High-Equity Multi-Asset Investing versus Pure Equity Investing: A Study of Risk-Adjusted Performance

by

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Submitted in fulfilment of the requirements for the degree

Magister Commercii – Investment Management

in the

Department of Finance and Investment Management

of the

College of Business and Economics
Johannesburg Business School

at the

University of Johannesburg

supervised by

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June 2019

Acknowledgements

I would like to thank every individual who guided me through this path of completing my Master studies. I would like to thank my supervisor, Dr le Roux, for her guidance and patience while I climbed this steep learning curve. I would also like to thank Mr Snyman for the debates, encouragement and motivation around the initial idea and assistance for this study while completing my Honours. A thank you also goes to my language editor, Ms Greatorex, for assisting me.

I would like to thank my family and friends for their understanding and patience while I prioritised my study requirements and a special thank you to my family for their unwavering belief and faith in me.

There are many other people who have supported me throughout this journey that I cannot name individually, but I would like to extend my thanks to each and every one. My views and abilities are the outcomes of my collective interactions with each and every one of you.

Abstract

Investors are faced with a daunting number of decisions and options that can be made and taken on their path to their wealth accumulation over the course of their investing lives. As a result, investors often find the wealth accumulation process to be an overwhelming task. Investors, and their advisors, also do not have the time and means to adequately assess the trade-offs associated with asset allocations decisions and therefore having to trust processes on a tacit basis. Research shows that Equity, as an asset class in isolation, has provided the largest cumulative return for the South African context for the last century. However, empirical research assessing this against the outcomes of multi-asset portfolios is rare for the South African context, with studies also not being specifically considered for a time horizon more appropriate to a period when Property has explicitly been separated in the South African context.

The purpose of the study was twofold: firstly, to test whether investors are rewarded by moving from multi-asset high Equity investing into a pure Equity portfolio. Secondly, to contrast how the risk-adjusted reward presented to an investor changes across the risk-spectrum of the efficient frontier as an investor moves from less volatile asset classes to volatile asset classes.

The general stylised graphical depiction efficient frontiers, and understanding by retail investors, is that Equity provides investors with the highest rate of return and the largest ending wealth level over time. This stylisation implies that marginal returns for the risk taken by investing into Equity only are still offered at the far end of the efficient frontier where the assets with the largest volatilities reside.

The perception that Equities may offer the largest cumulative return over time, relative to other single asset classes, is often confused with Equity investing providing the highest ending wealth levels for retail investors. Investors also have no direct means of considering volatility and risk in the allocations to Equity. This could potentially result in Equities receiving a large percentage, or full, allocation within an investors' portfolio. Retail investors are not generally equipped with the tools to consider the incremental return versus the incremental risk of decisions, nor are they equipped with the tools to consider the effects such as volatility drag on assets in their portfolio.

In this research, the risk-adjusted return metrics were determined for the FTSE/JSE ALSI, SA Listed Property and BEASSA ALBI Indexes. The performance return series data for each respective index was then used to construct risk-adjusted return metrics for multi-asset portfolios.

Three sets of multi-asset investments were created, using the asset class proxy’s historical returns, to represent the general risk profiling outcomes offered to investors, which entailed low-Equity, medium-Equity, and high-Equity investment portfolios. The results were then assessed to gauge whether investors received marginal benefits by increasing their allocation to Equities. The FTSE/JSE ALSI Index was used as the comparison for a pure Equity portfolio.

It was found that the risk-adjusted returns of the multi-asset portfolios generated larger risk-adjusted returns than an Equity-only portfolio provided. It was further found that the ending wealth levels for multi-asset portfolios were larger in the majority of instances for an investor over the sample period of the study. The marginal returns relative to risk taken rapidly diminished over the study period for allocations to Equity larger than 50% of total assets.

The conclusion was that an investor did not need to accept the additional risk required by investing in an Equity-only portfolio in order to achieve a greater ending wealth level over the sample period studied. An investor can potentially achieve a greater ending wealth level by accepting a smoother return profile as reported by lower return standard deviation, while not forgoing returns contributing towards ending wealth levels over a cumulative 15-year period within the South African investment context.

Keywords: Multi-asset, Equity, risk-adjusted returns, efficient frontier, expected returns, FTSE/JSE ALSI, SA Listed Property, BEASSA ALBI, STEFI Composite

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List of Abbreviations and Acronyms

APT	Arbitrage Pricing Theory
CAPE	Cyclically Adjusted Price-to-Earnings
CAPM	Capital Asset Pricing Model
CML	Capital Market Line
GFC	Global Financial Crisis
MPT	Modern Portfolio Theory
REIT	Real Estate Investment Trust
The Act	Pension Funds Act (24 of 1956)
VBA	Visual Basic for Applications

Chapter One

Introduction and Background to the Study

1.1. Introduction and Background

> *"Here's the key to understanding risk: it's largely a matter of opinion." (Goodreads.com: Howard Marks, The Most Important Thing: Uncommon Sense for the Thoughtful Investor)*

Since 2012, South Africa has been in a low growth environment, in which annual GDP growth rate has been below the average experienced since 1994 to 2018 (Trading Economics, 2018). It can be argued that in a low growth environment, naïve retail investors may be lured into placing too great a weighting into Equity in order to extract extra investment portfolio growth, without being aware of the portfolio risk and return characteristics associated with this asset class.

This additional allocation to Equity may lead to unintended consequences where a portfolio exhibits greater short-term draw-downs or volatility (Lazard, 2016). The unintended consequences may be a cause for concern given the tendency for myopic evaluation of portfolios against the investor's long-term plan. Knee-jerk behavioural responses by investors may lead to mathematically optimal portfolios, especially for long-term time horizons, achieving lower than expected results due to client intervention given short-term return volatilities.

Investors also may not consider the marginal benefit versus marginal cost of allocation more or less weight to asset classes, specifically in terms of the risk of investment decisions (Hurst, Johnson & Ooi, 2010). The lack of ease of such comparisons may lead to investors over-weight growth asset classes in their portfolios in pursuit of greater returns, which is based on the potentially incorrect perceptions of the performance of Equity as an investable asset class.

In order to address the aforementioned problem of potentially over-weighting Equity to seek additional investment returns, the risk-adjusted measures for asset classes and multi-asset portfolios will be constructed and the results compared. The results will assess whether investors should consider accepting the marginal risk associated with an increase in Equity weights in their portfolio (Markowitz, 1952; Campbell & Viceira, 2001; Gibson, 2007). The study's findings will aim to assist investors in making more informed decisions regarding the trade-offs in outcomes of investment returns given the associated portfolio weights given to asset classes.

1.2. Problem Statement

Since the Global Financial Crisis (GFC) of 2007 and 2008, investors have subsequently been rewarded for holding Equity, given that the asset class has provided returns off of depressed levels to where valuations stand today. This is evidenced by the US S&P500 Cyclically Adjusted Price-to-Earnings (CAPE) Ratio being 30.5 as at December 2017 (BB Star Capital, 2018), which is the third highest in the history of the index data, which dates back to 1881.

Further to the above, the US economy is now in its 9th year of expansion, only having ever exceeded the current number of years of expansion twice – in the 1960s and 1990s (Royal London Asset Management, 2018). Investors may now be anchoring on the performance of the last 10 years as the reality of what could be expected going forward, which is especially the case for retail investors whom may accept past experiences as a guide to future outcomes.

Retail investors do not have the ability to easily compare the trade-offs between various asset allocations levels within a portfolio, and the return profile of the investment, particularly when forward looking expectations need to be considered and not past historical performance of the asset classes. Even if investors had access to financial advisors who could fully grasp the mechanics of risk-reward trade-offs, the financial advisors themselves would potentially not be able to have the time, insight or ability to delve deeply into the various optimisation techniques and the prudent uses thereof. Furthermore, the tools associated with obtaining this insight could potentially cost a large amount of money or require a staff complement that have specialised skill sets and experience in this type of analysis for investments.

The volume of literature available for this risk-return assessment, specific to the South African investors context, is limited. Most research tends to focus narrowly on the long-term characteristics of individual asset classes in isolation, and the associated historical behaviour (Firer & McLeod, 1999; Pask, 2008; Hassan & Van Biljoen, 2010; Gordon & Fermoyle, 2017).

This study aims to assess whether there is any marginal benefit for investors in moving beyond multi-asset high Equity portfolios into an Equity-only portfolio for a South African investor. This study will assess the outcomes on both a risk-adjusted basis and a return-only basis, as reflected by ending wealth levels simulated for investors.

An understanding of this trade-off will allow investors to better assess their inclination to target additional margin returns while acknowledging the potential increased volatility, or to smooth over the return profile by accepting a lower targeted return, but not needing to interfere with portfolio allocations to asset classes given emotional responses over the investment path. Therefore, this will potentially lead to a better investment outcome for the investor.

1.3. Research Questions and Objectives

The research questions and objectives of the study will be directed towards assessing whether the risk-adjusted returns of Equity investing are sufficient to attract asset allocations beyond the point of multi-asset high-Equity investments.

With the aim of the study being framed, the below listed research questions will be addressed in Chapters 4 and 5 to provide insight into the research goal. The main objective of this study is to:

- To assess the risk-adjusted return of pure Equity investing against multi-asset investing.

The sub-objectives of the study, which will assist in answering the above main objective are:

- To determine the effect on risk-adjusted returns by introducing additional asset classes and using an Equity portfolio as a departure point.

- To determine the effect on a client's ending wealth levels by introducing multiple asset classes and using an Equity portfolio as a departure point.
- To determine the shape of the efficient frontier in the South African investment context, in addition to assessing how the efficient frontier has changed over time.

1.4. Purpose of the Study

The purpose of the study is to investigate the marginal risk-adjusted return benefits of moving beyond multi-asset high Equity investing into pure Equity investing. This investigation will aim to highlight whether any marginal benefit exists for investors to support such a decision.

Individual investors have been plagued with the decision regarding allocation of capital since the dawn of investing itself. However, this has become more pronounced with the advent of technology for finance and the associated ease of access to various investment options and portfolio construction choices.

The findings of the study can assist in a pragmatic way, in that financial advisors and retail investors could potentially avoid the pitfalls associated with naïve portfolio planning, thereby potentially increasing their financial wealth and well-being. The importance of this research is further compounded with the shift from defined benefit to defined contribution retirement plans, and the shift of the asset allocation decision from investment professionals and actuaries to financial advisors and retail individuals.

1.5. Research Methodology

This study will assess whether any marginal benefit exists for investors, in terms of the portfolio's asset allocation, to move beyond a multi-asset high-Equity portfolio, into a fully Equity portfolio. The data utilised in the study is limited to the South African context for two reasons: firstly, to remove the complexity attached to currencies in asset allocation decisions in order to simplify the general findings for retail investors. Secondly, to enhance the depth of studies applicable to the South

African investment market, given the relatively low body of academic knowledge, relative to developed market studies.

The research considers secondary index data, which is applicable to the main asset classes being considered. The research methods applied to this study are methods appropriate for studies being quantitatively and empirically inclined. The research methodology of the study is outlined in detail in Chapter 3 of this study. However, as a summary, the various financial methods focus on the calculation of return and risk characteristics, descriptive statistics, risk-adjusted return levels, rolling assessments of the data and portfolio optimisations for asset class weights.

Microsoft Excel and Visual Basic for Applications (VBA) is used to analyse the data to obtain results from various financial assessments of the various data sets.

The objective of the study is to compare the compiled risk-adjusted and cumulative return metrics for the various portfolios and conclude whether investors should accept the risk and return dynamics associated with certain Equity weights in their portfolio.

1.6. Collecting and Analysing the Information

The data collected for the study is secondary in nature, and is obtained from Morningstar South Africa from the 01st of June 2002 to the 31st of December 2017. This date range is chosen to accommodate the inception of the SA Listed Property sector as a formalised index with data provided by Morningstar. Data extends back marginally further for the chosen Equity and Bond indices, with the FTSE/JSE SWIX extending back to January 2002, and the BEASSA ALBI extending back to July 2000.

The discrete weekly performance of the indices on a total return basis will be used. These data points will be used to create multi-asset portfolio. These multi-asset portfolios will be based to 100 at the inception of each of the data sets. The multi-asset portfolios will be rebalanced each quarter back to the original target weights for the various levels in order to avoid portfolio drift.

1.7. Limitations of the Study

The research process uncovered the following limitations for the results of the study:

- This study is limited to asset allocation decisions for domestic asset classes to remove complexity with foreign currency conversions and associated interpretations.
- The study does not directly assess the theoretical underpinning for including additional asset classes and securities in a portfolio. Diversification benefits are assessed, but not specifically from a theoretical basis before the fact.
- The weighting scheme for the portfolio allocations to non-Equity asset classes is on an equal-weight basis. This simplifies the study to avoid subjective factors or views regarding short-term tactical allocations to asset classes based on personal opinions or views.
- Allocations to factor exposures, as compared to asset allocation, are not considered for the purposes of this study.
- The study does not include contributions from the investor on a recurring basis. The reason for this is due to the varying effects that different values between investors can have on the Internal Rate of Return of an investment. Rolling periods are adopted to remove the sensitivity of particular starting points for the investments to offset the loss of information from including contributions in the study.
- Trading costs, taxation, and investment in additional asset classes and securities are ignored for the purposes of this research paper.
- The study is limited to the selected data, the time period and the methods utilised to obtain the results for interpretation and conclusion.

The analysis of the data is based on accepted investment management metrics in addition to peer-reviewed research in the investment management field. Additional methods of analysis could potentially be applied to the same data set leading to potentially different relative results and, therefore, different conclusions.

1.8. Chapter Outline

In this chapter, the purpose of the study is put forward and framed. In Chapter 2, the literature review will be conducted, with a detailed overview of the research methodology being provided in Chapter 3. Chapter 4 will highlight the results and findings from the research in Chapter 3, with the author's conclusions being put forward in the final chapter of the research.

Table 1.1: Summary of Chapters and Content

CHAPTER	CONTENT
Chapter 1:	Introduction and Background In the first chapter, the study is introduced. The background to the study which resulted in the research problem is explained. The limitations of the study are also introduced.
Chapter 2:	Literature Review In the second chapter, a critical review of the current literature on the research problem is presented.
Chapter 3:	Research Methodology The research design and methodology used in the study is explained in the third chapter. The chapter commences with a discussion of the issues of research design, and then proceeds with a discussion on the methods that are used for collecting and measuring the data. Techniques to ensure the validity and reliability of the data are also considered.
Chapter 4:	Results and findings The results of the study are presented in the fourth chapter. The data is presented and interpreted in various statistical formats, that is, figures, graphs and tables.
Chapter 5:	Conclusion Conclusions are drawn on the basis of the results of the study.

Source: Own deductions

Chapter Two

Literature Review

2.1. Introduction

The financial planning community may use rules of thumb or heuristics to advise clients on decisions regarding their asset allocation. A common heuristic is to advise clients to allocate to equities on the basis of 100% minus the investor's age (CNN Money, n.d.; Faulkenberry, n.d.; Mitchell & Utkus, 2003). Other rules of thumb come in the form of “10, 5, 3” rule, which states that the returns from Equity, Bonds and Cash are 10%, 5%, and 3% per annum respectively (Beniwal, 2011; Marquit, 2012); and the “Tim Hale” suggestion of holding 4% in Equity for each year you invest (The Accumulator, 2012). Studies, which assess the efficacy of these asset allocation rules, are limited in the South African context.

Goodall, Rossini, Botha, Geach and Du Preez (2015) state that a financial planner needs to consider portfolio construction as important, and the authors lean towards advocating a Markowitz mean-variance efficient portfolio, but no mention is made of an appropriate and optimal Equity asset allocation level.

Goodall et al. (2015) mainly point out three types of asset allocation strategies, which are strategic asset allocation, tactical asset allocation, and dynamic asset allocation. But, the authors fail to outright state their preference for their preferred method of asset allocation, how to account for differences in investment horizon, and what the marginal benefit or cost of various asset allocations are as the weight to the asset classes are varied.

With the framework for asset allocation decisions being open ended and subjective, and with a constantly changing investment landscape, the trade-offs between different outcomes associated with varied asset class weights can become blurred and hard to assess.

Consideration of the appropriate weight for Equity in an investor’s portfolio is essential. The long-run implications of less than optimal decisions on the retail investor’s ending wealth level may be drastic. Practices need to be adopted that support greater wealth accumulation, especially in a country such as South Africa, where it is estimated that only 6% of retiring individuals can retire with their desired income levels (Strydom, 2007; Prinsloo, 2008; Darley, 2011).

This chapter will set the context for this research and the studies that have already been compiled for topics relating to, and relevant to, this research being conducted. Given the broad nature of studies within finance, the studies themselves will be varied across geographies, time periods, asset classes, the level of detail considered, and the mathematical complexity through which the problem is analysed.

2.2. Modern Portfolio Theory and the Efficient Frontier

Modern Portfolio Theory (MPT) puts forward that investors should be cognisant of both return and risk when making investment and capital allocation decisions (Markowitz, 1952). Subsequent to this, the efficient frontier became a prominent graphical display tool for investment thinking by showing the risk and return trade-offs visually on a graph.

Campbell and Viceira (2001) illustrate Figure 2.1 in such a manner that indicates there will be marginal benefit by moving fully into Equity. This graphical depiction has been recreated a large number of times in freely available information and articles on the internet, generally depicting the stylised example of higher risk providing greater levels of return. A naïve investor may consider this to be true without applying their own intellectual assessment, or having the know-how, to assess whether this may be correct in reality under a given investment landscape.

As a stylised depiction, Figure 2.1 highlights that the portfolios on the efficient frontier are such that for a given level of risk, an investor could not obtain a higher return, or for a given level of return, an investor cannot obtain a lower level of risk. Any portfolio inside the efficient frontier is sub-optimal and can be improved, while any portfolio beyond the efficient frontier is not obtainable.

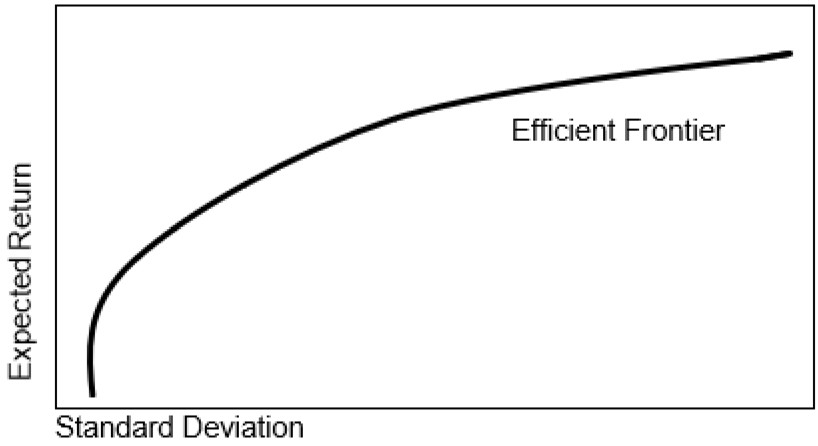

Figure 2.1: Illustration of the Efficient Frontier

Source: Adapted from Reilly and Brown (2003:228-230)

However, not all efficient frontiers are illustrated in such a stylised manner. Although Figure 2.1 may depict an ideal stylised situation, it may not be representative of the risk and return trade-offs always faced by investors. Figure 2.2 highlights an additional scenario whereby the marginal returns to an investor are limited through the efficient frontier levelling off beyond a certain point and exhibiting much lower marginal benefits in moving along the frontier fully into the riskiest asset.

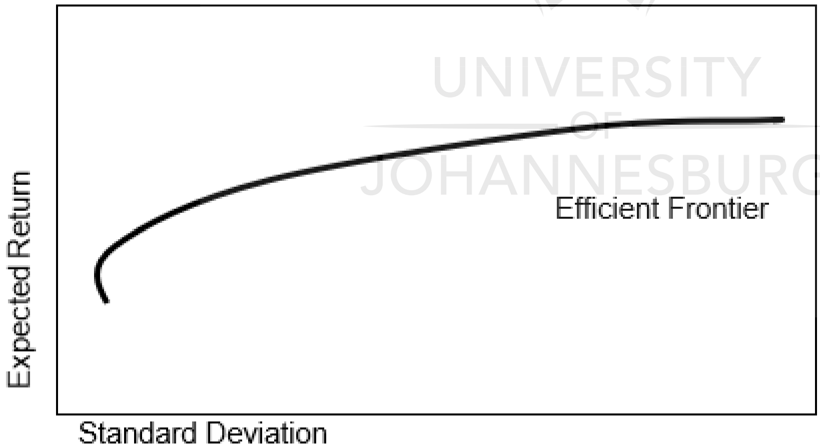

Figure 2.2: Illustration of the Efficient Frontier

Source: Adapted from Reilly and Brown (2003:228-230)

Firer and McLeod (1999) show that Equities, as an aggregate asset class, have historically provided the highest cumulative returns over their sample period from 1925 to 1998. The largest cumulative returns for Equity translated into higher ending wealth levels over time, as a result of outperforming other asset classes in isolation.

However, what is not tested in their study is the shape of the multi-asset efficient frontier and the relative position of Equity within this.

Further to the Firer and McLeod (1999) study, in a broader geographical context, there is academic research conducted regarding the risk-adjusted performance of multi-asset portfolios (Blake, Lehmann & Timmermann, 1999). The most prominent discussion in this regard are the two papers by Brinson, Hood, and Beebower (1986) and Brinson, Singer, and Beebower (1991), which in themselves do not speak directly to performance and comparison of multi-asset portfolios versus single asset classes. These studies can be taken further by considering the comparison of multi-asset portfolios against single asset class, such as Equity in isolation, and considering the associated return and risk trade-offs to investors.

The stylised fact that Equity provides the highest return over time, illustrated by the results provided by Firer and McLeod (1999) from 1925 to 1998, is not disputed given that there has been a limited number of studies conducted in the area of risk-adjusted returns for multi-asset portfolios, specifically in the South African context. This result could lead investors to potentially allocate more Equity to their portfolios with the hopes of harvesting this additional return for their personal investment and wealth levels. In this process of allocation greater portfolio percentages to Equity, retail investors may naïvely follow this principle and place too large a portion of their wealth into Equities without assessing whether a pure Equity portfolio offers marginal risk-adjusted return benefits or higher ending wealth levels when compared to alternative solutions, such as a multi-asset portfolio. Retail investors may also lack the behavioural discipline to correctly trade the portfolio during periods of volatility, thereby potentially locking in a capital loss.

In the South African context, Regulation 28 of the Pension Funds Act (24 of 1956) places constraints on the potential portfolio allocations to certain asset classes (South Africa, 1956). Given the constraints imposed by legal limitations towards certain asset class weights, an investor may ultimately not be able to obtain their desired asset allocation.

2.3. Pension Funds Act: Regulation 28 and Prudential Investment Guidelines

In the South African context, the Pension Funds Act (24 of 1956) imposes limits on the asset allocation decisions that can be made on retirement funds, with the intention being the protection of assets. Specifically, Regulation 28 of the Pension Funds Act (The Act) prescribes maximum percentages for various asset classes that may be invested into in the retirement fund on behalf of the investor. The Minister of Finance has control over these limits under section 36(1)(b) of the act (South Africa, 1956).

Under Regulation 28 of the Pension Funds Act (24 of 1956), assets that must comply with legislation are:

- Insurance policies that provide any form of guarantee, or
- Where performance is linked to the performance of the underlying assets and the investment of the underlying asset conforms to the requirements of Regulation 28, and
- Unit trusts which conform to the requirements of Regulation 28.

The maximum limits referred to in The Act are:

- No more than 75% may be invested in equities.
- No more than 25% may be invested in property.
- No more than 90% may be invested in a combination of equities and property.
- No more than 5% may be invested in the sponsoring employer.
- No more than 15% may be invested in a large capitalisation listed Equity, and 10% in any other single Equity.
- No more than 20% may be invested with any single bank.
- No more than 15% may be invested off-shore.
- No more than 2.5% may be invested in “other assets”. Derivative instruments are not defined, leaving them to fall into the “other assets” category.

On the 23rd of February 2011, Pravin Gordhan, the then Minister of Finance, announced changes to the above framework, with the largest amendment being the increasing of allowable offshore investment from 15% to 25% (Momentum, 2011). This change has implications for constraints surrounding asset allocation decisions for South African investors.

This section put forward the constraints imposed on retirement funds. Equity, in particular, has a limitation of a maximum investment amount of 75% in Equities. It is important that investors have clear and concise definitions of the various asset classes under consideration for the purpose of adherence to Regulation 28 guidelines, in addition to managing various risks in a portfolio.

2.4. Asset Class Definitions

The Association for Savings and Investment South Africa has a sub-tier classification system for investments in South Africa, which are comprised of Equity portfolios, Interest Bearing portfolios (hereinafter referred to as Bonds), Real Estate portfolios, and multi-asset portfolios (Association for Savings & Investment SA, 2017). These asset classes encompass the broad spectrum of asset classes that the majority of retail investors have access to but, exclude alternative investments and non-traditional investment asset classes.

2.4.1. Equity

Equity, alternatively referred to as shares or stock, are investment securities that allow the holder of the Equity to claim against the net assets of the business through ownership rights in the entity. The right to claim a proportion of the income or assets is not guaranteed under general Equity and, therefore, Equity is sometimes said to have a residual right or claim to assets or income (Marx, Mpofu, De Beer, Mynhardt & Nortje, 2013).

Equity has many classifications, such as ordinary Equity or preferred Equity. Preferred Equity is defined as Equity that ranks above ordinary Equity holders, and typically receives an agreed to rate of return against their Equity value (Fundrise, 2018). Ordinary Equity is the residual right attached to the interests of a company, where the claims against income and assets are subordinated to the rights of other capital providers to an entity (The South African Institute of Chartered Accountants, 2013).

The context of Equity for the purposes of this study will be limited to the Ordinary Equity referenced by the FTSE/JSE All Share SWIX Index (ALSI) on the Johannesburg Stock Exchange (JSE). The ALSI is an index weighted by market capitalisation of the constituents within the entire market, with the market being adjusted for free float considerations (Johannesburg Stock Exchange, 2017a).

2.4.2. Bonds

Bonds are fixed interest investment instruments where the issuer (borrower) of the instrument agrees to pay the investor (lender) a certain rate of interest periodically until the maturity of the investment when the capital will also be returned. Bond instruments are issued by both the Government and Corporate entities (Marx et al., 2013).

The Bond constituents in South Africa will be represented by the Composite All Bond Index (ALBI) and is an index on the Johannesburg Stock Exchange. The ALBI index considers only conventional listed Vanilla Bonds, in which Bonds with maturities of less than one year are not included. The number of constituents is limited to 20 instruments, with a dual ranking system applied based on both market capitalisation and liquidity. The ALBI will serve as the proxy for Bond investments in South Africa, in spite of having a bias towards government issued Bonds at certain points.

2.4.3. Property

Property refers to both listed and unlisted, or direct, investments into direct property, or exposure to the underlying physical property asset (OnePath, 2013). Investing into direct property is synonymous with purchasing a direct physical property asset. This study will consider investments in a listed property index as listed investments have easily accessible data with liquidity, rather than illiquid counters, which have stale pricing. There is a concern that listed property will behave like Equity rather than behaving as direct property investments would, especially given that a Real Estate Investment Trust (REIT) is a relatively newer investment vehicle. A REIT would cause a different risk and return behaviour profile given that income in this vehicle needs to be passed onto investors by applying certain minimum percentages.

The listed property will be represented by the FTSE/JSE SA Listed Property index (J253), referred to as SAPY hereafter, and is an index on the Johannesburg Stock Exchange (JSE). The SAPY is an index weighted by free float market capitalisation of the constituents within the entire market. The free float screening has a hurdle rate of 15%, has a fixed number of 20 companies, and has a liquidity screening. This index serves as the best proxy for the performance of property as an asset class (Johannesburg Stock Exchange, 2017b).

2.4.4. Cash

Cash is considered to be all short-term fixed income instruments, which is generally represented by instruments with maturities of less than one year (OnePath, 2013). Cash, if needed for the analysis, will be represented by the Alexander Forbes Short Term Fixed Interest Composite Index, (STeFI). The STeFI composite is calculated and published daily via the South African Futures Exchange (SAFEX) and is comprised of weightings to the interbank call rate (represented by the SARB SABOR) and NCD instruments with maturities of 3, 6, and 12 months.

2.5. Asset Class Behaviour and Characteristics

An important component in the study of the performance of an asset class is to have as many data points as possible to ensure that the data is representative of the behaviour of the asset class over a full investment cycle. Since the inception of the SAPY index on the 22nd of March 2002, an in-depth and rich collection of data is available for relatively short periods of time. However, for periods prior to technological advancements and the formal recording of index data, trustworthy and accurate data is harder to obtain and key studies are relied upon.

The history of asset classes and their associated return and risk profiles in South African, are put forward in a study conducted by Firer and McLeod (1999), where the historical performance of asset classes is studied over the period 1925 to 1998. This is a perfect complement to the currently available data given the limited history of the South African index data.

In the Firer and McLeod (1999) study, the South African domestic Equity asset class returns are a combination of the BER study (from 1925 to 1946), and the Rand Daily

Mail Index (from 1949 to 1960). Thereafter, the ALSI Price Return Index is utilised, which remains in existence today.

The South African domestic Bond returns are based on the JSE-Actuaries Bond Performance indices. The components of the aforementioned index are available on a monthly basis from January 1986. Prior to this, the index is built-up using a combination of the BER study data and the JSE-Actuaries Long Bond Yield.

The market for money market, or cash returns, is based on information collected for a negotiable certificate of deposit (NCD's). NCD's were first issued in 1964. However, reliable information to calculate performance was only collected from late 1966 onwards. Information prior to this would be based on data for three-month fixed deposits for Standard Bank.

Table 2.1 was created utilising the findings from the Firer and McLeod (1999) study.

Table 2.1: SA Asset Class Nominal Return Summary for the Period 1925 to 1998

Asset Class	Annualised Geometric Returns	Annualised Standard Deviations
Equity	13.65%	22.94%
Bonds	6.69%	10.04%
Cash	6.21%	6.47%

Source: Author's own adapted from Firer and McLeod (1999:16)

The information contained in Firer and McLeod's (1999) paper, however, does not contain information regarding formally listed property within South Africa, as the SAPY Index inception date of the 22nd of March 2002 occurred after the study was concluded. It is, however, essential to isolate this out from domestic Equity, as the domestic Property has its own risk and return characteristics and, therefore, should be considered as its own asset class.

The importance of relative annual returns compounded over a period is highlighted in Table 2.2 by comparing the ending wealth levels of investors all starting with the same initial contributions.

Table 2.2: Comparison of Historical Cumulative Asset Class Returns and Ending Wealth Levels, 1925-1998

Asset Class	Initial Investment	Ending Wealth Level
Equity	R1	R12 951
Bonds	R1	R121
Cash	R1	R86

Source: Author's own adapted from Firer and McLeod (1999:1-23)

Table 2.2 illustrates the ending wealth level for Equity would have far exceeded that of Bonds and Cash over the period from 1925 to 1998. The data is obtained from Colin Firer's database of return history and was presented in Firer and McLeod's (1999) paper, which appeared in the Investment Analysts Journal.

Figure 2.3 below graphically depicts the above numerical values from Table 2.2 in terms of the ending wealth values for R1 invested in each asset class in 1925 until 1998 on a cumulative basis. The data shows that regardless of short term volatility, Equity still provided investors with ending higher wealth levels over this historical period. The study, however, does not consider how sensitive the ending wealth levels are to the starting point of the period.

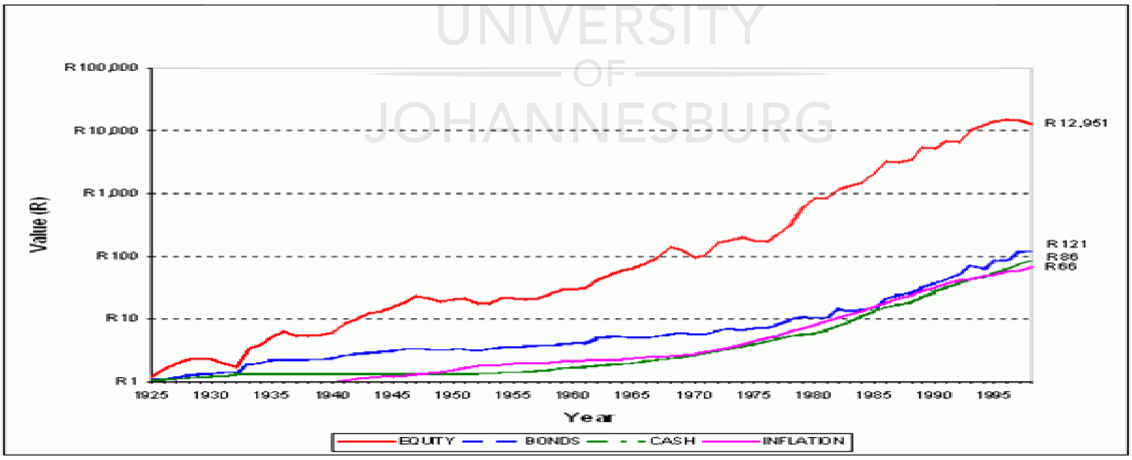

Figure 2.3: Cumulative Historical Performance of Asset Classes, 1925-1998

Source: Firer and McLeod (1999:1-23)

The Firer and McLeod (1999) study, however, as already mentioned, does not show the performance of property as an asset class. More importantly, the study does not investigate the relative return profiles and cumulative return levels for multi-asset portfolios over the research periods. This does not allow an investor to compare the risk and return trade-offs that are available to them.

Figure 2.4 provides the distributions of the nominal 1-year returns for the various asset classes considered in the Firer and McLeod (1999) study. It is evident that the 1-year distributions for Equity are far more dispersed when compared on a relative basis to the other asset classes over the sample period indicating the higher volatility associated with Equity returns for the study.

Table 2.3 is adapted from the Firer and McLeod (1999) study and highlights summary statistics over various rolling periods in the sample set of data. Across all rolling periods in the data set, it is observed that Equity has the highest Arithmetic and Geometric mean returns; the higher Equity returns are accompanied by higher variance over all periods, as reflected by the larger standard deviations.

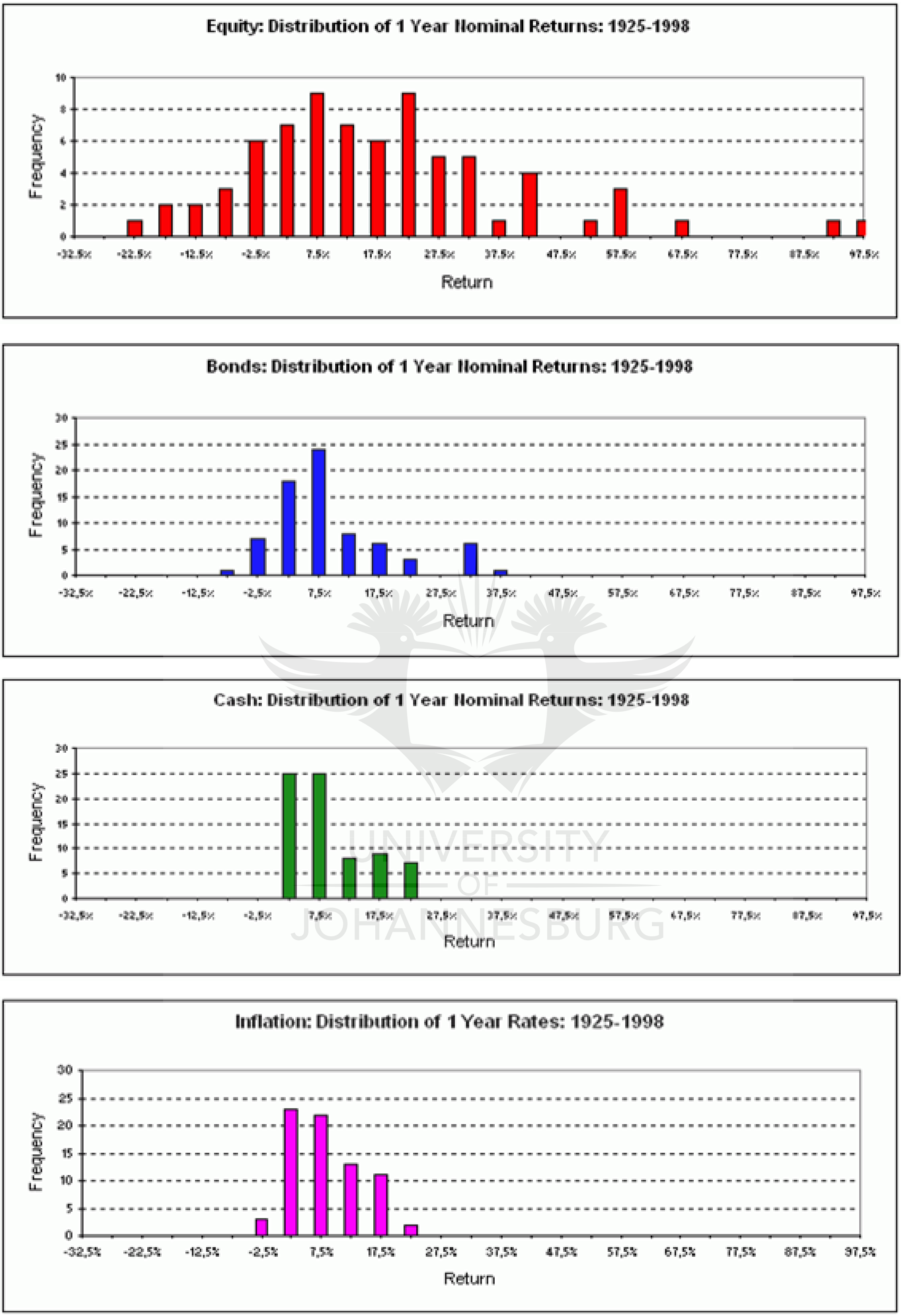

Figure 2.4: Asset Class Return Distributions, 1925-1998

Source: Firer and McLeod (1999:1-23)

Table 2.3: Summary Statistics for Real Returns, 1925-1998

	Observation Rolling Periods	Minimum Value	Maximum Value	Range	Arithmetic Mean	Geometric Mean	Standard Deviation
Annual	74						
Equity		-26.39	93.74	120.13	15.70	13.62	22.94
Bond		-9.05	35.89	44.94	7.13	6.69	10.04
Cash		0.00	21.76	21.76	6.39	6.21	6.47
Three Years	72						
Equity		-10.32	54.92	65.24	14.59	13.85	13.34
Bond		-1.52	24.49	26.02	6.81	6.64	6.21
Cash		0.00	19.64	19.64	6.27	6.10	6.16
Five Years	70						
Equity		-5.39	38.94	44.33	14.30	13.89	9.77
Bond		-1.56	22.25	23.81	6.65	6.52	5.36
Cash		0.00	17.87	17.87	6.16	6.00	5.95
Ten Years	65						
Equity		-0.42	34.13	34.54	14.29	14.06	7.38
Bond		0.88	18.50	17.62	6.33	6.23	4.69
Cash		0.00	17.05	17.05	5.93	5.78	5.74
Twenty Years	55						
Equity		5.90	25.10	19.20	13.72	13.59	5.63
Bond		2.04	14.20	12.16	5.46	5.41	3.43
Cash		0.13	15.01	14.88	5.43	5.32	4.88
Returns are shown as a percentage per annum							

Source: Adapted from Firer and McLeod (1999:1-23)

The Firer and McLeod (1999) study further points out that over any ten-year rolling period, there is only ever one period (1948 to 1957) where Equities delivered a negative return, while Bonds always delivered a positive return. The results put forward support the stylised thought that, in the long run, an investor can simply place their wealth in Equities and will achieve the highest ending wealth level regardless of the current investment landscape.

In addition to the above study, Dimson, Marsh and Staunton (2002) expanded the data set by covering the period 1900 to 2001. They also obtain similar results in terms of the relative asset class performance, and specifically the outperformance of Equity, supporting the findings in the Firer and McLeod (1999) study. The Dimson et al., (2002) findings highlighted by Table 2.4 below:

Table 2.4: SA Asset Class Nominal Return Summary for the Period 1900 to 2000

	Geometric Annualised Returns	Annualised Standard Deviation	Lowest Return & Year	Highest Return & Year
Equity	12.0%	23.7%	-29.6%: 1920	107.7%: 1933
Bonds	6.3%	9.5%	-10.7%: 1915	35.9%: 1986
Cash (Bills)	5.7%	5.80%	0%: 1934	21.8%: 1985

Source: Author's own adapted from Dimson, Marsh and Staunton (2002:279)

The Dimson et al., (2002) study is conducted using the database provided by Firer and McLeod (1999), and the study added returns for years at the margin for asset class returns. Comparing the data above to the Firer and McLeod (1999) study, one can state that Equity is the asset class that moved the most in terms of changes from one period to the next, lowering the experienced returns and increasing the experienced volatility.

This argument is also supported in the United States context, where investors choose to hold more Equity, in spite of the risk (Suri, 2013). In addition, Equity provides the greatest annual return over long holding periods (Beach & Rose, 2016).

Luus (2015) states that the return for South African equities since 1925 until 2015 would have provided an average real return of 8.4% per annum. However, it is illustrated that the rolling 10-year real returns on Equities fluctuate from levels of between 15% to 20%, in the upper bounds, and by -5% in the lower bounds in 1958.

Luus (2015) further highlights that bonds would have provided investors with a real return 1.60% per annum, with cash falling in behind the return of bonds with a 0.90% annual real return being provided to investors. This makes a strong case for investing in Equities as an asset class, while also highlighting that more recently, such as in the past 10 years, Equity has been outperformed by a recently added asset class in South Africa, namely Listed Property.

Research analysts Gordon and Fermoyle (2017) conducted a study which showed the relative performance of asset classes from 1976 to 2016. This study allows for 40 years' worth of recent data performance to be considered, and the data is collected from reputable sources such as I-Net, FactSet, SARB, Gold Coin Exchange, and SBG Securities.

Table 2.5: SA Asset Class Nominal Returns for the Period 1976 to 2016

	Annualised Returns
Equity	20.90%
Property	15.90%
Bonds	10.80%
Cash (Bills)	10.80%

Source: Author's own adaption from Gordon and Fermoyle (2017:03)

The advantage of the Gordon and Fermoyle (2017) study is the inclusion of property as an asset class, adding to the robustness of the comparative performances of the South African asset class sub-sets.

However, a disadvantage of the Gordon and Fermoyle (2017) study is the lack of granular insight into the volatility of the asset classes. The relative Sharpe ratios of various countries were shown, but the information is insufficient to draw meaningful conclusions and may be exposed to the sensitivity of the starting point of the analysis.

Credit Suisse issued a paper authored by Dimson, Marsh and Staunton (2017), which covers the long-term perspective of the individual markets of a large number of countries across the world. An excerpt of the table specific to South African data is recreated below.

Table 2.6: South African Real Return on Equities, Bonds and Bills: 1900-2016 in Perspective

	Annualised real return (% per year)				
Time Period	Equities	Bonds	Bills	Inflation	Best
2000 – 2016	8.20	5.10	2.20	5.80	Equities
1980 – 1999	6.70	1.90	3.20	11.90	Equities
1900 – 2016	7.20	1.80	1.00	5.00	Equities

Source: Adapted from Dimson, Marsh and Staunton (2017)

What can be observed from Table 2.6 is that Equities always provided the best returns over the period 2000 to 2016. Table 2.6, however, does not consider the volatility taken nor the relative performance of multi-asset portfolios. Table 2.6 is only the return aspect of the risk and return dimensions put forward by Markowitz. Dimson et al. (2017) also do not consider Property as a separate asset class in their study.

Dimson et al. (2017) illustrated the returns that can potentially be provided by Equity above that of Cash, which is termed the Equity risk premium. The larger the Equity risk premium, the greater the return awarded to investors for bearing the risk of Equity above that of Cash. Given that Equity has the potential to provide rewards of this nature, the Equity risk premium will need to be considered.

2.6. Equity Risk Premium and Empirical Observation

Risk premiums refer to the notion that the more uncertain the outcomes for an investment are, the higher the expected return should be (Damodaran, 2017). This is over and above the risk-free rate, with this additional marginal return being termed the risk premium (Damodaran, 2017).

Understanding the risk premium offered by asset classes, specifically Equity, has an important part to play in investing. The expected, and actual, returns on Equity will ultimately affect the shape and spatial position of the efficient frontier on a risk and return diagram. The expected return on Equity will also affect the allocation to Equity as an asset class within the portfolio. Weights may be tilted towards assets providing greater premiums for risks accepted.

Pindyck (1983) put forward that the decrease in stock capital prices during the 1970s is a result of increased risk premiums caused by an increase in the volatility of the stock market. The study is based on the New York Stock Exchange. Stock market volatility, therefore, may create a perfect situation for investors to potentially succumb to the behaviour of switching out of Equity at a potentially inopportune time, regardless of the long-term Equity risk premium that can be harvested. Investors will myopically assess the environment and a reduction in the allocation to Equity, regardless of the long-term risk premiums offered by the asset class (Pindyck, 1983).

The relevance for the South African context is, however, limited. This is due to the study being conducted more than three decades prior, in addition to the study being based on the New York Stock Exchange, which is a developed market.

Moving to a South African context, Hassan and Van Biljon (2010) provide a detailed study of South African historical data, showing conclusions based on the history of 105 years' worth of data covered in their study. One conclusion is that an investor would not have experienced a single negative Equity risk premium above Bonds and Bills over any meaningful rolling period, such as 10-years and above.

A further finding of Hassan and Van Biljon (2010) is that there has been a compression in the Sharpe ratio provided by Equity since the mid-1980's, as illustrated in Figure 2.5. The decline is the result of a decrease in the Equity risk premium rather than an increase in the return volatility of the asset class. This will have implications for asset allocations to Equity if the Sharpe ratio and expected return of the asset class decreases on a relative basis.

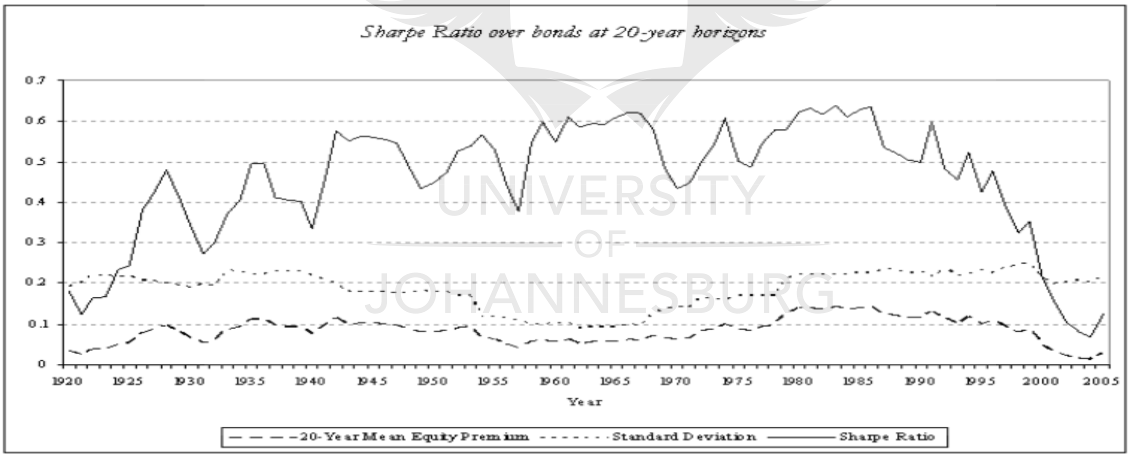

Figure 2.5: Sharpe Ratio at 20-year Horizons

Source: Hassan and Van Biljon (2010:12)

In a more recent study, Damodaran (2017) points out that there are a number of factors affecting the Equity risk premium demanded, which are listed below:

- Risk aversion and consumption preferences
- Economic risk
- Information

- Liquidity and fund flows
- Catastrophic risk
- Government policy
- Monetary policy
- Behavioural/irrational component

From the above-listed factors, one can observe that determining the Equity risk premium suitable for Equity is a complicated affair that is also subject to change over time. This supports the evidence found by Hassan and Van Biljon (2010).

Damodaran (2017) highlights the Equity risk premium for various countries from the period 1900 to 2016. However, the focus will be limited to the South African context given the problem statement of this study. The results are such that the geometric mean return for Equity above short-term government Bonds is 6.20% per annum, with the geometric mean return above long-term Bonds is 5.30% per annum.

Damodaran (2017) highlights the additional benefit above Bonds and Cash proxies that investors could receive by holding Equity. This is, however, limited in terms of general conclusions being able to be drawn given that property as an asset class is not displayed, in addition to multi-asset class portfolios not being contrasted to the performance of a pure Equity portfolio.

The section above highlighted the empirical observations regarding the Equity risk premium experience in the South African context, highlighting that South African investors have been rewarded for taking on Equity allocations and enduring the volatility. However, it has also been highlighted that investors may myopically react to interim volatility associated with Equity and, therefore, not harvest the long-term risk premium that is offered.

The next section will cover the literature review on Markowitz Portfolio Theory.

2.7. Markowitz Portfolio Theory and Investing

In his seminal work in 1952, Harry Markowitz highlights the importance of diversification. Markowitz (1952) put forward that an investor would be wise to consider both the expected return that an asset offers with the variance in the returns, and that the variance embedded in this expectation is to be undesirable to the investor. This meant that rational investors should consider a portfolio to be efficient when the portfolio cannot offer a higher return per a given level of risk. This set of optimal portfolios is then labelled the efficient frontier and graphically illustrates the efficient portfolio opportunity set given incremental changes for risk and return given the security weightings within a portfolio.

The Markowitz mean-variance framework is a frequently utilised technique for solving optimisation problems, with any points within the efficient frontier being considered inefficient. This is because the investor can achieve a greater return for the given level of risk, or a lower risk level for a given level of return (Schulmerich, Leporcher & Eu, 2015). This further means that the investor has the choice to target a higher level of return but must also accept a higher level of volatility in the process (Amene & Martellini, 2000; Brandt, 2010).

Koch (2007) surmised that Markowitz made the following assumptions:

- Investors are concerned only with the underlying return of a security and the embedded volatility over a particular period. That is, the investor's preference can be put forward in a mean-variance utility function.
- Financial markets contain no friction in the form of taxes, indivisible assets, or transaction costs.
- Investors adopt a myopic stance and assume a one period time horizon.

Chopra and Ziemba (1993) highlight that the use of mean-variance analysis has certain problems in portfolio management, such as the sensitivity of the inputs and the so-called corner portfolios. These points will, however, not be discussed in this dissertation given the focus of the research not being inclined to directly question mathematical optimisation techniques.

Investors, thereafter, began to focus on the characteristics of the entire portfolio, versus the characteristics of the individual security in the portfolio, so long as there is a less than perfect correlation between the securities. This line of thinking has, however, to a great degree, not been extended empirically in the multi-asset class investment world.

Given the aforementioned efficient frontier considerations, Mitchell and Utkus (2003) state that risk-averse investors will require increased marginal benefits, in terms of returns, to accept higher levels of risk. In reality, it is plausible to believe that investors do not consider this trade-off, or do not generally have the skill-set and tools to do so. Even if they had these tools at their disposal, investors may not be familiar with what the acceptable trade-offs of Sharpe ratios alternative portfolios may be.

To generate the efficient frontier, investors will need the sample of asset classes from which to choose portfolios. Hewitt EnnisKnupp (2014) advocated that, as per Standard Finance Theory, the departure points for investing in various asset classes should be the global market capitalisation of the world's asset classes. For the global capital market, Equity is not the whole market, and is 38.94% of the estimated global market capitalisation (Hewitt EnnisKnupp, 2014). This means that a 100% Equity portfolio would be a large deviation from a truly passive investor, who would hold the world assets in their market capitalisation. The above weighting, however, takes into account that non-traded assets cannot be included in a portfolio. Table 2.7 illustrates the asset classes considered in the Hewitt EnnisKnupp (2014) study.

Table 2.7: Estimated Total Size of the Global Capital Market (US Investors Perspective)

Asset Class / Category	Market Size (USD, Trillions)	Proportion of Global Invested Capital Market (%)
U.S. Equity ex REITs	18.19	18.0
Non-U.S. Equity (Developed) ex REITs	13.85	13.7
Emerging Markets Equity ex REITs	3.99	4.0
Frontier Markets Equity ex REITs	0.15	0.2
Private Equity	2.52	2.5
Private (Unlisted) Infrastructure	0.24	0.2
Timberland	0.05	0.0
Private Real Estate Debt	5.80	5.7
Private Real Estate Equity	4.20	4.2
Public Real Estate Equity	1.26	1.2
Commodities	0.33	0.3
High Yield Bonds	1.85	1.8
Bank Loans	0.88	0.9
Emerging Market Bonds (Sovereign; USD)	0.55	0.5
Emerging Market Bonds (Sovereign; Local Currency)	1.48	1.5
Emerging Market Bonds (Corporate; USD)	0.68	0.7
Insurance-Linked Securities	0.02	0.0
U.S. Bonds (Investment Grade)	15.34	15.2
Non-U.S. Bonds (Developed)	22.65	22.4
Inflation-Linked Bonds	2.57	2.5
Money Market/Cash Equivalents	4.49	4.4
Total Global Invested Capital Market including Hedge Funds	$101.1	100.0%

Source: Hewitt EnnisKnupp (2014)

Given the asset classes available on a global basis, Sharpe (2010) shows the Fidelity Freedom Fund’s policies (Fidelity International, 2016) in terms of asset allocation as highlighted in Figure 2.6. It is observed that the asset allocation of a solution will change over time. However, what is observed is that, even at a 50-year time horizon, there is not a 100% allocation to Equity funds, which adopts a closer stance to the market capitalisation weighting of securities.

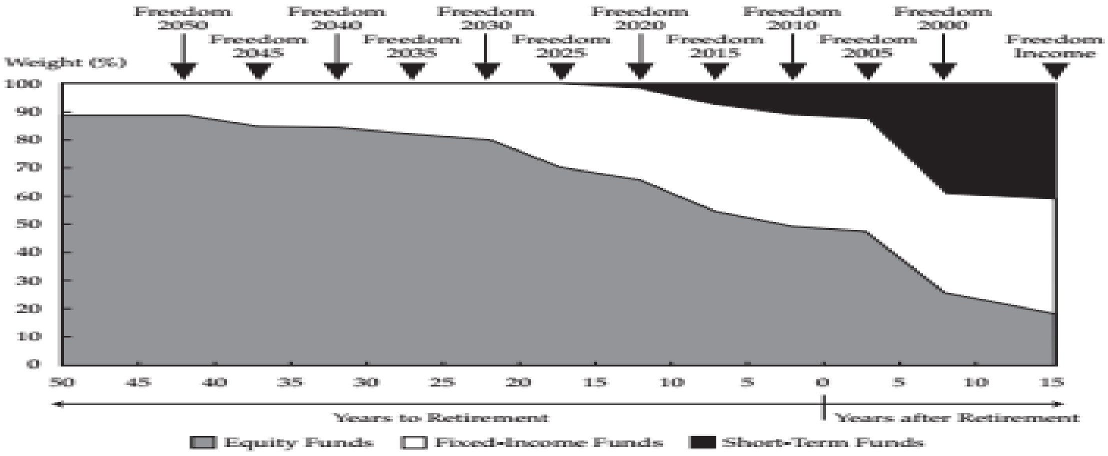

Figure 2.6: Fidelity Freedom Funds' Asset Allocations

Source: Sharpe (2010:3)

Markowitz (1952) provided investors with a powerful analytical tool through which to analyse the trade-offs associated with investment decisions. Investors, however, may often deviate from the rational and basis underpinning the MPT framework behind asset class allocation decisions by considering the Capital Assist Pricing Model.

2.8. Capital Asset Pricing Model (CAPM)

The Capital Asset Pricing Model (CAPM), introduced by William Sharpe (1964), makes an effort to price expected return based on an asset's beta to the underlying systemic environment, referred to as the market. The methodology incorporates the risk-free asset into consideration and is deemed to be a single-factor model (Tuck School of Business, 2003).

The CAPM framework makes some simplifying assumptions (Schulmerich et al., 2015):

- Investors are concerned with both the expected return and associated volatility of an asset.
- Investors are considered rational and will aim to maximise return for a given level of risk.
- All investors have the same views regarding the risk and reward payoffs provided by the market; they expected the same probability distributions.

- The market systemic risk is the common factor to a diversified portfolio, which contains only non-diversifiable risk.
- Unlimited borrowing and lending can occur at the risk-free rate.
- The markets are frictionless in that they contain no taxes, there is no transaction costs, and investments are infinitely divisible.
- Inflation is fully anticipated.
- Capital markets are in equilibrium and are considered efficient.

CAPM is often criticised for its unrealistic assumptions. The framework does, however, allow investors and capital allocators to introduce a risk-free asset, which is an asset with no volatility, to the efficient portfolio opportunity set. This introduction of the risk-free asset essentially changes the efficient frontier from the envelope of portfolios to the capital market line (CML). The CML is the portfolio which is a combination of the risk-free asset and the portfolio to which there is tangency on the Markowitz efficient frontier (Schulmerich et al., 2015). This introduction of the risk-free asset directly allows investors to consider the risk and return trade-off that they would like to accept.

2.9. Asset Allocation Decisions and Portfolio Choice Theory

Multiple theories have shaped the decisions and thinking framework associated with asset allocation and investing. Such theories are Tobin’s Two-fund Separation Theorem, and the afore-mentioned Capital Asset Pricing Model discussed by Treynor (1961) and Litner (1965), both of which build onto the seminal work conducted and pioneered by Markowitz (1952).

Considering the framework associated with the allocation of capital, Batman and Summerford (2009) take the view that the inclusion of multiple asset classes into the portfolio will present the investor with the opportunity cost of lower returns. However, the authors do not make mention of both the magnitude of reduction of return and the associated reduction in the levels of risk that accompany a decision such as this.

A prior study by Hoernemann, Junkans and Zarate (2005) support Batman and Summerford (2009) in their conclusion. Hoernemann et al. (2005) clarify and provide their input regarding what proportion of asset allocation affects the variability of return. More specific to the conclusion of Batman and Summerford (2009) is that Hoernemann et al. (2005) find that the inclusion of additional asset classes does lower the return of the portfolio, but simultaneously drastically lowers the associated variability of the portfolio, which ultimately leads to a better risk-adjusted outcome for the investor.

When considering the discussion on asset allocation decisions, there has been a large amount of discussion on the impact of asset allocation in a portfolio. One simply needs to consider articles and papers from the likes of Brinson et al. (1986) and Ibbotson and Kaplan (2000). Brinson et al. (1986) and Ibbotson and Kaplan (2000) are often misconstrued by many investment professionals to make claims to the determination of performance of a portfolio based on asset allocation rather than a portfolios variance in returns, such as the conclusions drawn by Baars, Kocourek, Van der Lende and Somaia (2013).

Following on from the Brinson et al. (1986) study, Jahnke (1997) acknowledges the study performed by Brinson et al. (1986) but claims that Brinson et al. (1986) incorrectly concluded their findings in their study. Jahnke (1997) purports that the three assumptions made by the study, listed below, can lead to an incorrect conclusion on the success of outcomes:

- The average asset class weights are assumed to be the same of the normal policy weights.
- Investing in foreign stocks, real estates, private placements, and venture capital can be proxied the combining stocks, bonds, and cash.
- An assumption is made that the benchmark for stocks, bonds, and cash are appropriate benchmarks for performance evaluation.

Jahnke (1997) further states that it would have been ideal if the authors focussed on the source of asset allocation decisions on returns, which have subsequently been researched by Ibbotson (2010). Jahnke (1997) cites further errors in the analysis, from the likes of comparing variance to standard deviation, to not taking cost into account. It would seem that Jahnke (1997) has taken a general finding and applied it to a specific scenario with further insight but forgot about the power of general assumptions and findings for the investment community.

Moving forward a number of years, Ibbotson (2010) aimed to bring correct understanding to the Brinson et al. (1986) article by clarifying the intention of the authors, as well as shedding light onto the effects of asset allocation, ultimately showing that approximately 100% of the return is explained by asset allocation policy decisions. This conclusion makes sense given that the apportionment of weights to asset classes, and subsequent returns, is a simple linear additive relationship.

In support of Ibbotson's (2010) findings, Xiong, Ibbotson, Idzorek and Chen (2010) highlight that setting policy decisions for the portfolio matters and conclude that the market is largely responsible for returns, over and above that of active management contributions to a portfolio. This conclusion highlights that setting the correct asset allocation for a portfolio is essential for an investor to achieve the risk levels, in terms of volatility, with which the investor is comfortable.

However, Investor Literature (2013) made a claim that the famous, and often cited, Brinson et al. (1986) study is incorrect and so disagree with its findings. Investor Literature (2013) conclude that the studies performed by Chau, Kritzman and Page (2009) and Ibbotson and Kaplan (2010) more correctly highlight that asset allocation plays a lesser part than originally claimed and that security selection is almost as equally important. Investor Literature (2013) refer readers to letters to the editor of the Financial Analysts Journal where Kritzman clarified the points made under the Brinson et al. (1986) study, with the original authors responding and still maintaining their original conclusions from the study. Considering the ongoing debate currently in the academic community, the findings lack general consensus amongst academics and practitioners as to what truly matters the most to investors - asset allocation or security selection.

As a final point, considering a behavioural perspective, the Dalbar (2016) study highlights that investors tend to allocate capital to investments that have previously performed well when, to some degree, this is contrary to the discipline of selling high and buying low. This may be a concern when investors decide to allocate capital to Equity as an asset class in isolation (Dalbar, 2015). This finding adds to the complexity of the current ongoing debate. Another added complexity is introduced by the inclusion of unpredictable investor behaviour in financial markets given the emotional aspect of decision making.

This section highlighted the current ongoing debate regarding the importance of asset allocation within the investment community. Asset Allocation and Portfolio Choice Theory require portfolio management techniques to maintain a decided upon portfolio over time.

2.10. Portfolio Management Techniques

Portfolio management is considered to be the decision making regarding the composition of the portfolio with relevance to the stated objectives of the investor's requirements (Marx et al., 2013). This study makes no aim to provide insight into active investment decisions associated with portfolio management. However, consideration will still need to be given to both portfolio rebalancing considerations and general underlying potential diversification benefits of the portfolio constituents, if there are any. The following two sub-sections will cover these two considerations, respectively.

2.10.1. Rebalancing

Given the nature of the multi-asset portfolios put forward in the study, and the requirements for Equity to be set at specific asset allocation levels, one needs to be cognisant of how the risk and return characteristics of a portfolio would change over time should portfolio drift of the initial targeted asset class weights occur due to differing return levels of the asset classes. Batman and Summerford (2009) confirm this by stating that a portfolio needs to be rebalanced to the original allocations given portfolio drift. This is the situation where one asset class has a faster growth rate over time compared to the other asset classes, or alternatively where weightings are changed given the drawdown of an asset class within the portfolio.

The importance of rebalancing to target portfolio weights is put forward by Fisher (2016) and Suri (2013). Suri (2013) puts forward that rebalancing helps investors to avoid the pitfalls of trading on emotions, and further mentions that two comparator balanced stock and bond portfolios, from 1987 to 2012, were compared. The finding showed that the rebalanced portfolio experienced a higher ending wealth level, lower volatility, and greater risk-adjusted returns.

Fisher (2016) also conducts a similar analysis for balanced portfolios over the period 01st of January 1926 to the 30th of September 2014, where one portfolio is rebalanced quarterly while the other adopted a buy-and-hold strategy. The results were that the rebalanced portfolio achieved an annualised return of 8.73% versus the buy-and-hold strategy, which yielded an annualised return of 9.47%. The difference, however, is that the risk levels, 11.66% and 14.47%, respectively, were very different in their outcomes.

Rebalancing can occur through various techniques, such as periodic rebalancing over a calendar period, or when the portfolio's asset allocations reach certain breach point. Rebalancing based on weights reaching breach points is referred to as trigger rebalancing. A final measure for portfolio rebalancing is rebalancing back to target weights based on interim cash flows into or out of the portfolio (Fisher, 2016; Jaconetti, Kinniry & Zilbering, 2010; Sun, Fan, Le-Wei, Schouwenaars, Albota, Freyfogle & Grover, 2006).

Rebalancing can remove the behavioural aspect of buying an asset at a high price, and selling the asset at a low price, as is shown to occur in reality by the actions of the average investor (Dalbar, 2016). Rebalancing allows the investor to have a structured system in place to manage the inherent risk in the portfolio caused by portfolio drift of the best performing asset class.

2.10.2. Diversification

Diversification is the concept of spreading risks amongst multiple sources. It is important in the portfolio management context as it avoids the scenario where a substantial decrease in one asset class's return can be detrimental to the entire return and risk profile of the portfolio (Suri, 2013). The essence of diversification is the inclusion of assets whose returns are less than perfectly correlated with each other.

Diversification, rather than simply chasing the highest expected return over time, can allow for a situation where investors can marginally decrease their returns while drastically decreasing their risk levels (Fisher, 2016).

J.P. Morgan Asset Management (2015) states that diversification is an effective method to reduce the risk a portfolio of securities has and makes claim to the statement that a balanced portfolio is able to provide Equity-like returns with far less volatility. The concern with this claim is the lack of empirical evidence in the study to support this hypothesis. It is also prudent for consideration to be given as to what factors could also cause this dynamic to change over time.

Adding additional securities to a portfolio will reduce the overall volatility of the portfolios return profile, given less than perfectly correlated assets. Figure 2.7, presented by the Tuck School of Business (2003), points out that one can observe that there is a marginal benefit in the addition of the first few securities, to the point of approximately 15 securities. This reduction in risk assumes a zero correlation between securities and has not been tested in the South African context.

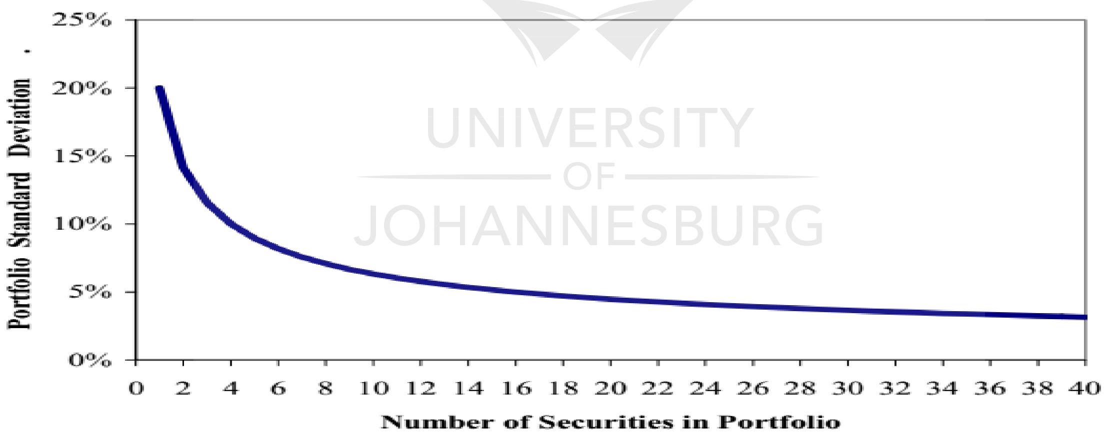

Figure 2.7: Diversifying Reduces Portfolio Volatility

Source: Tuck School of Business (2003:3)

2.11. Risk Defined and Additional Considerations

Risk tends to be dependent on the frame from which the question is asked, and who the person is who is asking. One often quoted measure of risk is the standard deviation of an asset class’s return. It is shown that the short-term volatility of an asset class in a single period is greater than the long-term volatility by extending the time horizon (Campbell & Viceira, 2000; Piros, 2015).

Campbell and Viceira (2000) state that Equities have traditionally been thought of as risky assets, but nonetheless have been attractive due to their high returns offered on average to investors over time. The authors provide a framework to think about asset allocation, from a mathematical perspective but do not empirically and directly contrast a multi-asset portfolio with that of a single asset class portfolio.

Campbell and Viceira (2000) further discuss myopic loss aversion, which is when an investor will make a long-term decision but evaluate the portfolio on a short-term basis. This is a widespread occurrence in the field of investing, as retail investors are legally required to be contacted by their financial advisors annually for a review. This process automatically forces a short-term evaluation of the portfolio, exposing the investor to the full visibility of the short-term volatility.

Cochrane (1999) puts forward that an investor with a longer time horizon can accept more volatility, as defined as risk, than an investor with a short period of time. However, this statement does not take into account the myopic behaviour of investors. There is also the consideration that the stock market may be independent in its returns over time; the so-called random walk hypothesis. This means that should price changes in the stock market result in a loss today, they are not likely to mean-revert over time to reverse the loss. However, this goes against the statement of Cochrane (1999) in that the variance of stock market returns of a period of 5-years is approximately 50% to 66%, indicating that there is some evidence of negative serial-correlation is stock market returns.

2.12. Risk Adjustments and Performance Evaluation

Since Harry Markowitz's 1952 seminal paper, investors now consider both risk and return, especially in an optimisation process to find the efficient frontier. This should naturally translate into investors insisting on risk-adjusted performance metrics, which is not seen in practice.

Cochrane (1999) states that one of the practical applications of portfolio theory to date is that an investor must determine their appropriate risk-tolerance. What

Cochrane (1999) is referring to is the investor deciding what their personal trade-off between marginal returns and additional volatility is going to be. Cochrane (1999) is, therefore, stating that investors should consider risk in the investment decision making process. One such measure of a combination of both risk and return is the Sharpe ratio, which measures the return that exceeds the risk-free rate, and then takes the values relative to that of the portfolio's standard deviation, with a higher Sharpe ratio indicating greater marginal benefit for portfolio risk taken (Goodall et al., 2015).

The literature on the Sharpe ratio by Hodges, Taylor and Yoder (1997) has shown that the ratio is not static over time and is responsive to the time period selected for the investment. Specifically, Hodges et al. (1997) highlight that by extending the time horizon, the Sharpe ratios of relatively less volatile investments improve.

Hodges et al. (1997) show that the Sharpe ratio for Long-Term Corporate Bonds exceeds that of both Small Stocks and Common Stocks, for the US context, exceeding the Sharpe ratio of Small Stocks since inception and exceeding Common Stocks after a period of approximately 18 years. These finding highlight that the results of Sharpe ratios need to be used in conjunction with the investment period under consideration for the term of the investor. In addition to highlighting the importance of considering term matching of the investor and evaluation, the finding illustrates that Stocks relative to Bonds offer diminishing marginal returns to investors in terms of accepting volatility and receiving the additional return.

Various authors, such as Hodges et al. (1997), Lin and Chou (2003), Bednarek, Patel and Ramezani (2014), move on to support the statement that the Sharpe ratio will vary with time. Their conclusions are that the Sharpe ratio first increases, and then decreases as the period is extended. The various authors conclude that Sharpe ratio evaluation should be matched to the period of both the investment valuation and horizon to ensure that the comparison is being conducted correctly

Based on the above discussion, it is important to consider both risk and return in the evaluation of the outcomes of portfolios. These metrics will be discussed in Chapter 3. Metrics should be considered in addition to investor behaviour and how this behaviour impacts the metrics and outcomes over time.

2.13. The Dalbar Qaib Study

Dalbar (2016) highlights that investors often earn far less than the market and funds due to timing flows into, and out of, funds at inopportune times. The series of reports are thorough, covering 30 years of data up to the end of 2015.

The Dalbar study, ending December 2015 highlights that the average return of investors in the US mutual stock funds is 4.25% per annum, while the S&P 500 returns 8.21% per annum over the same period. The cost of making an incorrect decision in a volatile asset class is, therefore, a significant one, which drastically affects the investors ending wealth levels.

The Dalbar (2016) study shows that investments into mutual funds, in the American context, result in superior investment results for investors that maintain their positions in the fund. However, many investors are held prey to their emotional responses, leading to inferior investment performance.

A key finding of the Dalbar (2016) study is that Equity investors often underperform the aggregate market, in the 2015 instance this is as high as 3.66% against the S&P500. The margin is somewhat larger in the asset allocation fund context. This study has rich data illustrating that pursuing an Equity-only strategy, while being subjected to behavioural biases, may result in the investor ending with a lower wealth level.

The Dalbar (2016) study further highlights that asset allocation strategies have retention rates longer than that of their Equity-only counterparts, indicating that investing in asset allocation strategies may result in investors maintaining their intended course for longer.

Investors that succumb to cognitive biases and emotions do not tend to act in a rational manner. One such example is where investors know that short return periods, such as one year, do not often display evidence of skill in a manager. However, investors will tend to allocate capital to managers who have performed well over the past year, as also shown in a different perspective by studies such as the QAIB Dalbar analysis over time (Statman, 1999).

These findings strongly go against the rational behaviour of buying low and selling high, and further highlights that factors like myopic loss aversion may affect an investors ability to maintain the allocation of 100% to equities over time.

2.14. Summary

This chapter has identified and discussed literature that is relevant to the investigation and has put forward the areas of weaknesses in the research examined, specifically with regards to multi-asset portfolios having relative empirical observations for performance evaluation compared to single asset classes. It is put forward that many studies consider asset class investigations in isolation, but do not consider the multi-asset portfolios as a whole.

The sampled literature highlighted that there is rich data for the South African market in terms of historical asset class returns in isolation. The data showed that Equity performance in South Africa has been stellar and has actually been the best performer across similar studies against 22 other countries and from 1900 to 2016 (Dimson et al., 2017).

Given the performance of Equity as an asset class in the South African context, the desire to have an increased allocation towards Equities can be understood. However, the literature is not as rich and in-depth in terms of the comparison of multi-asset portfolios against individual asset classes in isolation. Therefore, it does not provide a deep research pool to allow investors to make an informed decision regarding the multi-asset efficient frontier and the associated risk and return trade-off.

Markowitz Portfolio Theory laid the foundation as to how rational investors should allocate capital in the investment portfolios, considering both risk and return of the securities, and how the securities correlate with one another. Markowitz paved the way for thinking about the efficient frontier of portfolios and graphically illustrating the investment opportunity set for the portfolio.

The importance of asset allocation within a portfolio management context is still hotly debated, with various investment professionals all employing many different techniques for managing money. What is definitive is that asset allocation matters and should be a part of the investment decision-making framework.

Chapter 3 will now discuss the research methodology adopted for the study. Insight will be provided on the research strategy, goals and objectives. The data collection and analysis will be discussed, and the various financial methods chosen for the data analysis will be thoroughly examined.

Chapter Three
Research Methodology

3.1. Introduction

In Chapter 1 and 2, it was noted that Equity provided the largest cumulative return of all asset classes being investigated under the period considered. However, the aforementioned comparisons were conducted to assess two points of consideration: firstly, at what level does the marginal returns to Equity diminish while accepting increased risk; secondly, can similar levels of ending wealth be achieved while not having a portfolio invested fully into Equity? This can be summarised as assessing what happens to risk-adjusted return levels by introducing multiple asset classes to an Equity-only portfolio.

Today, through technological advancements, the optimisation processes and the required data are now more easily accessible to investors. If one combines this ease of access with the use of simple programmes, such as Microsoft Excel, investors can now make more informed investment decisions with the greater dissemination of access to tools allowing this. This use of technology will allow a greater number of retail investors to make decisions in the investment world than before. However, the availability of programmes does not guarantee that these programmes and methods of thinking will be used.

This chapter will explain what research methods were adopted in this study, with the goals being restated in the first portion of the chapter, followed by an explanation of the data collection methodology. The financial methods are then discussed and the chapter concludes by detailing the methodology used in the data analysis.

3.2. Goal of the Study

The goal of this study aims to assess whether there is any marginal benefit for investors in moving beyond multi-asset high Equity portfolios into Equity-only portfolios for a South African investor. This study will assess the outcomes on both a risk-adjusted basis and a return-only basis by means of comparisons of ending wealth levels. A conclusion in this regard will be reached, with the hopes of providing investors will additional insight into the trade-offs associated with asset allocation decisions.

3.3. Research Questions and Objectives

To reiterate, the research questions and objectives of the study will be directed towards assessing whether the risk-adjusted returns of Equity investing are sufficient to attract asset allocations beyond the point of multi-asset high-Equity investments. The main objective of this study is to assess the risk-adjusted return of pure Equity investing against multi-asset investing.

The sub-objectives of the study, which will assist in answering the above main objective are:

- Determine the effect on risk-adjusted returns by introducing additional asset classes and using an Equity portfolio as a departure point.
- Determine the effect on a client's ending wealth levels by introducing multiple asset classes and using an Equity portfolio as a departure point.
- Determine the current shape of the efficient frontier in the South African investment context, in addition to assessing how the efficient frontier has changed over time.

3.4. Research Strategy

The strategy utilised for the study is based on the use of secondary data and the application of financial methods applied to the data. Numerical mathematics is the application of computing power to solve for multiple different fields in mathematics, which require scientific computing in obtaining their solutions (Quarteroni, Sacco & Saleri, 2000).

The computation of risk-adjusted return metrics, efficient frontiers, and investor ending-wealth levels, which are assessed through the creation of indices, are required for the purposes of the study. These computational methods will be contextualised and outlined in detail in the remainder of this chapter.

3.4.1. Research Paradigm

A positivist paradigm is adopted for the study given the quantitative and repeatable nature of the data. This is underpinned by a deductive approach. Saunders, Lewis and Thornhill (2009) state that a positivist approach emphasises structured methodological methods, while a deductive approach involves the generation of a hypothesis to be tested, which is followed by a research strategy specifically designed to test the hypothesis.

3.4.2. Research Method

This study is based on historical time-series secondary data having quantitative research methods applied to it. Quantitative research methods focus on the use of financial data in a positivist environment, where the results are objective and not subject to one's own opinion of the study (Quinlan, 2011). The quantitative methods employed will be somewhat exploratory in their outcomes in assessing the marginal change in risk-adjusted returns by introducing multiple asset classes at the margin to a fully Equity portfolio.

Performance and risk metrics will be calculated from the historical time-series data, collected from Morningstar South Africa, in order to answer the research objectives of the study. In addition to the data from Morningstar South Africa's database, additional sources of data were considered for purposes of the literature review, with the data being embedded in previous journal articles. The context of the study is in the South African environment, but global studies were considered given that they contained South African data.

3.4.3. Research Instruments

Research instruments are used in order to analyse the data collected for the purpose of answering the study's research objectives. The instruments utilised in this study are Microsoft Excel, and Visual Basic Applications (VBA) combined with financial metrics and empirical observations to provide insight into the research question and objectives. Microsoft Excel and VBA are environments that allow for financial methods to test data, amongst other generalised applications in various fields.

3.4.4. Sampling Strategy

A sampling strategy is a manner in which the researcher chooses to select a sample from the population data available, where the population is the entire data set that is obtainable. The intention is to select a sample that is representative of the population data set (Greener, 2008).

The strategy adopted for this study is a non-probability sampling technique, given that the entire history of data can be utilised from the inception of the data for the chosen historical time-series indices. The non-probability sampling technique is purposive given the researcher's choice in sample selection, and the focus being in-depth and related to a key theme in answering the research question and objectives (Saunders et al., 2009).

3.4.4.1. Target Population

The population available to answer the research question and objectives is the historical time-series indices from all asset classes worldwide. Given that the research question is focusing on South Africa variables, the study is limited to the inclusion of the FTSE/JSE SWIX, FTSE/JSE SA Listed Property, and BEASSA ALBI historical time-series indices. The analysis of the data is performed according to systemised financial methods in order to answer the research question.

3.4.4.2. Sample Selection

The sample is selected post the formulation of the research question and associated objectives. South Africa is selected as the country for the research given that the researcher is based in South Africa, with the researcher wanting to identify additional asset allocation considerations for the South African retail investors and professional investment market.

The aforementioned samples are selected for the study as proxies given the indices being the broadest representation of available securities in the South African market. International securities are excluded from the study in order to simplify the results of the study to the South African retail investor.

The proxies for the various asset classes are listed below, with the date range considered for the research being from the 01st of June 2002 to the 31st of December 2017:

- FTSE/JSE All Share SWIX Index
- FTSE/JSE SA Listed Property Index
- BEASSA All Bond Index

3.4.5. Data Collection Method

Data is collected from Morningstar's database via the use of the API plug-in for Microsoft Excel. Morningstar is utilised internationally for investment research by financial advisors and asset managers

3.4.6. Data Analysis

The data analysis is performed in a single chapter and will be discussed in greater detail in the sections that follow. The sections are listed in the order in which the financial methods and analyses were run. Quinlan (2011) describes data analysis as the process of exploring and examining the data with the aim of uncovering any meaning.

3.4.6.1. Data Collected

The data for this study is the various total return indices published by the Johannesburg Stock Exchange (JSE) and provided through Morningstar South Africa, which makes the time-series data secondary in nature. Secondary data is data that is not compiled by the researcher, but that already exists (Quinlan, 2011). The discrete period for the data is weekly, which allows for sufficient points of observation for volatility estimates and rolling period assessments.

The weekly total returns for the below indices were obtained:

- FTSE/JSE All Share SWIX Index
- FTSE/JSE SA Listed Property Index
- BEASSA All Bond Index

The period from the 01st of June 2002 until the 31st of December 2017 contains 814 data points for each of the above-mentioned indices. The full data set, from the common inception of the various indices, is chosen to ensure that the asset class proxy returns were as representative of history as possible. The 2007 GFCis specifically included to illustrate the proxy’s risk and return characteristics over a full investment cycle, inclusive of both bull and bear periods. The use of longer term periods may be ideal in that they provide greater insight into the behaviour of risk and return, but may also be misleading if done does not expect the future behaviour to be as it was in the past (Brigham & Houston, 2016)

3.4.6.2. Data Quality and Cleaning

Li (2012) states that data dimensions required for the classification of data as high-quality data include accuracy, timeliness, completeness, and consistency. Li (2012) further states that there is no formal definition of data cleaning. The data collected from Morningstar is for a number of discrete periods, which is the closing weekly values with non-trading days excluded. This allows for all the data, across the different indices to be in the same format with no data points missing. Therefore, no data cleaning is required during the research given the high-quality data obtained.

3.4.6.3. Transformation and Analysis of Data

The first consideration is transforming the data provided into a usable format; with the data being the total return for discrete weekly periods in excel through the Morningstar API. The Microsoft Excel environment is used to perform these calculations.

Starting with the creation of indexes based to 100, various tests and metrics will be calculated, all of which will be highlighted below under various sub-headings. No Cash flows will be assumed for purposes of the testing. However, rolling starting points will remove the sensitivity to the bases of particular starting points in history.

Four sets of investment portfolios will be created, with the simplest being the portfolio assumed to be fully invested in Equity, as proxied by the FTSE/JSE All Share SWIX Index. The other three portfolios will be multi-asset portfolios based on guidelines for

Equity allocation put forward by ASISA. These three portfolios will represent low-Equity, medium-Equity, and high-Equity allocation portfolios. The three comparator portfolios will serve the purpose of highlighting the effects on risk-adjusted returns as additional asset classes to Equity are introduced, with the weight not allocated to Equity being equally split between the additional asset classes.

The analysis that will be performed on the information in order to build up additional sub-periods returns is illustrated in Figure 3.1. The same approach will be utilised on all comparator portfolios.

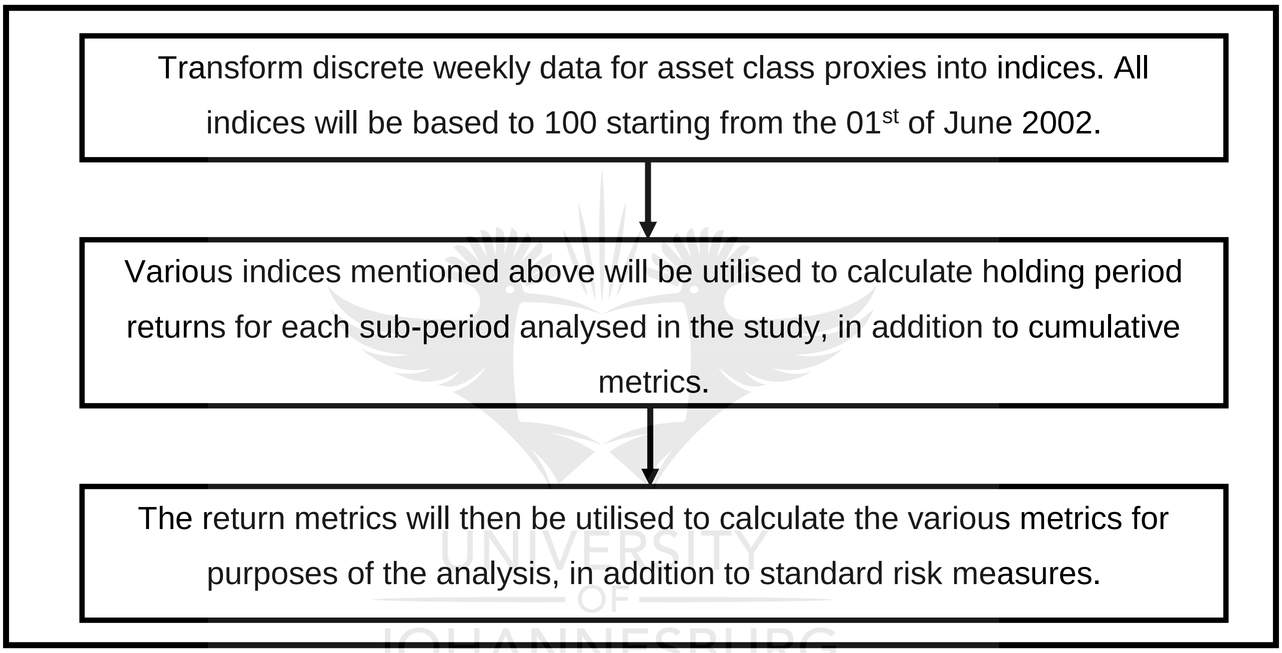

Figure 3.1: Determination of the Required Returns
Source: Researcher's own deductions

The sub-periods referred to represent discrete period rolling-returns for the study. The choice of rolling returns to analyse sub-periods is decided upon based on the following beliefs:

- The sensitivity to the starting point of the investment should be removed.
- Adding many sub-period's rolling returns can more accurately reflect whether the investment achieves the desired objectives over the required period.

- Rolling returns are more likely reflect investor experience in the investment more so than on a cumulative return basis. A cumulative investment assumed that the investor allocated capital at inception.

To illustrate the difference for sub-period analysis that rolling returns imply, Table 3.1 highlights the number of sub-periods for the data are given for the various rolling return periods.

Table 3.1: Illustration of the Number of Rolling Periods over the Sample Period Given Weekly Returns

Rolling Return Sub-Period	Number of Observations
1 Year	759
3 Years	651
5 Years	547
7 Years	442
10 Years	286

Source: Researcher's own deductions

3.4.6.4. Creation of Indices

The data analysis will begin by the creation of indices, with the use of Microsoft Excel, for both the asset classes in isolation as well as the three multi-asset portfolios. All the indices will be based to 100 at the inception of the study. The weekly returns for the data collected will be used to grow the indices. The index level method of calculating the change in the index level will be used, with all multi-asset portfolios being rebalanced to original weights quarterly using logic rules within the Microsoft Excel environment.

$$Index\ Level = 100\ \times (1 + weekly\ index\ return\ \%\ for\ sub\ period\ t) \qquad [3.1]$$

This approach used in the calculation of the monthly Equity performance is that the index is "purchased" at the start of each month. The index is purchased using the Index at the start of the month and sold using the Index at the end of the month. Dividends and distributions are accounted for via the use of total return indices.

Ending wealth levels will be based on the comparison of the ending value of the indices, which is synonymous with a cumulative performance for the investment over the sample period. The disadvantage of comparing ending wealth levels since the inception of the data is the sensitivity to a single starting point for the performance of various asset class sub-period returns.

In order to remove the disadvantage of subjecting the assessment to a single starting point, multiple sub-period rolling returns will be calculated for many comparison points. The periods in the sample are sufficiently long enough to allow for a full investment cycle.

3.4.6.5. Portfolio Construction

For portfolios where the allocation to Equities is not 100%, a weighting mechanism needs to be provided for. To this end, for the sake of simplicity, the research will be conducted on the basis of the below-listed considerations:

- Given that an introduction of a risk-free asset will linearly apportion risk and return for the portfolio, Cash will be left off when comparing the results for the risky assets.
- A data table will be created which varies the Equity weight from 0% to 100% in 10% increments, with the allocation not given to Equity being equally weighted between Listed Property (SAPY) and Bonds (ALBI).
- The data table will then record the ending index level and portfolio standard deviation for each of the portfolios, which aims to represent the ending wealth level for the client.

The standard deviation will be computed using array functions and matrix multiplication in excel. This is expressed by Scherer (2004) as:

$$\sigma p = W' \Omega \, W \qquad [3.2]$$

where:

σp = Standard deviation of the portfolio

Ω = k X k covariance of matrix returns

W' = Transposed k X 1 vector of asset weights

W = k X 1 vector of asset weights

Once the ending wealth level has been calculated and recorded, the geometric mean will be calculated for the compound annual growth rate. After the geometric mean has been calculated, a return to risk ratio will then be computed for each of the portfolios. The computed return to risk ratios will then be ranked from highest to lowest with the use of Microsoft Excel data validation and a heat map.

Graphs will then be generated in Microsoft Excel to allow for visual comparison of the ending wealth levels. The graphs will consider the portfolio standard deviation, ending wealth levels for the various Equity weightings in the portfolio, and the reward-to-risk ratio for the entire sample of portfolios.

Further metrics will be calculated from the various aforementioned rolling period periods. These metrics are listed below:

- Geometric returns
- Standard deviation
- Sharpe ratio
- Sortino ratio
- Modigliani risk-adjustment
- Jensen's alpha
- Return profile distributions
- Correlation
- Equity risk premium
- Portfolio optimisations and frontier generation

The above exercises will be conducted on the basis of rolling 1-year returns in order to remove the sensitivity of the analysis to a particular starting point in the data set. The rolling 1-year metrics for the various tests will be averaged in order to more easily make relative comparisons across the comparator portfolios. Given the nature of the study being an assessment of the trade-off between return and risk, the Sharpe ratio rolling period assessments will be extended to also include average of the rolling 3-year, 5-year, 7-year and 10-year observations to add depth to the interpretation of the trade-off.

3.4.6.6. Descriptive Statistics

Descriptive statistics is the term applied to the description of variables for a sample of a study, with the intention to provide the summarised behaviour and features of the sample or data in the study (Saunders et al., 2009). The descriptive statistics will be calculated to understand and interpret the differences between the various comparison portfolios. The descriptive statistics that will be calculated are the mean, median, standard deviation, maximum value, minimum value, the probability distribution of returns, skewness, and kurtosis.

3.4.6.7. Calculation of Metrics Utilised

Various metrics will be calculated and computed in order to make comparative assessments of the alternative portfolios being considered. The various metrics calculated will shed light on multiple frames of analysis to allow the author to be able to draw detailed conclusions regarding the outcomes of the various comparator portfolios for the perspectives and requirements of a multitude of investors.s The metrics will begin with the geometric return and standard deviation being calculated, after which the metrics for return and risk adjustments will be considered. The final calculations and computations will aim to add greater insight into the analysis by assessing return distributions, correlations to Equity, and optimal portfolios with visual representations via efficient frontiers.

3.4.6.7.1. Geometric Returns

One of the outcomes of a potentially superior portfolio would be considered a higher ending wealth level of the investment for the investor. The geometric mean is a measure of central tendency which makes an adjustment for the volatility of the data, which ensures that the ending wealth level experienced by a client is achieved (Keedy, Bittinger, Smith & Nelson, 1981:292). The geometric mean is lower than the arithmetic-mean by a level of half the volatility. The appropriate use of a geometric mean is when one wishes to consider the rate of change over time for a variable (Keller, 2012). The outcomes of the test will be compared for each comparator portfolio to assess which portfolio provided a larger ending wealth level.

$$\left(\frac{Ending\ Index\ Value\ (t+1)}{Begin\ Index\ Value\ (t)}\right)^{\left(\frac{1}{N}\right)} - 1 \quad [3.3]$$

where:

N = Number of observations

t = Time period

Ending Index Value = Taken from indices created for the end of rolling period

Begin Index Value = Taken from indices created for the start of rolling period

3.4.6.7.2. Standard Deviation

The variability of returns will then be assessed in order to make comparative assessments of the volatility of the return profile over time, and this will be assessed by standard deviation, which provides a standardised measure to assess the dispersion of data around its central measure (Galton, 1886). Standard deviation is defined as the square root of the average squared variance of observations from the mean of the sample or population (Blanchett, n.d.).

$$\sigma = \sqrt{\frac{\left(\sum_{n}^{x=1}(x-\mu)^2\right)}{N-1}} \quad [3.4]$$

where:

X = observation for the period

μ = the expected value as represented by the average

N = Number of observations

Standard deviation will be calculated for all four portfolios and for all sub-periods analysed in the study. The standard deviation will form part of the standard descriptive statistics measures calculated.

3.4.6.7.3. Sharpe Ratio

Once an investor has both return and risk, informed decisions regarding the trade-off between the two can be made. The return per unit of risk will be considered by the Sharpe ratio (Sharpe, 1966). The Sharpe ratio measures the return that exceeds the risk-free rate, and then takes the values relative to that of the portfolio's standard deviation, with a higher Sharpe ratio indicating greater marginal benefit for portfolio risk taken (Goodall et al., 2015), and is suitable for a diversified portfolio. The Sharpe ratio is an appropriate ranking measure to illustrate the profile of the marginal return benefit to risk taken.

$$Sharpe\ Ratio = \left(\frac{Rp-Rf}{\sigma p}\right) \qquad [3.5]$$

$$\boldsymbol{\sigma} = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(Xi-u)^2} \qquad [3.6]$$

where:

Rp = Portfolio return for period *i*

Rf = Risk-free rate for period *i* (proxied by STeFI Call)

σp = Portfolio standard deviation for period *i*

μ = Average of all Xi returns

Sharpe ratios will be calculated for all portfolios and sub-periods and will form part of the risk-adjusted return metrics.

3.4.6.7.4. Sortino Ratio

Investors may not consider all risk to be associated with bad outcomes and will associate adverse outcomes to be problematic with upside outcomes to be a benefit to the portfolio. This consideration will be assessed via the Sortino ratio (Sortino & Price, 1994). The Sortino ratio makes an adjustment for the penalising of deviations to the downside of the expected or targeted returns and assumes that investors are not as punitive to upside surprises that result from the portfolio (Rollinger & Hoffman, 2015). When a return distribution is non-normal, the Sharpe ratio may not result in a true reflection of the portfolio risk, depending on the direction of the skew. As a result, the Sortino ratio will help assess the downside deviations the investors will need to bear relative to return received.

$$Sortino\ Ratio = \left(\frac{Rp - Rf}{\boldsymbol{\sigma downside}}\right) \quad [3.7]$$

$$\boldsymbol{\sigma downside} = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(\min(0, Xi - T)^2)} \quad [3.8]$$

where:

Rp = Portfolio return for period *i*

Rf = Risk-free rate for period *i* (proxied by STeFI Call)

σp = Portfolio downside standard deviation for period *i*

T = Target return

Sortino ratios will be calculated for specific sub-periods and will form part of the risk-adjusted return metrics.

3.4.6.7.5. Modigliani Risk-Adjustment

Should an investor wish to make comparisons to a given benchmark or comparator portfolio, the investor also has the option to adjust the return levels to that of the benchmark to ensure that returns are compared for a given risk level scaled to the benchmark point. This will be done via the Modigliani risk-adjustment (Modigliani & Modligliani, 1997).

The risk-adjusted performance (RAP) measure equates the risk level of the comparative portfolio to that of the benchmark selected for comparison purposes (Liano, 2000). The Modigliani risk-adjusted performance will assist in comparisons of portfolios by adjusting the return levels to that of Equity in order to help readers make comparisons against Equity as a benchmark.

$$M' = \left(\frac{\sigma p}{\sigma i}\right)(Ri - Rf) + Rf) \quad [3.9]$$

where:

Rp = Portfolio return for period i

Rf = Risk-free rate for period i (proxied by STeFI Call)

σp = Portfolio downside standard deviation for period i

T = Target return

Modigliani risk-adjusted performance measures will be calculated for all portfolios and specific sub-periods and will form part of the risk-adjusted return metrics.

3.4.6.7.6. Treynor Ratio

Should an investor not want to consider total risk, in the form of standard deviation, an investor can consider the use of systematic risk to adjust returns against. This is measured via the use of the Treynor ratio (Treynor, 1965).

The denominator in the Treynor ratio highlights the beta of the portfolio to the market, which is assumed to be the chosen measure of risk (Goodall et al., 2015); the market will be represented by the FTSE/JSE All Share SWIX Index for the study. The portfolio beta will be calculated using the SLOPE function in the Microsoft Excel environment.

A portfolio which has a beta of 1 will move in tandem with the market, while a portfolio which has a beta of greater or less than 1 will rise or fall proportionally faster or slower, respectively, than the market. For the Treynor ratio, the excess return above the risk-free rate is compared relative to the portfolio beta. The Treynor ratio will assist in making comparisons again the Equity benchmark given the sensitivity of the comparators to Equity.

$$Treynor\ Ratio = \left(\frac{Rp - Rf}{\beta p}\right) \qquad [3.10]$$

where:

Rp = Portfolio return for period i

Rf = Risk-free rate for period *i* (proxied by STeFI Call)

βp = Portfolio beta for period *i*

Treynor ratios will be calculated for all portfolios and specific sub-periods and will form part of the risk-adjusted return metrics.

3.4.6.7.7. Jensen's Alpha

The aim of an investor will be to invest in a portfolio which can provide alpha relative to the risk taken or comparative benchmark. The comparative portfolios will be assessed against with the risk relative to the Equity portfolio in order to assess the returns provided. This assessment will be done via Jensen's alpha (Jensen, 1967).

Alpha is the portfolio return that cannot be explained by the market risk, more particularly by CAPM, for a level of beta and market return (Goodall et al., 2015).

$$Jensen's\ Alpha\ (\alpha) = Rp - [Rf + \beta p(Rm - Rf)] \qquad [3.11]$$

where:

Rp = Portfolio return for period *i*

Rf = Risk-free rate for period *i* (proxied by STeFI Call)

βp = Portfolio beta for period *i*

Rm = Return of the market for period *i*

Rf = Risk-free rate for period *i*

Jensen's alpha will be calculated for all portfolios and specific sub-periods and will form part of the risk-adjusted return metrics.

3.4.6.8. Return Profile Distributions

The distribution of portfolio returns can be assessed via the standard deviation metric calculated, however, this single metric does not give an investor insight into the shape of the distribution of outcomes and the tail events that an investor can potentially experience. The tail events and relative skewness of the outcomes are important considerations an investor needs to factor in when making decisions regarding trade-offs.

The calculation of the distribution of return profiles for the portfolios will be calculated in the Microsoft Excel environment, with the following functions being utilised:

- Skew returns: the skewness of a distribution highlights the distribution around the mean. A positive skewness is indicative of the distribution having a tail extending towards positive values, while a negative distribution is indicative of a distribution extending towards negative values.
- Kurt: returns the kurtosis of a data set, which indicates the weight of the observations in the tail of a distribution. This is indicated by the peakedness or flatness of the distribution and is compared to a normal distribution with a positive kurtosis value being indicative of a relatively peaked distribution and a negative kurtosis being indicative of a relatively flat distribution.
- Graphical depiction of distributions will be compiled through the following process
    - Frequency: calculates how often values occur within a range of values and then returns a vertical array of numbers having more than 1 element in the Bins_Array.
    - Bins_Array identifies the groupings of the observations within the data set.
    - A histogram chart will be created to highlight the distribution of returns.

3.4.6.9. Correlation

Correlation is a quantitative method that provides an estimation of the strength of a linear relationship between two variables, with the output ranging from between “+1”, indicating a perfectly positive linear relationship, and “-1”, indicating a perfectly negative linear relationship (Saunders et al., 2009). It is important to note that should the correlation coefficient be equal to zero, it does not imply that there is no relationship between the two variables but rather implies that there is no linear relationship between the two variables.

It must be noted that a high correlation does not imply that there is causality between one variable and another, although there are measures, such as the coefficient of determination, which statistically explains the variation of the dependent variable by assessing movements in the independent variable (Saunders et al., 2009). This, however, also does not imply causality between the dependant and independent variables.

DeFusco, McLeavey, Pinto and Runkle (2017) advise that limitations attached to correlation assessments are that:

- Correlation can only make sound assessments of linear data, however, data may have a non-linear relationship between two variables;
- Correlation assessments are sensitive when outliers are present in the sample set;
- Correlation does not imply causation in the relationship between the dependant and independent variables used for the test; and
- Correlation assessments can illustrate spurious correlation, which is a term used to indicate that possibly random chance occurred in the data. For example, there is a common factor included in both data sets which may need to be removed, or that both the variables move in relation to a third variable not included in the study.

3.4.6.10. Portfolio Optimisations and Frontier Generation

Markowitz (1952) put forward that investors need to consider both risk and return in their evaluation of investments for consideration in a portfolio. By considering the optimal portfolio weightings to various asset classes, and the associated visual representation, investors can consider the trade-offs between return and associated risk levels for portfolio decisions. Further to this forward-looking trade-off, investors can assess historically if any reward was obtained optimally via investing into risky assets in isolation, such as Equity.

Portfolio returns will be based on the sample period being considered for the data, and the return will be on an ex post basis given the actual performance of the asset classes.

$$Rp = \sum_{i=1}^{n} WiRi \quad [3.12]$$

where:

Rp = Portfolio return for period *i*

Wi = Weight of asset *i* in the portfolio

Ri = Return associated with asset *i*

In order to compute the optimal portfolio, which will be the portfolio that achieves the highest level of return for a given level of portfolio standard deviation, the associated standard deviation for each targeted return level needs to be computed. The standard deviation will be calculated using Microsoft Excel array functions and matrix multiplication functions based on the below portfolio.

$$\sigma p = W' \Omega \, W \quad [3.13]$$

where:

σp = Standard deviation of the portfolio

Ω = k X k covariance of matrix returns

W' = Transposed k X 1 vector of asset weights

W = k X 1 vector of asset weights

In order to calculate the required covariance matrix, Ω, Microsoft Excel array functions and matrix multiplication functions will be utilised to apply the required arithmetic steps to the sample data.

$$s = \frac{A^T . \, A}{M-1} \quad [3.14]$$

where:

s = Covariance matrix

A^T = Transpose of the matrix of demeaned returns

A = Matrix of demeaned returns

M = Number of sample points in the data time-series

For the efficient frontier generation, which will be for the range from the minimum to the maximum of the returns from the data sample, the portfolio optimisation will make use of VBA to step through all returns. The returns for the data will be defined as the Range via Dim rngObjectCells. All optimisations will be solved for by using the Microsoft Excel solver function, with the method of solver optimisation being GRG Nonlinear.

Portfolio constraints will be placed onto the optimisation to ensure that the portfolio weights are summed to 100%, that no short-sales are permissible, and that the Sharpe ratio for each return point will be maximised. The relevant portfolio standard deviation value, as well as associated asset class weights assigned to the optimal point will be recorded for consideration. Both the efficient frontier and asset allocation composition maps will be visually illustrated for consideration in the study's findings.

3.5. Validity of Data

The quality of the data provided is essential for a study that is quantitative in nature and deemed to be crucial for the integrity of a study's conclusions (Greener, 2008). When considering validity of the data, the researcher needs to consider face validity, construct validity and internal validity (Greener, 2008).

3.5.1. Validity of Measurement

Validity of measurement is concerned with whether the methods utilised are appropriate for the analysis of the research question and objectives in order to ensure that the tests actually measure what one intends them to measure (Greener, 2008). This study will employ the following methods of data analysis, which are supported by both past literature (Markowitz, 1952; Idzorek, 2006; Gibson, 2007; Benninga, 2014) and common usage in practice:

- Index build and rebalancing; the rebalancing periods will be quarterly and will restore the asset allocation of the portfolios to their original weights.
- Data table analysis.
- Rolling period analysis – correlations, risk and return metrics.
- Mean-variance analysis and VBA logic – for the generation of the efficient frontier and asset allocation composition map, in terms of both quantitative data and graphical display.

3.5.2. Reliability

Should the reliability of the data be questionable, this would bring the entire study into question given the potential for inaccurate findings. Reliability is another way of making reference as to whether the study is both consistent and repeatable over time, and is required for research studies Industrial Development Corporation (2017) and (Greener, 2008). Morningstar is considered a reliable institution that is utilised and relied upon by the investment professionals in both research and asset management. Therefore, the data used for this study is reliable.

3.6. Ethical Considerations

All data utilised for the study is obtained with permission from the data providers given the author paid for access to the Morningstar database through the researcher's employer. Permission to use the data was obtained from both the Chief Executive Officer and Chief Investment Officer of the researcher's employer. Further to the above, special consideration was paid the point of plagiarism to ensure that all of the work above is the original work of the author, and where another's work has been used, it has been duly cited.

3.7. Limitations

The techniques utilised in the study are fairly comprehensive in their coverage of the various points of analysis. However, the study itself is limited by the following considerations:

- This study is limited to asset allocation decisions for domestic asset classes to remove the complexity associated with foreign currency conversions.
- The study does not directly assess the theoretical underpinning for including additional asset classes and securities in a portfolio. Diversification benefits are assessed, but not specifically from a theoretical basis before the fact.
- This weighting scheme for the portfolio allocations to non-Equity asset classes is on an equal-weight basis. This simplifies the study to avoid subjective factors regarding short-term tactical allocations to asset classes based on views.
- Allocations to factor exposures, as compared to asset allocation, is not considered for the purposes of this study.
- The study does not include contributions from the investor on a recurring basis; the reason for this is due to the varying effects that different values between investors can have on the Internal Rate of Return of an investment. Rolling periods are adopted to remove the sensitivity of particular starting points for the investments.
- Trading costs, taxation, and investment in additional asset classes and securities are ignored for the purposes of this research paper.
- The study is limited to the selected data, the time-period and the methods utilised to obtain the results for interpretation and conclusion.

The analysis of the data is based on accepted investment management metrics in addition to peer-reviewed research in the investment management field. Additional methods of analysis could potentially be applied to the same data set leading to potentially different relative results and, therefore, different conclusions.

3.8. Significance of the Study

This study's significance is derived from the assessment of whether there is any marginal benefit for an investor in deciding to invest beyond the point of multi-asset high Equity. The findings of this study will potentially have an impact on the potential investor's asset allocation decision.

This study illustrates that various reward-to-risk levels need to be considered by investors and will begin the discussion for the trade-offs associated with various asset allocation levels. This is of concern for investors for a number of reasons:

- Investors in the South African context research indicate that only 6% of retiring individuals can retire with their desired income levels (Strydom, 2007; Prinsloo, 2008; Darley, 2011). Smarter investment decisions regarding asset allocation can assist in providing increasing ending wealth levels for the average investor.
- Investors experience emotional responses to the return and risk profile of their investment over the investment time horizon; an incorrect asset allocation will cause undue stress to the investor.
- Stylised thoughts and beliefs in the investment industry need to be constantly assessed and challenged for the relevance in an ever-changing investment landscape. Studies, such as this one, aid in bringing beliefs to the current level of what the empirical evidence shows.

3.9. Summary

This study researched the risk-adjusted performance and assessment of outcomes for multiple portfolios. This studied considered Equity to be a departure point and introduced multiple asset classes at the margin in order to derive risk-adjusted return comparisons. Consideration was given to the optimal asset allocation to Equities on an ex post basis. This study is both quantitative and explorative.

Data from the following existing indices were utilised for the study:

- FTSE/JSE All Share SWIX Index
- FTSE/JSE SA Listed Property Index
- BEASSA All Bond Index

This data is used to calculate various standard metrics, such as the geometric returns, standard deviation, distribution of return profiles, ending wealth levels using index build methodology, risk-adjusted return metrics for the various asset classes and multi-asset portfolios, and efficient frontiers from the ex post sample data.

After comparing the above metrics, four portfolios were built for the purposes of relative evaluation to answer the research questions put forward in the study. All multi-asset portfolios were rebalanced back to target weights on a quarterly basis.

The first portfolio is an Equity-only portfolio, which will be used as a benchmark for the metrics and discussion points. The second portfolio is a low-Equity multi-asset portfolio. The third portfolio is a medium-Equity multi-asset portfolio. The fourth, and final portfolio, is a high-Equity multi-asset portfolio. For all multi-asset portfolios, the Equity weight will be based on the Association for Savings and Investment South Africa (ASISA) guidelines for Equity allocation. Weightings to all other asset classes were equally split amongst the remainder of the weight.

Based on the analysis of the data, interpretation by the author was then made concerning the risk-adjusted returns of the various portfolios. The intention was to asses at which the marginal return was affected by varying the allocation to Equity.

The next chapter will discuss the results of findings from the above-mentioned techniques and metrics.

Chapter Four
Results and Findings

4.1. Introduction

The previous chapter discussed the research methodology. This chapter will present the results obtained from the tests performed, with the final chapter of the study presenting the conclusions.

4.2. Description of the Sample

The sample utilised for the study is the selection of indices which served as proxies for South African asset classes in aggregate, with these indices being the FTSE/JSE All Share SWIX, FTSE/JSE SA Listed Property, and BEASSA ALBI. The weekly performance data for the aforementioned indices were obtained from the 01st of June 2002 to the 31st of December 2017, with all tests being performed in the Microsoft Excel environment and supporting infrastructure (such as VBA). The sample data includes the GFC and is representative of investment performance over a full cycle.

4.3. Analysis of the Data

In the following sections, the relevant performances of the asset class proxies under consideration will be transformed into indices based at the initiation of the starting period. The asset class proxy’s return and risk metrics will first be considered in isolation, followed by the metrics for the various comparator portfolios being constructed.

Risk-adjusted performance metrics will be calculated for all portfolios and associated outcomes. For the purposes of the rolling period assessments, and to limit the number of possible comparison portfolios, the three comparator portfolios will be selected based on the guided Equity weighting by ASISA. However, to overcome the limitation imposed by three comparator portfolios, a data table assessment will be conducted varying the weight allocated to Equity from 0% to 100%, with the remainder being allocated equally to alternative asset classes.

The analysis of the data will also consider the return distribution profiles of the three comparator portfolios against that of the Equity-only portfolio. To add depth to the various interpretations, the rolling Correlation to Equity and the rolling Equity risk premium will also be assessed.

The final assessment will be the efficient frontiers for the ex post performance and the risk of the asset classes will be considered. The efficient frontiers will be generated over the full period, the first and second half of the date range, the pre-GFC period and finally the post-GFC period respectively.

The analysis and findings of the above will be presented in both a graphical and tabular format, with the findings and conclusions will being presented in Chapter 5.

4.4. Asset Classes in Isolation

The asset classes considered for the study were first assessed in isolation in order to obtain their own individual descriptive statistics; this assessment in isolation will act as a departure point for the assessment of the multi-asset portfolios. Asset class returns were converted into indices with the base being 100 at the inception of the period under consideration.

In Figure 4.1, the cumulative returns for the asset classes are displayed. SA Listed Property has provided the largest cumulative return over the period of the sample period, well ahead of all other asset classes, and specifically Equity.

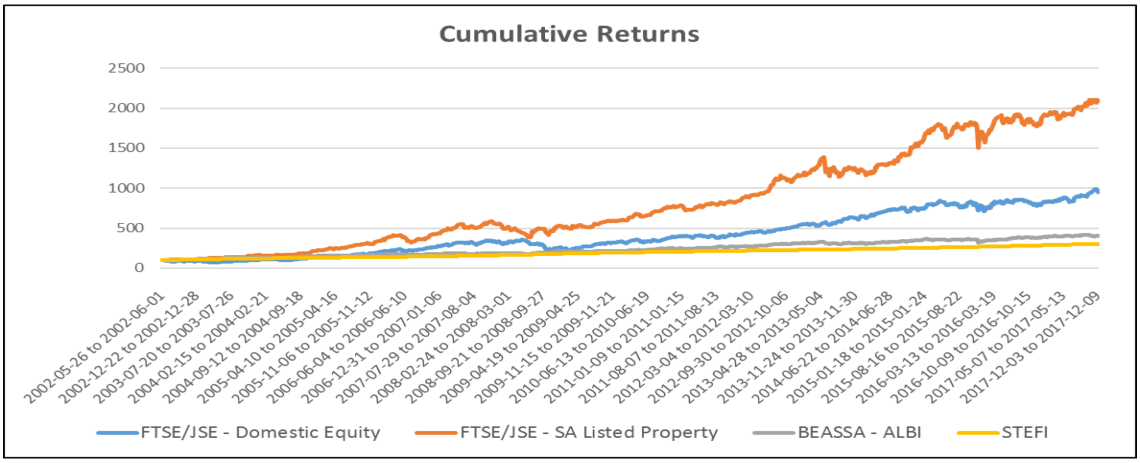

Figure 4.1: Cumulative Asset Class Returns for the Full Period (2002/06/01 – 2012/12/15)

Source: Morningstar and author's own deductions

Figure 4.2 illustrates the return and risk scatter plot for each individual asset class relative to one another for the asset classes considered, and is the graphical depiction of Table 4.1 below. Cash provided the lowest return accompanied by the lowest volatility, followed by Bonds with a marginally higher return and increased volatility. Both Equity and Property experienced increased levels of return, which were accompanied by increased levels of volatility. Equity experienced the largest levels of annualised volatility over the sample period, without providing the largest annualised return.

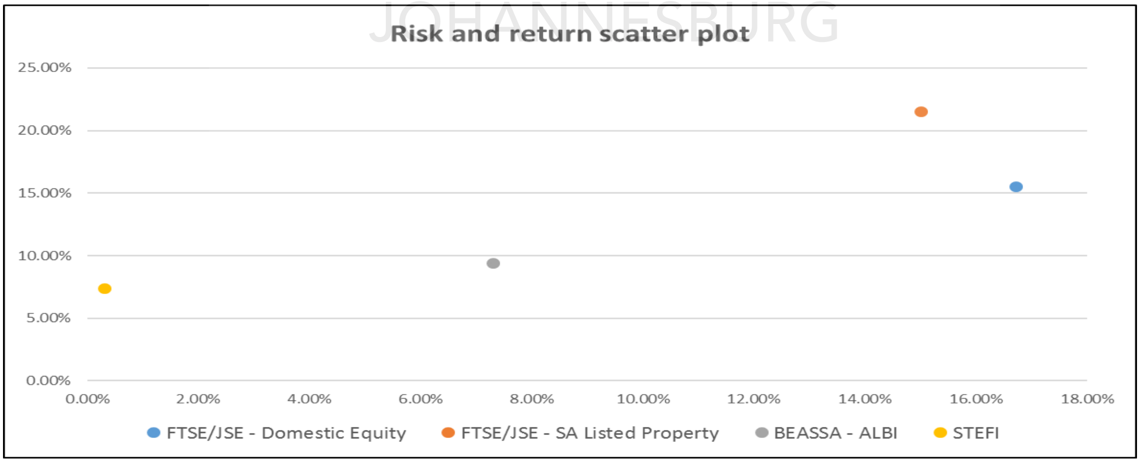

Figure 4.2: Risk and Return Scatter Plot for the Full Data Period (2002/06/01 – 2012/12/15)

Source: Morningstar and author's own deductions

The sample period asset class annualised returns and risks are summarised in tabular format in Table 4.1, in addition to the lowest and highest weekly returns being provided. It is observed that Equity has the largest weekly return, while Property has the lowest weekly return. It is also observed that Bonds have a lower weekly drawdown than that of Equity, which is not generated expected from the asset classes with relatively more predictable and stable cash flows. A final observation is that Cash has no negative drawdown over the data period.

Table 4.1: Risk and Return Summary for the Full Data Period (2002/06/01 – 2012/12/15)

	Geometric Annualised Returns	Annualised Standard Deviations	Lowest Weekly Return & Year	Highest Weekly Return & Year
FTSE/JSE - Domestic Equity	15.53%	16.72%	-9.14%: 2008-10	14.27%: 2008-10
FTSE/JSE SA Listed Property	21.50%	15.01%	-12.66%: 2015-12	12.88%: 2008-07
BEASSA - ALBI	9.39%	7.30%	-10.76%: 2015-12	7.57%: 2015-12
STEFI	7.38%	0.31%	0.08%: 2011-04	0.26%: 2003-01

Source: Morningstar and author's own deductions

Sorting the asset classes in descending order of performance, based on calendar years, indicates that no single asset class consistently performs the best in any given calendar year. Over the sample period, in terms of the calendar year performance, Equity is the best performing asset class with 6 observations being the largest return for the calendar year. This is followed by Property with 5 observations, Bonds with 2 observations, and Cash with 1 observation.

Table 4.2: Best and Worst Performing Asset Class per Calendar Year

	2003	2004	2005	2006	2007	2008	2009
Best	Equity	Equity	Equity	Property	Equity	Cash	Property
	Property	Property	Property	Equity	Property	Bonds	Equity
	Bonds	Bonds	Bonds	Cash	Cash	Property	Cash
Worst	Cash	Cash	Cash	Bonds	Bonds	Equity	Bonds
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Best	Equity	Bonds	Equity	Property	Property	Property	Bonds
	Property	Property	Property	Equity	Equity	Cash	Property
	Bonds	Cash	Bonds	Cash	Bonds	Equity	Cash
Worst	Cash	Equity	Cash	Bonds	Cash	Bonds	Equity

Source: Morningstar and author’s own deductions

4.5. Portfolio Construction

The construction of portfolios was based on allocation to risky assets comprising of Equity, Property and Bonds, which meant that allocations to Cash were excluded. The logic for doing is based on Cash being a risk-free asset with low correlations to risky assets; the additional allocation considerations would simply be linear considerations against the various outcomes for the risky assets.

The results for the associated cumulative returns are illustrated in Figure 4.3. There are periods where the Equity-only portfolio provides the largest cumulative return, such as mid-2006 until late-2008. Thereafter, the Equity-only portfolio has offered one of the lower returning portfolios on a cumulative basis. This finding goes against the stylised belief that one needs to overweight Equity in a portfolio to achieve the largest cumulative ending wealth level over time.

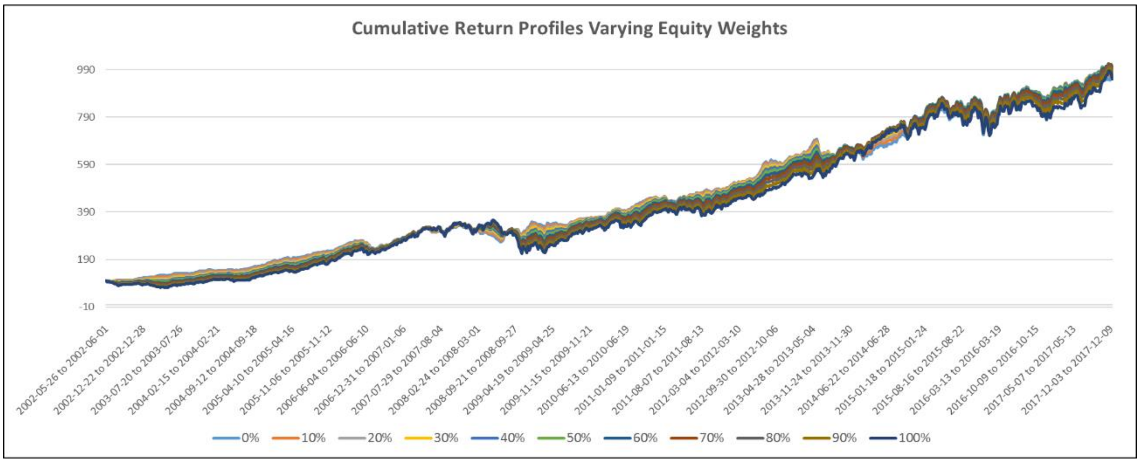

Figure 4.3: Cumulative Returns with Varied Equity Weights for the Full Data Period (2002/06/01 – 2012/12/15)

Source: Morningstar and author's own deductions

Observing the rolling 1-year returns, with weekly data points, for the various portfolios illustrates that the Equity-only portfolio varies over time from being the portfolio which delivers the largest return on a rolling 1-year basis, to the portfolio which delivers the lowest return on this same basis. This varied relative performance illustrates that Equity has a wide dispersion of outcomes on a relative basis, and that one cannot simply obtain a higher rolling return on a 1-year basis by overweighting Equity within an investment portfolio. No persistent outperformance of one single portfolio is evident.

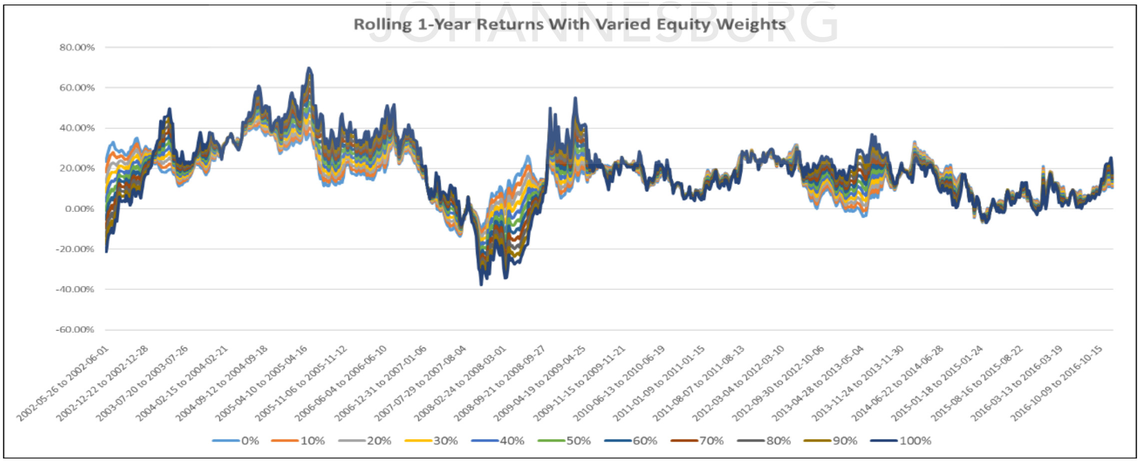

Figure 4.3: Rolling 1-year Returns with Varied Equity Weights for the Full Data Period (2002/06/01 – 2012/12/15)

Source: Morningstar and author's own deductions

Observing the rolling 1-year standard deviations illustrated in Figure 4.4 below, one notes that Equity and Property dominate the higher region of the graph in being the most volatile of the comparators. This illustrates the fact that Bonds are less volatile than Equity and Property given that their future revenue stream, in the form of dividends, is defined in advance, and that multi-asset portfolios offer diversification benefits when the asset classes are less than perfectly correlated. This less than perfect correlation results in lowered rolling standard deviation outcomes over time.

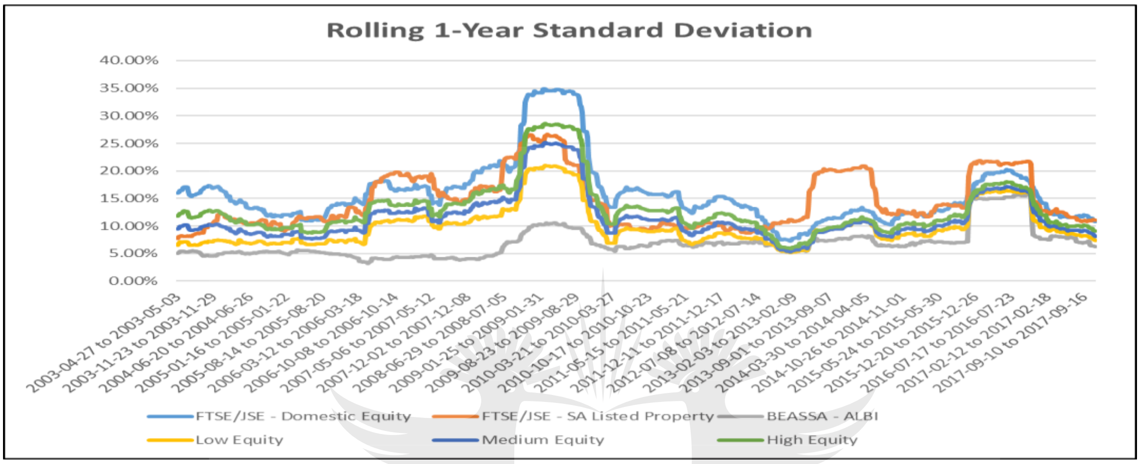

Figure 4.4: Rolling 1-year Volatility for the Full Data Period (2002/06/01 – 2012/12/15)

Source: Morningstar and author's own deductions

Table 4.3 provides comparisons of various metrics for portfolios with weights to Equity varying from 0% to 100%. The ending wealth levels of the portfolios peaked at 998.06, starting from a base of 100, for the portfolio with 50% allocation to Equity; the portfolio with 100% allocation to Equity provided the lowest cumulative return with an ending wealth value of 950.58. The portfolio with the highest annualised geometric return is also the portfolio which ended in the highest ending wealth level, and the lowest ending wealth level is associated with the lowest annualised geometric return. This corroborates with expectations.

The portfolio with the lowest annualised standard deviation is the portfolio with 10% allocated to Equity, with the largest annualised standard deviation being provided by the portfolio with 100% allocation to Equity.

The reward-to-risk ratio for the various solutions is the highest for the portfolio with 10% allocation to Equity, and then subsequently decreased for each incremental 10% allocation to Equity, with the portfolio allocating 100% to Equity providing the lowest reward-to-risk ratio.

Table 4.3: Summary Statistics with Varied Equity Weights for the Full Data Period (2002/06/01 – 2012/12/15)

Weight to Equity	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Ending Wealth Level	955.25	970.69	982.82	991.50	996.61	998.06	995.83	989.91	980.33	967.18	950.58
Annualised Geometric Mean	14.91%	15.02%	15.11%	15.17%	15.21%	15.22%	15.20%	15.16%	15.09%	15.00%	14.87%
Annualised Standard Deviation	9.62%	9.46%	9.55%	9.89%	10.45%	11.20%	12.10%	13.13%	14.26%	15.46%	16.72%
Reward to Risk Ratio	1.55	1.59	1.58	1.53	1.46	1.36	1.26	1.15	1.06	0.97	0.89

Source: Morningstar and author's own deductions

Figure 4.5 illustrates the rolling 1-year Sharpe ratios for the below four portfolios. It is observed that the Equity-only portfolio sporadically appears as the portfolio with the greatest Sharpe ratio over the sample period. The rolling 1-year Sharpe ratio points to a potential consideration that an increased return at a disproportionately larger increase in risk results in less optimality of the portfolio, in terms of risk and return, as an investor increases their allocation to Equities in a portfolio. This may further speak to an efficient frontier, which may offer diminishing marginal returns as an investor moves down the risk spectrum to the asset providing the greatest level of return achievable.

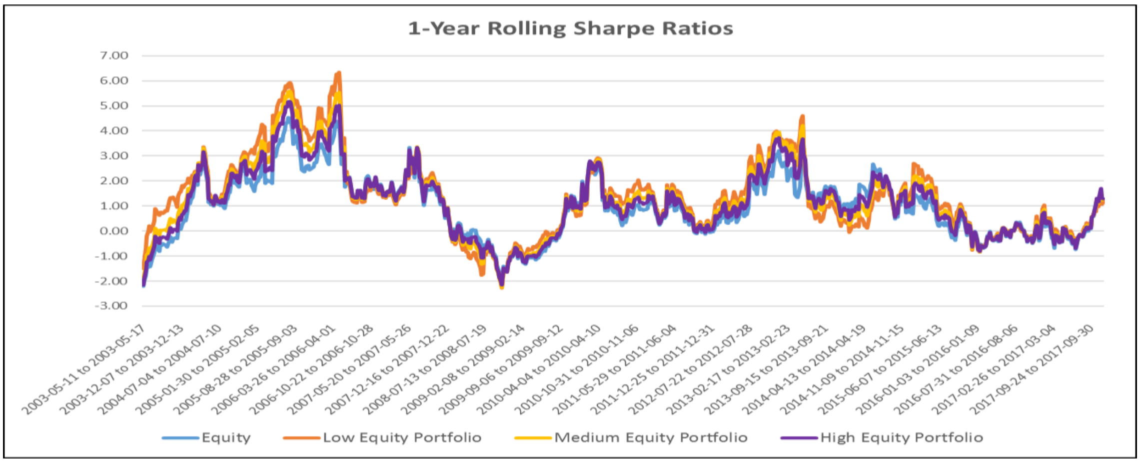

Figure 4.5: Rolling 1-year Sharpe Ratios

Source: Morningstar and author's own deductions

Observing the average rolling 1-year Sharpe ratio in Figure 4.6, illustrates that the Equity-only portfolio has the lowest average rolling 1-year Sharpe ratio of the four portfolios considered, with the low-Equity portfolio having the highest ratio, decreasing in order as the Equity proportion of the portfolios increase. This finding implies that an Equity-only portfolio may rarely sit on the Capital Allocation Line, and that the point of tangency will occur on average in the region of the low-Equity points on the efficient frontier.

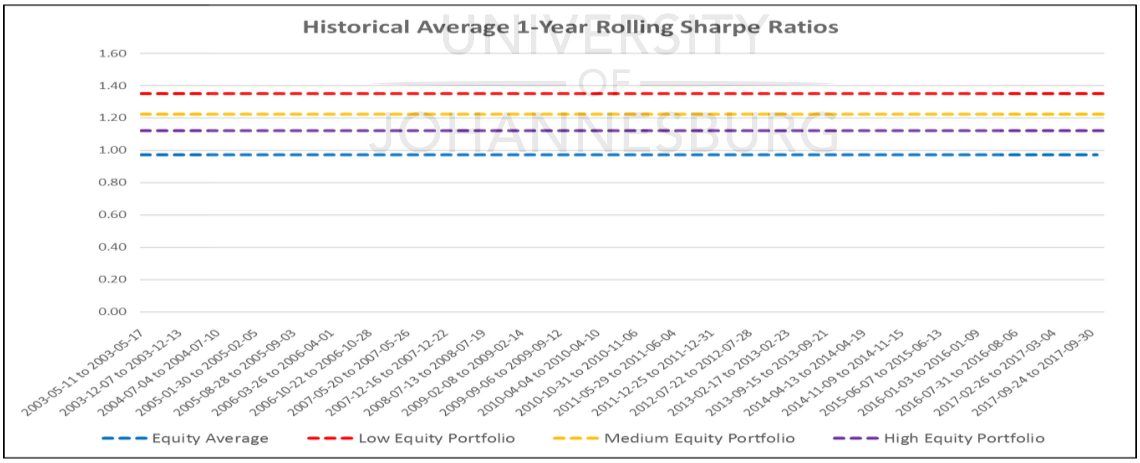

Figure 4.6: Average Rolling 1-year Sharpe Ratios

Source: Morningstar and author's own deductions

In order to assess whether the chosen rolling period would affect the results of the comparisons, additional rolling periods were chosen. Figure 4.7 through to Figure 4.10 illustrates the average outcomes of the rolling 3-year to rolling 10-year Sharpe ratios, respectively. Longer time horizons may be referenced with the attempt to avoid the pitfalls of reacting based on short-term volatility and emotional sentiment.

The ranking of average Sharpe ratios over all periods is consistent with the ranking over the rolling 1-year period. This finding suggests that the time diversification benefits associated with Equity over longer time horizons still do not result in the improvements in reward-to-risk ratios to exceed any of the multi-asset comparator solutions. As one moves from Figure 4.7 through to Figure 4.10, one observes that the relative average Sharpe ratio for the Equity-only portfolio narrows relative to the rolling Sharpe of the other multi-asset categories, with specific reference to the high-Equity multi-asset category. There is no significant separation in the rolling 10-year Sharpe ratio for the high-Equity multi-asset portfolio when compared against the Equity portfolio.

One also observes that the Sharpe ratios for the comparative portfolios is relatively higher for the multi-asset portfolios over the 3-year and 5-year time horizon periods when compared to the 7-year and 10-year periods, with the low-Equity multi-asset portfolio providing average rolling Sharpe ratios of approximately 1.20 and 0.8, respectively.

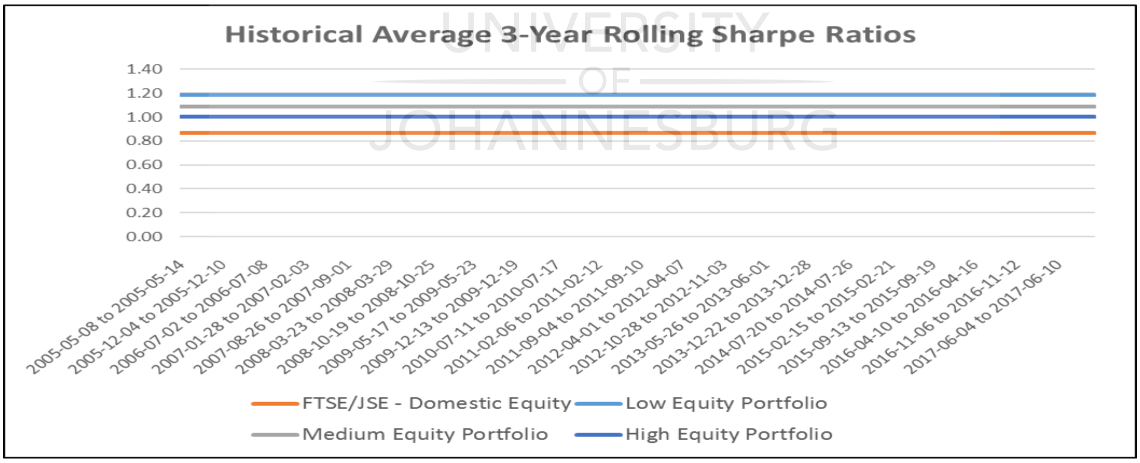

Figure 4.7: Average Rolling 3-year Sharpe Ratios

Source: Morningstar and author’s own deductions

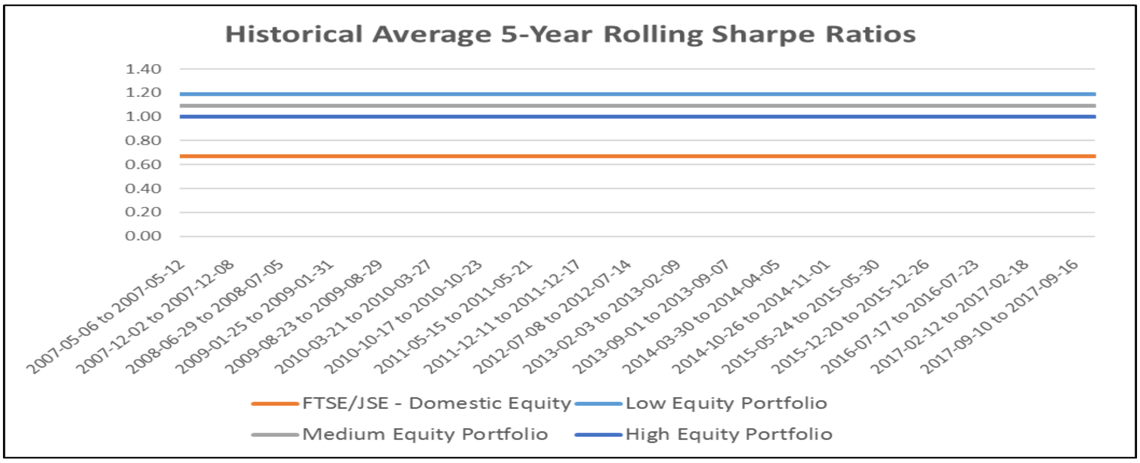

Figure 4.8: Average Rolling 5-year Sharpe Ratios

Source: Morningstar and author's own deductions

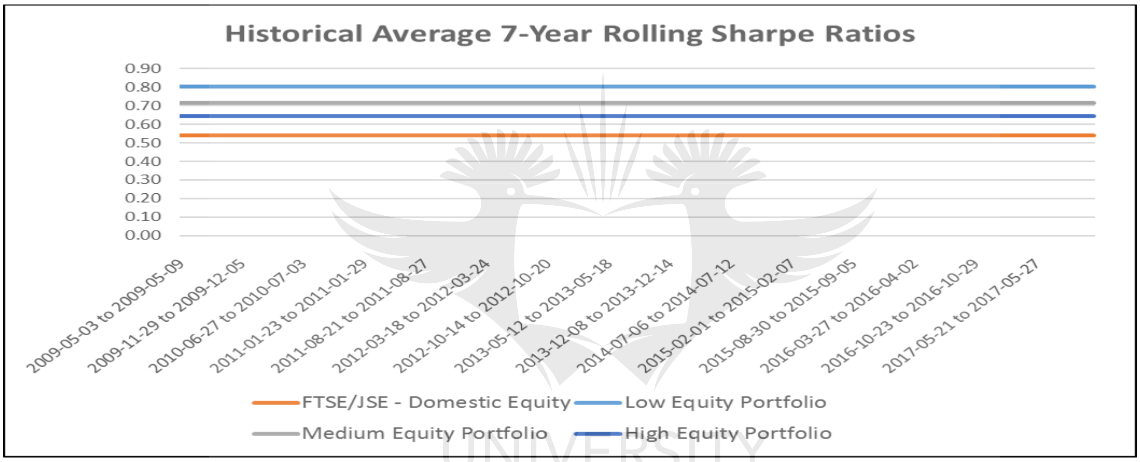

Figure 4.9: Average Rolling 7-year Sharpe Ratios

Source: Morningstar and author's own deductions

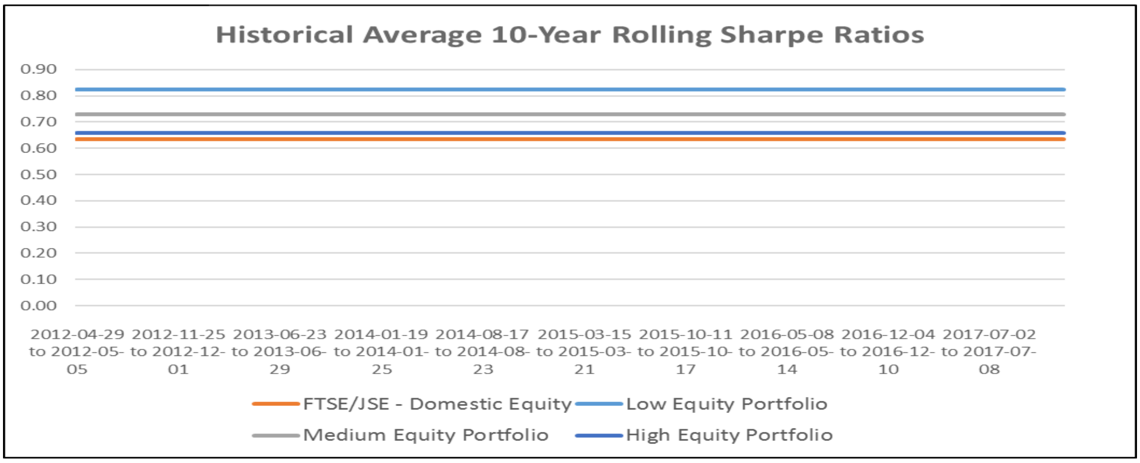

Figure 4.10: Average Rolling 10-year Sharpe Ratios

Source: Morningstar and author's own deductions

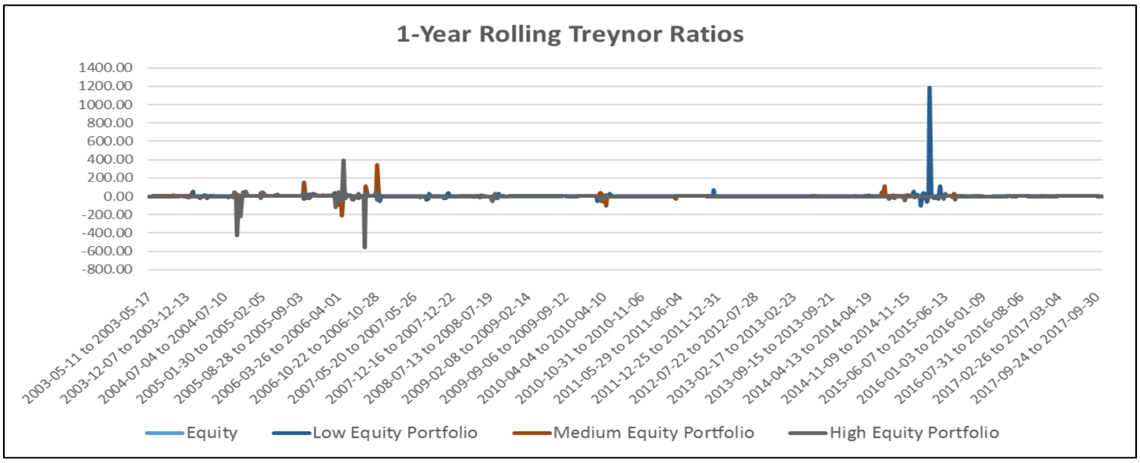

Figure 4.11: Rolling 1-year Treynor Ratios

Source: Morningstar and author's own deductions

The rolling 1-year comparative Treynor ratios presented in Figure 4.11 are not easily comparable with the eye given the spikes in the metrics during 2004, 2006, 2007 and 2016. Figure 4.12 highlights the average rolling 1-year rolling Treynor ratios, which makes the comparison easier to interpret. Figure 4.12 illustrates that the low-Equity portfolio holds the highest Treynor ratio on average from the four sample portfolios. This result supports the findings that multi-asset portfolios can generate risk-adjusted metrics larger than that of Equity in isolation. The outlier in the results is that a high-Equity multi-asset does not generate a Treynor ratio above that of Equity. The average of the 1-year rolling returns for Equity was 18.51% while the high-Equity multi-asset average of the rolling 1-year return was 17.89%, which was too low given the average rolling 1-year beta estimate of -0.08 against the Equity-only portfolio.

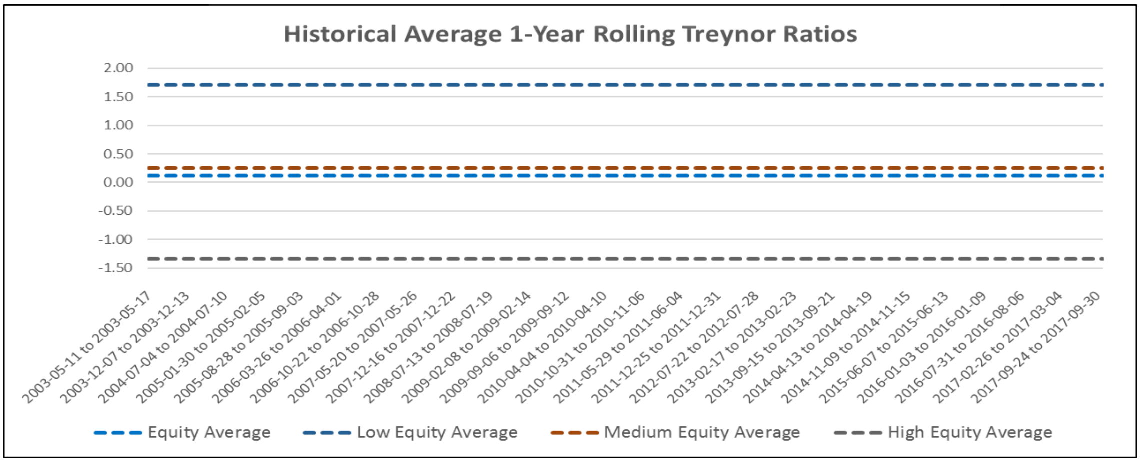

Figure 4.12: Average Rolling 1-year Treynor Ratios

Source: Morningstar and author's own deductions

Figure 4.13 illustrates the rolling 1-year Sortino ratios. The Equity-only portfolio sporadically makes an appearance as the portfolio with the largest rolling 1-year Sortino ratio of the sample portfolios. This result suggests that Equity tends to have a greater downside volatility potential and is, therefore, penalised on this basis when the portfolios are compared based on the 1-year rolling Sortino ratio.

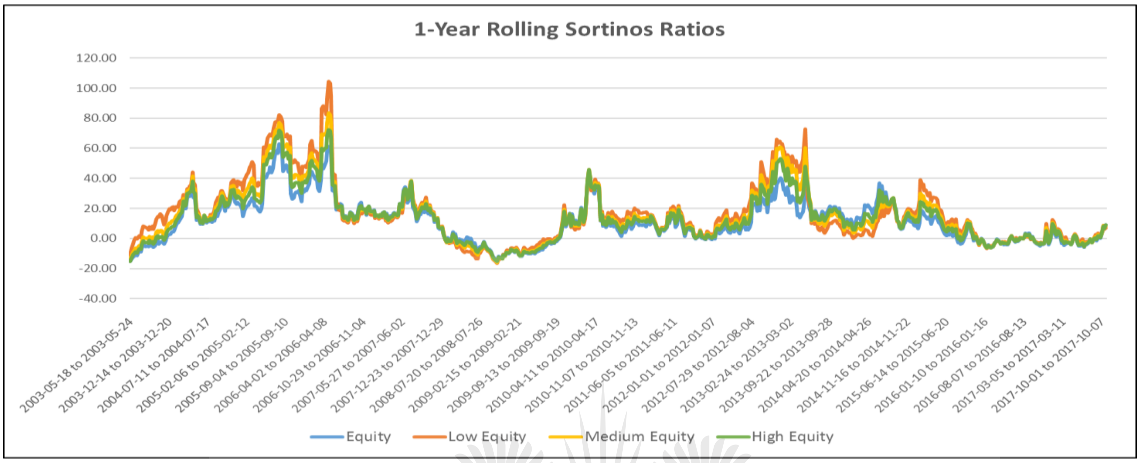

Figure 4.13: Rolling 1-year Sortino Ratios

Source: Morningstar and author's own deductions

Figure 4.14 illustrates the average rolling 1-year Sortino ratio of the sample portfolios, with the output illustrating that the low-Equity portfolio has the highest average ratio. This ranking is followed in descending order as the weight to Equity is increased. The Equity-only portfolio has the lowest average ratio over this sample period illustrating that the upside potential reward is more than offset via a disproportionately increased downside deviation number.

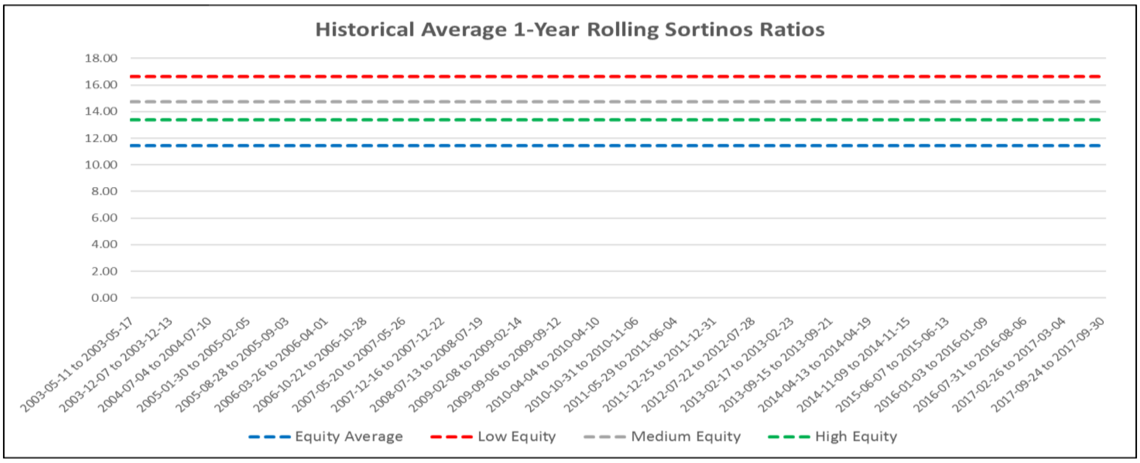

Figure 4.14: Average Rolling 1-year Sortino Ratios

Source: Morningstar and author's own deductions

Figure 4.15 illustrates the rolling 1-year Jensen's alpha for the multi-asset portfolios, which are positive for the majority of the sample period. A positive ratio indicates that a portfolio has earned a return above the level predicted based on the beta to the Equity-only portfolio.

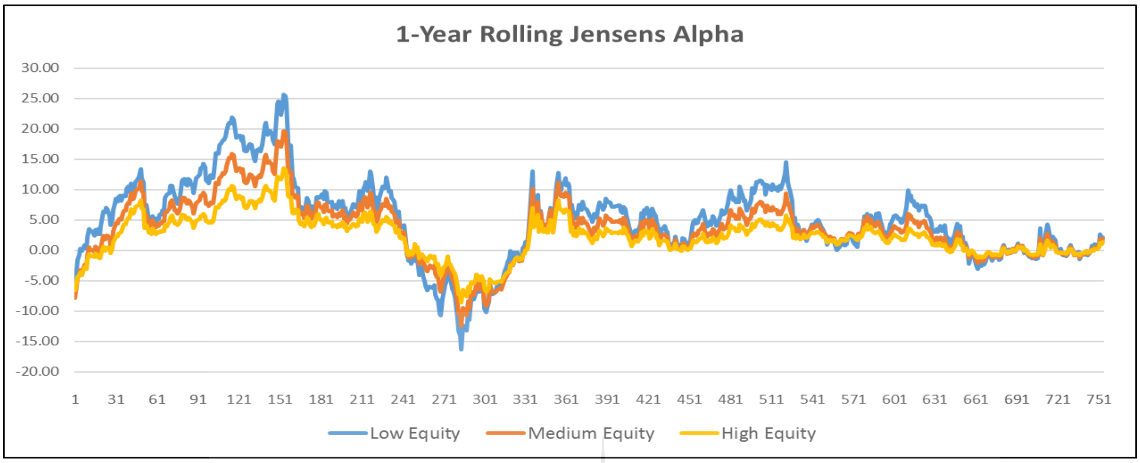

Figure 4.15: Rolling 1-year Jensen's Alpha

Source: Morningstar and author's own deductions

Taking the average of the Figure 4.15 and illustrating the results, Figure 4.16 highlights that the low-Equity portfolio has the greatest average rolling 1-year ratio, followed sequentially by medium-Equity and high-Equity portfolios. All the Jensen's alpha metrics for the multi-asset portfolios are above 1. These findings suggest that multi-asset portfolios tend to earn returns larger than what is predicted when using Equity as a comparative point, with the benefits being delivered via larger returns than expected, or via lower beta estimates to Equity than expected.

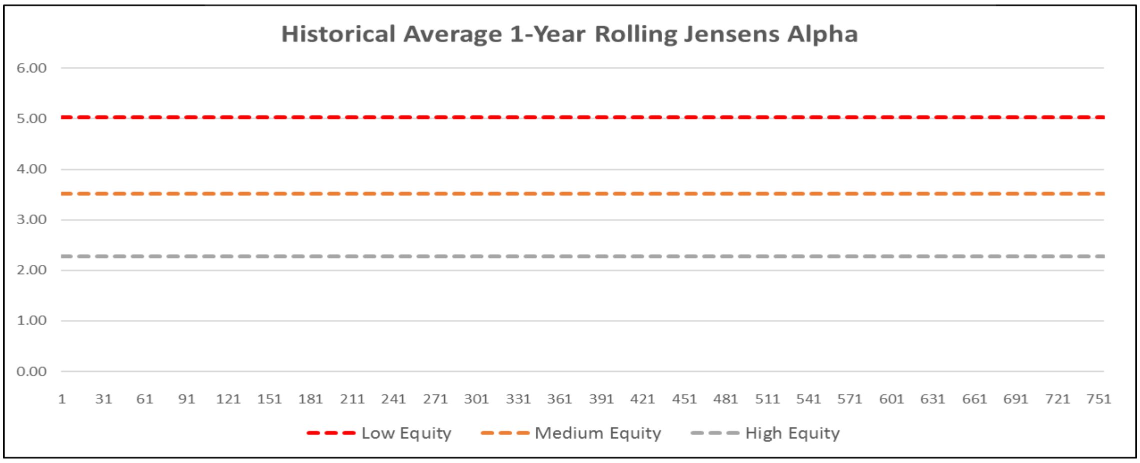

Figure 4.16: Average Rolling 1-year Jensen's Alpha

Source: Morningstar and author's own deductions

Figure 4.17 displays the rolling 1-year Modigliani risk-adjusted measure for the Equity-only and multi-asset portfolios for the sample period. It is observed that on a risk-adjusted basis equal to that of the Equity portfolio, the multi-asset portfolios have returns that are frequently greater than that of the Equity-only portfolio. This illustrates that the efficient frontier would exhibit a diminishing marginal expected return for additional units of standard deviation accepted.

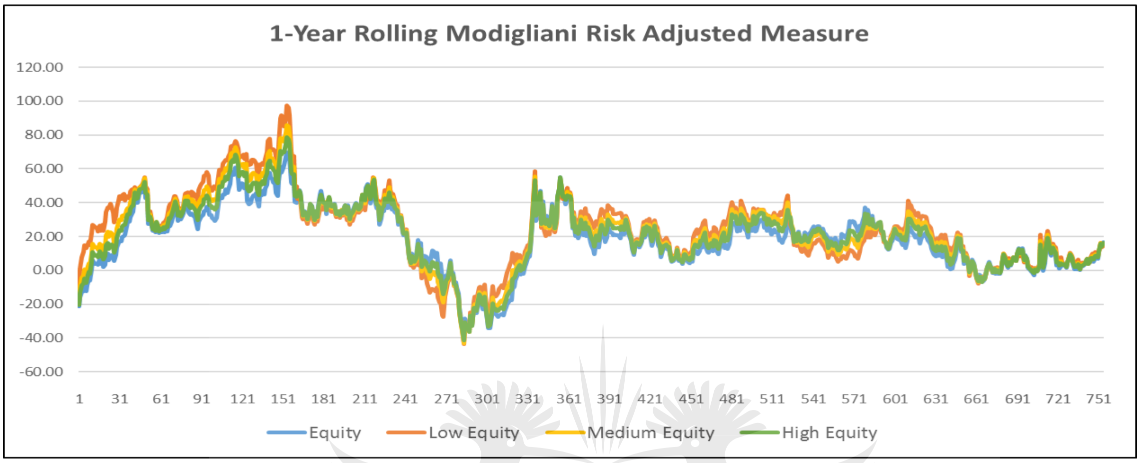

Figure 4.17: Rolling 1-year Modigliani Risk-Adjusted Measure

Source: Morningstar and author's own deductions

Taking the above risk-adjusted returns presented on a rolling 1-year, and considering the average, illustrates that the low-Equity portfolio provides the greatest risk-adjusted return of the various portfolios, with the Equity-only portfolio providing the lowest return of the sample portfolios.

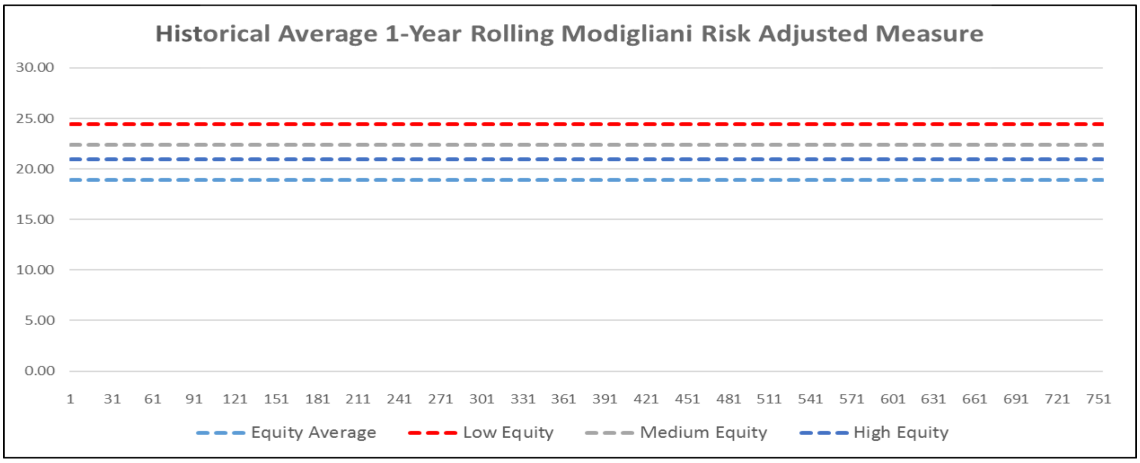

Figure 4.18: Average Rolling 1-year Modigliani Risk-Adjusted Measure

Source: Morningstar and author's own deductions

An observation of the frequency distributions of the portfolios based on weekly data for the sample period, as indicated in Figure 4.19, illustrates that the distribution with the largest peak is the low-Equity portfolio, followed sequentially by the medium-Equity, high-Equity and then the Equity-only portfolio. The distribution of returns indicates that the Equity-only portfolio has the widest dispersion of returns, and in turn offers less predictable outcomes when aiming to make estimates regarding expected return.

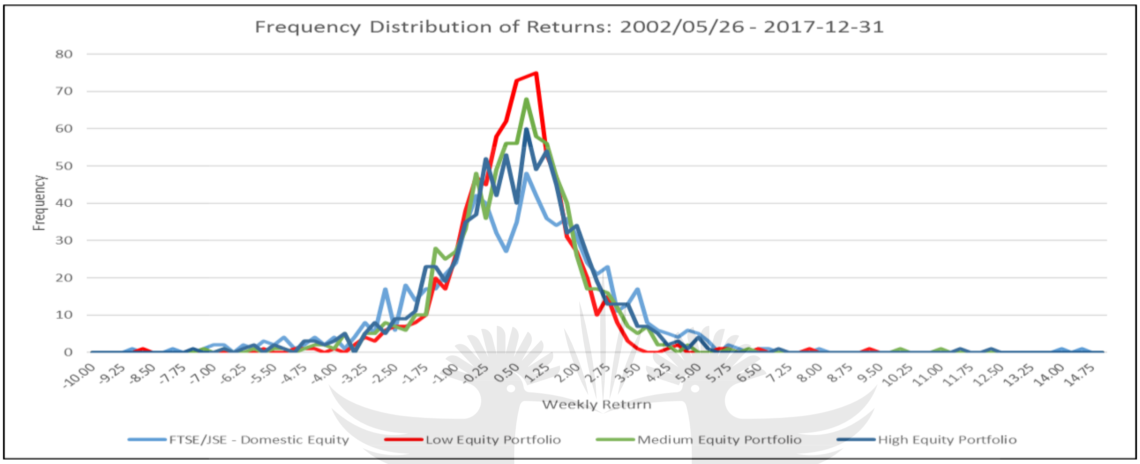

Figure 4.19: Portfolio Distributions

Source: Morningstar and author's own deductions

Table 4.4 summarises the descriptive statistics for the various asset classes and the three multi-asset comparator portfolios. Property has both the largest mean and median weekly return over the sample period, with the second largest standard deviation, being only less than that of Equity.

Skewness is a number which provides insight into the asymmetry of a distribution around its mean, with positive skewness indicating that the distribution has a right tail, and a negative skewness indicating that the distribution has a negative tail. Equity, Cash, medium-Equity and high-Equity have positive skews, while Property, Bonds and low-Equity have negative skews.

Kurtosis describes the peakedness or flatness of a distribution compared to a normal distribution. In Microsoft Excel, a kurtosis number in excess of zero indicates a distribution that is relatively peaked, while a negative number indicates that the distribution is relatively flat. It is observed that all the comparator multi-asset portfolios have distributions that are more peaked than Equity. A noteworthy point is the kurtosis metric associated with Property, which is indicative that Property had greater weight in the tails of its return distribution than Equity over the sample period.

Table 4.4: Portfolio Distribution Statistics (2002/06/01 – 2012/12/15)

Portfolios	Equity	Property	Bonds	Cash	Low Equity	Medium Equity	High Equity
Min	-9.14%	-12.66%	-10.76%	0.08%	-8.89%	-7.47%	-7.70%
Max	14.27%	12.88%	7.57%	0.26%	9.06%	10.75%	12.05%
Mean	0.30%	0.40%	0.18%	0.14%	0.29%	0.30%	0.30%
Median	0.44%	0.46%	0.21%	0.13%	0.39%	0.42%	0.44%
Portfolios	**Equity**	**Property**	**Bonds**	**Cash**	**Low Equity**	**Medium Equity**	**High Equity**
Standard Deviation	2.35%	2.10%	1.02%	0.04%	1.45%	1.68%	1.90%
Skewness	0.07	-0.18	-1.14	1.15	-0.13	0.00	0.05
Kurtosis	3.66	5.18	20.23	0.33	5.35	4.29	4.01

Source: Morningstar and author's own deductions

Figure 4.20 provides the rolling 1-year correlation to Equity for the sample period. Bonds are generally the asset class which provides the greatest diversification, given the lower correlation on a rolling basis. This is followed to a lesser degree by Property, albeit that Property still offers some diversification benefit given the less than perfect correlation to Equity. This rolling correlation assessment illustrates the diversification benefits offered by Bonds being included in the portfolio, which in turn will lower the volatility of the multi-asset comparator portfolios.

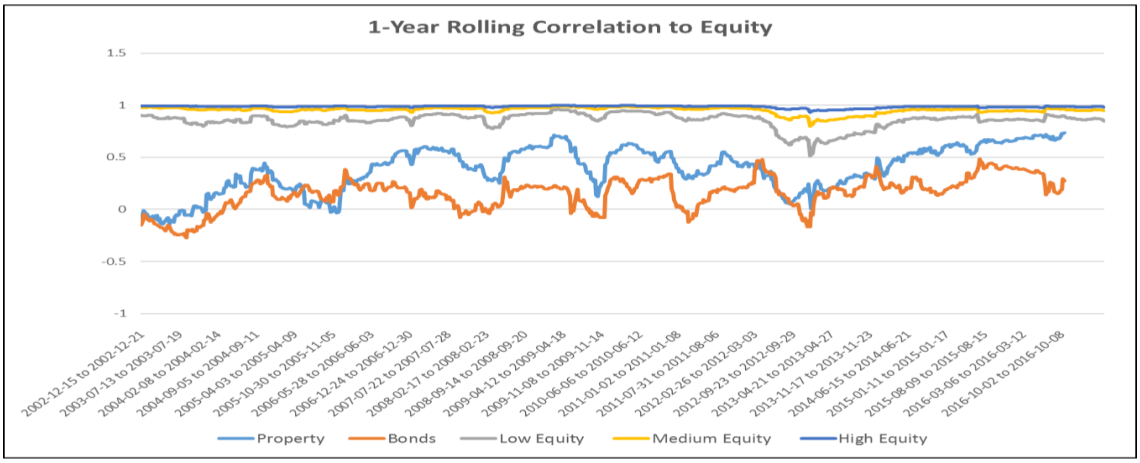

Figure 4.20: Rolling 1-Year Correlation to Equity

Source: Morningstar and author's own deductions

Figure 4.21 contains the rolling 1-year Equity risk premium over the sample period. The period from mid-2003 to mid-2004, mid-2008 to early-2010 and early-2016 to late-2016 have been periods where the risk premium has been negative. This indicates that remaining invested in cash would have delivered a return greater than that of Equity.

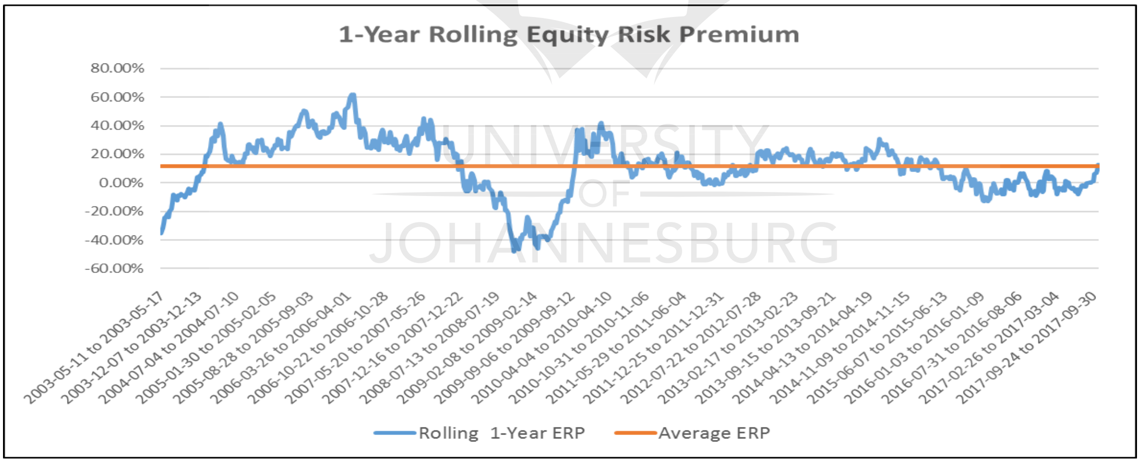

Figure 4.21: Rolling 1-Year Equity Risk Premium

Source: Morningstar and author's own deductions

Figure 4.22 contains both the ending wealth levels and the annualised standard deviations of all portfolios where Equity is varied from 0% to 100%, in 10% increments. It is observed that as an investor initially adds Equity to a portfolio, the ending wealth level initially increases. The increase in the ending wealth levels reach a peak level once the allocation to Equity is approximately 50% and, thereafter, declining as the allocation to Equity increases to 100%. The portfolio standard deviation increases as the allocation to Equity moves from a small percentage, to being fully invested in Equity. This suggests that the marginal benefit of adding Equity to one's portfolio, over this sample period, would start to diminish, and turn negative, beyond allocation levels of approximately 50%.

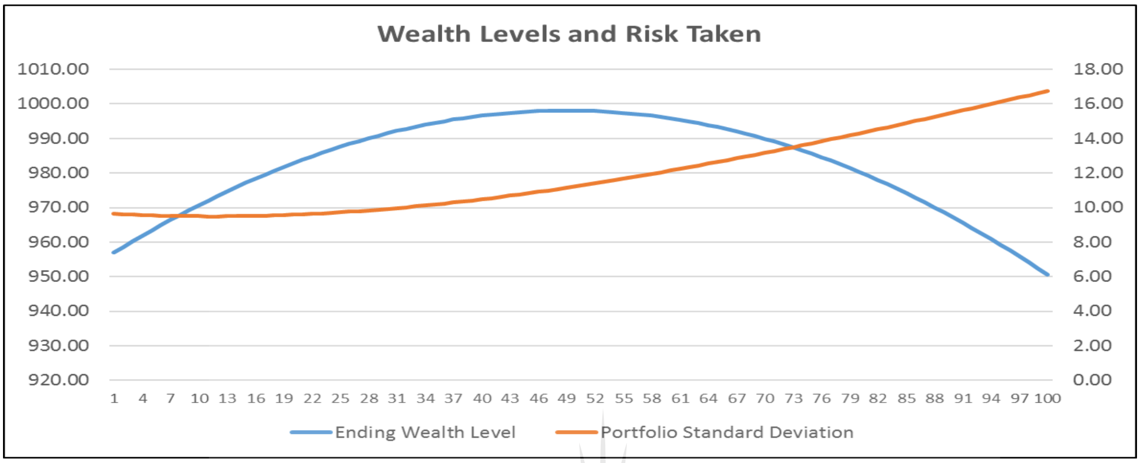

Figure 4.22: Ending Wealth Levels and Risk Taken with Varied Equity Weights

Source: Morningstar and author's own deductions

Figure 4.23 provides the reward-to-risk ratio for the various portfolios, with the Equity weight being varied from 0% to 100%. It is observed that once the allocation to Equity within the portfolios passes 20%, the reward-to-risk ratio steadily declines as an investor adds more Equity. This declining ratio would indicate that an investor receives a smaller marginal benefit as the allocation to Equity moves towards an Equity-only portfolio at 100% allocation.

Figure 4.23: Reward-to-risk Ratio with Varied Equity Weights

Source: Morningstar and author's own deductions

4.6. Efficient Frontiers

For the purpose of gaining insight into the optimal allocation to Equity, the ex post risk and return characteristics were considered alongside the correlation of the various asset classes. This information was utilised to create efficient frontiers and asset class allocation composition maps for five periods over the same date range.

4.6.1. Full Period

The full-period data, from the 01st of June 2002 to the 31st of December 2017 was characterised by Property providing the largest return, followed by Equity and Bonds respectively. The efficient frontier for the sample period began at Bonds and ended at Property, with Equity falling inside the frontier indicating a 100% weighting to Equity as being a sub-optimal allocation. The largest allocation to Equity across the ex post return range was approximately 10%, with the remainder of the weight being split between Property and Bonds.

Table 4.5: Portfolio Risk and Return Parameters for the Period 2002/06/01 – 2017/12/31

Portfolios	Equity	Property	Bonds
Annualised Average Return	16.01%	20.90%	9.50%
Standard Deviation	16.71%	15.00%	7.31%

Source: Morningstar and author's own deductions

Var-Covar Matrix			
	Equity	**Property**	**Bonds**
Equity	5.371	2.112	0.385
Property	2.112	4.325	0.895
Bonds	0.385	0.895	1.028

Correlation Matrix			
	Equity	**Property**	**Bonds**
Equity	1.000	0.438	0.164
Property	0.438	1.000	0.425
Bonds	0.164	0.425	1.000

Figure 4.24: Variance-Covariance and Correlation Matrices (2002/06/01 – 2017/12/31)

Source: Morningstar and author's own deductions

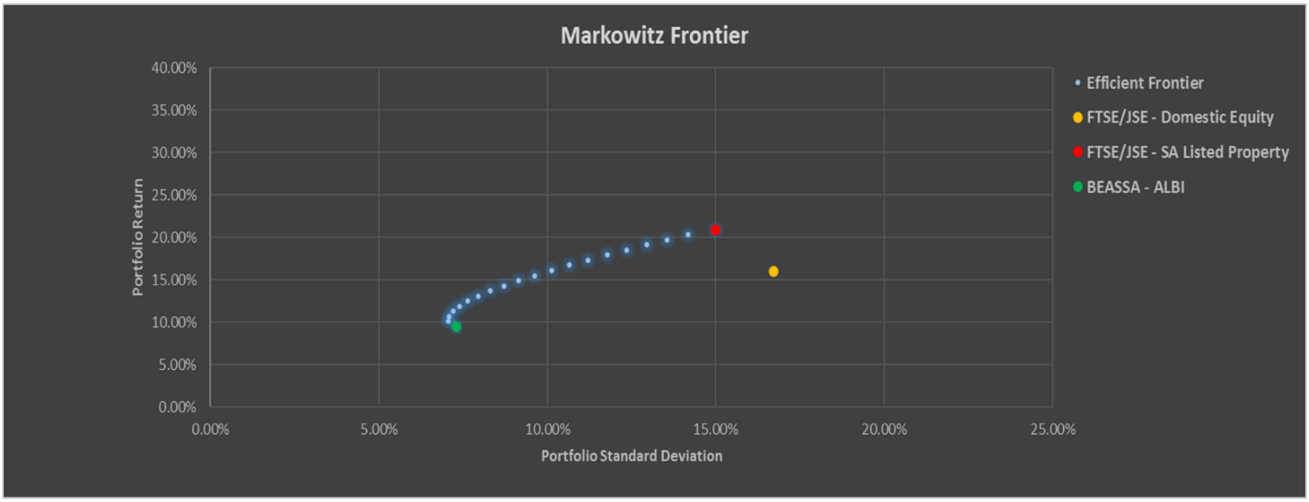

Figure 4.25: Markowitz Efficient Frontier (2002/06/01 – 2017/12/31)

Source: Morningstar and author's own deductions

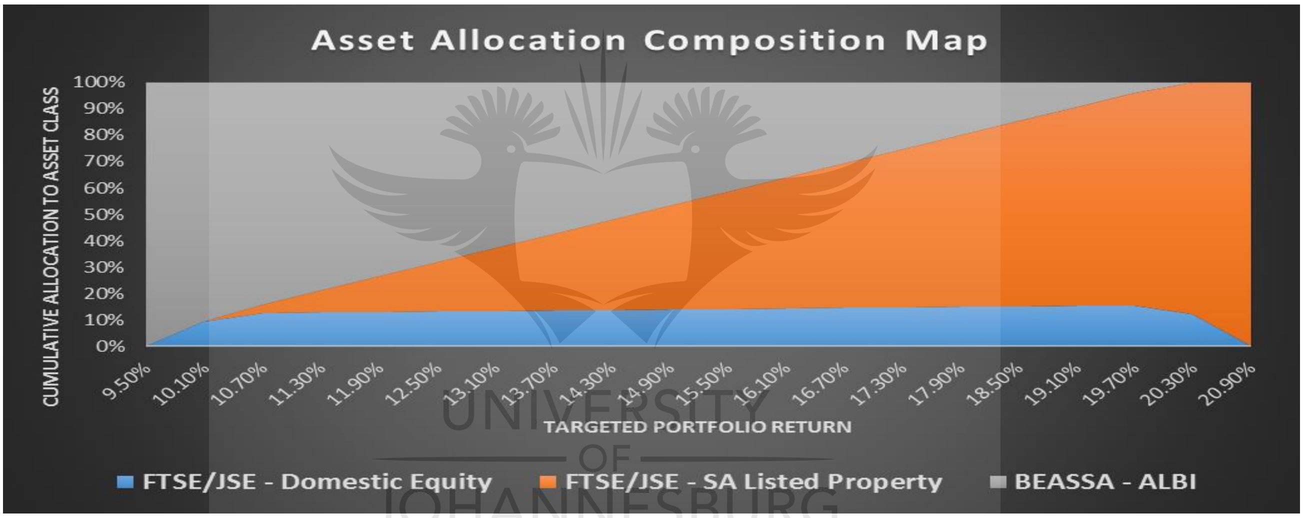

Figure 4.26: Asset Class Composition Map (2002/06/01 – 2017/12/31)

Source: Morningstar and author's own deductions

4.6.2. First Half of Period

For the first half of the sample period, starting from the 01st of June 2002 and ending on the 13th of March 2010, the sample was characterised by Property providing the largest return, following by Equity and Bonds, respectively. The efficient frontier for the sample period began at Bonds and ended at Property, with Equity falling inside the frontier indicating a 100% weighting to Equity as being a sub-optimal allocation. The largest allocation to Equity across the ex post return range was approximately 5%, with the remainder of the weight being split between Property and Bonds. One also observes that the overall correlations between the asset classes reduced from the full-period data, with the largest reduction in correlation being between Property and Bonds.

Table 4.6: Portfolio Risk and Return Parameters for the Period 2002/06/01 – 2010/03/13

Portfolios	Equity	Property	Bonds
Annualised Average Return	17.62%	24.85%	10.32%
Standard Deviation	19.34%	15.61%	5.93%

Source: Morningstar and author's own deductions

Var-Covar Matrix			
	Equity	**Property**	**Bonds**
Equity	7.191	2.382	0.189
Property	2.382	4.693	0.576
Bonds	0.189	0.576	0.677

Correlation Matrix			
	Equity	**Property**	**Bonds**
Equity	1.000	0.410	0.086
Property	0.410	1.001	0.323
Bonds	0.086	0.323	1.000

Figure 4.27: Variance-Covariance and Correlation Matrices (2002/06/01 – 2010/03/13)

Source: Morningstar and author's own deductions

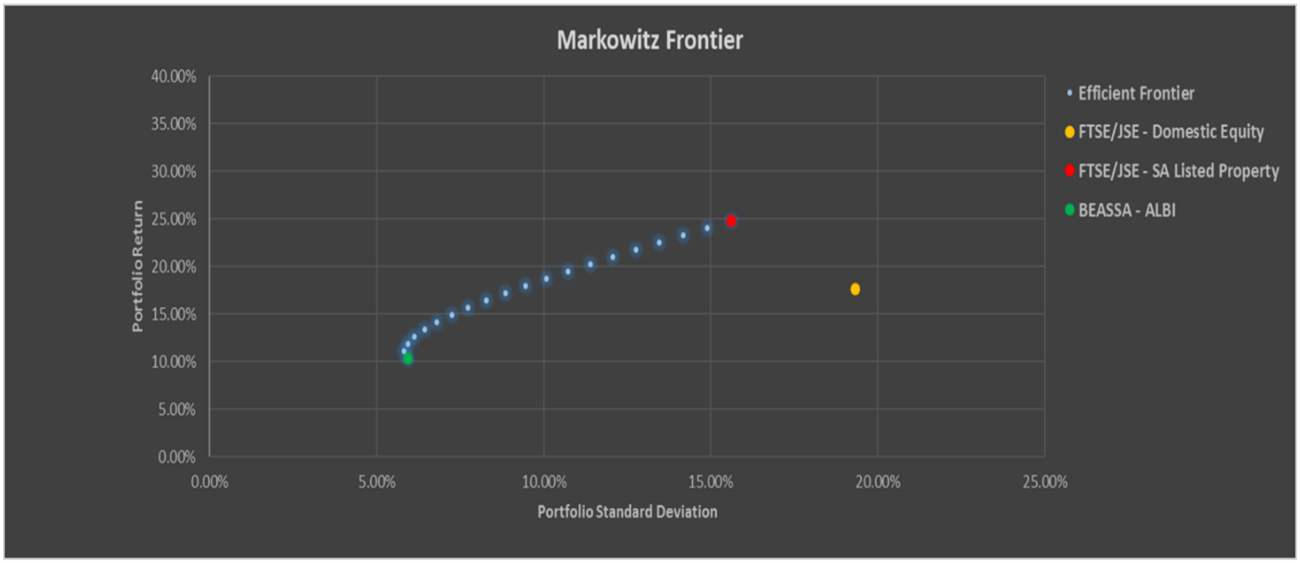

Figure 4.28: Markowitz Efficient Frontier (2002/06/01 – 2010/03/13)

Source: Morningstar and author's own deductions

Figure 4.28 illustrates that Equity is well within the efficient frontier, which illustrates that the same return level can be obtained with a volatility level nearly half of that associated with Equity in isolation, through a multi-asset portfolio.

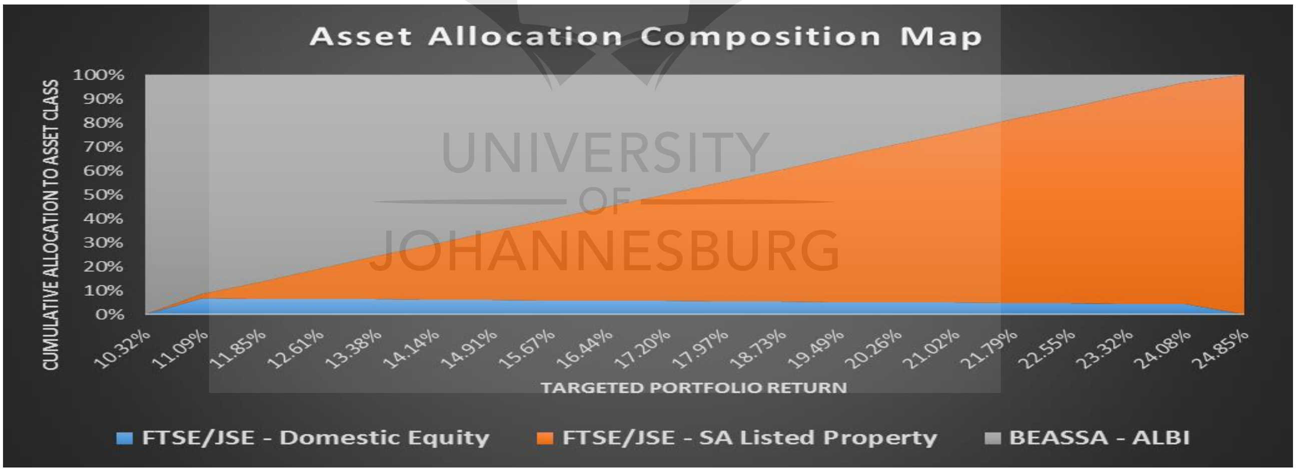

Figure 4.29: Asset Class Composition Map (2002/06/01 – 2010/03/13)

Source: Morningstar and author's own deductions

Figure 4.29 illustrates that Equity does receive allocation within the portfolios on the efficient frontier. However, this allocation is marginal and the optimal portfolios over this period can be obtained by combinations of Bonds and Property allocations.

4.6.3. Second Half of Period

For the second half of the sample period, starting from the 14th of March 2010 and ending on the 31st of December 2017, the sample was characterised by Property providing the largest return, followed by Equity and Bonds respectively. The efficient frontier for the sample period began at Bonds and ended at Property, with Equity falling inside the frontier indicating a 100% weighting to Equity as being a sub-optimal allocation. The largest allocation to Equity across the ex post return range was approximately 30%, with the remainder of the weight being split between Property and Bonds. Compared to both the full-period and the first half of the data one observes that the correlations across asset classes increased with Bonds increasing in correlation to both Equity and Property and, therefore, offering less potential diversification benefit.

Table 4.7: Portfolio Risk and Return Parameters for the Period 2010/03/14 – 2012/12/31

Portfolios	Equity	Property	Bonds
Annualised Average Return	14.39%	16.96%	8.67%
Standard Deviation	13.61%	14.36%	8.47%

Source: Morningstar and author's own deductions

Var-Covar Matrix			
	Equity	**Property**	**Bonds**
Equity	3.565	1.847	0.582
Property	1.847	3.969	1.217
Bonds	0.582	1.217	1.381

Correlation Matrix			
	Equity	**Property**	**Bonds**
Equity	1.000	0.491	0.262
Property	0.491	1.001	0.520
Bonds	0.262	0.520	1.000

Figure 4.30: Variance-Covariance and Correlation Matrices (2010/03/14 – 2012/12/31)

Source: Morningstar and author's own deductions

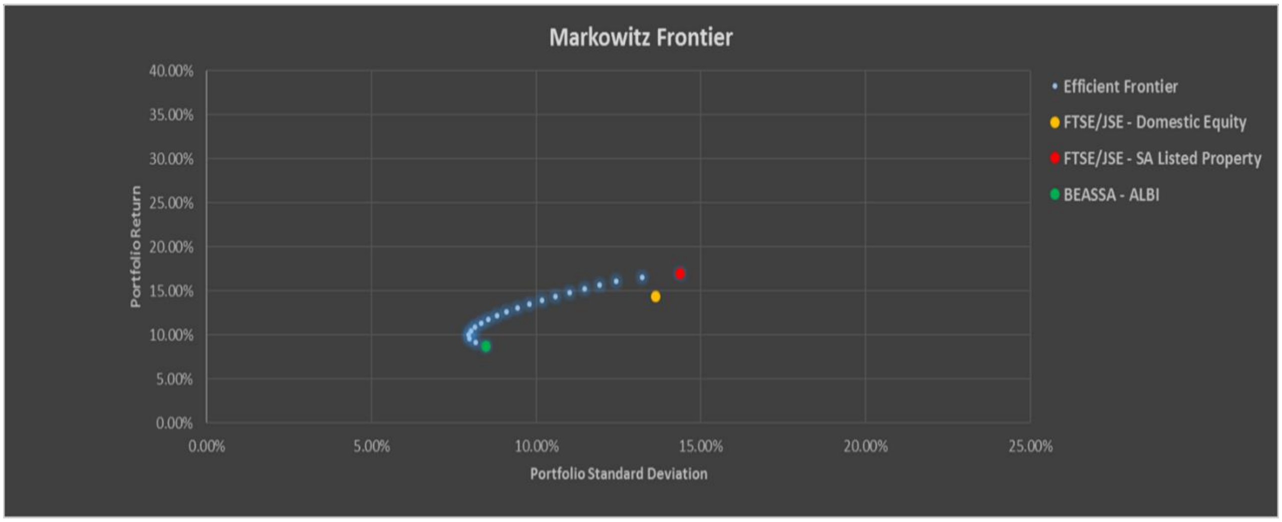

Figure 4.31: Markowitz Efficient Frontier (2010/03/14 – 2012/12/31)

Source: Morningstar and author's own deductions

Figure 4.30 illustrates that Equity is within the efficient frontier, albeit it marginally so. However, this sub-optimal return and return point for Equity still illustrates that the same return level can be obtained with a volatility level less than that of Equity in isolation, through a multi-asset portfolio.

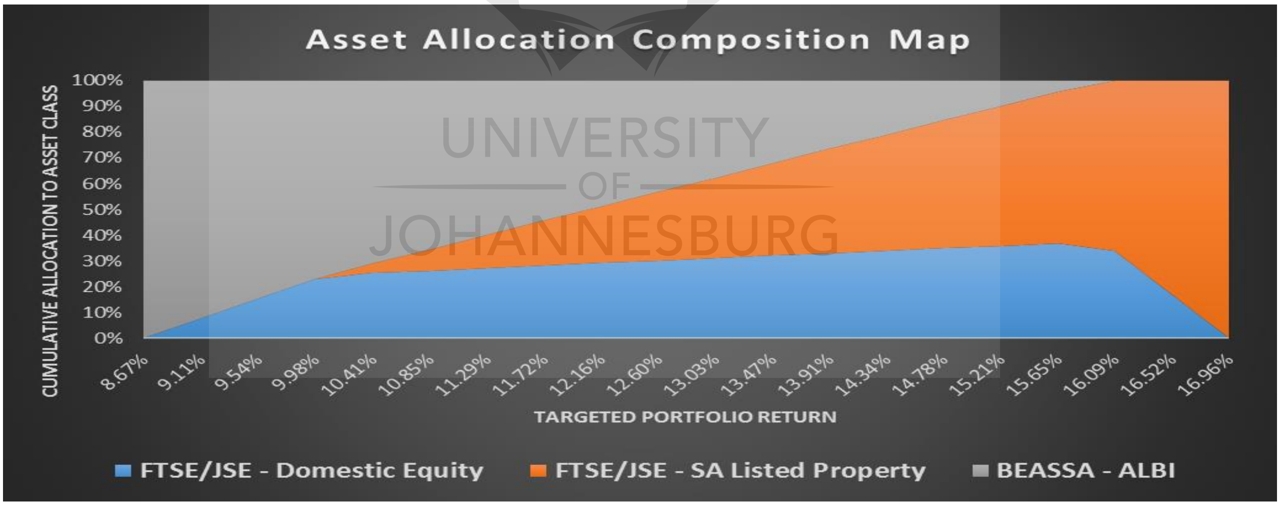

Figure 4.32: Asset Class Composition Map (2010/03/14 – 2012/12/31)

Source: Morningstar and author's own deductions

Figure 4.32 illustrates that Equity does receive allocation within the portfolios on the efficient frontier. However, even though the allocation has increased when compared to the first half of the period, the optimal portfolios can still be primarily obtained by combinations of Bonds and Property allocations.

4.6.4. Pre-GFC

For the pre-GFC sample period, starting from the 01st of June 2002 and ending on the 05th of March 2007, the sample was characterised by Property providing the largest return, followed by Equity and Bonds respectively. The efficient frontier for the sample period began at Bonds and ended at Property, with Equity falling inside the frontier indicating a 100% weighting to Equity as being a sub-optimal allocation. The largest allocation to Equity across the ex post return range was approximately 20%, with the remainder of the weight being split between Property and Bonds. One observes in the pre-GFC period that asset class correlations dropped to their lowest levels in all of the comparator periods indicating the greatest benefit from diversification was offered over this period of time.

Table 4.8: Portfolio Risk and Return Parameters for the Period 2002/06/01 – 2007/05/05

Portfolios	Equity	Property	Bonds
Annualised Average Return	24.80%	35.08%	12.43%
Standard Deviation	15.04%	12.83%	4.85%

Source: Morningstar and author's own deductions

Var-Covar Matrix			
	Equity	**Property**	**Bonds**
Equity	4.380	1.008	0.041
Property	1.008	3.240	0.290
Bonds	0.041	0.290	0.456

Correlation Matrix			
	Equity	**Property**	**Bonds**
Equity	0.751	0.190	0.015
Property	0.190	0.672	0.116
Bonds	0.015	0.116	0.353

Figure 4.33: Variance-Covariance and Correlation Matrices (2002/06/01 – 2007/05/05)

Source: Morningstar and author's own deductions

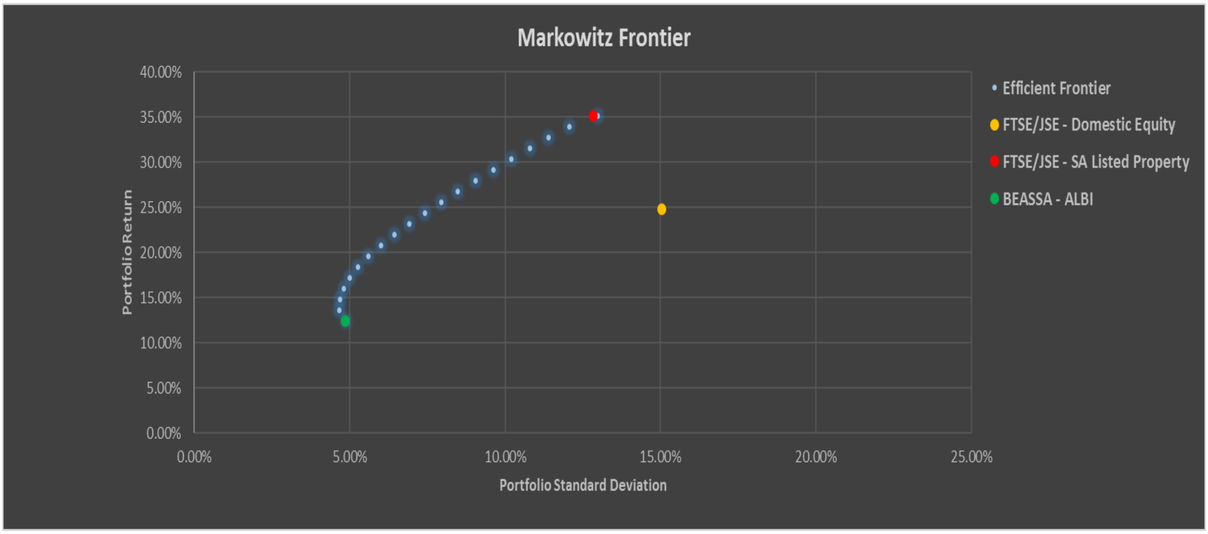

Figure 4.34: Markowitz Efficient Frontier (2002/06/01 – 2007/05/05)

Source: Morningstar and author's own deductions

Figure 4.34 illustrates that Equity is well within the efficient frontier, which illustrates that the same return level can be obtained with a volatility level nearly half of that associated with Equity in isolation, through a multi-asset portfolio.

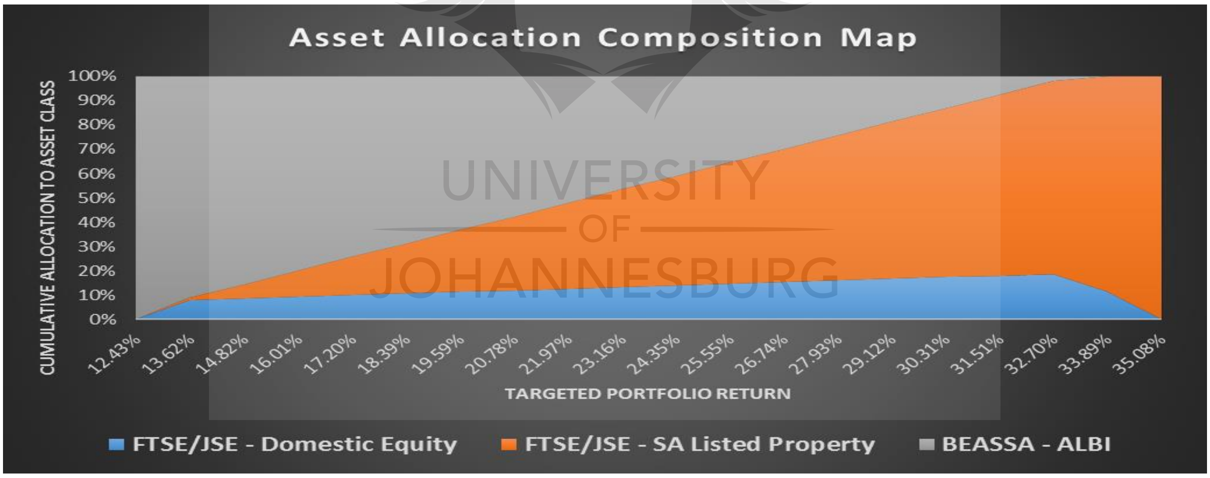

Figure 4.35: Asset Class Composition Map (2002/06/01 – 2007/05/05)

Source: Morningstar and author's own deductions

Figure 4.35 illustrates that Equity does receive allocation within the portfolios on the efficient frontier. However, this allocation is marginal and the optimal portfolios over this period can be obtained by combinations of Bonds and Property allocations.

4.6.5. Post-GFC

For the post-GFC sample period, starting from the 06^{th} of March 2007 and ending on the 31^{st} of December 2017, the sample was characterised by Property providing the largest return, followed by Equity and Bonds, respectively. The efficient frontier for the sample period began with Bonds and ended with Property, with Equity falling inside the frontier indicating a 100% weighting to Equity as being a sub-optimal allocation. The largest allocation to Equity across the ex post return range was approximately 10%, with the remainder of the weight being split between Property and Bonds. One observes that the correlation between Equity and Property was the highest over this sample period, which may be indicative of risk assets recovering together post the GFC event.

Table 4.9: Portfolio Risk and Return Parameters for the Period 2007/05/05 – 2017/12/31

Portfolios	Equity	Property	Bonds
Annualised Average Return	11.93%	14.32%	8.13%
Standard Deviation	17.42%	15.83%	8.20%

Source: Morningstar and author's own deductions

Var-Covar Matrix			
	Equity	**Property**	**Bonds**
Equity	5.840	2.626	0.545
Property	2.626	4.836	1.177
Bonds	0.545	1.177	1.294

Correlation Matrix			
	Equity	**Property**	**Bonds**
Equity	1.001	0.495	0.198
Property	0.495	1.003	0.472
Bonds	0.198	0.472	1.001

Figure 4.36: Variance-Covariance and Correlation Matrices (2007/05/05 – 2017/12/31)

Source: Morningstar and author's own deductions

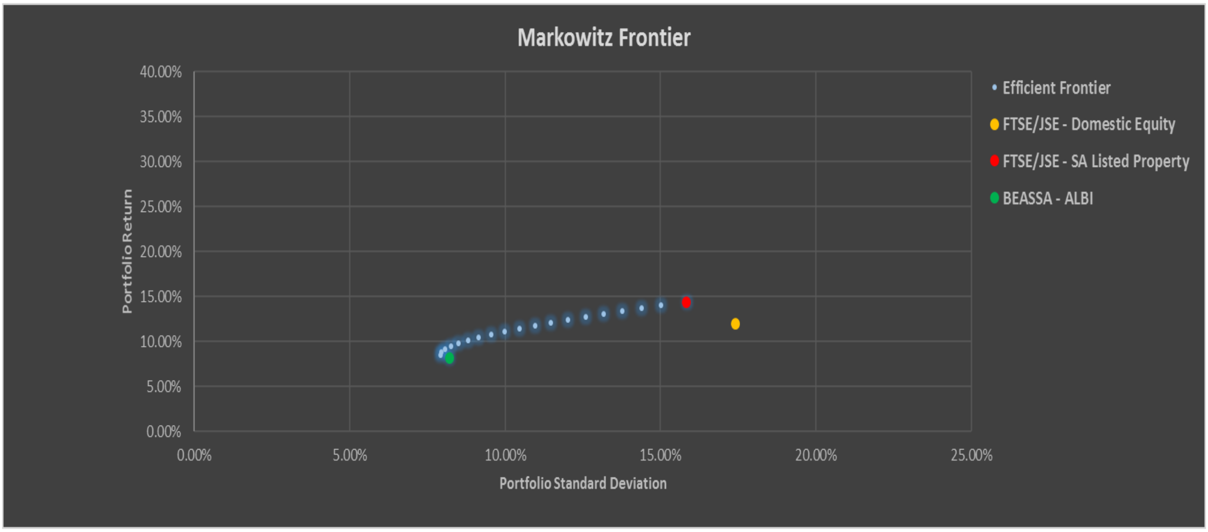

Figure 4.37: Markowitz Efficient Frontier (2007/05/05 – 2017/12/31)

Source: Morningstar and author's own deductions

Figure 4.37 illustrates that Equity is within the efficient frontier, and further exceeds the risk level of Property, which provides the greater level of return over this period. This sub-optimal Equity return and return can be improved upon by accepting the same return with a lower volatility level than that of Equity in isolation, through a multi-asset portfolio.

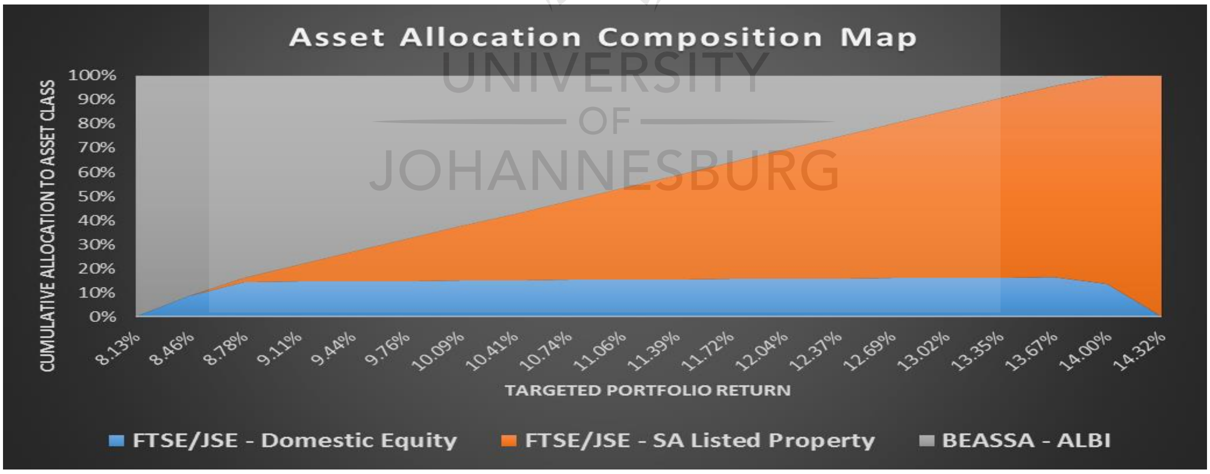

Figure 4.38: Asset Class Composition Map (2007/05/05 – 2017/12/31)

Source: Morningstar and author's own deductions

Figure 4.38 illustrates that Equity does receive allocation within the portfolios on the efficient frontier. However, this allocation is marginal and the optimal portfolios over this period can be obtained by combinations of Bonds and Property allocations.

4.7. Frontiers and Composition Map Interpretations

When one observes the output from the efficient frontiers and composition maps over various periods it is noted that the efficient frontier and allocation to various assets is not stationary and will vary over time. These variations are dependent on the inputs to the optimisation process, which occur through the returns, standard deviation of the asset class, and the correlations of the various asset classes to each other.

One observation is that Equity did not feature on the efficient frontier in any of the various sample periods assessed. The asset with the largest individual return over the various sample periods was Property. This means that investors could have varied their desired return and risk levels by varying weights primarily between Bonds and Property, with minimal allocations to Equity.

A final point to note is where the efficient frontiers sit spatially and their shape through time. The efficient frontiers shift spatially on both the return and risk axis meaning that these parameters are not stationary through time. The slope of the efficient frontier also changes through time, which has implications for both the point of tangency associated with the CML and the diminishing marginal returns accepted beyond this point under the assumptions of no leverage in long-only investment environments.

4.8. Validity and Reliability

The data collected for this study is from the Morningstar South Africa database. The data is standard and can be collected by multiple practitioners over multiple instances. The financial methods adopted for this study are based on standard practices in finance, which have been discussed in detail in Chapter 3 of this study.

4.9. Summary

This chapter highlighted the results obtained from the data analysis based on the financial methods discussed in the previous chapter of this study. The aim of the study was to assess whether there is a marginal benefit in investing in an Equity-only portfolio versus a multi-asset portfolio by assessing the reward-to-risk ratio of the portfolios using Equity as a departure point.

Various financial methods were assessed, on both a rolling 1-year basis and the average of the rolling 1-year results, to discern whether any positive marginal benefit exists for investing in Equity-only portfolios rather than multi-asset high-Equity portfolios. The tests were performed by assessing the various asset classes in isolation relative to both the three multi-asset portfolios, ranging from low-Equity to high-Equity, and various portfolios stepping through from no-Equity to Equity-only in 10%-point increments.

The analysis, which will be discussed in greater detail in the following section, highlights that the greatest reward-to-risk exists in the low-Equity multi-asset portfolios, thereafter diminishing rapidly as one moves towards an Equity-only portfolio. This is indicative of an investor having to accept disproportionately large amounts of additional volatility for relatively small amounts of additional return as compensation.

Chapter Five Findings, Conclusion and Recommendation

5.1. Introduction

This study assessed whether there are marginal benefits in moving beyond multi-asset high Equity investing into an Equity-only portfolio. This study was conducted within the South African context, and the main objective of this study was to directly assess whether the risk-adjusted returns of an Equity portfolio were larger or smaller than that of a multi-asset high Equity portfolio.

The sub-objectives to assist in reaching the main objective of the study were:

- Determine the effect on risk-adjusted returns by introducing additional asset classes and using an Equity portfolio as a departure point.
- Determine the effect on a client's ending wealth levels by introducing multiple asset classes and using an Equity portfolio as a departure point.
- Determine the shape of the efficient frontier in the South African investment context, in addition to assessing how the efficient frontier has changed over time.

Chapter 2 presented the current debate and research available for the area of study, Chapter 3 put forward the research methods chosen for this study, and Chapter 4 presented the findings associated with the research methods for the chosen sample periods. The analysis was conducted on asset classes in South Africa with the following indices being utilised as proxies:

- Equity - FTSE/JSE All Share SWIX Index
- Property - FTSE/JSE SA Listed Property Index
- Bonds - Composite All Bond Index

The data was obtained from Morningstar South Africa for weekly discrete periods from the 01st of June 2002 to the 31st of December 2017, and indices were created to compute the required risk-adjusted metrics and outputs. Rolling period data was considered to offset the sensitivity of the starting point for cumulative assessments.

The sample set encompassed a full investment cycle over the period 01st of June 2002 to the 31st of December 2017. This period included the GFC, which adds depth to the analysis of experiences in returns by investors but required the sample to be split for the analysis of returns.

5.2. Reason for Undertaking Research

The research is undertaken in order to assess the change in the marginal benefit of moving up and down the risk spectrum from a multi-asset perspective. The study was completed with the hope of being able to provide greater insight for retail and institutional investors to allow market participants to make more informed decisions regarding their investment planning.

Greater insight is required for a country's investors who cannot afford to make less than optimal investment decisions given the already large proportion of the South African population who cannot afford to retire with their desired living standards (Strydom, 2007; Prinsloo, 2008; Darley, 2011).

5.3. Summary and Discussion of the Findings

This research study was conducted in order to assess whether any marginal benefit exists in moving beyond multi-asset high-Equity portfolios to being fully invested into Equity-only portfolios as an investor and was conducted over the period 01st of June 2002 to the 31st of December 2017.

The sub-objectives of the portfolio were as follows:

- Determine the effect on risk-adjusted returns by introducing additional asset classes and using an Equity portfolio as a departure point.
- Determine the effect on a client's ending wealth levels by introducing multiple asset classes and using an Equity portfolio as a departure point.
- Determine the shape of the efficient frontier in the South African investment context, in addition to assessing how the efficient frontier has changed over time.

The literature on the topic was introduced and discussed in Chapter 2. The literature in this thesis gave context to the various asset classes considered and their characteristics, Equity risk premium, Markowitz Portfolio Theory, CAPM, asset allocation decisions, and portfolio management techniques. The existing literature showed that Equity, as an asset class in isolation, provided the greatest cumulative return regardless of its volatility levels over the period 1925 to 1998 (Firer & McLeod, 1999). The returns were followed in sequential order from highest to lowest as being Bonds and then Cash.

Property as an asset class in the South African context has a relatively limited history, and has been incepted as an index in March 2002, which precluded the Firer and McLeod (1999) studying from incorporating the performance of Property explicitly into their analysis. However, since the inception of Property it has been the asset class which, on a cumulative basis, has provided the greatest return. This is the period for which this study was conducted.

This performance of Equity as an asset class is framed in the context of MPTand the shape of the efficient frontier, in a stylised manner, with the literature being indicative of Equity being the point furthest out on the efficient frontier in terms of risk and return. Regulation 28 was discussed, with mention of the constraint being placed on retirement funds and specifically the limitation to Equity being a maximum of 75%. Finally, the literature review was concluded with a discussion on the definition of risk, and the various risk-adjustments that should be accounted for when comparing portfolios, which will be discussed in the methodology.

Chapter 3 put forward the research methodology for the study, while Chapter 4 covered the findings from the study over the sample period. Chapter 3 and Chapter 4 aimed to answer the main research objectives by answering the sub-objectives of this study. The data utilised in the study was secondary in nature and was analysed using Microsoft Excel and VBA.

The main methods considered in this study were the construction of the indices based on both single asset classes, and portfolios of asset classes. The portfolios varied the weights to Equity and then recorded the various metrics to assess both the marginal risk and return. The tests performed ranged across standard accepted financial practices, and involved the comparisons of Sharpe ratios, Sortino ratios, Treynor ratios, Jensen's alpha, and Modigliani risk-adjustments. As a final measure, financial methods were employed to consider the allocation to Equity given the ex post data over various sample periods.

The significance of the study is due to the contribution towards the limited context of relative analysis for single asset classes versus multi-asset portfolios for the South African context. The study will also contribute towards investors gaining insight into the associated trade-offs given their asset allocation decisions.

The main conclusions that can be drawn from Chapter 4 are broad, and will be discussed in detail, starting from the consideration of Equity as an asset class in isolation. Chapter 2 put forward that Equity has, on a cumulative basis, outperformed all other asset classes in isolation from 1925 to 1998 (Firer & McLeod, 1999). The first observation in this study, is that over the sample period, from 2002 until 2017, that Property was the asset class that provided the largest cumulative return over the period. These two periods cannot be fully contrasted given that Firer and McLeod (1999) did not include Property as an isolated asset class. Equity, however, continued to outperform Bonds and Cash, which corroborates with Firer and McLeod (1999).

Over the sample period, one observed that in spite of Property providing a larger cumulative and annualised return to investors, its annualised standard deviation was still lower than that of Equity. Property did experience a larger weekly drawdown in December 2015, but this was more than offset by larger returns over the period. On a calendar basis, Equity was the asset class that provided the largest return for 6 of the calendar years, followed by Property with 5 years of top performance. Without considering the magnitude of returns, this would indicate the superior performance of Equity. However, the magnitude and variance of returns are essential for the assessment of investor ending wealth levels.

Comparing the Equity-only portfolio to the multiple comparator portfolios with Equity varying in weight from 0% to 100%, in 10%-point increments, one observes that the portfolio with the lowest risk-to-reward ratio is that of Equity in isolation. An investor that is risk-neutral would seek the highest return and, therefore, control their emotional responses to volatility in pursuit of this. An investor seeking the largest cumulative return over the period would not have been rewarded by investing 100% into Equity, regardless of the volatility experienced. The portfolio with the largest return, on a cumulative basis over the sample period, was one with a 50% allocation to Equity, with an equal allocation to Property and Bonds for the remaining portion. This goes against the originally claimed notion that an investor would need to seek additional returns via the acceptance of additional risk, as experienced by portfolio volatility.

Chapter 4 showed that across all metrics, such as Sharpe ratio, Sortino ratio, Treynor ratio, Jensen's Alpha, and the Modigliani risk-adjusted measure, that the low-Equity multi-asset portfolio had the highest average metrics over the sample period. The rolling 1-year data only had sporadic moments of the Equity-only portfolio providing the highest metrics for certain ratios, such as the rolling 1-year Sharpe ratio (Figure 4.5), rolling 1-year Treynor ratio (Figure 4.11) and rolling 1-year Sortino ratio (Figure 4.13). In order to assess whether the reduction in Equity volatility over longer term horizons would affect the risk-adjusted measures, the Sharpe ratio was assessed over rolling 3, 5, 7 and 10-year periods, with the average findings supporting the rolling 1-year data for every extended period.

Figure 4.19 provides an assessment of the distributions of portfolio returns for the sample period. One observed that the low-Equity multi-asset portfolios provide the better risk-adjusted returns regardless of having a median return lower than that of Equity, indicating that an Equity-only portfolio had its larger returns more than offset via the disproportionately larger increases in volatility associated with the investment strategy. The lower portfolio standard deviation can in part be explained by the less than perfect correlations of Property and Bonds to Equity. Figure 4.20 illustrates that the rolling 1-year correlations to Equity for Property and Bonds varied from approximately 0 to approximately 0.75, while never experiencing a correlation on this basis of 1 to Equity.

Investors would seek to be compensated for the additional uncertainty of Equity by receiving a return from Equity larger than that of Cash (Damodaran, 2017). Figure 4.21 illustrates that the rolling 1-year Equity risk premium for the sample period varies from positive territory to negative territory. This indicates that, over shorter time horizons, the benefit of Equity is uncertain. Using a cumulative assessment to remove the uncertainty associated with shorter time horizons, an assessment of ending wealth levels relative to risk taken was performed.

Figure 4.22 highlights that the ending wealth level initially increases and subsequently decreases as the weight from Equity is increased from 0% to 100%, with the maximum ending wealth level being experienced at an Equity weighting of 50% of the portfolio. The portfolio standard deviation experienced an increase from approximately 10% to approximately 17% as the investor moved from 0% in Equity to a 100% weighting. This relationship would imply that the reward-to-risk ratio for the portfolio should decrease as the Equity weight increases, which is evidenced in Figure 4.23.

For the sample period, and sub sample periods, an efficient frontier was generated. The efficient frontier highlights the ex post optimal allocations to Equity, Property and Bonds with the intention of maximising the portfolios reward-to-risk ratio. For all periods Equity in isolation was considered sub-optimal in terms of return and risk. The degree of this sub-optimality differed, as illustrated by Figure 4.28 compared to Figure 4.34.

Asset allocation composition maps were generated for all sample periods (see Figures 4.26, 4.29, 4.32, 4.35 and 4.38). The composition map highlights the optimal allocation to Equity for a given targeted return level as the investor moves from the lowest return to the highest return over the sample period. The largest allocation to Equity was experienced in the second half of the total sample period, from the 14th of March 2010 to the 31st of December 2017. The weighting for Equity over this period reached 36.84%. At no point in time, over any of the sample periods, did Equity receive a greater allocation for any optimal portfolios of the generated Markowitz efficient frontiers.

The analysis demonstrated that the ending-wealth levels of the portfolio are not necessarily diminished by introducing additional asset classes, and can be increased over certain sample-periods, such as is evidenced by Table 4.3 and Figure 4.18. The results highlight that investors can receive additional returns, and higher ending wealth levels, while accepting lower levels of volatility from their investments.

In conclusion, and in specifically answering the main objective of the study, it is evidenced that an investor did not need to accept the full volatility of Equity in isolation in order to achieve ending wealth levels that keep pace with that of Equity in isolation. An investor was able to obtain higher ending wealth level by not increasing allocation to Equity beyond approximately 50% of the portfolio weight.

In assessing the effect on risk-adjusted returns, the evidence also points to the investor receiving a rapidly diminishing marginal benefit for increased allocations to Equity within the portfolio. Tying into the assessment of ending wealth levels with the introduction of additional asset classes, an investor would have achieved both superior cumulative and risk-adjusted performance across all sample periods by being invested in a multi-asset portfolio compared to being invested in Equity in isolation.

In the final assessment regarding the shape of the efficient frontier and changes over time, the first conclusion is that Equity did not receive a position on the efficient frontier over any of the sub-sample periods tested in the study. The shape and position of the efficient frontiers was primarily determined by the expected return and risk of Bonds and Property and the associated correlations between the asset classes.

The efficient frontier varied dramatically in its shape and level depending on the underlying returns of the assets classes over the period, and it will continue to exhibit changes going forward dependant on how the inputs to the optimisation process continue to dynamically adjust and change in the market place. Attention needs to be paid to both the level of the efficient frontier and its shape in order to assess whether the marginal return accepted via increased standard deviation is sufficient for the investor.

The findings of the study in light of Prudential Investment Guidelines and Regulation 28 in the South African context indicate that – for the average investor – the constraints on the allocation to Equity did not materially affect the investor outcomes in ending wealth levels that could have been achieved over the period in question.

5.4. Contribution of the Study

The study's contributions are primarily on three fronts. The first contribution of the study is one of enriching the analysis and interpretation of multi-asset investment data for the South African context, which gets relatively less attention compared to asset classes in isolation.

The second contribution of the study was to draw conclusions on the risk-adjusted benefits of investing in multi-assets for the South African context, providing academics with a departure point for further discussions on portfolio structuring. This point also assists the current practising investment professionals with a greater understanding of the marginal benefits of asset allocations, which is important given that investment professionals need to deal with end naïve investors, whom can hopefully now have the trade-offs better explained to them.

The final consideration is the understanding of whether constraints, such as Regulation 28 limiting Equity exposure to 75% of an investor's retirement fund portfolio, are an economic burden on investors. This study suggests otherwise, although there will always be exceptions to this generalisation.

5.5. Limitations and Recommendations for Further Research

The limitations of this study were created by the constraint of the study to the South African context, which allows for the study to be expanded to different geographical regions of the world. This study also did not include additional alternative asset classes, such as commodities, private Equity and structured investments to draw conclusions from regarding the comparison of risk-adjusted benefits.

A further limitation of the study was created by equally weighting the weight for allocations to asset classes other than Equity. In practice, any combination of asset classes is possible and not considering all permutations of weightings limits the applicability of the conclusions to individual investors' portfolios. The study can be expanded by considering the optimality of the asset classes in the portfolios given more freedom regarding the asset class weights.

Further considerations for expanding the study are those of the impact of Regulation 28, and whether this regulation has been a constraint or not on the wealth accumulation of South African citizens. The impact of wealth accumulation, and ending wealth levels, can also be expanded by considering the impact of cash flows into, and out of, the portfolio in terms of the accumulation and drawdown of wealth.

A consideration in today's environment is that of Behavioural Economics. The study's research topics can be broadened to extend the understanding of how investors react to the interim volatility of various portfolios and understanding which targeted return would result in the highest ending wealth value given the constraints of investors reacting to volatility and taking myopic decisions.

As a final additional point of research for this study, risk-management techniques can be applied or considered for multi-asset portfolios with the aim to potentially improve upon any risk-adjusted benefit that may result from the portfolios.

5.6. Final Remarks

Investors have access to a multitude of asset classes globally, which can be used in conjunction with Equity in their portfolios and allocations. Investors do not solely need to rely on Equity to provide them with the required rate of return they desire. Investors can allocate to additional asset classes and achieve their required returns with the added benefit of drastically reducing the volatility of the return profile of the investment.

By understanding how investors react to volatility in investment outcomes, an investment professional could potentially guide an investor to a higher ending wealth level by accepting a lower targeted return level. This lower targeted return level experiences a proportionately larger reduction in associated volatility of the return profile. Knowing the trade-offs associated with different asset allocation levels can greatly assist investors in their wealth accumulation journey without abandoning the strategy along the way.

This study illustrated that there are large benefits, on a risk-adjusted basis, of investing in multi-asset portfolios, when compared to Equity in isolation. This study also showed over the period considered that the loss in ending wealth value, when compared to fully investing in Equity, is only experienced for levels below a 50% allocation to Equity. An investor may want to make this trade-off and still go fully into Equity, but the investor would need to be aware that the only way to gain the extra incremental target return annually, which compounds out massively over a multi-decade span, is to accept a disproportionately larger amount of volatility for the allocation to Equities.

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