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U N I V E R S I T Y

Equity Investment Analysis, the Case for a Private University Endowment

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DECLARATION

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

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ABSTRACT

The purpose of this study is to investigate the assertion that university and college endowments should maintain one hundred percent equity holdings in their portfolios. An equity portfolio is compared to a traditional 60/40 stock-bond portfolio in testing this assertion. The focus is on the Kenyan stock market and the Nairobi Securities Exchange (NSE) All Share Index (NASI) is taken as a representative diversified equity market portfolio. A fifteen-year Kenyan infrastructure government bond is taken to represent the bond portfolio. The study considers whether the returns generated would sustain an endowment both in the short term (less than ten years) and in the long term (more than ten years). The study finds that equity returns are indeed sufficient to fund the endowment portfolio both in the long-run and short-run, but a traditional 60/40 portfolio is seen to have a higher risk-adjusted return.

LIST OF ABBREVIATIONS

CAPEX – Capital Expenditure

CBK – Central Bank of Kenya

FTSE – Financial Times Stock Exchange

KES – Kenya Shillings

KNBS – Kenya National Bureau of Statistics

NASI – NSE All Share Index

NSE – Nairobi Securities Exchange

NSE 20 – Nairobi Securities Exchange 20 Share Index

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CHAPTER ONE: INTRODUCTION

1.1 Introduction

Institutional investors have acquired great importance in financial markets due to the sizes of portfolios they control, as noted by Tschampion et.al.(2007). Endowments especially, according to Lerner, Schoar, & Wongsunwai (2007), have been seen to outperform other institutional investors in the United States, with the top twenty endowments growing by more than nine % annually on a real basis according to Lerner, Schoar, & Wang (2008). Lerner, Schoar, & Wang (2008) also highlight the importance of an endowment in maintaining the academic excellence of a university, for example by allowing for lower tuition fees due to improved perfomance of the endowment fund, thereby increasing access to higher education.

Endowments, according to Ehrenberg (2009) consist of both financial and real assets, held to generate income for current and future operations of their affiliated universities. Brown et.al.(2014) show that most university endowments follow payout policies that support their affiliated university's educational mission, with true endowments being those assets specified by a donor and held in perpetuity and quasi-endowments being funds that the university treats as an endowment but which it could spend if it so wishes. In this study, both the true and quais-endowments are taken into consideration; annual surplus amounts made by the hypothetical university considered feed into the endowment value.

Endowment payouts are also found to be an important component of a universities' revenues, as noted by Brown et.al.(2014), given the growth rate of the average endowment has far exceeded the growth of university expenditures. Tschampion et.al.(2007) additionally find that endowments tend to provide significant budgetary support to the university, as they are not subjected to a required spending level. This study assumes that endowments play the same budgetary support for private universities in Kenya.

Looking at the appropriate asset allocation for a university endowment, Jennings (1992) proposes that a college or university endowment be invested in a fully diversified portfolio of common stocks with income distribution policies that are a percentage of the market value of the portfolio. According to Jennings (1992) a diversified equity portfolio will in the long run create

more value for the endowment than if a fully diversified portfolio of bonds is invested in, or one that combines both stocks and bonds. Conversely, Markowitz (1952) calls for portfolio diversification and alludes to finding optimal weights across asset classes that guarantee the highest possible return for a given level of risk, or lowest risk for a certain level of return. However, some authors such as Lerner, Schoar, & Wang (2008) suggest that what is important for superior endowment performance is not the asset classes invested in, but rather the superiority of the endowment committee, the skill of the investment managers and the broader knowledge bases and social networks of the universities themselves.

Purely equity portfolios have nonetheless been criticized for bearing too much risk by Jennings (1992), as compared to bond or mixed portfolios, with the measure of risk being standard deviation, yet this measure has also been criticized for only capturing a one-dimensional measure of market risk and failing to differentiate between upside and downside volatility, Chhabra (2005). Other measures of risk linked more directly to attaining the investment objective, such as semi-variance, may be more suitable.

Another challenge in the management of any investment portfolio comes with the costs of rebalancing and choosing when to rebalance. Sharpe (2010) recommends an adaptive asset allocation, where initial asset allocations adapt to market movements by taking into account the changes in outstanding market values for each major asset class, a technique expected to reduce the number of transaction costs from portfolio rebalancing, but one opposed to strict maintenance of particular weights in an asset class.

Negative financial shocks have an effect on endowments, resulting in a significant deviation from their pay-out policies, Brown et.al.(2014). These shocks also affect the operations of the university and lead to a cut in the hiring of employees or an accelerated firing, with the exception being for university administrators, according to Brown et.al.(2014).

The study is testing the sufficiency a one hundred % equity portfolio in sustaining an endowment fund and uses the NASI as a proxy for a diversified equity market portfolio. This will be compared to a traditional 60/40 portfolio, where 60 % of the funds are invested in stocks while 40 % are invested in bonds. The bonds considered for this study are long-term (over ten years) Kenyan government bonds, due to their guarantee of payment. The question asked is whether the

returns generated form the equity portfolio would create more value for an endowment both in the short term (less than ten years) and in the long term (more than ten years). This ten year base period is chosen given that the index was floated in February 2008 and has been in existence for less than ten years. Forecasts are then made for its future returns to assess its sufficiency over a period greater than ten years. The institutional investor considered is a hypothetical private university as data on university endowments is not available for the Kenyan market; with revenues originating from the fees paid by students, and these being required to run the day-to-day operations of the university.

1.2 Problem Statement

Institutional investors have gained importance in financial markets due to the large size of the portfolios they maintain and their relatively long time horizons. University endowments contribute largely to a university's revenue and therefore the investment approach adopted is significant. It has been suggested that college and university endowments should be invested fully in equity portfolios, to maximize long-term returns, especially where the endowment only acts to supplement the university's income. This study therefore seeks to investigate the sufficiency of an equity portfolio, the NASI, in sustaining a private university's endowment objectives, as compared to a traditional 60/40 portfolio where Kenyan government securities form the bond portfolio. This particular index has been in existence for less than ten years and based on its historical returns, forecasts are made to assess its performance over a longer term.

1.3 Research Objective

The purpose of the study is to investigate the assertion that college and university endowments should be fully invested in equity portfolios to meet their endowment objectives, and whether this holds for the Kenyan market. This study uses the NASI as a proxy for a diversified equity market portfolio and considers if the returns generated would create value for an endowment both in the short term (less than ten years) and in the long term (more than ten years). The institutional investor considered is a hypothetical private university; with revenues originating from the fees paid by students, and these are required to run the day-to-day operations of the university.

1.4 Research Questions

1. Are returns from the NASI sufficient to fund a private university's spending needs in the short run (less than ten years), and are they more superior to a traditional 60/40 portfolio with Kenyan government securities forming the bond portfolio?

2. Are returns from the NASI sufficient to fund a private university's spending needs in the long run (more than ten years) and are they more superior to a traditional 60/40 portfolio with Kenyan government securities forming the bond portfolio?

1.5 Justification of the Study

The aim of this study is to investigate the practicality and benefits associated with universities and colleges investing one hundred percent of their endowment portfolios in equities, as opposed to a traditional 60/40 portfolio. Current wealth management practices call for diversified portfolios with at least a certain percentage held in stocks and another in bonds. This study will therefore contribute to the body of research surrounding the best investment practices for institutional investors, particularly endowments for institutions of higher learning.

CHAPTER TWO: LITERATURE REVIEW

2.1 Portfolio Construction

The key finding of Brinson, Hood, & Beebower (1986) was that the asset allocation in a portfolio greatly determined its overall volatility. This caused many advisers to seek the perfect asset allocation that will guarantee the highest returns for an investor with the lowest risk, leading to the popularity of asset allocation as a portfolio construction technique. However, according to Huxley (2006) asset dedication is a superior investment strategy because it considers an investor's particular investment requirements and suggests an investment portfolio that will fund the cash flow needs as they fall due. Any personal or institutional investor with predictable cash flow needs can apply it.

Brinson, Hood, & Beebower (1986) nonetheless prescribe four key steps in porfolio construction. The first step is deciding on which asset classes to include and which to exclude from the portfolio. Secondly, the normal or long term weights for each of the asset classes should be set. Third is to strategically alter the investment mix weights away from normal in an attempt to capture excess returns from short term fluctuations in asset class prices (market timing). The final step involves selecting individual securities within an asset class to achieve superior returns relative to that asset class (security selection).

Portfolio construction as suggested by Markowitz, Portfolio Selection (1952), involves two steps. The first is grounded on having observations and forming certain beliefs, with the second being converting those beliefs to portfolio choices. He acknowledges the importance of portfolio diversification and states that, "*Diversification is both observed and sensible; a rule of behaviour which does not imply the superiority of diversification must be rejected both as a hypothesis and as a maxim.*"

The process suggested by Jennings (1992) specifically for college or university endowments appears to be simpler because it suggests that only equities be invested in, forming both the short-term and long-term asset class. He mentions no perceived benefits of diversification, stating clearly that including bonds in an endowment portfolio will only serve to depress volatility in the short-term and minimize return in the long-run. This author does not describe how the stocks should actually be picked, only emphasizing their ability to weather short-term

market fluctuations. In his paper, Jennings (1992) considers the case of two universities with one investing its endowment fund in a fully-diversified portfolio of common stocks and the other investing in a full-diversified high quality corporate bond portfolio, over the period 1929-1991. The beginning value for both funds at the beginning of 1929 was $25 million.

2.2 Assumptions about the Market

An analysis by Niko, Mankiw, & Weil (1997) of the historical returns of stocks and bonds shows higher variability in stock returns and lower variability in bond returns. Jennings (1992) acknowledges that indeed stocks have higher variability but asserts that an inclusion of bonds in an endowment portfolio only suppresses volatility but does not completely eliminate it, and since partial or complete liquidation of the portfolio will not be required, the market fluctuations will not be relevant, especially in the short run, because they do not represent risk.

Jennings (1992) makes certain assumptions about the market. The first is that over the long-term, equity returns will always be greater than those available on fixed- income securities. Second, market fluctuations over the short-run are not relevant because market recoveries are sufficiently robust to achieve equity superiority over a period of four or five years, a maximum of seven to fourteen years. Third, market predictions and individual security selection will not be profitable to the individual college or university since their long-term accuracy will be no better than chance. Fourth is that prudent man rules tolerate a policy of full equity investment and full diversification will be possible. A fully diversified portfolio is defined as one whose performance corresponds with the market.

2.3 An Endowment Portfolio

2.3.1 Building an Endowment Portfolio

Different authors present different views on how an endowment should be used. For example, that endowments should smooth the income provided to the universities they support by spending the real return each year according to Brown et.al.(2014) or that they should be a form of self-insurance and only be viewed as another source of income for the university as proposed by Black (1976).

Calculating the return objective as the sum of the spending rate, the expected inflation rate, and the cost of generating investment returns can serve as a starting point for determining an endowment's appropriate return objective, Tschampion C. R et.al.(2007). Spending distributions

should be stable and reliable to ensure a smooth running of the activities of the endowed institution. Examples of spending rules include the simple spending rule, where spending equals the spending rate multiplied by the market value of the endowment at the beginning of the fiscal year and the rolling three-year average spending rule, where spending equals the spending rate multiplied by the average market value of the last three fiscal year-ends.

Liquidity needs for true endowments are limited by their perpetual nature and measured spending; showing that the number of withdrawals made is limited in a particular period, say one year, a feature also noted by Jennings (1992). The endowments must, however, have enough cash to make the required spending distributions, meet capital commitments and facilitate portfolio-rebalancing transactions.

Endowment time horizons tend to be extremely long term because of the objective of maintaining purchasing power in perpetuity. However, annual draws for spending introduce short-term considerations. Each withdrawal of capital has its specific time horizon and considerations such as planned decapitalizations to fund large projects, may suggest a multistage time horizon, as noted by Tschampion C. R et.al.(2007).

2.3.2 Evaluating the Performance of an Endowment Portfolio

Standard deviation as a measure of portfolio risk is criticized by Huxley (2006) because it does not distinguish between upside and downside volatility. The Sharpe ratio is also criticized by Huxley (2006) as a measure of return because it fails to adequately capture the magnitude of returns. Levitz (1974) defines investment risk as the uncertainty of the expected return at any given time in the future. With common stocks, this risk is created by the uncertainty of the future movements of stock prices in general, as well as by the uncertainty concerning developments affecting each specific company and its industry. Sensitivity of a stock's price to changes in the general stock market is referred to as "market risk," while price changes related to company or industry developments are referred to as "specific risk."

Markowitz H. M. (1959) introduces alternative measures of risk such as semi-variance, which captures the failure of portfolio returns reaching a set benchmark, or in the case of an endowment, failure to meet the required return. This measure concentrates on reducing losses. Semi-variance is computed as

$$S = \frac{1}{N}\sum_t (r_t - b)^2,$$

(2.1)

$$where\ r_t \leq b\ ,r_t\ is\ the\ observed\ return\ and\ b\ is\ the\ benchmark\ return$$

In a situation where all returns obtained in the portfolio are above the benchmark, a semi-variance measure of risk would allude to zero presence of risk, which is counter-intuitive for a rational investor. The presence of volatility and uncertainty still allude to some risk. It is however an improved measure of risk as it does not penalize a portfolio for upside volatility.

2.4 Empirical Evidence and Support

Jennings (1992) shows how a pure stock portfolio outperforms a pure bond portfolio for the case of a university endowment over a sixty-two year period. This, again, is in light of the assumption that the endowment is truly a permanent endowment, so that the university will never be forced to sell any portion of its investment. At the beginning of 1929 both portfolios are worth $25 million. At the end of 1991, the bond portfolio is worth $109.6, over four times its initial amount and is expected to provide income of $3.3 million per annum. The equity portfolio on the other hand is worth a staggering $1.34 billion, over fifty-three times its initial amount and is expected to provide an annual income of $40.1 million. A conservative assumption is made that there are no additions to the endowment during the investment period. Many portfolio managers however follow an experience-based approach, using allocations that have previously worked well for other clients.

Sharpe et.al.(2007) highlight some of the most common approaches. The first is having a 60/40 stock/bond asset allocation as a starting point for an average investor's asset allocation. This has been suggested as a neutral (neither highly aggressive nor conservative) asset allocation. The equities allocation is viewed as supplying a long-term growth foundation and the fixed-income allocation as supplying risk-reduction benefits. If the stock and bond allocations are themselves diversified, an overall diversified portfolio should result. The second approach is to have the allocation to bonds increasing with increasing risk aversion. Bonds tend to lower portfolio volatility and conservative investors value low volatility. The third approach is that for investors with longer time horizons their allocation to stocks should increase. One idea behind this rule of thumb is that stocks are less risky to hold in the long run than in the short run, based on past data. This is known as time diversification.

2.5 Chapter Summary

The chapter has revisited some common practices in the portfolio construction process, highlighted some of the possible functions of a university endowment fund and introduced the idea and basis for a pure equity portfolio in the case of a university or college endowment. Various assumptions are made to support this assertion and the empirical evidence clearly supports the above mentioned allocation. Measures of portfolio performance are considered, with the literature alluding to the possible superiority of the semi-variance measure of risk over variance or standard deviation. The return required by an endowment must be sufficient to fund the spending requirements of the endowed institution. Other commonly-used portfolio construction practices are also considered.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This research considers a hypothetical private university and its endowment, as university endowment data is not available for the Kenyan market. The objective is to test the assertion that college and university endowments should be fully invested in equity portfolios to guarantee maximum long-term returns. The first step will be to model a typical private university's revenues and costs. The second step will be to determine if the returns from the NASI would be sufficient to fund the university's endowment and meet its operating budget requirements. The third step will be to consider a traditional 60/40 portfolio and assess whether it outperforms the equity portfolio. Kenyan government bonds form the bond portfolio and a fifteen year infrastructure bond is considered, as proceeds from infrastructure bonds are not taxed, according to the Income Tax Act of Kenya. The study considers monthly returns on the NASI between March 2008 and February 2016. Microsoft Excel will be the primary tool used build a model for the university's cash flows and to analyse the data, given its statistical nature. Simulations shall also be performed to extend the returns obtained to the long run, in order to test their sufficiency.

3.2 Research Design

The design of this research is both experimental and case study. It is a case study because it focuses on the specific case of a private university endowment and experimental because it tests the assertion that an equity portfolio is sufficient to sustain the endowment. A private university is considered because these do not receive additional funding from the government, with their major revenue sources being student fees, gifts and donations, and would thus have to generate funds internally or through the other mentioned sources for any capital expenditure. This is in contrast to public universities whose capital expenditure can be funded by the government.

The university's assumed objective is to establish an endowment fund that can meet its capital expenditure without getting depleted or going below its initial value. Certain assumptions, which are outlined in section 3.5.1, are made about the university's cash flows and historical equity returns are analysed to check if they would indeed be sufficient, in the short-run and long-run. The stock index returns obtained are monthly and these are used to grow the endowment fund over an eight-year period, which is about the time the market proxy for the equity portfolio has been trading. University cash flows are also estimated for the same period.

3.3 Population and Sampling Design

3.3.1 Population

The population relevant for this study is the NSE, where different securities are traded. A representative equity portfolio is required and among the existing indices are the NASI, NSE 20 and Financial Times Stock Exchange (FTSE). It has been argued that the NSE 20 in itself is not fully representative of the market, despite containing the twenty stocks with the largest market capitalization, since this composition is revised depending on the performance of the individual constituent stocks. The NASI contains all shares traded on the exchange though has been faulted on containing some illiquid stocks. The FTSE NSE would be an inappropriate proxy given that its component equities are kept confidential for commercial purposes. The NASI is picked as a proxy for the market equity portfolio because it contains all the shares traded on the exchange, following the assertion by Jennings (1992) that the equity portfolio chosen should be well-diversified.

3.3.2 Sampling Design and Sample Size

The sampling design adopted is cluster sampling, since an equity index is picked from the existing indices, allowing for inferences to be generalized to the existing equity indices. Monthly prices of the index from February 2008 to February 2016 are obtained and returns from March 2008 to February 2016 are used in the study. A total of 96 monthly returns are considered.

3.4 Data Collection

The information to be used in the study will be historical data compiled by the NSE and the Central Bank of Kenya (CBK). Stock index data is obtained from the NSE while data on Kenyan government securities is obtained from the CBK. Data on the hypothetical university considered is based on average market rates, such as the inflation rate, to grow the costs, with realistic assumptions being made about other relevant cash flows and the organisation of the university.

3.5 Research Procedures

Ziskind & Boldin (1973) introduce a computer simulation model for an endowment portfolio. Returns for each asset class considered can be predicted by a statistical process over the period of interest, based on observed historical returns. Once these returns have been predicted the spending rules and other constraints of the investment policy can be applied, to calculate the ending values of the portfolio. By iterating the simulation a large number of times, there will be

increased confidence that the results are in fact a reliable representation of the real process, and various statistical tests can be used to check the trustworthiness of the results. The researcher specifies the number of iterations to be performed.

For purposes of this study, in order to ascertain whether an equity portfolio is sufficient to run a college or university endowment, a hypothetical private university is considered and its cash flows modelled over a period of eight years, to match the period of historical index returns obtained. An assumption is made that the university existed and was in operation before 2009 but without an endowment fund. An endowment fund is then set aside in 2009, with its purpose being to fund both short term and long term capital expenditure. The fund is built from grants, donations and the previous year's surplus. The university model and historical returns will be necessary to test if the planned capital expenditures could be fully funded by the endowment, based on returns on the index and the 60/40 portfolio.

3.5.1 Private University Model

University cash flows are considered for the period between 2009 and 2016. The endowment fund is set up in 2009 and its value grows based on the returns considered. The fund is set up to meet capital expenditures (CAPEX). CAPEX could be minor or major, depending on the university's expansion plan. For purposes of this paper, minor CAPEX is defined as the construction of new buildings for classrooms and offices and increasing parking space, while major CAPEX encompasses the construction of a new university campus.

The university's expansion plans are such that a new building will be put up in 2017, to cater for the increased number of students and lecturers. Additional parking space will also need to be created in respect of this. In 2022, construction of a new campus will begin, to facilitate the addition of three faculties to the university, namely the school of humanities, the department of life sciences and the school of engineering. Each faculty will begin by offering three full-time courses.

A simplifying assumption is made that currently all students are undergraduate and full-time. The initial number of students assumed to be enrolled in 2009 is 2,000, based on historic data from the Kenya National Bureau of Statistics (KNBS) on existing universities in Kenya, and this grows at 12 % per annum to an estimated 3,428 in 2016, after adjusting for a drop-out rate of four %, per annum;

$$St_n = St_i \times [1 + (g - a)] \tag{3.1}$$

St_n is the new number of students, St_i is the initial number of students, g is the growth rate and a is the attrition rate. The growth in the number of students directly affects the growth of the university's revenues.

The assumed lecturer to student ratio is 1:20, a recommendation for institutions of higher learning for quality purposes, resulting in an initial one hundred lecturers in 2009, and this number grows at seven % per annum to 161 in 2016. The number of administrative staff and support staff is also assumed to be linked to the total number of students. The assumed ratio of administrative staff to students is 1:30 while that of support staff to students is 1:40. Administrative staff includes those concerned with the recruitment of lecturers and admission of students, as well as those in the mentoring and career services department. The support staff includes cleaners and security personnel.

Aside from teaching facilities there is a cafeteria and clinic on campus grounds, which are run independently of the main school activities. It is assumed that there are currently five independent faculties, with each having its own research centre that allows for consultation with industry practitioners. Each academic year has two semesters and the school is open for eleven out of twelve months every year. The academic board of the university is composed of all faculty deans and heads of curriculum and exam, as well as three independent members. The applicable inflation rate for the model is 6.3 %, which is a historical eleven year average for Kenya. All costs are assumed to grow at this inflation rate per annum. Student fees grow at the inflation rate plus administrative fee charge.

There are both full-time and part-time lecturers. They receive their remuneration per hour taught, with each unit taught for three hours a week. The average number of units taught per semester is taken as 3.5, to account for both the full-time and part-time lecturers. The fee per hour is Kenya Shillings (KES) 2,500.

$$Ls = f \times h \times w \times u \tag{3.2}$$

Ls is lecturer salary, f is the fee per hour, h is the hours taught per unit per week, w is the number of weeks taught in a semester and u is the number of units taught per semester.

The average monthly fee for administrative staff is KES 60,000 while that for support staff is KES 30,000. Other costs include estimates for teaching materials, insurance and utilities.

The current capital expenditure revolves around the maintenance of the library catalogue, access to financial databases, subscription to academic journals and equipment for use in the clinic.

3.5.2 Weaknesses of the Methodology

The NASI is a relatively new index as it was introduced on the NSE in 2008 and therefore the period of returns considered may fail to accurately predict future performance and be representative of the equity market in Kenya.

Secondly, only infrastructure bonds are considered for the bond portfolio, as these are tax-free and would thus create more value for an investor. Other bond issues could be considered for comparative purposes.

Thirdly, as a developing country Kenya is subject to volatility in its financial markets due to political turmoil and its exposure to external shocks. These could distort the true value of the financial markets.

3.6 Stock Index Data Analysis

3.6.1 Statistical Analysis of NASI Returns

This section discusses the procedure of isolating index returns and the process of analyzing the statistical properties of the index return data.

3.6.1.1 Definition of Index Returns

In this study, it is assumed that the daily index return follows a geometric Brownian motion, a stochastic process, so that returns are logarithmic in nature. This is considered to be a more accurate representation of real data according to Adams et.al.(2003). The reasons for this are: logarithmic returns are found to be more symmetric than arithmetic returns, that is, positive and negative percent returns are equal for logarithmic returns while they are unequal for arithmetic returns; if single period returns have a lognormal distribution, then compounded multi-period returns will also have a lognormal distribution, this is untrue for many other distributions; the use of logarithmic returns is preferable to a simple percentage change, since this allows for the addition of returns over multiple periods and introduces time consistency.

The daily index return, R_t, which is a random variable, is computed as the difference between the natural logarithms of two consecutive index values.

$$R_t = \ln I_t - \ln I_{t-1} \tag{3.3}$$

I_t is the index value at time t, I_{t-1} the index value at time t-1 and both are random variables with a lognormal distribution. The process of isolating the series R_t is done in Microsoft Excel and the series is then imported to the analysis software, Eviews 9.

3.6.1.2 Analysis of Correlation of Returns

3.6.1.2.1 The Autocorrelation Function

To determine whether the share index returns are predictable, an autocorrelation function will be computed. This is done using the sample variance and covariance.

$$sample\ variance, \widehat{\gamma_0} = \frac{\sum(R_t - \bar{R})^2}{n-1} \qquad (3.4)$$

$$sample\ covariance\ at\ lag\ k, \widehat{\gamma_k} \qquad (3.5)$$
$$= \frac{\sum(R_t - \bar{R})(R_{t+k} - \bar{R})}{n-1}$$

k is the lag period, the time difference in days between R_t and R_{t+k}; $\bar{R}$ is the mean return and n is the sample size. The sample autocorrelation function is therefore given by

$$\widehat{\rho_k} = \frac{\widehat{\gamma_k}}{\widehat{\gamma_0}}\ where\ -1 \le \widehat{\rho_k} \le 1\ and\ \widehat{\gamma_0} \ne 0 \qquad (3.6)$$

The autocorrelation function will be computed for up to twenty lags, to investigate for evidence of autocorrelations in index returns that are up to twenty days apart. If the value of $\widehat{\rho_k}$ is $zero$, there is no evidence of correlation between the returns. one represents a perfect positive association while $negative\ one$ represents a perfect negative association between the returns.

3.6.1.2.2 The Ljung-Box test statistic

This test developed by Ljung & Box (1978) is a portmanteau test that tests for the autocorrelations of the data series as a whole, as opposed to individual data values. It tests the joint hypothesis that all the autocorrelation coefficients γ_k are simultaneously zero.

$$H_0: \widehat{\rho_k} = 0 \qquad (3.7)$$
$$that\ index\ returns\ are\ independently\ distributed$$
$$H_1: \widehat{\rho_k} \ne 0$$
$$that\ index\ returns\ are\ NOT\ independently\ distributed$$

The Ljung-Box test statistic is given by

$$Q = T(T + 2) \sum_{k=1}^{s} \frac{\widehat{\rho_k}^2}{(T - k)} \tag{3.8}$$

T is the number of observations, s is the number of lags being tested, $\widehat{\rho_k}$ is the autocorrelation coefficient for lag k and Q is the test statistic.

The null hypothesis H_0 is rejected if the value of Q exceeds the critical value of the chi-square distribution with k degrees of freedom, i.e., if $Q > \chi^2_{1-\alpha,k}$, at a significance level α. A significant value of the Q-statistic at any lag is evidence of autocorrelation in the index returns series.

3.6.1.3 Determining the Distribution of Index Returns

It is important to ascertain the distribution characteristics of the index returns to determine the reliability of any forecasts made from the same data. With stationary data, for example, it is assumed that the mean and variance are constant over time, so that any forecasts made are assumed to be representative of future returns, prima facie. In addition, a normal distribution would allow for hypothesis testing to be done and for confidence intervals to be created, within which the data is assumed to meet certain characteristics at a certain level of confidence.

3.6.1.3.1 Skewness

Skewness of returns R_t with mean μ and variance σ^2 is computed as

$$S = \frac{E[(R_t - \mu)^3]}{\sigma^3} \tag{3.9}$$

A normal distribution has zero skewness so a value not equal to zero will indicate a non-normal distribution. A negative value shows skewness to the left while a positive value shows skewness to the right. A normality test would consider both the skewness and kurtosis of the data set.

3.6.1.3.2 Kurtosis

The kurtosis of a random variable R_t is given by

$$K = \frac{E[(R_t - \mu)^4]}{\sigma^4} \tag{3.10}$$

A normal distribution has a kurtosis of three so that any kurtosis value not equal to three indicates non-normality. With a value greater than three a return series is more likely to have outlier values, while with a value less than three a return series is less prone to outlier values than a normal distribution.

The joint hypothesis for the distribution of returns is therefore:

$$H_0: S = 0 \; and \; K = 3 \tag{3.11}$$

$$that \; index \; returns \; are \; normally \; distributed$$

$$H_1: S \neq 0 \; and \; K \neq 3$$

$$that \; index \; returns \; are \; NOT \; normally \; distributed$$

3.6.1.4 Investigating for the Presence of Volatility Clustering

Volatility clustering can be defined as periods of high volatility being followed by more periods of high volatility and periods of low volatility being followed by more periods of low volatility. According to Engle (2004) volatility clustering will show up as significant autocorrelations in squared or absolute returns. To find evidence of volatility clustering in the NASI, the residuals of the index returns will be squared and plotted, to test the assertion that volatility clustering is actually observed.

CHAPTER FOUR: FINDINGS

The purpose of this study was to test the sufficiency of an equity portfolio in sustaining a private university's endowment fund as compared to a traditional 60/40 portfolio. The market proxy chosen for the equity portfolio is the NASI and monthly returns over an eight-year period were considered. A fifteen-year infrastructure bond formed the bond portfolio. The statistical properties of the stock index returns had to be analysed to ensure that the results generated could be generalized for other equity portfolio proxies and could be expected to hold for any future predictions.

A hypothetical university was considered and its respective cash flows modelled. The endowment fund was established in 2009 and subsequent years' surpluses were added to the fund. In line with Hansmann (1990) whose proposition was that endowments provide precautionary savings for times when other revenue sources are low, the endowment was not used to fund operational expenses but was maintained for purposes of capital expenditure. The endowment was required to fund a minor capital expenditure in 2017 and a major one in 2022. The historical returns on the NASI and the coupon rate on the infrastructure bond were used as a basis for predicting how future returns and indeed how the endowment value would grow.

4.1 Graphical Observation of Volatility in Index Returns

Figure 4.1 and 4.2 below show the graphical distribution of the NASI prices and the index returns, respectively, over the time period considered. From *figure 4.1* it can be seen that high volatility is present when the index value is trending upwards or downwards.

4.2 Descriptive Statistics

Table 4.1 shows the preliminary data analysis for the index returns considered in the study. In checking for normality in the series, skewness, kurtosis and Jarque-Bera statistics are considered. The returns are negatively skewed and have a kurtosis in excess of three indicating a leptokurtic distribution. The Jarque-Bera statistic and its corresponding *p-value* also confirm the rejection of the null hypothesis of normality, i.e. the index returns are not normally distributed.
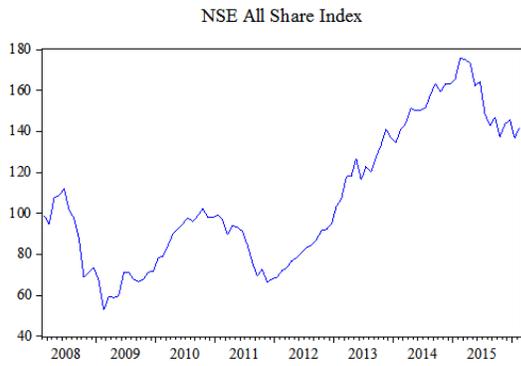
Figure 4. 1: The NSE All Share Index monthly values between February 2008 and February 2016
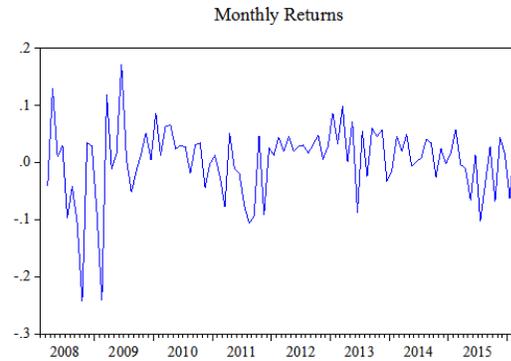
Figure 4. 2: The NSE All Share Index monthly returns between March 2008 and February 2016

Series: MONTHLY_RETURNS	
Observations 96	
Mean	0.003802
Median	0.015216
Maximum	0.171947
Minimum	-0.242707
Std. Dev.	0.063633
Skewness	-1.130578
Kurtosis	6.353032
Jarque-Bera	65.42260
Probability	0.000000
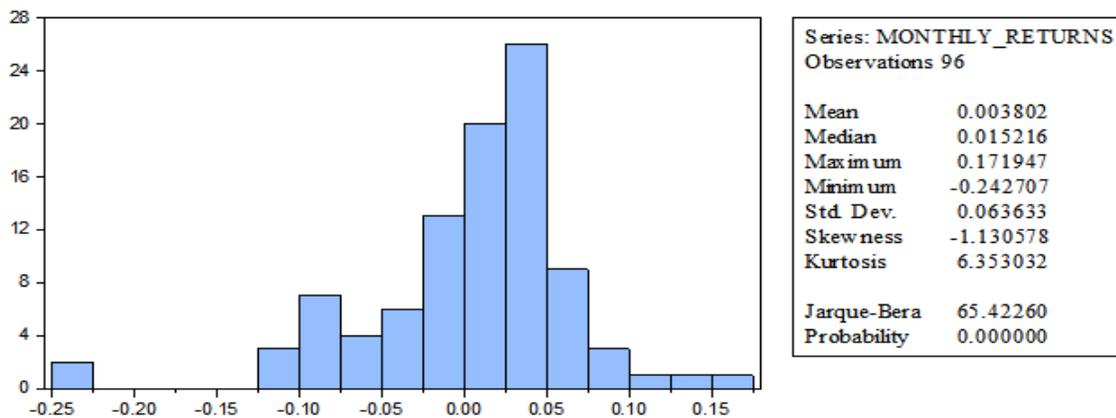
Table 4. 1 Descriptive Statistics for NASI monthly returns

Figure 4. 3: Plot of squared residuals

4.3 Return Correlations

The null hypothesis was that index returns are independent, that is, do not show evidence of autocorrelation. Appendix A shows the results of an autocorrelation test of the index returns up to 36 lags. The Q-statistic and the p-value prove sufficient in failing to reject the null hypothesis of no autocorrelation, i.e., there is no autocorrelation in the index returns.

Appendix B.2 shows the results of the Augmented Dickey Fuller test of non-stationarity. The null hypothesis is that the monthly index returns have a unit root, so that future returns are dependent on previous returns, i.e., that the returns are non-stationary. The test statistic derived lies in the region of rejection, so that we reject the null of non-stationarity, i.e. the monthly index returns are stationary.

The Breusch-Godfrey test for high order serial correlation and is given by:

$$\varepsilon_t = \rho_1 \varepsilon_{t-1} + \rho_2 \varepsilon_{t-2} + \ldots \ldots \rho_p \varepsilon_{t-p} \tag{4.1}$$

The null hypothesis is that $\rho_1 = \rho_2 = \rho_p = 0$. This test also confirms the absence of autocorrelation in the monthly stock index returns.

4.4 Volatility Clustering
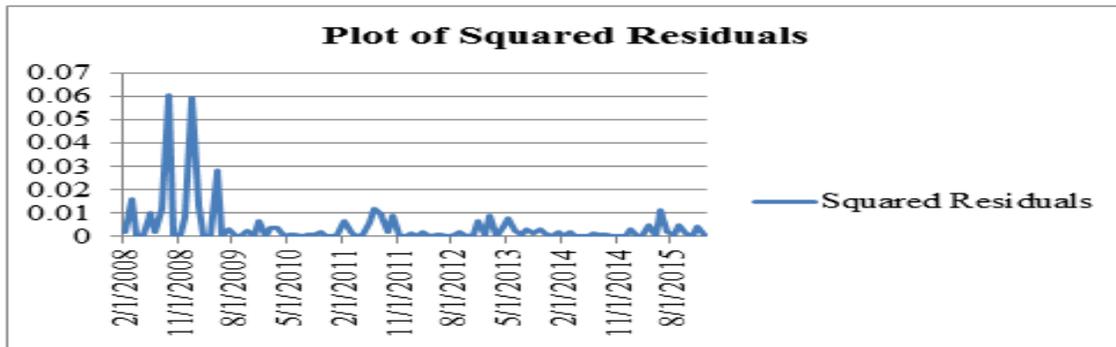
The residuals are obtained as the difference between observed returns and the mean return for the entire period of interest, since above results have shown presence of stationarity in the data.

The plot in *figure 4.3* above shows near constant volatility, except for the two evident spikes between late 2008 and early 2009. This could have been as a result of the global financial crisis that occurred then. However, further analysis outside the scope of this study would be required to confirm the cause of the higher observed volatility.

4.5 Performance of the Endowment

The monthly index returns are used to grow the value of the university endowment for the equity portfolio, which is the reference portfolio and end-of-year values are reported. For the 60/40 portfolio, the coupon rate is taken as the return on the Kenyan government infrastructure bond. The initial endowment value at the beginning of 2009 is KES 400 million. Appendix C.3 shows the end-year values of the equity portfolio endowment between 2009 and 2015, based on the monthly index returns, which are used to grow the endowment on a month-to-month basis.

The geometric average growth rate for the index returns per annum over the period is 13.5 % while the relevant coupon rate is 12 %, without factoring in an annual management fee of 2.5 %. The endowment fund in the equity portfolio is thus assumed to grow at the net of 11 % beyond 2015; while for the 60/40 portfolio equities are assumed to grow at 11 % while the bond value earns a return of 9.5 %. As the return on the stock index is higher than the coupon rate, investing more in equities should yield a higher overall return for the endowment fund.

The major capital expenses as planned by the university would fall in 2017 and 2022.

Without funding from the endowment, the university is able to make a surplus every year and if 90 % of this is added to the endowment value, it grows as shown in Appendix C.2 based on the index monthly returns, which form the reference portfolio for the study.

4.6 Funding the Planned Capital Expenditure

The university's expansion plans are such that a new building will be put up in 2017. In respect of this, the estimated costs are KES 120 million. The equity portfolio endowment fund can sufficiently fund this, given its value of over KES 1 billion at the end of 2015 and a forecasted value of over KES 2 billion in 2016. This figure is based on the 11 % annual growth rate of the endowment when the surplus carried forward from 2015 is included. The 60/40 portfolio can also sufficiently fund the expenditure as its value is at KES 1.1 billion at the end of 2015 and KES 1.7 billion at the end of 2016. However, the funding base for the equity portfolio is stronger in 2016.

In 2022, construction of a new campus will begin, to facilitate the addition of three faculties to the university. This expansion is planned to take place over three years, with different amounts required for each phase. Phase one involves the identification of a suitable location and all the costs involved to prepare the land for construction, as well as drawing up all the construction plans and securing the sources of necessary equipment and supplies. This will cost an estimated KES 750 million. Phase two encompasses the actual construction of the different buildings and amenities. This will cost an approximate KES 3.2 billion. Appendix D.1 shows the forecasted performance of the endowment fund without the mentioned capital expenditures.

The relevant endowment values for the second planned capital expenditure are those in 2021, 2022 and 2023. The values of the equity and 60/40 portfolios in 2021 alone of KES 7 billion and KES 6.8 billion respectively are sufficient to cover the entire expansion and thus either endowment portfolio more than suffices to cover the capital expenditure. However, the equity portfolio is seen to generate more value for the university endowment fund.

Appendix D.2 shows the university's annual surplus, were it not to maintain the endowment fund. If 90 % of the surplus amount were set aside each year and earn no return, its value would be over KES 2.5 billion by the end of 2016. This would be sufficient to cover the expansion in 2017 but not sufficient to cover that in 2022. Appendix D.3 then shows the performance and

value of the endowment if it were only funded by 90 % of each annual surplus and invested in the equity portfolio.

With the initial endowment amount of KES 400 million, the geometric average return on the equity portfolio per annum over the six years between 2009 and 2015 is approximately 21 % while that on the 60/40 portfolio is 19 %. Over the forecasted period from 2016 to 2024, the geometric average returns are 31 % for the equity portfolio and 30 % for the 60/40 portfolio. Despite yielding higher end-of-year amounts before the planned capital expenditures, the returns on the index are highly volatile and the equity portfolio is exposed to more of this volatility. Over the entire period between 2009 and 2024, the equity portfolio has a higher end-of-year figure 81 % of the time, with the 60/40 portfolio having a higher value only in 2009, 2011 and 2015.

The annual surplus amounts grow at an approximate 60 % per annum. Applying the 11 % geometric average annual return calculated from the original reference endowment fund, the forecasted values of the new endowment fund, based on the equity portfolio, are shown in Appendix D.4.

From the results it is clear that the equity portfolio outperforms the 60/40 portfolio when the endowment fund is assumed to have the beginning value of KES 400 million. This is because the average return on the index is higher than the interest on the chosen Kenyan government security. Even without the initial endowment value of KES 400 million, investing 90 % of each annual surplus in the chosen equity portfolio which is based on the NASI still proves sufficient to fully fund both planned capital expenditures. The initial amount of KES 400 million however leaves the university in a better position with a higher endowment value.

4.7 Risk Inherent in the Endowment Portfolio

The measure of risk adopted for this study is semi-variance, as proposed by Markowitz H. M. (1959). Assuming a benchmark return of zero % so that there are no negative returns, the reference equity portfolio of monthly returns on the NASI between March 2008 and February 2016 has a semi-variance of 0.4 %. This shows a relatively small amount of absolute risk associated with the portfolio. Out of the ninety-six observed returns, sixty-one are greater than or equal to the benchmark return, which is 64 % of all returns. The average return is also positive at 0.38 %, signifying very high probabilities of continued portfolio growth into the future. The

semi-variance of the 60/40 portfolio is approximately 0.24. Its average return is also positive but lower at 0.27 %. The risk-adjusted returns are therefore 0.95 and 1.125 per unit of risk for the equity and 60/40 portfolios respectively. The 60/40 portfolio therefore outperforms the equity portfolio on a risk-adjusted basis.

CHAPTER FIVE: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Scope and Limitation of the Study

The scope of this research project has been the equity and bond market in Kenya and testing the assertion that a university or college endowment fund fully invested in equities can sustain the endowed institution and provide more value than would be derived from a traditional 60/40 portfolio. The equity portfolio was taken as the reference portfolio for the study.

The proxy picked for the equity portfolio was the NASI, one of the equity indexes on the NSE, while a fifteen-year Kenyan government infrastructure bond was taken as the bond portfolio. The period of index returns considered is the eight years between 2008 and 2016, as the chosen proxy was created in February 2008. The NASI was picked because it encompasses all the equities traded on the exchange.

Monthly historical returns on the index are used and it is found that the data is non-normal. This could be because of the relatively few observations employed in the study. Stock index returns are however observed to have aggregational gaussianity, Cont (2001), so that with larger time scales, say quarterly or semi-annual returns, the data follows a normal distribution. Daily returns were not used as that data was considered to be too noisy and would take focus away from the key research objective.

5.2 Discussion and Conclusions

5.2.1 Sufficiency of an Equity Portfolio in the Short Run

It is assumed that the university relies on the endowment for purposes of capital expenditure since recurrent expenditure can be financed from the revenues collected from student fees. The first research question was whether equity returns alone would be sufficient to fund a university's spending requirements in the short-run. The short-run is assumed to be a period less than ten years. In the first case, it is assumed that the university begins with an endowment value of KES 400 million in 2009 and this grows based on historical returns, after which the fund grows based on the geometric average rate of return. The first planned capital expenditure takes place in 2017 (less than ten years since establishment of the fund); which is the construction of a

new building in the school premises to cater for the increased number of students and staff, as well as the curving out of additional parking space. It is shown that the fund can fully fund this expenditure without being depleted.

In the second case it is assumed that the university does not begin with an initial endowment amount but relies on a portion (90 %) of its annual surpluses to go into the endowment. As in the first case, the endowment fund grown at the historical rates proves sufficient to meet the capital expenditure. Thus, as asserted by Jennings (1992) an equity portfolio was indeed sufficient to cover the university's spending requirements.

5.2.2 Sufficiency of an Equity Portfolio in the Long Run

The second research question was whether equity returns alone would be sufficient to fund a university's spending requirements in the long-run. The long-run is assumed to be a period greater than ten years. As above it is assumed in the first case that the university begins with an endowment value of KES 400 million in 2009 and this grows based on the historical returns on the index, after which the fund grows based on the estimated geometric average rate of return. The second planned capital expenditure takes place in 2022 (more than ten years since establishment of the fund), where it is shown that the fund can fully fund the expenditure without being depleted. This expansion involves the enrolment of a new campus to cater for the introduction of three new faculties and the basic amenities that support the running of the school. It takes place in two phases, each with its own funding requirement, over three years.

In the second case it is assumed that the university does not begin with an initial endowment amount but relies on a portion (90 %) of its annual surpluses to go into the endowment. As in the first case, the endowment fund grown at the historical rates proves sufficient to meet the capital expenditure. Thus, as asserted by Jennings (1992) an equity portfolio proves sufficient to fund a university's spending requirements.

The NSE All Share Index has also proven to be a sufficient proxy for a diversified equity portfolio in the Kenyan market, given the available data on the index.

5.2.3 Comparison with a 60/40 Portfolio

The second part of each of the research questions was testing whether the returns generated by the equity portfolio were greater than those from a traditional 60/40 portfolio. For both cases where the endowment had a beginning value of KES 400 million, i.e. the short term and the long term, a traditional 60/40 portfolio was also sufficient to fund the planned capital expenditures.

However, the endowment values for the equity portfolio were larger, showing that the one hundred % equity portfolio outperformed the 60/40 portfolio on a return basis. Nonetheless, as equities tend to have more volatility, the 60/40 portfolio outperformed the equity portfolio on a risk-adjusted basis. This is because the former was exposed to lower volatility, with less than one hundred % of its value invested in the stock index.

Despite the equity portfolio achieving higher end-of-year values than the 60/40 portfolio, the difference between their geometric average returns was narrow, at two hundred and one hundred basis points for the historical and forecasted periods. In light of this, a longer horizon, whether historical or forecasted, for the returns of the two portfolios would be required to see the difference in their growth rates over time more distinctly and determine which portfolio is reasonably superior.

5.3 Recommendations and Further Areas of Research

5.3.1 Recommendations

From the research findings and interpretation of results, it is advisable for colleges and universities to maintain a purely equity portfolio, especially where the endowment will be required to fund capital and not recurrent expenditure.

It is also advisable that colleges and universities invest whatever annual surpluses they have into their endowment in order to generate higher returns for the university in the long-run.

The portion of surpluses not invested in the endowment, say the ten % considered in this study, may be used to fund scholarships for exemplary or needy students, whether on a full or partial basis, or to sponsor the lecturers for further studies within or outside the country. These endeavours will serve to increase the goodwill of the university and attract top talent.

However, as a traditional 60/40 portfolio has also proven sufficient in funding the capital expenditures outlined, and as it is exposed to less volatility so has a higher risk-adjusted return, private universities could consider such a portfolio, depending on the interest rates on the available government bonds and hold them to maturity.

5.3.2 Further Areas of Research

The scope of this research was relatively narrow and could be extended to any or all of the following four scenarios:

A longer time horizon could be considered for the case of the long-run performance of an equity endowment portfolio, say twenty years, to test the robust nature of such portfolios and their ability to withstand market fluctuations. The limited scope of the historical returns applied could however diminish the accuracy of longer forecasted periods over which an endowment would be required to fund further capital expenditure.

The case considered in this study is of a private university, which could be extended to include public universities. The case of a public university differs in that they tend to be much larger in Kenya, in terms of the number of students, faculty and courses offered; the fees tend to be much lower than those in private universities since they are partly funded by the government. It would be interesting to study whether a public university could manage its own endowment so that it does not have to rely on government funding for day-to-day operations.

The proxy considered in this study for a fully diversified equity portfolio is the NSE All Share Index. Other proxies within the NSE could be considered, such as the NSE 20 share index, to check whether the conclusion arrived at in this paper can be generalized to the entire equity market in Kenya. The NSE 20 share index would also have the advantage of increased data points as it was created in 1966. Thus, performance of an equity endowment fund could be forecasted for much longer periods, say forty years, with a much higher degree of precision. Also, alternative government bond issues could be considered for the bond portfolio.

The study of whether college or university endowment funds could be fully sustained on equity portfolios could also be extended beyond the Kenyan context, say to the East African context. This would introduce an aspect of comparison among the different securities exchanges and bond markets. It would also challenge the definition of a diversified equity portfolio, to possibly cover select equities or indices across each of the exchanges.

APPENDIX

Appendix A: Correlogram of Stock Index Returns

Date: 10/27/16   Time: 16:21
Sample: 2008M02 2016M02
Included observations: 96

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.075	0.075	0.5583	0.455
		2	0.118	0.113	1.9523	0.377
		3	0.159	0.145	4.5025	0.212
		4	0.118	0.090	5.9155	0.206
		5	-0.054	-0.101	6.2121	0.286
		6	0.100	0.066	7.2568	0.298
		7	0.149	0.134	9.5934	0.213
		8	-0.146	-0.178	11.880	0.157
		9	-0.061	-0.091	12.277	0.198
		10	-0.028	-0.047	12.364	0.261
		11	-0.034	0.019	12.496	0.328
		12	0.022	0.109	12.549	0.403
		13	-0.045	-0.086	12.783	0.465
		14	-0.104	-0.125	14.025	0.448
		15	-0.094	-0.030	15.057	0.447
		16	-0.145	-0.118	17.532	0.352
		17	-0.145	-0.092	20.031	0.273
		18	-0.149	-0.130	22.709	0.202
		19	-0.024	0.022	22.778	0.247
		20	-0.228	-0.117	29.219	0.084
		21	0.000	0.091	29.219	0.109
		22	-0.017	0.032	29.255	0.138
		23	0.047	0.097	29.544	0.163
		24	-0.059	-0.059	30.004	0.185
		25	0.126	0.075	32.100	0.155
		26	-0.121	-0.199	34.063	0.133
		27	-0.051	-0.044	34.424	0.154
		28	0.027	-0.033	34.528	0.184
		29	0.052	0.062	34.914	0.207
		30	0.049	0.086	35.256	0.233
		31	0.086	0.079	36.324	0.234
		32	-0.029	-0.129	36.444	0.270
		33	0.099	0.142	37.903	0.256
		34	0.124	0.014	40.237	0.214
		35	0.110	0.030	42.107	0.190
		36	0.019	-0.149	42.162	0.222

Appendix B.1: Auto-correlation Test Results using Augmented Dickey Fuller

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.952809	0.0000
Test critical values:	1% level	-3.500669	
	5% level	-2.892200	
	10% level	-2.583192	

Appendix B.2: Auto-correlation Test Results using the Breusch-Godfrey Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.874104	Prob. F(2,93)	0.4206
Obs*R-squared	1.771306	Prob. Chi-Square(2)	0.4124

Appendix C.1: End-year Values of the Hypothetical University Endowment Fund

Year	2009	2010	2011	2012	2013	2014	2015
Endowment value (KES)	358,028,615	483,588,468	328,175,788	455,048,398	641,511,167	761,186,531	671,061,107

Appendix C.2: End-year Values of the Hypothetical University Endowment Fund with Added Proportion of Surplus

Year	2009	2010	2011	2012	2013	2014	2015
Endowment value (KES)	358,028,615	511,501,501	406,517,974	596,240,344	859,512,680	1,072,559,287	1,095,428,555

Appendix D.1: Forecasted Performance of the Endowment Fund

Year	2016	2017	2018	2019	2020	2021	2022	2023
Endowment value (KES)	2,012,621,726	3,332,383,245	4,015,127,387	4,837,753,269	5,828,920,090	7,023,158,795	8,462,075,083	10,195,798,900

Appendix D.2: University Annual Surplus Amounts

Year	2009	2010	2011	2012	2013	2014	2015	2016
Surplus amount	31,809,724	89,278,844	160,902,503	248,434,772	354,840,748	483,609,627	638,845,575	836,792,456

Appendix D.3: Endowment Performance if only Funded by Annual Surplus Amounts

Year	2010	2011	2012	2013	2014	2015
Endowment value (KES)	38,929,736	80,947,001	313,037,677	756,520,582	1,276,584,597	1,509,150,093

Appendix D.4: Forecasted Values of the New Endowment Fund

Year	2016	2017	2018	2019	2020	2021	2022	2023
Endowment value (KES)	1,675,156,603	1,859,423,830	2,063,960,451	2,290,996,100	2,543,005,671	2,822,736,295	3,133,237,288	3,477,893,389

BIBLIOGRAPHY

Adams, A. T., Booth, P. M., Bowie, D. C., & Freeth, D. S. (2003). *Investment Mathematics.* West Sussex: John Wiley and Sons.

Black, F. (1976). The Investment Policy Spectrum: Individuals, Endowment Funds and Pension Funds. *Financial Analysts Journal, 32*(1), 23-31.

Brinson, G. P., Hood, R. L., & Beebower, G. L. (1986). Determinants of Portfolio Performance. *Financial Analysts Journal*, 39-44.

Brown, J. R., Dimmock, S. G., Kang, J.-K., & Weisbenner, S. J. (2014, March). How University Endowments Respond to Financial Market Shocks: Evidence and Implications. *American Economic Review, 104*(3), 931-962.

Chhabra, A. B. (2005). Beyond Markowitz: A Comprehensive Wealth Allocation Framework for Individual Investors. *Journal of Wealth Management*, 8-34.

Cont, R. (2001). Empirical Properties of Asset Returns: Stylized facts and statistical issues. *Quantitative Finance*, 223-236.

Ehrenberg, R. G. (2009). Demistifying Endowments. *TIAA-CREF Institute Research Paper*.

Engle, R. F. (2004). Risk and Volatility: Econometric Models and Financial Practice. *American Economic Review*, 405-420.

Hansmann, H. (1990). Why Do Universities Have Endowments? *Journal of Legal Studies, 19*(1), 3-42.

Huxley, S. J. (2006). Asset Dedication vs. Asset Allocation: Dawn of a new paradigm? *61st International Atlantic Economic Conference* (pp. 1-17). Berlin: Atlantic Economic Conference.

Jennings, E. H. (1992). Endowment Policy: A Suggestion for Colleges and Universities. *Change, 24*(3), 32-41.

Lerner, J., Schoar, A., & Wang, J. (2008). Secrets of the Academy: The Drivers of University Endowment Success. *Journal of Economic Perspectives, 22*(3), 207-222.

Lerner, J., Schoar, A., & Wongsunwai, W. (2007). Smart Institutions, Foolish Choices? The Limited Partner Performance Puzzle. *Journal of Finance, 62*(2), 731-764.

Levitz, G. D. (1974). Market Risk and the Management of Institutional Equity Portfolios. *Financial Analysts Journal*, 53-60+91.

Ljung, G. M., & Box, G. P. (1978). On a Measure of Lack for Fit in Time Series Models. *Biometrika*, 297-303.

Markowitz, H. (1952, March). Portfolio Selection. *Journal of Finance, 7*, 77-91.

Markowitz, H. M. (1959). *Portfolio Selection, Efficient Diversification of Investments.* New York: John Wiley and Sons, Inc.

Niko, C., Mankiw, G. N., & Weil, D. N. (1997). Canner, N., Mankiw, N. G., & Weil, D. N. An Asset Allocation Puzzle. *The American Economic Review*, 181-191.

Sharpe, W. F. (2010). Adaptive Asset Allocation Policies. *Financial Analysts Journal*, 45-59.

Sharpe, W. F., Chen, P., Pinto, J. E., & McLeavey, W. D. (2007). Asset Allocation . In C. Insitute, *Managing Investment Portfolios* (pp. 230-257). New Jersey: John Wiley and Sons, Inc.

Tschampion, C. R., Siegel, L. B., Takahashi, D. J., & Maginn, J. L. (2007). Managing Institutional Investor Portfolios. In J. L. Maginn, D. L. Tuttle, J. E. Pinto, & D. W. McLeavey, *Managing Investment Portfolios: A Dynamic Process* (pp. 63-127). New Jersey: John Wiley & Sons, Inc.

Ziskind, R., & Boldin, R. (1973). A Computer Simulation Model for Investment Portfolio Management. *Financial Management, 2*(3), 23-33.