



UNIVERSIDADE CATÓLICA PORTUGUESA

Real Estate Investment Trusts

A Historical Performance Analysis

By

Miguel Bernardo Dias Faro

Católica Porto Business School

2020



UNIVERSIDADE CATÓLICA PORTUGUESA

Real Estate Investment Trusts

A Historical Performance Analysis

Master's thesis
presented to Católica Porto Business School of
Universidade Católica Portuguesa
to obtain a master's degree in Finance.

By
Miguel Bernardo Dias Faro

Under the supervision of
Prof. Dr. Ricardo Cunha

Católica Porto Business School

2020

Agradecimentos

O presente trabalho é dedicado à minha família: ao meu pai, mãe e irmão. Muito obrigado pelo apoio e confiança que sempre demonstraram por mim.

Gostaria igualmente de agradecer ao Professor Doutor Ricardo Cunha por me ter orientado e ajudado neste enorme projeto, bem como ao Professor João Novais e ao Professor Ricardo Ribeiro pelo apoio que sempre me deram ao longo deste percurso.

A todos vós, obrigado.

Resumo

Esta tese avalia a performance e os riscos de três Real Estate Investment Trusts (REIT) portfólios: EREIT, MREIT e AREIT.

O portfólio EREIT é composto apenas por ações REIT, MREIT é composto por ações REIT hipotecárias e AREIT composto por ambas as ações descritas. Ao analisar os retornos excessivos, desvio padrão e Sharpe Ratio, os resultados sugerem que o portfólio que contém ambos os tipos de ações REIT (AREIT) teve a melhor performance de todos, para o período em análise (janeiro de 2000 até janeiro de 2020).

A performance dos índices S&P500 e Russell 2000 foi igualmente avaliada. Os resultados obtidos sugerem que o Russell 2000 teve melhor performance do que o índice S&P500.

Quando todos os ativos foram comparados - MREIT, EREIT, AREIT, S&P500 e Russell 2000 – verificou-se que o portfólio que contém ambos os tipos de ações REIT (AREIT) teve a melhor performance, para o período em análise.

O presente trabalho desenvolve a sua análise ao estudar a capacidade explicativa que o modelo de três fatores de Fama e French (1992), o modelo de três fatores de Fama e French (1992) aumentado com o fator momento (MOM) do modelo de Carhart (1997) e ainda o modelo de cinco fatores de Fama e French (2015) têm em explicar os retornos excessivos em cada um dos portfólios REIT. Os resultados obtidos sugerem os fatores MKTRF, SMB e HML como sendo os mais capazes de explicar os retornos excessivos.

Quando comparando qual ou quais os modelos mais válidos para explicar os retornos de cada um dos portfólios REIT, verificou-se que o modelo de três fatores de Fama e French (1992) é o único capaz de os explicar. Verificou-se igualmente que o modelo de quatro fatores de Carhart (1997) e o modelo de cinco fatores de Fama e French (2015) não acrescentam valor, ao não serem capazes de explicar os retornos excessivos em cada portfólio.

PALAVRAS-CHAVE: Real Estate Investment Trusts (REITs), Equity REIT (EREIT), Mortgage REIT (MREIT), All REIT (AREIT), Capital Asset Pricing Model (CAPM), Arbitrage Pricing Theory (APT), Modelo de Três Fatores de Fama e French (1992), Modelo de Quatro Fatores de Carhart (1997), Modelo de Cinco Fatores de Fama e French (2015).

Abstract

This paper examines the performance and risk sensitivities of three (Real Estate Investment Trusts (REIT) portfolios, when compared to more conventional funds: MREIT, EREIT and AREIT.

The MREIT portfolio includes only the returns on investment of mortgage REIT stocks (MREIT), the EREIT portfolio includes the returns on investment of equity REIT stocks (EREIT) and the AREIT portfolio includes the returns on investment of both equity and mortgage REIT stocks (AREIT). Analyzing excess returns, standard deviation and Sharpe Ratio, results suggest that the portfolio holding all types of REIT stocks (AREIT) was the most attractive investment during the twenty-year period covered (January 2000 - January 2020).

The performance of a large capitalization index (S&P500) and a small capitalization index (Russell 2000) were also tested. Results suggest that the Russell 2000 index outperformed the S&P500 index. When risk-adjusted returns of all commodities were evaluated - MREIT, EREIT, AREIT, S&P500 index and Russell 2000 index - results obtained indicate the AREIT portfolio as the one which performed the best among all.

This thesis broadens its scope evaluating the explanatory capacity for the Fama and French (1992) asset pricing model augmented with the Carhart (1997) momentum factor and the Fama and French (2015) five-factor model to help explain excess returns in REIT portfolios. Results suggest the market risk-free (MKTRF), small minus big (SMB) factor and the high minus low (HML) factors, as the main variables capable of explaining their excess returns.

Results also show that the Fama and French (1992) three-factor model is the most capable at explaining the REIT portfolio excess returns. It was also shown that Carhart (1997) four-factor model and Fama and French (2015) are insufficient at explaining excess returns in any REIT portfolio.

KEY WORDS: Real Estate Investment Trusts (REITs), Equity REIT (EREIT), Mortgage REIT (MREIT), All REIT (AREIT), Capital Asset Pricing Model (CAPM), Arbitrage Pricing Theory (APT), Fama and French (1992) Three-factor model, Carhart (1997) Four-factor Model, Fama and French (2015) Five-factor model.

Index

Abstract	v
1. Introduction	8
2. Portfolio Performance Literature	11
2.1. Markowitz	11
2.2. Capital Asset Pricing Model (CAPM)	12
2.3. Arbitrage Pricing Theory (APT).....	15
2.4. Fama and French (1992) Three-Factor Model	18
2.5. Carhart (1997) Four-Factor Model	20
2.6. Fama and French (2015) Five-Factor Model.....	22
3. REIT Literature	23
4. Methodology	25
4.1 REITs Portfolio Performance	25
4.2 Benchmark Performance	26
4.3 REITs Portfolio Regression	27
5. Data	30
6. Results	31
6.1 REIT Portfolios and Benchmark Performance	31
6.2 REIT Portfolios Factor Models.....	33
7. Conclusion	37
Literature References	40

Index of Tables

Table 1 Summary of performance statistics of the REIT portfolios and benchmarks.....	32
Table 2 Summary of performance statistics of the REIT Portfolios and Factor Models.....	33
Table 3 Factor Models.....	35

1. Introduction

Real estate is one of the most lucrative sectors and normally produces excellent returns in the long term. Whether it is buying and selling houses, renting, or even owning any real estate property that generates income, an increasing number of people is looking for new ways of increasing their wealth. However, real estate equally presents a downside. During the subprime crisis, the U.S. household net worth declined by nearly 13 trillion USD, the average U.S. housing prices dropped nearly 30% and the U.S. stock market fell approximately 50% by early 2009 (Chong, 2011).

Real Estate Investment Trusts (REITs) can be an effective investment vehicle alternative for anyone who wishes to have a source of passive income. A real estate investment trust is a company that owns or produces financial income through real estate assets. Investment assets can go from office buildings, data centers, health care facilities, hotels as well as commercial and residential spaces. According to the National Association of Real Estate Investment Trusts (NAREIT), REITs can even be divided into equity REIT (EREIT) which own and manage real estate properties and mortgage REIT (MREIT) that hold or trade mortgages securities.

REITs are an effective source for any investor who wants to gain economic and other real estate investment benefits. The ownership of a REIT can be equated with owning a stock or a treasury bill, which requires little active management. Investing in real estate through REIT ownership does not demand the large and long-term financial commitment, seen on other real estate investment alternatives.

The present study will try to answer two questions: First, can a portfolio holding only REIT stocks beat traditional benchmark performance? And second, how well does the Fama and French (1992) asset pricing model augmented with the Carhart (1997) momentum factor and the Fama and

French (2015) five-factor model, help explain the excess returns for the REIT portfolios.

A lot of empirical work has been done on how REITs perform over time and how they are compared with benchmarks. However, there seems to be no real conclusion on how these instruments behave over time. One reason for this is due to short sample periods used in earlier studies. Since these instruments are designed to supply long-term returns, a short period analysis may not be ideal when looking for a time-return relationship. Another problem found in most REITs research is that the traditional benchmark used is the S&P500 index. Though commonly known and broadly assumed as the biggest reference in the financial world, the main problem with using this proxy is that it excludes mostly small stocks and most REITs are small capital stocks (Han and Liang, 1995).

The present work addresses these two issues: First by comparing the risk and excess returns of three REIT portfolios - equity REIT (ERIT), mortgage REIT (MREIT) and both equity and mortgage REIT (AREIT) - with a similar capitalization benchmark, the Russell 2000 as well as with the S&P500 index. Second, since most studies focus on a short-term analysis, this paper will overcome this, by studying a twenty-year period (2000-2020).

The analysis of each portfolio was performed by estimating three equations: the Fama and French (1993) asset pricing model, the Fama and French (1993) asset pricing model augmented with the Carhart (1997) momentum factor and the Fama and French (2015) five-factor model. The results of this study show that portfolio holding both equity and mortgage REIT stocks (AREIT) outperformed the other two REIT portfolios as well as the two benchmarks. By regressing each REIT portfolio with Fama and French (1993) asset pricing model, Fama and French (1993) asset pricing model augmented with the Carhart (1997) momentum factor and Fama and French (2015) five-factor model, results suggest market risk-free, small minus big and high minus low

seem to be the only variables capable of explaining excess returns in each portfolio.

This paper is structured as follows. In Section 2 and 3 is presented the literature used to assess this work. In Section 4 and 5, it is discussed the methodology and the data respectively. In Section 6 are presented the empirical results. Lastly, in Section 7 the conclusions are presented.

2. Portfolio Performance Literature

2.1. Markowitz

According to Harry M. Markowitz (1952), the process of choosing ideal portfolios, can be divided into two stages. The first begins with the observation and experience and ends with beliefs about the future performances of available securities. The second stage starts with some relevant beliefs about future performance and ends with the choice of the portfolio. Nevertheless, Markowitz's (1952) focused his attention on the second stage.

First, the author considered the rule that an investor maximizes (or should maximize) discounted expected returns. Since the future is uncertain, returns must be "anticipated" or "expected", which he will discount. Secondly, he considered another rule where the investor considers (or should consider) the expected return as desirable and variance of return as undesirable.

An investor who truly wants to maximize his expected returns, should diversify his funds among all the securities in order to maximize expected returns. This is a special case of expected returns – variance of return ($E-V$) rule. This rule implies that there is a portfolio which yields a maximum return for a minimal variance (Markowitz, 1952).

Markowitz (1952) on his paper rejects the expected returns rule since it does not necessarily lead to superior gains of diversification. On the other hand, the $E-V$ rule implies diversification for a large range of expected return and risk. The $E-V$ hypothesis not only does imply diversification, but also the "right kind" of diversification for "the right reason". For example, a portfolio with nothing but railroad securities would not be as well-diversified as a portfolio with some railroad securities, public utility securities, etc.

The reason lies on the fact that it is more common for firms within the same industry to perform worst simultaneously, than for firms in different

industries. However, investing in many securities is not enough to reduce variance. It is also necessary to invest in securities with high covariances among themselves (Markowitz, 1952).

2.2. Capital Asset Pricing Model (CAPM)

Dealing with the different risk conditions has been one of the major problems in predicting capital markets' behavior. In equilibrium, capital asset prices are adjusted so that the investor, following rational procedures, can obtain any desirable point along the *capital market line*. The *capital market line* represents the level of additional return above the risk-free rate for any change in risk level. Its analysis allows investors to allocate their investments in order to achieve the maximum amount of expected return with the minimum amount of risk. In fact, an investor may get a higher expected rate of return on a given security, only by adding some risk. Hence, portfolio diversification plays an important role in reducing some risk of a given asset (Sharpe, 1964).

Although many authors have used the same model of investor behavior, none tried to extend it and construct a market equilibrium theory of asset prices under certain risk conditions. This behavior model considers that an investor will choose from the investment opportunity that maximizes its utility from a given set. The investor will select among all the possibilities the one that, along with its indifference curve, is placed at the highest level of utility.

By developing earlier studies, Sharpe (1964) concludes that an investor may arbitrarily select any efficient combination of risky assets, since rates of return from all efficient combinations are perfectly correlated with each other. Thus, his study provides an useful interpretation of the relationship between an individual asset's risk and its expected return.

Diversification allows the investor to minimize a substantial part of overall risks - except risk resulting from swings in the economy - and even in efficient combinations, risk still exists. Since all other types of risk can be avoided, the asset's rate of return is of single relevancy in assessing the asset's risk. Sharpe (1964) concludes that assets that are not affected by changes in the economic activity, will return the pure interest rate and those that present movement, will promise higher expected rates of return. Sharpe's study allows for a new understanding on the relationship between the price of an asset and the different components of its overall risk.

Lintner (1965) sets a simple logic leading directly to the determination of explicit equilibrium prices of risk assets, under ideal conditions. The author shows that these equilibrium valuations of individual risk assets, are simply, explicitly, and linearly related to their respective expected returns, variances and covariances. His findings appear to present that total risk on a given security can be obtained as the sum of the variance of its own dollar return, and the joint covariance of the returns of all other securities. The total risk of each security is finally determined by multiplying by a "market price of risk" (Lintner, 1965).

Moreover, the value of an individual security within a portfolio is not simply and linearly correlated to the standard deviation of its returns. Up until then, literature seemed to suggest that the "risk premium" on securities varied linearly with their risk - measured by the standard deviation. In his study, he reveals that the risk measure of a given security is determined by its return variance and covariance.

While studying the maximal gains from diversification, Lintner found that the best possible portfolio is one with the highest ratio between the expected excess rate of return to the standard deviation of the portfolio return. This new idea adds an enormous value to previous studies because, contrary to the

former belief, gains from diversification depend on the relationship between expected income and risk and not only on risk considerations alone.

Lintner's study (1965) becomes even more relevant as he concludes that real gains obtained from diversifying portfolios, come from "averaging over" independent components of return and risk within an individual stock. Apart from negative correlations, there would not be any gains from diversification if the residual variances or independent variations were absent. The goal of diversification is not to minimize or even avoid risk but, instead, to select the best portfolio with the best combination of risk and expected return. (Lintner, 1965).

Sharpe (1964) and Lintner (1965) have proposed models that could properly measure the risk of a capital asset. They also focused their attention on determining the equilibrium relationship between the asset's risk and its expected return. When comparing both studies, Lintner believes that the measures of risk derived from his model are more general and different from the ones in Sharpe's model. Sharpe eventually agreed that Lintner's work surpasses his (Fama, 1968). The apparent conflict between both authors was caused because Sharpe focused his attention on a special stochastic process for returns' description, not necessarily implied by his asset pricing model. Fama (1968) showed that there was no conflict between both models and when the models were properly applied to the market both led to the same measures of risk of a given asset and to the same relationship between risk and expected return of a given asset.

A central problem in the finance world has been on how to properly evaluate the "performance" of portfolios of risky investments. Jensen (1968) wrote that the concept of portfolio "performance" had at least two different dimensions. The first being the ability for a portfolio manager to increase returns on the portfolio through correct predictions of future security prices and the second being the portfolio manager's ability to minimize, through

“efficient” diversification, the amount of “insurable risk” born by the holders of the portfolio.

The author confined his attention on the problem of evaluating a portfolio manager’s predictive ability. He intended to test their ability to produce returns through successful prediction of security prices and compare them with expected returns, given the level of riskiness of their portfolio. Numerous studies have tried to evaluate the performance of portfolios while using relative measures of performance, when they should have used an absolute measure of performance (Jensen, 1968).

In addition to the lack of an absolute measure of performance, earlier studies of portfolio performance have presented problems with the definition of “risk” and the need to properly control the varying levels of riskiness among portfolios. In his paper, Jensen (1968) decided to properly measure the effects of “risk” on the returns of a given portfolio. The final step of his analysis was to estimate the measure’s sampling error which allowed to measure its statistical “significance”.

The evidence from Jensen (1968) suggests that mutual funds are, on average, unable to predict the security prices well enough to outperform a *buy-the-market-and-hold* policy. There is little evidence that any individual fund is able to perform significantly better than that. Jensen’s findings hold true even when he measured gross management expenses’ fund returns. Mutual funds were not successful enough in their trading activities to recoup even their brokerage expenses. However, funds have done an excellent job at minimizing the “insurable” risk born by their shareholders (Jensen, 1968).

2.3. Arbitrage Pricing Theory (APT)

Ross (1976) decided to thoroughly examine the arbitrage model of capital asset pricing. This new model was presented as an alternative to the mean

variance capital asset pricing model (CAPM), introduced by Sharpe (1964) and Lintner (1965). By using Sharpe (1964) and Lintner (1965) assumption that investors have similar anticipations, Ross (1976) concludes that the arbitrage theory still requires identical expectations and agreement on the Beta coefficients, if the identification of ex-ante beliefs with ex-post realizations is to provide empirically fruitful results (Ross, 1976). Using data for individual equities during the 1926-1972 period, Ross discovered that “three or four priced” factors are related to generating process of returns. It appears that estimated expected returns depend mostly on estimating factors’ loadings and other variables such as the standard deviation and though highly associated with estimated expected returns, they do not add any further explanatory power to the factor loadings.

Looking for an alternative to the capital asset pricing model (CAPM), Ross (1976) developed the Arbitrage Pricing Theory (APT). Although CAPM has been widely used since formulated, research has raised many doubts on its ability to explain empirical assets returns. Despite criticism, CAPM holds an enormous reputation and many academic scholars and finance practitioners still rely heavily on this model in the present.

A good explanation for its durability relies on its compatibility with the single most widely-acknowledge empirical regularity in assets returns, their common variability. This common variation, with a random disturbance, generates returns for each individual asset. Nevertheless, this intuition is divorced from the formal CAPM theory. Different finance texts for example have revealed that rationalizations of the CAPM are rather based on the dichotomy between diversifiable and non-diversifiable risk.

APT is a viable alternative to CAPM since it agrees perfectly with its intuition. In fact, APT is based on a linear return generating process and does not require any utility assumptions beyond monotonicity and concavity. Another excellent feature of APT is that it is not restricted to a single period

since it holds both multiperiod and single period cases. Also, unlike CAPM, there is no requirement that the market portfolio be mean variance efficient (Roll and Ross, 1980).

There are two relevant differences between the original Sharpe's model (1964) and the APT. On the one hand, APT allows for more than just one generating factor. Secondly, APT proves that since any market equilibrium must be consistent with no arbitrage profits, every equilibrium will be characterized by a linear relationship between each asset's expected return and its returns response amplitudes, also known as loadings, on the common factors (Roll and Ross, 1980).

Since it is not possible for CAPM to devise cross-sectional tests, APT's empirical usefulness rests precisely on its ability to allow for cross-sectional tests regardless of how many factors exist. In fact, past empirical studies have concluded that there may exist multiple factors in the assets' process for generating. APT proves to be a solid theoretical framework to find whether those factors, if they exist, are "priced" (Roll and Ross, 1980).

Earlier studies have developed a simple criterion for optimal portfolio selection without any mathematical programming. They tried to determine which securities to include in an optimal portfolio and how much to invest in it (Chen and Brown, 1983). The main results of Chen and Brown (1983) study indicate that the presence of proper estimation risk reduces the relative impact of estimated systematic risk on optimal portfolio choices. Thus, investors may get an unexpected outcome by not taking estimation risk into account. Chen and Brown (1983) conclude that, using the single index model for the return generating process, the decision rules for optimal portfolio selection derived by previous works are not identical under the Bayesian and traditional methods of analysis.

Previous studies of mutual fund performance have examined the returns achieved by investors. Nevertheless, there has not been any consensus

regarding the ability of professional portfolio managers to earn abnormal returns. In fact, with very few exceptions, the actual returns achieved by investors seem to have either negative performance or no performance for the average mutual fund. If there was indeed a superior investment talent, fund managers would capture the rent from their talent through higher fees. This way, abnormal performance could be observed only by examining gross returns (Grinblatt and Titman, 1989).

These authors decided to compare the abnormal returns of both active and passive investment strategies – with and without transaction costs, fees, and expenses and found that transactions costs are inversely related to the fund dimension and that abnormal performance of the funds, is based on gross returns, is inversely related to fund size. However, since transaction costs are inversely related to fund size, net returns are unrelated to net-assets' values of the funds. Grinblatt and Titman (1989) also discovered that, on average, actual returns do not display positive abnormal performance for any category of fund. The most important finding in this study shows that superior performance may, in fact, exist, particularly among aggressive-growth, growth funds and funds with the smallest net asset values. It was also found that these funds with highest expenses do not present abnormal performance in their actual returns. In conclusion, investors cannot take advantage of the superior abilities of these portfolio managers, purchasing shares in their mutual funds (Grinblatt and Titman, 1989).

2.4. Fama and French (1992) Three-Factor Model

CAPM's central assumption is that the market portfolio of the invested wealth is mean-variance efficient, according to Markowitz (1959). The market portfolio efficiency suggests that expected returns on securities are a positive linear function of their market betas and that market betas are enough to

describe the cross-section of expected returns. Fama and French (1992) decided to evaluate the joint roles of market beta, size, earnings-price ratio (E/P), leverage and book-to-market equity in the average returns' cross-section.

Their study suggests that the relationship between beta and average return disappears, even when beta is used alone to explain average returns. Moreover, it was found that the relationship between beta and average returns was also weak for the period under analysis (1941-1990) and, therefore, their tests did not support the basic predictions of the CAPM, where average stocks are positively related to the market's beta. On the other hand, the authors found that the relationship between average return and size, leverage, E/P and book-to-market equity is strong. Fama and French (1992) also present that size (ME), leverage and book-to-market equity (BE/ME) supply a powerful characterization on the average stock returns' cross-section.

CAPM is the most used model instrument when assessing the cash-flow risk of a portfolio. However, investors seem to not fully understand how to measure the inherent risk to any investment and how they determine what risk premium to demand. According to CAPM, risk is measured by cash-flow beta relating to market portfolio return of all assets and the relation between expected return and beta is linear. Most empirical studies on CAPM also assume that betas stay constant over time and that the return on the value-weighted portfolio of all stocks is a proxy for the return on aggregate wealth.

Fama and French (1992) suggest the inability of the static CAPM to explain some average returns' cross-section. Using return data on an assets collection, they test the model's static version and find that the "relation between market beta and average return is flat". One other problem associated with CAPM is that it is based on the idea that investors live for only one period when, in fact, they live for many periods. Due to CAPM's inability to explain cross-sectional variations in average returns on a large collection of stock portfolios, the authors argued that it was very inaccurate as an asset-pricing model.

To test static CAPM, Jagannathan and Wang (1996) decided to construct a set of portfolios and see how the model would behave. The results were surprising as the static CAPM was unable to explain satisfactorily the cross-section returns among them. It was also demonstrated that stocks portfolios with small capitalization produced, on average, higher returns than those predicted by CAPM and that when the conditional version of the CAPM holds, betas and expected returns vary over the business cycles, a two-factor model obtains unconditionally.

Using a market portfolio, Jagannathan and Wang (1996) found that the unconditional CAPM model explains nearly 30 percent of the cross-sectional variation in average returns, while static CAPM only explains 1 percent of the cross-sectional variation in average returns. It was also found that when human capital is included in wealth measuring, the unconditional model implied by conditional CAPM explains over 50 percent of the cross-sectional variation in average returns. Moreover, size and book-to market variables have little ability to explain what is left unexplained.

2.5. Carhart (1997) Four-Factor Model

Persistence in mutual fund performance does not reflect a superior stock-picking skill (Carhart, 1997). In fact, common factors in stock returns, persistence difference in mutual fund expenses and transaction costs explain most of the predictability in mutual fund returns. Earlier studies found that funds which earned higher one-year returns did it, not because the fund managers followed any momentum strategies, but because some mutual funds held larger positions in comparison to the previous year's winning stocks (Carhart, 1997). Carhart found that individual mutual funds which followed the one-year momentum strategy, earned significantly lower abnormal returns after expenses. Thus, he concludes that transaction costs

consumed the gains from following a momentum strategy in stocks. Carhart (1997) expands the existing literature, showing that common factors in stock returns and investment expenses almost completely explain persistence in equity mutual funds' mean and risk-adjusted return.

Carhart's (1997) paper ends with three suggestions for any wealth-maximizing mutual fund investor: first, avoid funds who constantly present a poor performance; second, funds with high returns in the previous year are expected to have higher-than-average expected returns in the following year, but not in the year after that; third, investment costs, transaction costs and load fees all have a direct and negative impact on performance.

One of CAPM's premises is that investors choose the portfolio with the highest expected excess return and leverage to suit their risk preferences. However, one of the biggest problems that many investors and mutual funds face is that most of the times they are constrained in the leverage that they can take and thus tend to overweight risk securities instead of using leverage (Frazzini and Pederson, 2014). In their study, the authors empirically found that portfolios of high-beta assets have lower alphas and Sharpe ratios than portfolios of low-beta assets. It was found that the security market line was flatter than what was predicted by the standard CAPM. The authors showed that this deviation from the standard CAPM could be captured by using betting against beta (BAB) factors.

Leveraged buyout funds with access to leverage buy stocks with betas below one on average and as a result, investors end up taking advantage of the betting against beta effect, by applying leverage on safer assets. Another interesting discovery is that a BAB factor, which is composed by long leveraged low-beta assets and short high-beta assets, produces significant positive risk-adjusted returns. Frazzini and Pederson (2014) suggest that increased funding liquidity risk compresses betas toward one.

2.6. Fama and French (2015) Five-Factor Model

Earlier studies have shown the relation between the average stock return and the book-to-market equity ratio (B/M). Further evidence shows that the description of average returns provided by (B/M) is added by profitability and investment. Much of the variation in average returns is related to profitability and investment, and the three-factor model is unable to explain this relation. Hence, a new five-factor model is created by adding the profitability (RMW – Robust minus Weak) and the investment (CMA – Conservative Minus Aggressive) factors to the market, size, and B/M factors to the Fama and French three-factor model (Fama and French, 2015).

However, the addition of the two new factors did not erase some of the problems that the earlier model presented. This new model is still unable to capture low average returns on small stocks whose returns behave like firms which invest considerably, despite low profitability. The biggest contribute of this model is that its performance is not sensitive to the way their factors are defined. By adding profitability and investment factors, the value factor of the Fama and French three-factor model, becomes obsolete to describe average returns.

For a better understanding of monthly excess returns on each REIT portfolio, the present work regresses each REIT portfolio using Fama and French (1993) asset pricing model, Fama and French (1993) asset pricing model augmented with Carhart (1997) momentum factor and Fama and French (2015) five-factor model. A great amount of empirical work done in the past concluded that most of these models are unable to fully explain average returns on small stocks (Fama and French, 2015). Since most REIT stocks are small capital stocks, this thesis tests if the three models above are enough to explain excess returns on each REIT portfolio.

3. REIT Literature

Early studies on real estate returns concluded that real estate earns substantial risk-adjusted returns as well as serving as a good hedge against inflation. Chan, Hendershott and Sanders (1990). focused their attention on appraisal-based returns and analyzed monthly returns on equity real estate investment trusts (REITs), traded on major stock exchanges. While their series might evidence the volatility of real estate returns owing to the closed-end nature of REITs, these are more representative of transaction prices than those based on appraised value. To assess the relative risk of real estate returns, a multifactor Arbitrage Pricing Model as well as the Capital Asset Pricing Model, was applied and the results present the importance of using a multifactor model given that, when a simple Capital Asset Pricing Model (CAPM) was applied, the authors found evidence of excess real estate returns. In contrast, when a five-factor model was employed, this evidence disappeared. Furthermore, when the equally weighted equity REIT return index was regressed on the closed-end stock-fund discount, results show that real estate presents an inferior risk to that of common stocks (Chan, Hendershott & Sanders, 1990).

REITs have earned their space and interest among researchers and institutional investors with many studying and contributing for a better understanding of the importance of this real estate investment vehicle. One particular paper focused its attention on the historical performance of Real Estate Investment Trusts evaluating long-term (1970-1993) performance of REITs, examining their performance stability during that time frame and investigating their performance when compared to some performance benchmarks (Han and Liang, 1995).

In their research, the authors concluded that REIT performance was similar to a three-month treasury bill and that equity REITs performed much better

than mortgage REITs for the period under analysis. Although most studies on REITs performance have used the S&P500 index as the performance benchmark, according to Han and Liang (1995), this proxy leads to some biased results as it tends to overstate REIT performance. This overstatement is caused by the inclusion in the S&P500 index of mostly large capitalization stocks and most REITs being small capital stocks (Han and Liang, 1995).

Using Han and Liang (1995) work, performance of three REIT portfolios is also compared with the S&P500 index. Since this proxy excludes mostly small capital stocks, the present study adds another index into its analysis, Russell 2000. The reason for inclusion of this benchmark is the present possibility to compare a small capital index with a portfolio composed mainly by small capital stocks. In their study, Han and Liang compare the performance of REIT portfolios and S&P500 index evaluating their excess returns, standard deviation and Sharpe Ratio.

The present study evaluates the performance of both indexes and assesses REIT portfolios comparing their excess returns, standard deviation and Sharpe Ratio.

4. Methodology

4.1 REITs Portfolio Performance

The first part of this study compares the performance of three REIT portfolios - equity REIT (EREIT), mortgage REIT (MREIT) and all REIT (AREIT). This analysis assesses the average excess returns, standard deviation and Sharpe Ratio of each security.

Markowitz (1952) shows that the excess returns estimation equation (1) and the standard deviation equation (2) can be written as:

$$(1) \quad ER_{it} = RI_{it} - RF_t + \varepsilon_{it}$$

where ER_{it} denotes excess returns of security i in month t , RI_{it} denotes the expected return on security investment i in month t , RF_t denotes return in month t of a one-month treasury bill and ε_{it} stands for the idiosyncratic error.

The standard deviation equation is given by equation (2):

$$(2) \quad \sigma_p = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1}}$$

where σ_p denotes the standard deviation of the portfolio's excess return, x_i denotes the value of the point i in the data, \bar{x} the mean value of the data set and n the number of data points in the data set.

Sharpe (1964) shows that Sharpe Ratio estimation equation can be written as:

$$(3) \quad \text{Sharpe Ratio} = \frac{ER_t - RF_t}{\sigma_p}$$

Where ER_i is the expected return of the portfolio i , RF_t is the return in month t of a one-month treasury bill and σ_p denotes the standard deviation of the portfolio's excess return.

4.2 Benchmark Performance

Similarly, each benchmark excess returns, standard deviation and Sharpe were compared.

To obtain the excess return for each benchmark, first and foremost, we need to determine the return on investment. To do so, the following equation was applied:

$$(4) \quad RI_{it} = \frac{P_{it}}{P_{it-1}} - 1$$

where RI_{it} denotes the returns on investment of the index i in month t , P_{it} denotes the adjusted-close price of index i in month t and P_{it-1} denotes the adjusted-close price of index i in month $t - 1$.

Having determined the returns on investment of each index, we, then, had to determine their excess returns. The estimation equation of the excess returns is given by:

$$(5) \quad Y_{it} = ER_{it} - RF_t + \gamma_{it}$$

where Y_{it} denotes excess returns of index i in month t , ER_{it} denotes the expected return on investment of index i in month t , RF_t denotes the return in month t of a one-month treasury bill and γ_{it} stands for the idiosyncratic error.

Standard deviation was calculated using:

$$(6) \quad \sigma_p = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1}}$$

where x_i denotes the value of the point i in the data, \bar{x} the mean value of the data set and n the number of data points in the data set.

Sharpe Ratio was assessed using:

$$(7) \quad \text{Sharpe Ratio} = \frac{ER_i - RF_t}{\sigma_p}$$

where ER_i is the expected return of index i , RF_t is the return in month t of a one-month treasury bill and σ_p denotes the standard deviation of the index excess return.

4.3 REITs Portfolio Regression

The second part of our empirical work is the comparison of the monthly excess returns of each REIT portfolio, assessing the Fama and French (1993) asset pricing model, the Fama and French (1993) asset pricing model augmented with the Carhart (1997) momentum factor and the Fama and French (2015) five-factor model.

The three-factor model includes the market ($MKTRF$), size (SMB), book-to-market (HML) factors. According to Fama and French (1993), equation (8) denotes the estimation equation of the three-factor model:

$$(8) \quad ER_i - RF_t = \alpha + \beta_{MKTRF}(RM_t - RF_t) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + \varepsilon_{it}$$

where ER_i is the expected return on portfolio i , RM_t is the return in month t on a value weighted market proxy, RF_t is the return in month t of a one-month treasury bill, α is the four-factor adjusted return of the portfolio, SMB (Small Minus Big) is the equal-weight average returns on the three small stock portfolios for the region minus the average returns on the three big stock portfolios, HML

(High Minus Low) is the equal-weight average returns for the two high B/M portfolios for a region, minus the average returns for the two low B/M portfolios

The four-factor model includes the market ($MKTRF$), size (SMB), book-to-market (HML) and momentum (WML) factors.

According to Carhart (1997) the estimation equation (9) of the four-factor model can be written as:

$$(9) \quad ER_i - RF_t = \alpha + \beta_{MKTRF}(RM_t - RF_t) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + \beta_{WML}WML_t + \varepsilon_{it}$$

where ER_i is the expected return on portfolio i , RM_t is the return in month t on a value weighted market proxy, RF_t is the return in month t of a one-month treasury bill, α is the four-factor adjusted return of the portfolio, SMB (Small Minus Big) is the equal-weight average returns on the three small stock portfolios for the region minus the average returns on the three big stock portfolios, HML (High Minus Low) is the equal-weight average returns for the two high B/M portfolios for a region, minus the average returns for the two low B/M portfolios and WML (Winners Minus Losers) is the equal-weight average returns for the two winner portfolios for a region minus the average returns for the two loser portfolios, β_{MKTRF} , β_{SMB} , β_{WML} are the factor loadings on the four factors, and ε_{it} stands for the idiosyncratic error.

The Fama and French (2015) five-factor model includes the market ($MKTRF$), size (SMB), book-to-market (HML), profitability (RMW) and investment (CMA) factors. Its calculation equation is given by:

$$(10) \quad ER_i - RF_t = \mu + \beta_{MKTRF}(RM_t - RF_t) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + \beta_{RMW}RMW_t + \beta_{CMA}CMA_t + \varepsilon_{it}$$

where ER_i is the expected return of the portfolio i , RM_t is the return in month t on a value weighted market proxy, RF_t is the return in month t of a one-month

treasury bill, *SMB* (Small Minus Big) is the equal-weight average returns on the three small stock portfolios for the region minus the average returns on the three big stock portfolios, *HML* (High Minus Low) is the equal-weight average returns for the two high B/M portfolios for a region minus the average returns for the two low B/M portfolios, *RMW* (Robust Minus Weak) is the average return on the two robust operating profitability portfolios minus the average return on the two weak operating profitability portfolios, *CMA* (Conservative Minus Aggressive) is the average return on the two conservative investment portfolios minus the average return on the two aggressive investment portfolios, μ is the five-factor adjusted return of the portfolio, β_{MKTRF} , β_{SMB} , β_{HML} , β_{RMW} and β_{CMA} are the factor loadings on the five factors, and ε_{it} stands for the idiosyncratic error.

5. Data

FTSE Nareit U.S. Real Estate Index Series provided the monthly index values and returns for the three portfolios created: EREIT, MREIT and AREIT. The EREIT portfolio holds only equity REIT stocks, the MREIT portfolio has just mortgage REIT stocks and the AREIT portfolio holds both equity and mortgage REIT stocks. Each REIT portfolio's monthly returns on investment were collected from January 2000 to January 2020.

The reason behind this choice is the fact that it tracks the performance of the U.S. REIT industry at both an industry-wide level and on a sector-by-sector basis.

Using Kenneth French Library, data was collected to estimate Fama and French (1993) asset pricing model, Fama and French (1993) asset pricing model augmented with the Carhart (1997) momentum factor and the Fama and French (2015) five-factor model equations. The four-factor equation was assessed using Fama and French North American 3 Factors data plus North American Momentum Factor. The five-factor model equation was assessed using Fama and French North American 5 Factors data. The Fama and French North American 3 Factors risk-free rate was used to determine excess returns of the REIT portfolios.

The monthly historical prices for the S&P500 index and Russell 2000 index were collected from Yahoo Finance and corresponding excess returns were also determined using the Fama and French North American 3 Factors risk-free rate.

Monthly data collection occurred between January 2000 and January 2020.

6. Results

6.1 REIT Portfolios and Benchmark Performance

When comparing mean excess returns, MREIT was the portfolio presenting the lowest value (0.765%), followed by AREIT (0.925%) and, finally, EREIT (0.940%). An analysis of each portfolio's volatility level suggests EREIT presents the riskiest portfolio (5.597%), followed by AREIT (5.903%) and, lastly, MREIT with a standard deviation percentage of 5.401%. The inclusion of the Sharpe Ratio in this analysis is justified by the need to clearly understand the relation of return on an investment compared to its risk. The greater the value of the Sharpe ratio, the more attractive the risk-adjusted return is. MREIT's Sharpe Ratio of 0.142%, suggests that the portfolio held more risk than excess returns during the analyzed period. When their risk-adjusted returns are compared, AREIT surpasses EREIT with 0.159% and 0.165% respectively. Thus, the AREIT portfolio had the best performance of all.

Studying REITs' historical performance, Han and Liang (1995) concluded that equity REITs portfolio outperformed the mortgage and all REITs. Results presented above suggest that equity REITs also performed better than the mortgage REITs ($0.159\% > 0.142\%$) but unlike Han and Liang (1995) were outperformed by all REITs ($0.159\% < 0.165\%$).

The second part of this work consisted in the comparison of the performance of two indexes: S&P500 and Russell 2000. The results obtained suggest that the small capitalization index generated more returns than the large capital index. Russell 2000 presented average excess returns of 0.517% whereas S&P500 index average excess returns was 0.283%. The risk level was also compared, and the results evidenced that the small cap index held a higher risk (5.510%) than the other large cap proxy (4.203%). Overall, a Sharpe Ratio analysis suggests that Russell 2000 performed slightly better (0.094%) than S&P500 index (0.067%).

Table 1 summarizes the basic performance statistics for the three REIT portfolios and the benchmarks. Average Excess Returns, Standard Deviation and Sharpe Ratio are presented in percentage points. The results presented were analyzed for the period between January 2000 – January 2020.

Table 1
Summary of performance statistics of the REIT portfolios and benchmarks.

Variables	Excess Returns	Std. Deviation	Sharpe Ratio
MREIT	0.765	5.401	0.142
EREIT	0.940	5.903	0.159
AREIT	0.925	5.597	0.165
S&P500	0.283	4.203	0.067
Russell2000	0.517	5.510	0.094

Excess Returns, Standard Deviation and Sharpe Ratio are presented in percentage points.

Though the small cap index may have had a better overall performance than the large cap proxy, both commodities performed a lot worse than REIT stocks. The benchmarks excess returns were substantially lower than the REIT portfolios. The EREIT was the portfolio generating more average excess returns (0.940%) and the S&P500 index generated the lowest excess returns (0.283%). The EREIT portfolio presented the highest levels of volatility with a standard deviation of 5.903% and the S&P500 the lowest (4.203%). When comparing the risk-adjusted return of all commodities, AREIT stands as the asset which had the best performance among all (0.165%) and the S&P500 index as the least attractive investment, with a Sharpe Ratio of 0.094%.

The results obtained are partly consistent with Han and Liang (1995) work. In their study, they showed that the equity REIT portfolio outperformed the

mortgage REIT portfolio. By consulting **Table 1**, the results obtained show that the equity REIT portfolio surpassed the mortgage REIT portfolio. However, it performed worse than the REIT portfolio holding both equity and mortgage REIT stocks (AREIT).

In the same paper, Han and Liang (1995) showed that the S&P500 index outperformed any REIT portfolio. In this study, the results obtained show the S&P500 index did not only outperformed any REIT portfolio, but also had the worst performance among all assets.

6.2 REIT Portfolios Factor Models

The last part of this thesis consists in the comparison of the three REIT portfolios using the Fama and French (1993) asset pricing model augmented with the Carhart (1997) momentum factor and the Fama and French (2015) five-factor model. Table 4 presents the statistical values of both models.

Table 2

Summary of performance statistics of the REIT Portfolios and Factor Models.

Variable	Mean	Standard Deviation	Minimum	Maximum
MREIT	0.765	5.401	-24.280	13.630
EREIT	0.940	5.903	-31.660	31.010
AREIT	0.925	5.597	-30.310	27.960
MKTRF	0.485	4.368	-18.410	11.560
HML	0.269	3.486	-14.070	17.580
SMB	0.123	3.042	-16.600	21.230
WML	0.211	5.212	-24.990	29.320
RMW	0.431	2.706	-15.450	13.940
CMA	0.368	2.724	-10.780	14.390

The statistics presented are computed across 240 observations.

Data seem to suggest that the average MREIT, EREIT and AREIT stock presented an excess return of 0.765%, 0.940% and 0.925% per month, respectively. When analyzing the three-factor model (1992) augmented with Carhart (1997) momentum factor, data initially suggests that mean market risk-free return on a region's value-weight market portfolio minus U.S. one month T-bill rate was 0.485%. Average returns on three small stock portfolios for the region minus average returns on three big stock portfolios, measured by the SMB factor was 0.123%, whereas mean average returns for two high B/M portfolios for a region minus the average returns for two low B/M portfolios measured by the variable HML factor was 0.269% and mean returns for two winner portfolios for a region minus the average returns for two loser portfolios, measured by the variable WML was 0.211%. An analysis on the Fama and French (2015) five-factor model, suggests that the average return on two robust operating profitability portfolios minus the average return on two weak operating profitability portfolios measured by the RMW variable was 0.431% and the mean return on the two conservative investment portfolios minus the average return on the two aggressive investment portfolios measured by the variable CMA was 0.368%.

The results of the linear regression models are presented below. No multicollinearity problems were found in any of the models and all variables were independent from each other. The variance of the residual variables is presented as constant, hence the models exhibited homoscedasticity.

Tabela 3
Factor Models

	MREIT	EREIT	AREIT
3 Factor Model			
MKTRF	0.501*** (0.075)	0.813*** (-0.069)	0.789*** (0.064)
SMB	0.290** (0.112)	0.323** (0.103)	0.302** (0,096)
HML	0.382*** (0.094)	0.575** (0.086)	0.548** (0.081)
R-Squared	0.221	0.451	0.468
4 Factor Model			
MKTRF	0.485*** (0.081)	0.786*** (0.074)	0.766*** (0.069)
SMB	0.306** (0.116)	0.350** (0.107)	0.326** (0.100)
HML	0.372** (0.096)	0.558** (0.088)	0.533** (0.082)
WML	-0.034 (0.066)	-0.059 (0.061)	-0.051 (0.057)
R-Squared	0.219	0.450	0.467
5 Factor Model			
MKTRF	0.513 (0.083)	0.843*** (0.076)	0.819*** (0.071)
SMB	0.319*** (0.131)	0.428*** (0.120)	0.399*** (0.112)
HML	0.300*** (0.155)	0.429** (0.141)	0.407** (0.132)
RMW	0.044 (0.160)	0.170 (0.146)	0.157 (0.136)

CMA	0.011 (0.194)	0.039 (0.177)	0.046 (0.166)
R-Squared	0.215	0.454	0.470

All specifications include a constant term and are based on 240 observations. Standard errors in parenthesis. *** denote p-values <0.01 ** denote p-values <0.05 and * denote p-values <0.10

When all portfolios were tested using the Fama and French (1992) three-factor model, *MKTRF*, *SMB* and *HML* factors evidenced a positive contribution on the prediction of excess returns for the MREIT, EREIT and AREIT portfolio.

When all portfolios were tested using the Fama and French (1992) three-factor model augmented with the Carhart (1997) momentum factor *MKTRF*, *SMB* and *HML* factors also have a positive contribution on the prediction of excess returns for the MREIT, EREIT and ALLREIT portfolio. Though the *WLM* factor may have a negative impact on explaining excess returns in all REIT portfolios, this variable is not statistically significant in any REIT portfolio.

By testing the MREIT portfolio using the Fama and French (2015) five-factor model, *MKTRF* and *SMB* seem to be good predictors at explaining excess returns. The *HML* factor contribution is also positive, but only close to statistical significance (p-value = 0.054 > 0.05). The *RMW* and *CMA* factor are not statistically significant at predicting the excess returns.

When the EREIT and AREIT portfolios were tested using the same model the *MKTRF*, *SMB* and *HML* factors evidenced a positive contribution at predicting their excess returns. The *RMW* and *CMA* variables are not statistically significant and therefore, insufficient at explaining their excess returns.

Fama and French (1992) concluded that size and book-to-market equity capture the cross-sectional variation in average stock returns. When the three-factor model was tested on each REIT portfolio, all variables seemed to capture their excess returns.

Using Carhart (1997) four-factor model, results obtained show that despite *HML* variable being insufficient at capturing REIT portfolio's excess returns, it evidenced a negative contribution in explaining REIT portfolio's excess returns.

Fama and French (2015) concluded that their model was unable to capture low average returns on small stocks. By regressing each REIT portfolio using the Fama and French (2015) five-factor model, results showed that variables *RMW* and *CMA* were in fact, unable to capture their excess returns.

7. Conclusion

The present study tried to answer two questions: First, can a portfolio holding only REIT stocks beat traditional benchmark performance? And second, how well does the Fama and French (1992) asset pricing model augmented with the Carhart (1997) momentum factor and the Fama and French (2015) five-factor model, help explain the excess returns for the REIT portfolios.

In conclusion, results of this study demonstrate that, in the 2000-2020 period, REIT portfolios performed much better than the two proxies used (S&P500 and Russell 2000). The first part of this thesis consisted in comparing three types of REIT stocks and evaluating which of them presented the best performance for the covered period. Equity REIT (EREIT) portfolio was constructed collecting returns on investment of only equity REIT stocks. The mortgage REIT (MREIT) portfolio was constructed collecting returns on

investment of only mortgage REIT stocks and, finally, AREIT portfolio was constructed collecting returns on investment on both equity and mortgage REIT stocks.

The portfolio holding all REIT stocks (AREIT) evidenced the highest risk-adjusted return ratio among all other portfolios, suggesting it as the most attractive portfolio of all three. The second part of this study compared two proxies: a small capitalization index (Russell 2000) and a large capital index (S&P500). By applying the same method as the one used to compare REIT portfolios, the results seem to show that the Russell 2000 index outperformed the S&P500 index overall. Though the EREIT portfolio may have generated more excess returns and the S&P500 index may have evidenced the lowest volatility levels (4.203%), by comparing each asset's risk-adjusted returns ratio, it was concluded that the AREIT portfolio outperformed all other commodities for the twenty-year period covered.

The third part of this thesis consisted in the comparison of excess returns of each REIT portfolio using the Fama and French (1993) asset pricing model augmented with the Carhart (1997) momentum and the Fama and French (2015) five-factor model. Results suggest the Fama and French (1992) three-factor model - *MKTRF*, *SMB* and *HML* factors - as most capable of explaining the REIT portfolios returns. Though not statistically significant, when the momentum factor - *WML* - was tested, results suggest a negative contribution to explain the REIT portfolio's excess returns. When the Fama and French (2015) five-factor model was tested, the *RMW* and *CMA* factors were not statistically significant, and therefore are insufficient to explain the portfolios excess returns. Overall the *MKTRF*, *SMB* and the *HML* factors seem to be the sole variables capable of explaining excess returns in each portfolio, irrespective of the model applied.

Though many versions of the CAPM have been developed over the years in order to help investors on how they perceive excess returns, this thesis

suggests the Fama and French (1992) three-factor model as the most capable of doing so. The four-factor model (1997) and the five-factor model (2015) were insufficient at explaining the REIT portfolios excess returns.

Literature References

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

Sharpe, W. F. (1964). Capital Asset Prices: A Theory Of Market Equilibrium Under Conditions Of Risk. *Journal of Finance, American Finance Association*, 19(3), 425-442.

Lintner, J. (1965). Security Prices, Risk, and Maximal Gains from Diversification. *The Journal of Finance*, 20(4), 587-615.

Fama, E. F. (1968). Risk, Return and Equilibrium: Some Clarifying Comments. *Journal of Finance*, 23, 29-40.

Jensen, M. C. (1968). The Performance of Mutual Funds In The Period 1945-1964. *Journal of Finance*, 23(2), 389-416.

Padberg, M. W. (1976). Simple Criteria for Optimal Portfolio Selection. *Journal of Finance*, 31(5), 1341-57

Roll, R., & Ross, S. A. (1980). An Empirical Investigation of The Arbitrage Pricing Theory. *The Journal of Finance*, 35(5), 1073-1103.

Chen, S., & Brown, S. J. (1983). Estimation Risk and Simple Rules for Optimal Portfolio Selection. *The Journal of Finance*, 38(4), 1087-1093.

Grinblatt, M., & Titman, S. (1989). Mutual Fund Performance: An Analysis of Quarterly Portfolio Holdings. *The Journal of Business*, 62(3), 393-416.

Chan, K. C., Hendershott, P. H. & Sanders, A. B. (1990). Risk and Return on Real Estate: Evidence from Equity REITs. *Real Estate Economics, American Real Estate and Urban Economics Association*, 18(4), 431-452.

Fama, E. F., & French, K. R. (1992). The Cross-Section of Expected Stock Returns. *The Journal of Finance*, 47(2), 427-465.

Han, J. & Liang, Y. (1995). The Historical Performance of Real Estate Investment Trusts. *Journal of Real Estate Research, American Real Estate Society*, 10(3), 235-262.

Jagannathan, R., & Wang, Z. (1996). The Conditional CAPM and the Cross-Section of Expected Returns. *The Journal of Finance*, 51(1), 3-53.

Carhart, M. M. (1997). On Persistence in Mutual Fund Performance. *The Journal of Finance*, 52, 57-82.

Chong, C. Y. (2011). Effect Of Subprime Crisis On US Stock Market Return And Volatility. *Global Economy and Finance Journal*.

Frazzini, A., & Pederson, L. H. (2014). Betting against beta. *The Journal of Financial Economics*, 111, 1-25

Fama, E. F., & French, K. R. (2015). A five-factor asset pricing model. *The Journal of Financial Economics*, 115, 1-22.