

U.S. REITS: A FINANCIAL ECONOMICS REVIEW AS OF 2018

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Abstract

The U.S. Real Estate Investment Trust (REIT) sector, since its inception in the 1960s, has been witness to continuous evolution. The numerous events that have characterized its growth and its actual structure over time have made this sector an object of interest many researchers and authors, who tried to give answers to several financial questions that are still open to debate. We contend that a global review of financial literature on this specific industry could give good suggestions for further research themes for all those who are interested in studying the U.S. REIT market and its characteristics and for investors at large.

Key words: *REIT, equity, beta, pricing model, real estate, stock.*

JEL Classification: *F3, G12.*

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1. Introduction

REITs' (Real Estate Investment Trust) shares have been publicly traded on the U.S. financial market since the 1960, making available daily data returns on U.S. REITs (which hold only real estate assets), while giving researchers the opportunity to analyze issues and questions commonly related to real estate financial economics. Moreover, the unique structural form and taxation characteristics of this specific industry offer the possibility to single out issues exclusively related to corporate finance (i.e. capital structure and dividend policy).

Nowadays, REIT literature can be considered one of the pillars of financial economics literature, witnessing an important development in recent years. The scope of this work is to reorganize it (highlighting the methodology employed) and to describe, in the most accurate way possible, the main findings, dividing them into three strands by argument. In particular, the paper focuses on studies written from 1980¹, while discussing published and unpublished papers, in order to give interesting research inputs to all authors and researchers who are interested in addressing U.S. REIT financial issues.

The remaining part of the paper follows this structure: **Section 1** briefly gives a brief overview on the history of REITs, highlighting the most important events that had an impact on their evolution; **Section 2** reviews REIT literature, divided into three main strands by topic; finally, **Section 3** concludes the paper.

¹ This restriction is due to the fact that, from this period on, REITs started to be considered as special cases in financial economics.

2. A Brief History of U.S. REITs

The REITs sector can be considered one of the youngest industries within the American financial market. However, since its establishment in 1960, following the release of the Real Estate Investment Trust Act, this industry has been protagonist of exponential growth. REITs can be classified into two main categories: **Equity REITs** and **Mortgage REITs**. The former derive most of their income from the rental of properties purchased. The latter instead aims to buy mortgage obligations on real estate properties, in order to make themselves creditors with liens given. A third classification of REITs, **Hybrid REITs**, is a combination of Equity and Mortgage REITs.

Between 1968 and 1973 REITs increased their total assets by almost 2000% (Han and Liang, 1995); this can be considered as their first growth period which is linked to the high demand for construction and funding development. Traditional capital sources were not able to satisfy this growing market, offering REITs the opportunity to step in and fill this gap.

The increase of interest rates in 1972 led to a significant lowering of high spreads, which eventually became negative, causing many REITs to start operating at a net loss. In addition to this, lots of developers started to default on their existing loans because of the overbuilding. As a final result, the NAREIT index experienced a fall of nearly 56% in two years, from 1973 to 1975.

All these events made clear that structural changes were needed. Short-term debt and leverage declined significantly, same for construction and development loans (Hang and Liang, 1995).

However, the release of the Tax Reform Act in 1986 gave way to a significant growth period. The amendments included in this act coupled with a much-needed capital structure revision allowed REITs to recover from their crisis, giving shape to the modern REITs industry.

In the early 1990s real estate sector was shocked by a severe recession. Banks and others traditional suppliers decided to not trust this sector anymore because of the lowering demand and the huge overbuilding. This liquidity crisis provided the REITs industry the right opportunity to expand.

On the wave of this success almost all REITs went public in the early 1990s. In 1990, prior to the Omnibus Budget Reconciliation Act of 1993, the number of REITs was about 117 with a total market value of \$8.5 billion. After the Act, in 1994 the number of REITs had grown to 230 with a total market capitalization of \$46 billion. By 2005, even if REITs slightly decreased in number (208), their total market value was about \$355 billion, which means a compound annual growth rate of more than 20%².

2.1. The advent of the UPREIT structure

An umbrella partnership real estate investment trust, or UPREIT, is an entity that REITs use to let property owners contribute their real estate property in exchange for operating partnership units that can be converted into REIT shares.

UPREIT structure development was triggered by the advent of an umbrella partnership structure in 1992. This new structure, named UPREIT was used for the first time with the Taubman's IPO. The operating partnership units received in an UPREIT transaction are generally similar to shares in the REIT, but they possess few key differences. They are equal in value to REIT shares, and their value can move up and down in the same manner. Additionally, the dividend distributions are equal to those paid to the REIT's shareholders. The major difference is their tax treatment. Operating partnership unit holders are deemed to earn a portion of the partnership's total income in each state where the REIT conducts business, which means they may have to report taxable income in multiple states. By contrast, REIT shareholders' income is taxable only in their home state, so only one state tax return is necessary. In addition, operating partnership unit holders do not have voting rights, while REIT shareholders do.

A weak point of this structure is that it could create conflicts between common shareholders and owners of UPREIT units because of the differing tax liabilities. However, without the creation of the UPREIT structure probably most of the top real estate companies would have not chosen to go public. Nowadays, most of the top REITs in the U.S. are structured as UPREIT.

The industry began to struggle in 2007 as the global financial crisis kicked in. In response to the global credit crisis, listed REITs deleveraged and started to get funds with equity, that is selling stock, their balance sheets. Listed REITs and REOCs raised \$375 billion in 91 secondary equity offerings, nine

² Source: National Association of Real Estate Investment Trust (NAREIT) Website Data.

IPOs and 37 unsecured debt offerings as investors continued to act favorably to companies strengthening their balance sheets following the credit crisis.

From the end of February 2009 through the end of October 2014, stock-exchange listed Equity REITs have posted total returns of 312% (28.4% per year) and all stock-exchange listed REITs have gained 295% (27.5% per year), outpacing the return of 217% (22.6% per year) in the broad stock market and 210% (22.1% per year) in large-cap stocks. Economic climates characterized by rising interest rates have a detrimental effect on REIT shares. The dividends paid by REITs look less attractive when compared to bonds that have increasing coupon rates. Also, when investors shy away from REITs, it makes it difficult for management to raise additional funds to acquire more property³.

3. Literature Review

To better appreciate the evolution of REITs' sector from its foundation to our days, we analyze it through the eyes of researcher who worked on this specific industry's financial issues. It is useful to highlight selected economic and political events that took place over the past two decades and that have had a significant impact on the US REITs market.

The post 1990s period observed a structural change in the REITs betas. The 1993 Tax Reform not only eased the rules restricting institutional holdings of REITs, unleashing a large influx of capital into the US REITs market, but also could have transformed the REITs beta characteristics. The 2000s also represents an interesting period. Not only the early 2000s witnessed the Greenspan' low interest regime, but a significant switch in REIT capital structure from "leveraging" in 2000-2006 to "deleveraging" after 2007, right before the subprime crises, also occurred during these years.

3.1. REITs' characteristics

In light of such important events, literature contributions can be essentially divided in three strands, based not only on the specific issue they tried to address but also on the time period they covered.

To the first one belongs all those studies that tried to shed light on the **nature of REITs' stocks**⁴. Among many, there are some works worth mentioning.

GILIBERTO (1990) tried to comprehend whether REIT stocks were more stock- or bond-like. The outcomes confirmed the presence of a "pure" real estate common factor for both REITs and unsecuritized real estate which can be thought of as real estate market fundamentals, confirming that REIT shares are unique. GILIBERTO (1993) used a methodology similar to his earlier study to expand his findings and creates a "Hedged" REIT Index. He proved that stocks and REITs' "pure" common factor are put together in this index, confirming that REITs are more stock-like.

GYOURKO and KEIM (1992) showed that stock market activity, in particular REITs' shares, trading is an important source of information about changes in real estate fundamentals.

MYER and WEBB (1994) used a more rigorous methodology (i.e. Granger's Causality Test) than GILIBERTO (1990, 1993) and found a relationship between Retail REITs and Retail stocks, partially confirming LIU, HARTZELL, GREIG and GRISSOM (1990) results of an integration between stocks' and REITs' markets, but not between the real estate and stock market.

McIntosh, Liang and Tompkins (1991), as one of the first to attempt to understand the nature of REITs' risk attributes comparing the estimation ability of two different models: the classic CAPM and the 3-Factor model of Fama and French. They showed that REITs' betas have similar characteristics of small-cap stock. They also were the first to detect a decline in equity REITs' betas within the period 1973 to 1983. Moreover, they showed evidence of a *size effect* in REITs, demonstrating that small firms perform better than large firms⁵. They found that smaller REITs provided greater return without greater risk, and that there is a negative relationship between size and return. Thus, opening a debate on the impact that the size may have on performances of securitized real estate. ALSO CHEN, HSIEH and JORDAN (1993) applying a multi-factor statistical approach (two different APT models) on a total sample of 12-27 Equity REITs, found the fact that the changing of one factor in the model could lead to

³ Source: National Association of Real Estate Investment Trust (NAREIT) Website Data.

⁴ This may be due to the fact that the empirical data used did not cover the most important periods of REIT modernization in the U.S.

⁵ This can be one of the reasons explaining why the three-factor model of Fama and French, which keeps in account a size factor (SML), gives more stable betas than the one-factor model.

different results in REIT betas - especially before 1986 - interesting, highlighting the significance of choosing the right variables for factor loading estimation for this special sector.

BHARATI and GUPTA (1992) built a regression model based on REIT fundamentals to predict REIT and stocks returns in order to find the optimal asset allocation of risk-free, REIT and stocks, and then compared the active strategy deriving from the model's prediction to a passively managed portfolio. Their findings prove that the analysis of REIT fundamentals leads to superior investment performances, again showing how a model that takes a REIT-specific factor into consideration produces more accurate information.

Contrasting with BHARATI and GUPTA (1992), HAN and LIANG (1995), using the Jensen Index single-factor CAPM, claim that REIT performances are closer to those of a passively managed portfolio of stock and risk-free⁶.

HAN (1990) examined 21-100 REITs from 1970 to 1988 employing a multi-factor regression. Their results suggested that REIT portfolio returns are very closer to those of the stock portfolio, and that over the sample period analyzed Equity REITs returns were higher than Mortgage REITs'. On the contrary, HOWE and SHILLING (1990) and MARTIN and COOK (1991) studies, using two different approaches (Jensen Index and Stochastic Dominance), instead showed how the market portfolio had - over more or less the same sample period - superior performances as compared to those of the REIT portfolio.

KHOO, HARTZELL and HOESLI (1993) extended the MCINTOSH, LIANG and TOMPKINS (1991), sample period. Using a multi-factor model that takes in account the "size factor", they examined the stability of the REIT betas over the period 1970 to 1989 finding that equity REIT betas were significantly lower in the 1980s than in the prior ten years. They also argued that the information efficiency in the market can be improved by the increment in the number of REIT analysts, contrasting the thesis that an increment in analysts' coverage results in a reduction of the variation between stock markets and REITs, confirming also WANG, ERICKSON, GAU and CHAN (1992) findings that REITs' performances are positively related to the number of analysts following them.

MEI and LEE (1994), LI and WANG (1995) and MYER and WEBB (1997) found that, using multi-factor regression models, there is no market segmentation, and that REIT returns behave more like common stocks with their variation mainly due to their sensitivity to market and default risk. Contrasting with these findings, WANG, ERICKSON and CHAN (1995) claimed that the stock market does not provide as important information about REIT stocks as it does for other type of stocks.

The two-index regression model of LIANG, MCINTOSH and WEBB (1995) instead found that the systematic risk for equity REITs was relatively stable over the period 1973 to 1989. GOSH, MILES and SIRMANS (1996)⁷ showed that REITs return after the 1980s were more correlated with real estate market fundamentals.

LIANG and WEBB (1993) used a two-factor market model on a sample of 61 REITs from 1976 to 1990, finding a strong correlation between Mortgage REITs and interest rate risk⁸. Peterson and Hsieh (1997) extend the Liang and Webb (1993) sample and apply both single-factor and a multi-factor regression to evaluate correlation between Equity and Mortgage REITs with market factors. Their results show how Equity REITs are related with the all stock portfolio and with both the size and book-to-market portfolio, while Mortgage REITs risk premium is more correlated with the three stocks and two bonds market factors.

LEE, LEE and CHIANG (2008), as one of the latest studies on the topic, attempt to understand the relation between REITs and market factors using a multi-factor model over all listed Equity REITs from 1978 to 2003. Their results show that Equity REITs are indeed sensitive to the market stock factor, the size factor, the book-to-market factor and the interest rate factor, but not to the "pure" real estate factor.

3.2. Second strand of literature: REITs' cycle

The second strand of literature analyzes factors that impact on the cyclical pattern of REITs. The presence of a systematic risk's asymmetry in real estate market securities was initially identified by

⁶ This contrast once again points out how different estimation results can be using different statistical approaches, in this case, the single-factor model and a fundamental-based REIT model.

⁷ Not included in Table 1.

⁸ This is quite intuitive given the activity performed by this type of REIT.

SAGALYN (1990), who found that equity REIT securities have different risks and properties in growing and declining markets. His results showed how REIT betas were higher (lower) during periods of low (high) economic growth. GOLDSTEIN and NELLING (1999) also address this issue, showing a correlation between booms and busts phases respectively with a period of positive and negative excess market returns. Using this definition of market cycle, both SAGALYN (1990) and GOLDSTEIN and NELLING (1999) showed how REIT betas were lower in up-markets than in declining markets. Differently, GLASCOCK (1991) used the NBER (National Bureau of Economic Research) definition of market cycle. The results of the study contrast with the findings of the other two studies, showing how REIT betas were pro-cyclical.

GYOURKO and LINNEMAN (1988) tried to understand the relationship between Equity REITs and inflation rate applying the ARMA model over a period of 15 years, from 1972 to 1986. Results find no correlation between Equity REIT returns and inflation. LIU and MEI (1992) instead demonstrate that the excess returns on Equity REITs are influenced by the so called "January effect" in the measure of 5%.

This feature was then analyzed by other authors including CHATRATH, LIANG and MCINTOSH (2000) who defined it as "the asymmetric REIT-Beta puzzle"⁹ and sought to investigate the origin of this symmetry by testing possible determinants such as the dividend effect, the stationarity of the historical series and the variance effect. They observed REIT betas patterns in two different periods: from 1972 to 1985 and from 1986 to 1998. Their findings showed how beta asymmetry was significant in both sub-periods, but the effect was stronger in the first period compared to the second one. In the end, even CHATRATH, LIANG and MCINTOSH (2000) was not able to explain "the asymmetric REIT-Beta puzzle" since asymmetry still remains, even using more recent statistical models which consider the variance effect such as GARCHM and GJR-GARCHM.

Next, CHIANG, LEE and WISEN (2004) tried to understand the determinants of this asymmetry and to cancel it by introducing a relatively more general asset pricing model, the three-factor CAPM model of Fama and French (1993), while attributing this asymmetry to the model used from their predecessors. CHIANG, LEE and WISEN (2005) analyzed the time-series properties of the REIT betas, highlighting their sensitivity to the nature of the data and the asset pricing model used, and consistent with previous CHIANG, LEE and WISEN (2004) the results obtained with the three-factor model of FAMA and FRENCH (1993) found betas more stable than those obtained with Sharpe's single factor model (1964), the CAPM.

The *puzzle* was re-addressed by SING, TSAI and CHEN (2012), which, unlike CHIANG, LEE and WISEN (2004), concluded that asymmetry in betas still remains showing how it increases significantly in declining markets, concluding that the issue is still open. Sing, Tsai, Chen (2012) make slightly different hypotheses compared to their predecessors about what the determinants of beta changings are. According to them, this symmetry is not related only to the periods of major or minor economic growth but, above all, to periods of greater or lesser volatility.

SING, TSAI and CHEN (2012) introduce, in their study, a scientific system to divide the horizon of analysis into periods of greater and lesser volatility using SWARCH-type econometric models. Starting from the assumption by JAGANNATHAN and WANG (1996) that the regression coefficient does not depend solely on yields but also on volatility, it is considered that market volatility in recession periods determines the asymmetry of the regression coefficient. Logically, they attribute the phenomenon to the fact that the investor expects to have a return, especially in times of market decline, which is higher than the systematic risk of the market itself.

Concerning data analysis tools, many works have been used econometric models. Moreover, other authors, including DEVANEY (2001), BROWN and ONG (2001)¹⁰, used, in their analyses, different specifications of GARCH models, which take into account not only the heteroscedasticity of yield volatility, but also the fact that volatility responds very often asymmetrically and is characterized by the so-called volatility clustering phenomenon. Devaney (2001) applies the GARCH-M model finding that 1986 tax law had a negative impact on both Equity and Mortgage REITs; BROWN and ONG (2001) instead apply the GARCH model, showing that there is positive skewness in the serial cross-

⁹ This asymmetry of betas was previously observed for small-cap stocks by Jagannathan and Wang (1996) and Golsten, Jagannathan and Runkle (1993), who defined it as a "small stock-effect" attributing it to the relation between the growth in yields and their volatility.

¹⁰ Not included in Table 1.

correlations, which could lead to high serial cross-correlation at an index level. NELLING and GYOURKO (1998) use autocorrelation regressions to examine the predictability of Equity REITs returns. Their analysis indicates statistically significant evidence of predictability of monthly returns which is mainly related to return behavior between 1975–84 and 1993–95; moreover, results suggest that REIT return predictability is compared to that of small- and mid-cap stocks. OPPENHEIMER and GRISSOM, (1998) using spectral analysis, also find that REITs share more common patterns with small stock indices than large stock.

Real estate stock returns, as highlighted by COLEMAN and MANSOUR (2005), are also characterized by a leptokurtic and asymmetric distribution which makes it difficult to use the media-variance approach.

SING, TSAI and CHEN (2012) analyzes the phenomenon by subdividing the analysis interval into sub-periods characterized by a homogeneous volatility through the econometric tools provided by the SWARCH models. The use of econometric models to estimate trends and assess the characteristics of market indices is not new in financial analysis and is justified by the fact that, as evidenced by many authors, including MILLS and MARKLLOS (2008), markets are far from being perfect and prices do not instantly reflect all available information.

KAWAGUCHI, SAAADU and SHILLING (2012) use a different specification of the GARCH approach, the E-GARCH model. The results suggest the presence of a negative REIT stock price elasticity before the Greenspan era, considered the new REIT era. However, the negative elasticity disappears during the Greenspan period.

DELISLE, PRICE and SIRMANS (2012), applying the Idiosyncratic Volatility Estimation Method, show that idiosyncratic volatility risk is priced in the cross-section of equity REIT returns and that the price is negative; the results furthermore suggest that REITs with low idiosyncratic volatility outperform those with high idiosyncratic volatility.

The real estate market has more imperfections when compared to the stock market due to multiple factors: significant transaction costs, shortage of information, high investment costs, low number of transactions and the difficulty of estimating the value of a property. The financial value of real estate securities indirectly reflects the characteristics of this underlying market. The nominal value of many securities is based on expert estimates and is related to the time-lag between the valuation and the evolution of the current price and of the so-called *smoothing effect*, that is, the correlation between the estimates over time. Another feature of real estate's securities portfolios highlighted by GLASCOCK and HUGHES (1995) and contradicted by subsequent analyses is to present a lower systematic risk than market risk, making them often considered as conservative securities.

3.3. How betas structure changed over time?

All studies that belong to the third strand of literature addressed a specific issue: *what the determinants that drive changes in REIT betas are and whether they have turned to be more stock-like or real estate-like*. Results from Clayton and Mackinnon (2001, 2003) show that REITs beta had a higher correlation with large-cap stock risk factors during the 70s but turned out to be more correlated with small-cap stock risk factors in the 1980s. They also show, however, that REIT betas become more real-estate like after 1992, which they defined as a period of maturation of REITs.

On the contrary, GLASCOCK, LU and SO (2000) found that REITs return were more stock-like than real-estate like in the post-1992 period. Their results show that, prior to 1992, REITs were correlated with bonds and inflation, while after 1992, they were correlated with stocks and small caps.

Connors and Jackman (2000), in their unpublished paper, compare the estimation ability of three statistical approaches: the CAPM, the Three-Factor of Fama and French and the Arbitrage Pricing Theory Model of Ross. Their results once again suggest the presence of a size factor and, more importantly, indicate that the Fama and French model provide more accurate estimates of cost of equity capital for the research sample examined.

CHIANG, LEE and WISEN (2005) find weak evidence for a decline in equity REIT betas with a single-factor model; however, the declining trend in equity REIT betas disappears when they use a three-factor model. They observe a sharp decline in market beta in 2002 but cannot identify whether it is random or significant.

During the second part of the 1990s REIT betas observed a significantly change in their structure. The new breed of more sophisticated institutional investors fueled the U.S. REIT market with a large influx of capital, causing not just a huge growth in the US REIT markets, but most likely also some

changings in REIT beta characteristics. As result, the new generation of REITs entering the market after 1992 was notably different from the old generation of REITs.¹¹ OTT, RIDDIOUGH and YI (2005) found that the new generation of REITs generally had a larger dimension, a higher leverage ratio and tended to invest more.

The years after the 2000s represent another interesting period of changes for the U.S. REIT market. Significant was the passage from “leveraged” (from 2000 to 2006) to “deleveraged” (from 2007 onwards). In their work BAI, CHANG and GLASGOCK (2011)¹² found evidence that REIT took advantage of the inexpensive credit supply to increase their real estate property portfolios, causing a notable price inflation in real estate.

Recently, SING, TSAI and CHEN (2016) found evidence showing temporal declines in REIT betas in the pre-2000 period and, more interestingly, that REITs in the 2000s became more sensitive to stock market shocks relative to the earlier periods. Their work covers the period 1972-2013, fully considering the most important events regarding the transformation and the modernization of US REITs over the past four decades.

Even more recently, BUSATO and COLETTA (2018) used a new multi-factor model which combines Bayesian linear regression and a fundamental-based approach to compute REIT betas over the period 1996-2014, thus fully considering the most important events that had an impact on U.S. REIT market evolution. They showed how results obtained with a new statistical technique seem to better fit the evolution of the global market in the period considered also having a more accurate forecast power. Moreover, they found that a size factor does exist and that, in many situations, smaller REIT have had better performances than bigger REITs.

4. Conclusion

This paper shows how the U.S. REIT market went from a young and totally new sector, to being, in a relatively short-time period, one of the most sophisticated industries, not just in the U.S. but all over the world. In particular, we focused on the most important events that characterized its evolution from its establishment to our days, shading light on what have been the questions - from a financial standpoint - about this market troubling researchers and authors the most. The nearly fifty papers reviewed in our work share one common purpose: taking steps to understanding the financial economic issues of the U.S. REIT sector, placing emphasis on what have been the statistical methodologies applied and on their findings. We contend that our review contains important insights not just for academics and researchers, but also for managers and investors at large who share an interest in the U.S. REIT sector and are in need of statistical guide model that satisfy their purposes in the best way possible.

Table 1 summarizes all the papers we analyzed, dividing them by subtopic and by year of publication, indicating the samples examined by each author(s), the statistical methodology applied and the most important finding(s). Overall, there are three main conclusions we can draw from our survey: (1) a small-firm effect is confirmed in most works, suggesting that, oftentimes, smaller sized REITs perform better than larger ones, especially in declining periods; (2) Equity REITs have behaved more like stocks over the years, especially after the upcoming of the UPREIT era in 1992, while Mortgage REITs are more correlated with bonds; (3) multi-factor models seem to be more appropriate in providing factor loading estimations for the U.S. REIT sector since they consider variables such as size and book-to-market, which proved to have a the greatest impact on the evolution of real estate investment trust¹³.

However, despite the amount of studies that have been conducted over the time, the debate about many financial economic issues regarding the U.S. REIT market remains open. For instance: what really drives changes in REIT beta behavior? Why do Equity REITS turn out to be more stock-like and not real estate-like?

As we had mentioned before, the unique structure of REITs and tax characteristics represent single opportunities to analyze specific problems such as capital structure and dividend policy. Covering the

¹¹ This period coincides with the introduction of the UPREIT structure, which can be considered to be the main cause that drove the structural changes in REIT betas.

¹² Not included in Table 1.

¹³ 29 out of the nearly 50 papers used multi-factor regressions, 6 compare their estimation ability with that of the single-factor model, and 8 employ only the single-factor CAPM or Jensen Index.

most important works on financial economic issues divided into three main subtopics, our review on the U.S. REIT sector offers important insights, not just for all authors who want to deepen their knowledge and try to solve financial questions related to this market, but also for managers who need appropriate estimation models for reasons of capital budgeting and investment projects, and private investors who are interested in investing in this industry.

Table 1

Summary of Real Estate Investment Trust Financial Literature

2.1 REITs' characteristics			
Author(s)	Sample	Methodology	Major Finding(s)
Liu, Hartzell, Greig and Grissom (1990)	Trade REITs from 1978 to 1986	Single-factor Model (CAPM) and Jorion and Schwartz Tests	Integration between REITs and stock market
Giliberto (1990)	Equity REITs from 1978 to 1989	Multi-factor Model	Common factor is significant for both REITs and unsecuritized real estate
Han (1990)	21-100 REITs from 1970 to 1988	Multi-factor Model	REIT portfolio has comparable performance with the stock portfolio; Equity REITs outperform Mortgage REITs
Howe and Shilling (1990)	105 REITs from 1973 to 1987	Jensen Index (CAPM)	REITs underperformed the market portfolio over the sample period examined
McIntosh, Liang and Tompkins (1991)	Traded REITs from 1974 to 1988	Single-factor Model (CAPM) and Multi-factor Model	Presence of small-firm effect
Martin and Cook (1991)	27 Equity REITs, 7 finite-life REITs from 1980 to 1990	Stochastic Dominance	Stock portfolios dominated traditional Equity REITs after tax reform
Gyourko and Keim (1992)	Trade REITs (15-47) from 1978 to 1990	ARMA Models	Checking for smoothing lead REIT returns to appraisal-based returns
Bharati and Gupta (1992)	30 REITs from 1973 to 1990	Multi-factor Model	Analysis of fundamentals lead to superior performance from active investment in REIT
Giliberto (1993)	Equity REIT Index (NAREIT) from 1978 to 1991	Single-factor Model (CAPM)	Stock market and REITs common factor are put together in the hedged index
Myer and Webb (1994)	8-10 Retail REITs from 1983 to 1991	Granger's Causality Test	Relationship between Retail REITs and Retail stocks
Chen, Hsieh and Jordan (1993)	12-27 Equity REITs from 1974 to 1991	Two APT Models: Factor Loading Model (FLM) and Macrovariable Model (MVM)	Different APT model provide different results prior 1986 but the same afterwards
Khoo, Hartzell and Hoesli (1993)	14 Equity REITs from 1970 to 1989	Multi-factor Model	Declining REIT betas and return standard deviation are due to the higher number of analysts following REITs and to the higher trading volume
Liang and Webb (1993)	61 REITs from 1976 to 1990	Two-factor Market Model	Mortgage REITs' market risk is strongly related to interest rate risk; two-factor market model is preferred for performance evaluation
Mei and Lee (1994)	Equity REITs portfolio from 1978 to 1989	Multi-factor Model	Presence of a real estate factor; no market segmentation when we allow for multi-factors other than the market factor to impact asset return

Han and Liang (1995)	Listed REITs on NYSE, ASE and NASDAQ from 1970 to 1993	Jensen Index (CAPM)	REIT performance similar to that of a passively managed portfolio of risk-free and stocks
Liang, McIntosh and Webb (1995)	36-102 REITs from 1973 to 1989	Two-index Regression Model	REIT returns generating processes present significant shifts during 1976, 1980, 1983 and 1986
Li and Wang (1995)	Equity and Mortgage REITs listed on NAREIT from 1971 to 1991	Multi-factor Model	Cross-sectional variation in expected REIT returns is largely due to their sensitivity to market and default risk
Wang, Erickson and Chan (1995)	139 REITs from 1973 to 1992	Multi-factor Model	Stock market does not provide significant information for REIT stocks as it does for other stocks
Myer and Webb (1997)	61 Equity REITs from 1978 to 1990	VAR Model and Granger's Causality Test	REIT returns behave more like common stocks and closed-end funds than unsecuritized commercial real estate
Lee, Lee and Chiang (2008)	Equity REIT Index (NAREIT) from 1978 to 2003	Multi-factors Models	Equity REITs are significantly sensitive to the stock market factor, the size factor, the book-to-market factor, and the term-structure factor, but not to the real estate factor

2.2 REITs' cycle

Author(s)	Sample	Methodology	Major Finding(s)
Gyourko and Linneman (1988)	Equity REIT Index (NAREIT) from 1972 to 1986	ARMA Models	REIT returns and inflation are negative correlated
Sagalyn (1990)	20 REITs from 1973 to 1989	Jensen index (CAPM)	In advancing periods REIT returns is higher, systematic risk and volatility are lower
Glascok (1991)	109 REITs from 1965 to 1986	Single-factor Model (CAPM) with two dummy variables	There is no excess returns for REITs even under different market conditions
Liu and Mei (1992)	Equity REITs from 1971 to 1989	Multi-factor Model	Excess returns of Equity REITs is influenced by January effect by five percent
Glascok and Hughes (1995)	12-151 REITs from 1972 to 1991	Single-factor Model (CAPM)	On average a REIT exists for 99.7 months; from 1971 to 1991 REITs underperformed the market also on a risk-adjusted basis
Nelling and Gyourko (1998)	Listed Equity REITs on NYSE, AMEX and NASDAQ from 1975 to 1995	Autocorrelation Regressions	Equity REIT returns negatively autocorrelated at the first lag
Oppenheimer and Grissom (1998)	178 REITs from 1989 to 1994	Spectral Analysis	Stock indices influence REIT price movement with a six week period frequency; small stock indices share more common pattern with REITs than large stock indices do
Goldstein and Nelling (1999)	Equity and Mortgage Portfolios Returns Data (NAREIT) from 1972 to 1998	Single-factor Model (CAPM) and Multi-factor Models	During declining market's phases REITs are more correlated with stocks; REIT betas useful to reduce portfolio risk
Chatrah, Liang and	Equity REITs Index	Single-factor Model	REIT betas higher during

McIntosh (2000)	(NAREIT) from 1972 to 1998	(CAPM) with a dummy variable	advancing periods; small stock effect does not fully explain REIT betas asymmetry
Devaney (2001)	Listed Equity and Mortgage REITs from 1978 to 1996	GARCH-M Model	The 1986 tax law had a negative impact on the excess returns to both Equity and Mortgage REIT sectors; GARCH-M specification is more appropriate for the mortgage REIT portfolio than for the portfolio of equity REITs
Chiang, Lee and Wisen (2004)	Equity REITs Index (NAREIT) from 1972 to 2001	Single-factor Model (CAPM); Single-factor Model (CAPM) with a dummy variable; Extension of Fama and French Three-Factor Model	REIT betas seem to be symmetrical when estimated via Fama and French Model; CAPM estimations could mislead investors
Chiang, Lee and Wisen (2005)	Equity REITs Index (NAREIT) from 1972 to 2002	Fama and French Three-Factor Model and Vogelsang Method	Three-Factor Model is more useful than the Single-Factor Model (CAPM) in explaining the variation in Equity REIT returns and in providing stable estimates of market betas
Coleman and Mansour (2005)	NCREIF Property Indices from 1978 to 2003	Bayesian Linear Model	The Bayesian model allows for a better reflects the underlying statistical properties of real estate returns allowing for a more stable and realistic measure of risk
Kawaguchi, SaAadu and Shilling 2012	Equity REITs listed on NYSE, AMEX and NASDAQ from 1985 to 2012	Single-factor Models and EGARCH Model	Negative REIT stock price elasticity of variance before and after the Greenspan era, but not during the Greenspan era
Sing, Tsai and Chen (2012)	Equity REITs Index (NAREIT) from 1972 to 2009	MS-GARCH Model	Positive and significant volatility persistence effects on the Equity REIT beta especially after 1993
DeLisle, Price and Sirmans (2012)	Equity REITs traded on NYSE, AMEX and NASDAQ from 1996 to 2010	Idiosyncratic Volatility Estimation Method (3-Factor Fama and French Model)	Idiosyncratic volatility is negatively priced in the cross-section and is largely independent of Non-REIT idiosyncratic volatility

2.3 How betas structure changed over time?

Author(s)	Sample	Methodology	Major Finding(s)
Wang, Erickson, Gau and Chan (1992)	134 REITs from 1970 to 1989	Jensen Index and Multi-factor Models	REITs performances are positive related to the number of analysts following them; REITs have peculiar market microstructure
Peterson and Hsieh (1997)	Equity and Mortgage REITs from 1976 to 1992	Singl-factor Model (CAPM) and Multi-factor Model	Equity REITs risk premium related to overall stock portfolio and size and book-to-market portfolio; Mortgage REITs risk premium the three stocks and the two bonds market factors; Mortgage REITs underperform of 6.8% on average
Glascok, Lu and So (2000)	Equity REITs Index (NAREIT) from 1972 to 1996	Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) tests	Cointegration between REITs and bonds before 1992; no cointegration between REITs and stock markets before 1991

			but afterwards REITs start to behave more like stocks
Connors and Jackman (2000)	49 Equity REITs from 1995 to 1999	Single-factor (CAPM), 3-factor Fama and French, APT	The 3-factor model of Fama and French more appropriate from a statistical standpoint in providing accurate estimates of beta
Clayton and MacKinnon (2001)	Equity REITs Index (NAREIT) from 1978 to 1998	Multi-factor Model	REIT returns show the largest sensitivity to bonds and stocks (both large and small); cyclical relationship between REIT, real estate and financial assets returns
Clayton and MacKinnon (2003)	Equity REITs Index (NAREIT) from 1979 to 1998	Multi-factor Model	Before 90s REITs are more like large cap stocks; late 80s large cap factor declines and a small cap factor starts to emerge; during 90s is observed also a significant real estate factor
Ott, Riddiough and Yi (2005)	41-147 Equity REITs from 1981 to 1999	IRR-on-cost and value	In the new-REIT era growth caused by firm-specific investment, financing policies stabilized and capital structures became more complex, new firms invested more than seasoned firms and realized higher returns on average
Sing, Tsai and Chen (2016)	Listed Equity and Mortgage REITs from 1972 to 2013	Time-varying Coefficient (TVC) Framework	Declines in Equity and Mortgage REITs betas in pre-2000s, but strong reversal in Equity REITs betas after 2000s, higher leveraged Equity REITs have higher betas than lower leveraged Equity REITs; no significant size factor
Busato and Coletta (2018)	51 Equity REITs from 1997 to 2014	Single-factor CAPM, 3-factor Fama and French, Hybrid Beta Approach	The Hybrid Beta technique provides more accurate estimations of Equity REITs betas over the sample period examined; small-firm effect confirmed

5. References

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