basket of currencies was adopted, namely the US dollar, the South African rand, the Botswana pula, the Euro and the British pound in place of the domestic currency (Government of Zimbabwe, 2009). Moreover, the country completely abandoned its domestic currency until October 2016, when the Central Bank introduced a new surrogate currency which was backed by a bond secured from the Afrexim Bank, known as the “bond note” (Reserve Bank of Zimbabwe [RBZ], 2016). The bond notes also became part of the basket of

currencies used in the multiple currency system, although the US dollar maintained its dominance over other currencies as all transactions are priced in US dollars. The Reserve Bank of Zimbabwe estimated that the US dollar constituted about 90% of total transactions in the multiple currency system (Reserve Bank of Zimbabwe [RBZ], 2015).The continued weakening of regional currencies such as the rand and the pula against the US dollar also prompted economic agents to prefer the US dollar to such currencies (Reserve Bank of Zimbabwe [RBZ], 2016). Moreover, the country had more US dollars already in circulation before the official introduction of the multiple currency system (Reserve Bank of Zimbabwe, 2013). Although the multiple currency system involves use of a basket of currencies, it is often cited as equivalent to dollarization, not only due to the wide use of foreign currency in place of domestic currency in transactions, but also because all the accounts and prices, both in the public and the private sector, are in foreign currency (Mpofu, 2015).

This scenario has, therefore, made it necessary to understand how the multiple currency system could have affected the performance of the stock market in Zimbabwe. While existing empirical literature provides some insights on the impact of macroeconomic factors on stock market performance in Zimbabwe, it would be important to try and understand the influence of the multiple currency system on stock market performance in Zimbabwe in order to fully understand why the stock market performance was very poor while the economy registered robust economic growth after the introduction of the multiple currency system in 2009.Following the introduction of the multiple currency system, the stock market was characterised by very low trade volumes, as the market was predominantly associated with low prices, low demand for stocks by investors, a lack of activity on the stock market, and the losses suffered by investors after the conversion from the Zimbabwe dollar to the US dollar (Reserve Bank of Zimbabwe, 2015).

The Zimbabwe Stock Exchange (ZSE) also realised significant delisting, with the number of companies declining from a peak of 82 counters in 2009 to 54 counters by December 2016. Market capitalisation also declined from a peak of approximately US$6 billion in 2013 to around US$3 billion in 2016.In addition, the participation of foreign investors on the ZSE was subdued, notwithstanding the fact that the economy was relatively stable and that the multiple currency system effectively eliminated the exchange rate risk since trading was being conducted in US dollars as opposed to a domestic currency, which historically has proved to be more prone to depreciation against major currencies.

The poor stock market performance following the introduction of the multiple currency system has therefore been a great concern in Zimbabwe, which requires some further empirical investigation (Sibanda, 2015). Based on the recorded performance of the ZSE, it is possible that the multiple currency system may have been one of the factors that altered the dynamics of the stock market performance and the transmission mechanisms through which macroeconomic variables affect stock market performance. There is thus a gap in the empirical literature on the impact of the macroeconomic factors on the stock market under the multiple currency environments. This is especially important given the poor performance of the Zimbabwean stock market, despite the firm economic recovery experienced following the adoption of the multiple currency system in 2009.

According to Campbell and Schiller (1988) and Fama and French (1992), the stock returns in long-term are influenced by variables such as Price-Earnings ratio, previous returns, organisation term structure, risk or volatility performance and quality management. The market risk situation of ZSE has been worsening over the years as weak economic activities have resulted in ZSE experiencing declining investor interest and trading volumes in the past seven years.

The Capital Asset Pricing Model (CAPM) is a model advanced through Markowitz. Sharp (1963) and it is possible to estimate the expected return of a stock using the model. Under the CAPM, the degree of risk is taken into consideration to be beta and therefore, stocks with excessive beta are expected to generate better return than with small beta. The Markowitz Model is goes to be implemented on this study. Systematic risk of a portfolio is usually measured by Beta and Beta is represented by the Greek letter β.

1.3 Problem Statement

It has normally been documented that there may be, or need to be, some trade-off among risk and return. The problem, however, is that diverse theoretical and empirical studies have exposed conflicting outcomes about risk and return relationship and also there is no guarantee that high risk will be compensated with high return (Makkar, 2020). Moreover, there is also a challenge of limited understanding and poor performance of portfolios due to internal and external variables (COVID 19) and decline in investors. The use of complicated models to model risk and return relationship and the examples of models include the Arbitrage Pricing Model (APM) and Portfolio Theory. Data may be gathered to reveal that risk and return are

associated in a positive manner, excessive risk securities essentially rewards the investor with higher returns. The common concept behind CAPM is that investors want to be compensated in two ways, time value of money and the risk faced. This study is eager to decide the risk and expected returns for the industrial index for companies listed on Zimbabwe Stock Exchange examine the correlation and the interdependence among risk and expected return and test the applicability of the Capital Asset Pricing Model.

1.4 Aim

The intention of the research is to establish the empirical relationship among risk and return, the analysis is focused on two risk-return evaluations and to examine the validity of the Capital Asset Pricing Theory on evaluating the relationship between risk and expected return for industrial index for companies listed on ZSE.

1.5 Objectives

(1) To identify the relationship between risk and expected return on the Zimbabwe Stock Exchange.

(2) To identify whether the expected rate of return and stock beta is linearly related.

(3) To establish the validity of Capital Asset Pricing Model in Zimbabwe Stock Exchange.

1.6 Research Questions

(1) What is the relationship between risk and expected return of securities at the ZSE?

(2) Is there a linear relationship between the rate of return and stock beta?

(3) Is the CAPM valid in the evaluation of risk and return of the ZSE?

1.7 Significance of the study

The significance of the study is to explore the relationship between risk and expected return and the overall performance of security market (ZSE). However, the study is essential to the following:

(1) Investors

The research could be beneficial to investors due to the fact that investors are risk averse, whilst they may be determining to whether or not to invest in a specific stock, they want to recognize how the stock will make a contribution to the risk and return on their portfolio

(Pamane and Vikpossi, 2010).Thereby to keep away from risky security, investors not directly pay a top rate in the sense of accepting lower returns from securities of low risk. In respect, there may be an implication that securities which might be characterised through an excessive degree of risk definitely yield high return. According to Chiang and Zhang (2018), there will generally be a positive top rate on risk. That is expected risk yields will be higher than sure yields. That the market does pay fantastic risk rates is an assertion that many human beings declare has in fact been refuted. However, I accept as true that the burden of the facts indicates that risk medias of investment do have better expected yields than secure medias.

(2) To the student

The study will enhance and improve the researcher's research capabilities and equip him with intensity knowledge of the subject of the subject under study.

(3) To the University

The study could be saved in the university library and upload reference fabric to the library.

(4) Policy Makers

The study could have some positive contribution to the policy makers in their policy drafting and implantation and decision making.

1.8 Scope of the study

The research concentrates on risk and expected return hypothesis of the industrial index on the Zimbabwe Stock Exchange. The research included statistics and financial results for the period of January 2014 up to March 2019. The Python Package is used on this study.

1.9 Assumptions

The research became carried under the subsequent assumptions:

(1) Investors are risk averse.

(2) Investors are price takers and cannot have an effect on the market individually.

(3) There are no transaction costs.

1.10 Limitations of the study

(1) The study only takes under consideration the organizations under the economic index.

(2) The cease of the month share prices is not adjusted to account for cash and stock dividends because of unavailability of data ensuing in the underestimation of security returns.

(3) The study is going to use previous data.

1.11 Delimitation of the study

The research centred on return and risk on asset and the applicability of the Capital Asset Pricing Model (CAPM) in a stock market. The thesis was conducted on the companies listed on the Zimbabwe Stock Exchange for the period of January 2014 up to March 2019.

1.12 Definition of terms

(1) Risk- refers to the loss of fundamental amount of an investment. It is the range of returns from the expected return.

(2) Return- refers to expected rate of return from a funding.

(3) Security market- refers to series of markets and exchanges in which the issuing of equities, bonds and different securities takes place.

(4) Beta-refers to average sensitivity of a stock's returns to modifications in returns available in the market portfolio.

1.13 Summary

This chapter brought the study and mentioned the elements that triggered this study. The background of the study, the importance of the study, assumption and limitations were also mentioned on this bankruptcy.

1.14 Organisation of the study

In presenting the empirical evidence relating to the nature of the risk and return hypothesis, it is necessary to develop and interpret a large amount of data. For this reason, the summary data related to the subject of this research are presented in the main text. Chapter two describes a concentrated review of closely related research in the area of risk - return and security performance describing the conclusions and research methodology used by the respective authors. Chapter three goes on to describe the data that were used in this analysis and related methodology and research design that was developed to permit an examination of the risk and return hypothesis for the period of the study. Chapter four it presents the general findings of the analysis in presented to examine and evaluate security performance. Lastly, chapter five contains the summary of the study, conclusions and recommendations, highlights the solutions in addressing the statement of the problem.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

Literature review is defined as a description of what has been available on a certain topic or notion by authorized authors (McCombes, 2019). The literature review is there to express to the reader the knowledge and facts that have been recognised on the topic and those that need for further research.

This part of research critically examines what has been studied so far in the subject of risk and return hypothesis in security market. The researcher will be easily identifying factors that influencing risk and return in this chapter of literature review.

2.1 The Security Market Trend (ZSE)

Since 2009, the economic system registered sturdy increase rates averaging over 10 percent among 2009 and 2013, at the same time as the stock market signs had been all miserable. The economy registered a growth of 5.6 percent during 2009, in comparison to a decline of 14.8 percent during 2008. The market additionally persisted towards reinforcement as proven through excessive growth rates of 11.4%, 11.9% and 10.6% in 2010, 2011 and 2012 correspondingly (Reserve Bank of Zimbabwe [RBZ], 2013). The restraint of economic growth from 2012 however particularly pondered a cease to the restoration phase for the reason that economy became rising from a decade long economic crisis. While the security market concert turned into terrible, following the advent of a couple of forex gadget and there had been a few tremendous tendencies within side the banking sector and the economy at large. The several legal tender devices boosted self-assurance within the economy with the banking segment registered exceptional growth in deposits from US$400 million in February 2009 up to US$4.5 billion through December 2015 (Reserve Bank of Zimbabwe [RBZ], 2015). These fantastic tendencies, conversely, now no longer enlarge to the stock market overall performance beneathneath a couple of forex environment.

The pinnacle of ten indices became the worst performer posted 724.68% increased to seal at record of 1671.47%. To lead the way, it was the midpoint cap index which turned into positive through 1808.02 to shut at 5491.09 that is the greatest ever climbed. In phrases of worth Zimbabwe Stock Exchange’s marketplace capitalisation closed the year up via way of

means of 968% to publish the ZWL$317 billion up from ZWL$29 million that became registered in 2019.In other words, equities bazaar which were closed at 2019 worthing US$1.77 billion grew through 115.5% up to US$3.88 billion going with an aid of using the authentic public sale rate of $81.78 Zimbabwean dollar (www.zse.co.zw). By the near exchange in 2020 the ZSE all shares became 1045.85% to 2636.34%, which marks the most important year climbed in support of the neighbourhood trade for a decade.

2.2 Theoretical Literature

It is a growing concern of investors to have good return from their investment as they were taking risk through investment. There were various theories which try to explain the relationship between the expected return of portfolio in addition to return of a security via a linear combination. These theories include Capital Asset Pricing Model that was developed by Sharpe (1964) after being originally developed by Markowitz (1952), Modern Portfolio Theory developed by Markowitz (1952) and the Arbitrage Pricing Model developed by Stephen Ross (1976). From the theories stated, the researcher is basically based on the Capital Asset Pricing Model to analyse the volatility and expected return hypothesis for industrial index of ZSE.

2.2.1 The Capital Asset Pricing Model

Sharpe (1964) developed a model called the Capital Asset Pricing Model after being originally developed by Markowitz (1952). The Capital Asset Pricing Model is one of the best models in analysing the relationship between risk and expected return; it is also an addition to Modern Portfolio Theory. The CAPM represent that risk assets and symmetry rate of return were role to the covariance with market portfolio. The model states that a linear relationship exists between the risk of investing and the return from investment. The markets will be able to value the individual security return with various risk levels. From Capital Asset Pricing Model, return to risk ratio for individual security is equal towards market return to risk ratio if the expected rate of return become depressed through the beta (β). The general equation for the Capital Asset Pricing Model (CAPM) is as follows.

$E(R) = R_f + \beta\ (R_m - R_f)$

Where,

E(R) =the expected rate of return.

R_f= the risk-free interest rate.

β= the beta of an asset.

R_m= the market returns.

2.2.2 The Modern Portfolio Theory

Risk and return equivalents is a foundation of Modern Portfolio Theory. The Modern Portfolio Theory (MPT) was developed by Markowitz (1952). The motive of the theory is to calculate the expected return and expected risk of a portfolio. Markowitz (1952) offered the variance as a measure of risk thereby implemented the method of calculating the general risk of a portfolio. Markowitz factor-in the imperfect correlation of price movement between securities. From all that Markowitz (1952) has done in calculating the portfolio value, has enabled today's investors to quantify the relationship between risk and expected return rather guess work. However, the Modern Portfolio Theory it only analyses the portfolio based on variance. The general equation for the relationship is as follows.

$$R_{jt} = a_j + b_{jt} + e_{jt}$$

Where,

R_{jt}= the return on security j in time period t.

a_j= the constant, the return axis intercept.

b_{jt}=the slope of regression line relating to R_{jt}

e_{jt}= random variable with a mean zero and a variance of a V_{ej}

2.2.3 The Arbitrage Pricing Model

Ross (1976) developed the Arbitrage Pricing Model and the model act as an equilibrium pricing that is used towards examination of the relationship between risk and expected return. Arbitrage Pricing Model act as an alternative for Capital Asset Pricing Model's hypothesis method of generating rewards on security. According to Ross (1976), the model assumes that there is a straight relationship between risk assets in addition to the return on risk assets. The APT is an advanced model of CAPM, however the Capital Asset Pricing Model is more accuracy in estimating the beta therefore the required rate of return is also exactly rationally.

2.3 Research Variables

2.3.1 Expected Return (Dependent Variable)

Return from stock portfolio will be the most concern of investors, government and even the international community. According to Martin (2019) expected return is the subjective average return expected from a portfolio. There is a positive correlation between risk and return as investors assume that the risk of investing intends to reward through the same return (Mehara, 2014). The general curriculum that an investor can study from the capital marketplace is that the riskier the asset will also compensate with higher return.

2.3.2 Risk (Independent Variable)

Murumba (2012), risk is the chief factor that can influence the decision making by investment managers. This therefore means that the greater the risk or the lower the risk will help investment managers in the decision making. Risk is defined as the quantity of deviation between expected return and the levels that is achieved. In addition, Nurhayati and Endri (2020) risk is calculated through the following broadly method of standard deviation. The formula to calculate the standard deviation using historical data is as follows.

$$\text{SD} = \frac{\sqrt{\sum[X-E(X)]}}{(\text{N}-1)}$$

Where,

SD =the standard deviation.

X = the value of a random variable.

E(X) =the expected value of a random variable.

N =the sum of historical data observations for large samples with n.

2.4 Determinants of Return

2.4.1 The Interest Rate Risk

Chen (2021) defines interest rate as a probable for saving victims as an outcome from adjustment in interest rate. In other word, the interest rate risk will be narrated as a likelihood of interest rate earned in an investment, possibly will be lower than an increase in market interest rate which can consequentially decrease the market value. Various research look after the effects of interest rate risk on financial stock returns. An exploration of interest rate risk

put an interest rate keen to quantify with return from the market debt that is used in estimating market risk.

2.4.2 The Inflation Risk

The correlation between inflation and stock return is originally developed on Fisher's effect framework that can be termed Fisher hypothesis (Fisher, 1930). Fisher's theory states that the nominal return of security might also decrease. Uwebanmwen (2015) states that in 1970 most investors realised that there was a parallel relationship between inflation and stock return.

2.4.3 The Exchange Rate

According to Elsevier (2015), an introduction of an asset might result in instability in exchange rate. In research carried by Hussian (2014), the firm's risk was poisoned through instability of the exchange rate as well as market value. In carrying out my research, i am going to examine if there is a correlation between exchange rate and stock price.

2.5 Systematic and Unsystematic Risk

Risk that affects small clusters of securities or a particular security is termed as unsystematic risk. One can eliminate unsystematic risk through a well-diversified portfolio. According to (Farhat, 2021)**,** unsystematic risk demonstrated a negative impact on Dhaka Stock Exchange. Systematic risk is the one that is related to the market. It affects the whole market of securities, and it is also erratic. Both systematic and unsystematic risk will have a negative impact on stock return.

2.6 Risk Measures

2.6.1 Value at Risk (VaR)

According to Happer (2020), the concept of Value at Risk (VaR) basically used to weigh up the degree of risk related with the portfolio. The concept measures the greatest possible loss consists of a measure to confidence intended for particular period. For instance, the portfolio of an outlay has got one year 10% Value at Risk of 5 million dollars, therefore a portfolio has 10% probability of losing above 5 million dollars over a year.

2.6.2 Conditional Value at Risk

This concept is one of additional methods to weigh up tail risk of an investment. Conditional Value at Risk is an addition to Value at Risk, and it examines the possibility of a particular confidence with a break in VaR. It also examines what is happening in an investment other than the maximum loss brink.

2.7 Risk and Return Indicators

The five indicators of risk and return include α, β,r^2, σ and the Shape Ratio. Risk and return indicators might be used independently or else jointly to carry out risk appraisal. The geometric parameters outlined above are chronological predictions of volatility. These parameters are main mechanisms of the Capital Asset Pricing Model. These parameters might help to determine risk and return in any investment. They are of great importance as they help investors to decide on which investment consists of high risk.

2.7.1 (Beta) β

The statistical parameter known as beta is the one that is used to calculate security's portfolio risk. The parameter measures the sum of systematic risk on a security or else the trade zone that have relation towards a complete stock market. When the beta of a security is 1, the price of a security shifts within time step with the market. If the value of beta on a security exceeds one, this shows that the security is more risk as compared to the market. On the contrary, when security's beta does not exceed1, it shows that the security is less likely to be risk as compared to the market.

2.7.2 Standard Deviation (σ)

Standard deviation (σ) normally used to calculate the distribution of data from the expected value. Investors normally consider the standard deviation when making investment decision, as it is used to calculate the volatility related through an investment, linked towards its annual rate of return. The standard deviation indicates the extent current return differs from its expected historical normal returns. Securities with high standard deviation experience higher volatility and as a result these securities associated with high risk.

2.7.3 Sharpe Ratio

It is used in assessing the routine as accustomed through the related risk and the way to solve it, is through removal of rate of return from risk-free savings and thereby divides it by the standard deviation. Therefore, it shows whether return from investment was due to judicious investment or hypothesis of surplus risk. In other words, the bigger the portfolio's Sharpe ratio will result in improved risk-adjusted performance it has. On the other hand, a negative Sharpe ratio shows that less risk security would do better than the security being analysed. The formula to calculate Sharpe ratio is as below.

Sharpe ratio $= \frac{(r_x - r_f)}{\text{Std } Dev_x}$

2.7.4 Alpha (α)

It is used to gauge an investment's performance on a risk adjusted. Alpha is also an average return in excess benchmark. Finally, it can be calculated using the following formula.

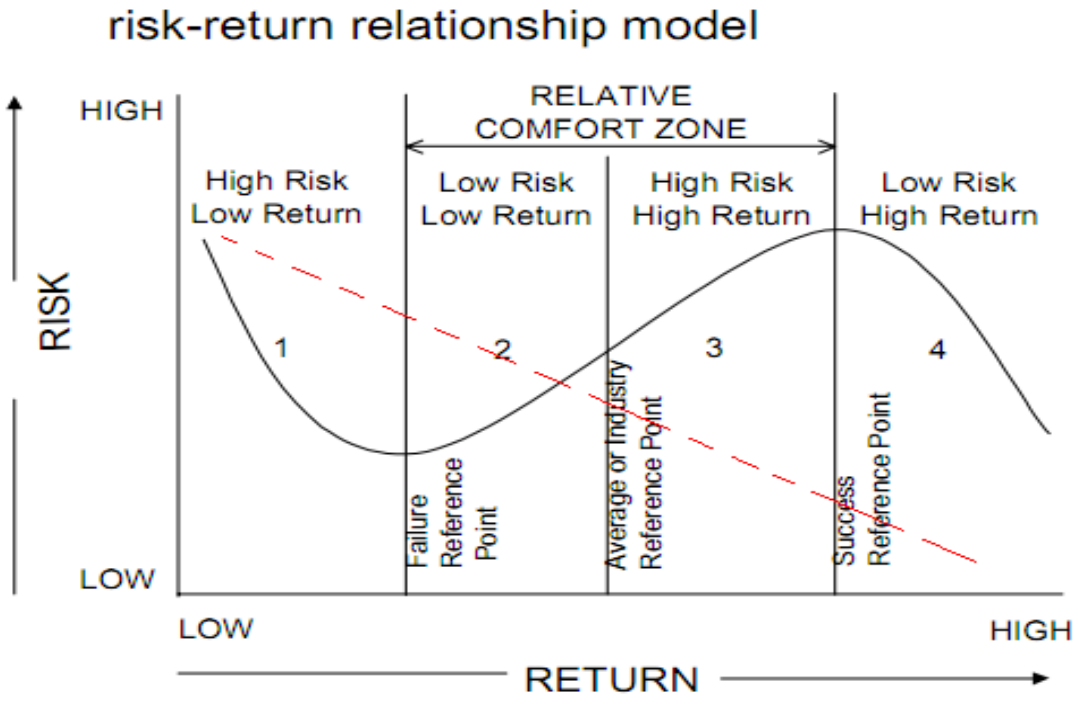
Alpha$= r_x - r_f$

2.7.5 R- Squared (r^2)

A geometric measure used to represent percentage of portfolio fund or else security schedule explained by a shift in standard index is called R- squared (r^2). Flat income stock together with bond funds in standard are the U.S. Treasury Bill. Range of R-squared start from 0 to 100. According to Morningstar (2019), if the value of R- squared ranges between 85 to100 and the performance of mutual fund is directly related with the index.

2.8 The Relationship between Risk and Return

Mostly, investors will go for securities that they deemed to be more risk since the higher the return will be gifted by higher risk. In other words, those investors that were interested in earning higher return should go for securities with large beta (β) that is they are greater risk appetite. However, those that do not prefer to be risk takers should go for securities with low beta that associated with safety and low return



Source: (svtution.org/2014/relationship-between-risk and return. html)

Figure 2.1: Risk and return relationship model

A diagram above shows the correlation between risk and return in different zones. The zone represented by high risk corresponded to high return and low risk corresponded to low return indicates that there is direct correlation between risk and return. Conversely, the zone represented by high risk corresponding to low return and low risk corresponding to high return shows that there is negative correlation between return and beta. The x-axis represented with the return while the y-axis represented with risk (β).

2.8.1 Conceptual Framework

Nurwulandari (2021) observed the relationship between the risk and return and the results argued that there will be a positive correlation between the risk and expected return. The relationship between risk and expected return can be well explained with the following diagram below.

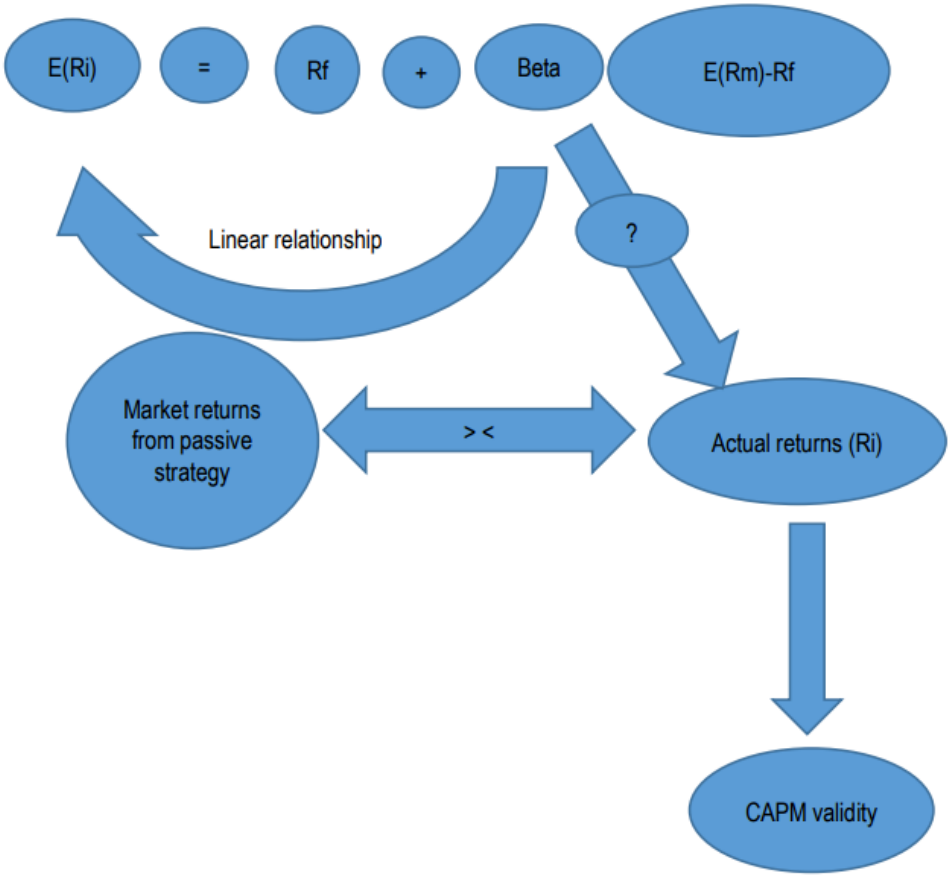


Figure 2.2: Conceptual framework

2.9 Empirical Literature

Capital Asset Pricing Model was used to confirm the effects of non –diversified risks on stock market returns and it considers one risk factor that is the market risk. The model was used to estimate the beta coefficients and return for every stock of companies listed on ZSE. The data to be used on the Capital Asset Pricing Model was retrieved from the ZSE website.

Nurwulandari (2021) analysed the relationship between risk and return with Capital Asset Pricing Model (CAPM) technique at Kompas 100 using Pearson Correlation coefficient model. The results from his correlation coefficient test indicated that a sample used in Capital Asset Pricing Model calculation indicated a strong positive relationship between beta and the models expected return. However (Nurwulandari, 2021) examined the risk and return relationship over extended time periods, he or she disregarded the market trends consideration.

Although, Nurwulandari (2021) analysed the relationship between risk and return using a regression model and found a positive relationship between risk and expected return, Fifield et al. (2020) explore the relationship between risk and expected return using the regression model and from their findings they concluded that there might be a negative correlation between risk and return. Chiang and Zhang (2018) explored a relationship between risk and expected return of the Chinese equity markets. In their research they used a TARCH-M model to discover the relationship between stock returns and volatility. They concluded that the security returns and risk are positively correlated, thereby encouraging risk and return relationship in sectoral markets. Chiang and Zhang discovered that there was a positive correlation among risk and security return whilst managing liquidity.

Dzingirai (2018) examined the association among risk and return on Zimbabwe Stock Exchange (ZSE) and he used the Capital Asset Pricing Model in order to assess if there is a linear combination between risk and return. Dingirai's results do not support this hypothesis since high beta-high returns relationship was not exhibited on the stocks. My research is also going to apply the models or concepts employed by Dzingirai (2018) but due to changes in environment and economic conditions there will be a great different in terms data employed, research objectives and even results from the findings will distinguishes the research. . He considered specific market trends but was limited, for the most part to an evaluation of the level of correlation between the two variables for the purpose of determining the ability of beta to predict return.

Dwarika (2020) examined the risk and return relationship and volatility feedback in South African market. The author employed the GARCH model to test the availability of risk – return relationship and volatility feedback. The tests results of the parametric Bayesian model indicated that there is a positive and linear relationship between risk and return in accordance with the traditional theoretical expectations.

Mili (2019) evaluated whether the relationship between risk and expected return explained main setback in sovereign Credit Default Swap spread. The outcome from Mili's research indicated that the sovereign Credit Default Swap spread changes regularly as well as the mean hypothesis for most European countries.

Rachmawati and Rizkianto (2020) analyzed the relationship of the risk-return trade-off between excess return and excess return volatility on the stock exchange in Indonesia Stock

Exchange (in which both of them are ready being conditioned by the macroeconomics factors). The research was primarily based totally on the regression model to examine the relationship between risk return trade-off. From their analysis they concluded that the there is a negative relationship of risk return trade-off between excess return and excess return volatility. However, they do not outline the concepts of risk and return.

Kamar et al. (2020) investigated the correlation between risk and return for the Iraq Stock Exchange (ISE). They used the daily closing prices of six banks from Iraq Stock Exchange over a period of January 2015 to December 2017. They also employed both symmetric and asymmetric models of various properties of the GARCH model. The results could not provide evidence of the presence of a positive risk premium in the marketplace; and they concluded that there was a negative correlation between risk and return for the Iraq Stock Exchange (ISE). However, the GARCH model assumes deterministic volatility based on past returns and conditional variances (Fiszeder, 2020). The model is also restrictive.

Hundal et al. (2019) examined the relationship between expected return and risk in the Finnish stock market in the light of Capital Asset Pricing Model (CAPM). Hundal et al. (2019) employed the cross-sectional regression model in their research. The findings indicated that risk and return has been worked in sync and concluded that there is strong and significant relationship between risk and return.

Mehara (2014) examine the association among risk and the security return on Tehran Stock Exchange. The Capital Asset Pricing Model was used in order to model data of 50 performing companies in the stock market for the 5- year period. Mehara's outcome from the research undertaken indicated that there was an affirmative correlation between risks with the expected return.

Trang (2021) examined the validity of the Capital Asset Pricing Model (CAPM), with empirical evidence from the London Stock Exchange (LSE) in the period of 2012 to 2020. The researcher adopted the simple linear regression model to examine the positive and linear relationship between beta values and the average real return in the period of 2012 to 2020. The results of the researcher indicated that the Capital Asset Pricing Model was not valid due to its own deficiencies.

Alqise et al. (2016) investigated whether the Capital Asset Pricing Model was good when modelling data for Amman Security Exchange for the period of 2010 up to 2014. They used

the monthly returns in their research and the concepts of Black, Jensen and Scholes. Their outcome indicated that the more risk (beta) was not related with more return and therefore violated the Capital Asset Pricing Model's assumptions.

Khan et al. (2020) evaluated function of Capital Asset Pricing Model with respect to Pakistan Stock Exchange via the use of Seemingly Unrelated Technique of Regression (SUR) model. The outcomes showcased and the beta was quite significant except for a single model and the same alpha exhibited the value about zero. From the analysis it has been concluded that CAPM holds in context of Pakistan Stock Exchange (PSX).

Shinde et al. (2019) assessed the stock market of India using the Capital Asset Pricing Model. From their outcome they concluded that the Capital Asset Pricing Model do not perform well for the security market of India. Pavin et al. (2019) also analysed how valid is the Capital Asset Pricing Model in the stock market of India. They also concluded that the model was not applicable to the security market of India.

Abbasi et al. (2017) also observed the applicability of the Capital Asset Pricing Model for monthly returns. Their outcome indicated that the model was not applicable and do not clarify the return of listed companies. However, the researcher do not outlined factors which caused the model to be inapplicable.

Farhat (2021) tested the validity of Capital Asset Pricing Model using the New York Stock Exchange (NYSE) NASDAQ-100. Farhat (2021) adopted Fama- French model to test the validity of the Capital Asset Pricing Model. According from the findings, the researcher concluded that the Capital Asset Pricing Model does not give a valid account of the New York Stock Exchange using Nasdaq-100. This therefore means that the model was not valid for the New York Stock Exchange. Alshomaly et al. (2018) examines the applicability of Capital Asset Pricing Model together with the Arbitrage Pricing Model on Jordanian security market. Their outcomes indicated that the security market faced great risk than the expected return.

From the above empirical literature, there is deficiency in total agreement regarding the relationship between risk and expected return of securities. Most researchers indicated that the predominant relationship is positive. The researcher is goes to undertake a regression model to analyse the linear relationship between risk and expected return although the model

has its own limitations that is, it only considers the mean of the dependent variable (Kumari, 2020).

2.10 Chapter Summary

The episode highlighted the literature review of the research. The presenter concentrates in evaluating risk and return hypothesis on security market that is Zimbabwe Stock Exchange. The common agreement within the literature review is that risk and return moves within a positive direction (Nurwulandari, 2021). Therefore, the researcher support that there is a linear relationship between risk and stock return hence investors to make better investment decisions they need to know how much return they can earn from any investment.

CHAPTER 3

RESEARCH METHODOLOGY

3.0 Introduction

The chapter is going directly to introduce a significant skeleton which provides solutions the research questions and objectives, that is to identify whether the expected rate of return and stock beta are linearly related and to identify the relationship between risk and expected return on the Zimbabwe Stock Exchange. Furthermore, the chapter concentrates on research design, targeted population, research instrument and how the data gathered. However, earlier than the researcher went to observe the data and to be extra precise at the methodology and techniques he ought to use within side the evaluation of data.

3.1 Research Design

Research design is a way the researcher used to perform answers to the study questions (Bouchrika, 2020). The researcher used the quantitative descriptive research design in the study, as it conveys collectively numerous components, techniques and ways to collect data and eventually examine it. Quantitative descriptive study layout was suitable for the study undertaken as it provides an intensity assessment and an account of different phenomena under evaluation of risk and return hypothesis ZSE using the Capital Asset Pricing Model. The thesis focused on data collected from Zimbabwe Stock Exchange website.

3.2 Target Population

Target population was defined as the overall organization of individuals where the researcher was interested in researching and analysing (Copper and Schilnder, 2012). Recently, there had been sixty-three (63) agencies indexed on Zimbabwe Stock Exchange and they were targeted. Investors, audit and risk committee for the security market were also targeted respondent as they consist of information pertaining to risk and return. On the other hand, the researcher has now no longer conducted data from the whole population due to confined budget to get right of entry to data.

3.3 Data Type and Source

The data used within side the thesis was the primary and secondary data. Secondary data refers to as the information that is already in existence (Panchenko, 2020).

3.3.1 Primary Data

Key Informant Interviews

These might be used to gather technical and other crucial information on the subject of matter. Key informant interviews were carried out on three stakeholders of the Zimbabwe Stock Exchange to understand the performance of the ZSE and the relationship between the risk and return of investing on the Zimbabwe Stock Exchange (ZSE).

3.3.2 Secondary Data

The research focused on the analysis of secondary methods of collecting data. The researcher used secondary data from the Zimbabwe Stock Exchange authentic website. Secondary data refers to relevant information that is already in existence prior to carrying out their search (Aaltio and Pia, 2009).

3.4 Research Instrument

According to Canals (2017), research instrument was defined as a device used to gather measure and analyse data related to the research. The researcher used programming software program referred to as Python Package in the analysis of data. Lastly, the researcher used textbooks and internet to access closing security prices for companies listed on Zimbabwe Stock Exchange, models literature review and relevant information.

3.5 Data Collection

Data collection is a scientific way of gathering and measuring information. The collection of data is more substantial as it may result in the fulfilment of research objectives. The researcher used secondary data from the Zimbabwe Stock Exchange authentic website (www.zse.co.za). Interviews were also carried out with the workers to understand the background and current running of the Zimbabwe Stock Exchange (ZSE). The data collected from the bourse, was from the period of 2009 to 2019 and the market return will be obtained from the Zimbabwe Stock Exchange Industrial Index (ZSEINDX). In addition, the data consists of the average weekly stock prices rather than the monthly data because the use of high frequency data may result in biased or inefficient results being obtained.

3.6 Data Preparation

3.6.1 Stationarity Test

The researcher tested the entire monthly stock prices for non-stationarity using an Augmented Dickey- Fuller (ADF). The negative numbers were tested using the augmented Dickey- Fuller statistic. The Augmented Dickey-Fuller test was conducted by adopting log transformation.

3.6.2 Heteroskedasticity

Heteroskedasticity was discovered when the residuals related with a regression analysis were not equal; thus, the error variance related with the model is equal across all degrees of the independent variable. In other words, heteroskedasticity occur when the error term has a nonconstant variance. The researcher test data for heteroskedasticity.

The following are the hypotheses.

H_0**:** The data is homoskedastic

H_1: The data is heteroskedasticity

3.6.3 Autocorrelation

Autocorrelation measures the extent of correlation between same variables amongst two successive time intervals. The researcher undertook the Durbin Watson statistic to test for autocorrelation in the residuals from a regression analysis. The values from 0 to less than 2 indicate that there is positive autocorrelation and those from 2 to 4 indicate that there is negative autocorrelation.

3.7 Data Presentation and Analysis

The presentation of data means displaying the analyzed statistical information for easier comprehension of trends. The deductive and inferential statistics were presented in tables, graphs and narrative way. Data analysis it is a systematic way of collecting, modelling and analysing data in order to extracts insights that support decision making (Calzon, 2021).

3.8 The Analytical Model

The study makes use of the cross- sectional regression technique of Fama and Macbeth (1973) to investigate the validity of Capital Asset Pricing Model. The researcher used the regression model in the analysis of data to identify relationship between the expected rate of return and stock beta and to establish the validity of CAPM. Therefore, the regression model is in the form

$$\boldsymbol{R_{i,t} - R_{f,t} = \alpha + \beta_i \, (R_{m,t} - R_{f,t}) + \varepsilon_t}$$

Where:

(**1**) $\boldsymbol{R_{i,t}}$ = the return on the asset i at time t.

Return = $\frac{\boldsymbol{Closingprice - Openingprice}}{\boldsymbol{Openingprice}} \times \mathbf{100}$

Average Return = $\frac{\boldsymbol{Total\ return}}{\boldsymbol{N}}$

$(\mathbf{2})$ $\boldsymbol{R_{f,t}}$ = the risk-free rate at time t.

$(\mathbf{3})$ $\boldsymbol{\beta_i}$ = the beta of an asset at time t. (Risk)

$\mathbf{(4)}$ $\boldsymbol{R_{m,t}}$= the rate of return on the market portfolio on the portfolio at time t.

$(\mathbf{5})$ $\boldsymbol{\varepsilon_t}$= the error term which is assumed to be random

Correlation = $\frac{\boldsymbol{Covariance}}{\boldsymbol{Standarddeviationofmarketindicator}}$ × **Standard deviation of specific stock**

<u>Model Assumption</u>

(1) Fixed risk-free rate exists and it allows investors to borrow unlimited amount at same the interest rate.
(2) All investors use the same expected return and covariance matrix of return.
(3) Investors are risk averse.

The researcher used the linear regression model in the analysis of data to identify whether the expected rate of return and stock beta are linearly related. Therefore, the linear regression model is in the form

$\boldsymbol{R_{i,t}} = \boldsymbol{\beta_0} + \mathbf{X}\boldsymbol{\beta_i} + \boldsymbol{\varepsilon_i}$

Where:

$\boldsymbol{R_{i,t}}$ = the average rate of return on security $\boldsymbol{i}$ in the examined time interval for the same period.

$\boldsymbol{\beta_0}$= the predicted equation's intercept.

X = the predicted slope of the equation.

$\beta_i =$ represent the beta value of stock i behind the relationship between the beta of stock i and rate of return.

$\varepsilon_i =$ the error term at time i.

3.8.1 Model Fit

(1) Jarque-Bera Test

It is a form of Lagrange multiplier test for normality of data. The Jarque –Bera test it is mainly used for large volume of data because some of the normality tests were not reliable when N is large. The test is a measure of goodness-of-fit test of whether the sample data have the skewness and kurtosis matching a normal distribution.

(2) Durbin Watson Test

The researcher undertook the Durbin Watson statistic to test for autocorrelation in the residuals from a regression analysis. The values from 0 to less than 2 indicate that there is positive autocorrelation and those from 2 to 4 indicate that there is negative autocorrelation.

3.8 Ethical Considerations

The researcher discovered research principles when the research was conducted. Permission was required from the Zimbabwe Stock Exchange (ZSE) to legitimise the study. The researcher explained to the respondent's issues on confidentiality matters and also on the intention of the study and they were requested to acknowledge as a sign of consent by signing a confidentiality indemnity form

3.9 Summary

This chapter discussed the research design, data collection methods and the data analysis procedure. Its focus was on giving an insight into the methodology that was used during research. The succeeding chapter focuses on data presentation, analysis and discussion.

CHAPTER 4

DATA PRESENTATION AND ANALYSIS

4.1 Introduction

This chapter presents the research findings of the risk and return relationship and the validity of the CAPM model as highlighted in previous chapters. The Capital Asset Pricing Model was used to analyse the data. The Python programming software package was also used in the calculation and presentation of results and the results were interpreted according to the objectives of the study.

4.2 Presentation of Results

The Zimbabwe Stock Exchange daily stock prices data for the period from January 2014 to March 2019 was converted to monthly prices and used to calculate the average monthly stock returns.

4.2.1 Importing Data onto Pythons 3

The data was on the excel sheet and was converted to a csv (comma delimited) file. The following Python codes were imputed in order to upload the csv file.

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
get_ipython(). magic('matplotlib inline')
import statsmodels.api as sm
import statistics as stats
from statsmodels.tsa.stattools import as adfuller
```

The csv file to read the following codes was run.

```
Data = pd.read_csv(r'C:\Users\munnah\Desktop\Munnah.csv')
Data.head()
```

The results for the first five rows for the uploaded data have been viewed below.

```
In [5]: data = pd.read_csv(r'C:\Users\munnah\Desktop\Munna.csv')
        data.head()
```

Out[5]:

	Date	UNIFREIGHT	ECONET	DELTA	OLDMUTUAL	INNSCOR	LAFARGE	OK ZIM	TRUWORTHS	TSL	SIMBISA	Industrial index
0	2014-Jan	3.00	61.10	133.17	242.40	78.48	110.0	19.94	4.08	38.14	0.0	198.70
1	2014-Feb	4.30	62.00	124.12	242.92	76.48	90.6	19.45	4.00	36.40	0.0	190.47
2	2014-Mar	5.00	63.87	119.67	251.03	70.27	82.9	17.48	3.89	37.09	0.0	183.62
3	2014-Arp	5.50	61.33	111.56	247.65	61.65	71.0	19.10	3.24	32.77	0.0	171.83
4	2014-May	6.55	65.08	116.68	248.31	67.87	65.0	18.65	2.73	29.53	0.0	174.06

```
In [ ]:
```


Figure 4.1: Uploaded ZSE Monthly Data

4.3 Testing for Stationarity Assumption

The monthly stock prices have been tested for stationarity and the test was carried out to test whether the data can be predictable or there may be need to use predictive models if possible. Risk and return will be forecasted based on the past values. The researcher carried out log-transform data using Python ADF since some of the data met the stationarity assumption; consequently, the data was not normally distributed. The p-value of DELTA before log-transform is 0.142820 and after the log-transform is -0.277913.

```
In [6]: #ADF Stationarity test

        from statsmodels.tsa.stattools import adfuller
        test = adfuller(data["DELTA"])
        print("ADF Test statistic: %f" % test[0])
        print("P-value: %f" % test[0])
        print("Critical values:")
        for key, value in test [4].items():
            print("\t%s : %.3f" %(key, value))

ADF Test statistic: 0.142820
P-value: 0.142820
Critical values:
        1% : -3.546
        5% : -2.912
        10% : -2.594
```

Figure 4.2: Before Log- Transformation

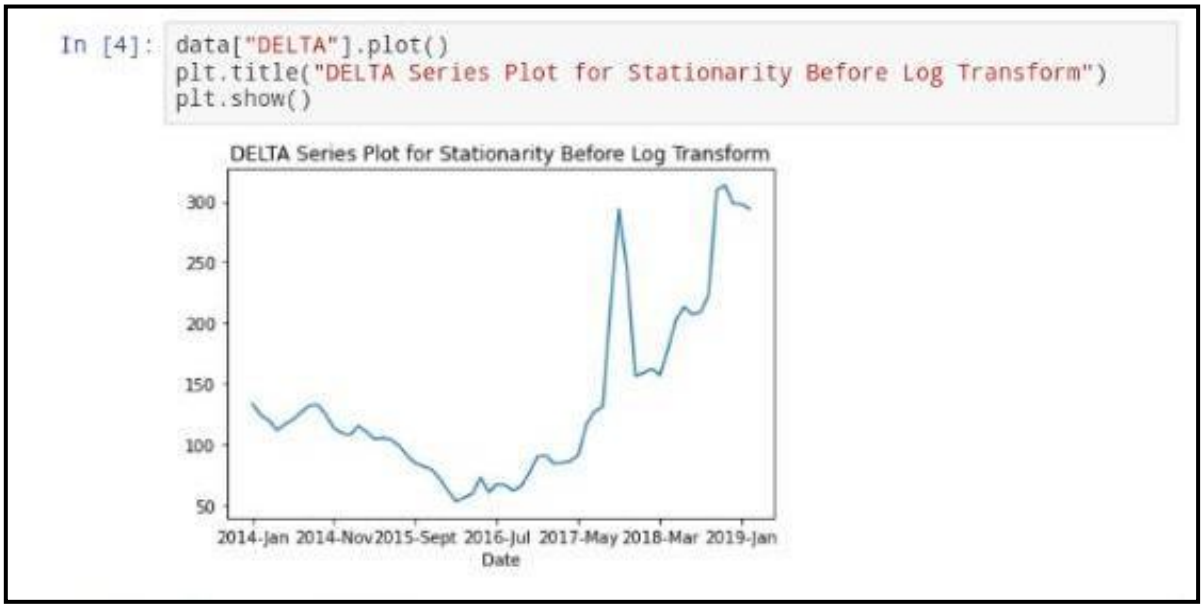


Figure 4.3: Graphical Presentation Before Log- Transformation

From the graph above (figure 4.3), we can see the non-stationarity of variables. This means the statistical properties such as variance and mean are changing through time and this was evidenced by (Ryan, 2021).

After Log transformation

Results Using logged data

In [16]:
```
data2 = log(data)
```

In [17]:
```
data2.head()
```

Out[17]:

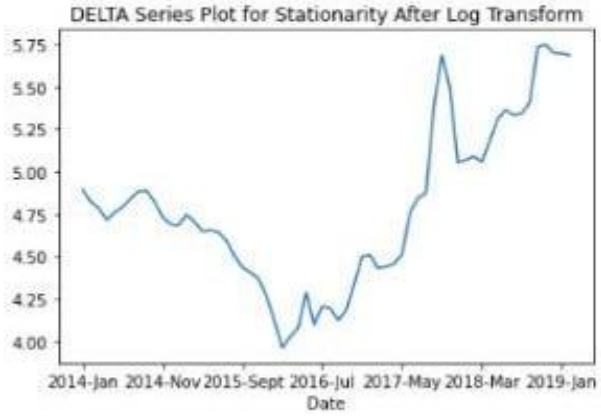
Date	UNIFREIGHT	ECONET	DELTA	OLDMUTUAL	INNSCOR	LAFARGE	OK ZIM	TRUWORTHS	TSL	SIMBISA	Industrial index
2014-Jan	1.098612	4.112512	4.891627	5.490589	4.362844	4.700480	2.992728	1.406097	3.641264	-inf	5.291796
2014-Feb	1.458615	4.127134	4.821249	5.492732	4.337029	4.506454	2.967847	1.386294	3.594569	-inf	5.249495
2014-Mar	1.609438	4.156850	4.784738	5.525572	4.252345	4.417635	2.861057	1.358409	3.613347	-inf	5.212868
2014-Arp	1.704748	4.116269	4.714563	5.512016	4.121473	4.262680	2.949688	1.175573	3.489513	-inf	5.146506
2014-May	1.879465	4.175617	4.759435	5.514678	4.217594	4.174387	2.925846	1.004302	3.385407	-inf	5.159400

In [18]:
```
#ADF Stationarity test

from statsmodels.tsa.stattools import adfuller
test2 = adfuller(data2["DELTA"])
print("ADF Test statistic: %f" % test2[0])
print("P-value: %f" % test2[0])
print("Critical values:")
for key, value in test2 [4].items():
    print("\t%s : %.3f" %(key, value))
```

```
ADF Test statistic: -0.277913
P-value: -0.277913
Critical values:
        1% : -3.546
        5% : -2.912
        10% : -2.594
```

Figure 4.4: After Log Transformation

```
In [5]: from numpy import log
log_data =log(data["DELTA"])
log_data.plot()
plt.title("DELTA Series Plot for Stationarity After Log Transform")
plt.show()
```




```
In [6]: #ADF Stationarity test
```

Figure 4.5: Graphical Presentation After Log-Transformation

From the graph above (figure 4.5), we can see the non-stationarity of variables. This means the statistical properties such as variance and mean are changing through time and this was evidenced by (Ryan, 2021).

4.4 The Mean and Variance

Mean and variance are the most effective two characteristics of the return distribution of securities (Markowitz, 1952). The researcher calculated the mean and variance of the selected counters from the Zimbabwe Stock Exchange and the results are presented below.

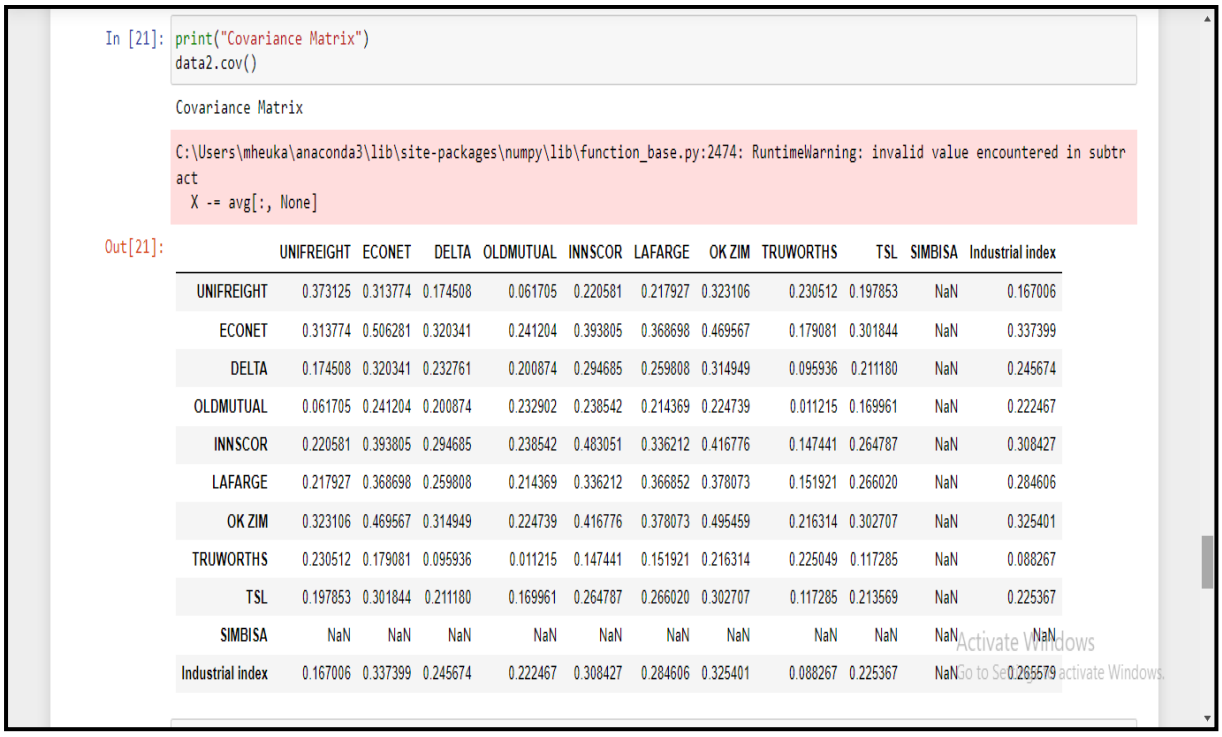
```
In [19]: print("Mean Values")
print(data2.mean())

Mean Values
UNIFREIGHT          0.568288
ECONET              3.912687
DELTA               4.782910
OLDMUTUAL           5.851078
INNSCOR             4.176754
LAFARGE             4.051605
OK ZIM              2.406041
TRUWORTHS           0.239814
TSL                 3.260365
SIMBISA                 -inf
Industrial index    5.268453
dtype: float64

In [20]: print("Variances")
print(data2.var())

Variances
UNIFREIGHT          0.373125
ECONET              0.506281
DELTA               0.232761
OLDMUTUAL           0.232902
INNSCOR             0.483051
LAFARGE             0.366852
OK ZIM              0.495459
TRUWORTHS           0.225049
TSL                 0.213569
SIMBISA                  NaN
Industrial index    0.265579
dtype: float64
```

Figure 4.6: Mean and Variance Results

From the above diagrams it is shown that OLDMUTUAL had a highest mean return of 5.851078 and risk of 0.482600, and the risk was calculated by applying square root on variances and this agree with the view that the higher the return the higher the risk.

4.5 The Covariance Matrix

The covariance matrix measures the direction of stocks (Patjoshi et.al, 2020). The covariance of two stocks tends to be high when their prices move in the same direction, conversely low covariance means the two stock prices move in the opposite direction. Thus, when constructing a portfolio, investors were entitled to choose stocks that will not move in the same direction or not move together, given that there may be greater chance of economic shift. It is found from the covariance matrix below that ECONET, and OK ZIM have the highest covariance amongst them, and it is not advisable for investors to invest in these two stocks as they are likely to be affected in the case of economic change.



```
In [21]: print("Covariance Matrix")
         data2.cov()
```

```
Covariance Matrix
C:\Users\mheuka\anaconda3\lib\site-packages\numpy\lib\function_base.py:2474: RuntimeWarning: invalid value encountered in subtr
act
  X -= avg[:, None]
```

Out[21]:

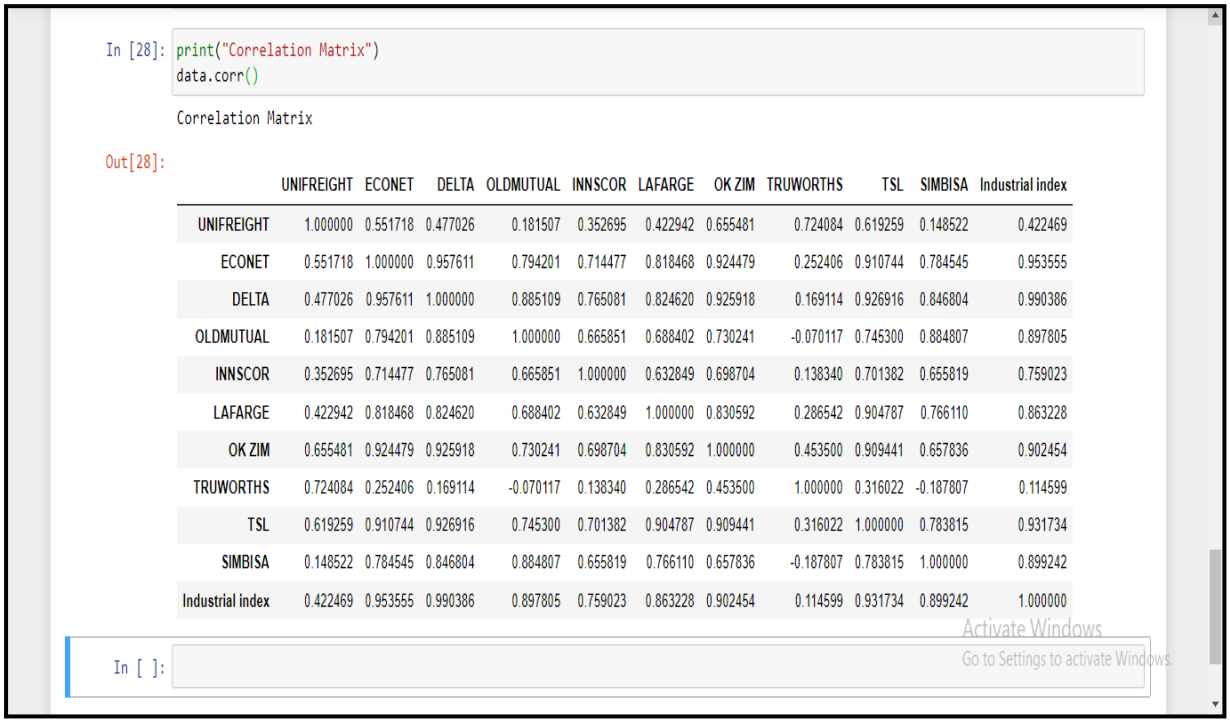
	UNIFREIGHT	ECONET	DELTA	OLDMUTUAL	INNSCOR	LAFARGE	OK ZIM	TRUWORTHS	TSL	SIMBISA	Industrial index
UNIFREIGHT	0.373125	0.313774	0.174508	0.061705	0.220581	0.217927	0.323106	0.230512	0.197853	NaN	0.167006
ECONET	0.313774	0.506281	0.320341	0.241204	0.393805	0.368698	0.469567	0.179081	0.301844	NaN	0.337399
DELTA	0.174508	0.320341	0.232761	0.200874	0.294685	0.259808	0.314949	0.095936	0.211180	NaN	0.245674
OLDMUTUAL	0.061705	0.241204	0.200874	0.232902	0.238542	0.214369	0.224739	0.011215	0.169961	NaN	0.222467
INNSCOR	0.220581	0.393805	0.294685	0.238542	0.483051	0.336212	0.416776	0.147441	0.264787	NaN	0.308427
LAFARGE	0.217927	0.368698	0.259808	0.214369	0.336212	0.366852	0.378073	0.151921	0.266020	NaN	0.284606
OK ZIM	0.323106	0.469567	0.314949	0.224739	0.416776	0.378073	0.495459	0.216314	0.302707	NaN	0.325401
TRUWORTHS	0.230512	0.179081	0.095936	0.011215	0.147441	0.151921	0.216314	0.225049	0.117285	NaN	0.088267
TSL	0.197853	0.301844	0.211180	0.169961	0.264787	0.266020	0.302707	0.117285	0.213569	NaN	0.225367
SIMBISA	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
Industrial index	0.167006	0.337399	0.245674	0.222467	0.308427	0.284606	0.325401	0.088267	0.225367	NaN	0.265579

Figure 4.7: Covariance Matrix

4.6 Correlation Matrix

Figure 4.8 below provides the correlation matrix for the average monthly returns. The correlation matrix measures the consistency or tendency for two stocks to act in a similar way. It is found that the average monthly returns of Industrial Index are positively correlated

with that of DELTA returns. The Industrial Index monthly returns are highly correlated with that of DELTA (0.990386), whereas it has recorded the lowest correlation with that of TRUWORTHS (0.114599). The top five highly correlated stocks with the Industrial Index are DELTA, ECONET, TSL, OK ZIM and SIMBISA and less correlated are TRUWORTHS, UNIFREIGHT, INNSCOR, LAFARGE and OLDMUTUAL.



```
In [28]: print("Correlation Matrix")
         data.corr()
```

Correlation Matrix

Out[28]:

	UNIFREIGHT	ECONET	DELTA	OLDMUTUAL	INNSCOR	LAFARGE	OK ZIM	TRUWORTHS	TSL	SIMBISA	Industrial index
UNIFREIGHT	1.000000	0.551718	0.477026	0.181507	0.352695	0.422942	0.655481	0.724084	0.619259	0.148522	0.422469
ECONET	0.551718	1.000000	0.957611	0.794201	0.714477	0.818468	0.924479	0.252406	0.910744	0.784545	0.953555
DELTA	0.477026	0.957611	1.000000	0.885109	0.765081	0.824620	0.925918	0.169114	0.926916	0.846804	0.990386
OLDMUTUAL	0.181507	0.794201	0.885109	1.000000	0.665851	0.688402	0.730241	-0.070117	0.745300	0.884807	0.897805
INNSCOR	0.352695	0.714477	0.765081	0.665851	1.000000	0.632849	0.698704	0.138340	0.701382	0.655819	0.759023
LAFARGE	0.422942	0.818468	0.824620	0.688402	0.632849	1.000000	0.830592	0.286542	0.904787	0.766110	0.863228
OK ZIM	0.655481	0.924479	0.925918	0.730241	0.698704	0.830592	1.000000	0.453500	0.909441	0.657836	0.902454
TRUWORTHS	0.724084	0.252406	0.169114	-0.070117	0.138340	0.286542	0.453500	1.000000	0.316022	-0.187807	0.114599
TSL	0.619259	0.910744	0.926916	0.745300	0.701382	0.904787	0.909441	0.316022	1.000000	0.783815	0.931734
SIMBISA	0.148522	0.784545	0.846804	0.884807	0.655819	0.766110	0.657836	-0.187807	0.783815	1.000000	0.899242
Industrial index	0.422469	0.953555	0.990386	0.897805	0.759023	0.863228	0.902454	0.114599	0.931734	0.899242	1.000000

```
In [ ]:
```


Figure 4.8: Correlation Matrix

4.7 Estimating Beta

β is a statistical parameter known as beta is the one that is used to calculate security's portfolio risk. The parameter measures the sum of systematic risk on a security or else the trade zone that have relation towards a complete stock market. If β is less than 1 it means that the security is less volatile than the market whilst if β is greater than 1, it means that the security is likely to be more volatile than the market. The beta values were computed by regressing the returns of stocks for counters listed under the industrial index. The regression model to be used is as follows.

$R_{i,t} - R_{f,t} = \alpha + \beta_i (R_{m,t} - R_{f,t}) + \varepsilon_t$

Where:

$R_{i,t}$ = the return on the asset i at time t.

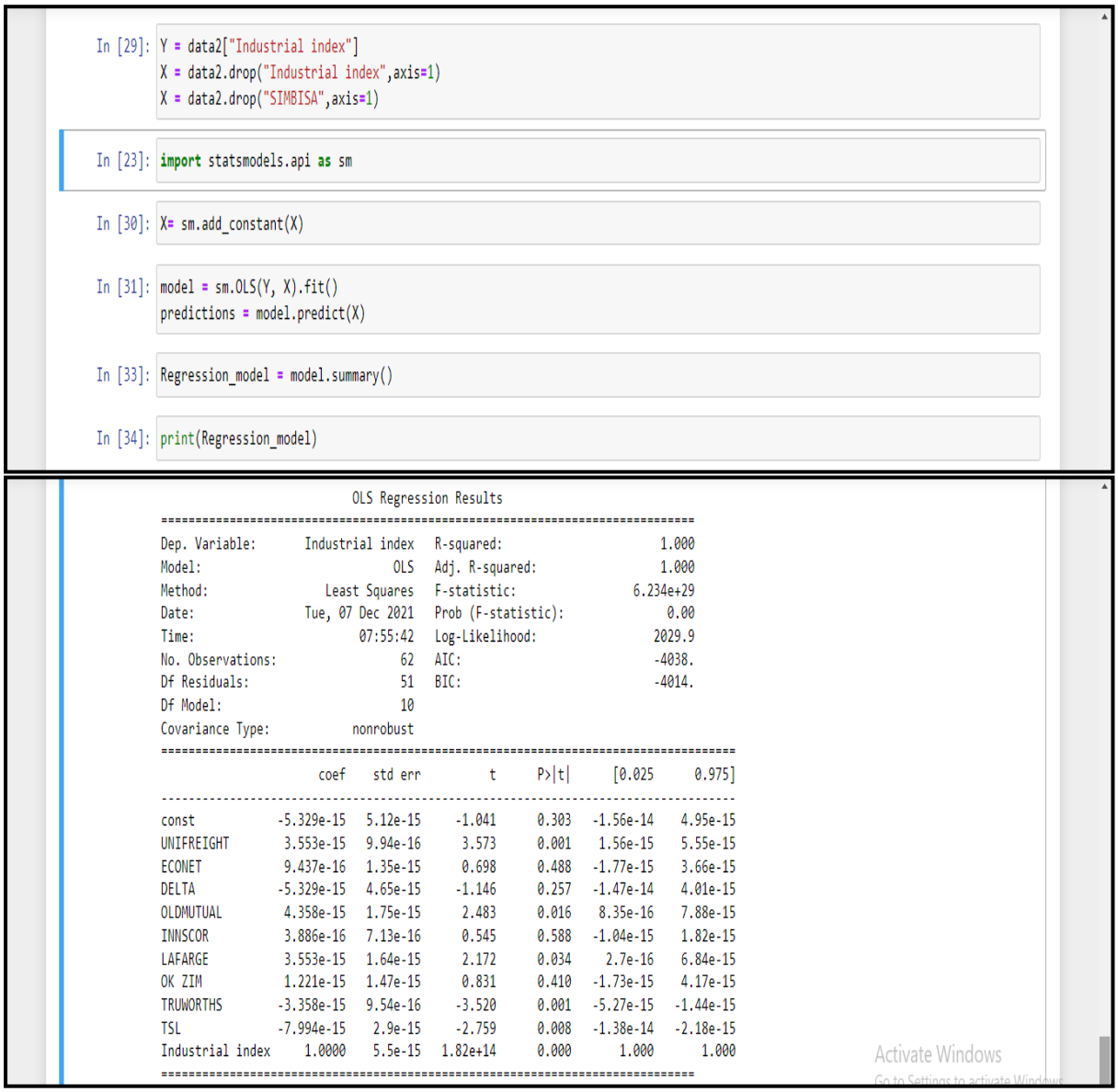
$R_{f,t}$ = the risk-free rate at time t.

β_i = the beta estimate of an asset i.

$R_{m,t}$= the rate of return on the market portfolio at time t.

$\boldsymbol{\varepsilon_t}$= the error term which is assumed to be random.

To compute the values of beta, the relevant statistics (OLS regression) was carried out for ten (10) counters selected.



```
In [29]: Y = data2["Industrial index"]
         X = data2.drop("Industrial index",axis=1)
         X = data2.drop("SIMBISA",axis=1)

In [23]: import statsmodels.api as sm

In [30]: X= sm.add_constant(X)

In [31]: model = sm.OLS(Y, X).fit()
         predictions = model.predict(X)

In [33]: Regression_model = model.summary()

In [34]: print(Regression_model)
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:      Industrial index   R-squared:                       1.000
Model:                          OLS   Adj. R-squared:                  1.000
Method:               Least Squares   F-statistic:                6.234e+29
Date:              Tue, 07 Dec 2021   Prob (F-statistic):               0.00
Time:                      07:55:42   Log-Likelihood:                2029.9
No. Observations:                62   AIC:                            -4038.
Df Residuals:                    51   BIC:                            -4014.
Df Model:                        10
Covariance Type:           nonrobust
==============================================================================
                     coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          -5.329e-15   5.12e-15     -1.041      0.303   -1.56e-14    4.95e-15
UNIFREIGHT      3.553e-15   9.94e-16      3.573      0.001    1.56e-15    5.55e-15
ECONET          9.437e-16   1.35e-15      0.698      0.488   -1.77e-15    3.66e-15
DELTA          -5.329e-15   4.65e-15     -1.146      0.257   -1.47e-14    4.01e-15
OLDMUTUAL       4.358e-15   1.75e-15      2.483      0.016    8.35e-16    7.88e-15
INNSCOR         3.886e-16   7.13e-16      0.545      0.588   -1.04e-15    1.82e-15
LAFARGE         3.553e-15   1.64e-15      2.172      0.034     2.7e-16    6.84e-15
OK ZIM          1.221e-15   1.47e-15      0.831      0.410   -1.73e-15    4.17e-15
TRUWORTHS      -3.358e-15   9.54e-16     -3.520      0.001   -5.27e-15   -1.44e-15
TSL            -7.994e-15    2.9e-15     -2.759      0.008   -1.38e-14   -2.18e-15
Industrial index    1.0000    5.5e-15   1.82e+14      0.000       1.000       1.000
==============================================================================
```


Figure 4.9: Regression Results

From the figure 4.9 above the coefficients represent the beta values for each stock in the regression output.

The table below shows the mean values.

Table 4.1: Mean Returns

Stock	Mean Return
UNIFREIGHT	0.568288
ECONET	3.912687
DELTA	4.782910
OLDMUTUAL	5.851078
INNSCOR	4.176754
LAFARGE	4.051605
OK ZIM	2.406041
TRUWOTHS	0.239814
TSL	3.260365
SIMBISA	-inf
INDUSTRIAL INDEX	5.268453

4.8 The relationship Between Risk and Expected Return

From the regression results in a table 4.9 above, it can be seen that 5 out of 10 counters were statistically significance in explaining the relationship between risk and expected return at 5% significance level, these include UNIFREIGHT (P = 0.001), OLDMUTUAL (P = 0.016), LAFARGE (P = 0.034), TRUWORTHS (P = 0.001) and TSL(P = 0.008). In addition, the other 5 counters which include ECONET, DELTA, INNSCOR, OK ZIM and SIMBISA were statistically insignificant according to the results on figure 4.9 at 5% significance level.

UNIFREIGHT, OLDMUTUAL and LAFARGE have high coefficients of beta values of 3.553, 4.358 and 3.553. This means an additional one unit of risk on UNIFREIGHT leads to an increase in return by 3.553, also an additional unit of risk on OLDMUTUAL will resulted to an increase in return by 4.358 and finally an additional unit of risk on LAFARGE will lead to an increase in return by 3.553. UNIFREIFGT, OLDMUTUAL and LAFARGE have high beta values of 3.553, 4.358 and 3.553 with mean return of 0.568288, 5.851078 and 4.051605 respectively. Therefore, we conclude that high beta – high return view is shown hence there

is a positive relationship between risk and expected return. Hundal et al. (2019) who concluded that the high beta- high returns relationship was fully exhibited by ZSE stocks support this. However, Rachmawati and Rizkianto (2020) contradicts the findings of this research and they conclude that there is a negative relationship between risk and expected return.

4.9 Linearity Between Expected Rate of Return and Stock Beta

From the regression results in table 4.9 above,5 out of 10 counters were statistically significance in explaining that risk and expected return are linearly related at 5% significance level, these include UNIFREIGHT (P = 0.001), OLDMUTUAL (P = 0.016), LAFARGE (P = 0.034), TRUWORTHS (P = 0.001) and TSL (P = 0.008). In addition, the other 5 counters which include ECONET, DELTA, INNSCOR, OK ZIM and SIMBISA were statistically insignificant according to the results on figure 4.9 at 5% significance level.

It is shown that UNIFREIGHT, OLDMUTUAL and LAFARGE have high beta values of 3.553, 4.358 and 3.553 with high mean returns of 0.568288, 5.851078 and 4.051605 respectively; therefore, an increase in beta resulted in an increase in mean return. This means that the risk and return are moving in the same direction; therefore, we conclude that there is linearity between risk and expected return. Mehara (2014) who concluded that there is an affirmative linearity between risks with the expected return was fully supported by the Zimbabwe Stock Exchange's stocks which showed linearity between risk and return. On the other side, Kamar et al. (2020) contradicts these findings and they conclude that there is no linearity between expected return and stock beta.

4.10 Validity Capital Asset Pricing Model

From the regression results in table 4.9 above, it can be seen that 5 out of 10 counters were statistical significance in explaining the validity of Capital Asset Pricing Model at 5% significance level, these include UNIFREIGHT (P = 0.001), OLDMUTUAL (P = 0.016), LAFARGE (P = 0.034), TRUWORTHS (P = 0.001) and TSL(P = 0.008). In addition, the other 5 counters which include ECONET, DELTA, INNSCOR, OK ZIM and SIMBISA were statistically insignificant according to the results on figure 4.9 at 5% significance level. From the regression output above (figure 4.9), it is shown that the Adjusted R-Squared value is 1.000 which means the model is performing well and we conclude that the Capital Asset Pricing Mo del is valid for Zimbabwe Stock Exchange as this was supported by (Khan et al. 2020) who evaluated the validity of Capital Asset Pricing Model the no Pakistan Stock

Exchange. From their findings they conclude that the Capital Asset Pricing Model is valid for Pakistan Stock Exchange. However, Farhat (2021) contradicts the notion that the CAPM is valid on the Zimbabwe Stock Exchange therefore Farhat (2021) conclude that the CAPM is not valid for the stock exchange.

UNIFREIGHT, OLDMUTUAL and LAFARGE have high beta coefficients of 3.553, 4.358 and 3.553 with high mean return of 0.568288, 5.851078 and 4.051605 respectively. This satisfies a notion of high risk- high return of Capital Asset Pricing Model and we conclude that the CAPM model is valid for Zimbabwe Stock Exchange with evidence along the study findings by Khan et al. (2020). However, Farhat (2021) contradicts the notion that the CAPM is valid on the Zimbabwe Stock Exchange therefore Farhat (2021) conclude that the CAPM is invalid.

The researcher calculated the R- squared, that is the coefficient of determination which tells us how much percentage of variation dependent variable can be explained by independent variable. In this case 100% variation in Industrial Index can be explained by stocks (UNIFREIGHT, ECONET, DELTA, OLDMUTUAL, INNSCOR, LAFARGE, OK ZIM, TRUWOTHS and TSL) therefore the CAPM model fits the data well and conclude that the Capital Asset Pricing Model is valid on the Zimbabwe Stock Exchange.

4.11 Summary

This chapter centred on the findings, data interpretation and analysis. From the results, high risk- high return relationship was fully hold on Zimbabwe Stock Market. Hundal et al. (2019) agrees with the notion that high risk- high return, which is fully exhibited by the counters on the Zimbabwe Stock Market. Most of the counters have positive beta values, which mean the stocks are more volatile hence it is risk to invest in these stocks. The next chapter presents the conclusion and the recommendation of the study.

CHAPTER 5

SUMMARY, RECOMMENTATION AND CONCLUSION

5.1 Introduction

This chapter summarizes the research project as well as conclusions and recommendations based on the results presented and related theory stated in literature review. The research intends to look at the relationship between risk and expected return and testing the validity of Capital Asset Pricing Model. Under this thesis the researcher carried out the mean- variance analysis so as to model risk and expected return on the Zimbabwe Stock Exchange. The model namely Capital Asset Pricing Model was used to calculate the coefficients of beta values for the ten counters selected. Based on research findings in previous chapter and the objectives of the study, the researcher drew recommendations and suggestions.

5.2 The Summary of Findings and Conclusions

The objectives of the research was to identify the risk and return relationship using the Capital Asset Pricing Model for monthly stock returns of the ten counters selected. The research methodology in this study was particularly based on quantitative analytics. The data was collected from the Zimbabwe Stock Exchange websites for the period of January 2014 to February 2019. The research set out the findings to determine the degree of risk and expected return. The researcher used a sample size of ten counters which have been traded constantly for the period under the study.

The study used the Capital Asset Pricing Model to identify the relationship between risk and expected return and the model (CAPM) states that high risk (β) is associated with high returns. The results indicate that UNIFREIGHT, OLDMUTUAL and LAFARGE were statistically significance at 0.05 significance level with their p-values of 0.001, 0.016 and 0.034 respectively. The results of the study support this notion as high beta- high return relationship was exhibited on the counters (OLDMUTUAL, UNIFREIGHT and LAFARGE); therefore we conclude that there is positive relationship between risk and expected return and the model is valid for Zimbabwe Stock Exchange. Hundal et al. (2019) who concluded that the high beta- high returns relationship was also fully exhibited by ZSE stocks supporting this. From the research findings it is shown that beta coefficients and mean returns were moving in same direction. Therefore we conclude that there is linearity between risk and return. However the findings of this research contradicts with the findings of Rachmawati and Rizkianto (2020). The researcher tested the presence of stationarity assumption and most of

the counters were non- stationary, however the researcher have applied log transformation on the counters that confirm non- stationarity.

5.3 Recommendations

It is of great important to conduct surveys so as to provide investors with clear investment decisions primarily based totally on risk and return as the study has recognized that if an investor accepts higher risks, therefore the returns would be higher as well. Basing on research findings obtained, we can see that beta coefficients act as the measure to determine the volatility of stocks, thereby before figuring out which stock to invest in, there may need to check the values of betas so that it becomes easy to predict stock returns and this was supported by (Sinaee and Morad, 2010).

There are other risk measures that can be used other than CAPM to ensure exact and accurate forecast of the variance. Before making a decision on investing on the stock market, one should weigh up the performance of the stock market first and before choosing counters to include in your portfolio, one should have visible information of the stocks in terms of current performance that is whether they are not encountering losses.

5.4 Suggestions for further research

The purpose of the study has been met, that is to identify the relationship between risk and expected return and to test if the CAPM is valid for Zimbabwe Stock Exchange. This provides additional avenues for further research that is other factors affecting stock returns and risk of a stock should be considered. To add more factors that affecting the performance of Zimbabwe Stock Market have been considered and some of these factors encompass inflation and exchange rates.

5.5 Chapter Summary

This chapter give the summary of results and it was centred on the summary of findings, conclusions, recommendations and suggestions for further research.

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APPENDIX

APPENDIX 1: Regression Results

OLS Regression Results

Dep. Variable:	Industrial index	R-squared:	1.000
Model:	OLS	Adj. R-squared:	1.000
Method:	Least Squares	F-statistic:	6.234e+29
Date:	Tue, 07 Dec 2021	Prob (F-statistic):	0.00
Time:	07:55:42	Log-Likelihood:	2029.9
No. Observations:	62	AIC:	-4038.
Df Residuals:	51	BIC:	-4014.
Df Model:	10		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	-5.329e-15	5.12e-15	-1.041	0.303	-1.56e-14	4.95e-15
UNIFREIGHT	3.553e-15	9.94e-16	3.573	0.001	1.56e-15	5.55e-15
ECONET	9.437e-16	1.35e-15	0.698	0.488	-1.77e-15	3.66e-15
DELTA	-5.329e-15	4.65e-15	-1.146	0.257	-1.47e-14	4.01e-15
OLDMUTUAL	4.358e-15	1.75e-15	2.483	0.016	8.35e-16	7.88e-15
INNSCOR	3.886e-16	7.13e-16	0.545	0.588	-1.04e-15	1.82e-15
LAFARGE	3.553e-15	1.64e-15	2.172	0.034	2.7e-16	6.84e-15
OK ZIM	1.221e-15	1.47e-15	0.831	0.410	-1.73e-15	4.17e-15
TRUWORTHS	-3.358e-15	9.54e-16	-3.520	0.001	-5.27e-15	-1.44e-15
TSL	-7.994e-15	2.9e-15	-2.759	0.008	-1.38e-14	-2.18e-15
Industrial index	1.0000	5.5e-15	1.82e+14	0.000	1.000	1.000

Omnibus:	1.165	Durbin-Watson:	0.464
Prob(Omnibus):	0.558	Jarque-Bera (JB):	1.209
Skew:	0.298	Prob(JB):	0.546
Kurtosis:	2.666	Cond. No.	408.

Notes:

[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

APPENDIX 2: Mean Values

```
In [19]: print("Mean Values")
         print(data2.mean())

         Mean Values
         UNIFREIGHT         0.568288
         ECONET             3.912687
         DELTA              4.782910
         OLDMUTUAL          5.851078
         INNSCOR            4.176754
         LAFARGE            4.051605
         OK ZIM             2.406041
         TRUWORTHS          0.239814
         TSL                3.260365
         SIMBISA               -inf
         Industrial index   5.268453
         dtype: float64
```

APPENDIX 3

CODE A

```
import pandas as pd

import numpy as np

import matplotlib.pyplot as plt

data = pd.read_csv(r'C:\Users\munnah\Desktop\Munna.csv')

data.head()
```

CODE B

```
data["DELTA"].plot()

plt.title("DELTA Series Plot for Stationarity Before Log Transform")

plt.show()

from numpy import log

log_data =log(data["DELTA"])

log_data.plot()
```

```
plt.title("DELTA Series Plot for Stationarity After Log Transform")

plt.show()

#ADF Stationarity test


from statsmodels.tsa.stattools import adfuller

test = adfuller(data["DELTA"])

print("ADF Test statistic: %f" % test[0])

print("P-value: %f" % test[0])

print("Critical values:")

for key, value in test [4].items():

print("\t%s : %.3f" %(key, value))
```

CODE C

```
print("Mean Values")

print(data.mean())

print("Variances")

print(data.var())

print("Covariance Matrix")

data.cov()

print("Correlation Matrix")

data.corr()
```

CODE D: Results Using logged data

```
data2 = log(data)

data2.head()
```

#ADF Stationarity test

```
from statsmodels.tsa.stattools import adfuller

test2 = adfuller(data2["DELTA"])

print("ADF Test statistic: %f" % test2[0])

print("P-value: %f" % test2[0])

print("Critical values:")

for key, value in test2 [4].items():

print("\t%s : %.3f" %(key, value))
```

CODE E

```
print("Mean Values")

print(data2.mean())

print("Variances")

print(data2.var())

print("Covariance Matrix")

data2.cov()
```

```
C:\Users\munna\anaconda3\lib\site-packages\numpy\lib\function_base.py:2474: RuntimeWar
ning: invalid value encountered in subtract
  X -= avg[:, None]
Y = data2["Industrial index"]
X = data2.drop("Industrial index",axis=1)
X = data2.drop("SIMBISA",axis=1)
import statsmodels.api as sm
X= sm.add_constant(X)
model = sm.OLS(Y, X).fit()
predictions = model.predict(X)
```

```
Regression_model = model.summary()
print(Regression_model)
```