The Performance of Sector Concentrated versus Diversified Equity Portfolios in Kenya

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Declaration

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

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Abstract

The purpose of this study is to compare the performance of sector concentrated equity portfolios versus diversified equity portfolios in Kenya. Sector concentrated equity portfolios are created when all funds available are invested in a particular segment of the economy to maximize returns. On the hand, diversified portfolios are created when funds available are invested in different sectors of the economy to minimize risks. The data used to construct the portfolios in this study is from 66 NSE listed firms classified into 8 sectors. NSE 20 Share Index is used as the benchmark index while the 91-Day Treasury bill is adopted as the risk free rate. The study period is from 2002 to 2016. Sharpe's Single Index Model is used to construct diversified equity portfolios while CAPM and matrix algebra are used to construct sector concentrated equity portfolios. Sharpe ratio is used as performance measure to determine which portfolio is better performing. In this study, the higher the Sharpe ratio the better the portfolio performance. The study concludes that diversified equity portfolios perform better than sector concentrated equity portfolios over time. The study further concludes that the out performance is time varying.

Key words: ***Best idea, capital asset pricing model, concentrated portfolios, diversified portfolios, Sharpe ratio, single index model.***

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List of Abbreviations

AIM	-	Alternative Investment Market
BSE	-	Bangladesh Stock Exchange
CAPM	-	Capital Asset Pricing Model
CBK	-	Central Bank of Kenya
DSE	-	Dhaka Stock Exchange
EBITDA	-	Earnings Before Interest Tax, Depreciation and Amortization
GEM	-	Growth Enterprise Market
ICI	-	Industry Concentration Index
IPS	-	Investment Policy Statement
MIM	-	Main Investment Market.
MPT	-	Modern Portfolio Theory
MVO	-	Mean Variance Optimization
NASI	-	Nairobi All Share Index
NSE	-	Nairobi Securities Exchange
NYSE	-	New York Stock Exchange
REIT	-	Real Estate Investment Trust
RBA	-	Retirement Benefits Authority
S&P	-	Standard & Poor's
USA	-	United States of America

Definition of Terms

Asset Class	Refers to a group of securities with similar characteristics and properties such as stocks and bonds. (Levisauskate, 2010).
Best Idea Stock	Stock identified through research that that has the opportunity to generate superior returns (Howard, 2012).
Concentrated Portfolio	The extent to which the portfolio weights held in stocks ,industries and sectors deviate from the underlying index or market portfolio (Brandes et al., 2005)
Diversified Portfolio	A portfolio which is not heavily exposed to individual shocks (Meucei, 2009, as cited in Pola, 2014).
Jensen's Alpha	Shows excess actual return over required return and excess actual premium. It measures a portfolio managers performance based on cash (Yeung et al., 2012).
Portfolio	Combination of assets having risk and return characteristics of their own which when combined make up a portfolio (Donald et al., 1993 as cited in Nyokangi, 2016).

Tracking Error	Refers to the difference between a portfolio return and the benchmark index (Kacperczyk et al., 2005).
Treynor's Ratio	Shows excess actual return over the risk free rate or risk premium per unit of systematic risk measured by beta (Kacperczyk et al., 2005).
Unsystematic Risk	Also known as idiosyncratic risk. Company or industry specific risk that is inherent in each investment also known as diversifiable risk (Tucker, 2011).
Sharpe Ratio	A risk adjusted measure of return that is often used to measure the performance of a portfolio (Kacperczyk et al., 2005).
Systematic risk	Risk that cannot be avoided by diversifying (Tucker, 2011).

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Chapter 1: Introduction

1.1. Background to the study

Despite the widespread support of diversification in portfolio construction (Choi et al., 2014, Cohen et al., 2008 and Kacperczyk et al., 2005), portfolio concentration is not alien in the investment world, albeit its application is with caution. For instance, Kacperczyk et al., (2005) observe that prior to the seminal work of Markowitz (1952), concentrated portfolios were the norm. John Maynard Keynes' advocacy for portfolio concentration is aptly immortalized in a letter to a friend in 1934 where he states:

> "As this goes, I get more and more convinced that the right method of investment is to put large sums in enterprise which one thinks one knows something about and in the management of which one thoroughly believes. It is a mistake to think that one limits one's risk by spreading too much between enterprises about which one knows little about and has no reason for special confidence" (Yeung et al., 2012 page 4).

The work of Markowitz (1952) shifts focus to portfolio based investment. Markowitz (1952) asserts that risk should not be assessed at the level of individual securities. According to Markowitz, risk should be assessed in terms of contribution that each security makes to the overall portfolio. Markowitz warns that investors who do not diversify their portfolios will be taking risk not compensated by the market. Accordingly, these investors will be paying too much for securities.

Swensen (2009), a diversification proponent, argues that having significant concentration in a single asset class creates extraordinary risk to a portfolio of assets. Swensen argues that portfolio diversification provides investors with free lunch since risk can be reduced without sacrificing expected returns. Swensen further argues that, diversification provides investors with a powerful risk management tool. This is through combination of assets that respond differently to market forces.

Renewed focus on concentrated portfolios started in earnest in early 2000 with researchers seeking to tackle the question of whether diversified portfolios perform better than concentrated ones (Kacperczyk, et al., 2005 and Cohen et al., 2008). In their study Kacperczyk et al., (2005), find that on average concentrated portfolios perform better than diversified portfolios by 1.58% per annum. Subsequent studies carried out by Yeung et al., (2012) and Choi et al., (2014), reach the same conclusion arguing that concentrated portfolios increase an investor's chance of superior performance. The findings of these studies have been backed by seasoned investors like Warren Buffet and George Soros. Warren Buffet for instance is quoted saying "Wide diversification is only required when investors do not know what they are doing" (Tucker, 2011, pg. 3).

Even with growing evidence, diversification seems deeply entrenched among regulators, fund managers and their clients (Yeung et al., 2012). The authors argue that diversification is embedded in the prudent man's principle that govern fiduciaries. The result has been most investment policy statements have explicit and implicit provisions that drive investment managers towards holding diversified portfolios.

The assertion of Yeung et al., (2012) reflects the position in Kenya. For instance, Miriti (2014) and Kipanga (2012) observe that in 2011 pension funds who are major investors with over Kshs 433 billion (US$ 5.094 billion) worth of investments, have minimum and maximum investment limits set by law. Miriti (2014) further observes that prior to enactment of the Retirement Benefits Act No. 3 of 1996, which introduced limits, there was little diversification. According to Miriti, portfolio mix of assets was disproportionate and unprofessionally selected. Miriti further links this lack of diversification to low growth and dismal returns registered by pension funds.

In addition, diversification is an important pension fund industry performance benchmark. This importance is demonstrated through annual reporting on the pension funds' level of diversification. For instance, RBA (2015) reports that the pension industry investment portfolio was well diversified with heavy investments in quoted securities, immoveable properties and government securities at 41.8%, 27.3% and 24.8%

respectively. Miriti summarizes the entrenchment of diversification by stating that the limits set by regulation 38 of the Retirements Benefits Act No.3 of 1996 are important since they reduce the possibility of concentration on an asset class like real estate.

1.2. Problem statement

Studies carried out in developed countries show that concentrated portfolios outperform diversified ones on a risk adjusted basis. Among the various studies is the study by Kacperczyk et al., (2005). In the study, kacperczyk et al., (2005) examines the relationship between industry concentration and performance of actively managed equity funds in the United States of America. Kacperczyk et al., find that on average more concentrated funds perform better. Howard (2012) in a further study argues that concentrated portfolios in a few selected assets dramatically increases the chance of investors recording superior performance. In addition, Yeung et al., (2012) conclude that concentrated portfolios outperform both the actual performance of the fund and its benchmark. Taken from the standpoint of these researchers, by continuing to invest in diversified portfolios, investors are missing out on the benefits of superior performance associated with concentrated portfolios.

In Kenya, various studies have been done on the wider subject of portfolio holdings and performance as well as risk and return of quoted stocks, listed and unlisted firms. For instance Mbogo (2012), focus is on the pension industry and examines the effect of portfolio size on the financial performance of pension funds in Kenya. Awino (2013), looks at the importance of measuring performance of pension funds and concludes that there is a strong correlation between longevity of life and positive returns. On risk and return Giva (2015), seeks to establish the relationship between risk and return of listed firms; Mwaniki (2015), seeks to establish risk and return of quoted stocks while Murithi (2012), studies risk and return trade-off among private equity firms.

It is the difference in opinions and conclusions in global studies on which between concentrated and diversified portfolios perform better as well as the inadequacies of local studies that form the research gap this study wishes to address. This study compares the

performance of sector concentrated equity portfolios and diversified equity portfolios in Kenya for the period 1st January 2002 to 31st December 2016. The study also seeks to establish if the outperformance of is consistent.

1.3. Research objectives

1.3.1. General Objective

The overall objective of this study is to compare the risk adjusted performance of sector concentrated equity portfolios versus diversified equity portfolios in Kenya.

1.3.2. Specific Objectives

The specific objectives are:

a) To compare the performance of sector concentrated equity portfolios versus diversified equity portfolios on a risk adjusted basis over time.
b) To establish if the performance of sector concentrated equity portfolios versus diversified equity portfolios on a risk adjusted basis is consistent.

1.4. Research questions

a) Do sector concentrated equity portfolios perform better than diversified ones on a risk adjusted basis over time?
b) Is the performance of concentrated equity portfolios versus diversified equity portfolio on a risk adjusted basis consistent?

1.5. Scope of the study

The study seeks to compare the performance of sector concentrated equity portfolios against that of a diversified portfolio on risk adjusted basis. The area of coverage is limited to 68 firms listed at the NSE between 1st January 2002 and 31st December, 2016. The firms are classified into 11 sectors namely agricultural, automobile and accessories, banking, construction and allied, commercial and allied, energy and petroleum, insurance, investment, investment services, manufacturing and allied and telecommunication. The period of interest is from 1st January 2002 to 31st December 2016.

This period is chosen because it is long enough to depict different market cycles and provide sufficient data points for analysis. In addition, data for this period is readily available from the NSE. According to Bureau et al. (2012), the study period should provide sufficient data points to obtain satisfactory estimates of variability and to minimize measurement error.

1.6. Significance of the Study

The study is an additional source of knowledge to the ongoing debate on whether it is better to concentrate or diversify portfolios. This debate is yet to formally take place in Kenya and its findings will aid retail and institutional investors, fund managers, pension advisors, trustees, policy makers and scholars as follows:

Fund managers and investors may use findings of this study to improve on their portfolio construction techniques and knowledge. Such optimal portfolios may bring sustainability and competitive advantage to their firms. The optimal portfolios may also give high returns to individuals as well as institutional investors. Fund managers and investors may also use the findings to lobby for review and changes in investment guidelines, laws and regulations.

Policy makers and regulators need research findings to support their decisions and actions. The findings of this study will therefore help policy makers and regulators review, improve and propose informed investment regulations to guide investment funds like pension funds and insurance companies.

The study has implications on the choice of models scholars use in portfolio construction and performance measurement research. It will also significantly contribute literature to the ongoing debate on portfolio concentration versus diversification. The findings of the study will help clarify which of the two portfolios is better. The study will make contributions toward validation on the use of portfolio construction models such as Sharpe single index model (SIM) and capital asset pricing model (CAPM). It will also validate the use of Sharpe ratio as measure of portfolio performance.

Chapter 2: Literature Review

2.1. Introduction

This chapter presents theories and empirical studies on portfolio construction and performance. The chapter also presents general literature on stock exchanges and market indices. It summarizes theories and studies done by different scholars and researchers in the same field of study.

2.2. Review of Theories on Portfolio Construction

2.2.1. Modern Portfolio Theory

According to Mangram (2013), modern portfolio theory (MPT) comprise Markowitz portfolio selection theory introduced in 1952 and William Sharpe's CAPM introduced in 1964. The Consulting Group (2010), observes that, evolution of portfolio construction began in 1952 with the publication of an article titled *"Portfolio Selection"* by Harry Markowitz in the Journal of Finance. According to the Consulting Group (2010), the ideas shared in the article is what forms the foundation of MPT. Yeung et al., (2005), add that Markowitz, work on portfolio theory changed the view on portfolio construction. The change occurs by demonstrating that risk should not be assessed at the level of individual securities.

In its simplest form, MPT is useful as it provides a framework to construct and select portfolios. This is based on expected performance of the investments and the risk appetite of investors. Song (2014) adds that portfolio construction using MPT involves asset class selection, asset allocation, security selection and portfolio optimization. Yeung et al. (2005), further add that Markowitz switched attention to portfolio construction and the need to diversify portfolio to achieve risk reduction. By not diversifying, investors will therefore be taking risks not compensated by the market and thus paying too much for securities. Chan-Lau (2004), supports this view by asserting that portfolio diversification across asset classes with imperfectly correlated returns increase portfolio volatility.

The theory emphasizes how risk averse investors can construct portfolios to optimize expected returns based on a given level of risk. The emphasis is that risk is an inherent

part of higher reward. MPT advocates that risk averse investors should diversify their portfolios. A major criticism of MPT is that it focuses on highly complex statistics based modelling and formulas (Mangram, 2013) and (Shah, 2015). Sarker (2013), demonstrates this complexity by pointing out that the model requires $\frac{N(N+3)}{2}$ separate pieces of information. Accordingly, for a 50 stock portfolio the amount of data required will amount to 1,325.

MPT lays a useful framework, for constructing both sector concentrated and diversified portfolios that will be compared to achieve study objectives.

2.2.2. Sharpe's Single Index Model

SIM was developed by William Sharpe (1984). The model lays down steps that are required to construct optimal portfolios. This was because of the limitations of the Markowitz Model which was found to be demanding. According to Shah (2015), Markowitz model requires large amounts of data to compile the expected returns, standard deviation, variance and covariance of each security to every other security. Sarker (2013), points out that William Sharpe (1963) studied Markowitz model and simplified the calculations. For instance Sarker (2013), observes that the covariance data requirements reduced from $\frac{N^2-N}{2}$ under Markowitz to on only N measures of each security as it relates to the index. Overall SIM requires $3N + 2$ separate pieces of information compared to Markowitz $\frac{N(N+3)}{2}$. Accordingly, for a similar 50 stock portfolio Sharpe's model will require 152 different pieces of information compared to 1,325 Markowitz model. This simplification made the use of the model practical. SIM simplified this process by relating the return of a security to a single market index (Shah, 2015).

SIM further assumes that stocks vary together because of the common movement in the stock market (Sarker, 2013). According to the author, SIM further assumes that there are no effects beyond the market that account for stocks co-movement. The expected returns, standard deviation and co variance of the single index model represent the joint movement of securities. The basic equation underlying SIM is:

$$R_i = \propto_i + \beta_i R_m + e_i \quad (1)$$

Where:

R_i= expected return on security i.

$\propto_i$= intercept of the straight line or alpha co-efficient.

β_i= Slope of the straight or beta co-efficient. It measures how sensitive a stock's return is due to its relationship with the return on the market. Where:

$$\beta_i = \frac{\sigma_{im}}{\sigma_m^2} \quad (2)$$

σ_{im} is the covariance of stock i with market and σ_m^2 is the variance of the market return.

R_m= the rate of return on market index

e_i = error term.

Sathyapriya (2016), notes that SIM is similar to Markowitz model. However, the author, points out that there is a distinction between the two models. This distinction is a simplifying assumption that returns on securities is through common relationship with a basic underlying factor. The basic underlying factor according to the author, is represented by the rate of return on a market index that causes the systematic risk to affect all stocks returns.

SIM will be used in this study, to create diversified equity portfolios for performance comparison with sector concentrated portfolio

2.2.3. Capital Asset Pricing Model

CAPM was developed by William Sharpe in 1964. According to Sharpe (1963), the selective appeal of a security is linked to its return to beta ratio. Shah (2013), notes that CAPM provides a linear relationship between the required rate of return of a security and its beta value. The model goes further and relates the return of a security to systematic

risk which cannot be avoided. The underlying assumption in the model is that the market is in equilibrium and the expected rate of return is equal to the required rate of return for a given level of risk. The equation for CAPM is as follows:

$$R_i = R_f + \beta_i(R_m - R_f) \quad (3)$$

Where:

$R_i = Expected\ rate\ of\ return$

$R_f = Risk\ free\ return$

$\beta_i = Beta\ Co - efficient$

$R_m = Return\ on\ the\ market\ portfolio$

$R_m - R_f = Excess\ return\ for\ extra\ risk$

CAPM puts emphasis on individual security. According to the model, investors should only invest in underpriced securities. This is because the chances of earning higher returns in the future are increased. It follows therefore that securities which are overpriced should not be purchased. CAPM is useful and applicable as it provides a powerful tool for identifying stocks to invest in. Shah (2015), also observes, CAPM has a limitation in that it can only suggests different securities where an investor can invest. The author, further adds that CAPM does not give a portfolio any weightage to invest in different securities.

CAPM in this study will be used to select securities to be included in the sector concentrated portfolios which will be compared with diversified equity portfolios.

2.3. Review of Empirical Studies

In constructing portfolios, one would end up with either a diversified portfolio or a concentrated one. In addition, different models exist in constructing portfolios as well as measuring their performance. In this section we will review empirical studies on construction and performance of diversified and concentrated portfolios

2.3.1. Diversified Portfolios

Various scholars have conducted empirical studies on the models used by investors and fund managers in construction of diversified portfolios. The scholars have also focused on measurement of performance of diversified portfolios. These scholars include Sarkar (2013), Sathyapriya (2013), Shah (2015), Paudel et al., (2016), Nyokangi (2016) and Kuhle (1987).

Shah (2015), examines the use of SIM and CAPM in the construction of optimal portfolios. Shah's study covers 15 securities in the BSE between 2000 and 2015. The study methodology is descriptive design and uses monthly secondary data. The variables of interest in the study are standard deviation, expected returns and residual variance. Shah uses return to beta ratio to select stocks to be included in the portfolio constructed using SIM. On the other hand, excess alpha is used to select stocks to include in the portfolio constructed using CAPM. The study concludes 5 stocks are needed to construct an optimal portfolio using SIM. In contrast, the study also concludes that 11 stocks are needed to construct a portfolio using CAPM. The Study further concludes that SIM gives the exact number of securities along with weightage for investment. The study is critical of CAPM and concludes that it is only useful in suggesting the stocks to invest in. Shah further concludes that CAPM does not result in a portfolio or weightage. The study recommends that investors should hold a portfolio suggested by SIM rather than CAPM.

Sarker (2013), is of the view that rational investors should aim to minimize risk and maximize returns while constructing portfolios. Sarker further adds that investors ought to maximize levels of return at a given level of risk. Alternatively, they should minimize the level of risk at a given level of return. Sarker like Shah (2015), constructs an optimal portfolio using SIM. Shah uses secondary data from 164 companies listed in the DSE. In the study, the author similarly uses monthly closing prices and monthly index value of the DSE All Share index. The DSE All Share Index is the assigned bench mark index. Further, the 91-day Treasury bill from Bangladesh Bank is adopted as a proxy for the risk-free rate. The key variables in the study are risk and return. The study covers the period

July 2007 to June 2012. Shah constructs an optimal portfolio using return to beta ratio. This is combined with a unique stock selection process that involves a formulated cut-off point. Only stocks with an excess return to beta ratio which surpass the cut off rate form the portfolio. According to Sarker investors will not invest in ventures that are unlikely to give higher returns. Sarker in addition sets two conditions that need to be satisfied. These are (i) there is no short selling and (ii) the sum of all stock weights in the portfolio must be equal to one.

From the study, stock selection results in an optimum portfolio comprising 33 stocks with a return of 6.17%. Shah demonstrates that implementing MVO is much more time consuming and complex by number of estimates required. The study concludes that SIM is more efficient in constructing optimal portfolios. The study further concludes that portfolio beta is much lower than market beta. In addition portfolio return is much higher than portfolio variance.

Paudel et al. (2006) and Nyokangi (2016), examine which portfolios constructed using MVO and SIM offer investors a better investment alternative. Paudel et al. (2006), samples 30 stocks trading on the Nepalese Stock Exchange. The study period is from 1997 to 2006. Nyokangi (2016), on the other hand samples 20 companies trading on the Nepalese Stock Exchange. The study period is from 2002 to 2015. The two studies use the same methodology as Sarker (2013). Sharpe ratio is used to measure performance of the two portfolios, while the 91-day Treasury bill is used as the risk-free rate. Standard deviation is adopted as a proxy measure for risk. According to the authors, the portfolio with the highest Sharpe ratio is to be judged the best performing. Both studies agree with Shah (2015), in concluding that MVO is complex and time consuming to implement compared to SIM. Paudel et al., (2006) and Nyokangi (2016), also conclude that both MVO and SIM are useful to investors. Nyokangi (2013), however adds that MVO is better when considering investments with a long-term horizon while SIM is better for short term investments. Nyokangi further concludes that MVO model is better for risk averse investors. On the other hand, SIM is better for investors who are risk lovers.

Kuhle (1987) examines the effects of diversification on reduction of total portfolio risk in real estate investments trusts and mixed assets portfolios. Kuhle uses monthly return values data over a five-year period between September, 1980 and August 1985. The study covers 82 firms of which 26 are equity REITs, 16 are mortgage REITs and 42 randomly selected companies that make the S&P 500 index. From this Kuhle creates 600 portfolios comprising 1, 2, 3 and 12 assets in five categories. The five categories are equity portfolios, mortgage REIT, common stock and mixed portfolio of equity REIT and common stock. Each asset is equal weighted and no attempt is made to solve for optimal asset proportions. Portfolio risk level is measured using variance while Sharpe ratio is used to determine the overall performance of the portfolios. From the analysis Kuhle concludes that risk magnitude of the portfolio standard deviation is reduced significantly by including REIT stock in the portfolio of common stock. The study also concludes that equity REIT portfolio significantly outperform mortgage REIT portfolios. The study further shows that risk reduction occurs when number of stocks increased from one to 12 and that the mixed portfolio has a much lower standard deviation.

2.3.2. Concentrated Portfolios

Studies on concentrated portfolios are more about comparison of performance with diversified ones than on construction. However, Cohen et al. (2008) and Kacperczyk et al. (2005), did create concentrated portfolios while Choi et al. (2014) and Yeung et al. (2012), focused on comparing performance.

Cohen et al. (2008), examine which of the managers' portfolios are best ideas. The authors use monthly data from USA domestic equity funds from 1984 to 2007. In the study, the Cohen et al. construct a concentrated portfolio with stocks having positive alphas using CAPM. According to Cohen et al. stocks with positive (excess) alpha are considered the best idea stock. Cohen et al. like Sarker (2013), note that CAPM is only useful in stock selection but cannot be used to assign weights to the selected stock. To solve for weight, Cohen et al, (2008), suggest an optimization problem. Cohen et al. summarize the optimization problem as simply selecting a portfolio from a set of N risky assets and

proceed to solve it using matrix algebra. Cohen et al., argue that the goal in solving this optimization problem is to maximize portfolio Sharpe ratio. Cohen et al conclude that concentrated funds out performance range from 1.2% to 2.6% per quarter. Cohen et al. further conclude that both theory and evidence suggest investors benefit from managers holding more concentrated portfolios. Cohen et al., (2008), further conclude that the outperformance is sustainable and investors stand to gain substantially if managers choose less diversified portfolios that tilt toward their best ideas.

Choi et al. (2014), look at portfolio performance from the perspective of institutional investors globally. Choi et al. examine whether concentrated strategies of institutional investors result in superior abnormal returns across three different measures of concentration. These different measures are home country, foreign country and industry. Data is collected from 10,771 institutional investors from 71 countries. The study period is from 1st October 1999 to 31st March 2010. The variables of interest are quarterly stock prices adjusted for splits, portfolio excess return and a risk-free rate. Choi et al. use a unique measure of concentration that is based on the weight of holdings. According to this measure if 70% of holdings are in a foreign country or industry then the investment is said to be foreign country or industry concentrated. Choi et al. conclude that investors who concentrate in a few countries and industries perform better than portfolios that are more diversified across countries and industries. Choi et al. also conclude that it is possible to have an under diversified but optimal portfolio.

Kacperczyk et al. (2005), examine the relationship between industry concentration and performance of actively managed USA equity mutual funds. The study covers the period 1984 to 1999. Data was collected from 1,771 USA equity mutual funds and used to create 10 industry portfolios with different concentration levels. The industries are Consumer Non-Durables, Consumer Durables, Health Care, Manufacturing, Energy, Utilities, Telecommunication, Business Equipment and Services, Wholesale and Retail and Finance. The variables of interest are portfolio weights, portfolio returns and risk-free rate. Like Choi et al. (2014) the authors use a unique industry concentration measure

known as industry concentration index which is based on the difference between the industry weights of the mutual fund and industry weights of the total market portfolio. The authors conclude that mutual funds with higher levels of industry concentration yield an average abnormal return of 1.58% per annum. The authors further conclude that more concentrated funds perform better after adjusting for risk. Kacperczyk et al. (2005), also find that that concentrated funds perform better than the assigned bench mark index.

Yeung et al. (2012) also compare the performance of concentrated funds and diversified funds. The Yeung et al., study over 4,700 USA equity mutual funds with 30 or more stocks with different styles, asset levels and client bases. The study uses quarterly data for the period 1999 to 2009. Yeung et al., create concentrated portfolios by measuring active weights of stocks from largest to smallest. Concentrated portfolios are then built using the largest active weights. These active weights are interpreted as fund manager's highest conviction stocks (best idea). The concentrated portfolios have between 5 and 30 stocks. The variables in the study are standard deviation and returns. Sharpe ratio is used to compare the performance of concentrated and diversified portfolios. The findings show that absolute returns from concentrated portfolios outperform the diversified funds. The portfolios further outperform the assigned benchmark.

Additionally, Yeung et al., (2012), finds that the performance of concentrated funds improve as they become more concentrated. Yeung et al., conclude that concentrated portfolios perform better than diversified ones on a risk adjusted basis. In the study, the authors find that, standard deviation of the concentrated portfolio increased as the holdings declined. Similarly, the decline as the holding declined so did the corresponding Sharpe ratio. According to the Yeung et al., this means that investors receive increasingly more return per unit of additional risk taken by investing in more concentrated portfolios. The authors also measure excess returns and observe that concentrated portfolios deliver favorable risk adjusted performance. The authors' further study the relative performance of diversified portfolios vis a vis concentrated ones. The study like Kacperczyk et al. (2005) and Choi et al. (2014), concludes that the more concentrated the portfolio the higher

the absolute risk and also its risk measured relative to the benchmark. Absolute risk is measured using standard deviation while risk relative to the benchmark is measured using tracking error.

2.4. The Nairobi Securities Exchange

Stocks markets around the world play a major role in enhancing efficiency in capital formation and allocation (Olweny et al. 2011). Olweny et al. note that stock markets provide listed companies with a platform to raise long term capital. In addition stock markets also provide investors with a forum for investing their funds. Mudida et al. (2010) adds that financial markets allow efficient risk sharing among investors. Benjelloun (2011), observes that stock markets like the NYSE because of their large size and correlation structure offer more opportunities for diversification. Ivkovic et al. (2008) observe that a large number of investors are from the USA. For this reason, it is possible that only USA investors benefit from diversification strategies due to better development of their financial market. Unlike in the developed world, stock exchanges in developing countries face constraints which result in liquidity issues, absence of activities and absence of well-developed investor base (Olweny et al. 2011).

The NSE like other stock exchanges plays a similar function in Kenya. Giva (2015), notes that the NSE has 64 listed companies classified into eight sectors. The sectors are agricultural, automobile and accessories, commercial and services, construction and allied energy and petroleum, growth and enterprise segment, manufacturing and allied, Investments, Insurance sectors and Telecommunications Technology. Nyokangi (2016), adds that it is from this listed firms and sectors that investors' construct their optimal portfolios using various techniques which include multiples, price to earnings ratio and enterprise value to EBITDA ratio, single index model and MVO.

Pivotal to the proper functioning of a securities exchange is the presence of market indices. Market Indices are useful in establishing performance benchmarks or proxies, asset allocations and as well as conducting risk analysis (Flippin Bruce and Porter, 2008). Njuguna (2014), adds that investors use bench mark indices to gauge market

performance. Njuguna (2014), further adds that bench mark indices are also useful in comparing individual portfolio performance with whole market.

Mwaniki (2015) notes that the NSE has three indices which track and measure the stock market performance. These are NSE 20, NASI and NSE 25 Share Index. NSE 20 is the oldest and widely used market benchmark. The NSE 20 Share Index is a price weighted index adjusted for share bonus and splits. The NSE 20 Share index generally reflects the performance of the whole market (Nyokangi, 2016). Njuguna (2014), asserts that NSE 20 is a better market measurement index compared to NASI.

2.5. Summary of empirical literature

Three foundational theories and empirical studies on portfolio construction and performance have been reviewed in this chapter. From the review of the theories and studies, MPT sets a useful framework for portfolio construction. MPT is however complex and more time consuming to use. SIM on the other hand is a simplification of the MPT. SIM has an additional advantage of it being able to assign weights to selected stocks. Stock selection using SIM is through a return to beta ratio which surpasses formulated cut-off rate. Two conditions, however must be satisfied. These are (i) prohibition of short selling and (ii) the sum of all stock weights in the portfolio must is equal to one. SIM is therefore an ideal model for creating diversified portfolios. CAPM on the other hand draws its strength as a suitable stock selection tool. It is a useful tool for selecting stocks using excess alpha. From the studies, stocks with excess alpha get selected for inclusion in the portfolio. CAPM is however limited in allocating weight to the stocks included in the portfolio. From the study by Cohen et al. (2008) this limitation is addressed by solving a maximization problem using matrix algebra. CAPM is the proposed tool in selecting stocks to be included in the sector concentrated portfolios.

The studies have different conclusions on which between diversified and concentrated portfolio perform better. The studies have several variables of interest. These variables include portfolio returns, standard deviation, stocks weights and number of stocks. The studies also use various performance measures in order to compare which portfolio is

better. The performance measures include Treynor's ratio, Jensen's alpha, and Sharpe ratio. Sharpe ratio is the recommended performance measure making portfolio return and standard deviation variables of interest. From the studies the higher the Sharpe ratio the better the portfolio performance. Therefore the portfolio with the highest Sharpe ratio is better performing one.

The studies comparing the performance of diversified and concentrated portfolios have largely been carried out in the developed world while limited studies have been carried out in Kenya. Accordingly the difference of opinions and conclusions in global studies as well as the inadequacies of local studies form the research gap that this study wishes to fill. The purpose of this study is to determine if sector concentrated equity portfolios perform better than diversified equity portfolios in Kenya.

Chapter 3: Research Methodology

3.1. Introduction

This chapter discusses research methodology. It discusses research design, population and sampling, data and sources of data, describes the variables used in the study and explains how collected data is analyzed.

3.2. Research Design

This study uses a comparative research design. The study seeks to compare returns of investors who invest in sector concentrated equity portfolios and those that invest in diversified equity portfolios. Bureau et al. (2012) states that the main goal of comparative research design is to search for identity or variance or similarity.

3.2. Population and sampling

The population of interest are the listed firms at the NSE. The number of listed firms at the NSE has changed over the years and so has the classifications. Giva (2015), notes that in 2014 the NSE had 64 listed firms categorized as main investment market, alternative investment market and growth enterprise market (GEMs). According to Giva the firms are further classified into 12 sectors agricultural, automobile and accessories, banking, construction and allied, commercial and allied, energy and petroleum, insurance, investment, investment services, manufacturing and allied, telecommunication and GEMs. GEMs is however a market segment and not a sector. For the purpose of this study therefore, GEMs is excluded from the list of sectors. With exclusion of GEMs, the firms listed on the NSE are therefore classified into 11 sectors. Further all firms which number 68 that traded between 1st January 2002 and 31st December 2016 are eligible for selection. A list of the firms and the sectors they are classified into are shown in part I of the appendices. The sectors used are those that existed as at 31st December 2016. Firms that did not trade for the entire period or entire sub periods for various reasons including, having not been listed, under suspension or delisted for part or the entire time frame have been excluded. Accordingly, following the above criteria, the total number of firms, those excluded and those eligible for selection for the entire period and sub periods are as

shown in Table 3.1 below:

Table 3.1 Number of firms eligible for selection

Period Sub Period	Total number of firms	Number excluded	Number eligible for selection
2002 to 2016	68	35	31
2002 to 2006	42	11	31
2007 to 2011	56	16	40
2012 to 2016	68	14	52

The list of firms eligible in each period is shown in part I of the appendices.

3.3. Data and Sources of Data

Investors in Kenya have a range of investment options which includes stocks, bonds, cash and real estate. This study confines itself to NSE quoted equities as the market is active, liquid and data is readily accessible compared to other investment options. The study uses secondary data obtained from monthly closing prices of the equities and the monthly closing value of the NSE 20 Index for the period 1st January 2002 to 31st December 2016. These dates are chosen because a period of 15 years gives sufficient data points for analysis. The NSE 20 Share Index is chosen because it generally reflects the performance of the whole market (Nyokangi, 2016). Njuguna (2014), adds that the NSE 20 Share Index is a better market measurement index compared to NASI and NSE 20 Share Index. Data will also be collected on the interest earned on the 91-day Treasury bills issued by the CBK. The interest from the 91-day Treasury bills will be used as a proxy for the risk-free rate.

3.4. Variables Used in the Study

There are three key variables used in this study are portfolio returns, portfolio standard deviation and portfolio Sharpe ratio.

Portfolio returns represents the expectation and reward for investing. An increase in portfolio returns with either a decrease or freeze of portfolio standard deviation increases

the portfolio Sharpe ratio (Kacperczyk et al. 2005, Cohen et al., 2008, Sarker, 2013, Paudel et al. 2006 and Nyokangi, 2016).

On the other hand, portfolio standard deviation is a measure of risk. An increase in portfolio standard deviation with either a freeze or reduction in portfolio returns reduces the portfolio Sharpe ratio and vice versa (Yeung et al. 2006, Paudel et al. 2006, Sarker, 2013 and Nyokangi, 2016).

Portfolio Sharpe ratio is measures the performance of a portfolio. An increase in portfolio return with either portfolio standard deviation decreasing or remaining constant, increases the portfolio Sharpe ratio (Kuhle, 1987, Paudel et al. 2006, Cohen et al. 2008, Yeung et al. 2012 and Nyokangi, 2016).

3.5. Data analysis

3.5.1. Diversified Portfolio

In this study, diversified portfolios will be constructed using SIM. This is consistent with the recommendation of Nyokangi (2016), Sathyapriya (2016) and Shah (2015). The authors' note that SIM is useful in determining stocks to be included in a diversified portfolio. In addition, SIM also assists in determining the share of the overall portfolio that is allocated to each selected security. Shah (2015) and Sathyapriya (2016), propose the following steps in constructing a diversified portfolio using SIM:

Step 1: List all eligible stocks.

Step 2: calculate the "excess return to beta ratio" for each stock under consideration using the following formula:

$$\frac{R_i - R_f}{\beta_i} \qquad (4)$$

Where

R_i= Expected Return.

R_f= the return of a riskless asset.

β_i= the expected change in the rate of return on the stock *i* associated with one unit of change in the market return. $\beta_i$is obtained by running regression for each security as shown in appendix IV.

Step 3: Rank the securities from the highest to the lowest in a table format.

Step 4: Calculate C_i for each stock and establish the optimum C_i. The optimum C_i is also the cut-off point C^*. C_i for all stocks is calculated and arranged in ranking order using the following formula (Shah, 2015):

$$C^* = \frac{\frac{\sigma_m^2 \sum_{i=1}^{n}(R_i - R_f)}{\sigma_{ei}^2}}{1 + \sigma_m^2 \sum_{i=1}^{n} \beta_i^2} \quad (5)$$

In equation (5), σ_m^2 represents systematic risk while σ_{ei}^2 represents unsystematic risk.

Step 5: Select all stocks with a value equal or greater than C*.

Only stocks with an excess return to better ratio that is equal to or greater than the cut-off point that is $\frac{(R_i - R_f)}{\beta_i} \geq C^*$ are selected into the optimal portfolio. This is because investors will only invest in risky ventures if they have higher returns.

Step 6: Calculate the proportions/weights (%) of each security as follows:

$$X_1 = \frac{Z_i}{\sum_{i=1}^{n} z_i} \quad (6)$$

Where the relative weights in each security Z_i are defined as

$$Z_i = \frac{\beta_i}{\sigma_{ei}} \left(\frac{R_i - R_f}{\beta_i} - C^* \right) \quad (7)$$

In equation (6) X_1 represents the share of the portfolio to be allocated across the total number of selected securities (n) and they sum up to 1. This means there is full investment. In addition each $Z_i > 0$ thus satisfying the constraint of no short selling.

Step 7: calculating the optimal portfolio returns, standard deviation and Sharpe ratio.

The final step is to calculate the optimal portfolio returns (R_p) standard deviation (σ_p) and Sharpe ratio (S_p) using the following formulae:

$$R_p = \propto_p + \beta_p R_m \quad (8)$$

Where:

$\propto_p = \sum_{i=1}^{n} X_i \propto_i$ and;

$\beta_p = \sum_{i=1}^{n} X_i \beta_i$

$$\sigma_p = \sqrt{\beta_p^2 \sigma_m^2} + \sum_{i=1}^{n} X_i^2 \sigma_{ei}^2 \quad (9)$$

The $\propto_p$ and β_p of the portfolio represent the weighted average of each of the selected

securities respective $\propto_i$ and β_i parameters.

$$S_p = \frac{R_p - R_f}{\sigma_p} \quad (10)$$

3.5.2. Sector Concentrated Portfolios

Cohen et al., (2008), observe that many managers are limited in the set of stocks that they may consider investing in. The authors note that a manager's or investor's choice may be limited to specific sectors or industry. In this study we will create 8 sector concentrated portfolios based on the NSE sectors. Cohen et al., (2008), propose a three (3) step process of creating a concentrated portfolio based on best ideas as follows:

***Step 1*: Select the best idea stock.**

The best idea stock is stock with positive alpha. Alpha is the rate of return that exceeds a financial expectation. To calculate alpha (∝), CAPM formula is used as follows:

$$R_i = R_f + \beta_i(R_m - R_f) + \propto \quad (11)$$

$$\propto = R_i - [R_f + \beta_i(R_m - R_f)] \quad (12)$$

Where:

R_f= Risk free Return.

β_1= Beta co-efficient-risk measure for the non-diversifiable risk part of the total risk. R_i=expected rate of return on security i.

R_m= Return on Market Portfolio.

$R_m - R_f$ = Excess return for extra risk.

The securities with positive alpha represent the best idea stock.

***Step 2*: Establish the weight of each stock in the portfolio.**

After determining the best idea stocks, the next step is to choose weights that will maximize the Sharpe ratio subject to the following conditions (a) the total sum of weights will equal to 1and (b) Short selling is not allowed. That is no stock in the portfolio will have negative weight.

Optimal portfolio is one with the combination of stocks that will maximize the weight of each security and result in the highest Sharpe ratio (S_P). To maximize Sharpe ratio

therefore matrix algebra is used to obtain a portfolio of N assets and having a vector of optimum portfolio weights of N assets. Matrix algebra is used because it is easier to express the weights and returns of many assets as vectors. The beginning point is to express the maximization problem as an objective function as follows:

$$\underset{W}{Max} S_p = \frac{E(R_p)-R_f}{\sigma_p} \; subject\ to \; \sum_{i=1}^{n} W_i = 1 \qquad (13)$$

The solution to the objective function (13) is as shown in part II of the appendices.

Step 3: Concentrated Portfolio Excess return $(\boldsymbol{E(R_p)})$***and Sharpe ratio (SR).***

The final stage is to calculate the portfolio excess return and Sharpe ratio as follows:

Portfolio Excess Return:

$$\boldsymbol{E(R_p)} = \boldsymbol{W^T}\left(R_i - R_f\right) \qquad (14)$$

Sharpe Ratio

$$\frac{\boldsymbol{E(R_p)}}{\sigma_p} \qquad (15)$$

3.5.3. Market Index

There are two major stock indices which are used to characterize equities in Kenya. These are Nairobi All Share Index (NASI) and NSE 20 Share Index. The NSE 20 is used in this study because it is the oldest and the most widely used. The index is geometrically weighted. It is constructed from stock prices data adjusted for corporate actions such as stock splits and changes in companies' market capitalization over time. According to Njuguna (2014), the NSE 20 Share Index is a better market measurement index. The formula that will be applied to calculate the returns of market index NSE 20 share Index will be as follows:

$$R_m = \frac{N_t - N_{to}}{N_t} \qquad (16)$$

Where

- N_t is the closing index value at the end of the month t.
- N_{to} is the closing index value at time t_o (that is the previous month).

3.5.4. Determining the better performing portfolio

Kacperczyk et al. (2005) and Yeung et al. (2012), argue that more concentrated portfolios outperform diversified ones on a risk adjusted basis. Sathyapriya (2016) observes that Sharpe ratio is regularly employed to assess the performance of portfolios. Accordingly in this study we will use the Sharpe ratio to compare the performance of the two portfolios. For the diversified portfolio, Sharpe ratio will be calculated using equation (10). For the sector concentrated equity portfolios, Sharpe ratio will be calculated using equation (15).

The portfolio with the highest Sharpe ratio during the period 2002 to 2016 will be judged the best performing in line with objective 1. To determine if the performance is consistent over time in line with objective 2 of this study, the period Jan 2002 to December, 2016 is divided into 3 parts. That is from 1st January 2002 to 31st December 2006, 1st January, 2007 to 31st December, 2011 and 1st January, 2012 to 31st December, 2016. The same process is then used as in objective 1 to find out if the results are consistent.

Chapter 4: Presentation of Research Findings

4.1. Introduction

The general objective of this study is to compare the performance of sector concentrated equity and diversified equity portfolios. The study period is 2002 to 2016. To achieve the set objectives, this chapter is divided into three parts. The first part, discusses the descriptive statistics and the results of statistical tests on the data. The second part compares the performance of the two portfolios during the whole period. This is in line with specific objective of comparing performance of a diversified equity portfolio and sector concentrated equity portfolios in fulfilment of objective one. The third part compares the performance in three specific sub periods. These sub periods are between 2002 and 2006, 2007 and 2011 and 2012 and 2017. The second part fulfills specific objective two which is to check consistency of performance.

4.2. Descriptive statistics and test for normality

Descriptive statistics are generated using MINITAB 14. The output is shown on table 4.1A and 4.1B. A standard normal distribution has a skewness of 0. Accordingly, if data has a positive value then it is skewed to the right. If it has a negative value, then it is skewed to the left. Similarly kurtosis of a standard normal distribution is 0. However if the kurtosis has a positive value, the data set will have a heavy tail. If kurtosis is negative then the data set will have a light tail (Nyokangi, 2016). In this study, skewness and kurtosis are used to determine the distribution of stock returns as shown by a histogram. For instance, the distribution of BAM is positively skewed (1.93) with a kurtosis of 10.51 shown on Table 4.1A. Stock returns used in the construction of both sector concentrated and diversified equity portfolios is non normal as shown by the BAM's histogram on appendix III Fig 0.1.

Table 4.1A: Descriptive statistics: diversified portfolio 2002 to 2016

Variable	N	Mean	St Dev	Minimum	Maximum	Skewness	Kurtosis
ARM	179	0.0344	0.2052	-0.6051	1.7241	4.66	34.59
BAM	179	0.01724	0.09763	-0.31430	0.63740	1.93	10.51
BAT	179	0.01951	0.08282	-0.26130	0.38890	1.32	5.18
CENTUM	179	0.0224	0.1411	-0.3359	0.7665	1.28	5.53
CFC	179	0.0204	0.1465	-0.3693	0.7727	2.41	9.55
CROWN P	179	0.0244	0.1570	-0.4733	0.8000	1.31	4.87
DTB	179	0.02162	0.12655	-0.29080	0.73210	1.77	8.75
JBH	179	0.0285	0.1501	-0.3659	0.9531	2.54	12.38
KAKUZI	179	0.0229	0.1553	-0.3759	0.7080	1.35	4.34
KCB	179	0.0237	0.1343	-0.2571	0.6923	1.77	6.30
KEN/K	179	0.01637	0.12355	-0.75950	0.54620	-0.61	10.42
KPLC	179	0.0169	0.1514	-0.3750	0.9278	2.79	13.42
NIC	179	0.01499	0.11433	-0.20400	0.46150	1.16	2.63
SASINI	179	0.0192	0.1451	-0.3376	0.8095	2.15	8.92
UNGA	179	0.0186	0.1434	-0.3906	0.6875	1.29	5.65
WT	179	0.0211	0.1610	-0.2615	0.9205	2.79	10.15

Table 4.1B: Descriptive statistics for sector concentrated portfolio 2002 to 2016

Sector	Stock	Count	Mean	St Dev	Minimum	Median	Maximum	Skewness	Kurtosis
Agriculture	KAKUZI	179	0.0229	0.1553	-0.3759	0	0.708	1.35	4.34
	SASINI	179	0.0192	0.1451	-0.3376	0.0035	0.8095	2.15	8.92
	WT	179	0.0211	0.161	-0.2615	-0.0111	0.9205	2.79	10.15
Constructio n and Allied	ARM	179	0.0344	0.2052	-0.6051	0	1.7241	4.66	34.59
	BAM	179	0.01724	0.09763	-0.3143	0	0.6374	1.93	10.51
	CROWN P	179	0.0244	0.157	-0.4733	0.009	0.8	1.31	4.87
Banking	CFC	179	0.0204	0.1465	-0.3693	0	0.7727	2.41	9.55
	DTB	179	0.02162	0.12655	0.2908	0.0084	0.7321	1.77	8.75

4.3. The best performing portfolio

To determine which portfolio is better performing between sector concentrated equity portfolios and diversified equity portfolios, Sharpe ratio is used. The portfolio with the highest Sharpe ratio during the study period 2002 to 2016 will be judged the best performing. The portfolio analysis is shown in appendix V for diversified equity portfolio and appendix VI for sector concentrated equity portfolios.

Study period 2002 to 2016

In the study, SIM is used to select stocks, assign weight and construct diversified equity portfolios. On the other hand, CAPM and matrix algebra are used to identify suitable stock and construct sector concentrated equity portfolios as shown in appendix V and VI respectively. The composition of the two portfolios is then analyzed to calculate portfolio return (R_p), standard deviation (σ_p)and Sharpe ratio (SR). The results of the analysis are presented in Table 4.1 A and 4.1B overleaf. Table 4.1A show the composition and analysis of the equity diversified portfolio while Table 4.1B shows the results of the sector concentrated equity portfolio.

The diversified portfolio comprise 13 stocks from 6 out of 11 sectors. BAT has the largest weight totaling 31.05% followed by BAM with 19.67%. The stocks with the least weight are CENTUM and ARM with 0.52% and 1.73% respectively. In terms of sectors, manufacturing and allied has weight totaling 35.93% followed by construction and allied with 26.72%. The least allocation is to Investments which has 0.52%. The portfolio return is 1.82% while the risk is 5.73%.

Table 4.2A: Composition of diversified portfolios 2002 to 2016.

Diversified Portfolio Composition Period 2002 to 2016					
Stock	**Sector**	W_i	R_p	σ_p	**SR**
			1.82%	5.73%	0.2076
WT	Agricultural	5.86%			
KAKUZI	Agricultural	4.01%			
SASINI	Agricultural	3.69%			
DTB	Banking	2.65%			
KCB	Banking	0.00%			
CFC	Banking	3.83%			
NIC	Banking	4.21%			
ARM	Construction and Allied	1.73%			
BAM	Construction and Allied	19.67%			
CROWN P	Construction and Allied	4.91%			
KENK	Energy and Petroleum	10.69%			
KPLC	Energy and Petroleum	0.00%			
JBH	Insurance	2.28%			
CENTUM	Investments	0.52%			
BAT	Manufacturing and Allied	31.05%			
UNGA	Manufacturing and Allied	4.88%			

Table 4.2B: Concentrated portfolios for the period 2002 to 2016.

Concentrated Portfolio					
Sector	**Stock**	W_i	R_p	σ_p	**SR**
			0.478%	292.361%	0.001634
Agriculture	SASINI	29.86%			
	KAKUZI	36.43%			
	WT	33.71%			
Automobile & Accessories					
Banking			0.66%	424.13%	0.00156
	CFC	51.21%			
	DTB	48.79%			
Commercial and Allied					
Construction and Allied			1.03%	280.57%	0.00366
	ARM	54.62%			
	BAM	19.27%			
	CROWN P	26.10%			
Energy and Petroleum					
Insurance					
Manufacturing					

On the side of sector concentrated equity portfolios analysis, a total of three portfolios were created. These are portfolios created from agricultural, banking and construction and allied sectors as shown on Table 4.1B. Agricultural sector has three stocks. These are SASINI, KAKUZI and WT. The weights are relatively evenly distributed with KAKUZI having the highest allocation of 36.43%.Banking has the least number of stocks (CFC and DTB). Construction and allied posted the highest portfolio return of 1.03% with a risk of 280.57% while Agriculture sector posted the lowest return of o,478% with a risk of

292.361%. It was not possible to create sector concentrated equity portfolios from 8 sectors. This is because the stocks in these respective sectors did not generate positive alphas during the study period. The affected sectors are automobile and accessories, banking, commercial and allied, construction and allied, energy, manufacturing and allied, energy and petroleum, insurance sectors and investment services.

Diversified portfolio posted higher portfolio returns (1.82%) compared to the sector concentrated portfolios. The higher returns are at a much lower risk (5.73%). The Sharpe ratio which is to determine which portfolio is better performing, shows that the diversified portfolio is better. The diversified portfolio has a higher Sharpe ratio of 0.2076 compared to that of 0.00156 and 0.00366 for banking and construction and allied sector concentrated portfolios respectively.

4.3. Consistency of performance

To determine consistency of performance the study period is divided into 3 sub periods. These sub-periods are 2002 to 2006, 2007 to 2011 and 2012 to 2016. A similar process as in the full period in section 4.1 above is used in the analysis of the sub periods to measure consistency of performance of the sector concentrated equity portfolios and diversified equity portfolios.

4.3.1. Sub period 2002 to 2016

The results in portfolio return, portfolio standard deviation and portfolio Sharpe ratio of the diversified equity portfolio and sector concentrated equity portfolio is shown in Tables 4.2A and 4.2B over leaf.

The diversified portfolio comprise 5 stocks from 4 sectors. The stocks are KQ from commercial and allied; BAM from construction and allied; MSC and EAC from manufacturing and allied and SASINI from agriculture. KQ and BAM have the largest weights of 34.08% and 31.29% respectively. EAC with 2.07% allocation has the least weight. The risk adjusted portfolio return is 3.12%, standard deviation is 8.50% and Sharpe ratio is 0.3083.

Table 4.3A Diversified portfolio composition for the period 2002 and 2006.

Diversified Portfolio Composition 2002 to 2006					
Stock	**Sector**	W_i	R_p	σ_p	**SR**
			3.12%	**8.50%**	**0.3083**
SASINI	Agricultural	16.67%			
KQ	Commercial and Allied	34.08%			
BAM	Construction and Allied	31.29%			
MSC	Manufacturing and Allied	15.89%			
EAC	Manufacturing and Allied	2.07%			

On the other hand, a total of 8 sector concentrated portfolios were created during the same period as shown on table 4.2B and 4.2C.

These are agricultural, banking, and commercial and allied, construction and allied, energy and petroleum, insurance, investment and manufacturing and allied. The banking and insurance sectors have the least number of stocks (2 each), while banking has the largest number of stocks (8). During this period, insurance sector concentrated equity portfolio recorded the highest risk adjusted returns (4.00%), standard deviation (329.72%) while the diversified portfolio recorded the highest Sharpe ratio of 0.3083 and the lowest portfolio risk of 8.50%.

Table 4.3 B. Concentrated portfolio composition for the period 2002-2006

Concentrated Portfolio Composition 2002 to 2006					
Stock	**Sector**	W_i	R_p	σ_p	**SR**
			1.81%	**291.69%**	**0.0062**
SASINI	Agriculture	49.63%			
KAKUZI	Agriculture	25.03%			
WT	Agriculture	25.33%			
	Automobile & Accessories				
			3.50%	**99.19%**	**0.0353**
BBK	Banking	6.71%			
NBK	Banking	19.60%			
CFC	Banking	14.84%			
HF	Banking	15.55%			
KCB	Banking	14.22%			
DTB	Banking	14.20%			
NIC	Banking	9.12%			
SCB	Banking	5.77%			
			3.37%	**273.52%**	**0.0123**
KQ	Commercial and Allied	21.68%			
STD G	Commercial and Allied	49.80%			
NMG	Commercial and Allied	17.52%			
SAMEER	Commercial and Allied	11.01%			
			3.96%	**121.56%**	**0.0326**
EAPC	Construction and Allied	35.70%			
CROWN P	Construction and Allied	13.06%			
ARM	Construction and Allied	38.22%			
BAM		13.02%			

Accordingly the diversified portfolio is adjudged as the best performing since it has a higher Sharpe ratio compared to all the sector concentrated equity portfolios.

Table 4.3 C. Concentrated portfolio composition for the period 2002-2006

Stock	Sector	W_i	R_p	σ_p	SR
			3.04%	284.42%	0.0107
KPLC	Energy and Petroleum	63.08%			
KENK	Energy and Petroleum	16.91%			
TOTAL	Energy and Petroleum	20.01%			
			4.00%	329.72%	0.0121
JBH	Insurance	63.22%			
SANLAM	Insurance	36.78%			
			2.85%	274.42%	0.0104
CENTUM	Investment	34.96%			
OLYM	Investment	65.04%			
			3.83%	162.33%	0.0236
EAC	Manufacturing	65.84%			
MSC	Manufacturing	14.38%			
BAT	Manufacturing	6.71%			
UNGA	Manufacturing	13.06%			
EABL	Manufacturing	0.00%			

4.3.2 Sub period 2007 to 2011

The portfolio return, portfolio standard deviation and portfolio Sharpe ratio are presented in Table 4.4. The diversified portfolio for the sub period 2007 to 2011 comprise three stocks the least of any sub period. The three stocks are WT, WPP SCANG and ARM. ARM has the highest weight with 65.53% while WT has the least weight with 8.90%.

Table 4.4: Diversified portfolio composition for the period 2007 to 2011

Diversified Portfolio 2007 to 2011					
Stock	**Sector**	W_i	R_p	σ_p	**SR**
			2.50%	8.20%	0.1878
WT	Commercial and Allied	8.90%			
WPP SCANG	Commercial and Allied	25.57%			
ARM	Construction and Allied	65.53%			

The portfolio return is 2.50%, standard deviation is 8.20% and Sharpe ratio is 0.1878. During this time, there were no eligible stocks to create sector concentrated portfolios.

4.3.3. Sub period 2012 to 2016

The portfolio return, portfolio standard deviation and portfolio Sharpe ratio for the equity diversified portfolios are shown in table 4.5A and 4.5B.

The diversified portfolio comprise seven stocks from four sectors as shown on Table 4.5A. These are KOL, BAT and UNGA from manufacturing and allied, SAFCOM from telecommunication, CROWN P from construction and allied, KAKUZI from agriculture and KRE from insurance. SAFCOM appearing for the first time and representing a new sector has the largest weight of 29.05% while KOL has the least with 0.24%.

On the concentrated side, a total of 2 sector concentrated portfolios were created during the same period as shown on table 4.5B over leaf. These are banking and manufacturing and allied. The banking sector concentered portfolio has 3 stocks namely CFC, Equity and KCB. CFC has the highest allocation of 45.61% while KCB has the least with 10.77%. Manufacturing sector concentrated portfolio has 5 stocks. KOL has the highest allocation of 90.74% while BOC has the least (0.91%).

Table 4.5A: Diversified portfolio composition for the period 2012- 2016

Diversified Portfolio 2012 to 2016					
Stock	**Sector**	**Wi**	R_p	σ_p	**SR**
			3.08%	4.33%	0.4392
KAKUZI	Agriculture	6.15%			
CROWN P	Construction and Allied	8.43%			
KRE	Insurance	11.81%			
KOL	Manufacturing and Allied	0.24%			
BAT	Manufacturing and Allied	28.03%			
UNGA	Manufacturing and Allied	16.30%			
SAFCOM	Telecommunication	29.05%			

On the concentrated side, a total of 2 sector concentrated portfolios were created during the same period as shown on table 4.5B over leaf. These are banking and manufacturing and allied. The banking sector concentered portfolio has 3 stocks namely CFC, Equity and KCB. CFC has the highest allocation of 45.61% while KCB has the least with 10.77%. Manufacturing sector concentrated portfolio has 5 stocks. KOL has the highest allocation of 90.74% while BOC has the least (0.91%).

During this period, manufacturing and allied sector concentrated equity portfolio recorded the highest risk adjusted returns (4.72%) while the diversified portfolio recorded the highest Sharpe ratio of 0.4392 and the lowest portfolio risk of 4.33%. Accordingly the diversified portfolio is the best performing since it has a higher Sharpe ratio compared to all the sector concentrated equity portfolios.

Table 4.5B: Concentrated portfolio composition for the period 2012- 2016

Concentrated Portfolio 2012 to 2016					
Sector	**Stock**	W_i	R_p	σ_p	**SR**
Agriculture					
Automobile & Accessories					
Banking			0.129%	1014%	0.00013
	BBK	0.00%			
	CFC	45.61%			
	CO-OP	0.00%			
	DTB	0.00%			
	EQUITY	43.61%			
	HF	0.00%			
	KCB	10.77%			
	NBK	0.00%			
	NIC	0.00%			
	SCB	0.00%			
Manufacturing			4.72%	165.81%	0.02845
	EABL	0.28%			
	KOL	90.74%			
	BOC	0.91%			
	BAT	3.21%			
	CARBACID	0.00%			
	EAC	0.00%			
	MSC	0.00%			
	UNGA	4.86%			

Chapter 5: Discussion, Conclusion and Recommendations

5.1. Introduction

The findings of this study suggests that diversified equity portfolios perform better than sector concentrated equity portfolios over time. The outperformance is consistent across time. This finding is consistent with MPT, SIM and previous research which proved that risk averse investors should diversify their portfolios (Paudel, et al., 2006, Sathyapriya, 2013, Nyokangi, 2016, Shah, 2015 and Sarker, 2015). This chapter discusses the study findings and draws conclusions on the performance of sector concentrated equity portfolios versus diversified equity portfolios. The chapter also highlights the limitations of the study and makes recommendations on areas for further research.

5.2. Discussion

MPT, SIM, previous research and the findings of this research further prove that investors who do not diversify their portfolios, create risk which is not compensated by the market. From this research, diversified portfolios consistently posted low risks of between 4.33% and 8.5% as measured by portfolio standard deviation. On the other hand, sector concentrated equity portfolios recorded high risks of between 99.19% and 690.71% as shown in Table 5.1. This coupled with relatively higher Sharpe ratios for diversified portfolios compared to sector concentrated portfolios, affirms that investors who choose concentrated investment strategies end up paying too much for securities.

An important aspect in portfolio construction is the number of stocks that make an optimal portfolio. From a wide selection of eligible stocks, it is an observation from this study that a range of between 3 to 13 stocks is sufficient. This observations agrees with observations of previous research that investors do not have to spread their funds in very many different stocks or sectors to maximize returns and minimize risk (Shah, 2015 and Yeung et al., 2012).

An interesting finding of this study, is that a portfolio may be diversified but tilted (concentrated) towards a particular stock or sector. This is illustrated in the period 2007

Table 5.1: Summary table of findings

Year	Portfolio	Stocks in Portfolio	Performance Measures			Year	Portfolio	Stock in Portfolio	Performance Measures		
2002-2016			R_p	σ_p	SR	2007-2011			R_p	σ_p	SR
	Diversified	13	1.49%	5.73%	0.2076		Diversified	3	2.50%	8.20%	0.1878
	Concentrated						Concentrated				
	Agriculture	3	1.33%	690.71%	0.0019		Agriculture	-			
							Automobile &				
	Manufacturing	5	4.72%	165.8%	0.0284		Accessories	-			
							Banking	-			
							Energy and				
2002-2006	Diversified	5	**3.12%**	**8.50%**	**0.3083**		Petroleum	-			
							Commercial and				
	Concentrated						Allied	-			
							Construction				
	Agriculture	3	1.81%	292%	0.0062		and allied	-			
	Automobile &										
	Accessories	-					Insurance	-			
	Banking	8	3.50%	99.19%	0.0353		Investment	-			
	Commercial and										
	Allied	4	3.30%	273.50%	0.0123		Manufacturing	-			
	Construction and										
	allied	4	3.96%	121.56%	0.0326	2012-2016					
	Energy and										
	Petroleum	3	3.04%	284%	0.0107		Diversified	7	3.08%	4.33%	0.4392
	Insurance	2	4.00%	329.72%	0.0121		Concentrated				
	Investment	2	2.85%	274.42%	0.0104		Agriculture	-			
							Automobile &				
	Manufacturing	5	3.83%	162.33%	0.0236		Accessories	-			
							Banking	-			
							Energy and				
							Petroleum	-			
							Commercial and				
							Allied	-			
							Construction				
							and allied	-			
							Investment	-			
							Manufacturing	-			

to 2012 where ARM one of the three stocks that made the portfolio from construction and allied sector recorded a weight of 65.53%. This makes the portfolio though diversified, to be tilted towards one stock (ARM) and one sectors (construction and allied). This finding while it relates to diversified portfolios, is consistent with Cohen et al., (2008) and Choi et al., (2014) research findings.

In view of the results of this research, it becomes necessary to question findings by previous research on the superiority of performance of concentrated equity portfolios over diversified ones. Kacperczyk et al., (2005), Cohen et al., (2008), Yeung et al., (2012) and Choi et al., (2014), all proved that concentrated portfolios perform better than diversified ones. These authors also did prove that, the outperformance is consistent across different definitions including sectors, regions and stocks.

It is, however possible, that the difference in findings may be due to various factors which mitigated against concentrated portfolios in this study. These factors include inconsistency of firms trading in the NSE to generate significant or positive alpha (most stocks recorded insignificant, negative or no alpha returns (see regression output summary on part IV of the appendix). The failure to generate positive or significant alpha may be the reason a number of sector concentrated portfolios could not be constructed in both the 2002 to 2016 period as well as the sub periods. The other consideration is that all previous research have been carried out in developed counties. These countries have large (in terms of number of firms actively trading) and mature exchanges compared to the NSE (Ivkovic et al., 2005 and Olweny et al., 2011). This observation, also seem to suggest that a combination of CAPM and matrix algebra (Cohen et al., 2008), as method of constructing sector concentrated portfolios in small exchanges in developing countries may be unsuitable.

A major factor to consider in questioning the difference in findings is the use of Sharpe ratio as a performance measure. While Sharpe ratio has its advantages, it is however known to penalize idiosyncratic volatility (Nyokangi, 2016). This critical factor in the performance measuring tool puts concentrated portfolios at a disadvantage.

5.3. Conclusion

The purpose of this study is to compare the performance of sector concentrated equity portfolios versus diversified equity portfolio using Sharpe ratio as a measure. The portfolios are built using data from the NSE for the period 2002 to 2016. A conclusion on which portfolio is better performing is based on Sharpe ratio.

From the study, it can be concluded that diversified portfolios perform better than concentrated portfolios over time. From the study, in the period 2002 to 2016, the constructed diversified portfolio has a higher Sharpe ratio compared to the sector concentrated portfolios. The out performance is consistent as diversified portfolio performed better than sector concentrated equity portfolio in sub periods. In the sub periods 2002 to 2006, 2007 to 2011 and 2012 and 2016, the diversified portfolio has a higher Sharpe ratio than sector concentrated portfolios.

In addition, diversified portfolios offer high returns and low risk compared to the sector concentrated portfolios which offer inconsistent returns and very high risks. This shows that diversified portfolios are better suited for risk averse investors. As the case in this study investors investing in diversified portfolios stand to benefit from better returns and at low risk.

5.4. Limitations of the Study

The conclusion of this study is based on Sharpe ratio. Sharpe ratio is a preferred tool by investors for comparing portfolios. While it has its advantages, it has a limitation in that it penalizes idiosyncratic volatility which is not appropriate in a concentrated portfolio context. Accordingly the design of this study may have favored diversification.

In addition, financial investments are behavioral. In this study behavioral aspects of financial investment which include stock selection skills and institutional factors have not been factored.

5.5. Areas for Further Research

The debate on which between diversification and concentration is not yet over based on the findings of this research. Accordingly further studies can be carried as follows:

An index chosen should accurately capture the investment characteristics of a portfolio. This study has used NSE 20 Share Index as the benchmark index. Kenya has two other indices namely NASI 20 and NSE 25 which can be used as a substitute for the NSE 20 Share Index.

The study has focused on quoted equities in Kenya. Investors have other investment options which include fixed income, real estate and unquoted equities. Investors also have opportunities to invest in foreign countries. Other investment options can be used in further research.

SIM has been used in constructing the diversified portfolio while CAPM and matrix algebra are used to construct sector concentrated portfolios. Different models like MVO, Multiples and earnings per share can be used for diversified portfolio while Cahart Four Factor model and Black Litterman model can used for concentrated portfolios.

Sharpe ratio was used in this study. Further studies can be carried out using different performance measures such as such as Jensen's alpha and Treynor's ratio.

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Appendices

I. NSE Listed and eligible companies with the acronym and sector

	Company	ACRONYM	SECTOR	2002-2016	2002-2006	2007 - 2011	2012-2016
1	EAAGADS LTD	EAAGADS	Agriculture				X
2	Kakuzi	KAKUZI	Agriculture	X	X	X	X
3	Kapchorua Tea CO	KT	Agriculture			X	X
4	Limuru Tea	LIMURU	Agriculture				X
5	Williamson Tea	WT	Agriculture	X	X	X	X
6	REA Vipingo Plantations	REA	Agriculture				X
7	Sasini LTD	SASINI	Agriculture	X	X	X	X
8	Car & General (K)	C&G	Automobile &Accessories			X	X
9	Marshalls East Africa	MARSHALS EA	Automobile &Accessories			X	X
10	Sameer	SAMEER	Automobile & Accessories	X	X	X	X
11	CMC Holdings LTD	CMC	Automobile &Accessories				

12	CFC STANBIC HOLD	CFC	Banking	X	X	X	X
13	Co-operative Banks	CO-OP	Banking				X
14	Diamond Trust	DTB	Banking	X	X	X	X
15	Equity Group Holdings Ltd	EQUITY	Banking			X	X
16	HF Group LTD	HF	Banking	X	X	X	X
17	I&M Holdings LTD	I&M	Banking				
18	KCB Group LTD	KCB	Banking	X	X	X	X
19	Barclays Bank Limited	BBK	Banking	X	X	X	X
20	National Bank of Kenya	NBK	Banking	X	X	X	X
21	NIC Bank LTD	NIC	Banking	X	X	X	X
22	Standard Chartered Bank	SCB	Banking	X	X	X	X
23	Atlas Development and Support Services Ltd	ATLAS	Commercial & Allied				

24	Hutchings Biemer	HBL	Commercial & Allied				
25	Kenya Airways	KQ	Commercial & Allied	X	X	X	X
26	WPP SCAN Group LT	WPP SCAN	Commercial & Allied			X	X
27	Deacons (East Africa)	DEACONS	Commercial & Allied				
28	Express Kenya	EXPRESSK	Commercial & Allied			X	X
29	Longhorn Publishers	LONGHORN	Commercial & Allied				
30	Nairobi Business Ventures	NBV	Commercial & Allied				
31	Nation Media Group	NMG	Commercial & Allied	X	X	X	X
32	Standard Group	STD G	Commercial & Allied	X	X	X	X
33	TPS Eastern Africa	TPS	Commercial & Allied			X	X

34	Uchumi Supermarkets Ltd	USL	Commercial & Allied				X
35	Bamburi Cement	BAM	Construction &Allied	X	X	X	X
36	Crown Paints	CROWNP	Construction &Allied	X	X	X	X
37	East African Portland Cement	EAPC	Construction &Allied	X	X	X	X
38	Kenol/Kobil	KENOL/KOBIL	Energy and Petroleum	X	X	X	X
39	Kenya Electricity Generation Co	KENGEN	Energy and Petroleum	X	X	X	X
40	Kenya Power and Lighting	KPLC	Energy and Petroleum		X	X	X
41	Umeme	UMEME	Energy and Petroleum				
42	Total Kenya	TOTAL	Energy and Petroleum	X	X	X	X
43	Britam Holdings Ltd	BRITAM	Insurance				X
44	CIC Insurance Group	CIC	Insurance				

45	Jubilee Holdings	JBH	Insurance	X	X	X	X
46	Kenya Re Insurance	KRE	Insurance				X
47	Liberty Kenya Holdings Ltd	LIBERTY	Insurance				X
48	Sanlam Kenya PLC	SANLAM	Insurance	X	X	X	X
49	Centum Investments	CENTUM	Investments	X	X	X	X
50	Home Africa	HAL	Investments				
51	Kurwitu Ventures	KTT	Investments				
52	Olympia Capital	OLYMPIA	Investments	X	X	X	X
53	Stanlib Fahari IREIT	STANLIB	Investments				
54	Trans Century Ltd	TCL	Investments				X
55	A. Baumann	A BAUMAN	Manufacturing				
56	Athi River Mining	ARM	Manufacturing	X	X	X	X
57	BOC Kenya Ltd	BOCK	Manufacturing				X
58	British American Limited	BAT	Manufacturing	X	X	X	X
59	Carbacid Investments Ltd	CARBACID	Manufacturing				X
60	East African Breweries	EABL	Manufacturing	X	X	X	X

	East African Cables						
61	Ltd	EAC	Manufacturing	X	X	X	X
62	Everready East Africa	EVERREADY	Manufacturing			X	X
	Flame Tree Group						
63	Holdings	FTG	Manufacturing				
64	Kenya Orchards Ltd	KOL	Manufacturing				X
	Mumias Sugar						
65	Company	MSC	Manufacturing	X	X	X	X
66	Unga Group LTD	UNGA	Manufacturing	X	X	X	X
			Telecommunic				
67	Safaricom	SAFARICOM	ation				X
			Telecommunic				
68	Acces Kenya	ACCESSK	ation				
	Total Kenya			31	31	40	52

II. Solution to objective function (13) using matrix algebra

For a portfolio of N assets:

$$E(R_p) - R_f = W_1(R_1 - R_f) + W_2(R_2 - R_f) + \cdots + W_n(R_n - R_f) \quad (0.1)$$

Express equation (0.1) in matrices

Weigh Vector $W = \begin{bmatrix} W_1 \\ W_2 \\ \vdots \\ W_n \end{bmatrix}$ Excess Return Vector $(\boldsymbol{R_i - R_f}) = \begin{bmatrix} R_1 - R_f \\ R_2 - R_f \\ \vdots \\ R_n - R_f \end{bmatrix}$

Which means $E(R_p) - R_f = \boldsymbol{W^T}(R_i - R_f)$ (0.2)

The standard deviation of a portfolio is calculated using the following formula

$\sigma_p = (\boldsymbol{W^T}S)^{\frac{1}{2}}$ Where S is the variance-covariance matrix. (0.3)

Therefore the maximization function can be written in matrix format as follows:

$$\underset{W}{Max} S_P = \frac{\boldsymbol{W^T}(R_i - R_f)}{(\boldsymbol{W^T}S)^{\frac{1}{2}}}, Subject\ to\ \boldsymbol{W^T}i = 1 \quad (0.4)$$

$where\ \boldsymbol{W^T}1 = 1\ is\ the\ constraint\ that$ sum of all weights add to 1

$$Therefore\ S_P = \boldsymbol{W^T}(R_p - R_f)(\boldsymbol{W^T}SW)^{-\frac{1}{2}} \quad (0.5)$$

The next step is to differentiate Sharpe ratio (S_P) with respect to weight W as follow:

$$\frac{ds_p}{dw} = \boldsymbol{W^T}(R_i - R_f).\left\{(-\frac{1}{2}(\boldsymbol{W^T}SW)^{-\frac{1}{2}}.2WS\right\} + (\boldsymbol{W^T}SW)^{-\frac{3}{2}}.(R_i - R_f) = 0 \quad (0.6)$$

Multiply by $(\boldsymbol{W^T}SW)^{-\frac{1}{2}}$

$$\boldsymbol{W^T}(R_i - R_f).(-(\boldsymbol{W^T}SW)^{-1}.WS) + (R_i - R_f) = 0 \quad (0.7)$$

$$R_i - R_f = \boldsymbol{W^T}(R_i - R_f)((\boldsymbol{W^T}SW)^{-1}.WS) \quad (0.8)$$

$$R_i - R_f = \boldsymbol{W^T}(R_i - R_f).\frac{WS}{\boldsymbol{W^T}SW} = \frac{\boldsymbol{W^T}(R_i - R_f).WS}{\boldsymbol{W^T}SW} \quad (0.9)$$

Let $\frac{\boldsymbol{W^T}(R_i - R_f)}{\boldsymbol{W^T}SW}$= A and is the price of risk (the numerator is the excess return and denominator is the volatility)

Therefore: $R_i - R_f = AWS$ (1.0)

Get rid of the variance- covariance Matrix S

$S^{-1}(R_i - R_f) = AWS^{-1}S; S^{-1}(R_i - R_f) = AW = Z$ (1.1)

From equation (1.1) we see the Z vector varies in proportion with weight vector. Therefore if we know that $S^{-1}(R_i - R_f) = Z$, we can use this formula to get values of Z vector which we note $W_i = \frac{Z_i}{\sum_{i-1}^{n} Z_i}$ expressed in matrix format as follows:

$$W = \begin{bmatrix} W_1 \\ W_2 \\ \vdots \\ W_n \end{bmatrix} \; and \; Z = \begin{bmatrix} Z_1 \\ Z_2 \\ \vdots \\ Z_n \end{bmatrix}$$

So the weight of the first asset in the portfolio will be $W_1 = \frac{Z_1}{Z_1+Z_2+\cdots+Z_n}$ while that of the n^{th} asset will be $W_n = \frac{Z_n}{Z_1+Z_2+\cdots+Z_n}$ (1.2)

III. Histogram with normal curve of BAM

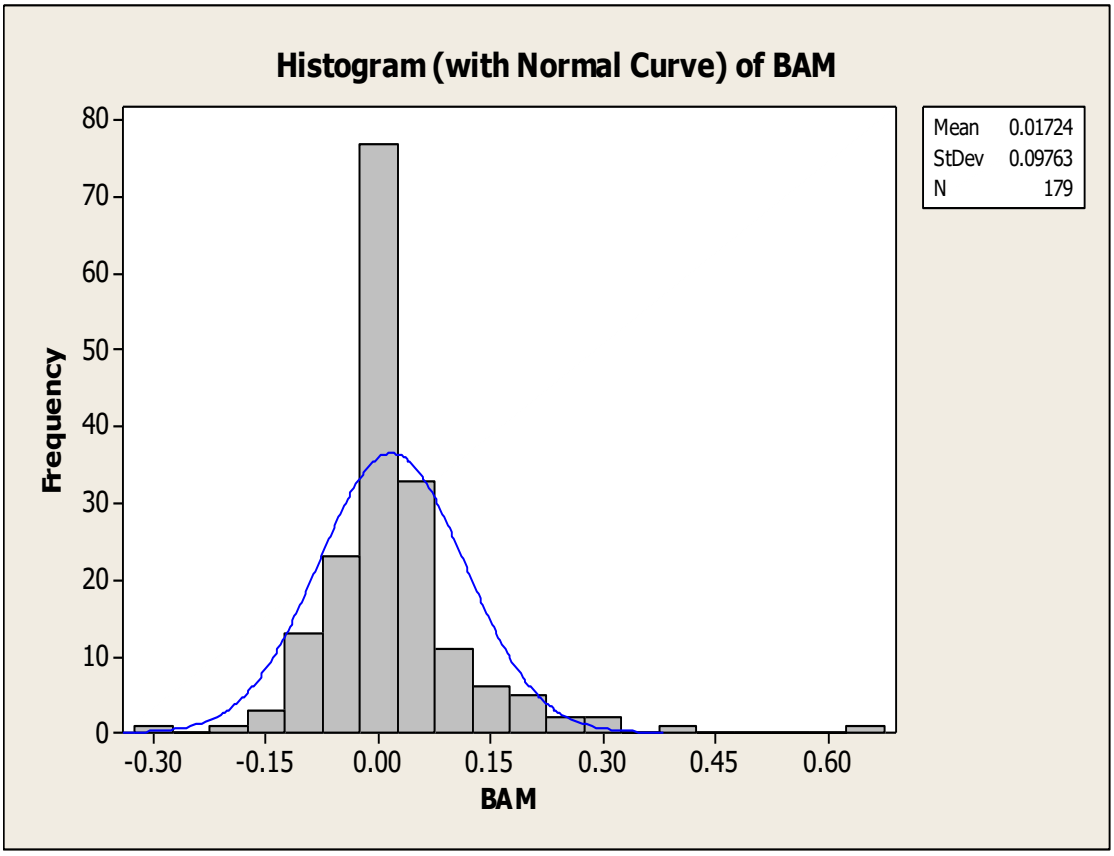

Figure 0.1: BAM stock return distribution for the period 2002 to 2016

IV. Regression

$\propto (Intercept), \beta$ $(X\ Variable\ 1)$ and the P-Values for each stock in each period are obtained by running a regression using Microsoft Excel as shown in Table 0.3. The Multiple R shows that at 35.06% BAM does not closely track NSE 20 Share Index. On the other hand R Square shows that only 12.3% of the excess returns of BAM stock is explained by the NSE 20 Share index.

BAM

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.3506674
R Square	0.1229676
Adjusted R Square	0.1180126
Standard Error	0.0916898
Observations	179

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.208636761	0.208637	24.8169523	1.49096E-06
Residual	177	1.488043584	0.008407		
Total	178	1.696680345			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.013487	0.006894513	1.956186	0.052016862	-0.00011907	0.027093	-0.000119073	0.027092979
X Variable 1	0.5604582	0.112504262	4.981662	1.49096E-06	0.338435816	0.782481	0.338435816	0.782480507

Table 0.1: Regression analysis output of BAM stock in the diversified portfolio 2002 to 2016

V. Diversified Portfolio Selection

							A_i	B_i	C_i	
STOCKS	$\overline{R}_i$	α_i	σ_i^2	β_i	σ_e^2	$(\overline{R}_i - R_f)$ $/\beta_i$	$[(\overline{R}_i - R_f)\beta_i]$ $/\sigma_e^2$	β_i^2 $/\sigma_e^2$	$(\sigma_m^2 * \mathbf{Sum}\ A_i)/$ $[1 + (\sigma_m^2 * \mathbf{Sum}\ B_i)]$	C^*
BAT	0.0163	0.0164	0.0068	0.4606	0.0156	0.0217	0.294	13.565	0.00104	0.00948
ARM	0.0195	0.0277	0.0419	1.0092	0.0239	0.0131	0.557	42.636	0.00261	
BAM	0.0129	0.0135	0.0095	0.5605	0.0123	0.0118	0.301	25.493	0.00328	
JBH	0.0191	0.0211	0.0224	1.0938	0.0167	0.0117	0.838	71.681	0.00471	
CROWN P	0.0132	0.0189	0.0245	0.8211	0.0164	0.0084	0.345	41.156	0.00503	
DTB	0.0145	0.0141	0.0159	1.1288	0.0093	0.0072	0.985	136.577	0.00553	
WT	0.0109	0.0164	0.0258	0.7001	0.0146	0.0065	0.219	33.504	0.00558	
KAKUZI	0.0121	0.0168	0.0240	0.9160	0.0137	0.0063	0.385	61.399	0.00564	
KCB	0.0158	0.0135	0.0179	1.5210	0.0049	0.0062	2.935	473.893	0.00586	
CENTUM	0.0133	0.0140	0.0198	1.2544	0.0082	0.0056	1.071	191.821	0.00583	
CFC	0.0115	0.0139	0.0213	0.9727	0.0104	0.0053	0.481	91.098	0.00579	
SASINI	0.0102	0.0125	0.0209	0.9910	0.0089	0.0039	0.427	110.697	0.00565	
UNGA	0.0091	0.0125	0.0205	0.9018	0.0095	0.0031	0.263	85.413	0.00552	
NIC	0.0090	0.0078	0.0130	1.0796	0.0034	0.0024	0.829	339.241	0.00500	
KENK	0.0070	0.0120	0.0152	0.6559	0.0104	0.0011	0.044	41.414	0.00491	
KPLC	0.0075	0.0066	0.0228	1.5404	-0.0022	0.0008	-0.828	-1064.595	0.00948	

Table: 0.2: Determining the diversified portfolio components

The average $\bar{R}i$ is obtained from the monthly NSE listed stock prices from 2002 to 2016. $\propto_i$ *and* β_i are obtained from running regressions using Microsoft Excel software (see BAM summary out on part IX) of the appendix. The unsystematic risk (σ_e^2) is calculated from subtracting the systematic risk ($\beta_i^2\sigma_m^2$) from the total risk (σ^2). The risk free rate (R_f) is the average 91 day Treasury bill rate and the variance of the market is 0.0037. The same process is used in constructing the diversified portfolios for the period 2002-2006, 2007 - 2011 and 2012 – 2016.

VI. Concentrated Portfolio Selection

Step 1: Stock selection using $\propto$ which is obtained by $\propto= R_i - R_f + \beta_i(R_m - R_f)$. Only stocks with positive alpha are selected.

STOCKS	$\bar{R}_i$	R_f	β_i	$\propto= R_i - R_f + \beta_i(R_m - R_f)$	$R_i - R_f$
ARM	0.0195	0.0063	1.0092	0.0068	0.0132
BAM	0.0129	0.0063	0.5605	0.0031	0.0066
CROWN P	0.0132	0.0063	0.8211	0.0017	0.0069
EABL	0.0065	0.0063	0.7645	-0.0046	
EAPC	0.0034	0.0063	0.6099	-0.0068	

Table 0.3: Selecting components of a concentrated portfolio

Step 2: Variance Covariance Matrix S

	ARM	BAM	CROWN P
ARM	0.04211	0.01232	0.01106
BAM	0.01232	0.00950	0.00383
CROWN P	0.01106	0.00383	0.02463

Table 0.4: Variance Covariance Matrix S

Step 3: S-Inverse (S^{-1})

	ARM	BAM	CROWN P
ARM	40.7822	-48.5563	-10.7702
BAM	-48.5563	170.1504	-4.6441
CROWN P	-10.7702	-4.6441	46.1669

Table 0.5: S-Inverse Table

Step 3: Weight calculation where Z= S^{-1} x $(R_i - R_f)$ and the constraint that sum of all weights must equal to 1.

ARM	0.14292		W1	0.54621
BAM	0.45177		W2	0.19275
CROWN P	0.14503		W3	0.26104
Total Z		0.7397204		1.00000

Table 0.6: Table Calculating total Z.