AN INVESTIGATION OF THE RELATIONSHIP BETWEEN SYSTEMATIC RISK AND RETURN AT THE NAMIBIAN STOCK EXCHANGE

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Abstract

This paper presents an empirical analysis on the relationship risk and return. This study is helpful to analyse the asymmetric nature of data including the seasonal effect and non-linear properties in risk and return relationship scenario. In this study, monthly data was used regarding stock prices and the NSX local index, Market capitalisation ratios and beta was calculated. The data span of all variables covers the time period from January 2013 to December 2017. Our results show that the transmission return to risk is partially complete in the long run. The result revealed that there is a long-run relationship between risk and return. The results also show that about 18.2% of the disequilibrium in return is corrected within the next period.

We employed VECM model in the study as we found a cointegrating relationship between the variables. VECM offers a possibility to apply Vector Autoregressive Model (VAR) to integrated multivariate time series. The study tested for serial correlation and conditional heteroscedasticity. The results confirm the absence of conditional heteroscedasticity and serial correlation. Moreover, the model was not normally distributed. Therefore, the econometric model employed in the study is not so vigorous, at least, from a technical perspective.

Keywords: Returns, Risk, Beta, Market cap

1. DECLARATION

I, TUPANDULE SHIPO declare that this research project is my own original work, and that all sources have been accurately reported and acknowledged, and that this Thesis has not been previously in its entirety, or in part been submitted at any academic institution in order to obtain an academic qualification.

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Signature Date

CHAPTER 1: INTRODUCTION

1.1 Introduction and Research Background

The Namibian Stock Exchange (NSX) is an automated market place where financial security listed are traded for example bonds and equities. The NSX manages and regulates the activities and transactions of its members listed on the stock exchange, providing information of the listed companies and of the stock exchanges. There are 38 companies listed on the (NSX, 2016).

Decision-making processes of financial firms are well determined by the risk and expected return trade-off which include: investment; finance; and reallocation decisions. Investors undertake high risk if there is a compensating expected return (Mollik & Bepari, 2015). Two measures of risk mainly endorsed in finance, include standard deviation as an indicator for a firms' specific risk and Beta and variance as an indicator of a market related risk. However, the effect of a security to the risk of a portfolio is best measured by Beta. (Ross, Westerfield & Jaffe, 2003).

With numerous risks that affect a stock exchange, systematic risk is of concern as it coincides with the CAPM that is to be undertaken in this research. Systematic risk is denoted as the contribution of an asset to the risk of a portfolio whilst attempting fair allocation. The widely used measure of systematic risk is "Beta" of a financial asset which as highlighted before is the influence of an asset to the risk of a financial security computed by the variance of the expected return (Kadan, Liu, & Liu, 2013). Similarly, as stated by Mollik and Bepari (2015) that "(CAPM) framework, systematic risk or beta is the only relevant risk of an asset and it can be measured by the covariance of the asset return with the market return or by the covariance with other common factors related to investors' marginal utility in Merton's (1973) inter-temporal capital asset pricing model (ICAPM).".

Consequently, Beta denotes the marginal contribution of systematic risk to the share or expected return of a risky security. It is hereby stated that a portfolio with a beta with a value of more than 1 is expected to have an over-average effect on the risk of the portfolio and vice versa (Agarwal & Mangle, 2014). A linear model that approximates the expected return on a particular asset in relation to systematic risk (β) is Capital Asset Pricing Model (CAPM).

In addition, systematic risk is identical with volatility hence it being difficult to entirely avoid it, unless an investor remains with cash positions. Non-systematic risks are risks specific to an investment in a company or sector. This risk is reducible through diversification. However, diversification is constrained when attempting to reduce systematic risk nonetheless, strategic asset allocation minimizes systematic risk in a portfolio (Mehrara, Falahati, & Zahiri, 2014).

Janata (2016) noted that the optimal decisions of financial investors usually depends on which is the suitable trade-off between risk and returns. Preferably, it should be one that reaps the highest returns achieved at the lowest risk. However, reaching such optimal state is challenging to investors as the risks and returns for any investment are positively correlated. if the CAPM prediction are true, it provides two indications of the strategy of investing: an investor should diversify their risky assets in proportion to the market portfolio; and combine risky assets with risk free securities to obtain the optimal desired levels (Czekierda, 2007).

1.1 Statement of the problem

With risk in its entirety being a very complex issue, its implications have been widely debated over the years, gaining more prominence during the recent financial crises where markets and financial securities were highly affected. When one seeks to determine the ex-ante probabilities of the effects of risk, this becomes a topic of interest (Kadan, Liu, & Liu, 2013).

The CAPM remains a dominant theoretical framework for studying the relationship between risk and return. However, since the seminal 1992 article of Fama and French, there has been growing evidence that Beta alone cannot explain the relationship between risk and return. Furthermore, there is also growing evidence that the relationship between Beta and returns are not always positive, as implied by CAPM. This is particularly factual in the emerging markets context see for example, Mollah and Mobarek (2009) and Džaja and Aljinović (2013) both discarding the applicability of the single factor CAPM. This questions whether Beta can explain the relationship between risk and return in all markets. Furthermore, there are currently no studies done on the relationship between risk and return in Namibia, and this identifies a huge research gap that needs to be explored.

1.2 Research objective

- The main objective of this paper would be to determine the relationship between systematic risk and returns of portfolios on the Namibian Stock Exchange.
- The second objective is to test the causal relationship between systematic risk and return.

1.3 Hypotheses

Ho: There is a no relationship between systematic risk and return

Ha: There is a relationship between systematic risk and return

Ho: Systematic risk does not Granger cause return

Ha: Systematic risk Granger cause return

1.4 Significance of the study

This research is crucial for present and future investors of companies that are to trade on the Namibian Stock Exchange as this would highlight how the market is impacted by risk. Similarly, to scholars, the addition to already existing literature serves as a pedestal for future explorations. Other stakeholders such as government and authoritative bodies such as NAMFISA that regulate the financial market would then be provided with valuable information that would assist in understanding the market. Lastly, the nature of estimating beta is extremely complicated, especially in a small emerging market, therefore. The study will not only contribute in terms of results but also in terms of testing the different methodologies and which works best for the NSX.

1.5 Limitations of the study

The extent to which the validity of results will be accurate depends on how the model used approximates that actual market. All financial markets function differently and will therefore not all produce similar results.

1.6 Delimitations of the study

The study will focus on the period when all 38 companies listed on the stock were in existence. This, therefore, limits the study to a period of 5 years.

CHAPTER 2: LITERATURE REVIEW

2.1 Theoretical Literature

As stated in the context of the introduction, the purpose of this study is to examine the relationship between systematic risk and returns on the counters listed on the Namibian stock exchange. Therefore, this chapter will focus on the theoretical and empirical literature review

The theories that revolve around the risk and return topic are the Markowitz Portfolio Theory (MPT) (1952), the Capital Asset Pricing Model (CAPM) (1964) and the Arbitrage Pricing theory (APT) (1976). The CAPM is founded on the perceptions of the MPT and the APT on those of the CAPM as highlighted by (Mwaniki, 2015).

The Markowitz Portfolio Theory as developed by Markowitz (1952) is an investment theory that expresses an idea that risk-averse investors are able to form portfolios that maximize expected return specified by a certain market risk. Furthermore, emphasised is that the market risk is inherent of the expected return. The portfolio theory indicates that investing in securities that yield returns that are inversely related in the long run, will yield a given return at a lower risk or a higher return with the same level of risk for the entire portfolio, this theory only caters to the portfolio aspect and not that of fixed investment. Focardi and Fabozzi (2004) concurred that the principles that underline the MPT are that of utility optimizations. Where an investor's preference is based on the utility index which is a convex function taking into consideration the investors risk-return preference. The theory assumes that stock returns are jointly normal, this leads to the returns of any portfolio being normal distribution which in turn is determined by two parameters mean and variance- indicating a mean-variance analysis.

The Capital Asset Pricing Model describes the relationship between risk and returns in an efficient market. It revolves around the idea that, not all risk should affect asset prices. The only way an investor can get a higher return on his investment is by taking a higher risk. These aspects are summarized in the CAPM of Sharpe (1964) and Treynor (1961) and further extended by Lintner (1965), Mossin (1966), and Black (1972). The assumptions that revolve around the Sharpe (1964) and Lintner (1965) include the following: the model is of static nature (one period); there is a fixed asset supply; borrowing and leading is at the same rate (r); CAPM as highlighted by Ward and Muller (2012) is a linear model that approximates the expected return on a particular asset in relation to systematic risk (β) denoted by:

$$E(R_i) = R_f + \beta_i(E(R_m) - R_f) \quad (1)$$

Whereby: $E(R_i)$ is the expected return of the asset; R_f is the risk free interest rate; β_i (Beta) is the susceptibility of the expected asset returns to that of the expected market returns; $E(R_m)$ is the expected market return; and $(E(R_m) - R_f)$ is the market premium which is the expected market return less the risk-free rate of return. Beta measures the volatility of a share portfolio or share and estimates the impact on returns based on the activities in the market portfolio.

An extension of the CAPM is the multifactor CAPM postulated by Merton (1976) whereby it states that despite the risk of uncertainty, investors should also be concerned about three other types of risks namely: the future price of consumer good; the future labour income; and future investment opportunities. Highlighted in this extension, is that consumers derive optimal life consumption given different market risks denoted as factors. The model articulates that investors who wish to necessitate compensation for the extra market incur risks and not only the market risk. Thus, investors evade the risk of uncertainty by diversifying their investment by retaining market portfolios. In addition, investing in mutual funds is too utilised to evade extra market risks. However, the pricing of assets in the market place should indicate the risk premiums to compensate for the extra market risk, this is however difficult to establish given the value and detection of all market risks (Focardi & Fabozzi, 2004).

A similar concept is that of Stephen Ross (1976) the Arbitrage Pricing Theory (APT) posits that market risk is not the only type of risk that affects expected return as theorised by the CAPM. The model suggests that the return on a security is linearly related to a number of systematic risks. However, the APT model does not identify what these particular risks are, only that they are linear to the expected return of an asset. Furthermore, the model theorizes that investors expect to receive compensation for all the risk factors that systematically affect the expected return of a security. The highlighted compensation is the sum of the products of all factors systematic risk and the risk premium attached to the capital market. Differences between the CAPM and APT deem the APT more favourable mainly due to: the APT revolves around minimal restrictive assumptions concerning investors preferred risk and return; no assumptions dictate the distribution of asset returns; and lastly the APT does not depend on true market portfolio identification, therefore the theory is testable. The APT model articulates that no arbitrage is possible, meaning that given no additional funds or increase in risk, an investor is unable to increase their expected return from a portfolio (Focardi & Fabozzi, 2004).

A contradicting notion by Fama and French (1992) 3-factor model articulated that Beta was not the only variable that explains returns amongst securities or portfolios but the following explanatory variables could determine returns too: size and book to market factors. The model proposed entails controlling size, leverage, earnings of a security per share, book to market value and beta in a single cross sectional study. The results are however debatable, as the first stated positive relation between beta and expected returns turns to be negatively correlated between the size of a firm and beta. However, when the negative relation is accounted for, the relation between beta and expected returns disappears. Surprisingly, when beta is allowed to vary without keeping size constant, the positive relation identified by CAPM between beta and expected returns vanishes, thereby contradicting the single-period CAPM notion.

2.2 Empirical Literature

Most empirical studies have identified that there is no relationship between risk and return despite the theoretical background and practical application of the CAPM theory. However, in African context some studies have found an inverse relationship such as Ward and Muller (2012) when testing the CAPM on the Johannesburg Stock Exchange ranging from the period 31 December 1986 to 31 December 2011. With the conclusion being that, the use of a single beta CAPM is insufficient. The methodology administered estimates beta using OLS regression with monthly total return data and two years' prior weekly total return data, and the Dimson (1979) correction model is used to estimate beta for thinly traded markets.

In addition, Pamane and Vikpossi (2014) study on the Bourse Regionale des Valeurs Mobilieres (BRVM) Stock Exchange during the period January 2000 to December 2008, testing the CAPM too found that the relationship takes a nonlinearity nature. A combination of Black, Jensen, Scholes, Fama and Macbeth methods were used to test CAPM for the whole period with stock beta's utilised instead of portfolio beta's due to limited sample size. The Black, Jensen, Scholes method is used to estimated betas in the last period which are then utilised in the next period so as to determine, the statistical errors from the beta estimates.

Similarly, a study undertaken by Nyangara, Ndlovu, Nyangara and Tyavambiza (2016) testing the validity of the Capital Asset Pricing Model on the Zimbabwe Stock Exchange

(ZSE). The study utilised cross sectional stock returns on 31 stocks listed on the (ZSE) during the period March 2009 and February 2014. In summary, beta fell rapidly for periods greater than 6 months, nevertheless beta is deemed significant in explaining average monthly stock returns on the (ZSE). Testing the validity of the (CAPM) discards its soundness on the (ZSE) due to skewness and liquidity anomalies, furthermore the study failed to detect a size effect. Stock betas are estimated by deriving monthly log returns from daily prices from each stock and the industrial index, in addition a time series regressions are conducted of stock returns in relation to the industrial index returns.

Likewise, Mwaniki (2015) confirmed a negative relationship between risk and return on the Nairobi Securities Exchange (NSE). The study focused on investigating the relationship between risk and return for the period 1st January 2009 and 6th June 2014. Evaluating all the stocks listed on the NSE, the return on stocks attributed to a 20 share index and the returns and beta were thus calculated composed with a descriptive research design. The findings of the study go against the linearity assumption of the CAPM and this further goes to show the underdevelopment of the NSE in terms of size and products. The stock betas from individual stocks are calculated using Microsoft Excel 2007 with the CAPM equation.

In the same way, Janata (2016) took on a research exploring the validity of the CAPM on NSE. The Fama and Macbeth's two-pass regression method was to estimate data from the period May 2013 to May 2016 for 18 firms trading on the NSE. The beta estimated was found to be statistically different from zero, which concluded that CAPM could not explain the relation between risk and return on the NSE, rejecting its validity. Furthermore, a month by month cross-sectional regression methodology still failed to explain the anomalies in asset pricing. To estimate the beta for individual stocks, time series regressions were administered on stock returns of different securities in relation to the market returns.

Overviewing more developed financial markets, an empirical test carried out by Abdulkarim (2012) assessed the CAPM on the New York Stock Exchange (NYSE). The study examined the validity using 780 stocks listed on the NYSE comprised of monthly and weekly data from the March 1992 to May 2012 applying first pass or second pass traditional methodologies. In addition, the study compares the differences in results when using the static and the Rolling Ordinary Least Squares (OLS) to estimate the betas to test the model. The results concluded are: the first pass/ second pass techniques are both sensitive to the number of observations used in the sample; the static OLS better elucidates changes in the risk premium rather than the rolling OLS; both OLS methodologies highlight that non-systematic risks have no effect on premiums; in addition the Security Market Line (SML) is steeper in slope compared to previous studies when using either of the OLS methodologies; however the static OLS determines the presence of a linear relationship between expected return and beta unlike the rolling OLS that exposes a non-linear relationship between the two variables.

Furthermore, a study exploring the effect of risk of an asset on expected return in five European countries: Italy, Portugal, Greece, Crezch Republic and Poland. Examined were 40 major companies listed on the stock markets in the stated countries from the period January 2009 to December 2013. Two stage regression methodology is used to approximate the CAPM model, the first stage entails determining stocks of beta by linear regression, and secondly to probe the relationship between beta and average return of a portfolio through cross-sectional regression. It was concluded that, there is no relationship between average return and beta, but in the Italian stock market a linear relationship between expected return and beta was ascertained. Therefore, CAPM does not hold for the selected sample (Khudoykulov, Allado'stov & Khalikov, 2016).

Similarly, an analysis done on the London Stock Exchange examined the relation between systematic risk and returns on stocks using monthly data of 100 stocks that are randomly selected for the period January 1996 to December 2013. The study inspected the ability of CAPM beta in explaining variants in the expected stock returns in the equity market. the results conclude that with the application of OLS cross sectional regression, beta is insignificant in explaining variations in the stocks returns- highlighting that stocks on the London stock exchange are not sensitive to systematic risk (Nwani, 2013). Two estimation techniques were applied when estimating for beta, firstly time series regressions were done with all betas of individual stocks being calculated with equally weighted portfolios being created; secondly cross sectional Ordinary Least Squares (OLS) were applied to test for t5he CAPM.

Some studies have found supporting evidence in favour of the CAPM such as Salvatore and Eraslan (2016) whose study tested the existence of linearity between systematic risk and excess returns from portfolios of Turkish Stock Exchange. The study concludes the presence of linearity conditional to the realization of the market portfolio excess return. Furthermore, this linearity tends to strengthen depending on the magnitude of the realization, meaning the stronger the magnitude the stronger the relation between the two variables as estimated by the security market plane (SMP) model. A sample of 281 firms listed on the Istanbul Stock Exchange (ISE) was used for the period 2003 to June 2013 with time-series and pool cross sectional methodologies applied.

Likewise, Malik and Bepari (2015) undertook a study measuring the relationship between risk and return on the Dhaka Stock Exchange (DSE). The study confirms the significant presence of a positive relationship between risk and expected returns both in individual securities and portfolios. However, inconsistencies were identified with regards to risk for portfolios that exhibited higher risk, signifying the presence of anomalies or mispricing in assets that are high-risked. The study further estimated beta by regressing the monthly security returns divided by the returns of the market index.

Similarly, Atilgan and Demirtas (2013) discovered the presence of linearity when undertaking a study that tested the relationship between downside risk and expected return in emerging markets. The downside risk is measured using a nonparametric and parametric value at risk (VAR) so as to estimate the significance and presence of a trade-off between the two variables. The data from 27 emerging countries, determined a positive relationship when fixed- effect panel regressions were applied when testing for the trade-off between monthly expected returns and downside risk. The results tend to be sturdy when controlling the following variables: price to earnings ratio; price to cash flow ratio; and aggregate dividend yield.

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CHAPTER 3 RESEARCH METHODOLOGY

3.1. Introduction

This section discussed the methodology used to carry out the study in an effort to investigate the relationship between Risk and return for companies listed on the Namibian Stock Exchange (NSX), the study will follow Nyangara, et al (2016) in testing the relationship between Risk and Stock market returns.

3.2. Research design

Williams (2007) defines research design as the plan according to which we obtain research participants (subject) and collect information from them. There are two types of research design, which are mainly quantitative and qualitative designs. However, this study will follow the quantitative approach.

3.2.1. Quantitative Design

According to Welman and Kruger (1999) quantitative research is all about quantifying relationships between variables. Variables include attributes such as weight, functioning, time, and behaviour. The aim of quantitative designs is to classify features, count them, and construct statistical models to explain what is observed. Its aim is to determine the relationship between one thing (an independent variable) and another (a dependent or outcome variable) in a population. In this regard, the study will employ statistical and numerical analysis as well as mathematical values of data to establish the relationship among the variables in question.

3.3 Sample period

The study utilized secondary monthly time series data on stock market returns and other variables used in the study, which covers the period 2013 to 2017. This data was obtained from the NSX monthly annual reports and website. The NSX is mainly responsible for collecting and computing the statistical data on the listed companies in Namibia. Monthly data was used to avoid heteroscedasticity problem which is a major concern in the regression analysis because it can invalidate statistical tests of insignificance that assume that the modelling errors are uncorrelated and uniform.

3.4. Analytical Framework

3.4.1 Regression equation

The study used econometric techniques to determine the relationships between the risk and return of the listed companies on Namibian Stock exchange from 2013 to 2017. Additionally, the study used the time series data that is subject to non-stationary, unit roots test will be employed to test for stationary of the variables and a VECM model will be exercised. Furthermore, the study also employed a cointegration test on the different variables used to examine a long run and short run relationships. Granger causality test will be the last test to establish the direction of the relationship between variables used. Furthermore, a variance decomposition test will be employed to determine the importance of a random act on the variables.

The model will be specified as follows:

$$Y_t = f(X_1, X_2,) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

Where Y is Dependent and Xn are the explanatory variables where n=1.

Even though stock returns are dependent on many variables, the variables used to estimate the model as the exogenous variables are; the stock beta (Risk on the individual stock to risk on the NSX overall index), Size factor (market capitalization), and equation 1 can be re-written as:

$$R = f(Beta, SF)$$

Using t to denote time period (monthly) the model can be written as follows:

$$R_t = f(Beta_t + SF_t)$$

We specify the above model linearly in the form of an equation

$$R_t = \beta_0 + \beta_1 Beta_t + \beta_2\, SF_t + U_t \ldots\ldots \text{Eq. (2)}$$

Equation 3 will be log transformed and estimated in the following form for easy interpretation:

$$lnR_t = \beta_0 + \beta_1 lnBeta_t + \beta_2\, lnSF_t + U_t \ldots\ldots \text{Eq. (3)}$$

R = 24 months average return on the listed companies on the NSX

Beta = Risk on the individual counters on the NSX to the NSX overall index

SF = The ratio of the difference between the average market cap and the median cap

β0 = Constant

β1, β2, = Coefficients of the explanatory Independent variables

Ut = Stochastic or error term assumed statistically independent and randomly distributed with mean zero, constant variance and serially uncorrelated

We specify the following equation used to calculate the Beta variable:

$$\beta p = \frac{Cov(rp,rb)}{Var\ (rb)} \text{……….. Eq. (4)}$$

Bp = Risk of the individual counters on the NSX to the NSX overall index

Cov (rp,rb) = Covariance of the asset and the stock market as a whole

Var (rb) = Variance of the asset of the individual security

3.5 Description of variabless

The variables that are used in this study are: 24 months average returns on the individual constituents on the NSX, which is a dependent variable and its lags as an explanatory variable like Beta as a proxy of Stock market risk, Size factor (SF) as a ratio of the Market cap.

3.5.1 Stock returns

For the dynamic nature of stock markets, we employed a data set of 60 months (2013-2017) but we took the average 24 months return on each stock on the NSX. We excluded the following stock because they are either new listings or their data were unavailable: Nimbus, Old Mutual, Paladin, Letshego etc.

3.5.2 Stock Beta

Historical beta estimates (HIST) postulated by Fama and Macbeth (1973) that entails regressing asset excess returns on the market excess returns. EWMA beta is a weighted form of historical estimator that contains an exponential weighted average structure. Shrinkage estimators postulated by Vasicek (1973) estimates beta to obtain a posterior beta by combining the historical estimate and a prior. The extent to which beta shrinks relies on the relative accuracy of the historical estimate and the prior. The priors used are: the cross sectional average beta; the cross sectional average beta of firms in the same Global Industry Classification Standard (GICS); and the fundamentals-based prior. Dimson Beta estimates a beta that accounts for potential infrequent trading effects. If stocks trade infrequently than the market index, then the stock prices then adjust automatically to this new information. Therefore, lagged market returns are added in the regression.

3.5.3 Size Factor (SF)

The size factor was estimated using the market capitalization value of the companies in question over a trailing 24 months period. We used the ratio of the average to the median to correct the effect of outliers in the data set.

3.6. Estimation Technique

3.6.1 Unit root tests

The stationary test is basically a pre-request of the cointegration procedure of each individual time series over the sample period. Before running the analysis of the long run relationships of variables, the unit root properties of each set of time series data need to be checked as a pre-requisite for inclusion in co-integration analysis and evaluation of long-run relationships.in economics most time series pose a trend over time and these are series contain unit root.

A time series data is said to be stationary if the mean and variance are constant over time and the value of the covariance between the two-time periods depends only on the distance or lag between the two-time periods and not the actual time at which the covariance is computed (Gujarati, 2009). However, if the mean and variance change in samples for different time spans then, this type of variable is known as non-stationary variables which imply that any results from such data will be nonsensical.

Although there are number of tests for stationary, the study will use the most popular test for testing the unit root test. The Augmented Dicker-Fuller (ADF) and Philips Peron (PP) statistics will be applied to test the stationary or non-stationary of the variables and their order of integration to avoid the spurious regression problem.

3.6.2 Co-integration

Co-integration means that a long run relationship of variables that are linked to form an equilibrium relationship when the individual series themselves are non-stationary in their levels. If there is co-integration between two or more time series then it is assumed that there is a long run relationship between variables. There are two broad approaches to test for cointegration; the Engel test (1987) and Johansen test (1998). Johansen uses more complicated Vector Auto Regression Model (VAR) structure to test for the cointegration. In a multiple non-stationary time series, it is possible that there is more than one linear relationship to form cointegration. This is called **co integration rank.**

Johansen test usually involves two tests namely "trace statistics" and "maximum eigenvalue". The null hypothesis for the trace test stipulates that if there should be (r) number of co-integration vectors whereas the null hypothesis for the eigen value test states that there should be (r) co-integrating vectors in contrast to the presence of the alternative null hypothesis r+1. The null hypothesis of no cointegration is checked on this test, Johansen and Juselius (1990). To test for cointegration, this study will use the Johansen procedure which is based on a vector auto regression (VAR) model, to determine the existence of the long-run relationship among variables.

3.6.3 Estimating long run and short run analysis

Error correction model can be used to test for a long run or short run analysis between variables. The term 'error correction models, applies to any model that directly estimates the rate at which changes in Yt return to equilibrium after a change in Xt. The ECM behavioural justification implies that the behaviour of Yt is tied to Xt in the long run and that short run changes in Yt respond to deviations from that long run equilibrium.

3.6.4 Granger Causality

A limited notion of causality where past values of one series (x_t) are useful for predicting future values of another series (y_t), after past values of y have been controlled for (Wooldridge, 2009). Granger causality provides important information about the exogeneity, in other words x_t is defined as an exogenous variable if the current and past values of y_t do not affect x_t.

There are different situations under which Granger causality test can be applied. These include:

i. A simple bivariate Granger causality where there are two variables and their lags.
ii. A multivariate Granger causality where more than two variables are considered and it is most applicable where more than one variable can influence the results.
iii. Granger causality can also be tested in a Vector Autoregressive (VAR) framework where a multivariate model is extended to test for simultaneity of all included variable.

The VAR can be considered as a means of conducting causality tests or more specifically Granger causality test.

3.6.5 Variance Decomposition

Variance decomposition divides the variation within the endogenous variable into the factor that shocks the VAR. Thus, the variance decomposition provides information about the relative importance of each random innovation in affecting the variables in the VAR, (Shedden, 2010).

3.7 Limitations

Models used in this study do not include all the variables, because of existing data discrepancies given the nature of the Namibian Stock Exchange. Another limitation was the statistical quality of data that is being used, that sometimes may lead to coefficients in the equations not to be stable and poses wrong signs.

3.8 Conclusion

This chapter described the research methodology used in the study such as; research design and sample period, analytical framework, and estimation techniques. Chapter four (4) discussed the findings and data analysis using the information from secondary data, while chapter five (5) presented the conclusion of the study.

CHAPTER 4 DISCUSSION OF RESULTS

4.1 Introduction

This chapter discusses the results of the data analysis as explained the Chapter 3. It covers the discussions of the descriptive analysis, unit roots test for stationary, co-integration results and the regression results.

4.2 Empirical Analysis

4.2.1 Descriptive statistics

Table 1 presents the summary statistics of the variables. In terms of variability measured by the standard deviation, the 24-month average return of the sample stocks on the Namibian Stock Exchange have the lowest variability, whilst their Beta recorded the highest during the period under study. The skewness and kurtosis coefficients ranging from -1.3 to 1.5 and 7.5 to 3.5 suggest a far from normal distribution amongst the variables. It also shows that the distributions are mostly positive. Only beta is negatively skewed. All kurtosis coefficients are more than 3 which is not an acceptable level of standard normal distribution, this come as no surprise as all the variables have very low variability.

Table 1: Summary statistics

	ln24_MONTH_AVERAGE_RETURN	lnSIZE_FACTOR	lnBETA
Mean	0.018035	0.002497	0.674871
Median	0.012237	-0.004127	0.466984
Maximum	0.097806	0.192609	3.289499
Minimum	-0.021611	-0.085553	-4.449601
Std. Dev.	0.028769	0.056031	1.380455
Skewness	1.028924	1.530286	-1.365919
Kurtosis	3.474519	6.252300	7.594003
Sum	0.541055	0.074914	20.24613
Observations	30	30	30

Source: Author's compilation.

4.2.2 Unit root Test

The empirical estimation process regarding the study began with testing for unit roots. In this regard, the study employed the augmented Dickey-Fuller (ADF) procedures in testing for unit roots. It is very useful to use unit root test as a starting point for all econometric time series studies because of the possibility of producing spurious correlation results from time-series data as a result of the problem of non-stationary time series. The results of unit root test in level form and in first difference are summarised in Table 1 below.

Table 2: Unit root tests:

	Levels		
Variables	**ADF stat**	**P-value**	**Remarks**
ln24_MONTH_AVERAGE_RETURN	-5.412877**	0.0001**	I (0)
lnSIZE_FACTOR	-5.196830**	0.0002**	I (0)
lnBETA	-10.89063**	0.0000**	I (1)

*Notes: ** implies rejection of the null hypothesis at the 5 percent level. *** implies rejection of the null hypothesis at the 5 percent level after second difference. Source: Author's compilation.*

Upon inspection of Table 2, it was observed that variables, namely, 24-month average return of the sample stocks on the Namibian Stock Exchange, Size factor which is a proxy of the market cap of the counters all became stationary at levels with the exception of Beta which only became stationary after first difference. It is worth to note that favouring a simple unrestricted VAR model instead of a VECM might render spurious results because we have established a condition for a possible existence of a long-run relationship. The study will test for co-integration to validate the existence of a genuine long-run relationship.

4.2.2 Testing for Co-integration

Testing for co-integration implies that if two or more variables do converge to some long-run equilibrium then they are said to be co-integrated. The economic interpretation of co-integration is that if two or more series are linked to form an equilibrium relationship of the long-run, they will move closely together over time.

It is essential to establish whether the variables have some long-term relationships. That is, the existence of a long-run equilibrium to which an economic system converges over time. The study made use of the Johansen test of co-integration with regard to the co-integration test. Table 4 below displays the co-integration test results

4.2.3 Pairwise Granger-causality Test Results

The granger causality test is conducted in order to determine whether there is existence of causality linkage among the series in question. Therefore, in order to do that, we use the method developed by (granger, 1969). Ordinarily, regressions reflect "mere" correlations, but granger argued that there is an interpretation of a set of tests as revealing something about causality. The study conducted granger causality to determine the direction of causality between 24-month average return of the sample stocks on the Namibian Stock Exchange and the independent variables in the study. The Granger-causality test results are displayed in Table 3 below.

Table 3: Pairwise Granger-causality test results

Null Hypotheses	Obs	Prob.
lnSIZE_FACTOR does not Granger Cause ln24_MONTH_AVERAGE_RETURN	**23**	**0.0392****
ln24_MONTH_AVERAGE_RETURN does not Granger Cause lnSIZE_FACTOR	23	0.3576
BETA does not Granger Cause _24_MONTH_AVERAGE_RETURN	23	0.2316
_ln24_MONTH_AVERAGE_RETURN does not Granger Cause lnBETA	23	0.1187
lnBETA does not Granger Cause lnSIZE_FACTOR	23	0.4339
lnSIZE_FACTOR does not Granger Cause lnBETA	23	0.6409

*Note that ** means the rejection of the null hypothesis at the 5 percent level. Source: Author's computation*.

The granger causality test consists of rejecting the null hypothesis of no causality when the probability of the F-Statistic is less than 5%. Upon inspection of Table 4, a unidirectional relationship running from size factor to 24-month average return of the sample stocks on the Namibian Stock Exchange was found respectively. By implication, the theory supports these causalities. The rest of the pairs did not demonstrate causality relationships between themselves.

Table 4: Johansen co-integration test

Maximum Eigen test				Trace test			
H_0: rank = r	H_a: rank =	Statistic	95% Critical value	H_0: rank = r	H_a: rank =	Statistic	95% Critical value
r = 0	r =1	18.67253	21.13162	r = 0	r =1	39.40493	29.79707
r <=1	r =2	13.91083	14.26460	r <=1	r =2	20.73240	15.49471
r <=2	r =3	6.821563	3.841466	r <=2	r =3	6.821563	3.841466

Note: The Maximum-Eigen test and Trace test shows none and three co-integrating equations at the 5 percent level respectively. Source: Author's construct.

It is apparent from the results reported in Table 4 that the variables under investigation are co-integrated. In this context, the study employed the Maximum-Eigen and Trace tests. The null hypothesis of r=0 (No co-integrating relations) was tested against the alternative hypothesis of r≠0 (There are co-integrating relations). The rejection of Ho would imply the acceptance of H1. That is the existence of co-integrating relations among the variables being examined, at least based on the trace statistic test which is regarded as the most superior test by most econometricians. In this particular case, the Maximum-Eigen test and Trace test show none and three co-integrating equations at the 5 percent level respectively, since the t-statistic is greater than the critical value at the 5% level implying co-integrating relationship among the variables assessed on the trace statistic test. These results are reported in Table 4. Afterwards, the study proceeded with the estimation of the long-run equation which yielded the following result:

Table 5: Long run regression results

Variable	Coefficient	t-statistic
Constant	-0.048783	
lnSIZE FACTOR	-2.795223	-4.43389
lnBETA	0.054117	2.40804

Source: Author's construct.

$R_t = -0.048783 - 2.795223SIZEFACTOR_t + 0.054117BETA_t$ (1)

The equation (1) confirms a long-run relationship among the dependent and independent variables used in the study. A scrutiny of this model indicates a negative relationship between the size factor and returns, this is against theory and should be taken with cautiousness, Large-cap companies are typically firms with a market value of $10 billion or more. Large-cap firms often have a reputation for producing quality goods and services, a history of consistent dividend payments, and steady growth. They are often dominant players within established industries, and their brand names may be familiar to a national consumer audience. As a result, investments in large-cap stocks may be considered more conservative than investments in small-cap or mid-cap stocks, potentially posing less risk in exchange for less aggressive growth potential, thus there should be a positive relationship between the size factor and returns. Beta is positively related to return and this is satisfying, we would expect that when the market is doing well, cyclical counters will do well and vis-a-visa. A further scrutiny of the estimated model suggests that a 1 percent increase in the market cap of a counter leads to approximately 2.8 percent detraction in the return of that counter, while a 1 percent increase in the sensitivity of that counter to the rest of the market is expected to lead to approximately 0.05 percent contribution to returns.

Next, the study reports on the VECM results, the results show that the estimated lagged error correction term of the 24-month average return of the sample stocks on the Namibian Stock Exchange is negative and significant which suggest that 24-month average return of the sample stocks on the Namibian Stock Exchange equation in this analysis does constitutes the co-integrating relationship in terms of the first co-integrating vector. The coefficient (i.e. the error correction term) is -0.018215 with a t-statistic of -0.19504 which is insignificant, this suggests that only 2% of disequilibrium in the average returns is corrected which is very weak, error correction for size factor is 0.315503 with a t-statistic of 1.71 which is also statistically significant. This suggests that there is long run causality from the market cap to the dependent variable. The value of R-square is 0.484713, meaning 48.5% of the variation in average returns is explained jointly by the variables in the model. Consequently, adjusted r-square indicates that only 29.5% of the variation of the 24-month average return of the sample stocks on the Namibian Stock Exchange is explained by the model as a whole.

4.2.4 Diagnostic Tests

The study tested for serial correlation and conditional heteroscedasticity. The results confirm the absence of serial correlation and conditional heteroscedasticity. Besides, the model was found to be not normally distributed. Therefore, the econometric model employed in the study is vigorous, at least, from a technical perspective. The results are reported in Table 6.

Table 6: Diagnostic checks

Test	Null hypotheses	t-statistic	Probability
Breusch-Godfrey LM Test	No serial correlation	6.652453	0.6733
Jarque-Bera (JB)	There is normality	22.61973	0.0000
Breusch-Pagan-Godfrey	No conditional heteroscedasticity	84.65371	0.4595

Source: Author's construct.

Next, the study reports on the Forecast error variance decomposition. The variance decomposition results are displayed in Table 7.

Table 7: Forecast error variance decomposition

Variance Decomposition of LOGRDGP				
PERIOD	**ln24_MONTH_AVERAGE_RETURN**	**lnSIZE_FACTOR**	**lnBETA**	
1	100.0000	0.000000	0.000000	
2	96.96178	2.529459	0.508759	
3	96.86678	2.651239	0.481978	
4	97.54158	2.079912	0.378506	
5	97.43337	2.138088	0.428538	
6	97.72045	1.899232	0.380313	
7	97.85326	1.800559	0.346181	
8	97.96724	1.698034	0.334722	
9	98.13364	1.559857	0.306503	
10	98.21953	1.490400	0.290069	

Source: Author's construct.

Table 7 presents forecast error variance decompositions for each variable in the model over a 10-period forecast horizon. The results depict that consistently, 24-month average return of the sample stocks on the Namibian Stock Exchange itself accounted for most of the changes or innovations that occurred with respect to itself for the entire period under consideration. Indeed, the results show that in the first period the fluctuations in 24-month average return of the sample stocks on the Namibian Stock Exchange are 100 percent purely driven or explained by the return itself. Amongst the three explanatory variables used in the model, the size factor contributed more towards innovations in average return of the sample stocks on the Namibian Stock Exchange during the forecast horizon. The beta variable made the weakest contribution towards explaining returns consistently for the forecast period.

CHAPTER 5 CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The previous chapter discussed the data and results obtained from the study. This chapter is that summary of findings, conclusion and recommendations.

5.2 Summary of findings

The study has been conducted using the monthly data spanning from 2013 to 2017 for the sake of identifying the relationship between Stock market returns and market risk on the counters listed on the Namibian stock exchange. The stationarity of the three variables was tested first, using Augmented Dickey Fuller test and the results showed that all variables apart from one attained a stationary status in levels; the variables were taken in the regression model to proceed with the next technique of the co-integration analysis.

The study tested for serial correlation and conditional heteroscedasticity. The results confirmed the absence of serial correlation and conditional heteroscedasticity. Besides, the model was found to be not normally distributed.

The co-integration test results confirmed the existence of a long run relationship on the variables of interest. While the granger causality test results show that there is a long run causality from the size factor, which represent the market cap to stock returns. This came as no surprise as the as the stock return equation in the VECM analysis does constitutes the co-integration relationship in terms of the first co-integrating vector.

Lastly, the study tested for variance decomposition, the results confirmed that the model suffered mostly from own shock and minor innovations were as a result of shocks from the independent variables.

Amongst the two explanatory variables used in the study, size factor contributed more towards innovations in stock returns during the forecast horizon. The beta variable made the weakest contribution towards explaining stock returns consistently.

In the light of the above, the study concludes that, the null hypothesis of no relationship between return and risk can be rejected. Therefore, the conclusion of the study is in support of the findings of prior empirical studies conducted on the subject matter by, among others, Nyangara, et al (2016) in testing the relationship between risk and stock market returns. Further, the study supports the Capital asset pricing model.

5.3 Policy implications

In the light of the study conclusions, the study has established that policy makers should focus on long run policies that promote economic growth, development of financial sector, efficient financial market and infrastructure to increase the efficiency and liquidity of the stock market which tend to be instrumental in promoting stock returns and thus growth in the long run. Further, it is vital that policy makers should capitalise on the listing of most parastatals to improve the efficiency of these entities and offer more liquidity to the Namibian stock exchange, with the recent increase in the prudential requirements of the Namibian pension Funds regulation 28 of 1996, this is paramount to cater for the extra 10% investment in Namibian assets.

5.4 Recommendations for Future Research

The findings of this study may contribute to the existing literature on the variables being examined for policy formulation. More variables that cover all aspects financial system can be used in future investigations. However, it should be also noted that this study is without limitation since it has only covered the Namibian stock exchange with only few listed counters and been covered over a period of 60 period of study. Hence, caution should be taken to the results and further future research extension on the study is very important.

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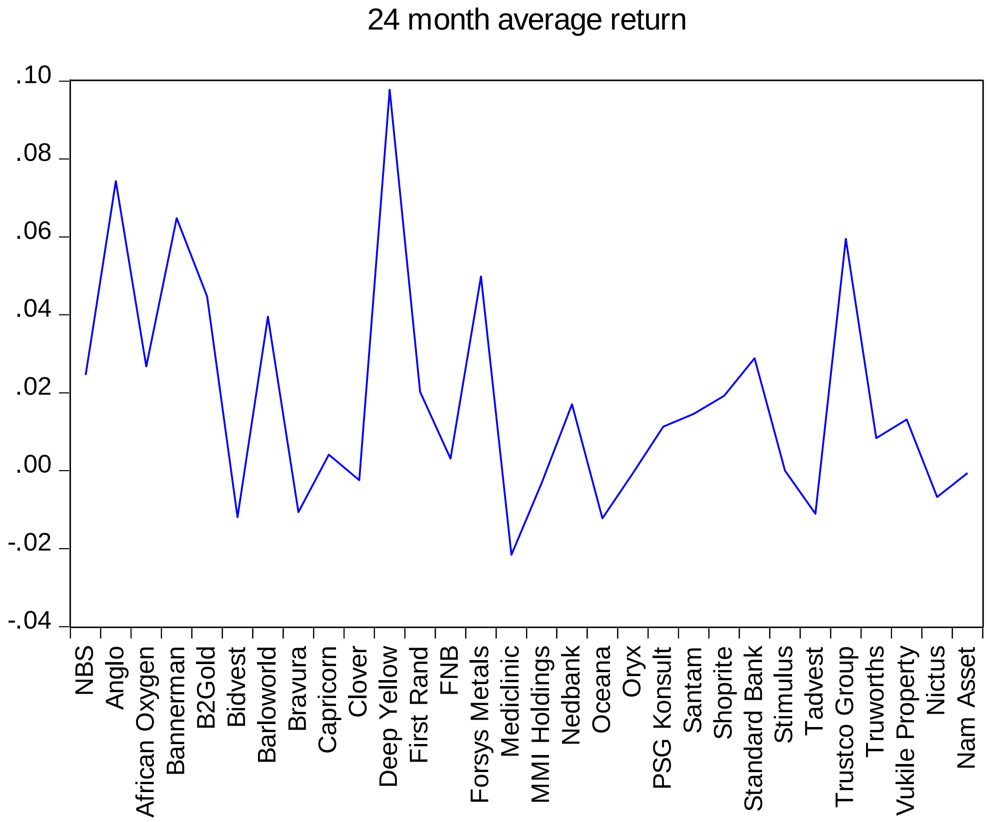
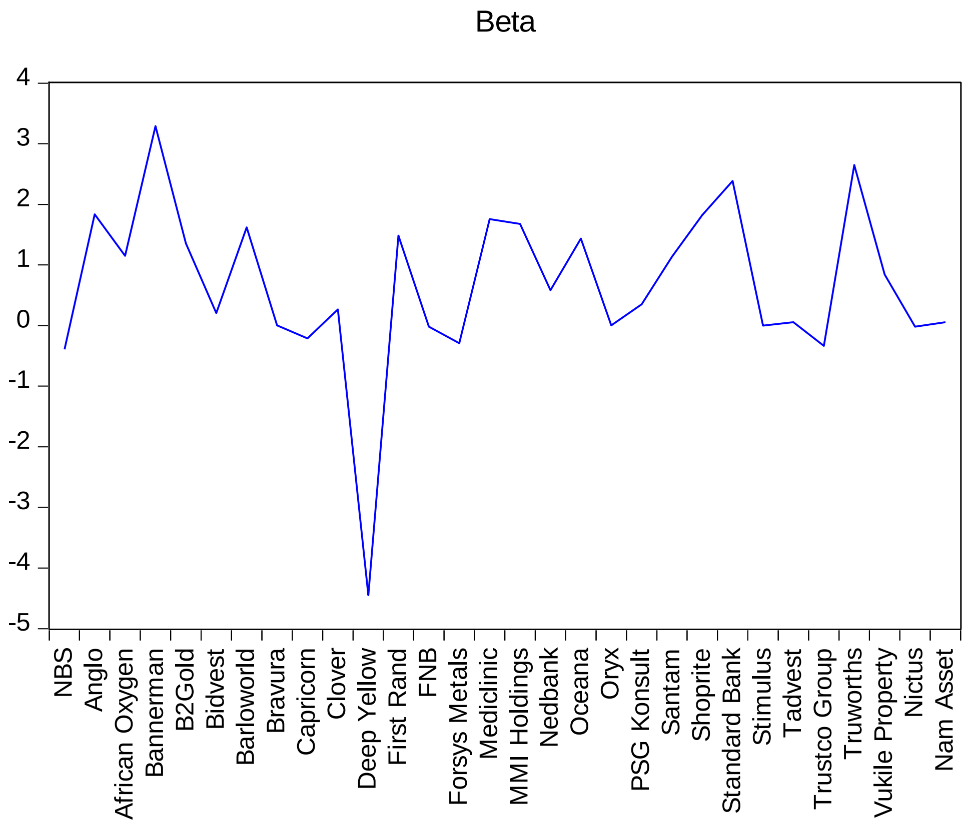
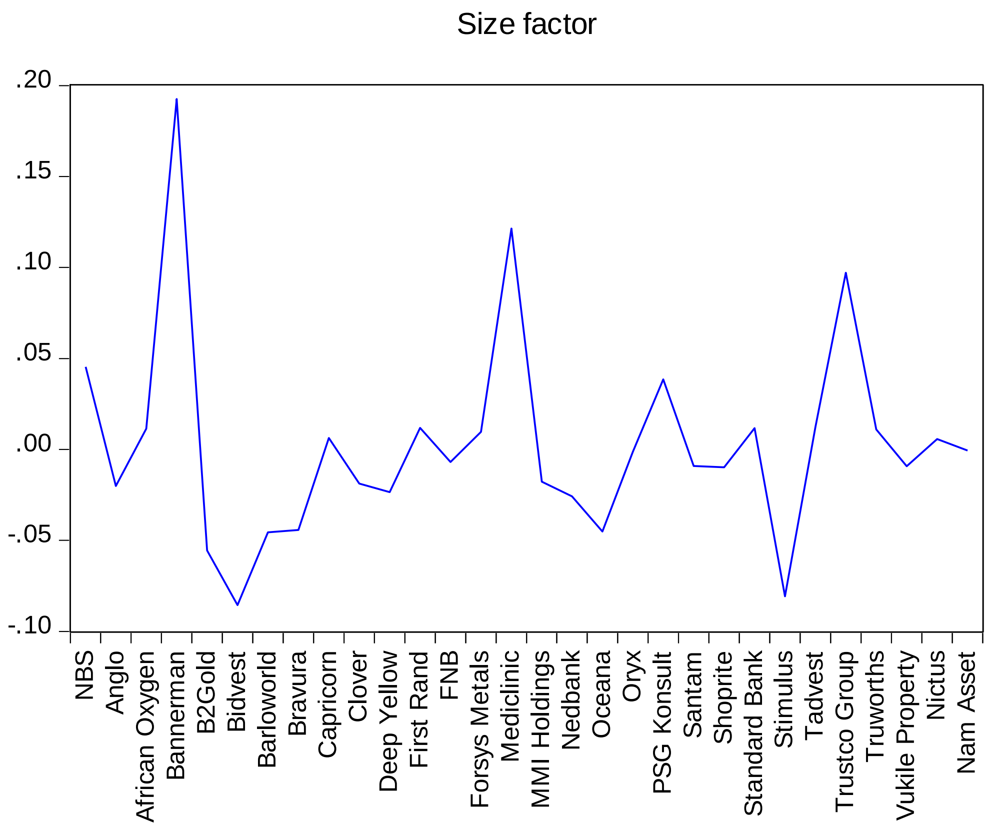
APPENDICES

Results: Graphical Illustration of the variables







Unit Root Test: Levels

Null Hypothesis: _24_MONTH_AVERAGE_RETURN has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.412877	0.0001
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: BETA has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.861230	0.3476
Test critical values:	1% level	-3.565430	

	5% level	-2.919952	
	10% level	-2.597905	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: SIZE_FACTOR has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.191061	0.0002
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

*MacKinnon (1996) one-sided p-values.

Unit Root Test: 1st Difference

Null Hypothesis: D(BETA) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.89063	0.0000
Test critical values:	1% level	-3.568308	
	5% level	-2.921175	
	10% level	-2.598551	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(_24_MONTH_AVERAGE_RETURN) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.06646	0.0000
Test critical values:	1% level	-3.568308	
	5% level	-2.921175	

	10% level	-2.598551	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(SIZE_FACTOR) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.148969	0.0000
Test critical values:	1% level	-3.568308	
	5% level	-2.921175	
	10% level	-2.598551	

*MacKinnon (1996) one-sided p-values.

Test Cointegration: Johansen test for Cointegration

Date: 20/05/19 Time: 19:15
Sample (adjusted): 3 30
Included observations: 28 after adjustments
Trend assumption: Linear deterministic trend
Series: _24_MONTH_AVERAGE_RETURN BETA SIZE_FACTOR
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.486690	39.40493	29.79707	0.0029
At most 1 *	0.391535	20.73240	15.49471	0.0074
At most 2 *	0.216220	6.821563	3.841466	0.0090

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.486690	18.67253	21.13162	0.1067
At most 1	0.391535	13.91083	14.26460	0.0568
At most 2 *	0.216220	6.821563	3.841466	0.0090

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Vector Error Correction Model:

Vector Error Correction Estimates
Date: 20/05/19 Time: 19:34
Sample (adjusted): 4 30
Included observations: 27 after adjustments
Standard errors in ( ) and t-statistics in [ ]

Cointegrating Eq:	CointEq1
_24_MONTH_AVERAGE_RETURN(-1)	1.000000
SIZE_FACTOR(-1)	-2.795223 (0.63042) [-4.43389]
BETA(-1)	0.054117 (0.02247) [2.40804]
C	-0.048783

Error Correction:	D(_24_MONTH_AVERAGE_RETURN)	D(SIZE_FACTOR)	D(BETA)
CointEq1	-0.018215 (0.09339) [-0.19504]	0.315503 (0.18367) [1.71781]	-7.585755 (3.89872) [-1.94570]
D(_24_MONTH_AVERAGE_RETURN(-1))	-0.852573 (0.24053) [-3.54453]	-0.276097 (0.47304) [-0.58367]	20.14034 (10.0413) [2.00575]
D(_24_MONTH_AVERAGE_RETURN(-2))	-0.422007 (0.22057) [-1.91325]	0.304203 (0.43378) [0.70128]	19.14399 (9.20801) [2.07906]
D(SIZE_FACTOR(-1))	0.063132 (0.19999) [0.31567]	0.250808 (0.39331) [0.63769]	-8.659731 (8.34886) [-1.03724]
D(SIZE_FACTOR(-2))	-0.011406 (0.13820) [-0.08253]	-0.095621 (0.27179) [-0.35181]	-11.74756 (5.76943) [-2.03617]
D(BETA(-1))	-0.001338 (0.00569) [-0.23530]	-0.021543 (0.01118) [-1.92608]	-0.427526 (0.23742) [-1.80070]
D(BETA(-2))	0.000528 (0.00489) [0.10779]	-0.001860 (0.00963) [-0.19328]	-0.014045 (0.20432) [-0.06874]

C	-0.003947	-0.002968	-0.016213
	(0.00679)	(0.01335)	(0.28337)
	[-0.58151]	[-0.22232]	[-0.05722]
R-squared	0.484713	0.480126	0.605621
Adj. R-squared	0.294871	0.288593	0.460324
Sum sq. resids	0.023241	0.089888	40.50331
S.E. equation	0.034974	0.068782	1.460052
F-statistic	2.553240	2.506756	4.168150
Log likelihood	56.96721	38.70649	-43.78622
Akaike AIC	-3.627201	-2.274555	3.836016
Schwarz SC	-3.243249	-1.890603	4.219968
Mean dependent	-0.001011	-0.000444	-0.040551
S.D. dependent	0.041650	0.081548	1.987476
Determinant resid covariance (dof adj.)		6.76E-06	
Determinant resid covariance		2.36E-06	
Log likelihood		59.99951	
Akaike information criterion		-2.444408	
Schwarz criterion		-1.148571	

LM Test: Serial Correlation LM Test

VEC Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 20/05/19 Time: 19:25
Sample: 1 30
Included observations: 27

Lags	LM-Stat	Prob
1	9.447535	0.3970
2	12.45209	0.1890
3	9.412083	0.4001
4	8.611363	0.4739
5	6.274655	0.7121
6	6.652453	0.6733
7	15.47428	0.0787

Probs from chi-square with 9 df.

Normality test: VEC Residual Normality Test

VEC Residual Normality Tests

Orthogonalization: Cholesky (Lutkepohl)

Null Hypothesis: residuals are multivariate normal

Date: 20/05/19 Time: 19:48

Sample: 1 30

Included observations: 27

Component	Skewness	Chi-sq	df	Prob.
1	1.719359	13.30288	1	0.0003
2	0.529288	1.260654	1	0.2615
3	-0.481604	1.043740	1	0.3070
Joint		15.60728	3	0.0014

Component	Kurtosis	Chi-sq	df	Prob.
1	7.418337	21.96192	1	0.0000
2	3.761875	0.653010	1	0.4190
3	2.934657	0.004803	1	0.9447
Joint		22.61973	3	0.0000

Component	Jarque-Bera	df	Prob.

Heteroskedasticity test: VEC Residual

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 20/05/19 Time: 20:46
Sample: 1 30
Included observations: 27

Joint test:

Chi-sq	df	Prob.
84.65371	84	0.4595

Individual components:

Dependent	R-squared	F(14,12)	Prob.	Chi-sq(14)	Prob.
res1*res1	0.172293	0.178420	0.9984	4.651915	0.9901
res2*res2	0.565533	1.115716	0.4292	15.26938	0.3600
res3*res3	0.197884	0.211459	0.9963	5.342860	0.9804
res2*res1	0.504798	0.873751	0.5997	13.62953	0.4777
res3*res1	0.193834	0.206091	0.9968	5.233529	0.9823
res3*res2	0.522721	0.938752	0.5501	14.11346	0.4413

Pairwise Granger Causality Tests

Date: 20/05/19 Time: 20:58
Sample: 1 30
Lags: 7

Null Hypothesis:	Obs	F-Statistic	Prob.
SIZE_FACTOR does not Granger Cause _24_MONTH_AVERAGE_RETURN	23	3.84402	0.0392
_24_MONTH_AVERAGE_RETURN does not Granger Cause SIZE_FACTOR		1.30106	0.3576
BETA does not Granger Cause _24_MONTH_AVERAGE_RETURN	23	1.72025	0.2316
_24_MONTH_AVERAGE_RETURN does not Granger Cause BETA		2.42678	0.1187
BETA does not Granger Cause SIZE_FACTOR	23	1.11999	0.4339
SIZE_FACTOR does not Granger Cause BETA		0.75056	0.6409

Variance Decomposition Analysis

Variance Decomposition of _24_MONTH_AVERAGE_RETURN:

Period	S.E.	_24_MONTH_AVERAGE_RETURN	SIZE_FACTOR	BETA
1	0.034974	100.0000	0.000000	0.000000
2	0.036367	96.96178	2.529459	0.508759
3	0.038928	96.86678	2.651239	0.481978
4	0.044345	97.54158	2.079912	0.378506
5	0.045979	97.43337	2.138088	0.428538
6	0.048820	97.72045	1.899232	0.380313
7	0.051729	97.85326	1.800559	0.346181
8	0.053696	97.96724	1.698034	0.334722
9	0.056121	98.13364	1.559857	0.306503
10	0.058332	98.21953	1.490400	0.290069

Variance Decomposition of SIZE_FACTOR:

Period	S.E.	_24_MONTH_AVERAGE_RETURN	SIZE_FACTOR	BETA
1	0.068782	6.178759	93.82124	0.000000
2	0.072810	7.413500	92.11719	0.469313
3	0.075610	7.401922	85.70181	6.896264
4	0.078785	7.174928	84.44935	8.375720
5	0.080922	7.933481	83.82122	8.245301
6	0.084150	8.420256	83.21948	8.360262

7	0.086968	8.499630	83.15781	8.342558
8	0.088877	8.996174	82.16682	8.837010
9	0.091102	9.195859	81.53507	9.269067
10	0.093282	9.367786	81.20008	9.432129

Variance Decomposition of BETA:

Period	S.E.	_24_MONTH_AVERAGE_RETURN	SIZE_FACTOR	BETA
1	1.460052	12.96406	28.59258	58.44336
2	1.847515	17.56244	44.97988	37.45769
3	1.985485	15.20872	48.38734	36.40393
4	2.326902	11.10020	59.08875	29.81105
5	2.509622	10.71169	62.12524	27.16307
6	2.667300	9.523275	63.61757	26.85916
7	2.842490	8.412820	65.85311	25.73407
8	2.991531	7.891468	67.23509	24.87344
9	3.144964	7.206238	68.69043	24.10333
10	3.287882	6.671058	69.86161	23.46733

Cholesky Ordering: _24_MONTH_AVERAGE_RETURN SIZE_FACTOR BETA

Descriptive statistics:

	_24_MONTH_AVERAGE_RETURN	SIZE_FACTOR	BETA
Mean	0.018035	0.002497	0.674871
Median	0.012237	-0.004127	0.466984
Maximum	0.097806	0.192609	3.289499
Minimum	-0.021611	-0.085553	-4.449601
Std. Dev.	0.028769	0.056031	1.380455
Skewness	1.028924	1.530286	-1.365919
Kurtosis	3.474519	6.252300	7.594003
Jarque-Bera	5.574880	24.93069	35.70975
Probability	0.061579	0.000004	0.000000
Sum	0.541055	0.074914	20.24613
Sum Sq. Dev.	0.024002	0.091044	55.26403
Observations	30	30	30

DATA SET

Counter	24 month average return	Beta	Size factor
NBS	2.5%	(0.39)	0.05
Anglo	7.4%	1.83	(0.02)
African Oxygen	2.7%	1.15	0.01
Bannerman	6.5%	3.29	0.19
B2Gold	4.5%	1.36	(0.06)
Bidvest	-1.2%	0.21	(0.09)
Barloworld	4.0%	1.62	(0.05)
Bravura	-1.1%	0.00	(0.04)
Capricorn	0.4%	(0.21)	0.01
Clover	-0.2%	0.27	(0.02)
Deep Yellow	9.8%	(4.45)	(0.02)
First Rand	2.0%	1.48	0.01
FNB	0.3%	(0.02)	(0.01)
Forsys Metals	5.0%	(0.29)	0.01
Mediclinic	-2.2%	1.76	0.12
MMI Holdings	-0.3%	1.68	(0.02)
Nedbank	1.7%	0.58	(0.03)
Oceana	-1.2%	1.44	(0.05)
Oryx	-0.1%	0.01	(0.00)
PSG Konsult	1.1%	0.35	0.04
Santam	1.5%	1.14	(0.01)
Shoprite	1.9%	1.82	(0.01)
Standard Bank	2.9%	2.39	0.01
Stimulus	0.0%		

		(0.00)	(0.08)
Tadvest	-1.1%	0.06	0.01
Trustco Group	6.0%	(0.34)	0.10
Truworths	0.8%	2.65	0.01
Vukile Property	1.3%	0.84	(0.01)
Nictus	-0.7%	(0.02)	0.01
Nam Asset	-0.1%	0.06	(0.00)