THE EFFECTS OF DIVERSIFICATION ON PORTFOLIO RISK AT THE NAIROBI SECURITIES EXCHANGE

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DECLARATION

This research project is my original work and has not presented in any other institution for examination.

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DEDICATION

I wish to dedicate this project to this project to all the people who made it possible for me to achieve my academic dreams and especially to my parents Mr. and Mrs. Mwangi for their immense contribution towards my education.

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APT	Arbitrage Pricing Theory
CAPM	Capital Asset Pricing Model
NSE	Nairobi Securities Exchange
SML	Security Market Line

ABSTRACT

Portfolio diversification is the practice of spreading one's money among many different investments. Portfolio risk is the chance that combination of assets or units within individual group of investment fail to meet financial objectives. In theory, portfolio risk can be eliminated by successful diversification (Ahuja, 2011). This study seeks to find out the effects of diversification on portfolio risk at the NSE. Its specific objectives include to find out the number of securities that makes a diversified portfolio and to find out the effect of number of assets in a portfolio on portfolio risk.

A security (Safaricom Ltd) was randomly chosen and its variance calculated. Next, this security was combined with another security (also randomly selected) to form an equally weighted portfolio of securities. Step by step more securities were randomly added to the portfolio until all 62 securities were included. The data was obtained from the NSE daily closing prices for the past three years. The findings show that it can be concluded that a portfolio of equally weighted 7 securities can diversify away significant amount of risk for the investors than large number of security whose returns is mixed.

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CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

A stock market can offer a broad variety of investment opportunities to investors if the returns of the traded stocks are not closely correlated. This provides the investors with two opportunities: first they can hold assets with different risk return combinations which best fit their personal attitude towards risk, and second, they can reduce the risk of their investments by increasing the number of different securities in their portfolios. The latter opportunity is known as diversification effect, and it is possible when the stock returns are not perfectly positively correlated (Papaioannou, 2010).

Individuals as well as institutional investors are confronted with basically the same problems when allocating their own financial funds or those of those of third parties. The asset allocation puzzle is - at least theoretically – actually of a huge dimension. There exist tens of thousands of listed companies in the world stock exchange markets, masses of government and commercial bonds with different risks and maturities, treasuries, currencies, commodities, arts and real estate. Moreover, there is an even much bigger number of financial derivatives on the mentioned asset classes and their representatives such as different kinds of options, swaps, Forwards and structural products. Practically every investor must thus undergo a pre-selection process. This starts with the selection of the “right” asset classes and is followed by the identification of the appropriate elements of the chosen asset class (Vorgelegt, 2010).

In the past decade or so, both institutional investors and individual investors have experienced large swings in their investment returns. Investors are eagerly seeking advice to weather such volatile markets. What is more striking as documented by Campbell ,Lettau, Malkiel and Xu (2001), is that the overall market is relatively calm while firm specific risks have gone up significantly. Nowadays, individual U.S stocks are more than twice as volatile as those in the 1950s on average. This evidence alone bears no consequence on asset prices within the CAPM framework, where investors are supposed to only invest in a market portfolio.

In other words, the required return from individual investors (thus the cost of capital to the firm) remains the same even in an increasingly volatile market as long as investors' holdings are well-diversified. Therefore, the prescription for long-term investors when facing volatile markets is diversification (Subrata, 2003).

1.1.1 Diversification

Portfolio diversification is the practice of spreading one's money among many different investments. Its theoretical foundations were introduced in the normative work of Markowitz (1959) and later confirmed by the work of Sharpe (1964). By including asset categories with investment returns that move up and down under different market conditions within a portfolio, an investor can protect against significant losses. Historically, the returns of the three major asset categories have never moved up and down at the same time. Market conditions that cause one asset category to do well often cause another asset category to have average or poor returns (Markides, 1996).

Markowitz's initial assumption was that risk-averse, mean-variance utility agents were concerned with only two elements of their portfolios – the expected return, as measured by the mean rate of return, and the risk, as quantified by the standard deviation or variance of the mean rate of return. When risky assets are aggregated, their correlation often determines the majority of the total risk rather than individual volatilities. Consequently, the total risk of a carefully constructed portfolio should be less than sum of the risks in the portfolio's component pieces (Subrata, 2003).

1.1.2 Portfolio Risk

Portfolio is the total collection of all investments held by an individual or institution, including stocks, bonds, real estate, options, futures, and alternative investments. Portfolio risk is the chance that combination of assets or units within individual group of investment fail to meet financial objectives. In theory, portfolio risk can be eliminated by successful diversification (Ahuja, 2011). It is measured from the dispersion of actual returns around the expected return of an investment. Standard deviation is the square root of variance which is calculated by weighting each possible dispersion by its relative probability i.e. the difference between the actual return and the expected return (Korajczyk, 2010).

As with securities, the objective of a portfolio may be for capital gains or for income, or a mixture of both. A growth-oriented portfolio is a collection of investments selected for their price appreciation potential, while an income-oriented portfolio consists of investments selected for their current income of dividends or interest. Most portfolios are

diversified to protect against the risk of single securities or class of securities. Hence, portfolio analysis consists of analyzing the portfolio as a whole rather than relying exclusively on security analysis, which is the analysis of specific types of securities. While the risk-return profile of a security depends mostly on the security itself, the risk-return profile of a portfolio depends not only on the component securities, but also on their mixture or allocation, and on their degree of correlation (Ahuja, 2011).

Most investors do not hold stocks in isolation. Instead, they choose to hold a portfolio of several stocks. When this is the case, a portion of an individual stock's risk can be eliminated, i.e., diversified away. This principle is presented on the diversification page. First, the computation of the expected return, variance, and standard deviation of a portfolio must be illustrated. Portfolio diversification is the means by which investors minimize or eliminate their exposure to company-specific risk, minimize or reduce systematic risk and moderate the short-term effects of individual asset class performance on portfolio value. In a well-conceived portfolio, this can be accomplished at a minimal cost in terms of expected return. Such a portfolio would be considered to be a well-diversified (Narzaidi and Siong, 2008).

1.1.3 Relationship between Diversification and Portfolio Risk

Modern portfolio theory suggests that as the number of securities in a portfolio increases the portfolio risks decrease. It basically implied that by investing in more securities investors can avoid the specific risks involved in individual firms (Markowitz, 1991)

Many researchers have carried empirical studies to test the theory and have indeed confirmed that portfolio risk reduces as the number of securities is added in a portfolio. Fama(1976) tested the theory of diversification by randomly selecting 50 New York Stock Exchange (NYSE) listed securities and calculated their standard deviation based on a monthly data. His noted that the standard deviation continually decreased and almost all diversification was achieved in the first 10-15 stocks. Other researchers Evans and Archer (1968) and Elton and Gruber (1977) though with a varying recommendation as to what constitutes a well-diversified portfolio have confirmed that addition of securities to a portfolio reduces the portfolio risk to a large extent.

1.1.4 Nairobi Securities Exchange

In Kenya dealing in shares and stocks started in the 1920's when the country was still a British colony. However the market was not formal as there did not exist any rules and regulations to govern stock broking activities. Trading took place on a gentleman's agreement. Standard commissions were charged with clients being obligated to honor their commitments of making good delivery, and settling relevant costs (Maina, 2011).

In 1954 the Nairobi stock Exchange was then constituted as voluntary association of stockbrokers registered under the societies Act. Since Africans and Asians were not permitted to trade in securities, until after the attainment of independence in 1963, the business of dealing in shares was confined to the resident European community. At the dawn of independence, stock market activity slumped, due to uncertainty about the future of independent Kenya. Since then the equity market has developed steadily with many

notable developments among them being the change of name to Nairobi Securities exchange Limited reflecting the strategic plan to evolve into a full service securities exchange which supports trading, clearing and settlement of equities, debts derivatives and other associated instruments (Ngugi, 2003)

The Nairobi Securities exchange (NSE) is licensed and regulated by the capital Markets Authority. It has the mandate providing a trading platform for listed securities and overseeing its member firms. Investors at the NSE are taking a portfolio approach on investing and not on individual securities in order to maximize the investment's expected rate of return for a given level of risk or minimize the level of risk for a given expected rate of return. Investors at the Nairobi Securities exchange are reducing the risk on their portfolio since the listed companies are from different industries and their co-variances for most of them is negative. (Business Daily, 2014)

1.2 Research Problem

Markowitz (1952) developed a basic and most accepted model for portfolio selection, by introducing the usage of expected rate of return and expected risk for a portfolio. He identified the risk-reduction benefits associated with holding a diversified portfolio of assets. Fama (1976) tested the theory of diversification by randomly selecting 50 New York Stock Exchange (NYSE) listed securities and calculated their standard deviation based on monthly data from July 1963 to June 1968. Fama (1976) selected one security noted its standard deviation, and then went on adding securities and creating equally

weighted portfolios. The standard deviation continually decreased and almost all diversification was achieved in the first 10-15 stocks.

Evans and Archer (1968), in a similar study, suggested that as few as 20 securities are adequate to have a well-diversified portfolio. They further concluded that a randomly selected and equally weighted portfolio provides a little risk reduction to be obtained from an expanding portfolio beyond 10 to 15 securities. Elton and Gruber (1977) studied and discussed the previous literature and developed an exact expression formula for determining the effect of diversification on risk. By using this approximation they found that total risk goes down at lower rate as more securities are added. They recommend that 15 stocks would appear to be significant for good diversification.

Statman (1987) analyzed the return of 500 stock portfolio traded in NYSE and S&P index. The study concluded that a well-diversified portfolio must contain at least 30 stocks. A recent study by Boscaljion, Filback and Cheng-Ho (2005), suggested that a randomly selected portfolio of 30 stocks or less selected from industry leaders and equally weighted stocks could provide the same level of diversification as the S&P 500 Index. The conclusions of this study were consistent with a study by Statman (1987). This study analyzed the return of 500 stock portfolio traded in NYSE and S&P index. The study concluded that a well-diversified portfolio must contain at least 30 stocks.

A study on diversification in the Malaysian Stock Market by Zulkifli, Basarudin, Narzaidi and Siong (2008) concluded that 15 stocks are enough to diversify away a satisfied amount of diversifiable risk.A simple approach for constructing portfolios is

constructing equally weighted portfolios. DeMigeul, Garlappi and Uppal (2005, 2007) studied the efficiency of the equal weights to all assets in a portfolio and concluded that this strategy is not inefficient and it outperforms models, such as sample-based mean variance model, minimum variance and value-weighted portfolio model, for selecting an optimal portfolio. Therefore the 1/N strategy is a good benchmark for constructing portfolios and testing portfolio diversification. In a very recent study Duchin and Levy (2009) also concluded that the 1/N strategy for individual portfolios outperforms another renowned strategy for portfolio selection, called Markowtiz's Mean-Variance rule.

A definitive answer to the question of what an optimal level diversification is all about has remained elusive despite the extensive research that the topic has had over the years. Some these studies have also been found to contradict each other. As an illustration, Evans and Archer (1968) observed that most of the effects of diversification take place with the aggregation of eight to ten securities and raised doubts about the usefulness of increasing portfolio sizes beyond that point, while Statman (2002) concluded that optimum level of diversification exceeds 120 stocks. Most of these studies have been carried out in the developed markets and it is this gap that this study intends to fill by investigating the effect of diversification on the Nairobi Securities Exchange.

The study sought to answer the following research question. What is the number of assets that one should include in an optimal portfolio?

1.3 Research Objectives

The general objective of the study is to investigate the effect of diversification on portfolio risk at the Nairobi Securities Exchange.

The specific objectives of the study are:

a) To find out the number of securities that makes a diversified portfolio.

b) To find out the effect of number of assets in a portfolio on portfolio risk.

1.4 Value of the Study

The ability to take advantage of the diversification effect is important for the managers of the mutual funds, trust funds, and pension funds who have either a managerial or a fiduciary responsibility in pursuing the investment of the funds entrusted to them.

It also of importance to the conservative investors who are averse at holding high return assets if at the same time the risk is high. In these cases, the diversification effect allows one to reduce risk without sacrificing materially the expected return of the investment.

In the case of a small stock market like that of Nairobi Securities Exchange (NSE), it is worth investigating the extent to which diversification effect works since the outcome can shed light on the potential of this market to serve as proper investment medium.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter examines various theories and empirical studies that have been conducted in the area of investment risk and return. The portfolio Theory as advanced by Markowitz (1952) has been reviewed. Subsequent asset pricing models such as the Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT) have been looked into. Empirical studies, both local and foreign in the area stock returns have also been reviewed. The Chapter is concluded by summarizing the research gaps identified.

2.2 Theoretical Framework

The theoretical framework helps to make logical sense of the relationship between all the variables and the factors that have been deemed relevant to the problem. The section will therefore guide the research, determining what factors will be measured and what statistical relationship the research will look for.

2.2.1 Portfolio Theory

Portfolio theory was advanced by Harry Markowitz in 1952. He defines portfolio is a collection of securities. As most securities are available, investments have uncertain returns and thus risky, one needs to establish which portfolio to own. Markowitz asserts investors should base their portfolio decisions solely on expected returns and standard deviations. Investors should estimate the expected return and standard deviation of each portfolio and then choose the best one on the basis of these two parameters. Expected

return can be viewed as a measure of potential reward associated with any portfolio over the holding period and standard deviation can be viewed as a measure of the risk associated with the portfolio. (Markowitz, 1952)

Since an infinite number of portfolios can be constructed from a set of securities, the problem is to determine the most desirable portfolio. The Efficient Set Theorem states that an investor will choose his or her optimal portfolio from the set of portfolios that; (i) Offer maximum expected return for varying degrees of risk; and (ii) Offer minimum risk for varying levels of expected return. The set of portfolios meeting these two conditions is known as the efficient set (also known as efficient frontier). The process will first involve identification of the feasible set which represents all portfolios that can be formed from a given number of securities. The investor will then select an optimal portfolio by plotting his or her indifference curve on the same figure as the efficient set and then proceed to choose the portfolio that is on the indifference curve that is farthest northwest. This portfolio will correspond to the point at which an indifference curve is just tangent to the efficient set. An investor's optimal portfolio is located at the tangency point between the investor's indifference curves and the efficient set (Markowitz, 1952).

2.2.2 Capital Asset Pricing Model

Capital asset-pricing model (CAPM) was developed independently by Sharpe (1964), Lintner (1965) and Mossin (1966). The theory is considered the most basic asset-pricing model. Basically the theory asks the question: What are the equilibrium rates of return if all investors apply the mean- variance criterion to an identical mean-variance efficient

set? There is an ongoing debate as to whether this theory gives an accurate description of equilibrium rates of return and whether alternative theories are more appropriate. Nevertheless, the CAPM is still widely used in practice (Sharpe, 1964)

CAPM is known to have three most important implications. Firstly, in equilibrium, all investors irrespective of their risk preferences hold the market portfolio of risky assets. Still, different investors hold different combinations of the market portfolio and the riskless asset. This property is known as the separation principle. Secondly, since everybody holds the market portfolio, the risk of an individual asset is characterized by its covariance with respect to the market; the remaining risk is diversified away. A standardized measure of the covariance with the market is known as the market beta. Lastly, since nonsystematic risk is diversified away, investors need to be compensated for bearing systematic risk (as measured by market beta) but not for non-systematic risk (Sharpe, 1964).

2.2.3 Arbitrage Pricing Model

Arbitrage Pricing Model (APT) like Capital Asset Pricing Model (CAPM) is an equilibrium pricing model. APT was developed by Ross (1976). However, CAPM is based on a different set of assumptions. In CAPM, it is assumed that all investors make investment decisions by a mean-variance rule. In APT, Ross does not assume risk-aversion or reliance on the mean- variance rule. Rather, APT explains the relationship between expected return and risk as arising because there are no arbitrage opportunities

in security markets. It is based on the law of one price i.e. two items that are the same cannot sale at different prices.

There are various assumptions underlying the APT. Firstly, it is assumed that the capital market is characterized by perfect competition. This implies there are a large number of investors, each with wealth that is small relative to the total market value of all capital assets. Hence the portfolio choice of individual investors has no noticeable effect on the price of the securities; investors take the price as given. Capital market imperfections such as transaction costs and taxes are assumed not to exist. It is secondly assumed that all investors have the same expectations regarding the future in terms of mean, variance and covariance terms (homogeneous expectations). Investors are also assumed to prefer more wealth to less wealth. No assumptions are made regarding risk attitude; investors may be risk - averse, risk-neutral or risk-seekers. APT also assumes existence of a very large number of capital assets exist in the economy. The number of assets is sufficiently large to create portfolios with no non-systematic risk and with any desired values for the factor sensitivity coefficients (betas). Finally, the theory assumes that short-sales are allowed, and that the proceeds are available to the short-sellers (Ross, 1976).

2.3 Determinants of Portfolio Risk

2.3.1 Number of assets

It is generally true that when stocks are randomly selected and combined in equal proportions into a portfolio, the risk a portfolio declines as the number of different stocks in it increases. Evans and Archer observed that the risk reduction effect diminishes rapidly as the number of stocks increases (Evans, 1968).

2.3.2 Size of the company

In 1981, Fama concluded that company size was a risk factor that successfully explained higher equity returns. The greater the exposure your portfolio has towards small company stocks, relative to large company stocks, the higher the return. This means that small company stocks have higher expected returns than large company stock because small companies are inherently risky (Fama, 1976).

2.3.3 Price Range

Lower priced stocks have a higher expected return than higher priced stocks. The greater exposure your portfolio has towards lower priced stocks, relative to higher priced stocks, the higher the return. Lower-priced stocks provide a high expected return otherwise nobody would invest in them (Malkiel, 2001).

2.3.4 Risk of the market

Market risk was first identified in the 1963, Fama/French Three factor model. It is described as the amount of exposure to the overall stock market. Stocks have higher expected returns than treasury bills and the more your portfolio is exposed to stocks relative to bonds then the higher the return (Fama,1963).

2.4 Empirical Evidence

Tang (2004) examined naive (equal weight) diversification is efficient. He analytically showed that for an infinite population of stocks, a portfolio size of 20 is required to eliminate 95 % of the diversifiable risk on average. However, an addition of 80 stocks (i.e. a size of 100) is required to eliminate an extra 4 % (i.e. 99 % total) of diversifiable risk. This result depends neither on the investment horizons, sampling periods nor the markets involved. But the number of stocks required in portfolio in order to eliminate the same percentage of diversifiable risk differs according to the size of population. For example, in order to eliminate 98 % of diversifiable risk, 50 stocks are required in 10000 stocks population and 22 – in 40 stocks population (Tang, 2004).

Alekneviciene (2012) empirical research was carried out to measure the diversification effect of differently weighted portfolios. It was done on the Lithuanian Stock Exchange market and based on daily stock market prices during 2009-2010. The authors formed both naïve portfolios and differently – weighted stocks 'portfolios by capitalization using three stocks' selection criterion. The research results showed that forming naïve

portfolios, the diversification effect is slightly larger than forming differently – weighted portfolios by capitalization (Alekneviciene, 2012)

Solnik (2007) examined the performance of international asset allocation strategies using conditioning information**.** He indicates that the sufficient number of stocks in portfolio in the U.S. stock market is 20. The results of this scientist's previous researches are far different. After performing the six years weekly return analysis in eight different countries Solnik (1974) indicates that the benefit of diversification is different in individual stock markets i.e. the elimination of non-systemic risk requires a different number of stocks. These results are contrary to the statement of Tang (2004) that the diversification effect does not depend on the market involved.

Zulkifli et al. (2010) investigated the optimum number of stock that can help the investor to maximize the benefit of diversification in their investment. Using a simplified approach by Elton and Gruber (1977) a series of portfolio variance was derived to identify the ultimate diversification. 80 samples of stock were randomly chosen from Bursa Malaysia for a period of 1999-2002. The finding was that 13 stocks are enough to make a well diversified portfolio.

Evans & Archer (1968) while investigating diversification and reduction of dispersion built equally-weighted d-asset portfolios comprising randomly chosen assets from S&P500 index for the year 1958. Their conclusion raised doubts concerning the economic justification of increasing portfolio sizes beyond 10 or so stocks, and indicate

the need for analysts and private investor alike to include some form of marginal analysis in their portfolio selection models".

Frahm and Wiechers (2011) carried a study on the diversification of portfolios of risky assets. The empirical research was carried out on monthly return data for the S&P500, with a return history spanning the last five decades. When measuring the diversification of naively allocated 40-asset portfolios, the average degree of diversification barely exceeds 60 %. This result indicates that for the mutual fund manager as well as for the private investor well-founded selection of assets indeed leads to better portfolio diversification than naive allocation does.

Kariuki (2009) carried out a study on the effects of diversification on growth of companies listed in the Nairobi Securities Exchange. The study intended to establish the effects of diversification on growth of listed companies in the Nairobi Securities Exchange. To achieve this aim a census of companies listed in the NSE was done using a model that incorporated measure of growth being the dependent variable and measures of diversification being the independent variables was formulated and regression analysis was carried to come up with the results. The results were consistent with agency theory and showed that companies had positive relationship between growth and firm size (Kariuki, 2009).

2.5 Summary of Literature Review

There are plenty of researches about forming portfolios of stocks. Scientists explore the possibilities of diversification when forming naive and differently weighted portfolios; diversification possibilities when forming portfolios of stocks traded in different countries or regional markets; diversification possibilities internationally. Markowitz (1952) developed a basic and most accepted model for portfolio selection, by introducing the usage of expected rate of return and expected risk for a portfolio. He identified the risk-reduction benefits associated with holding a diversified portfolio of assets.

Investment in stocks and expected return from such investment always comes with risk. Financial economists and financial analysts have been working for years to find ways to minimize risk. What all financial analysts believe is that creating well-diversified portfolio can minimize risk. Solnik (2007), Zulkifi et al (2010), Tang (2004), Evans & Archer (1968) and many other analysts have shown that well-diversified portfolios can actually minimize risk and have suggested the minimum number of stocks required for a well-diversified portfolio.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter looks at the procedures and methods that were employed in conducting the study in order to answer to answer the research question and achieve the objective. It entails the research design, target population, sampling, data collection and data analysis

3.2 Research Design

The study used descriptive research design. It is a type of non-experimental design that collects and analyzes data to describe the problem in its current status for the purpose of clarification. This method was appropriate due to its capacity to establish whether diversification helps reduce portfolio risk in the NSE.

3.3 Population

The target population of this study was all the 62 companies listed at the NSE as at August, 2014. This was used because of the availability of the relevant information on the quoted companies. A census survey of all companies was used.

3.4 Data Collection Techniques

The study utilized secondary data that was obtained from the Nairobi Securities Exchange official website. Daily closing prices, for 3 years; 2011, 2012 and 2013, was used.

3.5 Data Analysis Techniques

A security (Safaricom Ltd) was randomly chosen and its variance calculated. Next, this security was combined with another security (also randomly selected) to form an equally weighted portfolio of securities. Step by step more securities were randomly added to the portfolio until all 62 securities were included.

The model for calculating portfolio risk was:

$$\sigma_p^2 = \sum_{j=1}^{n} w^2{}_j.\sigma^2{}_j + \sum_{j=1}^{n}\sum_{\substack{k=1 \\ k\neq j}}^{n} w_j.w_k\sigma_{jk}$$

Where: σ^2_p– Portfolio variance

σ^2_j–Variance of asset j in the portfolio

σ_{jk}–Covariance between asset j and k in the portfolio

ω_j– Weighted of invested amount in each asset

The effects of diversification on portfolio risk was then determined by a multivariate regression as follows:

$Y= a+b_1x_1+b_2x_2+b_3x_3+e$

Where Y= Portfolio risk measured

a= regression constant

X_1=Number of assets in the portfolio

X_2=Size of the Company, calculated as nP_0 where n is the number of shares and P_0 is the price per share

X_3= Price Range

e=Error term

CHAPTER FOUR: DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

The main objective of the study was to investigate the effects of diversification on portfolio risk at the Nairobi Securities Exchange. The data was obtained from 61of the 62 listed companies at NSE. This gives rise to 98.4% response rate. The data consisted the daily share prices of the individual security, firms market capitalization, share prices ranges. The study used descriptive and inferential analytical techniques to analyze the data obtained. The study used Ordinary Least Squares (OLS) regression models. However, before running the regressions, descriptive statistics, correlation and covariance analysis were calculated.

4.2 Descriptive Statistics

This subsection presents the descriptive statistics and the distribution of the variables portfolio risk as shown in Appendix II. The descriptive statistic considered were minimum, maximum, mean, standard deviation, skewness and kurtosis. The mean of the securities returns shows that 7 of the 61 securities had negative average returns for the period considered. Sixteen of the securities' first quartile had positive values depicting that at least 75% of the trade produced positive returns.

4.2.1 Diversification, Return and Risk

In the present study, daily returns are calculated for each share. Return for each share for all daily periods are calculated for a three year time horizon. For each share the standard

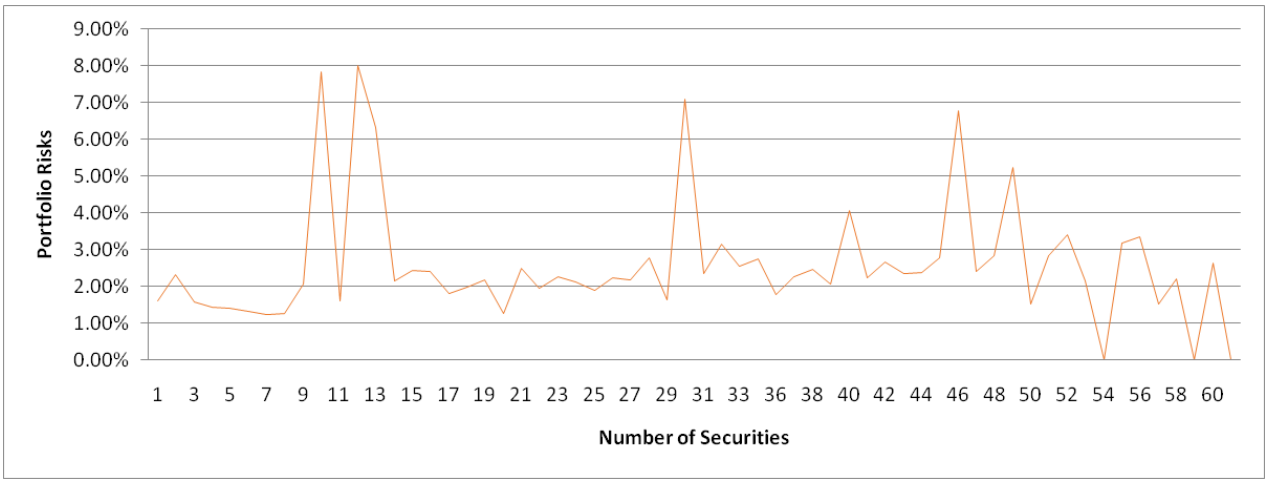
deviation of returns is then computed. The average of all standard deviation shows average risk for these one-security portfolios. Then the number of securities in each portfolio raised to two. An equal number of twenty portfolios of two securities are constructed by overlapping. Then standard deviation of returns for each two-security portfolio is computed and the average of standard deviation of all such portfolios is then considered as a measure of average risk when there are two securities in each portfolio. This process is repeated as the number of securities in each portfolio is gradually raised. Finally, there are twenty portfolios of ten-security each. Table 4.1 presents the portfolio risk of the security in such a combination that minimizes risks.

Table 4.1: Number of Securities & Portfolio Risk

Securities	Standard Deviation	Change in Risk	Cumulative Risks	Cumulative Change
1	1.600%			
2	2.320%	45.001%	0.450	0.000
3	1.564%	-32.557%	0.124	-0.326
4	1.443%	-7.745%	0.047	-0.077
5	1.415%	-1.985%	0.027	-0.020
6	1.321%	-6.624%	-0.039	-0.066
7	1.221%	-7.536%	-0.114	-0.075
8	1.273%	4.269%	-0.072	0.043
9	2.070%	62.528%	0.554	0.625
10	7.861%	279.795%	3.351	2.798
11	1.603%	-79.606%	2.555	-0.796
12	8.019%	400.198%	6.557	4.002
13	6.328%	-21.081%	6.347	-0.211
14	2.151%	-66.018%	5.686	-0.660
15	2.422%	12.602%	5.812	0.126
16	2.406%	-0.644%	5.806	-0.006
17	1.795%	-25.409%	5.552	-0.254
18	1.965%	9.473%	5.647	0.095
19	2.174%	10.656%	5.753	0.107
20	1.248%	-42.617%	5.327	-0.426
21	2.499%	100.356%	6.331	1.004

Securities	Standard Deviation	Change in Risk	Cumulative Risks	Cumulative Change
22	1.959%	-21.641%	6.114	-0.216
23	2.249%	14.851%	6.263	0.149
24	2.133%	-5.198%	6.211	-0.052
25	1.882%	-11.734%	6.093	-0.117
26	2.230%	18.480%	6.278	0.185
27	2.184%	-2.049%	6.258	-0.020
28	2.777%	27.124%	6.529	0.271
29	1.626%	-41.454%	6.114	-0.415
30	7.109%	337.277%	9.487	3.373
31	2.337%	-67.130%	8.816	-0.671
32	3.152%	34.886%	9.165	0.349
33	2.547%	-19.202%	8.973	-0.192
34	2.754%	8.153%	9.054	0.082
35	32.823%	1091.665%	19.971	10.917
36	1.764%	-94.627%	19.025	-0.946
37	2.273%	28.908%	19.314	0.289
38	2.450%	7.753%	19.391	0.078
39	2.073%	-15.367%	19.238	-0.154
40	4.063%	95.969%	20.197	0.960
41	2.245%	-44.746%	19.750	-0.447
42	2.654%	18.225%	19.932	0.182
43	2.337%	-11.959%	19.812	-0.120
44	2.375%	1.654%	19.829	0.017
45	2.778%	16.970%	19.999	0.170
46	6.775%	143.862%	21.437	1.439
47	2.402%	-64.546%	20.792	-0.645
48	2.849%	18.586%	20.978	0.186
49	5.239%	83.907%	21.817	0.839
50	1.527%	-70.849%	21.108	-0.708
51	2.837%	85.790%	21.966	0.858
52	3.409%	20.136%	22.168	0.201
53	2.136%	-37.337%	21.794	-0.373
54	0.000%	-100.000%	20.794	-1.000
55	3.192%	0.000%	20.794	0.000
56	3.341%	4.666%	20.841	0.047
57	1.521%	-54.474%	20.296	-0.545
58	2.194%	44.279%	20.739	0.443
59	0.000%	-99.995%	19.739	-1.000
60	2.648%	0.000%	19.739	0.000
61	0.000%	-100.000%	18.739	-1.000

The standard deviation of the first randomly chosen security (Safaricom Ltd) came out to be 1.600%. After combining one more security the standard deviation rose to 2.320% then decreasing to 1.564%, 1.443%, 1.415%, 1.321%, 1.221%, with a combination of 7 securities. Addition of the 8th, 9th and 10th security made the risk to rise to 1.273%, 2.070% and 7.861% respectively. Addition of 7 securities in the portfolio represented a reduction of 7.536%. It can be observed that there is a continuous reduction in portfolio risk up to 7 securities: a reduction of 11.45%. This can be plotted in the following graph.



Appendix IV shows that the security returns of Safaricom had a positive though low correlation with Equity Bank Limited (R = 0.127, p = .005), East Africa Breweries Ltd (R = 0.177, p < .001), Kenya Commercial Bank (R = 0.171, p < .001), Co-operative Bank (R = 0.151, p = .001), British American Tobbacco (R = 0.093, p = .038), CFC Bank (R = 0.133, p = .003), NIC Bank (R = 0.109, p = .015), Athi River Mining (R = 0.098, p = .030), Centum Ltd (R = 0.117, p = .009), KenGEn Ltd (R = 0.102, p = .022), East Africa

Portland (R = 0.103, p = .021), Standard Group (R = 0.099, p = .027), Longhorn Kenya (R = 0.097, p = .030). Most of these securities with positive and signiifcant correlation with Safaricom Security compose NSE-20 share index.

4.3 Inferential Analysis

The study sought to establish the relationship between portfolio risk reduction and diversification of securities. Pearson Correlation analysis was used to achieve this end at 99% and 95% confidence levels. The correlation analysis enabled the testing of study's hypothesis that diversification has a significant reduction on the portfolio risks. Table 4.2 shows significant, positive but good linear relationships between portfolio risk and: security price range (R = .984, p < .001) and size of the company (R = .772, p = .049). Negative correlation coefficient was established between portfolio risk and number of assets (R = -.311, p = .033).

Table 4.2: Correlation Analysis

		Portfolio Risk	**Number of Assets**	**Size of the Company**	**Price Range**
Portfolio Risk	Pearson Correlation	1			
	Sig. (2-tailed)				
Number of Assets	Pearson Correlation	-.311*	1		
	Sig. (2-tailed)	.033			
Size of the Company	Pearson Correlation	.772*	-.975	1	
	Sig. (2-tailed)	.049	.091		
Price Range	Pearson Correlation	.984**	.008	-.049	1
	Sig. (2-tailed)	.000	.954	.720	
	N	61	61	57	61

*. Correlation is significant at the 0.05 level (2-tailed); **. Correlation is significant at the 0.01 level (2-tailed).

Source: Research Data

Multiple regression analysis was used to measure the relationship between diversification of securities (number of assets, size of the company, price range)and portfolio risk.The regression model's goodness of fit was determined using overall correlation and the coefficient of determination between the independent variables and portfolio risk; that is, the strength of the relationship.

Table 4.3 presents a correlation coefficient of 0.986 and determination coefficients of 0.972. This depicts a strong relationship between portfolio risk reduction and diversification of securities in a portfolio. Thus, the number of assets, size of the company and security price range account for 97.2% of the variations in portfolio risks.

Durbin Watson (DW) test which check if the residuals of the models were not auto correlatedin order to determine the independence of the residuals produced a value of 2.029. It can, thus, be concluded that there was no autocorrelation.

Table 4.3: Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
.986[a]	.972	.971	.0073998	2.029

a. Predictors: (Constant), Price Range, Number of Assets, Size of the Company
b. Dependent Variable: Portfolio Risk

Source: Research Data

Analysis of Variance (ANOVA) was used to test the significance of relation exists between variables; thus, model's significance. The ANOVA results presented in Table 4.4 shows that the regression model has a margin of error of $p < .001$. This indicates that

the model has a probability of less than 0.1 of giving false prediction; this point to the significance of the model.

Table 4.4: Analysis of Variance (ANOVA)

	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Regression	.101	3	.034	615.760	.000b
Residual	.003	53	.000		
Total	.104	56			

a. Dependent Variable: Portfolio Risk
b. Predictors: (Constant), Price Range, Number of Assets, Size of the Company

Source: Research Data

Table 4.5 shows that the regression coefficients of independent variables. The following regression model was established:

Portfolio Risk = 0.039- 5.311E-05*Number of Assets - 0.002*Size of the Company + 0.039*Price Range

From the equation, the study found that holding price range, number of assets and size of the company at zero portfolio risk becomes 0.039. Additionally, when price range and size of the company are constant, a unit increase in number of assets would lead to a 5.311E-05decrease in portfolio risk.

When price range and number of assets are constant, a unit increase in size of the company would lead to a 0.002decrease in portfolio risk. Holding number of assets and

size of the company constant, a unit increase in security price range would lead to a 0.039increase in portfolio risk.

Table 4.5: Regression Coefficients

	Unstandardized Coefficients		**Standardized Coefficients**	**t**	**Sig.**
	B	**Std. Error**	**Beta**		
(Constant)	.039	.061		.635	.528
Number of Assets	-5.311E-05	.000	-.020	-2.797	.044
Size of the Company	-.002	.005	-.044	-3.425	.013
Price Range	.039	.001	.984	42.865	.000

a. Dependent Variable: Portfolio Risk

Source: Research Data

4.4 Discussion of Findings

Portfolio risk is discussed in terms of standard deviation, which describes how far, on average, a security's return deviates from the security's average or mean return. Standard deviation is the more intuitive concept than variance. As such, the process of deriving risk expectations began with an extension of the variance equation. The findings shows that combination of 7 securities led to reduction of standard deviation from 1.564% to 1.221%. Because covariance is scaled in terms of the standard deviations of the two assets being compared, the study found it convenient to convert it to correlation, which provided absolute and more intuitive measure of the degree to which two asset classes

move together. The study established that most of the securities composing NSE-20 share index have positive and significant relationship with Safaricom Ltd ($p \leq .05$)

The findings established that the process of diversification of security had led to portfolio risk reduction. Markowitz (1952) originated the basic portfolio model, Brealy (1983) showed that a portfolio of ten stocks provides 88.5 per cent of the maximum possible advantage of diversification. In another study Evans and Archer (1988) obtained the similar results. Gruble (1968) explained the potential gains to US investors from diversifying their portfolio internationally. Levy and Sarnet (1970) also used the Markowitz model of portfolio choice to examine the potential to US investors. Dimson (1980) also explained the similar benefits from diversification.

Since there was positive correlation between securities composing NSE-20 share index and Safaricom, investors can achieve diversification by investing in the NSE-20 share index stocks, since it has a wide variety of industries. However, these stocks are typically industry leaders and have high market capitalizations and trading volumes. Studies such as Campbell et al. (2001) suggest that returns on small firms be more volatile and therefore, to reduce the higher risk (measured by volatility) of small firms, it may be optimal to hold 20-30 stocks in a portfolio.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents summary of the key findings presented in chapter four, conclusions drawn based on such findings and recommendations there-to. This chapter will thus be structured into conclusion, recommendations and areas for further research

5.2 Summary

This paper addresses additional dimensions in the analysis of portfolio diversification and risk. In addition to the conventional measures of risk, namely variance and skewness, we propose a parametric model to estimate the whole distribution of asset returns and investigate the relationships between diversification and other distributional characteristics that have risk implications.

Our results indicate that variance, kurtosis, and extreme losses decrease with increasing diversification. As such, the goal of an investor who wants to decrease variance and extreme losses would be to hold a more-diversified portfolio. However, portfolio skewness also decreases with increasing diversification. Therefore, an investor who desires higher skewness would choose to hold a less-diversified portfolio. These results indicate that an investor's strategy of diversification depends on which risk measure is the main concern.

The study indicates that the total risk for an individual stock is about 11.03 per cent on average. It is apparent from the study that when number of securities increased in the portfolio then risk is reduced. Two-security portfolio average risk is 9.20 as compare to one security average risk 11.03. It is observed that marginal risk reduction is quite significant in the initial stages but declines gradually. Ten-security portfolios average risk is lowest i.e.7.25. But average return remains the same i.e. 2.86. So, the present study finds that diversification leads to risk reduction in Indian capital market. Variance, skewness, kurtosis, and extreme losses all decrease with increasing diversification, and the gains or losses from diversification all vanish very quickly and are ignorable when the portfolio size is greater than ten.

The correlation analysis established significant, positive but good linear relationships between portfolio risk, and security price range ($p < .001$) and size of the company ($p = .049$). Negative correlation coefficient was established between portfolio risk and number of assets ($p = .033$). The regression analysis produced the following model:

Portfolio Risk = 0.039- 5.311E-05*Number of Assets - 0.002*Size of the Company + 0.039*Price Range

The coefficients prove that when other factors are constant, a unit increase in number of assets would lead to a 5.311E-05decrease in portfolio risk, a unit increase in size of the company would lead to a 0.002decrease in portfolio risk, and a unit increase in security price range would lead to a 0.039increase in portfolio risk.

From the foregoing, therefore, for investors to a well diversified portfolio, theyneed to ensure adequately diversified portfolio that responds to the following. To begin with, the portfolio should be spread among many different investment vehicles such as stocks. Secondly, the securities should vary in risk. The investor should not restrict themselves to picking only blue chip stocks; picking different investments with different rates of return will ensure that large gains offset losses in other areas. The securities should vary by industry, minimizing unsystematic risk to small groups of companies. The investor must consider the number of stocks they should buy to reduce the risk of their portfolio. Therefore, investors can achieve diversification by investing in the NSE-20 share index stocks, as they have a wide variety of industries. However, these stocks are typically industry leaders and have high market capitalizations and trading volumes.

5.3 Conclusions

Investors use portfolios to diversify away the unpriced risk of individual securities. It can be concluded that portfolio diversification with respect to extreme downside and upside risk would lead to portfolio risk reduction. This is because, the risk of a security is decomposed into a part that is attributable to the market risk and independent risk factor consisting of idiosyncrasies. It can be concluded that the portfolio diversification theory is applicable for NSE: a reduction of 7.536% is risk was achieved. The results also indicate that 7 securities can bring significant reduction in risk.

After the first 7 securities the portfolio standard deviation kept increasing and decreasing. The portfolio consisting of 7 securities had a standard deviation of 1.221%, whereas the

portfolio consisting of 60 securities had a standard deviation of less than 0.001%. However, the change in risk from 60 to 61 securities was 2.648%. This indicates that there is high variability is risk. Thus, it can be concluded that a portfolio of equally weighted 7 securities can diversify away significant amount of risk for the investors than large number of security whose returns is mixed.

The majority of diversification benefits are realised when a portfolio of approximately seven active equity funds are included. However, the number of funds utilised by investors would also be influenced by the size of assets and company size with respect to capitalization. Furthermore, portfolios with large numbers of funds may achieve risk reduction that mimics the performance of the underlying index, while also incurring active management fees. Thus, investors do not weigh downside risk equally with upside potential and prefer more positively skewed returns over low return variance and extreme losses.

5.4 Recommendations

Based on the findings and conclusions drawn thereof, a number of recommendations are made. Risk managers use portfolios to diversify away the unpriced risk of individual securities and this study looks at portfolio diversification with respect to extreme risk in returns. The results also shed some light on the empirical puzzle that investors do not tend to hold fully diversified portfolios. As investors do not weigh down side risk equally with upside potential and prefer more positively skewed returns over low return variance and extreme losses. It is recommended that investors look at both the upside and

downside risk in choosing what securities to add to their portfolios. They should choose wisely so as not to have so many assets in their portfolios as this would lead to high portfolio management costs.

Furthermore, taking into account the transaction cost and information cost embedded in managing a more diversified portfolio, investors are likely not to hold more than ten stocks in their portfolios since the benefit of diversification beyond ten stocks is limited. The study recommends investors to achieve diversification by investing in the NSE-20 share index securities, because these securities include a wide variety of industries. However, these stocks are typically industry leaders and have high market capitalizations and trading volumes. This raises the cost of their purchase.

5.5 Limitations of the Study

Furthermore, portfolios with large numbers of securities may achieve fully diversified returns which might mimic performance of the market index, while also incurring active management fees. This study is limited by its lack of analysis of the cost, direct and incidental, in holding of diversified portfolio. The study looked at diversification in terms of returns and volatility. However, there are other dimensions of security performance such as liquidity. This limits the generalization of findings to only returns and volatility.

This study is limited by its inability of incorporating a model that forecast how market returns will become in future which would be useful to investors who are risk averse and try to minimize their risk insofar as investing in securities is concerned. This owes to lack of no forecasting model that can give a precise forecast for expected returns of assets.

This owes to the fact that all stock prices are always going to vary a lot, because investors have different opinions about how risky and profitable a stock is, due to this believe they have different believes on how the market will be in the future.

The study also failed to come up with an optimal mix of securities that would lead to maximum returns. Besides, security market performance is affected by exogenous factors and market noises that were not incorporated into the model. In addition, the data covered a limited period of time, 3 years, which might not have accounted for the cyclic nature of security market; ranging from bullish, bearish, poor to good performance.

In attaining its objective the study was limited to NSE in Kenya. However, case studies as this cannot be generalized to other securities as they might have differing dynamics. The study could not therefore incorporate the determinants of portfolio risk in other security markets. The study only concentrated on the stocks and did not look at other securities such as bonds and treasury bills.

Portfolio risks may have been affected by other factors other than those investigated by the study. Macroeconomic aggregates such as regulations and investor characteristics might have also moderated the changes. These factors could not be isolated in the study owing to difficulty in doing so.

5.6 Suggestions for Further Studies

The study looked at diversification in terms of returns and volatility. However, there are other dimensions of security performance such as liquidity. Future studies can ensure

holistic generalization by looking at diversification in terms of liquidity of the securities, which is measured by the turnover ratios (trading volume divided by shares outstanding).

Diversification of risks by including more and more security or assets into a portfolio while may lead to better returns, may also incurring active management fees and other incidental costs. Future research should examine the complete cost benefit analysis of diversification of portfolio risks.

The study recommends that future studies can be conducted by looking at other factors that might affect portfolio risks. This could include: regulations and investors characteristics. These might have an antecedent effect on trade that affects stock returns. Besides, exogenous factors and market noises could be also incorporated into the model Future studies might as well isolate these factors using models that would be able to.

Future studies can be done by looking at other security investments like bonds and Treasury bills. This would help augment this study as the performance of various security instruments differs.

Future studies can come up with an optimal mix of securities that would lead to maximum returns. This would be descriptive and prescriptive enough for amateur investors. Thus, boost their ability to invest in stocks market by getting considerable returns.

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APPENDICES

Appendix I: Securities Listed at NSE by 2013

Agricultural	**Construction & Allied**
Eaagads Ltd	ARM Cement Ltd
Kakuzi Ltd	Bamburi Cement Ltd
Kapchorua Tea Co. Ltd	Crown Paints Kenya Ltd
The Limuru Tea Co. Ltd	E.A.Cables Ltd
Rea Vipingo Plantations Ltd	E.A.Portland Cement Co. Ltd
Sasini Ltd	**Energy & Petroleum**
Williamson Tea Kenya Ltd	KenGen Co. Ltd
Automobiles & Accessories	KenolKobil Ltd
Car & General (K) Ltd	Kenya Power & Lighting Co Ltd
CMC Holdings Ltd	Kenya Power & Lighting Ltd 4% Pref 20.00
Marshalls (E.A.) Ltd	Kenya Power & Lighting Ltd 7% Pref 20.00
Sameer Africa Ltd	Total Kenya Ltd
Banking	Umeme Ltd
Barclays Bank of Kenya Ltd	**Insurance**
CFC Stanbic of Kenya Holdings Ltd	British-American Investments Co.(Kenya) Ltd
Diamond Trust Bank Kenya Ltd	CIC Insurance Group Ltd
Equity Bank Ltd	Jubilee Holdings Ltd
Housing Finance Co.Kenya Ltd	Kenya Re Insurance Corporation Ltd

I&M Holdings Ltd	Liberty Kenya Holdings Ltd
Kenya Commercial Bank Ltd	Pan Africa Insurance Holdings Ltd
National Bank of Kenya Ltd	**Investment**
NIC Bank Ltd	Centum Investment Co Ltd
Standard Chartered Bank Kenya Ltd	Olympia Capital Holdings Ltd
The Co-operative Bank of Kenya Ltd	Trans-Century Ltd
Commercial And Services	**Manufacturing & Allied**
Express Kenya Ltd	A.Baumann& Co Ltd
Hutchings Biemer Ltd	B.O.C Kenya Ltd
Kenya Airways Ltd	British American Tobacco Kenya Ltd
Longhorn Kenya Ltd	Carbacid Investments Ltd
Nation Media Group Ltd	East African Breweries Ltd
Scangroup Ltd	Eveready East Africa Ltd
Standard Group Ltd	Kenya Orchards Ltd
TPS Eastern Africa Ltd	Mumias Sugar Co. Ltd
Uchumi Supermarket Ltd	Unga Group Ltd
Telecommunication & Technology	**Growth Enterprise Market Segment (Gems)**
Safaricom Ltd	Home Afrika Ltd

Appendix II: Descriptive Statistics

Company	Mean of Returns	Variance	Skewness	Kurtosis	Range	Minimum	Maximum	Sum	1st Quartile	3rd Quartile
Jubilee	.0019	0.00054	-.160	4.633	.21	-.10	.11	.92	-.0059	.0098
safcom	.0027	0.00026	.178	1.832	.13	-.05	.08	1.36	-.0035	.0131
Equity	.0014	0.00024	.664	4.761	.16	-.06	.09	.69	-.0075	.0095
EABL	.0011	0.00021	-.675	4.511	.15	-.08	.07	.57	-.0041	.0084
KCB	.0022	0.00020	-.190	5.021	.14	-.07	.06	1.07	0.0000	.0092
SCBL	.0013	0.00017	-.798	4.684	.11	-.07	.04	.64	-.0038	.0067
COOP	.0011	0.00015	1.657	11.472	.13	-.04	.09	.56	-.0042	.0053
BCBL	.0007	0.00016	-1.355	14.373	.17	-.11	.06	.34	-.0036	.0058
BATK	.0020	0.00043	1.187	17.585	.25	-.10	.15	.98	-.0013	.0051
DTKL	-.0039	0.00618	-12.032	153.147	1.07	-1.00	.07	-.67	-.0043	.0088
NMG	.0021	0.00026	-.140	6.013	.18	-.08	.09	1.04	-.0043	.0086
BMBC	-.0075	0.00643	-11.906	148.245	1.09	-1.00	.09	-1.22	-.0057	0.0000

IM	-.0023	0.00400	-14.040	222.516	1.13	-1.00	.13	-.65	-.0073	.0079
BRIT	.0024	0.00046	.608	3.889	.21	-.10	.12	1.17	-.0080	.0095
TKNL	.0014	0.00059	.421	1.837	.17	-.07	.10	.69	-.0095	.0117
CFCB	.0021	0.00058	.507	3.846	.20	-.10	.11	1.04	-.0065	.0114
NICB	.0023	0.00032	.756	5.684	.18	-.07	.11	1.13	-.0070	.0091
ARML	.0023	0.00039	.650	7.446	.21	-.09	.12	1.13	-.0062	.0079
CENTUM	.0019	0.00047	.193	3.477	.19	-.10	.09	.96	-.0082	.0115
KPLL	-.0001	0.00016	-.195	3.932	.12	-.06	.05	-.06	-.0052	.0054
JBIC	.0018	0.00062	.748	7.497	.23	-.10	.13	.89	-.0055	.0065
KEGC	.0011	0.00038	1.065	5.656	.17	-.08	.10	.56	-.0063	.0063
CIC	.0019	0.00051	.765	2.861	.17	-.08	.09	.95	-.0102	.0108
SCAN	.0005	0.00045	.245	4.116	.20	-.08	.12	.26	-.0084	.0091
KNAL	-.0007	0.00035	.253	6.133	.19	-.10	.10	-.33	-.0077	.0053
KNOC	.0002	0.00050	-.255	7.556	.22	-.13	.09	.08	-.0067	.0067
KNRE	.0020	0.00048	.666	4.497	.21	-.07	.13	1.00	-.0079	.0101
PAIL	.0033	0.00077	.107	2.741	.21	-.09	.11	1.65	-.0080	.0154

HFCL	.0019	0.00026	.027	3.249	.14	-.06	.08	.96	-.0064	.0101
CFCI	.0035	0.00505	12.799	276.127	1.95	-.60	1.36	1.74	-.0073	.0085
NBKL	.0008	0.00055	-.019	3.158	.21	-.10	.11	.42	-.0118	.0120
EAPC	.0010	0.00099	-4.178	57.750	.51	-.41	.10	.49	0.0000	0.0000
TPSEA	.0001	0.00065	.286	3.644	.22	-.10	.12	.07	-.0102	.0101
TCL	.0005	0.00076	.031	2.249	.19	-.09	.10	.23	-.0084	.0100
CBIL	.0158	0.10774	21.377	470.287	8.04	-.83	7.21	7.84	0.0000	.0050
EACL	.0011	0.00031	.648	3.400	.15	-.06	.09	.53	-.0066	.0090
STCL	.0005	0.00052	-.604	5.777	.24	-.16	.08	.26	-.0109	.0130
KKZI	.0009	0.00060	.097	5.770	.20	-.10	.11	.46	0.0000	0.0000
MSUG	-.0007	0.00043	-.178	8.981	.23	-.13	.10	-.35	-.0102	.0088
STNG	.0011	0.00165	.590	2.727	.29	-.10	.19	.55	-.0115	.0163
UCSP	.0022	0.00050	-.116	4.435	.18	-.10	.09	1.07	-.0064	.0115
BOCK	.0008	0.00070	1.273	11.914	.31	-.10	.21	.40	0.0000	0.0000
UNGL	.0016	0.00055	.051	4.238	.20	-.10	.10	.77	-.0055	.0081
CRBG	.0029	0.00056	.156	5.202	.19	-.10	.09	1.41	0.0000	.0074

GWKL	.0001	0.00077	.668	9.107	.28	-.10	.18	.07	0.0000	0.0000
HAFR	-.0091	0.00459	-11.228	164.199	1.10	-1.00	.10	-2.55	-.0162	.0090
SAME	.0008	0.00058	.440	2.344	.19	-.08	.11	.41	-.0125	.0125
CRGN	.0008	0.00081	.031	3.993	.20	-.10	.10	.41	0.0000	0.0000
EGDL	.0017	0.00274	13.987	267.143	1.10	-.10	1.00	.85	0.0000	0.0000
LMTC	.0009	0.00023	2.185	29.112	.21	-.10	.11	.46	0.0000	0.0000
LKL	.0003	0.00081	.140	4.811	.23	-.13	.10	.17	0.0000	0.0000
EVRD	.0015	0.00116	.556	2.915	.31	-.09	.22	.75	-.0250	.0263
KPTC	.0003	0.00046	-.217	7.968	.20	-.10	.10	.15	0.0000	0.0000
KNOL	0.0000	0.00000			0.00	0.00	0.00	0.00	0.0000	0.0000
EXPL	.0005	0.00102	.189	2.307	.20	-.10	.10	.23	-.0123	0.0000
DNKN	.0012	0.00112	.064	1.247	.19	-.10	.10	.59	-.0130	.0139
MEAL	.0000	0.00023	.910	24.446	.19	-.10	.10	.02	0.0000	0.0000
ACCESS	.0014	0.00048	.963	3.723	.16	-.06	.10	.70	-.0087	.0054
ABCL	0.0000	0.00000			0.00	0.00	0.00	0.00	0.0000	0.0000
RVPL	.0017	0.00070	.390	3.483	.24	-.10	.14	.84	-.0082	.0103
CMCH	0.0000	0.00000			0.00	0.00	0.00	0.00	0.0000	0.0000

Appendix I: Covariance and Cross-Security Deviations

	Pearson Correlation (Safaricom)	Sig. (2-tailed)	Sum of Squares and Cross-products Deviations	Covariance
Jubilee	.056	.214	.010	2.074E-05
Equity	.127**	.005	.016	3.180E-05
EABL	.177**	.000	.020	4.092E-05
KCB	.171**	.000	.019	3.881E-05
SCBL	.062	.168	.006	1.309E-05
COOP	.151**	.001	.015	2.953E-05
BCBL	.026	.557	.003	5.380E-06
BATK	-.029	.526	-.005	-9.444E-06
DTKL	-.070	.359	-.015	-8.680E-05
NMG	.013	.781	.002	3.213E-06
BMBC	.003	.965	.001	4.395E-06
IM	.003	.961	.001	3.024E-06
BRIT	.093*	.038	.016	3.210E-05
TKNL	.013	.776	.002	4.968E-06
CFCB	.133**	.003	.025	5.101E-05
NICB	.109*	.015	.016	3.142E-05
ARML	.098*	.030	.015	3.065E-05
CENTUM	.117**	.009	.020	4.078E-05
KPLL	.039	.386	.004	7.785E-06
JBIC	.084	.060	.017	3.373E-05
KEGC	.102*	.022	.016	3.211E-05
CIC	.031	.486	.006	1.128E-05
SCAN	-.030	.502	-.005	-1.031E-05
KNAL	.006	.885	.001	1.954E-06
KNOC	.076	.090	.013	2.716E-05
KNRE	.040	.377	.007	1.389E-05
PAIL	.080	.073	.018	3.576E-05
HFCL	.077	.085	.010	2.015E-05
CFCI	.051	.255	.029	5.822E-05
NBKL	.025	.582	.005	9.256E-06
EAPC	.103*	.021	.026	5.207E-05
TPSEA	.053	.234	.011	2.179E-05
TCL	.068	.128	.015	3.013E-05
CBIL	.036	.423	.094	1.892E-04
EACL	.077	.088	.011	2.162E-05
STCL	.061	.172	.011	2.232E-05
KKZI	-.004	.934	-.001	-1.469E-06

MSUG	.032	.480	.005	1.054E-05
STNG	.099*	.027	.032	6.448E-05
UCSP	-.013	.770	-.002	-4.733E-06
BOCK	.006	.889	.001	2.677E-06
UNGL	.063	.164	.012	2.342E-05
CRBG	-.036	.421	-.007	-1.377E-05
GWKL	.087	.054	.019	3.854E-05
HAFR	-.037	.533	-.012	-4.154E-05
SAME	.021	.642	.004	8.042E-06
CRGN	.055	.218	.012	2.525E-05
EGDL	.010	.819	.004	8.637E-06
LMTC	.022	.633	.003	5.258E-06
LKL	.097*	.030	.022	4.411E-05
EVRD	.052	.250	.014	2.823E-05
KPTC	.052	.250	.009	1.770E-05
KNOL	.c		0.000	0.000E+00
EXPL	-.012	.794	-.003	-6.008E-06
DNKN	.024	.601	.006	1.257E-05
MEAL	-.016	.725	-.002	-3.850E-06
ACCESS	-.006	.892	-.001	-2.136E-06
ABCL	.c		0.000	0.000E+00
RVPL	.012	.782	.003	5.275E-06
CMCH	.c		0.000	0.000E+00

**. Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed).

c. Cannot be computed because at least one of the variables is constant.