Real Estate Investment Trusts versus Direct Real Estate Investments: A Portfolio Optimization Approach

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Abstract

We analyze the risk adjusted performance of Real Estate Investment Trusts (REITs) and Direct Real Estate Investments using US data between 1980 and 2014. As opposed to previous studies where emphasis was placed on Economies of Scale this study employs a multi-constraint portfolio optimization approach based on Mean Variance Optimization and Mean Gini Coefficient Approach. We find that Direct Real Estate Investments outperform REITs without the minimum return constraint. When we incorporate the minimum return constraint REITs out-perform Direct Real Estate Investments both for annual and monthly returns. These results can be attributed to the high risk-return characteristic of REITs.

1   Introduction

Since its introduction in 1963, the REITs Market, especially, in the United States of America (USA) has grown at a sturdy rate. Over the past decade, it has exhibited a compound annual growth rate (CAGR) of 11.6% (FTSE). Some attribute this sturdy growth to the fact that REITs provide investors with the income potential of bonds while still exposing them to the price appreciation of stocks [36].
According to [41], the observed growth has been as a result of the market providing benefits similar to those of the direct Investment in the Real Estate Market while still

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safeguarding investors from the problems of illiquidity and high costs associated with owning relatively concentrated privately owned properties.

The benefits of REITs extend to an international setting where REITs have offered investors opportunities to construct well diversified international property portfolios without the burden of acquiring, managing and disposing of direct property investments in distant countries with unfavorable legal, political and market structures. The beliefs above, among others, have contributed towards the listing of REITs in different countries and quite recently in South Africa (SA). This adoption is regarded as a growth strategy aimed at attracting foreign investments which would be stimulated by the tax exempt status that REITs enjoy. As a result, the Johannesburg Stock Exchange (JSE) during 2013, has seen a large scale incorporation of previously listed property stocks.

Although investors have accepted REITs as a cheaper and more profitable alternative to Direct Real Estate Investments, their value has been questioned as a result of their poor performance during the recent Global Financial Crisis. The crisis was characterized by a significant reduction in the liquidity and profitability of REITs which forced several Asset Managers to recapitalize their REITs so as to safeguard their existence. This proved the concerns of [45] on the true liquidity of REITs especially during market downturns.

Furthermore, this poor performance was exhibited even post global financial crisis when REIT alpha returns remained significantly low due to the reduction in the Federal Reserve which made debt financing quite expensive for the REIT managers. Other than poor performance during and after the crisis, REITs have been surrounded by significant controversy over their Economies of Scale with different researchers holding different opinions. For example, [5] found that REITs exhibit Economies of Scale that are mainly driven by the ability of REIT managers to innovate. Thus, their studies concluded that REITs were better investment alternatives as compared to Direct Real Estate Investments. However, [35] found that REITs exhibit inefficiency in their operations and therefore conclude that the previously exhibited growth rates may not be sustainable in the long run and thus Direct Real Estate Investments are more profitable alternatives to REITs.

As highlighted in the background, REITs have exhibited impressive growth patterns over the years. The growth over the past ten years has been graphically illustrated below.
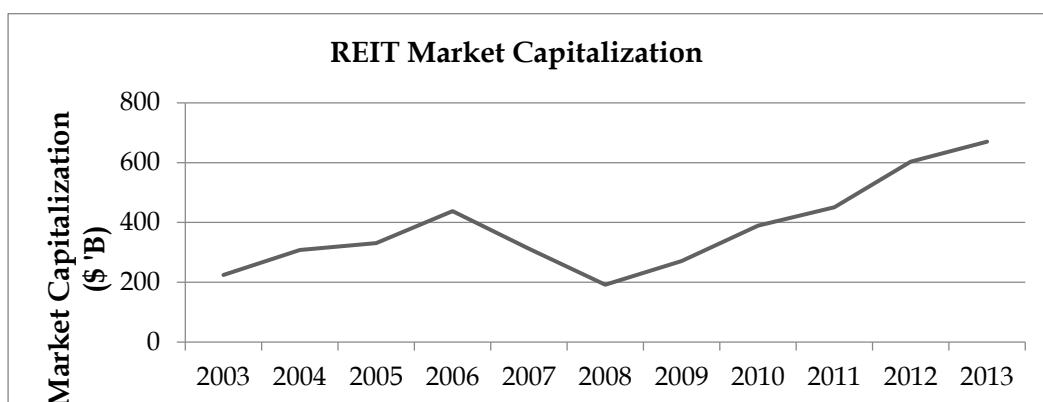

Figure 1: REIT Market Capitalization from 2003 to 2013

The graph above illustrates the general positive growth trend of the REIT Market. The negative growth rate however exhibited during the 2007 to 2008 period was attributed to

the Global Financial Crisis that adversely affected the financial markets.

Several studies have been centered on the growth drivers of REITs in the USA. Their major focus has been on the efficiency of REITs and contrasting these efficiencies against those of Direct Real Estate Investments. There is therefore very limited information on REITs outperforming Direct Real Estate Investments (or vice-versa) in terms of efficient portfolios. This research adds to the existing literature by contrasting REITs and Direct Real Estate Investments from an Efficient or Optimal Portfolio Perspective.

2 Literature review

REITs are a tax and legal entities that owns or finances income-producing real estate [10]. REITs are required to distribute a majority of its taxable net income to shareholders and must adhere to certain restrictions on their operations, organization and ownership so as to acquire a tax exempt status. These restrictions are usually dependent on the regulations of each country [15]. According to [10], REITs were first established in the USA in 1963 for two main reasons. First, the USA was facing a deficit in its financing such that it was unable to pump the necessary funds into the Real Estate Market. A special purpose vehicle thus had to be developed in order to increase the flow of funds from the Public sector to the Real Estate sector.

Secondly, the government was trying to motivate small-scale investors to participate in the Real Estate sector which was previously dominated by individuals who had large reserves of financial resources. REITs were thus developed so as to lead to the emergence of a new set of investors who could easily transfer ownership interest in such entities at given prices.

2.1 Why have REITs become Popular?

Various authors such as [17] have attributed the quick growth and continued performance of the REIT Industry to the growth of Investors who are more interested in liquid[3] mark to market assets as opposed to non-mark-to-market assets. Since REITs have a short trading and settlement period (of T+3 days), they are considered to be more liquid than Direct Real Estate Investments [42]. The popularity of REITs has also increased due to the long run growth and revenue enhancement benefits driven by the economies of scale[4] which are associated with them [5]. These Economies of Scale are driven by the increasing innovation levels of REITs and their ability to easily issue equity and debt securities.

In addition to the above, REITs have a tax exempt status and thus, they have been able to acquire more popularity than other listed real estate stocks such as PLSs and PUTs. This is as a result of the shareholders' ability able to avoid the double taxation dilemma associated with the comparable listed real estate stocks.

Despite the above, there are still several investors who opt to hold Direct Real Estate Investments as opposed to REITs. This has been attributed to two major factors. The first

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[3]An asset is said to be liquid if it can be traded at a fair price within a given period of time.
[4]Economies of scale are the   benefits associated when larger quantities of outputs are produced at lower average costs than smaller quantities of outputs

is the Status Quo associated with holding such investments and the second is the "Four-Quadrant Matrix" Methodology of Investing. The Four Quadrant Matrix ideology is one where investors believe that they can hold optimal portfolios which offer them superior returns only when they contain a mix of publicly traded real estate debt, publicly traded real estate equity, privately owned real estate debt and privately owned real estate equity [18].

2.2 The Problems Associated with REITs

The findings of recent studies have questioned the perceived benefits associated with REITs. For example, the study carried out by [34] found absence of Economies of Scale in REITs and increasing inefficiencies in the REIT Industry. The efficiencies were mainly attributed to the fact that REIT managers opted to operate the REITs at a level less than that which was considered optimally efficient so that they could enjoy a tax-exempt status[5]. These inefficiencies question the benefits of holding REITs as opposed to Direct Investments especially in the case of large scale investors who have enough resources and knowledge required to create well diversify portfolios with direct real estate investments. Studies have also shown the increased correlation between REITs and the stock market index from -0.034 during the period 1993-1997 to +0.086 during the period 2008-2013. This increase therefore means that REITs can no longer offer the diversification benefits that they used to offer in a portfolio. However, this can be contested as a long-run phenomenon because, during a crisis, correlations between asset classes increase [20]. Thus, the increase in the correlation between the REIT market and Stock markets is only a short-run phenomenon as the 2008-2013 period was characterized by a Financial Crisis. Increased globalization has also led to increased integration of international markets which means that markets will be affected by the same economic and financial shocks and stimulli [45]. This has thus led to lower returns for portfolios comprising mainly of REITs. The study by [44] on the future of REITs, questioned the liquidity of REITs especially during periods of financial distress. The 2007 Global Financial Crisis evidenced his doubts about the liquidity of REITs when their Intra-day liquidity greatly declined due to the rapid transmission of negative shocks from the equity stock market to the public real estate market as a result of the overuse of debt financing. However this was not the case for the private real estate market where the transmission of shocks was less marked and more extended. This thus questions the ability of a REIT to give liquidity benefits especially during crises[6][41]. The above issues have catechized whether the addition of REITs to a portfolio adds value to its investor. In order to answer this, Portfolio Optimization tests are undertaken so as to establish the proportion of REITs that need to be held in a portfolio for a risk averse investor [39].

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[5]REITs fail to operate at optimum because they tend to issue out a large proportion of their profits to shareholders so that they can qualify as tax exempt. These large issues lead to increased opportunity costs that are incurred by the REIT as they cannot be able to re-inject capital back to the REIT for growth and development purposes.

[6]As shown by the practice of most REITs Managers in the USA during the 2007-2008 Global Financial Crisis, this problem can be reduced through recapitalization of REITs. When REITs recapitalize, their quantity increases therefore reducing their price and increasing the rate at which they can be traded for a fair price.

Due to the nature of this study, focus is palced on   Portfolio Efficiency as opposed to Market or Information Efficiency in determining the viability of REITs.

2.2.1 Alternative Portfolio Optimization Techniques

Since the emergence of the MVO approach, several models have been proposed that could be considered improvements of Portfolio Optimization techniques. The common alternatives to the MVO approach are briefly discussed below.

This is the measure of inequality or dispersion of a risky asset. This measure is favored in practice as it provides the necessary condition for stochastic dominance[7] regardless of the probability distribution of the asset. This coefficient could therefore be complementary to MVO as it is able to account for individual investor preferences and the non-normal returns of assets. As attractive as this model may be, it is constrained by the fact that it is only suitable for small scale optimization as its complexity increases with the sample size [12].

This is a sophisticated portfolio construction method that that overcomes the problem of highly concentrated portfolios, input sensitivity and estimation errors. According to authors such as [21] and [26] it enables investors to combine their preferences and biases of various assets with the CAPM market equilibrium returns in a manner that will lead to the construction of well diversified portfolios. The Black Litterman Approach uses a Bayesian Approach to combine the investor preferences and biases in order to estimate the new expected return of the portfolio [28] and [31].

Although this model is able to account for investor preferences and market expectations, it is a difficult model to work with due to the difficulty of modeling human behavior and preferences [27].

Monte Carlo Portfolio Optimization is a problem-solving technique utilized to approximate the probability of certain outcomes by performing multiple trial runs, called simulations, using random variables. This technique is used to generate a distribution of random potential returns [16]. The major setback of this model is that, like MVO, it assumes the Normal Distribution of returns. Therefore, it cannot be used to complement the Traditional Mean Optimization Technique as it is constrained by the same assumption [13].

3   Empirical Approach

3.1 Data Sources

The data on the stock market performance is obtained from S&P 500 Dow Jones Index. This index is preferred as it is widely considered the best single gauge of the USA large cap equities [33]. This index is therefore in line with the assumptions of MVO of diversification of portfolios.

The data on the performance of the USA Treasury and Corporate Bonds is sourced from the Barclays Aggregate Bond Index This index is used as it is considered to be an

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[7]This is a concept where a particular random aspect is considered a better outcome than another random prospect based on preferences regarding outcomes.

accurate reflection[8] of the performance and characteristics of the underlying markets [43].

Data on Direct Real Estate Investment performance in the USA is sourced from the National Council of Real Estate Fiduciaries [38]. The NCREIF Index is a represantitive of the performance of a large pool of individual commercial real estate properties acquired in the private market purely for investment purposes. The properties listed on this index have been acquired on behalf of tax exempt institutional investors (National Council of Real Estate Fiduciaries). This tax exempt status for their investors therefore makes this benchmark comparable to that of REITs.

Data on REIT performance in the USA is sourced from The FTSE NAREIT Index which comprises of REIT performance indices that offer exposure to all investment and property sectors for its investors (FTSE) [22].

3.2 Model Formulation

In order to obtain reliable results, two Portfolio Opotimization techniques are used: The traditional Mean Variance Optimization Approach and The Mean Gini Coefficient. We opt for the traditional MVO approach as not only is it a simpler model to use, but also because it is able to capture the normartive nature of wealth allocation. This means that it will be able to generate the ideal or desired optimal portfolio as oppossed to that which investors actually hold [19].

The Mean Gini Coefficient is also used for control purposes. This is because, unlike traditional MVO, it is able to account for Non-Normality of returns. The estimated coefficient will then be used as an input in the simulation of optimal portfolios. The results will be compared to those of MVO so that a reliable conclusion can be made.

However, as explained in Section 2 above, the individual components of the portfolio will have to first have to qualify as Asset Classes. In order to determine this, we will rely on findings of the characteristics of each of the components and compare them to the requirements outlined above. After the components have been established as Asset Classes, we will first take on a Mean Variance Optimization test and then carry out a complementary Mean Gini Coefficient test that would either back or dispute the results obtained by the MVO test.

3.2.1 The Mean Variance Optimization

This will involve identifying and estimating the inputs. That is, the expected returns and standard deviations for each of the asset classes and the correlations between each pair of asset classes.

According to [7], the first step in carrying out an MVO test is estimating the mean of the portfolio which is given by:

$$E(R) = (w_1 E(R_1) + w_2 E(R_2) \ldots + w_N E(R_N)) \tag{1}$$

And since the asset classes compose a portfolio, then the summation of the individual

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[8]It is considered as such as it uses a standard rules based index methodology and a market capitalizations weighting.

asset class' weight should add up to one. Mathematically speaking;

$$\sum w_i = 1 \tag{2}$$

After estimating the return of the portfolio, we then estimate the Variation of each asset class. According to [30], this is given by:

$$V(R_i) = E\{[\sum w_i R_i - E(\sum w_i R_i)^2 \tag{3}$$

And since the Markowitz MVO technique accounts for the covariances between asset classes so as to reduce the risk of an entire portfolio [32], the variation of the portfolio with n asset classes is given by:

$$\delta_p^2 = \sum w_i^2 \delta_i^2 + 2 \sum \sum w_i w_j \delta_{i,j} \tag{4}$$

and the covariance matrix for an n asset class portfolio case is given by;

$$\delta_{i\dots n} = \begin{bmatrix} \delta_1^2 & \delta_{n-1,1} & \delta_{n,1} \\ \delta_{1,n-1} & \delta_{n-1}^2 & \delta_{n,n-1} \\ \delta_{1,n} & \delta_{n-1,n} & \delta_n^2 \end{bmatrix} \tag{5}$$

Where;

$$\delta_{i,j} = E[(R_i - \mu_i)(R_j - \mu_j)] \tag{6}$$

δ_i^2 the variance of asset class *I* as descrived in equation (3) and,
The main diagonal of the matrix (5) contains the variances.
However, since in reality invetsors hold portfolios with n assets so as to exploit diversification benefits, MVO would have to be extended to a scenario with several asset classes. According to [33], every investor is tasked wiith the problem of creating portfolios where that would minimizing the portfolio's risk given a certain return. This risk is constrained by the availablity of investable assets. Following the counsel of [2], [3] and [4] this is mathematically represented as;

Minimize $z = \frac{1}{2} X^T VX$ (7)
Subject to $X \epsilon \mathbb{R} / X^T, \mu = \mu_p, X^T e = 1$ (8)

Where, $X = [X_1, X_2 \dots X_n]^T$ is a column vector of portfolio weights for each security, V is a covariance matrix for the returns and μ_p is the desired portfolio return.
In order to solve the problem above given equation (7) and (8), authors such as [40], suggests the use of a Lagrangian Function given by;

$$L(X, \lambda) = \frac{1}{2} X^T VX - \lambda_1 X^T e - 1 - \lambda_2 X^T \mu - \mu_p \tag{9}$$

Assuming that all of the first and second moments of the random variables (X) exist, the

vectors are linearly independent and the covariance matrix is strictly positive definite, the solution to equation (9) gives the Optimal Portfolio (X*).
The Optimal Portfolio is;

$$X^* = V^{-1}(\lambda_{1e} + \lambda_{2\mu}) \tag{10}$$

Where the parameters λ_1 and λ_2 are given by;

$$\lambda_1 = \frac{(c - b\mu_p)}{(ac - b^2)} \tag{11}$$

$$\lambda_2 = \frac{(a\mu_p - b)}{(ac - b^2)} \tag{12}$$

And,

$$a = e^T V^{-1}, \ b = e^T V^{-1}\mu, \ c = \mu^T V^{-1}\mu \tag{13}$$

3.2.2 The Mean Gini Coefficient

According to [11], the Mean Gini Coefficient (Γ) will be given by:

$$\Gamma = \frac{1}{2} E\left(|Z_1 - Z_2|\right) \tag{14}$$

Where, $E(|Z_1 - Z_2|)$ is the expected value of the absolute difference between a pair of random returns drawn from a continuous probability distribution.
Since the study deals with portfolio optimization, we will want to minimize our dispersion or risk given a certain level of return. So the absolute difference between the pair of random returns can be given by;

$$Z_1 + Z_2 - Min(Z_1, Z_2) \tag{15}$$

If this is substituted in equation (14), we get the second representation of our Mean Gini Coefficient as;

$$\Gamma = \frac{1}{2} E\left(Z_1 + Z_2 - Min(Z_1, Z_2)\right) \tag{16}$$

Given that this is a Mean Gini Coefficient test, we are dealing with a continuous probability distribution. Therefore, we would have to express Z_1 and Z_2 in terms of F (z) and f (z). So,

$$\int_a^b f(z)dz = \int_a^b dF(z) = 1 \tag{17}$$

Where F (z) is a cumulative continuous probability distribution and f (z) is a continuous probability distribution.
The mean (μ) of each of the random variables would then be given by;

$$E(Z_1) = E(Z_2) = \int_a^b z f(z)dz = \int_a^b z dF(z) \tag{18}$$

We take a step further and assume that the probability that both the random variables are less than z is given by;

$$\Pr(Z_1 \leq z) = \Pr(Z_2 \leq z) = F(z) \tag{19}$$

When we follow probability assumptions, then the probability that both Z_1 and Z_2 are greater than z and the probability that both Z_1 and Z_2 are less than z should be equal to 1. So, the probability that the minimum of Z_1 and Z_2 is not greater than z, is given by;
$$\Pr[\min(Z_1, Z_2) \leq z] = 1 - [\Pr(Z_1 > z) \times \Pr(Z_2 > z)]$$

$$= 1 - [1 - F(z)]^2 \tag{20}$$

Where;

$$\Pr(Z_1 > z) \times Pr(Z_2 > z) = [1 - F(z)]^2 \tag{21}$$

As stated before, the main focus is to minimize the variation between the random variables. The Probability that $[\min(Z_1, Z_2) \leq z]$ can be viewed as a Cumulative Distribution function $G(y)$ where y represents the minimum deviation of the random variables. As y extends over the range of a to b, it follows that;

$$E[\min(Z_1, Z_2)] = \int_a^b y \, dG(y) \tag{22}$$

The above representation is an analytical equivalent of;
$$\int_a^b z \, dG(z) = \int_a^b zd \{1 - [1 - F(z)^2]\}$$
$$= 2 \int_a^b z [1 - F(z)] df(z) \tag{23}$$

When $\int_a^b z \, dG(z)$ is substituted in equation (16), we obtain the third representation of our Mean Gini Coefficient as;

$$\Gamma = \mu - 2 \int_a^b z[1 - F(z)] dF(z) = 2 \int_a^b z \left[F(z) - \frac{1}{2}\right] \tag{24}$$

And given that;

$$E[F(z)] = \frac{1}{2} \int_a^b \{F(z) - E[F(z)]\} dF(z) = 0 \tag{25}$$

And,
$$\int_a^b E(z)\{F(z) - E[F(z)]\} dF(z)$$
$$= E(z) \int_a^b \{F(z) - E[F(z)]\} dF(z) = 0 \tag{26}$$

Our fourth Mean Gini Coefficient representation becomes;

$$\Gamma = 2 \int_a^b [\, z - E(z)]\{ F(z) - E[F(z)]\}\, dF(z) \tag{27}$$

And since the definition of covariance between two random variables is simply the expected value of the product of their deviations from the corresponding means [11], equation (27) becomes;

$$\Gamma = 2\, Cov\, [z, F(z)] \tag{28}$$

The above formula gives us the Mean Gini Coefficient which yields the expected variation of returns of each asset class.

The estimates we obtain from both the MVO and Mean Gini Coefficient Techniques above, we will be able to construct optimal portfolios. Each Portfolio Optimization method will have two Optimal Portfolios; one containing REITs instead of Direct Real Estate Investments and the other containing Direct Real Estate Investments instead of REITs.

When being carrying out the optimizations, initially two constraints are used. They are: 1) the weightings of the individual asset classes in the portfolios should be equal to one and 2) short sales are not allowed. The results will then be compared against those of portfolios constructed with an addition constraint i.e. setting the minimum acceptable return as the return offered by a Naïve Portfolio.

If the portfolios containing the REITs outperforms the portfolio containing Direct Real Estate Investments, we shall conclude that REITs not only exist in optimal portfolios but also out-perform Direct Real Estate Investments. This would imply that REITs do have a future as they should be present in each Risk Averse Investor's portfolio.

3.3 Robustness Tests

Since a thirty-year period can be considered too short for reliable estimates to be obtained due to high volatility rates, robustness tests have to be undertaken. In our robustness tests, we construct Optimal Portfolios using monthly data from January 2005 to June 2014. The results from these tests will then be compared against the optimal portfolios constructed using annual data. If the results are consistent, then reliable conclusions will be drawn from results obtained from Optimizations using annual data. If the results are inconsistent, then conclusions will be drawn from the tests conducted using monthly data.

4   Findings and Discussion

Since the objective of this study is to determine whether REITs outperform Direct Real Estate Investments using a portfolio optimization technique, the Mean Gini Coefficient and the Mean Variance Optimization Approaches are used in the Construction of the Optimal Portfolios.

4.1 Descriptive Statistics

The data used for both the Asset Class Qualification and Portfolio Optimization tests, is briefly summarized below:

Table 1: Descriptive Statistics in %

Statistic	FI	EQ	RE	DI
Mean	8.43	13.22	13.54	8.46
σ	7.02	17.22	17.35	7.62
σ^2	0.49	2.97	3.01	0.58
Max	32.65	37.58	37.13	18.72
Min	-2.92	-37.00	-37.73	-17.96

Table 1 provides summary descriptive statistics for the returns for the different asset classes. FI – Fixed income represented by bonds, EQ – stocks, RE – REITS and DI – Direct Real Estate Investment.

4.2 Asset Class Classification Results

For MVO and Mean Gini optimization tests to be undertaken, the REITs have to be considered asset class. Since there has been a lot of controversy surrounding REITs being classified as Asset Classes, as seen in [23] we test for some of the requirements while still relying on scholarly research findings for some of the Asset Class Qualifications listed in Section 2.5.4 above.

On the front of being properly defined and offering investors sufficient liquidity, [8] show that not only are investors able to diversify their portfolios without large capital requirements through investing in REITs, but also that REITs offer sufficient liquidity to investors.

In the same study, [8] were able to show that REITs increase investor returns at all levels of risk. This was evidenced with their results of portfolios with higher weightings of REITs offering better risk adjusted returns as opposed to portfolios with lower weightings of REITs. In addition to this, [1] and [6] found that although REITs are positively correlated to the stock market, this correlation is quite low and it tends to reduce with an increase in the holding period. In addition to this, our own calculations show that REITs are lowly correlated to both Stocks and.

The authors [8] also prove that although many investors are underexposed to REITs, most investors still hold a substantially large weighting of their portfolios in REITs.

Another requirement for an Asset Class to be considered as such is that the assets within the Asset class should be relatively homogeneous. This means that they must have similar attributes. REITs according to [9] are composed of companies that own or finance income generating real estate as investments. In addition to this, a breakdown of the constituents of the NAREIT Index shows that it is comprised mainly of Industrial, Office, Residential and Retail Real Estate Investments [37].

The above analysis shows that REITs can be considered as an Asset Class thus disproving [23] findings that REITs cannot be considered an asset class. The results of the analysis of REITs above can be summarized below:

Table 2: The Qualification of REITs as an Asset Class

Criteria	Comments
Criteria 1: Does the asset offer sufficient Liquidity?	This is evidenced by [8] and [29]
Criteria 2: Does the asset offer Diversification Benefits?	This is evidenced by [8] and [29] the low correlations obtained the Researcher's own calculations
Criteria 3: Does it Push the Efficient Frontier up?	This is evidenced by [8] and [29]
Criteria 4: Does it Make up a significant fraction of the Investor's wealth?	This is also evidenced by [8] and [29]
Criteria 5: Are the assets withing the Asset Class Homogeneous?	This is evidenced by [37] and [29]

Table 2 summarizes the qualities of REITS as an asset class

4.3 Portfolio Optimization Results

In the construction of the optimal portfolios, annual data from FTSE NAREIT, NCREIF, S&P 500 and Barclays Aggregate Bond Indices were used. Since two models were being used to build the optimal portfolios, to sets of results were obtained for the Optimal Portfolios constructed using annual data.

4.3.1 Mean Gini Coefficient Approach Results

The Results for the portfolios constructed with only two constrains were as follows:

Table 3: Optimal Weightings using Annual Data-Mean Gini Approach with Two Constraints

Portfolio	EQ	FI	RE	DI	ER	Risk
1	7.41	89.96	2.63	-	8.92	3.58
2	1.48	49.51	-	49.02	8.52	2.69

The results above were obtained after minimizing the Mean Gini Coefficient $s.t. \sum_1^N W_i = 1$ and not allowing for short sales. Portfolio 1 includes REITS whereas portfolio 2 includes Direct Real Estate Investments.
The results for the portfolios constructed with three constraints were as follows:

Table 4: Optimal Weightings using Annual Data-Mean Gini Approach with Three
Constraints

Portfolio	EQ	FI	RE	DI	ER	Risk
1	30.5	33.5	35.9	-	11.7	5.9
2	33.3	28.2	-	38.5	10.0	4.0

Table 4 shows the results obtained after minimizing the Mean Gini Coefficient while constraining the summation of weightings to one, not allowing for short sales and setting the minimum acceptable return as that offered by a naïve portfolio.

4.3.2 MVO approach Results

The Results for the portfolios constructed with only two constrains were as follows:

Table 5: Optimal Weightings using Annual Data-MVO Approach using Two Constraints

Portfolio	EQ	FI	RE	DI	ER	Risk
1	9.27	90.73	0.00	-	8.87	6.83
2	2.00	52.64	-	45.37	8.54	4.94

Table 5 shows the results obtained after minimizing the standard deviation of the portfolio while constraining the summation of weightings to one and not allowing for short sales. *The results for the portfolios constructed with three constraints were as follows:*

Table 6: Optimal Weightings using Annual Data-MVO Approach using Three Constraints

Portfolio	EQ	FI	RE	DI	ER	Risk
1	40.86	32.86	26.28		11.73	3.14
2	33.34	34.00	32.66		10.04	4.94

Table 6 shows the results obtained after minimizing the standard deviation of the portfolio while constraining the summation of weightings to one, not allowing for short sales and setting the minimum acceptable return as that offered by a naïve portfolio.
From the above, we can see that the addition of a third constraint significantly alters the results obtained while using annual data from 1980 to 2013. This is because; the results show that portfolios with REITs outperform those with Direct Real Estate Investments in terms of risk adjusted return which is different from the results exhibited in Table 3 and 5. However, the fact that the two Portfolio Optimization techniques yield similar results shows that the results obtained are reliable.

4.3.3 Robustness Check

However, for the viability or reliability of results to be assured, robustness tests or out of sample tests have to be undertaken. This need is further aggravated by the fact that a thirty period horizon is too short to use variance as a risk measure. Therefore, for this particular study, four other optimal portfolios were constructed under both techniques while using

monthly data from January 2005 to June 2014.

If the results obtained from the robustness tests differ from those obtained from the original study, then, the results obtained from the robustness tests will be the basis for conclusions. This is because, the data will be more reliable as the risk measure will have been observed over a longer period of time and hence, results are more reliable.

4.3.3.1 Mean Gini Coefficient Approach Results

The results were constructed with only two constrains were as follows:

Table 7: Optimal Weightings using Monthly Data- Mean Gini Approach with Two Constraints

Portfolio	EQ	FI	RE	DI	ER	Risk
1	10.5	89.5	00.00	-	1.3	1.7
2	5.3	40.1	-	54.6	5.2	1.3

Table 7 shows the results obtained after minimizing the Mean Gini Coefficient while constraining the summation of weightings to one and not allowing for short sales.

Table 8: Optimal Weightings using Monthly Data- Mean Gini Approach with Three Constraints

Portfolio	EQ	FI	RE	DI	ER	Risk
1	52.3	24.2	23.4	-	5.9	5.2
2	4.8	38.7	-	56.5	5.2	1.3

Table 8 presents the results obtained after minimizing the Mean Gini Coefficient while constraining the summation of weightings to one, not allowing for short sales and setting the minimum acceptable return as that offered by a naïve portfolio.

4.3.3.2 MVO approach Results:

The results were as follows:

Table 9: Optimal Weightings using Monthly Data- MVO Approach with Two Constraints

Portfolio	EQ	FI	RE	DI	ER	Risk
1	7.5	92.5	00.0	-	3.8	1.7
2	0.4	46.1	-	53.5	2.6	4.7

These results were obtained after minimizing the standard deviation of the portfolio while constraining the summation of weightings to one and not allowing for short sales.

Table 10: Optimal Portfolios using Monthly Data- MVO Approach

Portfolio	EQ	FI	RE	DI	ER	Risk
1	51.6	24.6	23.8	-	5.9	11.9
2	0.2	42.6	-	57.2	2.6	4.9

Table 10 shows results obtained after minimizing the standard deviation of the portfolio while constraining the summation of weightings to one, not allowing for short sales and

setting the minimum acceptable return as that offered by a naïve portfolio.

4.4 Discussion

In building the optimal portfolios, initially, we minimized the deviation of the returns as measured by the Mean Gini coefficient in the Mean Gini optimization and the standard deviation in MVO subject to two constraints. These constraints included; the summation of weights had to be equal to one and short sales were not allowed.

From the results in Table 3 and 5, we see that Optimal Portfolios under both approaches have higher weightings of Direct Real Estate Investments as opposed to REITs and that the optimal portfolios containing REITs are outperformed by those containing Direct Real Estate Investments.

This could be attributed to the fact that REITs are more volatile investments as opposed to Direct Real Estate Investments as evidenced during the recent Global Financial Crisis when REITs were seen to have dropped by around 60% at one point in time during the worst of the crisis as opposed to the NCREIF Index when returns in comparison only dropped by about 15%. Considering that, the study was centered on minimizing deviations; our optimal portfolios would therefore have higher weightings of Direct Real Estate Investments as compared to REITs.

The high 'deviation' in this study is evidenced by the trend of the Mean Gini Coefficient in REITs where it increases steadily with the increase in weighting of REITs in a portfolio. Direct Real Estate Investments on the other hand exhibit a different trend where the Mean Gini Coefficient reduces with the increase in weighting of Direct Real Estate Investments up to a level of 80% where it starts increasing again.

Since REITs are considered high risk or high volatility investments, risk would have to be accounted for. Therefore, a third constraint, i.e. the return offered by a naïve portfolio was set as the minimal acceptable return.

The results obtained after adding the third constraint reveal that both Mean Variance and Mean Gini Coefficient Optimization approaches suggest that REITs in the USA are not only present in optimal portfolios but also outperform Direct Real Estate Investments as evidenced by the returns exhibited in Table 4 and 6 above.

The results above could be attributed to the fact that REITs are more volatile investments as opposed to Direct Real Estate Investments. And since unsystematic risk is positively correlated with potential return (Cummins & Harrington, 1988), the portfolios with REITs will yield higher returns as opposed to portfolios with Direct Real Estate Investments. This thus explains the results exhibited in Tables 4 and 6 above.

The findings above are similar to those of [24] and [25]. The two studies found that over the past thirty years, portfolios containing REITs have been able to outperform those containing Direct Real Estate Investments by about 4% annually. These results are also similar to those of [14] where they found that portfolios containing REITs continue to outperform those containing Direct Real Estate Investments on a long term and recurring basis.

Although a thirty-year time period is short period of time to reliably use Variance as risk measure, the robustness or out of sample tests yield results similar to those of our thirty-year period. The annual returns between the annual tests and monthly tests however differ because; the robustness tests focused at a period when the real estate cycle was considered to be in a trough as opposed to its boom. This would therefore mean that our initial Portfolio optimization results are reliable.

5   Conclusions

Due to the controversy surrounding the superiority of two Asset Classes; Direct Real Estate Investments and REITs, this study focused on a Portfolio Optimization approach in a bid to establish the more superior asset class. This study covered the period 1980-2014. It shows that Optimal Portfolios containing REITs offer superior returns as evidenced by the table 11 below.

The portfolios containing REITs were found to outperform those containing Direct Real Investments mainly due to two factors; a) the higher risk associated with REITs, thus the higher return exhibited by them and b) Direct Real Estate investments' return being a function of timing the real estate cycle.

Given the results obtained from the study, there is still room for further research as this research was based on certain assumptions which included; 1) the minimum acceptable return for well diversified investors interested in both the REITs and Direct Real Estate market is the return offered by a portfolio naively invested in, 2) the other asset classes (stocks, bonds and direct real estate investments) are correctly classified as asset classes, 3) investors were only willing to invest in either REITs or Direct Real Estate Investments. A mix of the two was not considered by any investor and 4) investors were behaving rationally during the entire study horizon such that they were not influenced by any sentiments or cognitive biases.

Table 11: Summary Output

Portfolio	1	2	3	4	5	6	7	8
Weights								
Bonds	7.4	1.5	30.5	33.3	9.3	2	40.8	32.8
Stocks	89.9	49.5	33.5	28.2	90.7	52.6	26.3	34.0
REITS	2.6	NA	35.9	NA	0.0	NA	26.3	NA
Direct Real Estate	N/A	49.02%	N/A	38.49%	N/A	45.37%	N/A	32.66%
Portfolio Outcome								
ER	8.9	8.5	11.7	10.0	8.9	8.5	11.7	10.0
Risk	3.6	2.7	5.9	4.0	6.8	4.9	3.1	4.9

Where both Portfolio 1 and 2 are portfolios constructed using the Mean Gini Coefficient Approach while subjecting them to the two constraints that were outlined above. Portfolio 3 and 4 on the other hand are portfolios constructed using the Mean Gini Coefficient Approach while subjecting them to the three constraints that were outline above and Portfolio 5 and 6 are portfolios constructed using the MVO Approach while subjecting them to the two constraints. Portfolio 7 and 8 are the portfolios constructed using the MVO Approach while subjecting them to the three constraints.

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