

Exhibit 3 Returns and risk

Author	Research Report/Source/Year of Review	Research Hypothesis	Research Area	Research Methodology	Research problem	Literature Review - Theory	Empirical Research
Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol. 10 No 3, pp 253-262, 1995	Whether REITs performed differently from the market portfolio, on a risk-adjusted basis, over the 1970-1993 period and whether REIT performance varies over time.	Returns and risk	Evaluate the long term performance of REITs and stability over time and investigate the sensitivity of Jensen index. Jensen performance measure index, is used to estimate the performance of REIT portfolios. Jensen is based on the CAPM. It compares the performance of a security or a portfolio to the standard performance benchmark, the security market line. By assuming that the CAPM holds period by period, and that returns on securities generated by the market model, Jensen derived a linear expression between the realised returns on any security and its systematic risk, the realised returns on the market portfolio, the risk-free interest rate and random error. The Jensen index is used in performance studies because it measures performance based upon a simple and realistic benchmark, a passive managed portfolio that invests in savings accounts and the stock market portfolio. A positive and significant Jensen index indicates a superior performance of a REIT portfolio relative to this portfolio (REITs outperforms), while negative is vice versa.	Characteristics : In today's illiquid real estate market, REITs have attracted more and more attention as a liquid real estate investment vehicles, even from institutional investors such as pension funds. Determine whether outcomes of REIT performance studies are sensitive to the choice of performance benchmarks and REIT samples	REITs are important vehicles in direct real estate ownership. Because such a high level of both resources and knowledge is required, REITs do not require the large and long term financial commitment typical of direct real estate investment. The ownership of most REITs can be easily transferred with very low transaction costs, since shares of most REIT stocks are publicly traded. REITs provide a mechanism to pool resources of private investors to gain the economic benefits of commercial real estate.	Unlike the apparently superior performance of unsecuritized real estate, most researchers findings on REITs performance, especially, equity REITs, have been mixed, relative to the stock market portfolio. Other studies found that the performance of REIT stocks was worse than, or comparable to, the market portfolio, others found REITs outperformed the stock market and the debate over REIT performance continues.
Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol. 10 No 3, pp 253-262, 1995		REIT performance	8 REIT portfolios are constructed based on ex ante feasible for all equity, debt and hybrid REITs. 2 portfolios based on equally weighted and value weighted strategies are constructed. The REIT study includes 255 REIT stocks. Centre for Research Security Prices (CRSP) stock market portfolio is used. The portfolio is equally weighted and the CRSP portfolio will be used. Stability over time. Summary of mean, variance, co variance and Sharpe index is calculated. The study is broken into six year periods, 1970-1975, 1976-1981, 1982-1987, 1988-1993. They respond relatively well to the historical fluctuations of the real estate market, the boom and burst in the early 70s and recovery late 70 and expansion in the 80s and REIT tax reform in 1986. Mean returns and standard deviation for each subperiod was calculated. T-test conducted for each subperiod.	Methodological flaws from previous studies, use of unrepresentative sample periods and use of S&P index as performance benchmark. Previous studies covered short period and inferences about REITs over a short period of time presents a serious problem in a volatile industry. The problem exists because of boom burst period in the REIT history. Secondly the S&P 500 has been used as a proxy for stock market portfolio. The S&P 500 is not a representative performance benchmark because it does not include small stocks and most REITs are small cap	In the long term, it should be expected that the REIT industry portfolio would perform similarly to the stock market portfolio adjusted for risk, if the market is efficient and the CAPM holds.	Studies suggest that REITs performed poorly in the 70s. Others found that REITs provided less than average returns during 1973-1976 recession period. Burns and Epley were slightly different, however. They investigated whether the efficient frontier of mixed-asset portfolios that consisted of REIT stocks and other common stocks dominated the efficient frontier for a single asset type and the S&P 500 for the for the period 1970 - 1979. . Titman and Warga also found that the performance of REITs stocks is not significantly different from that of market portfolio over the period 1973-1982. They calculated and compared both CAPM and APT based on Jensen index. Studies since the 1980s have come to different conclusions. The application of the Jensen index requires that the market portfolio, be ex-ante efficient and includes, theoretically, all available assets on the market comparison of statistics suggest that the performance of REIT stocks is about the same as or slightly poorer than that of the stock market portfolio over the sample period. The portfolio that most closely
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering and University of Geneva, 2003		Returns and risk	Asset returns are shrunk to global mean of each asset class. BS is applied for various levels of risk. For countries with appraisals concerns, de-smoothing variant called Geltner is used		This is a variant of the repeat sales method whereby pairs are formed with appraised values and transaction price. Repeated- regression method.	Summary of statistics for the various asset classes
Mueller AG, Muller GR	Public and Private Real Estate in a mixed-asset portfolio Journal of Real Estate Portfolio Management Vol. 10 no 3, pp 193-203, 2003		Asset Allocation	While history is never an accurate indicator of what may happen in future, it is instructive to study the contributions and optimal levels of inclusion that different investments have played in a return-maximising portfolio in the past. 2002 marks a time period that provides 25-year history for direct private real estate and 30 for NAREIT. The study analyses the usual 5, 10, 15 and 25 years, with surprising results.		Public and private real estate returns found that equity REITs were heavily influenced by stock and bond movements and had little direct correlation with the conventional leveraged real estate.	The 25 year time period is long enough to include many economic expansion and recession periods, as well as stock and real estate cycles.
Mueller AG, Muller GR	Public and Private Real Estate in a mixed-asset portfolio Journal of Real Estate Portfolio Management Vol. 10 no 3, pp 193-203, 2003		Returns and risk	Real estate (private and public) is compared with indexes representing various types of financial assets, including common stocks represented by S & P 500, small cap represented by Russell 2000, NASDAQ, bonds by Merrill Lynch Mortgage Index and risk free rates. Data is measured quarterly as most fund managers are measured on a quarterly basis.	The close to zero correlation (-0.19) to zero correlation of these two investment vehicles is surprising due to the fact that they hold similar underlying real estate assets that drive their returns. A closer look reveal that the composition of the NAREIT in the 80s was mainly retail and multifamily, while NCREIF was mainly office, industrial and retail. Dissimilar property types contributed to low correlation's		

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Norman EJ, Sirmans GS, Benjamin JD	Historical Environment of Real Estate Returns Journal of Real Estate Portfolio Management Vol 1 No 1 pp 1-23, 1995.		Returns and risk	Comprehensive review of the existing literature		A review of the extensive existing literature reveals that comparisons of nominal real estate returns on other assets has produced mixed results.	Most studies show that provide a comparison show that real estate has higher absolute returns than debt (such as bonds). The performance of real estate, in comparison to common stocks, is mixed. When comparing general real estate returns with returns from stocks or bonds, most studies agree that trends in returns from both groups are not consistent.

Findings/Conclusions
REIT performance varied over time. This study found that the use of unrepresentative S&P 500 index as a performance benchmark tends to overstate REIT performance. The inconclusive findings are not a surprise, due to the short sample periods used in the previous studies for an industry prone to boom and busts. The S&P 500 index, which contains large capitalisation stocks, has been used as the performance benchmark for the majority of previous studies, even though REITs are small capitalisation.
Summary of findings on the performance of REITs is inconclusive. The outcomes from REIT performance studies seem to be highly sensitive to the sample period studied. Burns and Eply found that the mixed-asset efficient frontier did dominate both, with respect to mean and variance at every risk and return level. Titann and Warga found that both indexes for the entire period studied were not statistically different from zero. The market risk-adjusted returns on REIT stocks are about the same as the returns on the market index. REIT performance varied over time. This study found that the use of unrepresentative S&P 500 index as a performance benchmark tends to overstate REIT performance. The inconclusive findings are not a surprise, due to the short sample periods used in the previous studies for an industry prone to boom and busts. The S&P 500 index, which contains large capitalisation stocks, has been used as the performance benchmark for the majority of previous studies, even though REITs are small capitalisation.
Stocks constitute the highest return and risk asset class, while cash exhibits low return and risk parameters. Bonds appear to have a higher return and risk than cash. Real estate securities varies quite substantially from different countries across
Equity REITs returns are either first or second in all time series, except the 20 year period. The S&P 500 was best over the 20 year period, while NASDAQ was the highest over the ten year period. The standard deviation varied considerably for different time periods, with the NASDAQ showing the highest overall return in both 10 and 15 year time periods, the extremely high volatility made it less desirable in a mixed-asset portfolio. Real estate's return performance and relatively low volatility in both public and private forms has made the asset class a popular investment in poor economic conditions. Public and private real estate exhibited low quarterly correlation's. The unrelated behaviour of these real estate assets makes a stronger case for both public and private real estate inclusion in a mixed-asset portfolio.

Findings/Conclusions
Slightly more than half of the studies that provide a direct comparison show a higher average return for stocks than for real estate. Some research demonstrated that real estate investments have outperformed debt and other fixed income securities, while other research finds that common stocks have outperformed real estate investments. On a risk-adjusted basis, most of the literature shows that real estate investments have a higher return per unit of risk than common stocks. When absolute risk of the investment is analysed, the results are nonconclusive. Several studies show that actual returns from real estate outperform returns from other investments, such as stocks and bonds.

Exhibit 4 Inflation hedging								
Author	Research Report/Source/Year of Review	Research Hypotheses	Research Area	Research Methodology	Research problem	Literature Review - Theory	Empirical Research	Findings/Conclusions
Chatrath A, Lian Y	REITs and Inflation: Along - Run Perspective Journal of Real Estate Research Vol. 16 no 3, pp 311-326, 1998	REITs tend to behave like other equities with respect to inflation hedging-characteristics	Inflation hedge		Examine the inflation hedge in the long run and also investigate the apparent lack of a positive relationship between general prices and REITs returns in prior studies arises from the impact stock market movements have on REITs.			It is now well documented that stock returns world-wide are either negatively or unrelated to inflation. Only a few studies, indicate that REITs possess some inflation-hedging properties. Some argued for partial hedge against inflation. Authors also find that REITs act as a perverse hedge against unexpected inflation and that REITs have some ability to hedge the expected inflation. Inflation decomposition technique allow for a stochastic trend component in the inflation proxies
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors. Journal of Portfolio Management Special Issue Sept 2003		Inflation hedge		Concern about disinflation and deflation have risen in the asset markets, particularly the commodities market. Real estate returns have a complicated relationship to inflation.	Conventional wisdom has held that real estate performs as an inflation hedge. This means that if inflation is greater than expected, real estate returns will compensate for the surprise and will help offset negative response of the other assets in the portfolio As real estate fell into disfavor through the 1980s crash, this rational was discredited and compounded by low inflation. Past inflation is partially embedded in rents set previously because every seller of rental space, wishes to keep price level or rising in real terms. Thus net operating income (NOI) is partly a function of past inflation, rising if past inflation has been greater, and falling (or rising less) if past inflation has been tame. The speed with which inflation affects NOI, or the time lag necessary to capture inflation's impact on current NOI, depends on the structure of leases.	Inflation impacts the capital value in two ways. First, it impacts current NOI, which feeds through to value via capitalisation rate. This feed is especially strong for retail assets. Conventional wisdom has held that real estate performs as an inflation hedge. This means that if inflation is greater than expected, real estate returns will compensate for the surprise and will help offset negative response of the other assets in the portfolio As real estate fell into disfavor through the 1980s crash, this rational was discredited and compounded by low inflation.	The impact of past inflation, appropriately lagged, is positive for all four major property types. The direct capital value impact of inflation is significantly positive for apartment and office properties, but not significantly from zero for warehouse. Thus the empirical assessment shows that private equity real estate is a very useful, partial inflation hedge. That said, it is also clear that the degree of inflation-hedging is not uniform across the property types. As is the case with most debt, real estate debt is not good inflation hedge because unexpected inflation and concomitant increases in nominal interest rates negatively hit the value of CMBS. REITs will capture some of the benefits of the inflation hedge but are less successful transmitter of this value than private equity because of links to the stock market, which is generally damaged by inflation. So, if inflation hedging is a key reason why an investor chooses an allocation to real estate, that investor must tilt the portfolio toward private equity real estate.
Rubens JH, Bond MT, Webb JR	The inflation-hedging effectiveness of real estate. The Journal of Real Estate Research Vol. 4 no 2, pp 45-55, 1989.		Inflation hedging	Portfolios are constructed consisting of real estate and government bonds to examine the benefits of including real estate in inflation hedging portfolios. The study extends these previous research by updating time. Furthermore the return components are separated into income and appreciation. The division of the return stream helps ascertain the portion of the total return that determines the hedging effectiveness of the asset. Finally mean-variance efficient portfolios are constructed to determine additional hedging benefit accrued from including real estate	Mean-variance portfolios. Nominal rate of interest is comprised of appropriate equilibrium real interest rate and expected inflation premium	In efficient markets, the nominal rate of return on asset incorporates the best possible estimate of expected future inflation .Fama test for hedging effectiveness of various asset financial assets against both expected and unexpected inflation. TBs are used as proxy for the expected rate of inflation. The measure of unexpected inflation is the difference between actual inflation and bill rate. The study uses the Livingston price expectations (LPE) as a measure of expected inflation. LPE is a forecast by business economists.	There is no consensus on the best method to estimate inflationary expectations. Both the survey-based data LPE) and regression generated data appear to be acceptable proxies for expected inflation.	Only residential estate is a complete hedge against inflation. TBs are the only are the only other asset exhibiting at least some hedging effectiveness. All other financial and real assets have standard errors so large that their hedging effectiveness is indeterminate. When examined against expected inflation as measured by the LPE, there are few more positive hedges. Only Treasury bills and business real estate provided a complete hedge against expected inflation. They find that commercial real estate is a complete hedge against both expected and unexpected inflation. Regression estimates for each type of inflation against the asset returns.
Rubens JH, Bond MT, Webb JR	The inflation-hedging effectiveness of real estate. The Journal of Real Estate Research Vol. 4 no 2, pp 45-55, 1989.		Inflation hedging	Expected returns were treated as a constant, a Beta Coefficient, Standard Error and R squared is calculated and the type of inflation hedge is determined 95% confidence interval was used to test whether a particular investment is a complete, partial or indeterminate hedge.				All total returns measures provided a positive real return. Furthermore, the market was fairly accurate in its assessment of inflation over the time period. Unexpected inflation, the difference between the CPI and the LPE data, shows that inflation was generally underestimated throughout the 1960s and 1970s, but overestimated in recent years.

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Yobaccio E, Rubens JH, Ketcham DC	The Inflation-Hedging Properties of Risk Assets: the case for REITS Journal of Real Estate Research Vol. 10 no 3, pp 279-296, 1995.	REITs act as a hedge against expected and/or unexpected inflation.	Inflation hedge	A model of real estate returns is derived that has components for expected and unexpected returns and allows for variation in the real return on risky assets. Since the findings for some real estate have been criticised due to apparel smoothing bias, logic was to use REITs returns reflect the value of the income and price appreciation components of the underlying assets, determined in a market that adjust rapidly to changes in information or expectations		Fisher noted that the nominal rate of interest equalled the rate of interest plus expected inflation premium. Thus it was expected that the nominal rate would incorporate the best possible estimate of future inflation. These sorted some of the effects of anticipated and unanticipated inflation and lead researchers concluding that stock prices adjust for inflation. The conclusions were challenged and all three papers concluded that both nominal rate of interest and real holding period returns for corporate equities were negatively and significantly related to the inflation rate. Fama tested the effectiveness of treasury bills, government bonds, real estate, corporate bonds etc as hedges against both expected and unexpected inflation		REITs provide some hedging capability against unexpected inflation, but act as a perverse hedge against unexpected inflation. That is, decrease in value as inflation increases. Empirical research concluded that unexpected inflation, not expected inflation, explained the negative relationship between the inflation and stocks
Yobaccio E, Rubens JH, Ketcham DC	The Inflation-Hedging Properties of Risk Assets: the case for REITS Journal of Real Estate Research Vol. 10 no 3, pp 279-296, 1995.		Inflation hedge	Hartzell used data from 1973 - 1983. Both tests involve using treasury bills as the basis for expected inflation. They construct portfolios consisting of real estate and government bonds to examine the benefits of including real estate in inflation hedging portfolios. Murphy and Kleiman examine REIT returns and find that, over short periods of time, equity REITs act as a perverse hedge against both expected and unexpected inflation		Fogler, two explanations for the positive relationship between real estate and inflation 1. Result of true high positive correlation of the two factors and the changing investor expectations concerning the effectiveness of real estate as an inflation hedge. Hartzell performed two tests to examine the hedging effectiveness of a commingled real estate fund. Chen and Tzang find that both equity and mortgage REITs show some hedging ability against expected inflation. Murphy f		They found that all three property types provide at least partial hedges and improves the hedging effectiveness of portfolios in which real estate is included. This perceived inflation-hedging effectiveness has been attributed to appraisal-smoothed biases in the data. Such biases have been thoroughly and Geltner notes only when returns are corrected for smoothing bias can be the risk characteristics of commercial properties be examined with a considerable degree of confidence in the results.
Yobaccio E, Rubens JH, Ketcham DC	The Inflation-Hedging Properties of Risk Assets: the case for REITS Journal of Real Estate Research Vol. 10 no 3, pp 279-296, 1995.		Inflation hedge	4 estimates for expected inflation are used, 6/12 month Livingston forecasts, time series predictions using AR model and short-term interest rates(TBs). The inflation hedging effectiveness of REIT returns is analysed using each measure of expected inflation and both the market-value and equal-weighted index. Fisher model; nominal rate if interest is comprised of an appropriate equilibrium real interest rate and the expected inflation premium. Fama and others extended the Fisher relationship to risky assets. Implicit in the model is the notion that the real return on the risk asset is independent of the level of expected inflation. During periods of high inflation or disinflation, investors may become more risk averse, and expect higher real returns on risk assets.	Investors make decisions based up estimates of future economic conditions, it is appropriate to examine REIT return performance given an information set containing estimates of expected inflation.	Park et al. Use two measures of expected inflation, a generalised Fisher equation from Fama and the Livingstone Price Expectations series. They find that REITs generally exhibit the same perverse hedging characteristics as common stock, although REITs appeared to be a partial hedge against anticipated inflation when using the LPE series against both expected and unexpected inflation.		REITs tend to mirror equity results against inflation and unexpected inflation. Hedging effectiveness was mixed for both inflation components, but performance was markedly worse against unexpected inflation. Secondly, in nearly all instances, REIT returns acted as a perverse hedge against unexpected inflation. Beta which estimates the systematic risk relative to changes in the real market return, is positive and highly significant. The coefficients on expected inflation are positive and near 1, especially the case for mortgage REITs. This indicates that REITs offered some hedging potential against expected inflation. However, the coefficients of unexpected inflation are negative, and most significantly are different from 1. In the high inflation period(1972 - 1981), the hypotheses that the coefficients of unexpected inflation were equal to 1 (indicating perfect hedging capability) could not be rejected for equity, mortgage, or hybrid REITs, primarily because of large standard errors. In low inflation period, the hypothesis that REITs were a perfect hedge against unexpe

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Chun GH, Sa-aadu J, Shilling JD	(2002) The role of real estate in an institutional investors portfolio revisited. Department of land economy, University of Cambridge	Are institutional investors underinvested in real estate securities	Asset Allocation	Capital stock estimates that commercial real estate represents only \$1.5 trillion, or between 3.5-4% investable wealth in the US	All available data show that institutional investors hold between 3.5 - 4% of their assets in real estate.		Studies suggest that institutional investors should invest between 15-20% of their assets in real estate. Even with real estate imperfections such as indivisibility, the optimal suggested for real estate in a mixed asset is 9%. A view is taken that institutional investors may not simply rank portfolios according to mean and variance	Real estate diversification pays off at the time the benefits are most needed (consumption growth low - not true for bonds), and that institutional investors can hold real estate for very long periods of time despite illiquidity.	
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors		Asset allocation	The starting point should be to include real estate and other assets at their market weights and then then to adjust the weights in order to best achieve the investment objectives. The Ruolac Capital Flows Database published in Investment Property provides an estimate of \$2.6 trillion as the current total size of real estate market. Using the above figures and data from the Flow of Funds report from the Federal Reserve Board for the size of the stock, bond and cash sectors puts real estate at approximately 8.3% of the current investment universe	Determining the size of the total investment universe to set weigh for real estate in an indexed portfolio has proven difficult.		Real estate belongs in a balanced investment portfolio because real estate is an important part of the investment universe. Any portfolio that does not include real estate is based on the bet that real estate will perform less well than is implied by the market-driven relative prices. Any allocation to real estate that does not reflect real estate's overall share in the investment universe implies a different bet from that of an indexed portfolio.	Real estate hed been as much as 11% of the overall universe in the 1980s. The recent correction in the stock market has begun to drive the figure up from 5.5% reached in 1998. A armket cap-weighted and quarterly rebalanced portfolio of major assets classes would have yielded annual average return of 10.4% with a risk of 7.7% over 1987 - 2002. Pension allocation to real estate is now approximately 4.8% (3.9% in equity real estate, 0.9% in mortgages). A portfolio with allocation of 4.8% rather than market the market allocation raises the portfolio average return by only 8 basis points to 10.5%, but also raises portfolio risk enough to cause the return per unit of risk to fall by two basis points. Replicating an insurance company allocation to commercial real estate at 10% the overall return would reduce by 8 basis points and risk would have dropped as well have dropped so that the return per unit of risk would have risen by three basis points	Apply the findings to the research report. Illustrate the return with actual weight and optimal weight.
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors		Asset allocation					Thus, the pension funds' underweighting relative to the cap weight causes overall performance to improve very slightly while the insurance companies over-weighting relative to the cap weight causes absolute return to suffer but risk-adjusted performance improve.	
Gold RB	Why the efficient frontier for real estate is fuzzy Journal of Real Estate Portfolio Management	MPT methodologies hides where the reduction in risk originate	Asset Allocation	Uncertainty is introduced by bootstrapping expected returns and SD in the traditional Markowitz framework.Departing from MPTs traditional approach for creating singular combinations of assets for any given level of risk-adjusted returns, this alternative helps quantify the impact of uncertainty by generating acceptable allocation ranges, rather than specific, and difficult to obtain, point estimates.	Difficulties related to both data quality and availability and have received much attention. These are perhaps overshadowed by the impact of uncertainty on the allocation process. Data limitations, as well as substantive issues regarding appraisal-based values, such as lumpiness, illiquidity and transaction costs, make the application of MPT to real estate impossible.	it is entirely possible that any two points on the efficient frontier are statistically indistinguishable from each other.	Asset allocation decisions must always reflect that their goal is to hold a portfolio that will reflect future market conditions. All explicit inputs into the asset allocation process need to be based on expectations of future returns, variability and correlations	The results show that the efficient frontier is not singular, but fuzzy.This study illustrates that numerous statistically dissimilar weighted portfolio can be equally attractive for any given combination of expected risk and return and allocation ranges ranges rather than specific targets.Introducing uncertainty into the Markowitz MPT framework helps to overcome the practical problem of balancing optimization's goals with real estate's illiquidity, transaction costs and data problems, creating bundles of portfolios to which investors are indifferent.	
Lee S	The return due to diversification of real estate to US mixed asset portfolio:A paper presented to the 10th Annual European Real Estate Society,2003		Asset Allocation				Re-allocation done in 4 ways: 1. Holding in real estate is replaced by the same % in the large cap, 2 % allocated to real estate replaced the same proportion in bonds, 3 real estate replaced small cap and holding equally split between large cap and bonds.	Real estate generally offer increase RDD to the mixed prtfolio.However the benefits depend upon which asset is replaced and the percentage allocation to real estate.	
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance,Volume 6 no 3 pp 60-83 1995		Asset Allocation			Strategic Asset Allocation: which studies have shown is the main determinant of portfolio returns, rather than stock selection. Consideration of the data series for property has shown the data are smoothed by the appraisal process, and true volatility is disguised. Desmoothing these series forces the volatility upwards.		Property still has aplace in a multi-asset portfolio, although it is significantly less than in previous studies, using appraisal based returns. Using a properly constrained constrained approach, there can still be allocation to property higher than current actual holdings. Reaffirms a case of property based on more discriminating assesement of desmoothing and MPT effects.	
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva	Benefits of including real estate assets- both domestic and international - in mixed-asset portfolio	Asset Allocation	Data from seven countries on three continents are considered for a common period of 1987-2001		Real estate as portfolio diversifier- Chaundry,Myer and Webb. Used co-intergration techniques and found that there is an inverse long-run relationship with real estate.	Data pertaining to stocks, bonds,direct real estate, real estate securities and cash for the U.S.,U.K., France, Netherlands, Sweden, Switzerland and Australia	Optimal weight allocated to real estate, with unhedged returns, is in the 5%-15% and inclusion of rela estate assets leads to a 5-10% reduction in the portfolio standard deviation	
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva	Whether the optimal which should be allocated to domestic real estate in mixed-asset portfolios is robust across countries	Asset Allocation	Appraisal-based indices are corrected for desmoothing using a variant of the method devised by Geltner. Use average of the standard deviation for stocks and bonds, instead of the normal assumption of real estate standard deviation being half of equities. Use average of the standard deviation for stocks and bonds, instead of the normal assumption of real estate standard deviation being half of equities	Institutional investors allocate a substantially lower weight to real estate than that reported in literature	Recent studies, have argued that the actual weight is in line when measured from an asset/liability framework or when imperfections such as indivisible assets and no short sales	Compile summary of statistics	Inclusion of international real estate, the risk reduction is increased to 10-20%. Optimal is constant across countries at approx 15%	
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva		Asset Allocation	Use average of the standard deviation for stocks and bonds, instead of the normal assumption of real estate standard deviation being half of equities		Uncertainty on optimal portfolio selection. Estimation error espacially returns. Variances are stable over time. One possibility is to constrain allocations, thereby forcing greater spread across the assets. The choice of constraints is arbitrary.		Unhedged returns are also similar: adding real estate reduces a portfolio's risk by 10 to 20%	
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance,Volume 6 no 3 pp 60-83 1995		Autoregressive Moving Average	Desmoothing property returns: UK returns are mainly based on comparable evidence, which is itself based on the previous valuations. Desmoothing process needs to capture essence of the appraisal process and at the same time and require relatively few data points. The simplest is the first autocorrelation.	This tendency to recycle valuations has the effect of incorporating previous prices in the current return. The consequence of this is that, if appraisal series is sufficiently long, the mean return is likely to represent an unbiased estimate of the true return index.The risk of property will be baised downwards and the returns series is likely therefore to exhibit strong positive autocorrelation, due to inertia in the system.	Valuation at time= true market value,theta and a constant lying between 0 and 1. $V_{1t} = (1 - \theta)P_t + \theta V_{1t-1}$. The main difficulty is determining the value of theta. Geltner is used. Full information model.	To bring property returns in line with stocks and bonds, the effects of autoregressive process must be removed. Desmoothed series is thus a simulated return series after such inertia has been expunged from the original data.	The valuation method best captures the appraisal behaviour of valuers at disaggregated level on which index values are ultimately based.	Given the way in which theta is derived, there is no absolute way of determining whether a particular value of theta is most appropriate for the desmoothing process. Arguments against valuations

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Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors		Bond nature	CMBS carves up the cash flows from pools of mortgages to produce high-grade cash flow characteristics in the senior tranches and more equity-like cash flow characteristics	Investor is often explicitly or implicitly(6 REITs in S&P)invested in all four quadrants. Past approaches to the analysis of the role of real estate based only on the private equity quadrant. Past approaches to the analysis of the role of real estate based only on the private equity quadrant reflect neither the reality of the investment structures that are available in the market.	The performance of each real estate is produced by a mix of equity-like and debt-like behaviors. For example, consider the polar case of a private real estate equity leased to a single credit tenant with a long term, triple net lease. The payments on that lease resemble the fixed payments one associates with a bond, not with equity. The value of this asset to the investor fluctuates in step with the same factors that influence the value of a bond or a mortgage.		REITs were the dominant competitors in the bidding for privately held real estate during 1995-1997	
Gold RB	Why the efficient frontier for real estate is fuzzy Journal of Real Estate Portfolio Management	Adding direct real estate to the other asset should result in lower portfolio risk especially on the downside	Bootstrapping	Rather than dealing with the difficulty associated with of using MPT-based asset allocation models because of the associated data problems, many institutions peg real estate allocation within a mixed-asset portfolio at some constant percentage.Within real estate property type, and geographic allocation decisions are often accomplished by using even more generic approaches.To illustrate uncertainty is a factor for asset allocators, total returns for Office, retail, apartment and industrial were recreated using bootstrapping	The problem is less acute for stock and bond returns, not only because they are high-frequency, transactional based series, but because data are available for longer periods	Bootstrapping was considered the most appropriate methodology for recreating the true distribution of future returns, given limited historical private real estate data, and therefore limited volatility of the series.	Generally, the bootstrap methodology has a tendency to more evenly distribute the intra-asset weightings within a portfolio. Assets with largest weights will have their allocations reduced, while assets with the smallest weights will receive a higher allocation. A base efficient frontier is created using a sixty-month holding period with an illustrative dataset of expected property type performance and correlations		
Chun GH, Sa-aadu J, Shilling JD	(2002) The role of real estate in an institutional investors portfolio revisited. Department of land economy, University of Cambridge	Real estate provides a hedge against changes in variables that matter to institutional investor	CAPM	Size of US institutional investment portfolio Size of real estate market. the problem when: individual investors are price takers, information is costless, taxes and transaction costs are zero, investors are mean-variance investors		CAPM Real estate risk Lack of information Real estate provides a hedge against inflation	Theoretical literature argues that institutional are underinvested in real estate: Real estate have quite a high average returns relative to their risk. This is inconsistent with CAPM, which states that high returns are only earned as a compensation for risk		
Lee S	The return due to diversification of real estate to US mixed asset portfolio:A paper presented to the 10th Annual European Real Estate Society,2003	Real estate should be included in a mixed portfolio because of the effect compound returns	Compound Returns	Adding real estate in portfolio to an existing mixed-asset portfolios increases the compound return and so the terminal wealth. Return due to diversification (RDD) is the difference between the compound return and the weighted average returns= Terminal Wealth.	Including real estate in the mixed-portfolio is based on diversification benefits than on its contribution to the return of the portfolio	Booth and Fama show that although the compound return of an investment is an increasing function of its expected return, it is also a decreasing function of its risk. In other words, investments with higher expected returns and high risks do not necessarily provide higher compound returns to portfolio, than investments with lower expected returns and lower risks	US annual returns over the period 1951-2001. Annual returns of Direct real estate, large cap stocks, small cap stocks, government bonds and cash	A large holding of real estate in the mixed portfolio may be justifiable on its compound return enhancing effect on the mixed-asset and not simply on its risk reducing ability.	RDD, the results are dependent on the percentage allocation to real estate and the asset class
Lee S	The return due to diversification of real estate to US mixed asset portfolio:A paper presented to the 10th Annual European Real Estate Society,2003		Compound Returns	RDD = the variance of the investment's simple returns, and the average continuously compounded return of the investment. The compound return is the increasing function of its expected return and decreasing variance		Booth and Fama shown that the compound returns of a portfolio is greater than the weighted average of the individual compound return of the investments. The result stems from the fact that although variance is an appropriate measure of risk of a portfolio it is not the relevant measure of risk within the portfolio. The risk of an investment should be measured by its covariance with the portfolio. Thus, an asset with a low expected return but a low covariance may be more desirable, than an asset with higher expected return but a high covariance.		The uncommonly low value of the risk of real estate data, compared with government bonds, and the presence of 1st order serial order correlation, is a common feature of commercial real estate.	
Lee S	The return due to diversification of real estate to US mixed asset portfolio:A paper presented to the 10th Annual European Real Estate Society,2003		Compound returns					Nonetheless, the justification for including real estate in the mixed portfolio need to rest on its diversification benefits alone, but can be made on its contribution to the compound return or terminal wealth.	Role
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors	Real estate can reduce the overall risk of a portfolio, provide high absolute returns, act as an inflation hedge and offer strong cash flows.	Four quadrant	A broader definition of real estate, historically was only including private real estate equity and private real estate debt. Advent of securitization lead to private commercial real estate equity, private commercial real estate debt and REITs and public commercial real estate debt structured as CMBS	Real estate viewed as a risk reducer as imposed by ERISA. Many investors manifest their sceptism by assigning only very small allocations to real estate in their portfolio.				
Kuhle JL	Portfolio Diversification and Return Benefits - Common Stocks vs REITs Journal of Real Estate Vol No	Diversification benefits can be obtained by using real estate assets to create well-diversified portfolios.	Diversification	Monthly 5 year returns to examine the effects of diversification on the reduction of total portfolio risk in a REIT and mixed-portfolio.	When does a holding in direct real estate contribute this increase in portfolio performance	Increased securitisation has lead to application of traditional portfolio theory. Markowitz analysis is employed to examine the risk and return potential of portfolios comprised of REITs only and REITs combined with common stocks.	Means and standard deviations are calculated to provide relative comparisons and correlations then calculated. The asset with the lowest correlation would usually be a good candidate for risk reduction in portfolio through increased diversification.	Traditional methods of portfolio analysis based on the long run correlation averages fails to identify in which periods real estate helps to reduce portfolio risk.	
Norman EJ, Sirmans GS, Benjamin JD	Historical Environment of Real Estate Returns Journal of Real Estate Portfolio Management Vol No		Smoothing		To avoid the problem of return smoothing due to use of appraised values, some studies employ REITs. A problem normally arises when using REIT returns to measure real estate problems. During some time periods, REIT yields may vary from actual underlying property yields. In the early 1970s for example, REITs had low returns, while returns on the underlying properties was high. The differences may be the result from high inflation, which increases the tax shelter benefit of investor-owned. Other factors such as leverage and confidence on management ability to contribute to divergence. Several problems associated with using REIT returns can distort homogeneity of the portfolio because they usually have varying degrees of leverage.	Portfolio risk risk falls when real estate is included. The allocation of real estate holdings in the optimal portfolio varies throughout the research, appearing to be based on such factors as the tax rate of investors, the risk assumptions, and time periods examined. For example, over along time period from 1947-1983, Webb et al find an optimal of portfolio weights about two thirds in real estate. Over shorter periods, Irwin and Landa find that real estate comprised 20% of minimum variance. In contrast, for even more recent times, 1980-89, Ennis and Burik find the optimal to contain 10-20% of total assets in real estate	Diversification benefits of real estate and the allocation of real estate in an optimal mixed-asset portfolio are a subject of studies summarized. There is clear consensus that diversification with real estate provides enhanced investment returns.		Arguments against using REITs
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors		Efficient frontier	The real estate's role extends from the lowest risk end of the efficient frontier to just past the midpoint of the mixed-asset efficient frontier. Real estate is both low-risk itself and an excellent risk reducer in a stock and bond portfolio.				This evidence suggests that real estate is very suitable for investors interested in capital preservation and need to earn a useful rate of return.	

Author	Research Report/Source/Year of Review	Research Hypothesis	Research Area	Research Methodology	Research problem	Literature Review - Theory	Empirical Research	Findings/Conclusions	Comments
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva		Efficient frontier	use Bayes-Stein which should increase the stability of portfolio composition, instead of portfolio allocation models		Means are usually shrunk towards are common value (the common mean, I,ethe mean across all assets considered. Dviersification benefits are more likely to accrue from reduction in risk, rather than gains in averages returns		Real estate returns are lowly(positively or negatively) correlated to those of stocks and bonds and 15-30% should be allocated to real estate	
Lee S	When does real estate improve portfolio performance, University of Reading, Centre for Real Estate Research,Reading		Four quadrant	Four possible outcomes: both markets up,both markets down, the asset is up and real estate is down, the asset is down and real estate up. Target return is required. The target is normally set to the minimum return that the investor would be willing to accept, typicall the risk-free rate on bonds.		Too few few investors appreciate the implications of the co-movement between investments that leads to correlation between assets. A breakdown of the imperfect correlation between direct real estate and the other asset classes to illustrate where the benefits originate.		By using the a four-quadrant table for each asset class, it is possible to see to what extent the investor really gains from holding direct real estate when it is most needed, i.e. where the losses in the asset class are offset by gains in direct real estate.Direct real estate mitigates the losses when both down and has limited upside. Thus if the goal is offsetting losses, then the results show that direct real estate may have been some benefit	Define the objectives of the portfolio
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors		Four quadrants	True value of real estate asset class is determined by the behaviors of all four quadrants, a combined performance is adopted, i.e.time series of capitalization-weighted performance of real estate in all the quadrants.		At the other extreme, an equity position in an empty, speculative, multi-tenanted property is driven almost entirely by equity forces. The value of the building is a fuction of supply and demand for space in that market, at that particular time. As the buildings becomes more fully leased, it changes from "pure" equity to a debt-equity hybrid, and perhaps - if fully leased to a long-term tenants - becomes very debt-like.		The private mortgage quandrant shows significant volatility during the high inflation/tight money era prior to 1986, but has since settled dow. The CMBS market, not measured before 1984 because the quandrant did not exist, the volatility shows volatility little different from that of the mortgage era.Appraisal-based private equity is the least volatile. Volatility is understated, while appraisals may lag, they eventually do capture the true range of performance of individual real estate assets	
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors		Four quadrants	Using four quantrant real estate index,calculate the optimal allocation for real estate in a mixed asset class portfolio of stocks, bonds and cash and calculate the mean returns, standard deviation and correlations Quarterly returns from 1987 - 2000				The correlations between real estate and stocks of 0.065, real estate and bonds of 0.34 , and real estate and cash of 0.259 suggest that real estate can play a significant role in a mixed-portfolio. Whenever two imperfectly related assets (correlation coefficient less than 1.0) are placed together in a portfolio, an oportunity exists to earn a greater return at each level of risk (or reduce the risk for a given level of return). In summary, when the return to an asset class is high enough, the risk is low enough, and or the correlation reflects a sufficiently different pattern of returns, the asset class earns aplace in the portfolio for at least a portion of return/risk premium spectrum. Real estate meets these tests and is therefore a component of the well diversified mixed asset portfolios.	Limitations in using four quadrant model - 1st securitization, immature
Yobaccio E, Rubens JH, Ketcham DC	The inflation-hedging properties of risk assets: the case for REITS Journal of Real Estate Research	REITs act as a hedge against expected and/or unexpected inflation.	Inflation hedge	A model of real estate returns is derived that has components for expected and unexpected returns and allows for variation in the real return on risky assets. Since the findings for some real estate have been criticized due to aprail smoothing bias, logic was to use REITs REITS returns reflect the value of the income and price appreciation components of the underlying assets, determined in a market that adjust rapidly to changes in information or expectations		Fisher noted that the nominal rate of interest equalled the rate of interest plus expected inflation premium. Thus it was expected that the nominal rate would incorporate the best possible estimate of future inflation.These sorted some of the effects of anticipated and unanticipated inflation and lead researchers concluding that stock prices adjust for inflation.The conclusions were challenged and all three papers concluded that both nominal rate of interest and real holding period returns for corporate euties were negatively and significantly related to the inflation rate.Fama tested the effectiveness of treasury bills, government bonds, real estate, corporate bonds etc as hedges against both expected and unexpected inflation		REITs provide some hedging capability against unexpected inflation, but act as a perverse hedge against unexpected inflation.That is, hh decrease in value as inflation increases. Empirical research concluded that unexpected inflation, not expected inflation, explained the negative relationship between the inflation and stocks	Argument for research report
Yobaccio E, Rubens JH, Ketcham DC	The inflation-hedging properties of risk assets: the case for REITS Journal of Real Estate Research		Inflation hedge	Hartzell used data from 1973 - 1983. Both tests involve using treasury bills as the basis for expected inflation. They construct portfolios consisting of real estate and government bonds to examine the benefits of including real estate in inflation heging portfolios. Murphy and Kleiman examine REIT returns and find that, over short periods of time, equity REITs act as a perverse hedge against both expected and unexpected inflation		Fogler, two explanations for the positive relationship between real estate and inflation 1. Result of true high positive correlation of the two factors and the changing investor expectations concerning the effectiveness of real estate as an inflation hedge. Hartzell performed two tests to examine the hedging effectiveness of a commingled real estate fund. Chen and Tzang find that both equity and mortgage REITs show some hedging ability against expected inflation. Murphy f		They found that all three property types provide at least partial hedges and improves the hedging effectiveness of portfolios in which real estate is included. This perceived inflation-hedging effectiveness has been attributed to appraisal-smoothed biases in the data. Such biases have have been thoroughly and Geltner notes only when returns are corrected for smoothing bias can be the risk characteristics of commercial properties be examined with a considerable degree of confidenc in the results.	They found limited support for the first explanation and but not enough to reject the second.
Yobaccio E, Rubens JH, Ketcham DC	The inflation-hedging properties of risk assets: the case for Real Estate Research		Inflation hedge	Best method to estimate inflationary expectations: Livingston data and data generated from time series.Assuming that Treasury Bills are perfectly liquid, they use the the rate on bills as a proxy for the expected rate of inflation. The measure of unexpected inflation is merely the difference between actual inflation and the bill rate as calculated on an ex post basis. This study analyzed the hedging effectiveness of REITs against expected inflation and /or unexpected inflation over the period 1972:1992. Two sub-periods are examined to asses the sensitivity of the results to inflation levels.CPI used as a measure of actual inflation.Time series predictions are generated and residuals are relatively well bahaved.Data NAREIT share price index, Livingston expectations index and monthly inflation rates.	If, for example, investors become more risk averse during periods of high inflation or disinflation and demand correspondingly higher real returns on risky assets, the correlation between expected inflation and real market rate of return that is accounted for in Parker may result in biased coefficients for inflation. This bias may be sufficiently large to suggest perverse hedging properties for real estate, even though none exist			Summary of All REITs, Treasury Bills, Livingston (measure of expected inflation, 6/12 month forecast), AR Model show the descriptive stats for all varaiables analyzed from 1972 - 1992, 172 - 1981, and 1982 -1992. Reflecting the bull market in the 1980s, both market indices reveal impressive gains only in the latter time period. Equity REITs perfomed better in the more recent ("low infanflation") subperiod while mortgage and hybridREITs performed better in the first ("high inflation") subperiod, thus obfuscating REIT performance against actual inflation.	Find out about the AR(1) model

Author	Research Report/Source/Year of Review	Research Hypothesis	Research Area	Research Methodology	Research problem	Literature Review - Theory	Empirical Research	Findings/Conclusions	Comments
Yobaccio E, Rubens JH, Ketcham DC	The inflation-hedging properties of risk assets: the case for REITS Journal of Real Estate Research		Inflation hedge	4 estimates for expected inflation are used, 6/12 month Livingston forecasts, time series predictions using AR model and short-term interest rates(TBs). The inflation hedging effectiveness of REIT returns is analyzed using each measure of expected inflation and both the market-value and equal-weighted index.	Investors make decisions based upo estimates of future economic conditions, it is appropriate to examine REIT return performance given an information set containing estimates of expected inflation.			REITs tend to mirror equity results against inflation and unexpected inflation. Hedging effectiveness was mixed for both inflation components, but performance was markedly worse against unexpected inflation. Secondly , in nearly all instances, REIT returns acted as a perverse hedge against unexpected inflation.Beta which estimates the systematic risk relative to changes in the real market return, is positive and highly significant. The coeficients on expected inflation are positive and near 1, espacially the case for mortgage REITs. This indicates that REITs offered some hedging potential against expected inflation. However, the coefficients of unexpected inflation are negative, and most significantly are different from 1.In in the high inflation period(1972 - 1981), the hypotheses that the coefficients of unexpected inflation were equal to 1 (indicating perfect hedging capability) could not be rejected for equity, mortgage, or hybrid REITs, primarily because of large standard errors. In low inflation period, the hypothesis that REITs were a perfec	
Yobaccio E, Rubens JH, Ketcham DC	The inflation-hedging properties of risk assets: the case for REITS Journal of Real Estate Research		Inflation hedge					The results were remarkably robust irrespective of the type of REIT returns or the measure of expected inflation utilized.Results indicate that REITs act poor hedge against any measure of inflation(actual, expected, or unexpected) with the poorest performance relative to unexpected inflation.In this respect, REIT returns mirrored results involving equity returns in general and would seem not to be proxies for direct investment in real estate. REITs indicate that real estate , at best, acts as a partial hedge against expected inflation and a perverse hedge against unexpected inflation.	
Chatrath A, Lian Y	Reits and Inflation: Along -Run perspective () Journal of Real Estate Research Vol no	REITs tend to behave like other equities with respect to inflation hedging-characteristics	Inflation hedge		Examine the inflation hedge in the long run and also investigate the apperent lack of a positive relationship between general rpices and REITs returns in prior studies arises from the impact stock market movements have on REITs.		It is now well documented that stock returns worldwide are either negatively or unrelated to inflation. Only a few studies, indicate that REITs possess some inflation-hedging properties. Someargued for partial hedge against inflation. Authors also find that REITs act as a perverse hedge against unexpected inflation and that REITs have some ability to hedge the expected inflation		
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors		Inflation hedge		Concern about disinflation and deflation have risen in the asset markets, particularly the commodities market. Real estate returnshave a complicated relationship to inflation.	Past inflation is partially embedded in rents set previously because every seller of rental space, wishes to keep price level or rising in real terms. Thus net operating income (NOI) is partly a function of past inflation, rising if past inflation has been greater, and falling (or rising less) if past inflation has been tame. The speed with which inflation affects NOI, or the time lag necessary to capture inflation's impact on current NOI, depends on the structure of leases.	Inflation impacts the capital value in two ways. First, it impacts current NOI, which feeds through to value via capitalization rate. This feed is espacially strong for retail assets. Conventional wisdom has held that real estate performs as an inflation hedge. This means that if inflation is greater than expected, real estate returns will compensate for the surprise and will help offset negative response of the other assets in the portfolio As real estate fell into disfavour through the 1980s crash, this rational was discredited and compounded by low inflation.	The impact of past inflation, appropriately lagged, is positive for all four major property types. The direct capital value impact of inflation is significantly positive for apartment and office properties, but not significantly from zero for warehouse. Thus the empirical assessement shows that private equity real estate is a very useful, partial inflation hedge. That said, it is also clear that the degree of inflation-hedging is not uniform across the property types. As is the case with most debt, real estate debt is not good inflation hedge because unexpected inflation and noncomitant increases in nominal interest rates negatively hit the value of CMBS. REITs will capture some of the benefits of the inflation hedge but are less successful transmitter of this value than private equity because of links to the stock market, which is generally damaged by inflation. So, if inflation hedging is a key reason why an investor chooses an allocation to real estate, that investor must tilt the portfolio toward private equity real estate.	
Mueller GR, Pauley KR	The effect if Interest-Rate Movements on REITs		Inflation hedge			Mullineaux and Chew studied inflation and found that real estate is a partial hedge to inflation. The dividend yield on REITs is positively related to both expected and unexpected inflation.			
Rubens JH, Bond MT, Webb JR	The inflation-hedging effectiveness of real estate. The Journal of Real Estate Research Vol No	Real estate has been regarded as one of the best inflation hedges of the past years	Inflation hedging	The study examines the inflation-hedging effectiveness of residential real estate or farmland as inflation hedges, as individual assets and as portions of mean/variance effcient portfolios. Further, the returns will be divided into the appreciation and income components as expositional aid. Return measures will be regressed against actual, expected and unexpected inflation.The hedging effectiveness is better examined by diving the two inflation components.Portfolios are constructed consisting of real estate and government bonds to examine the benefits of including real estate in inflation hedging portfolios. The study extends these previous research by updating time.Further more the return components are seperated into income and appreciation. The division of the return stream helps ascertain the portion of the total return that determines the hedging effectiveness of the asset. Finally mean-variance efficient portfolios are constructed to determine additional hedging benefit accrued from including real estate	Investors expect a resurgence of inflation to higher levels in the near to immediate future	Hartzell performed two tests to examine the hedging effectiveness of a comingled fund from 1973-1983 that contains business real estate. Both test involve using Tbs as the basis for expected inflation. One test is based on nonconstant real rate that moves according to an integrated moving average process and the other on asset returns and inflation.In efficient markets, the nominal rate of return on asset incorporates the best possible estimate of expected future inflation.Fama test for hedging effectiveness of various asset financial assets against both expected and unexpected inflation. TBs are used as proxy for the expected rate of inflation. The measure of unexpected inflation is the difference between actual inflation and bill rate. The study uses the Livingston price expectations (LPE) as a measure of expected inflation. LPE is a forecast by business economists.	During periods of inflation, certain financial instruments not only do not protect the investor, but actually perform as a perverse hedge, l.ie. Decrease in value as inflation increases.		Focus on business real estate

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Rubens JH, Bond MT, Webb JR	The inflation-hedging effectiveness of real estate. The Journal of Real Estate Research Vol No		Inflation hedging		Mean-variance portfolios. Nominal rate of interest is comprised of appropriate equilibrium real interest rate and expected inflation premium		There is no consensus on the best method to estimate inflationary expectations. Both the survey-based data (LPE) and regression generated data appear to be acceptable proxies for expected inflation.	Only residential estate is a complete hedge against inflation. TBs are the only other asset exhibiting at least some hedging effectiveness. All other financial and real assets have standard errors so large that their hedging effectiveness is indeterminant. When examined against expected inflation as measured by the LPE, there are few more positive hedges. Only Treasury bills and business real estate provided a complete hedge against expected inflation. They find that commercial real estate is a complete hedge against both expected and unexpected inflation. Regression estimates for each type of inflation against the asset returns.	Regression analysis between real estate and inflation
Rubens JH, Bond MT, Webb JR	The inflation-hedging effectiveness of real estate. The Journal of Real Estate Research Vol No		Inflation hedging	Expected returns were treated as a constant, a Beta Coefficient, Standard Error and R squared is calculated and the type of inflation hedge is determined. A 95% confidence interval was used to test whether a particular investment is a complete, partial or indeterminant hedge.				All total returns measures provided a positive real return. Furthermore, the market was fairly accurate in its assesement of inflation over the time period. Unexpected inflation, the difference between the CPI and the LPE data, shows that inflation was generally underestimated throughout the 1960s and 1970s, but overestimated in recent years.	
Mueller GR, Pauley KR	The effect if Interest-Rate Movements on REITs		Interest rates	Explores the historical relationship between interest-rate movements and REIT prices to determine what, if any impact interest rates movements have had on REIT prices. Monthly changes in interest rates, as measured by price data from Federal Government three month TB, 10 year bonds, Long government bonds and compared to monthly changes in the S&P 500 Price Index, Wilshire Real Estate Index (includes REITs). Correlations between these different indices is calculated from 1972-1993.		Chen and Zang looked at sensitivity to interest rates and inflation using regression model. They used a small sample of mortgage and equity REITs, and found that equity REITs were not sensitive interest rates, but only to changes in expected inflation.	Means and standard deviations are calculated to provide relative comparisons and correlations then calculated. The asset with the lowest correlation would usually be a good candidate for risk reduction in portfolio through increased diversification.	The matrix shows that NAREIT Equity Index had a low correlation with interest-rate movements over the time period studied. This was true for short, medium and long term interest rates as the correlations were low and negative for all.	
Chun GH, Sa-aadu J, Shilling JD	(2002) The role of real estate in an institutional investors portfolio revisited. Department of land economy, University of Cambridge		low consumption	While research is divided as to whether smoothing bias exist and whether it can be appropriately corrected, it seems that the issue is more of concern when comparing direct real estate with market based securities. Geltner desmoothing applied.	Predictability of real estate returns and a hedge against low consumption				
Hoesli M and Hamelink F	The maximum drawdown as a risk measure: The Role of Real Estate in the optimal portfolio revisited University of Geneva	Portfolios optimized in the Return/MaxDD space, rather than Return/SD yield a much lower MaxDD, while only slightly higher SD for the same level return.	MaxDD	Investigate the role of real estate in a mixed-portfolio when maximum drawdown (MaxDD), rather than the SD, is used as a measure of risk. The MaxDD is defined as the loss suffered when an asset is bought at a local maximum, and sold at the next local minimum. The study extends MaxDD framework to the multi-asset setting	Institutional investors allocate substantially lower weight to real estate than that reported in the literature.	Several studies argued for instance that the weight which should be allocated to real estate is much more in line with the actual institutional weight when asset-liability is considered, or when real estate market imperfections are considered. Some authors also stress that weights are reported with error, and hence Bayes-Stein estimators was suggested to address the issue of errors. By doing so, the calculated portfolio allocations have been shown to be more stable than when classical mean variance is used.	The empirical analysis is conducted from the perspective of a Swiss pension funds who are faced with legal constraints on the weights that can be allocated to the various asset categories and pertains to the period 1979-02	Argue that the MaxDD concept is one of the most natural measures of risk, and that such framework can help reconcile the optimal allocations to real estate and effective allocations by institutional investors. The reduction in MaxDD is highest for portfolios situated halfway on the efficient frontier, typically close to those held by pension funds. Also the reported weights are much more in line with the actual weights to real estate by institutional investors.	
Hoesli M and Hamelink F	The maximum drawdown as a risk measure: The Role of Real Estate in the optimal portfolio revisited University of Geneva		MaxDD	Empirical analysis is undertaken using Swiss pension funds data for the period 1979-02. Ceilings have been set for pension funds to ensure that they do not take too much. Four possible outcomes: both markets up, both markets down, the asset is up and real estate is down, the asset is down and real estate up. Target return is required. The target is normally set to the minimum return that the investor would be willing to accept, typically the risk-free rate on bonds.		The application of MaxDD is in line with Sing and Ong, and use downside risk as their measure of risk and show that the allocation to real estate does not change substantially. Too few few investors appreciate the implications of the co-movement between investments that leads to correlation between assets. A breakdown of the imperfect correlation between direct real estate and the other asset classes to illustrate where the benefits originate.		The results suggest that for 70% of the time direct real estate would have contributed little to the return performance of alternative assets. Returns from direct real estate only offset the losses in the alternative asset about 30% of the time. However the increase in performance occurs when the alternative asset showed negative returns. Addition of direct real estate always leads to reduction in portfolio risk, especially on the downside. By using the a four-quadrant table for each asset class, it is possible to see to what extent the investor really gains from holding direct real estate when it is most needed, i.e. where the losses in the asset class are offset by gains in direct real estate. Direct real estate mitigates the losses when both down and has limited upside. Thus if the goal is offsetting losses, then the results show that direct real estate may have been some benefit	
Hoesli M and Hamelink F	The maximum drawdown as a risk measure: The Role of Real Estate in the optimal portfolio revisited University of Geneva		MaxDD						Define the objectives of the portfolio

Author	Research Report/Source/Year of Review	Research Hypothesis	Research Area	Research Methodology	Research problem	Literature Review - Theory	Empirical Research	Findings/Conclusions	Comments
Gold RB	Why the efficient frontier for real estate is fuzzy Journal of Real Estate Portfolio Management		MPT		Strict interpretation of MPT defines a portfolio as efficient and inefficient portfolio only if, it lies directly on the frontier. Any change in expected returns, risk, and or correlation between assets could potentially trigger a reallocation decision. However in the real world, real time changes in portfolio allocations are generally regarded as impractical. Data limitations: Data availability varies significantly across asset classes.Illiquidity also makes direct comparisons between real estate and other asset more difficult.How much of areturn premuim is required to compensate real estate investors for illiquidity.Smoothing effect boosts real estate's apperant risk-adjusted return and dampens its correlation with other assets. All else equal, have a tendency to artificially raise equity real estate's share within a mixed-asset portfolio.	MPT takes advantage of the diversification effect provided by multiple and less than perfectly correlated assets, allowing minimization of unsystematic risk and choice of exposure to systematic risk for any given level of return. Efficient market theories suggest that investors are not rewarded for bearing unsystematic risk and therefore should seek to minimize its presence.	In their pursuit of reduced unsystematic risk, investors diversify their holdings across assets that less than perfectly correlated asset returns have on volatility.Diversification is only relevant when risk/uncertainty is present.	MPT provides investors with an infinite number of efficient portfolios. Each of the portfolios along the efficient frontier provides the best expected returns for a given level of risk.	
Lee S	When does real estate improve portfolio performance, University of Reading, Centre for Real Estate Research,Reading	MPT methodologies hides where the reduction in risk originate	MPT	Traditionally most analysis considers the correlation between direct real estate and the alternative asset classes in examiningthe risk reducing benefits of adding property to increase diversification. The overThe returns are broken into positive and negative returns. This study examines the risk and return effects that would have been realised by a hypothetical investor who elected to add direct real estate to their existing assets. The assets are 60/40-equity/bond portfolio.Quarterly data returns for direct real estate,FTA index,government bonds from 1977 ; 2002all correlation coefficient is an average of a large number of concurrent asset movements in many economic and financial environments.	When does a holding in direct real estate contribute this increase in portfolio performance		Means and standard deviations are calculated to provide relative comparisons and correlations then calculated. The asset with the lowest correlation would usuaaly be a good candidate for risk reduction in portfolio through increased diversification.	Traditional methods of portfolio analysis based on the long run correlation averages fails to indentify in which periods real estate helps to reduce portfolio risk.The results suggest that for 70% of the time direct real estate would have contributed little to the return performance of alternative assets. Returns from direct real estate only offset the losses in the alternative asset about 30% of the time.However the increase in performance occurs when the alterantive asset showed negative returns.Addition of direct real estate always leads to reduction in portfolio risk, espacially on the downside.	
Lee S	When does real estate improve portfolio performance, University of Reading, Centre for Real Estate Research,Reading		MPT		Covariance of an investment	The lower the covariance of an investment with a portfolio, the higher its contribution to reducing risk of the portfolio, and so the greater the attrativeness of the investment to the portfolio.			
Lee S	The return due to diversification of real estate to US mixed asset portfolio:A paper presented to the 10th Annual European Real Estate Society,2003		MPT					Those assets that show the greatest RDD should show the greatest contribution to the compound return of the portfolio	
Yobaccio E, Rubens JH, Ketcham DC	The inflation-hedging properties of risk assets: the case for REITS Journal of Real Estate Research		Nominal rates of interest	Fisher model: nominal rate if interest is comprised of an appropriate equilibruim real interest rate and the expected inflation premuim. Fama and others extended the Fisher relationship to risky assets. Implicit in the model is the notion that the real return on the risk asset is independent of the level of expected inflation. During periods of high inflation or disinflation, investors may become more risk averse, and expect higher real returns on risk assets.				Park et al. Use two measures of expected inflation, a generalised Fisher equation from Fama and the Livingstone Price Expectations series. They find that REITs generally exhibit the same perverse hedging characteristics as common stock, although REITs appeared to be a partial hedge against anticipated inflation when using the LPE series against both expected and unexpected inflation.	
Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995		REIT performance				REIT Act of 1960 granted tax-exmpt status to REITs.After a slow start in the late 60s,and early 70s, rise rose almost 2000% from 1968-1973. The growth was fuelled by demand forconstruction and develoment financing. The boom was financed by funds borrowed through short-term commercial paper. Because of the large spreads between the rates for C&D loans and short term interest rates, most REITs made very high returns. As interest rates rose in 1972 the previously large spreads began to disappear, and eventually became negative after the oil crises in 1973. The NAREIT dropped by about 56.2%. REIT experienced structural changes during the late 1970 and 80s. Leverage was reduced from 64% in 1972 to 55% in 1984. In nominal terms, the industry's total assets rose from historical low of \$7.00 billion in 1980 to \$61.05 billion in 1993. Market capitalisation of the industry increased by 330% in nominal terms and 25% in real terms for the period 1972-1993.	Several studies show that actual returns from	

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Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995		REIT performance	Jensen performance measure index, is used to estimate the performance of REIT portfolios.Jensen is based on the CAPM. It compares the performnce of a security or a portfolio to the standard performance benchmark, the security market line. By assuming that the CAPM holds period by period, and that returns on securities generated by the market model, Jensen derived a linear expression between the realized returns on any security and its systematic risk, the realized returns on the market portfolio, the risk-free interest rate and random error. The Jensen index is used in performance studies because it measures performance based upon a simple and realistic benchmark, a passive manged portfolio that invests in savings accounts and the stock market portfolio. A positive and significant jensen index indicates a superior performance of a REIT portfolio relative to this portfolio (REITs outperforms), while negative is vice versa.	Methodological flaws from previous studies, use of unrepresentative sample periodsand use of S&P index as performance benchmark. Previous studies covered short period and inferences about REITs over a short period of time presents a serious problem in a volatile industry.The problem exists because of boom burst period in the REIT history.Secondly the S&P 500 has been used as a proxy for stock amrket portfolio. The S&P 500 is not a representative performancne benchmark because it does not include small stocks and most REITS are small cap	In the long term, it should be expected that the REIT industry portfolio would perform similarly to the stock market portfolio adjusted for risk, if the market is efficient and the CAPM holds.	Studies suggest that REITs performed poorly in the 70s. Ohters foud that REITs provided less than average returns during 1973-1976 recession period.Burns and Epley were slightly differnet, however. They investigated whether the efficient frontier of mixed-asset portfolios that consisted of REIT stocks and other common stocks dominated the efficient frontier for a single asset type and the S&P 500 for the for the period 1970 - 1979. . . Titman and Warga also found that the performance of REITs stocks is not significantly different from that of market portfolio over the period 1973-1982.They calculated and compared both CAPM and APT based on Jensen index. Studies since the 1980s have come to differenent conclusions	Summary of findings on the performance of REITs is inconclusive. The outcomes from REIT performance studies seem to be highly sensitive to the sample period studied.Burns and Eply found that the mixed-asset efficient frontier did dominate both, with respect to mean and variance at every risk and return level. Titamn and Warga found that both indexes for the entire period studied were not statistically different from zero.The market risk-adjusted returns on REIT stocks are about the same as the returns on the market index.	
Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995		REIT performance				The portfolio that most closely resembles the stock market portfolios in the US is the stock constructed by the CRSP. Overall, five of eight REIT portfolios have higher volatility per unit of mean return, measured by the coefficients of variation, six of eight portfolios have lower total risk-adjusted excess returns, measured by sharpe ratio	Equity REITs tend to perform better than hybrid and mortgage REITs.	
Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995	To test whether the difference in performance between REIT portfolios and a passive strategy of investing in the stock market portfolio and savings is statistically significant	REIT performance	Summary of mean, varaince , co variance and sharpe index is calculated.				All REIT portfolio performed similarly to the CAPM benchmark.REIT portfolios have larger Jensen indexes than their mortgage couterparts. This evidence clearly indicates that the REIT portfolios carry a smmler market risk than the stock market portfolio.	
Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995		REIT performance	8 REIT portfolios are constructed based on ex ante feasible for all,equity, debt and hybrid REITs.2 portfolios based on equally weighted and value weighted strategies are constructed.The REIT study includes 255 REIT stocks. Centre for Research Security Prices(CRSP) stock market portfolio is used. The portfolio is equally weighted and the CRSP portfolio will be used.Stability over time.Summary of mean, varaince , co variance and sharpe index is calculated. The study is broken into six year periods, 1970-1975, 1976-1981, 1982-1987, 1988-1993. They respond relatively well to the historical fluctuations of the real estate market, the boom and burst in the early 70s and recovery late 70 and expansion in the 80s and REIT tax reform in 1986. Mean returns and SD for each subperiod was calculated. T-test conducted for each subperiod.		The application of the Jensen index requires that the market portfolio, be ex-ante efficient and includes, theoretically, all available assets on the market.A comparison of statistics suggest that the performance of REIT stocks is about the same as or slightly poorer than that of the stock market portfolio over the sample period.	The portfolio that most closely resembles the stock market portfolios in the US is the stock constructed by the CRSP. Overall, five of eight REIT portfolios have higher volatility per unit of mean return, measured by the coefficients of variation, six of eight portfolios have lower total risk-adjusted excess returns, measured by sharpe ratio. On a systematic risk-adjusted basis, REIT performance was also unstable over time.Examination of Jensen indexes, suggest that there are substantial variations in the systematic risk-adjusted performance for different subperiods. The equally weighted debt/euity REIT outperformed the stock market portfolio at 10% significantly during 1970-75. Both equally value weighted signifactnly outperformed at 5% in the 1976-81 subperiod.	REITs performed differently in different subperiods. 1970-75, all equally weighted REIT portfolio earned a negative return, and the following 3 subperiods the equally weighted portfoliohad positive returns. All eight REIT portfolios had the highest mean returns in the 1976-1981 subperiod. T- test results indicate that the mean returns are indeed significantly different between subperiods 70 - 75, 76 -81 for seven of the eight. Equally weighted portfolios equity REIT performed significantly worse in 1982-1987, than in 1976-1981. Jensen index suggest that there are substantial variations in the systematic risk-adjusted performance in the different subperiods. Studies focus on short time periods and come to different conclusions. Findings on short-term peromance in any subsequent periods, nor are they reliableindicators of the long-term performance of REITs stocks.	
Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995		REIT performance	T-test results				On a systematic risk-adjusted basis, REIT performance was also unstable over time.Examination of Jensen indexes, suggest that there are substantial variations in the systematic risk-adjusted performance for different subperiods. The equally weighted debt/euity REIT outperformed the stock market portfolio at 10% significantly during 1970-75. Both equally value weighted signifactnly outperformed at 5% in the 1976-81 subperiod.	
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva		Returns and risk	Asset returns are shrunk to global mean of each asset class. BS is applied for various levels of risk. For countries with appraisals concerns, desmoothing variant called Geltner is used		This is a variant of the repeat sales method whereby pairs are formed with appraised values and transaction price. Repeated- regression method.	Summary of statistics for the various asset classes	Stocks constitute the highest return and risk asset class, while cash exhibits low return and risk parameters. Bonds appear to have a higher return and risk than cash. Real estate securities varies quite substantially from different countries across	
Gold RB	Why the efficient frontier for real estate is fuzzy Journal of Real Estate Portfolio Management		Returns and risk	Alternative approach to applying MPt to asset allocation.	Unique problems that real estate presents to practitioners of MPT	In the world of asset allocation, risk is divided into two components: Systematic and unsystematic risk. Systematic risk is the force to which all investments within market are subject and which therefore must be borne by all investors. Unsystematic risk is confined to to the perculiarities of an individual investment and may be diversified away.Market vacancy, production and inflation are all part of systematic risk, while location, building age, tenant mix, and timing of lease rollovers are all examples of unsystematic risk.			

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Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995	Whether REITs performed differently from the market portfolio, on a risk-adjusted basis, over the 1970-1993 period and whether REIT performance varies over time.	Returns and risk	Evaluate the long term performance of REITs and stability over time and investigate the sensitivity of Jensec index.	Characteristics : In today's illiquid real estate market, REITs have attracted more and more attention as a liquid real estate investment vehicle, even from institutional investors such as pension funds. Determine whether outcomes of REIT performance studies are sensitive to the choice of performance benchmarks and REIT samples	REITs are important vehicles in direct real estate ownership. Because such a high level of both resources and knowledge is required, REITs do not require the large and long term financial commitment typical of direct real estate investment. The ownership of most REITs can be easily transferred with very low transaction costs, since shares of most REIT stocks are publicly traded. REITs provide a mechanism to pool resources of private investors to gain the economic benefits of commercial real estate.	Unlike the apparently superior performance of unsecuritized real estate, most researchers' findings on REITs' performance, especially equity REITs, have been mixed, relative to the stock market portfolio. Other studies found that the performance of REIT stocks was worse than, or comparable to, the market portfolio; others found REITs outperformed the stock market and the debate over REIT performance continues.	REIT performance varied over time. This study found that the use of unrepresentative S&P 500 index as a performance benchmark tends to overstate REIT performance. The inconclusive findings are not a surprise, due to the short sample periods used in the previous studies for an industry prone to boom and bust. The S&P 500 index, which contains large capitalization stocks, has been used as the performance benchmark for the majority of previous studies, even though REITs are small capitalisations.	
Norman E.J, Sirmans GS, Benjamin JD	Historical Environment of Real Estate Returns Journal of Real Estate Portfolio Management Vol No		Returns and risk	Comprehensive review of the existing literature		A review of the extensive existing literature reveals that comparisons of nominal real estate returns on other assets has produced mixed results.	Most studies show that provide a comparison show that real estate has higher absolute returns than debt (such as bonds). The performance of real estate, in comparison to common stocks, is mixed. When comparing general real estate returns with returns from stocks or bonds, most studies agree that trends in returns from both groups are not consistent.	Slightly more than half of the studies that provide a direct comparison show a higher average return for stocks than for real estate. Some research demonstrated that real estate investments have outperformed debt and other fixed income securities, while other research finds that common stocks have outperformed real estate investments. On a risk-adjusted basis, most of the literature shows that real estate investments have a higher return per unit of risk than common stocks. When absolute risk of the investment is analyzed, the results are nonconclusive. Several studies show that actual returns from real estate outperform returns from other investments, such as stocks and bonds.	
Norman E.J, Sirmans GS, Benjamin JD	Historical Environment of Real Estate Returns Journal of Real Estate Portfolio Management Vol No		Returns and risk				When comparing general real estate returns with returns from stocks or bonds, most studies agree that trends in returns from both groups are not consistent.	Several studies show that actual returns from real estate outperform returns from other investments, such as stocks and bonds.	
Lee S	When does real estate improve portfolio performance, University of Reading, Centre for Real Estate Research, Reading	Adding direct real estate to the other asset should result in lower portfolio risk especially on the downside	Smoothing	Adding a direct real estate holding of 5 to 20% to asset classes and calculating the risk the return of the resultant portfolio in the 4 quadrants. Calculate the overall average return and two measures of risk, standard deviation and semi-standard deviation, a measure of downside risk.				Adding real estate direct real estate to another asset class would probably lower overall returns, but may increase increase returns when it is most needed when the alternative asset shows negative returns. The most benefit comes when the asset class shows negative returns, as expected. When holding 20% in direct real estate to an equity portfolio, when equities have negative returns and direct real estate is showing positive performance, the gain (reduction in risk loss) in return is 36.9%... Even in worst cases when both markets are showing negative returns there is a reduction in the loss for the portfolio of 12.4%. Direct real estate reduces the upside potential of asset classes but compensates the investor by reducing the risk.	
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance, Volume 6 no 3 pp 60-83 1995	Reconsider "Case for real estate in a multi-asset portfolio"	Returns and risk	Summary of statistics Expected return of portfolio, standard deviation and parameters from 1971-1993(22 years)	Extreme results may arise when such an optimizing model is applied to a multi-asset portfolio including property, with some assets taking zero weights while others have large allocations		Potential contribution to diversification that real estate can provide. Risk return characteristics		
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance, Volume 6 no 3 pp 60-83 1995		Smoothing	Smoothed property returns (unconstrained) 3 asset classes. Maximum return, maximum risk portfolio places all of the portfolio in equities. Property rapidly appears appears in the mix, rising to a maximum of 70.5 at the minimum-risk end of the frontier. Along most of the frontier, the portfolio consists of only real estate and stocks, until bond replace stocks at the low risk end of the frontier	1. Unrealistic results stem from the fact that, most measures of property return are appraisal rather than market based, the volatility of property returns has been considerably understated. The case for property is therefore needs to be reassessed with more acceptable data in a more representative context	The case for real estate can be made better by the application of representative constraints on asset weight and by adjusting the property data series to compensate for appraisal bias.		Property seems to have desirable low risk as measured by standard deviation. The level of risk is lower than the mean return. This contrast with the market-based returns of equities and bonds and provides first indication that property are not actual market returns. The addition of cash alters the situation. Cash takes the position of property and property moves down to the position of bonds in 3 asset portfolio. The resultant efficient frontiers are unrealistic and academic. It is unlikely that an institution will invest 82%	Comment on discount to premium to NAV. Smoothing variant not defined
Chatrath A, Lian Y	Reits and Inflation: Along -Run perspective () Journal of Real Estate Research Vol no		Securitized			The evidence from unsecuritized real estate has been far more favourable. Rubens find that residential, commercial and farmland real estate provide at least partial hedges against inflation.	Inflation decomposition technique allow for a stochastic trend component in the inflation proxies	Prior findings	
Chatrath A, Lian Y	Reits and Inflation: Along -Run perspective () Journal of Real Estate Research Vol no		Securitized	Adds the two (problem) and also extend prior studies by conducting standard regression tests on the short-run relationship between REIT returns and the permanent and temporary components of inflation	Smoothing bias causes the divergence between REITs and unsecuritized real estate or could it also be the result of the behaviour of REITs themselves. It is now well documented that REITs have a substantial stock market component, and stock returns have tended to be negatively related to the rate of inflation	The evidence from unsecuritized real estate has been far more favourable. Rubens find that residential, commercial and farmland real estate provide at least partial hedges against inflation.	Inflation decomposition technique allow for a stochastic trend component in the inflation proxies		
Gold RB	Why the efficient frontier for real estate is fuzzy Journal of Real Estate Portfolio Management		Securitized		While stocks are constantly marked to market expectations for future equity real estate are normally derived from a limited dataset. Second, transaction times, while extremely short in the stock and bond markets, can be exorbitantly long for direct real estate. In a mixed portfolio, transaction times can have a significant impact on expected returns. Institutional investors need to be convinced that expected shifts in risks and returns are permanent, not transitory				
Lee S	The return due to diversification of real estate to US mixed asset portfolio: A paper presented to the 10th Annual European Real Estate Society, 2003		Smoothing	Data desmoothed			A mixed-asset portfolio was constructed, without real estate and its compound return, contribution return and RDD calculated. The weightings are selected to represent a typical institutional portfolio.		

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Hoesli M and Hamelink F	The maximum drawdown as a risk measure:The Role of Real Estate in the optimal portfolio revisited University of Geneva		Smoothing	While research is divided as to whether smoothing bias exist and whether it can be appropriately corrected, it seems that the issue is more of concern when comparing direct real estate with market based securities. Geltner desmoothing applied.				Direct real estate shows the lowest risk. The correlation between the three assets and real estate are all zero and significantly lower than between bonds and equities. Consequently adding direct real estate to these assets should significantly reduce portfolio risk	There is no desmoothing process that is perfect and the choice of method may bias the results
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance, Volume 6 no 3 pp 60-83 1995		Smoothing	Results using desmoothed	The errors accumulate than cancel one another. The expected return of the efficient frontier portfolio is overstated, while its risk is understated. 2ndly efficient portfolios risk and return misestimated, but this will be the wrong portfolio. Impose upper and lower bounds on the proportion of the portfolio allocated to any single asset, as would be expected in a real world situation			As theta is increased, the risk of property, measured by the standard deviation increases considerably, more than doubling in value from the smoothed case. Property now significantly positively correlated with equities and bonds, although less significant between bonds and equities. This indicates that property would still remain attractive in the MPT optimizer	BS has an intuitive appeal, in that returns are shrunk towards an asset class global mean, implying less dependence on the specific national returns.
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva		Smoothing	Returns are smoothed, unlike many studies. Total returns are reconstructed by adding the actual income return to the desmoothed data		For international real estate, exchange rate changes are discussed. Consider unhedged and hedged returns		In Sweden and the Netherlands, real estate stocks exhibit a lower return than cash, while their standard deviation is quite high. In France, the return on real estate stocks is only marginally higher than that on cash. In the US and UK, the return on real estate securities lies between that of stocks and bonds, but the standard deviation of securities real estate is higher than that of common stocks. Switzerland is the only country in which mean-variance efficiency is not violated, the standard deviation on real estate stocks lies between that of stocks and bonds, but the indirect real estate return is only marginally higher than that on bonds. Australia the return and risk parameters of real estate securities are favourable: the return is higher than stocks, while standard deviation lies between that of bonds and stocks. UK and Netherlands exhibit lower return than bonds, but a higher return than cash	
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva		Smoothing	BS estimators are performed for various levels of standard deviation for direct real estate. Four levels of standard deviation are considered. Compute the distance between the standard deviation of real estate with raw returns and standard deviation of desmoothed.				When real estate securities are compared to the desmoothed direct real estate investments, the levels of risk appear quite comparable in 5 of the 7. US and UK, the standard deviation of indirect real estate is substantially higher than that of desmoothed real estate data.	
Lee S	When does real estate improve portfolio performance, University of Reading, Centre for Real Estate Research, Reading		Smoothing	While research is divided as to whether smoothing bias exist and whether it can be appropriately corrected, it seems that the issue is more of concern when comparing direct real estate with market based securities. Geltner desmoothing applied.				Direct real estate shows the lowest risk. The correlation between the three assets and real estate are all zero and significantly lower than between bonds and equities. Consequently adding direct real estate to these assets should significantly reduce portfolio risk	There is no desmoothing process that is perfect and the choice of method may bias the results
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance, Volume 6 no 3 pp 60-83 1995		Smoothing	Appraisal-based data, Smoothed property returns (constraint) Property limited to not more than 20% . Viable for asset class, stocks between 40-60%, range of UK pension holding for the last 25 years. And next, cash is constraint at 6%.				Property because of risk/return characteristics, rapidly rises to constrained maximum, equities remain constant, but fall from constrained maximum to the constrained minimum. Bonds unconstrained strats from 40% falls rapidly as property rises to maximum and rise to 40%. Property because of risk/return characteristics, rapidly rises to constrained maximum, equities remain constant, but fall from constrained maximum to the constrained minimum. Bonds unconstrained strats from 40% falls rapidly as property rises to maximum and rise to 40%.	Constraining: what's the ideal world is unknown as a result of market imperfections
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance, Volume 6 no 3 pp 60-83 1995		Smoothing	Appraisal-based data, Smoothed property returns (constraint) Property limited to not more than 20% . Viable for asset class, stocks between 40-60%, range of UK pension holding for the last 25 years. And next, cash is constraint at 6%. Appraisal data leads to smoothing in the return series, and to an understatement of the true risk. Desmoothing result in poorer risk/return attributes and therefore lower weight to property even in unconstrained portfolio	The consequence is an overallocation to property relative to other asset classes. Approaches to removing smoothing are considered		Summary of statistics for the various asset classes	It should be noted that the risk/return characteristics of the constrained portfolio are markedly different when compared with the unconstrained case. The minimum variance is higher by 62 bpts, although the risk is considerably higher at 9.16%, compared with 2.45% for the unconstrained, a rise of 670 bpts.	Research report focuses on appraisal data
Kuhle JL	Portfolio Diversification and Return Benefits - Common Stocks vs REITs Journal of Real Estate Vol No	The portfolio risk level, measured by portfolio SD, for equity real and mortgage REIT portfolios is not significantly lower than the risk level for common portfolios.	Total portfolio Risk	Overall performance of portfolios is determined by a return/risk ratio. The various ratios are then tested for each category to determine if significant differences exist. The research consists of ex-post monthly prices and dividends for a total of 82 firms. Period under review 1980 -1985. Monthly return values were then used to create portfolios of various size within five portfolio categories. 1. Equity REIT portfolios 2. Mortgage REIT portfolios 3. Common Stocks portfolios 4. Mixed portfolios of equity REITs and Common Stock 5. Mixed portfolios of mortgage REITs and common stock. Within each category, a total of 600 portfolios were created containing various levels of assets. 50 random portfolios were created containing 12 assets of each and portfolios were equally weighted. SD was also calculated on the basis of equal weighting			The effects of portfolio diversification on risk was analyzed. The amount of total risk reduction occurring for the five portfolio asset categories when the total number of assets in the portfolios are increased from one to twelve. The results suggest that as the total assets in various portfolios are increased, a substantial reduction in risk results.	The amount of total portfolio risk reduction occurring for the five portfolio asset categories when the total number of assets are increased from one to twelve. The results suggest that as the total assets in various portfolios are increased, a substantial reduction in risk results. The absolute magnitude of SD for REITs is less than that for common stocks. Mixed-asset categories (number of REIT asset included in portfolio ranges from 1 to 11). The magnitude of the portfolio SD can be significantly reduced by including REIT stocks in portfolios of common stock. In addition, the magnitude in risk reduction is greater for mixed portfolios of common stock plus equity REITs than for mixed portfolios of common stock and mortgage REITs	

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Kuhle JL	Portfolio Diversification and Return Benefits - Common Stocks vs REITs Journal of Real Estate Vol No		Total portfolio Risk	The Z test was used to determine the statistical difference between various portfolio categories. 95% confidence was selected in calculating a critical value of 1.64 .				At an alpha level of 5%, the hypothesis will be rejected if the Z score registers above 1.64The calculated Z score are all above 1.64. The implication, under assumptions of normal distribution, is that risk levels of common stocks portfolios are substantially higher than the risk levels of equity and mortgage REIT portfolios. Therefore, these results suggest that a typical investor might be better off holding portfolios comprised of equity REITs rather than portfolios of common stocks	
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva		Total portfolio risk	For each of the seven countries, an investigation of the impact of including direct domestic real estate in portfolios containing financial assets and real estate. The impact is measured by the reduction in risk that results from including domestic real estate. Weight allocated is analysed.				When BS model applied, domestic real estate returns appear negatively correlated to bonds except Netherlands. A negative relation is also found between domestic real estate and international bonds, except for Netherlands and Switzerland where the relationship is positive. In contrast, real estate appear negatively correlated with both domestic and global stocks. The only exception is Australia where correlation is negative	BS has an intuitive appeal, in that returns are shrunk towards an asset class global mean, implying less dependence on the specific national returns.

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Gold RB	Why the efficient frontier for real estate is fuzzy Journal of Real Estate Portfolio Management	Adding direct real estate to the other asset should result in lower portfolio risk especially on the downside	Bootstrapping	Rather than dealing with the difficulty associated with of using MPT-based asset allocation models because of the associated data problems, many institutions peg real estate allocation within a mixed-asset portfolio at some constant percentage. Within real estate property type, and geographic allocation decisions are often accomplished by using even more generic approaches. To illustrate uncertainty is a factor for asset allocators, total returns for Office, retail, apartment and industrial were recreated using bootstrapping	The problem is less acute for stock and bond returns, not only because they are high-frequency, transactional based series, but because data are available for longer periods

Literature Review - Theory	Empirical Research	Findings/Conclusions	Comments
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Bootstrapping was considered the most appropriate methodology for recreating the true distribution of future returns, given limited historical private real estate data, and therefore limited volatility of the series.	Generally, the bootstrap methodology has a tendency to more evenly distribute the intra-asset weightings within a portfolio. Assets with largest weights will have their allocations reduced, while assets with the smallest weights will receive a higher allocation. A base efficient frontier is created using a sixty-month holding period with an illustrative dataset of expected property type performance and correlations		
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	Research Report/Source/Year of Review	Research Area		Research Topic
Chun GH, Sa-aadu J, Shilling JD	(2002) The role of real estate in an institutional investors portfolio revisited. Department of land economy, University of Cambridge	Asset Allocation	1	Asset Allocation
	Why Real Estate? -			
Hudson-Wilson S, Fabozzi FJ, Gordon J	An expanding role for institutional investors	Asset allocation	2	Autoregressive Moving Average
	Why Real Estate? -			
Hudson-Wilson S, Fabozzi FJ, Gordon J	An expanding role for institutional investors	Asset allocation	3	Bond nature
	Why the efficient frontier for real estate is fuzzy			
Gold RB	Journal of Real Estate Portfolio Management	Asset Allocation	4	Bootstrapping
	The return due to diversification of real estate to US mixed asset portfolio:A paper presented to the 10th Annual			
Lee S	European Real Estate Society,2003	Asset Allocation	5	CAPM
	Is there a place for property in the multi-asset portfolio			
Byrne P & Lee S	Journal of Property Finance,Volume 6 no 3 pp 60-83 1995	Asset Allocation	6	Compound Returns
	International evidence on real estate as a portfolio diversifier			
HOESLI M, Lekander J and Witkiewicz W	International Centre for Financial Management and Engineering	Asset Allocation	7	Diversification
	University of Geneva			
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier	Asset Allocation	8	Efficient frontier
	International Centre for Financial Management and Engineering			
HOESLI M, Lekander J and Witkiewicz W	University of Geneva	Asset Allocation	9	Four quadrants
	International evidence on real estate as a portfolio diversifier			
Byrne P & Lee S	Journal of Property Finance,Volume 6 no 3 pp 60-83 1995	Autoregressive Moving Average	10	Inflation hedge
	Why Real Estate? -			
Hudson-Wilson S, Fabozzi FJ, Gordon J	An expanding role for institutional investors	Bond nature	11	MaxDD
	Why the efficient frontier for real estate is fuzzy			
Gold RB	Journal of Real Estate Portfolio Management	Bootstrapping	12	MPT
	(2002) The role of real estate in an institutional investors portfolio revisited. Department of land economy, University of Cambridge			
Chun GH, Sa-aadu J, Shilling JD	The return due to diversification of real estate to US mixed asset portfolio:A paper presented to the 10th Annual	CAPM	13	Nominal rates of interest
	European Real Estate Society,2003			
Lee S	The return due to diversification of real estate to US mixed asset portfolio:A paper presented to the 10th Annual	Compound Returns	14	REIT performance
	European Real Estate Society,2003			
Lee S	The return due to diversification of real estate to US mixed asset portfolio:A paper presented to the 10th Annual	Compound Returns	15	Return and Return
	European Real Estate Society,2003			
Lee S	Why Real Estate? -	Compound returns	16	Securitized
	An expanding role for institutional investors			
Hudson-Wilson S, Fabozzi FJ, Gordon J		Diversification	17	Smoothing

Kuhle JL	Portfolio Diversification and Return Benefits - Common Stocks vs REITs	Journal of Real Estate Vol No	Diversification	18	Total portfolio Risk
	Historical Environment of Real Estate Returns				
Norman EJ, Sirmans GS, Benjamin JD	Journal of Real Estate Portfolio Management	Vol No	Diversification		
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors	International evidence on real estate as a portfolio diversifier	Efficient frontier		
HOESLI M, Lekander J and Witkiewicz W	International Centre for Financial Management and Engineering	University of Geneva	Efficient frontier		
Lee S	When does real estate improve portfolio performance, Research,Reading	University of Reading, Centre for Real Estate	Four quadrant		
	Why Real Estate? - An expanding role for institutional investors				
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors		Four quadrants		
Hudson-Wilson S, Fabozzi FJ, Gordon J	The return due to diversification of real estate to US mixed asset portfolio:A paper presented to the 10th Annual European Real Estate Society,2003		Four quadrants		
Lee S			Geltner		
Yobaccio E, Rubens JH, Ketcham DC	The inflation-hedging properties of risk assets: the case for REITS	Journal of Real Estate Research	Inflation hedge		
Yobaccio E, Rubens JH, Ketcham DC	The inflation-hedging properties of risk assets: the case for REITS	Journal of Real Estate Research	Inflation hedge		
Yobaccio E, Rubens JH, Ketcham DC	The inflation-hedging properties of risk assets: the case for REITS	Journal of Real Estate Research	Inflation hedge		
Yobaccio E, Rubens JH, Ketcham DC	The inflation-hedging properties of risk assets: the case for REITS	Journal of Real Estate Research	Inflation hedge		
Yobaccio E, Rubens JH, Ketcham DC	The inflation-hedging properties of risk assets: the case for REITS	Journal of Real Estate Research	Inflation hedge		
Yobaccio E, Rubens JH, Ketcham DC	Reits and Inflation: Along -Run perspective ()	Journal of Real Estate Research	Inflation hedge		
Chatrath A, Lian Y	Research Vol no		Inflation hedge		
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors		Inflation hedge		
	Why Real Estate? - An expanding role for institutional investors				
Hudson-Wilson S, Fabozzi FJ, Gordon J	The effect if Interest-Rate Movements on REITs		Inflation hedge		
Mueller GR, Pauley KR	The inflation-hedging effectiveness of real estate. The Journal of Real Estate Research	Vol No	Inflation hedging		
Rubens JH, Bond MT, Webb JR	The inflation-hedging effectiveness of real estate. The Journal of Real Estate Research	Vol No	Inflation hedging		
Rubens JH, Bond MT, Webb JR	The inflation-hedging effectiveness of real estate. The Journal of Real Estate Research	Vol No	Inflation hedging		
Rubens JH, Bond MT, Webb JR	The inflation-hedging effectiveness of real estate. The Journal of Real Estate Research	Vol No	Inflation hedging		

Mueller GR, Pauley KR	The effect if Interest-Rate Movements on REITs	Interest rates
Chun GH, Sa-aadu J, Shilling JD	(2002) The role of real estate in an institutional investors portfolio revisited. Department of land economy, University of Cambridge	low consumption
Hoesli M and Hamelink F	The maximum drawdown as a risk measure:The Role of Real Estate in the optimal portfolio revisited University of Geneva	MaxDD
Hoesli M and Hamelink F	The maximum drawdown as a risk measure:The Role of Real Estate in the optimal portfolio revisited University of Geneva	MaxDD
Hoesli M and Hamelink F	The maximum drawdown as a risk measure:The Role of Real Estate in the optimal portfolio revisited University of Geneva	MaxDD
Fraser WD, Leishman C, Tabert H	The long-run diversification attributes of commercial property (2004) Journal of Property Investments Vol 20 no 2	MPT
Gold RB	Why the efficient frontier for real estate is fuzzy Journal of Real Estate Portfolio Management	MPT
Lee S	When does real estate improve portfolio performance, University of Reading, Centre for Real Estate Research,Reading	MPT
Lee S	When does real estate improve portfolio performance, University of Reading, Centre for Real Estate Research,Reading	MPT
Lee S	The return due to diversification of real estate to US mixed asset portfolio:A paper presented to the 10th Annual European Real Estate Society,2003	MPT
Yobaccio E, Rubens JH, Ketcham DC	The inflation-hedging properties of risk assets: the case for REITS Journal of Real Estate Research	Nominal rates of interest
Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995	REIT performance
Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995	REIT performance
Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995	REIT performance
Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995	REIT performance
Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995	REIT performance

		Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995	REIT performance
Han J, Liang Y		International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva	
HOESLI M, Lekander J and Witkiewicz W		Why the efficient frontier for real estate is fuzzy Journal of Real Estate Portfolio Management	Return and Return
Gold RB			Returns and risk
		Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995	Returns and risk
Han J, Liang Y		Historical Environment of Real Estate Returns Journal of Real Estate Portfolio Management Vol No	Returns and risk
Norman EJ, Sirmans GS, Benjamin JD		Historical Environment of Real Estate Returns Journal of Real Estate Portfolio Management Vol No	Returns and risk
Norman EJ, Sirmans GS, Benjamin JD			Returns and risk
		When does real estate improve portfolio performance, University of Reading, Centre for Real Estate Research, Reading	Returns and risk
Lee S		Is there a place for property in the multi-asset portfolio Journal of Property Finance, Volume 6 no 3 pp 60-83 1995	Returns and risk
Byrne P & Lee S		Is there a place for property in the multi-asset portfolio Journal of Property Finance, Volume 6 no 3 pp 60-83 1995	Returns and risk
Byrne P & Lee S		The maximum drawdown as a risk measure: The Role of Real Estate in the optimal portfolio revisited University of Geneva	Risk and Return
Hoesli M and Hamelink F		Reits and Inflation: Along -Run perspective () Journal of Real Estate Research Vol no	Securitized
Chatrath A, Lian Y		Reits and Inflation: Along -Run perspective () Journal of Real Estate Research Vol no	Securitized
Chatrath A, Lian Y		Why the efficient frontier for real estate is fuzzy Journal of Real Estate Portfolio Management	Securitized
Gold RB		The maximum drawdown as a risk measure: The Role of Real Estate in the optimal portfolio revisited University of Geneva	Smoothing
Hoesli M and Hamelink F		Is there a place for property in the multi-asset portfolio Journal of Property Finance, Volume 6 no 3 pp 60-83 1995	Smoothing
Byrne P & Lee S		International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva	Smoothing
HOESLI M, Lekander J and Witkiewicz W			Smoothing

HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva	Smoothing
Lee S	When does real estate improve portfolio performance, University of Reading, Centre for Real Estate Research,Reading	Smoothing
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance,Volume 6 no 3 pp 60-83 1995	Smoothing
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance,Volume 6 no 3 pp 60-83 1995	Smoothing
Lee S	The return due to diversification of real estate to US mixed asset portfolio:A paper presented to the 10th Annual European Real Estate Society,2003	Smoothing
Kuhle JL	Portfolio Diversification and Return Benefits - Common Stocks vs REITs Journal of Real Estate Vol No	Total portfolio Risk
Kuhle JL	Portfolio Diversification and Return Benefits - Common Stocks vs REITs Journal of Real Estate Vol No	Total portfolio Risk
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva	Total portfolio risk

Exhibit 1 Securitised versus Unsecuritised								
Author	Research Report/Source/Year of Review	Research Hypothesis	Research Area	Research Methodology	Research problem	Literature Review - Theory	Empirical Research	Findings/Conclusions
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance, Volume 6 no 3 pp 60-83 1995		Smoothing	Smoothed property returns (unconstrained) 3 asset classes. Maxi-return, max-risk portfolio places all of the portfolio in equities. Property rapidly appears in the mix, rising to a maximum of 70.5 at the minimum-risk end of the frontier. Along most of the frontier, the portfolio consist of only real estate and stocks, until bond replace stocks at the low risk end of the frontier	1.Unrealistic results stem from the fact that, most measures of property return are appraisal rather than market based, the volatility of property returns has been considerably understated. The case for property is therefore needs to be reassessed with more acceptable data in a more representative context	The case for real estate can be made better by the application of representative constraints on asset weight and by adjusting the property data series to compensate for appraisal bias.		Property seems to have desirable low risk as measured by standard deviation. The level of risk is lower than the mean return. This contrast with the market-based returns of equities and bonds and provides first indication that property are not actual market returns. The addition of cash alters the situation. Cash takes the position of property and property moves down to the position of bonds in 3 asset portfolio. The resultant efficient frontiers are unrealistic and academic. It is unlikely that an institution will invest 82%
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance, Volume 6 no 3 pp 60-83 1995		Smoothing		The errors accumulate than cancel one another. The expected return of the efficient frontier portfolio is overstated, while its risk is understated. Secondly efficient portfolios risk and return is misestimated, but this will be the wrong portfolio. Impose upper and lower bounds on the proportion of the portfolio allocated to any single asset, as would be expected in a real world situation			As theta is increased, the risk of property, measured by the standard deviation increases considerably, more than doubling in value from the smoothed case. Property now significantly positively correlated with equities and bonds, although less significant between bonds and equities. This indicates that property would still remain attractive in the MPT optimiser
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance, Volume 6 no 3 pp 60-83 1995		Results using de-smoothed	Appraisal-based data, Smoothed property returns (constraint) Property limited to not more than 20%. Viable for asset class: stocks between 40-60%, range of UK pension holding for the last 25 years. And next, cash is constraint at 6%. Appraisal data leads to smoothing in the return series, and to an understatement of the true risk. De-smoothing result in poorer risk/return attributes and therefore lower weight to property even in unconstrained portfolio	The consequence is an over-allocation to property relative to other asset classes. Approaches to removing smoothing are considered		Summary of statistics for the various asset classes	Property because of risk/return characteristics, rapidly rises to constrained maximum, equities remain constant, but fall from constrained maximum to the constrained minimum. Bonds unconstrained starts from 40% falls rapidly as property rises to maximum and rise to 40%.Property because of risk/return characteristics, rapidly rises to constrained maximum, equities remain constant, but fall from constrained maximum to the constrained minimum. Bonds unconstrained starts from 40% falls rapidly as property rises to maximum and rise to 40%.It should be noted that the risk/return characteristics of the constrained portfolio are markedly different when compared with the unconstrained case. The minimum variance is higher by 62 basis points, although the risk is considerably higher at 9.16%, compared with 2.45% for the unconstrained, a rise of 670 basis points.
Chatrath A, Lian Y	Reits and Inflation: Along -Run perspective Journal of Real Estate Research Vol. 16 no 3, pp 311-326, 1998		Securitised	Extend prior studies by conducting standard regression tests on the short-run relationship between REIT returns and the permanent and temporary components of inflation		The evidence from unsecuritized real estate has been far more favourable. Rubens find that residential, commercial and farmland real estate provide at least partial hedges against inflation.	Inflation decomposition technique allow for a stochastic trend component in the inflation proxies	Smoothing bias causes the divergence between REITs and unsecuritized real estate or could it also be the result of the behaviour of REITs themselves. It is now well documented that REITs have a substantial stock market component, and stock returns have tended to be negatively related to the rate of inflation
Gold RB	Why the efficient frontier for real estate is fuzzy Journal of Real Estate Portfolio Management Vol. 1 no1 , pp 59-66, 1995	Adding direct real estate to the other asset should result in lower portfolio risk especially on the downside	Securitized	Rather than dealing with the difficulty associated with of using MPT-based asset allocation models because of the associated data problems, many institutions peg real estate allocation within a mixed-asset portfolio at some constant percentage. Within real estate property type, and geographic allocation decisions are often accomplished by using even more generic approaches. To illustrate uncertainty is a factor for asset allocates, total returns for Office, retail, apartment and industrial were recreated using bootstrapping	The problem is less acute for stock and bond returns, not only because they are high-frequency, transactional based series, but because data are available for longer periods	Bootstrapping was considered the most appropriate methodology for recreating the true distribution of future returns, given limited historical private real estate data, and therefore limited volatility of the series.	Generally, the bootstrap methodology has a tendency to more evenly distribute the intra-asset weightings within a portfolio. Assets with largest weights will have their allocations reduced, while assets with the smallest weights will receive a higher allocation. A base efficient frontier is created using a sixty-month holding period with an illustrative dataset of expected property type performance and correlation's	While stocks are constantly marked to market expectations for future equity real estate are normally derived from a limited dataset. Second, transaction times, while extremely short in the stock and bond markets, can be excruciatingly long for direct real estate. In a mixed portfolio, transaction times can have a significant impact on expected returns. Institutional investors need to be convinced that expected shifts in risks and returns are permanent, not transitory
Hoesli M and Hamelink F	The maximum drawdown as a risk measure :The Role of Real Estate in the optimal portfolio revisited International Centre for Financial Management and Engineering University of Geneva, 2003		Smoothing	While research is divided as to whether smoothing bias exist and whether it can be appropriately corrected, it seems that the issue is more of concern when comparing direct real estate with market based securities .Geltner de-smoothing applied.				Direct real estate shows the lowest risk. The correlation between the three assets and real estate are all zero and significantly lower than between bonds and equities. Consequently adding direct real estate to these assets should significantly reduce portfolio risk

Exhibit 1 Securitised versus Unsecuritised

Author	Research Report/Source/Year of Review	Research Hypothesis	Research Area	Research Methodology	Research problem	Literature Review - Theory	Empirical Research	Findings/Conclusions
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva, 2003		Smoothing	Bayes-Stein (BS) estimators are performed for various levels of standard deviation for direct real estate. Four levels of standard deviation are considered. Compute the distance between the standard deviation of real estate with raw returns and standard deviation of de-smoothed. estimators are performed for various levels of standard deviation for direct real estate. Four levels of standard deviation are considered. Compute the distance between the standard deviation of real estate with raw returns and standard deviation of desmoothed.				When real estate securities are compared to the desmoothed direct real estate investments, the levels of risk appear quite comparable in 5 of the 7. US and UK, the standard deviation of indirect real estate is substantially higher than that of desmoothed real estate data.
Mueller AG, Muller GR	Public and Private Real Estate in a mixed-asset portfolio Journal of Real Estate Portfolio Management Vol. 10 no 3, pp 193-203, 2003		Smoothing	The efficient frontiers of a portfolio with normal returns was then compared to unsmoothed private real estate. Returns are smoothed, unlike many studies. Total returns are reconstructed by adding the actual income return to the desmoothed data	Many investors believe that appraisal based private real estate provides an inaccurate estimate of return volatility due to the smoothing of returns.	Geltner developed an unsmoothing process that takes into account of the stale appraisal lag and auto-correlations problems.		Smoothed or unsmoothed private real estate offers lower volatility for the portfolio than bonds. Private real estate fall at the low end of the risk/return portfolio mix all the time frames, while public real estate end up in the mid and upper range of efficient frontier. Real estate have very low correlation's, and the inclusion of both public and private together in a mixed-asset portfolio produces a more efficient frontier.
Norman EJ, Sirmans GS, Benjamin JD	Historical Environment of Real Estate Returns Journal of Real Estate Portfolio Management Vol. No		Smoothing		To avoid the problem of return smoothing due to use of appraised values, some studies employ REIT's. A problem normally arises when using REIT returns to measure real estate problems. During some time periods, REIT yields may vary from actual underlying property yields. In the early 1970s for example, REITs had low returns, while returns on the underlying properties was high. The differences may be the result from high inflation, which increases the tax shelter benefit of investor-owned. Other factors such as leverage and confidence on management ability to contribute to divergence. Several problems associated with using REIT returns can distort homogeneity of the portfolio because they usually have varying degrees of leverage.	Portfolio risk falls when real estate is included. The allocation of real estate holdings in the optimal portfolio varies throughout the research, appearing to be based on such factors as the tax rate of investors, the risk assumptions, and time periods examined. For example , over along time period from 1947-1983, Webb et al find an optimal of portfolio weights about two thirds in real estate. Over shorter periods, Irwin and Landa find that real estate comprised 20% of minimum variance. In contrast, for even more recent times, 1980-89, Ennis and Burik find the optimal to contain 10-20% of total assets in real estate	Diversification benefits of real estate and the allocation of real estate in an optimal mixed-asset portfolio are a subject of studies summarised. There is clear consensus that diversification with real estate provides enhanced investment returns.	

Exhibit 2 Real Estate Allocation and diversification

Author	Research Report/Source/Year of Review	Research Hypothesis	Research Area	Research Methodology	Research problem	Literature Review - Theory	Empirical Research	Findings/Conclusions
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance, Volume 6 no 3 pp 60-83 1995		Asset Allocation			Strategic Asset Allocation: which studies have shown is the main determinant of portfolio returns, rather than stock selection. Consideration of the data series for property has shown the data are smoothed by the appraisal process, and true volatility is disguised. De-smoothing these series forces the volatility upwards.		Property still has a place in a multi-asset portfolio, although it is significantly less than in previous studies, using appraisal based returns. Using a properly constrained approach, there can still be allocation to property higher than current actual holdings. Reaffirms a case of property based on more discriminating assessment of de-smoothing and MPT effects.
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance, Volume 6 no 3 pp 60-83 1995		Returns and risk	Smoothed property returns (unconstrained) 3 asset classes. Maxi-return, max-risk portfolio places all of the portfolio in equities. Property rapidly appears in the mix, rising to a maximum of 70.5 at the minimum-risk end of the frontier. Along most of the frontier, the portfolio consist of only real estate and stocks, until bond replace stocks at the low risk end of the frontier	1.Unrealistic results stem from the fact that, most measures of property return are appraisal rather than market based, the volatility of property returns has been considerably understated. The case for property is therefore needs to be reassessed with more acceptable data in a more representative context	The case for real estate can be made better by the application of representative constraints on asset weight and by adjusting the property data series to compensate for appraisal bias.		Property seems to have desirable low risk as measured by standard deviation. The level of risk is lower than the mean return. This contrast with the market-based returns of equities and bonds and provides first indication that property are not actual market returns. The addition of cash alters the situation. Cash takes the position of property and property moves down to the position of bonds in 3 asset portfolio. The resultant efficient frontiers are unrealistic and academic. It is unlikely that an institution will invest 82%
Chun GH, Saadad J, Shilling JD	The role of real estate in an institutional investors portfolio revisited. Department of land economy, University of Cambridge 2002	Are institutional investors under-invested in real estate securities	Asset Allocation	Capital stock estimates that commercial real estate represents only \$1.5 trillion, or between 3.5-4% inevitable wealth in the US	All available data show that institutional investors hold between 3.5 - 4% of their assets in real estate.		Studies suggest that institutional investors should invest between 15-20% of their assets in real estate. Even with real estate imperfections such as indivisibility, the optimal suggested for real estate in a mixed asset is 9%. A view is taken that institutional investors may not simply rank portfolios according to mean and variance	Real estate diversification pays off at the time the benefits are most needed (consumption growth low - not true for bonds), and that institutional investors can hold real estate for very long periods of time despite illiquidity.
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva, no 70, 2003.		Efficient frontier	use Bayes-Stein which should increase the stability of portfolio composition, instead of portfolio allocation models		Means are usually shrunk towards are common value (the common mean, i.e. the mean across all assets considered. Diversification benefits are more likely to accrue from reduction in risk, rather than gains in averages returns		Real estate returns are (lowly) positively (or negatively) correlated to those of stocks and bonds and 15-30% should be allocated to real estate
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva, no 70, 2003.	Benefits of including real estate assets- both domestic and international - in mixed-asset portfolio	Asset Allocation	Data from seven countries on three continents are considered for a common period of 1987-2001		Real estate as portfolio diversifier- Chaundry, Myer and Webb. Used co-integration techniques and found that there is an inverse long-run relationship with real estate.	Data pertaining to stocks, bonds, direct real estate, real estate securities and cash for the U.S., U.K., France, Netherlands, Sweden, Switzerland and Australia	Optimal weight allocated to real estate, with unlevered returns, is in the 5%-15% and inclusion of real estate assets leads to a 5-10% reduction in the portfolio standard deviation
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva, n 70, 2003.	Whether the optimal which should be allocated to domestic real estate in mixed-asset portfolios is robust across countries	Asset Allocation	Appraisal-based indices are corrected for desmoothing using a variant of the method devised by Geltner. Use average of the standard deviation for stocks and bonds, instead of the normal assumption of real estate standard deviation being half of equities. Use average of the standard deviation for stocks and bonds, instead of the normal assumption of real estate standard deviation being half of equities	Institutional investors allocate substantially lower weight to real estate than that reported in literature	Recent studies, have argued that the actual weight is in line when measured from an asset/liability framework or when imperfections such as indivisible assets and no short sales	Compile summary of statistics	Inclusion of international real estate, the risk reduction is increased to 10-20%. Optimal is constant across countries at approx 15%
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors. Journal of Portfolio Management Special Issue Sept 2003		Four quadrants	True value of real estate asset class is determined by the behaviours of all four quadrants, a combined performance is adopted, i.e. time series of capitalisation-weighted performance of real estate in all the quadrants.		At the other extreme, an equity position in an empty, speculative, multi-tenanted property is driven almost entirely by equity forces. The value of the building is a function of supply and demand for space in that market, at that particular time. As the buildings becomes more fully leased, it changes from "pure" equity to a debt-equity hybrid, and perhaps - if fully leased to a long-term tenants - becomes very debt-like.		The private mortgage quadrant shows significant volatility during the high inflation/tight money era prior to 1986, but has since settled down. The CMBS market, not measured before 1984 because the quadrant did not exist, the volatility shows volatility little different from that of the mortgage era. Appraisal-based private equity is the least volatile. Volatility is understated, while appraisals may lag, they eventually do capture the true range of performance of individual real estate assets

Exhibit 2 Real Estate Allocation and diversification								
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors. Journal of Portfolio Management Special Issue Sept 2003		Four quadrants	Using four quadrant real estate index, calculate the optimal allocation for real estate in a mixed asset class portfolio of stocks, bonds and cash and calculate the mean returns, standard deviation and correlation's Quarterly returns from 1987 - 2000				The correlation's between real estate and stocks of 0.065, real estate and bonds of 0.34 , and real estate and cash of 0.259 suggest that real estate can play a significant role in a mixed-portfolio. Whenever two imperfectly related assets (correlation coefficient less than 1.0) are placed together in a portfolio, an opportunity exists to earn a greater return at each level of risk (or reduce the risk for a given level of return). In summary, when the return to an asset class is high enough, the risk is low enough, and or the correlation reflects a sufficiently different pattern of returns, the asset class earns place in the portfolio for at least a portion of return/risk premium spectrum. Real estate meets these tests and is therefore a component of the well diversified mixed asset portfolios.
Kuhle JL	Portfolio Diversification and Return Benefits - Common Stocks vs REITs Journal of Real Estate Vol. 2 No 2, pp 1-9,1987	Diversification benefits can be obtained by using real estate assets to create well-diversified portfolios .The portfolio risk level, measured by portfolio SD, for equity real and mortgage REIT portfolios is not significantly lower than the risk level for common portfolios.	Diversification	Monthly 5 year returns to examine the effects of diversification on the reduction of total portfolio risk in a REIT and mixed-portfolio. Overall performance of portfolios is determined by a return/risk ratio. The various ratios are then tested for each category to determine if significant differences exist. The research consists of ex-post monthly prices and dividends for a total of 82 firms. Period under review 1980 -1985.Monthly return values were then used to create portfolios of various size within five portfolio categories. 1. Equity 2. REIT portfolios 3. Mortgage REIT portfolios 4. Common Stocks 5. Mixed portfolios of mortgage REITs and common stock. Within each category, a total of 600 portfolios were created containing various levels of assets. 50 random portfolios	When does a holding in direct real estate contribute this increase in portfolio performance	Increased securitisation has lead to application of traditional portfolio theory. Markowitz analysis is employed to examine the risk and return potential of portfolios comprised of REITs only and REITs combined with common stocks.	Means and standard deviations are calculated to provide relative comparisons and correlation's then calculated. The asset with the lowest correlation would usually be a good candidate for risk reduction in portfolio through increased diversification.	The amount of total portfolio risk reduction occurring for the five portfolio asset categories when the total number of assets are increased from one to twelve. The results suggest that as the total assets in various portfolios are increased, substantial reduction in risk results. The absolute magnitude of SD for REITs is less than that for common stocks .Mixed-asset categories (number of REIT asset included in portfolio ranges from 1 to 11). The magnitude of the portfolio SD can be significantly reduced by including REIT stocks in portfolios of common stock.In addition, the magnitude in risk reduction is greater for mixed portfolios of common stock plus equity REITs than for mixed portfolios of common stock and mortgage REITs
Lee S	The return due to diversification of real estate to US mixed asset portfolio paper presented to the 10th Annual European Real Estate Society, 2003		Asset Allocation				Re-allocation done in 4 ways: 1. Holding in real estate is replaced by the same % in the large cap, 2 % allocated to real estate replaced the same proportion in bonds, 3 real estate replaced small cap and holding equally split between large cap and bonds.	Real estate generally offer increase RDD to the mixed portfolio. However the benefits depend upon which asset is replaced and the percentage allocation to real estate.
Lee S	The return due to diversification of real estate to US mixed asset portfolio paper presented to the 10th Annual European Real Estate Society,2003	Real estate should be included in a mixed portfolio because of the effect compound returns	Compound Returns	Adding real estate in portfolio to an existing mixed-asset portfolios increases the compound return and so the terminal wealth. Return due to diversification (RDD) is the difference between the compound return and the weighted average returns Terminal Wealth.	Including real estate in the mixed-portfolios based on diversification benefits than on it's contribution to the return of the portfolio	Booth and Fama show that although the compound return of an investment is an increasing function of its expected return, it is also a decreasing function of its risk. In other words, investments with higher expected returns and high risks do not necessarily provide higher compound returns to portfolio, than investments with lower expected returns and lower risks. Booth and Fama shown that the compound returns of a portfolio is greater than the weighted average of the individual compound return of the investments. The result stems from the fact that although variance is an appropriate measure of risk of a portfolio it is not the relevant measure of risk within the portfolio. The risk of an investment should be measured by its covariance with the portfolio. Thus, an asset with a low expected return but a low covariance may be more desirable, than an asset with higher expected return but a high covariance.	US annual returns over the period 1951- 2001. Annual returns of Direct era estate, large cap stocks, small cap stocks, government bonds and cash	A large holding of real estate in the mixed portfolio may be justifiable on its compound return enhancing effect on the mixed-asset and not simply on its risk reducing ability. The uncommonly low value of the risk of real estate data, compared with government bonds, and the presence of 1st order serial order correlation, is a common feature of commercial real estate. Nonetheless, the justification for including real estate in the mixed portfolio need to rest on its diversification benefits alone, but can be made on its contribution to the compound return or terminal wealth.
Lee S	When does real estate improve portfolio performance, University of Reading, Centre for Real Estate Research, Reading, 2003		Four quadrant	Four possible outcomes: both markets up ,both markets down, the asset is up and real estate is down, the asset is down and real estate up. Target return is required. The target is normally set to the minimum return that the investor would be willing to accept 無利 無害 無損 無益 the risk-free rate on bonds.	Too few investors appreciate the implications of the co-movement between investments that leads to correlation between assets. A breakdown of the imperfect correlation between direct real estate and the other asset classes to illustrate where the benefits originate.			By using the a four-quadrant table for each asset class, it is possible to see to what extent the investor really gains from holding direct real estate when it is most needed, i.e. where the losses in the asset class are offset by gains in direct real estate. Direct real estate mitigates the losses when both down and has limited upside. Thus if the goal is offsetting losses, then the results show that direct real estate may have been some benefit

Exhibit 2 Real Estate Allocation and diversification								
Lee S	When does real estate improve portfolio performance, University of Reading, Centre for Real Estate Research, Reading 2003	Adding direct real estate to the other asset should result in lower portfolio risk especially on the downside	Returns and risk	Adding a direct real estate holding of 5 to 20% to asset classes and calculating the risk the return of the resultant portfolio in the 4 quadrants. Calculate the overall average return and two measures of risk, standard deviation and seem-standard deviation, a measure of downside risk.				Adding real estate direct real estate to another asset class would probably lower overall returns, but may increase increase returns when it is most needed when the alternative asset shows negative returns .The most benefit comes when the asset class shows negative returns, as expected. When holding 20% in direct real estate to an equity portfolio, when equities have negative returns and direct real estate is showing positive performance, the gain (reduction in risk loss) in return is 36.9%.. Even in worst cases when both markets are showing negative returns there is a reduction in the loss for the portfolio of 12.4%. Direct real estate reduces the upside potential of asset classes but compensates the investor by reducing the risk.
Norman E.J, Sirmans GS, Benjamin JD	Historical Environment of Real Estate Returns Journal of Real Estate Portfolio Management Vol 1 No 1 pp 1-23, 1995.		Returns and risk	Comprehensive review of the existing literature		A review of the extensive existing literature reveals that comparisons of nominal real estate returns on other assets has produced mixed results.	Most studies show that provide a comparison show that real estate has higher absolute returns than debt (such as bonds). The performance of real estate, in comparison to common stocks, is mixed.	Slightly more than half of the studies that provide a direct comparison show a higher average return for stocks than for real estate. Some research demonstrated that real estate investments have outperformed debt and other fixed income securities, while other research finds that common stocks have outperformed real estate investments. On a risk-adjusted basis, most of the literature shows that real estate investments have a higher return per unit of risk than common stocks. When absolute risk of the investment is analysed, the results are nonconclusive. Several studies show that actual returns from real estate outperform returns from other investments, such as stocks and bonds.
Gold RB	Why the efficient frontier for real estate is fuzzy Journal of Real Estate Portfolio Management, Vol. 1 no 1, pp 59-66, 1996	MPT methodologies hides where the reduction in risk originate	Asset Allocation	Uncertainty is introduced by bootstrapping expected returns and SD in the traditional Markowitz framework. Departing from MPTs traditional approach for creating singular combinations of assets for any given level of risk-adjusted returns, this alternative helps quantify the impact of uncertainty by generating acceptable allocation ranges, rather than specific, and difficult to obtain, point estimates.	Difficulties related to both data quality and availability and have received much attention. These are perhaps overshadowed by the impact of uncertainty on the allocation process. Data limitations, as well as substantive issues regarding appraisal-based values, such as lumpiness, illiquidity and transaction costs, make the application of MPT to real estate impossible.	It is entirely possible that any two points on the efficient frontier are statistically indistinguishable from each other.	Asset allocation decisions must always reflect that their goal is to hold a portfolio that will reflect future market conditions. All explicit inputs into the asset allocation process need to be based on expectations of future returns, variability and correlation's	The results show that the efficient frontier is not singular, but fuzzy .This study illustrates that numerous statistically dissimilar weighted portfolio can be equally attractive for any given combination of expected risk and return and allocation ranges range's rather than specific targets .Introducing uncertainty into the Markowitz MPT framework helps to overcome the practical problem of balancing optimisations goals with real estate's illiquidity, transaction costs and data problems, creating bundles of portfolios to which investors are indifferent.

Author	Research Report/Source/Year of Review	Research Hypothesis	Research Area	Research Methodology
Gold RB	Why the efficient frontier for real estate is fuzzy Journal of Real Estate Portfolio Management	MPT methodologies hides where the reduction in risk originate	Asset Allocation	Uncertainty is introduced by bootstrapping expected returns and SD in the traditional Markowitz framework. Departing from MPTs traditional approach for creating singular combinations of assets for any given level of risk-adjusted returns, this alternative helps quantify the impact of uncertainty by generating acceptable allocation ranges, rather than specific, and difficult to obtain, point estimates.
Chun GH, Sa-aadu J, Shilling JD	(2002) The role of real estate in an institutional investors portfolio revisited. Department of land economy, University of Cambridge	Real estate provides a hedge against changes in variables that matter to institutional investor	CAPM	Size of US institutional investment portfolio Size of real estate market. the problem when: individual investors are price takers, information is costless, taxes and transaction costs are zero, investors are mean-variance investors

Research problem	Literature Review - Theory	Empirical Research
Difficulties related to both data quality and availability and have received much attention. These are perhaps overshadowed by the impact of uncertainty on the allocation process. Data limitations, as well as substantive issues regarding appraisal-based values, such as lumpiness, illiquidity and transaction costs, make the application of MPT to real estate impossible.	It is entirely possible that any two points on the efficient frontier are statistically indistinguishable from each other.	Asset allocation decisions must always reflect that their goal is to hold a portfolio that will reflect future market conditions. All explicit inputs into the asset allocation process need to be based on expectations of future returns, variability and correlations

	CAPM Real estate risk Lack of information Real estate provides a hedge against inflation	Theoretical literature argues that institutional are underinvested in real estate: Real estate have quite a high average returns relative to their risk. This is inconsistent with CAPM, which states that high returns are only earned as a compensation for risk
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Findings/Conclusions	Comments
The results show that the efficient frontier is not singular, but fuzzy. This study illustrates that numerous statistically dissimilar weighted portfolio can be equally attractive for any given combination of expected risk and return and allocation ranges rather than specific targets. Introducing uncertainty into the Markowitz MPT framework helps to overcome the practical problem of balancing optimization's goals with real estate's illiquidity, transaction costs and data problems, creating bundles of portfolios to which investors are indifferent.	

Exhibit 3 Returns and risk

Author	Research Report/Source/ Year of Review	Research Hypothesis	Research Area	Research Methodology	Research problem	Literature Review - Theory	Empirical Research
Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol. 10 No 3, pp 253-262, 1995	Whether REITs performed differently from the market portfolio, on a risk-adjusted basis, over the 1970-1993 period and whether REIT performance varies over time.	Returns and risk	Evaluate the long term performance of REITs and stability over time and investigate the sensitivity of Jensen index. Jensen performance measure index, is used to estimate the performance of REIT portfolios. Jensen is based on the CAPM. It compares the performance of a security or a portfolio to the standard performance benchmark, the security market line. By assuming that the CAPM holds period by period, and that returns on securities generated by the market model, Jensen derived a linear expression between the realised returns on any security and its systematic risk, the realised returns on the market portfolio, the risk-free interest rate and random error. The Jensen index is used in performance studies because it measures performance based upon a simple and realistic benchmark, a passive managed portfolio that invests in savings accounts and the stock market portfolio. A positive and significant Jensen index indicates a superior performance of a REIT portfolio relative to this portfolio (REITs outperforms), while negative is vice versa.	Characteristics : In todays' illiquid real estate market, REITs have attracted more and more attention as a liquid real estate investment vehicles, even from institutional investors such as pension funds. Determine whether outcomes of REIT performance studies are sensitive to the choice of performance benchmarks and REIT samples	REITs are important vehicles in direct real estate ownership. Because such a high level of both resources and knowledge is required, REITs do not require the large and long term financial commitment typical of direct real estate investment. The ownership of most REITs can be easily transferred with very low transaction costs, since shares of most REIT stocks are publicly traded. REITs provide a mechanism to pool resources of private investors to gain the economic benefits of commercial real estate.	Unlike the apparently superior performance of unsecuritized real estate, most researchers findings on REITs performance, especially, equity REITs, have been mixed, relative to the stock market portfolio. Other studies found that the performance of REIT stocks was worse than, or comparable to, the market portfolio, others found REITs outperformed the stock market and the debate over REIT performance continues.
Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol. 10 No 3, pp 253-262, 1995		REIT performance	8 REIT portfolios are constructed based on ex ante feasible for all equity, debt and hybrid REITs. 2 portfolios based on equally weighted and value weighted strategies are constructed. The REIT study includes 255 REIT stocks. Centre for Research Security Prices (CRSP) stock market portfolio is used. The portfolio is equally weighted and the CRSP portfolio will be used. Stability over time. Summary of mean, variance, co variance and Sharpe index is calculated. The study is broken into six year periods, 1970-1975, 1976-1981, 1982-1987, 1988-1993. They respond relatively well to the historical fluctuations of the real estate market, the boom and burst in the early 70s and recovery late 70 and expansion in the 80s and REIT tax reform in 1986. Mean returns and standard deviation for each subperiod was calculated. T-test conducted for each subperiod.	Methodological flaws from previous studies, use of unrepresentative sample periods and use of S&P index as performance benchmark. Previous studies covered short period and inferences about REITs over a short period of time presents a serious problem in a volatile industry. The problem exists because of boom burst period in the REIT history. Secondly the S&P 500 has been used as a proxy for stock market portfolio. The S&P 500 is not a representative performance benchmark because it does not include small stocks and most REITs are small cap	In the long term, it should be expected that the REIT industry portfolio would perform similarly to the stock market portfolio adjusted for risk, if the market is efficient and the CAPM holds.	Studies suggest that REITs performed poorly in the 70s. Others found that REITs provided less than average returns during 1973-1976 recession period. Burns and Epley were slightly different, however. They investigated whether the efficient frontier of mixed-asset portfolios that consisted of REIT stocks and other common stocks dominated the efficient frontier for a single asset type and the S&P 500 for the for the period 1970 - 1979. . Titman and Warga also found that the performance of REITs stocks is not significantly different from that of market portfolio over the period 1973-1982. They calculated and compared both CAPM and APT based on Jensen index. Studies since the 1980s have come to different conclusions. The application of the Jensen index requires that the market portfolio, be ex-ante efficient and includes, theoretically, all available assets on the market comparison of statistics suggest that the performance of REIT stocks is about the same as or slightly poorer than that of the stock market portfolio over the sample period. The portfolio that most closely
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering and University of Geneva, 2003		Returns and risk	Asset returns are shrunk to global mean of each asset class. BS is applied for various levels of risk. For countries with appraisals concerns, de-smoothing variant called Geltner is used		This is a variant of the repeat sales method whereby pairs are formed with appraised values and transaction price. Repeated- regression method.	Summary of statistics for the various asset classes
Mueller AG, Muller GR	Public and Private Real Estate in a mixed-asset portfolio Journal of Real Estate Portfolio Management Vol. 10 no 3, pp 193-203, 2003		Asset Allocation	While history is never an accurate indicator of what may happen in future, it is instructive to study the contributions and optimal levels of inclusion that different investments have played in a return-maximising portfolio in the past. 2002 marks a time period that provides 25-year history for direct private real estate and 30 for NAREIT. The study analyses the usual 5, 10, 15 and 25 years, with surprising results.		Public and private real estate returns found that equity REITs were heavily influenced by stock and bond movements and had little direct correlation with the conventional leveraged real estate.	The 25 year time period is long enough to include many economic expansion and recession periods, as well as stock and real estate cycles.
Mueller AG, Muller GR	Public and Private Real Estate in a mixed-asset portfolio Journal of Real Estate Portfolio Management Vol. 10 no 3, pp 193-203, 2003		Returns and risk	Real estate (private and public) is compared with indexes representing various types of financial assets, including common stocks represented by S & P 500, small cap represented by Russell 2000, NASDAQ, bonds by Merrill Lynch Mortgage Index and risk free rates. Data is measured quarterly as most fund managers are measured on a quarterly basis.	The close to zero correlation (-0.19) to zero correlation of these two investment vehicles is surprising due to the fact that they hold similar underlying real estate assets that drive their returns. A closer look reveal that the composition of the NAREIT in the 80s was mainly retail and multifamily, while NCREIF was mainly office, industrial and retail. Dissimilar property types contributed to low correlation's		

Exhibit 3 Returns and risk							
Author	Research Report/Source/Year of Review	Research Hypothesis	Research Area	Research Methodology	Research problem	Literature Review - Theory	Empirical Research
Norman EJ, Sirmans GS, Benjamin JD	Historical Environment of Real Estate Returns Journal of Real Estate Portfolio Management Vol 1 No 1 pp 1-23, 1995.		Returns and risk	Comprehensive review of the existing literature		A review of the extensive existing literature reveals that comparisons of nominal real estate returns on other assets has produced mixed results.	Most studies show that provide a comparison show that real estate has higher absolute returns than debt (such as bonds). The performance of real estate, in comparison to common stocks, is mixed. When comparing general real estate returns with returns from stocks or bonds, most studies agree that trends in returns from both groups are not consistent.

Findings/Conclusions
REIT performance varied over time. This study found that the use of unrepresentative S&P 500 index as a performance benchmark tends to overstate REIT performance. The inconclusive findings are not a surprise, due to the short sample periods used in the previous studies for an industry prone to boom and busts. The S&P 500 index, which contains large capitalisation stocks, has been used as the performance benchmark for the majority of previous studies, even though REITs are small capitalisation.
Summary of findings on the performance of REITs is inconclusive. The outcomes from REIT performance studies seem to be highly sensitive to the sample period studied. Burns and Eply found that the mixed-asset efficient frontier did dominate both, with respect to mean and variance at every risk and return level. Titamn and Warga found that both indexes for the entire period studied were not statistically different from zero. The market risk-adjusted returns on REIT stocks are about the same as the returns on the market index. REIT performance varied over time. This study found that the use of unrepresentative S&P 500 index as a performance benchmark tends to overstate REIT performance. The inconclusive findings are not a surprise, due to the short sample periods used in the previous studies for an industry prone to boom and busts. The S&P 500 index, which contains large capitalisation stocks, has been used as the performance benchmark for the majority of previous studies, even though REITs are small capitalisation.
Stocks constitute the highest return and risk asset class, while cash exhibits low return and risk parameters. Bonds appear to have a higher return and risk than cash. Real estate securities varies quite substantially from different countries across
Equity REITs returns are either first or second in all time series, except the 20 year period. The S&P 500 was best over the 20 year period, while NASDAQ was the highest over the ten year period. The standard deviation varied considerably for different time periods, with the NASDAQ showing the highest overall return in both 10 and 15 year time periods, the extremely high volatility made it less desirable in a mixed-asset portfolio. Real estate's return performance and relatively low volatility in both public and private forms has made the asset class a popular investment in poor economic conditions. Public and private real estate exhibited low quarterly correlation's. The unrelated behaviour of these real estate assets makes a stronger case for both public and private real estate inclusion in a mixed-asset portfolio.

Findings/Conclusions
Slightly more than half of the studies that provide a direct comparison show a higher average return for stocks than for real estate. Some research demonstrated that real estate investments have outperformed debt and other fixed income securities, while other research finds that common stocks have outperformed real estate investments. On a risk-adjusted basis, most of the literature shows that real estate investments have a higher return per unit of risk than common stocks. When absolute risk of the investment is analysed, the results are nonconclusive. Several studies show that actual returns from real estate outperform returns from other investments, such as stocks and bonds.

Exhibit 4 Inflation hedging								
Author	Research Report/Source/Year of Review	Research Hypotheses	Research Area	Research Methodology	Research problem	Literature Review - Theory	Empirical Research	Findings/Conclusions
Chatrath A, Lian Y	REITs and Inflation: Along - Run Perspective Journal of Real Estate Research Vol. 16 no 3, pp 311-326, 1998	REITs tend to behave like other equities with respect to inflation hedging-characteristics	Inflation hedge		Examine the inflation hedge in the long run and also investigate the apparent lack of a positive relationship between general prices and REITs returns in prior studies arises from the impact stock market movements have on REITs.			It is now well documented that stock returns world-wide are either negatively or unrelated to inflation. Only a few studies, indicate that REITs possess some inflation-hedging properties. Some argued for partial hedge against inflation. Authors also find that REITs act as a perverse hedge against unexpected inflation and that REITs have some ability to hedge the expected inflation. Inflation decomposition technique allow for a stochastic trend component in the inflation proxies
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors. Journal of Portfolio Management Special Issue Sept 2003		Inflation hedge		Concern about disinflation and deflation have risen in the asset markets, particularly the commodities market. Real estate returns have a complicated relationship to inflation.	Conventional wisdom has held that real estate performs as an inflation hedge. This means that if inflation is greater than expected, real estate returns will compensate for the surprise and will help offset negative response of the other assets in the portfolio As real estate fell into disfavor through the 1980s crash, this rational was discredited and compounded by low inflation. Past inflation is partially embedded in rents set previously because every seller of rental space, wishes to keep price level or rising in real terms. Thus net operating income (NOI) is partly a function of past inflation, rising if past inflation has been greater, and falling (or rising less) if past inflation has been tame. The speed with which inflation affects NOI, or the time lag necessary to capture inflation's impact on current NOI, depends on the structure of leases.	Inflation impacts the capital value in two ways. First, it impacts current NOI, which feeds through to value via capitalisation rate. This feed is especially strong for retail assets. Conventional wisdom has held that real estate performs as an inflation hedge. This means that if inflation is greater than expected, real estate returns will compensate for the surprise and will help offset negative response of the other assets in the portfolio As real estate fell into disfavor through the 1980s crash, this rational was discredited and compounded by low inflation.	The impact of past inflation, appropriately lagged, is positive for all four major property types. The direct capital value impact of inflation is significantly positive for apartment and office properties, but not significantly from zero for warehouse. Thus the empirical assessment shows that private equity real estate is a very useful, partial inflation hedge. That said, it is also clear that the degree of inflation-hedging is not uniform across the property types. As is the case with most debt, real estate debt is not good inflation hedge because unexpected inflation and concomitant increases in nominal interest rates negatively hit the value of CMBS. REITs will capture some of the benefits of the inflation hedge but are less successful transmitter of this value than private equity because of links to the stock market, which is generally damaged by inflation. So, if inflation hedging is a key reason why an investor chooses an allocation to real estate, that investor must tilt the portfolio toward private equity real estate.
Rubens JH, Bond MT, Webb JR	The inflation-hedging effectiveness of real estate. The Journal of Real Estate Research Vol. 4 no 2, pp 45-55, 1989.		Inflation hedging	Portfolios are constructed consisting of real estate and government bonds to examine the benefits of including real estate in inflation hedging portfolios. The study extends these previous research by updating time. Furthermore the return components are separated into income and appreciation. The division of the return stream helps ascertain the portion of the total return that determines the hedging effectiveness of the asset. Finally mean-variance efficient portfolios are constructed to determine additional hedging benefit accrued from including real estate	Mean-variance portfolios. Nominal rate of interest is comprised of appropriate equilibrium real interest rate and expected inflation premium	In efficient markets, the nominal rate of return on asset incorporates the best possible estimate of expected future inflation .Fama test for hedging effectiveness of various asset financial assets against both expected and unexpected inflation. TBs are used as proxy for the expected rate of inflation. The measure of unexpected inflation is the difference between actual inflation and bill rate. The study uses the Livingston price expectations (LPE) as a measure of expected inflation. LPE is a forecast by business economists.	There is no consensus on the best method to estimate inflationary expectations. Both the survey-based data LPE) and regression generated data appear to be acceptable proxies for expected inflation.	Only residential estate is a complete hedge against inflation. TBs are the only are the only other asset exhibiting at least some hedging effectiveness. All other financial and real assets have standard errors so large that their hedging effectiveness is indeterminate. When examined against expected inflation as measured by the LPE, there are few more positive hedges. Only Treasury bills and business real estate provided a complete hedge against expected inflation. They find that commercial real estate is a complete hedge against both expected and unexpected inflation. Regression estimates for each type of inflation against the asset returns.
Rubens JH, Bond MT, Webb JR	The inflation-hedging effectiveness of real estate. The Journal of Real Estate Research Vol. 4 no 2, pp 45-55, 1989.		Inflation hedging	Expected returns were treated as a constant, a Beta Coefficient, Standard Error and R squared is calculated and the type of inflation hedge is determined 95% confidence interval was used to test whether a particular investment is a complete, partial or indeterminate hedge.				All total returns measures provided a positive real return. Furthermore, the market was fairly accurate in its assessment of inflation over the time period. Unexpected inflation, the difference between the CPI and the LPE data, shows that inflation was generally underestimated throughout the 1960s and 1970s, but overestimated in recent years.

Exhibit 4 Inflation hedging								
Author	Research Report/Source/Year of Review	Research Hypotheses	Research Area	Research Methodology	Research problem	Literature Review - Theory	Empirical Research	Findings/Conclusions
Yobaccio E, Rubens JH, Ketcham DC	The Inflation-Hedging Properties of Risk Assets: the case for REITS Journal of Real Estate Research Vol. 10 no 3, pp 279-296, 1995.	REITs act as a hedge against expected and/or unexpected inflation.	Inflation hedge	A model of real estate returns is derived that has components for expected and unexpected returns and allows for variation in the real return on risky assets. Since the findings for some real estate have been criticised due to apparel smoothing bias, logic was to use REITs returns reflect the value of the income and price appreciation components of the underlying assets, determined in a market that adjust rapidly to changes in information or expectations		Fisher noted that the nominal rate of interest equalled the rate of interest plus expected inflation premium. Thus it was expected that the nominal rate would incorporate the best possible estimate of future inflation. These sorted some of the effects of anticipated and unanticipated inflation and lead researchers concluding that stock prices adjust for inflation. The conclusions were challenged and all three papers concluded that both nominal rate of interest and real holding period returns for corporate equities were negatively and significantly related to the inflation rate. Fama tested the effectiveness of treasury bills, government bonds, real estate, corporate bonds etc as hedges against both expected and unexpected inflation		REITs provide some hedging capability against unexpected inflation, but act as a perverse hedge against unexpected inflation. That is, decrease in value as inflation increases. Empirical research concluded that unexpected inflation, not expected inflation, explained the negative relationship between the inflation and stocks
Yobaccio E, Rubens JH, Ketcham DC	The Inflation-Hedging Properties of Risk Assets: the case for REITS Journal of Real Estate Research Vol. 10 no 3, pp 279-296, 1995.		Inflation hedge	Hartzell used data from 1973 - 1983. Both tests involve using treasury bills as the basis for expected inflation. They construct portfolios consisting of real estate and government bonds to examine the benefits of including real estate in inflation hedging portfolios. Murphy and Kleiman examine REIT returns and find that, over short periods of time, equity REITs act as a perverse hedge against both expected and unexpected inflation		Fogler, two explanations for the positive relationship between real estate and inflation 1. Result of true high positive correlation of the two factors and the changing investor expectations concerning the effectiveness of real estate as an inflation hedge. Hartzell performed two tests to examine the hedging effectiveness of a commingled real estate fund. Chen and Tzang find that both equity and mortgage REITs show some hedging ability against expected inflation. Murphy f		They found that all three property types provide at least partial hedges and improves the hedging effectiveness of portfolios in which real estate is included. This perceived inflation-hedging effectiveness has been attributed to appraisal-smoothed biases in the data. Such biases have been thoroughly and Geltner notes only when returns are corrected for smoothing bias can be the risk characteristics of commercial properties be examined with a considerable degree of confidence in the results.
Yobaccio E, Rubens JH, Ketcham DC	The Inflation-Hedging Properties of Risk Assets: the case for REITS Journal of Real Estate Research Vol. 10 no 3, pp 279-296, 1995.		Inflation hedge	4 estimates for expected inflation are used, 6/12 month Livingston forecasts, time series predictions using AR model and short-term interest rates(TBs). The inflation hedging effectiveness of REIT returns is analysed using each measure of expected inflation and both the market-value and equal-weighted index. Fisher model; nominal rate if interest is comprised of an appropriate equilibrium real interest rate and the expected inflation premium. Fama and others extended the Fisher relationship to risky assets. Implicit in the model is the notion that the real return on the risk asset is independent of the level of expected inflation. During periods of high inflation or disinflation, investors may become more risk averse, and expect higher real returns on risk assets.	Investors make decisions based up estimates of future economic conditions, it is appropriate to examine REIT return performance given an information set containing estimates of expected inflation.	Park et al. Use two measures of expected inflation, a generalised Fisher equation from Fama and the Livingstone Price Expectations series. They find that REITs generally exhibit the same perverse hedging characteristics as common stock, although REITs appeared to be a partial hedge against anticipated inflation when using the LPE series against both expected and unexpected inflation.		REITs tend to mirror equity results against inflation and unexpected inflation. Hedging effectiveness was mixed for both inflation components, but performance was markedly worse against unexpected inflation. Secondly, in nearly all instances, REIT returns acted as a perverse hedge against unexpected inflation. Beta which estimates the systematic risk relative to changes in the real market return, is positive and highly significant. The coefficients on expected inflation are positive and near 1, especially the case for mortgage REITs. This indicates that REITs offered some hedging potential against expected inflation. However, the coefficients of unexpected inflation are negative, and most significantly are different from 1. In the high inflation period(1972 - 1981), the hypotheses that the coefficients of unexpected inflation were equal to 1 (indicating perfect hedging capability) could not be rejected for equity, mortgage, or hybrid REITs, primarily because of large standard errors. In low inflation period, the hypothesis that REITs were a perfect hedge against unexpe

Author	Research Report/Source/Year of Review	Research Hypothesis	Research Area	Research Methodology	Research problem	Literature Review - Theory	Empirical Research	Findings/Conclusions	Comments
Chun GH, Sa-aadu J, Shilling JD	(2002) The role of real estate in an institutional investors portfolio revisited. Department of land economy, University of Cambridge	Are institutional investors underinvested in real estate securities	Asset Allocation	Capital stock estimates that commercial real estate represents only \$1.5 trillion, or between 3.5-4% investable wealth in the US	All available data show that institutional investors hold between 3.5 - 4% of their assets in real estate.		Studies suggest that institutional investors should invest between 15-20% of their assets in real estate. Even with real estate imperfections such as indivisibility, the optimal suggested for real estate in a mixed asset is 9%. A view is taken that institutional investors may not simply rank portfolios according to mean and variance	Real estate diversification pays off at the time the benefits are most needed (consumption growth low - not true for bonds), and thatinstitutional investors can hold real estate for very long periods of time despite illiquidity.	
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors		Asset allocation	The starting point should be to include real estate and other assets at their market weights and then then to adjust the weights in order to best achieve the investment objectives. The Ruolac Capital Flows Database published in Investment Property provides an estimate of \$2.6 trillion as the current total size of real estate market. Using the above figures and data from the Flow of Funds report from the Federal Reserve Board for the size of the stock, bond and cash sectors puts real estate at approximately 8.3% of the current investment universe	Determining the size of the total investment universe to set weigh for real estate in an indexed portfolio has proven difficult.		Real estate belongs in a balanced investment portfolio because real estate is an important part of the investment universe. Any portfolio that does not include real estate is based on the bet that real estate will perform less well than is implied by the market-driven relative prices. Any allocation to real estate that does not reflect real estate's overall share in the investment universe implies a different bet from that of an indexed portfolio.	Real estate hed been as much as 11% of the overall universe in the 1980s. The recent correction in the stock market has begun to drive the figure up from 5.5% reached in 1998. A armket cap-weighted and quarterly rebalanced portfolio of major assets classes would have yielded annual average return of 10.4% with a risk of 7.7% over 1987 - 2002. Pension allocation to real estate is now approximately 4.8% (3.9% in equity real estate, 0.9% in mortgages). A portfolio with allocation of 4.8% rather than market the market allocation raises the portfolio average return by only 8 basis points to 10.5%, but also raises portfolio risk enough to cause the return per unit of risk to fall by two basis points. Replicating an insurance company allocation to commercial real estate at 10% the overall return would reduce by 8 basis points and risk would have dropped as well have dropped so that the return per unit of risk would have risen by three basis points	Apply the findings to the research report. Illustrate the return with actual weight and optimal weight.
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors		Asset allocation					Thus, the pension funds' underweighting relative to the cap weight causes overall performance to improve very slightly while the insurance companies over-weighting relative to the cap weight causes absolute return to suffer but risk-adjusted performance improve.	
Gold RB	Why the efficient frontier for real estate is fuzzy Journal of Real Estate Portfolio Management	MPT methodologies hides where the reduction in risk originate	Asset Allocation	Uncertainty is introduced by bootstrapping expected returns and SD in the traditional Markowitz framework.Departing from MPTs traditional approach for creating singular combinations of assets for any given level of risk-adjusted returns, this alternative helps quantify the impact of uncertainty by generating acceptable allocation ranges, rather than specific, and difficult to obtain, point estimates.	Difficulties related to both data quality and availability and have received much attention. These are perhaps overshadowed by the impact of uncertainty on the allocation process. Data limitations, as well as substantive issues regarding appraisal-based values, such as lumpiness, illiquidity and transaction costs, make the application of MPT to real estate impossible.	, it is entirely possible that any two points on the efficient frontier are statistically indistinguishable from each other.	Asset allocation decisions must always reflect that their goal is to hold a portfolio that will reflect future market conditions. All explicit inputs into the asset allocation process need to be based on expectations of future returns, variability and correlations	The results show that the efficient frontier is not singular, but fuzzy.This study illustrates that numerous statistically dissimilar weighted portfolio can be equally attractive for any given combination of expected risk and return and allocation ranges ranges rather than specific targets.Introducing uncertainty into the Markowitz MPT framework helps to overcome the practical problem of balancing optimization's goals with real estate's illiquidity, transaction costs and data problems, creating bundles of portfolios to which investors are indifferent.	
Lee S	The return due to diversification of real estate to US mixed asset portfolio:A paper presented to the 10th Annual European Real Estate Society,2003		Asset Allocation				Re-allocation done in 4 ways: 1. Holding in real estate is replaced by the same % in the large cap, 2 % allocated to real estate replaced the same proportion in bonds, 3 real estate replaced small cap and holding equally split between large cap and bonds.	Real estate generally offer increase RDD to the mixed prtfolio.However the benefits depend upon which asset is replaced and the percentage allocation to real estate.	
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance,Volume 6 no 3 pp 60-83 1995		Asset Allocation			Strategic Asset Allocation: which studies have shown is the main determinant of portfolio returns, rather than stock selection. Consideration of the data series for property has shown the data are smoothed by the appraisal process, and true volatility is disguised. Desmoothing these series forces the volatility upwards.		Property still has aplace in a multi-asset portfolio, although it is significantly less than in previous studies, using appraisal based returns. Using a properly constrained constrained approach, there can still be allocation to property higher than current actual holdings. Reaffirms a case of property based on more discriminating assesement of desmoothing and MPT effects.	
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva	Benefits of including real estate assets- both domestic and international - in mixed-asset portfolio	Asset Allocation	Data from seven countries on three continents are considered for a common period of 1987-2001		Real estate as portfolio diversifier- Chaundry,Myer and Webb. Used co-intergration techniques and found that there is an inverse long-run relationship with real estate.	Data pertaining to stocks, bonds,direct real estate, real estate securities and cash for the U.S.,U.K., France, Netherlands, Sweden, Switzerland and Australia	Optimal weight allocated to real estate, with unhedged returns, is in the 5%-15% and inclusion of rela estate assets leads to a 5-10% reduction in the portfolio standard deviation	
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva	Whether the optimal which should be allocated to domestic real estate in mixed-asset portfolios is robust across countries	Asset Allocation	Appraisal-based indices are corrected for desmoothing using a variant of the method devised by Geltner. Use average of the standard deviation for stocks and bonds, instead of the normal assumption of real estate standard deviation being half of equities. Use average of the standard deviation for stocks and bonds, instead of the normal assumption of real estate standard deviation being half of equities	Institutional investors allocate a substantially lower weight to real estate than that reported in literature	Recent studies, have argued that the actual weight is in line when measured from an asset/liability framework or when imperfections such as indivisible assets and no short sales	Compile summary of statistics	Inclusion of international real estate, the risk reduction is increased to 10-20%. Optimal is constant across countries at approx 15%	
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva		Asset Allocation	Use average of the standard deviation for stocks and bonds, instead of the normal assumption of real estate standard deviation being half of equities		Uncertainty on optimal portfolio selection. Estimation error espacially returns. Variances are stable over time. One possibility is to constrain allocations, thereby forcing greater spread across the assets. The choice of constraints is arbitrary.		Unhedged returns are also similar: adding real estate reduces a portfolio's risk by 10 to 20%	
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance,Volume 6 no 3 pp 60-83 1995		Autoregressive Moving Average	Desmoothing property returns: UK returns are mainly based on comparable evidence, which is itself based on the previous valuations. Desmoothing process needs to capture essence of the appraisal process and at the same time and require relatively few data points. The simplest is the first autocorrelation.	This tendency to recycle valuations has the effect of incorporating previous prices in the current return. The consequence of this is that, if appraisal series is sufficiently long, the mean return is likely to represent an unbiased estimate of the true return index.The risk of property will be baisd downwards and the returns series is likely therefore to exhibit strong positive autocorrelation, due to inertia in the system.	Valuation at time= true market value,theta and a constant lying between 0 and 1. $V_{1t} = (1 - \theta)P_t + \theta V_{1t-1}$. The main difficulty is determining the value of theta. Geltner is used. Full information model.	To bring property returns in line with stocks and bonds, the effects of autoregressive process must be removed. Desmoothed series is thus a simulated return series after such inertia has been expunged from the original data.	The valuation method best captures the appraisal behaviour of valuers at disaggregated level on which index values are ultimately based.	Given the way in which theta is derived, there is no absolute way of determining whether a particular value of theta is most appropriate for the desmoothing process. Arguments against valuations

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Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors		Bond nature	CMBS carves up the cash flows from pools of mortgages to produce high-grade cash flow characteristics in the senior tranches and more equity-like cash flow characteristics	Investor is often explicitly or implicitly(6 REITs in S&P)invested in all four quadrants. Past approaches to the analysis of the role of real estate based only on the private equity quadrant. Past approaches to the analysis of the role of real estate based only on the private equity quadrant reflect neither the reality of the investment structures that are available in the market.	The performance of each real estate is produced by a mix of equity-like and debt-like behaviors. For example, consider the polar case of a private real estate equity leased to a single credit tenant with a long term, triple net lease. The payments on that lease resemble the fixed payments one associates with a bond, not with equity. The value of this asset to the investor fluctuates in step with the same factors that influence the value of a bond or a mortgage.		REITs were the dominant competitors in the bidding for privately held real estate during 1995-1997	
Gold RB	Why the efficient frontier for real estate is fuzzy Journal of Real Estate Portfolio Management	Adding direct real estate to the other asset should result in lower portfolio risk especially on the downside	Bootstrapping	Rather than dealing with the difficulty associated with of using MPT-based asset allocation models because of the associated data problems, many institutions peg real estate allocation within a mixed-asset portfolio at some constant percentage.Within real estate property type, and geographic allocation decisions are often accomplished by using even more generic approaches.To illustrate uncertainty is a factor for asset allocators, total returns for Office, retail, apartment and industrial were recreated using bootstrapping	The problem is less acute for stock and bond returns, not only because they are high-frequency, transactional based series, but because data are available for longer periods	Bootstrapping was considered the most appropriate methodology for recreating the true distribution of future returns, given limited historical private real estate data, and therefore limited volatility of the series.	Generally, the bootstrap methodology has a tendency to more evenly distribute the intra-asset weightings within a portfolio. Assets with largest weights will have their allocations reduced, while assets with the smallest weights will receive a higher allocation. A base efficient frontier is created using a sixty-month holding period with an illustrative dataset of expected property type performance and correlations		
Chun GH, Sa-aadu J, Shilling JD	(2002) The role of real estate in an institutional investors portfolio revisited. Department of land economy, University of Cambridge	Real estate provides a hedge against changes in variables that matter to institutional investor	CAPM	Size of US institutional investment portfolio Size of real estate market. the problem when: individual investors are price takers, information is costless, taxes and transaction costs are zero, investors are mean-variance investors		CAPM Real estate risk Lack of information Real estate provides a hedge against inflation	Theoretical literature argues that institutional are underinvested in real estate: Real estate have quite a high average returns relative to their risk. This is inconsistent with CAPM, which states that high returns are only earned as a compensation for risk		
Lee S	The return due to diversification of real estate to US mixed asset portfolio:A paper presented to the 10th Annual European Real Estate Society,2003	Real estate should be included in a mixed portfolio because of the effect compound returns	Compound Returns	Adding real estate in portfolio to an existing mixed-asset portfolios increases the compound return and so the terminal wealth. Return due to diversification (RDD) is the difference between the compound return and the weighted average returns= Terminal Wealth.	Including real estate in the mixed-portfolio is based on diversification benefits than on its contribution to the return of the portfolio	Booth and Fama show that although the compound return of an investment is an increasing function of its expected return, it is also a decreasing function of its risk. In other words, investments with higher expected returns and high risks do not necessarily provide higher compound returns to portfolio, than investments with lower expected returns and lower risks	US annual returns over the period 1951-2001. Annual returns of Direct real estate, large cap stocks, small cap stocks, government bonds and cash	A large holding of real estate in the mixed portfolio may be justifiable on its compound return enhancing effect on the mixed-asset and not simply on its risk reducing ability.	RDD, the results are dependent on the percentage allocation to real estate and the asset class
Lee S	The return due to diversification of real estate to US mixed asset portfolio:A paper presented to the 10th Annual European Real Estate Society,2003		Compound Returns	RDD = the variance of the investment's simple returns, and the average continuously compounded return of the investment. The compound return is the increasing function of its expected return and decreasing variance		Booth and Fama shown that the compound returns of a portfolio is greater than the weighted average of the individual compound return of the investments. The result stems from the fact that although variance is an appropriate measure of risk of a portfolio it is not the relevant measure of risk within the portfolio. The risk of an investment should be measured by its covariance with the portfolio. Thus, an asset with a low expected return but a low covariance may be more desirable, than an asset with higher expected return but a high covariance.		The uncommonly low value of the risk of real estate data, compared with government bonds, and the presence of 1st order serial order correlation, is a common feature of commercial real estate.	
Lee S	The return due to diversification of real estate to US mixed asset portfolio:A paper presented to the 10th Annual European Real Estate Society,2003		Compound returns					Nonetheless, the justification for including real estate in the mixed portfolio need to rest on its diversification benefits alone, but can be made on its contribution to the compound return or terminal wealth.	Role
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors	Real estate can reduce the overall risk of a portfolio, provide high absolute returns, act as an inflation hedge and offer strong cash flows.	Four quadrant	A broader definition of real estate, historically was only including private real estate equity and private real estate debt. Advent of securitization lead to private commercial real estate equity, private commercial real estate debt and REITs and public commercial real estate debt structured as CMBS	Real estate viewed as a risk reducer as imposed by ERISA. Many investors manifest their sceptism by assigning only very small allocations to real estate in their portfolio.				
Kuhle JL	Portfolio Diversification and Return Benefits - Common Stocks vs REITs Journal of Real Estate Vol No	Diversification benefits can be obtained by using real estate assets to create well-diversified portfolios.	Diversification	Monthly 5 year returns to examine the effects of diversification on the reduction of total portfolio risk in a REIT and mixed-portfolio.	When does a holding in direct real estate contribute this increase in portfolio performance	Increased securitisation has lead to application of traditional portfolio theory. Markowitz analysis is employed to examine the risk and return potential of portfolios comprised of REITs only and REITs combined with common stocks.	Means and standard deviations are calculated to provide relative comparisons and correlations then calculated. The asset with the lowest correlation would usually be a good candidate for risk reduction in portfolio through increased diversification.	Traditional methods of portfolio analysis based on the long run correlation averages fails to identify in which periods real estate helps to reduce portfolio risk.	
Norman EJ, Sirmans GS, Benjamin JD	Historical Environment of Real Estate Returns Journal of Real Estate Portfolio Management Vol No		Smoothing		To avoid the problem of return smoothing due to use of appraised values, some studies employ REITs. A problem normally arises when using REIT returns to measure real estate problems. During some time periods, REIT yields may vary from actual underlying property yields. In the early 1970s for example, REITs had low returns, while returns on the underlying properties was high. The differences may be the result from high inflation, which increases the tax shelter benefit of investor-owned. Other factors such as leverage and confidence on management ability to contribute to divergence. Several problems associated with using REIT returns can distort homogeneity of the portfolio because they usually have varying degrees of leverage.	Portfolio risk risk falls when real estate is included. The allocation of real estate holdings in the optimal portfolio varies throughout the research, appearing to be based on such factors as the tax rate of investors, the risk assumptions, and time periods examined. For example, over along time period from 1947-1983, Webb et al find an optimal of portfolio weights about two thirds in real estate. Over shorter periods, Irwin and Landa find that real estate comprised 20% of minimum variance. In contrast, for even more recent times, 1980-89, Ennis and Burik find the optimal to contain 10-20% of total assets in real estate	Diversification benefits of real estate and the allocation of real estate in an optimal mixed-asset portfolio are a subject of studies summarized. There is clear consensus that diversification with real estate provides enhanced investment returns.		Arguments against using REITs
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors		Efficient frontier	The real estate's role extends from the lowest risk end of the efficient frontier to just past the midpoint of the mixed-asset efficient frontier. Real estate is both low-risk itself and an excellent risk reducer in a stock and bond portfolio.				This evidence suggests that real estate is very suitable for investors interested in capital preservation and need to earn a useful rate of return.	

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HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva		Efficient frontier	use Bayes-Stein which should increase the stability of portfolio composition, instead of portfolio allocation models		Means are usually shrunk towards are common value (the common mean, I,ethe mean across all assets considered. Dviersification benefits are more likely to accrue from reduction in risk, rather than gains in averages returns		Real estate returns are lowly(positively or negatively) correlated to those of stocks and bonds and 15-30% should be allocated to real estate	
Lee S	When does real estate improve portfolio performance, University of Reading, Centre for Real Estate Research,Reading		Four quadrant	Four possible outcomes: both markets up,both markets down, the asset is up and real estate is down, the asset is down and real estate up. Target return is required. The target is normally set to the minimum return that the investor would be willing to accept, typicall the risk-free rate on bonds.		Too few few investors appreciate the implications of the co-movement between investments that leads to correlation between assets. A breakdown of the imperfect correlation between direct real estate and the other asset classes to illustrate where the benefits originate.		By using the a four-quadrant table for each asset class, it is possible to see to what extent the investor really gains from holding direct real estate when it is most needed, i.e. where the losses in the asset class are offset by gains in direct real estate.Direct real estate mitigates the losses when both down and has limited upside. Thus if the goal is offsetting losses, then the results show that direct real estate may have been some benefit	Define the objectives of the portfolio
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors		Four quadrants	True value of real estate asset class is determined by the behaviors of all four quadrants, a combined performance is adopted, i.e.time series of capitalization-weighted performance of real estate in all the quadrants.		At the other extreme, an equity position in an empty, speculative, multi-tenanted property is driven almost entirely by equity forces. The value of the building is a fuction of supply and demand for space in that market, at that particular time. As the buildings becomes more fully leased, it changes from "pure" equity to a debt-equity hybrid, and perhaps - if fully leased to a long-term tenants - becomes very debt-like.		The private mortgage quandrant shows significant volatility during the high inflation/tight money era prior to 1986, but has since settled dow. The CMBS market, not measured before 1984 because the quandrant did not exist, the volatility shows volatility little different from that of the mortgage era.Appraisal-based private equity is the least volatile. Volatility is understated, while appraisals may lag, they eventually do capture the true range of performance of individual real estate assets	
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors		Four quadrants	Using four quantrant real estate index,calculate the optimal allocation for real estate in a mixed asset class portfolio of stocks, bonds and cash and calculate the mean returns, standard deviation and correlations Quarterly returns from 1987 - 2000				The correlations between real estate and stocks of 0.065, real estate and bonds of 0.34 , and real estate and cash of 0.259 suggest that real estate can play a significant role in a mixed-portfolio. Whenever two imperfectly related assets (correlation coefficient less than 1.0) are placed together in a portfolio, an oportunity exists to earn a greater return at each level of risk (or reduce the risk for a given level of return). In summary, when the return to an asset class is high enough, the risk is low enough, and or the correlation reflects a sufficiently different pattern of returns, the asset class earns aplace in the portfolio for at least a portion of return/risk premium spectrum. Real estate meets these tests and is therefore a component of the well diversified mixed asset portfolios.	Limitations in using four quadrant model - 1st securitization, immature
Yobaccio E, Rubens JH, Ketcham DC	The inflation-hedging properties of risk assets: the case for REITS Journal of Real Estate Research	REITs act as a hedge against expected and/or unexpected inflation.	Inflation hedge	A model of real estate returns is derived that has components for expected and unexpected returns and allows for variation in the real return on risky assets. Since the findings for some real estate have been criticized due to aprail smoothing bias, logic was to use REITs REITS returns reflect the value of the income and price appreciation components of the underlying assets, determined in a market that adjust rapidly to changes in information or expectations		Fisher noted that the nominal rate of interest equalled the rate of interest plus expected inflation premium. Thus it was expected that the nominal rate would incorporate the best possible estimate of future inflation.These sorted some of the effects of anticipated and unanticipated inflation and lead researchers concluding that stock prices adjust for inflation.The conclusions were challenged and all three papers concluded that both nominal rate of interest and real holding period returns for corporate euties were negatively and significantly related to the inflation rate.Fama tested the effectiveness of treasury bills, government bonds, real estate, corporate bonds etc as hedges against both expected and unexpected inflation		REITs provide some hedging capability against unexpected inflation, but act as a perverse hedge against unexpected inflation.That is, hh decrease in value as inflation increases. Empirical research concluded that unexpected inflation, not expected inflation, explained the negative relationship between the inflation and stocks	Argument for research report
Yobaccio E, Rubens JH, Ketcham DC	The inflation-hedging properties of risk assets: the case for REITS Journal of Real Estate Research		Inflation hedge	Hartzell used data from 1973 - 1983. Both tests involve using treasury bills as the basis for expected inflation. They construct portfolios consisting of real estate and government bonds to examine the benefits of including real estate in inflation heging portfolios. Murphy and Kleiman examine REIT returns and find that, over short periods of time, equity REITs act as a perverse hedge against both expected and unexpected inflation		Fogler, two explanations for the positive relationship between real estate and inflation 1. Result of true high positive correlation of the two factors and the changing investor expectations concerning the effectiveness of real estate as an inflation hedge. Hartzell performed two tests to examine the hedging effectiveness of a commingled real estate fund. Chen and Tzang find that both equity and mortgage REITs show some hedging ability against expected inflation. Murphy f		They found that all three property types provide at least partial hedges and improves the hedging effectiveness of portfolios in which real estate is included. This perceived inflation-hedging effectiveness has been attributed to appraisal-smoothed biases in the data. Such biases have have been thoroughly and Geltner notes only when returns are corrected for smoothing bias can be the risk characteristics of commercial properties be examined with a considerable degree of confidenc in the results.	They found limited support for the first explanation and but not enough to reject the second.
Yobaccio E, Rubens JH, Ketcham DC	The inflation-hedging properties of risk assets: the case for Real Estate Research		Inflation hedge	Best method to estimate inflationary expectations: Livingston data and data generated from time series.Assuming that Treasury Bills are perfectly liquid, they use the the rate on bills as a proxy for the expected rate of inflation. The measure of unexpected inflation is merely the difference between actual inflation and the bill rate as calculated on an ex post basis. This study analyzed the hedging effectiveness of REITs against expected inflation and /or unexpected inflation over the period 1972:1992. Two sub-periods are examined to asses the sensitivity of the results to inflation levels.CPI used as a measure of actual inflation.Time series predictions are generated and residuals are relatively well bahaved.Data NAREIT share price index, Livingston expectations index and monthly inflation rates.	If, for example, investors become more risk averse during periods of high inflation or disinflation and demand correspondingly higher real returns on risky assets, the correlation between expected inflation and real market rate of return that is accounted for in Parker may result in biased coefficients for inflation. This bias may be sufficiently large to suggest perverse hedging properties for real estate, even though none exist			Summary of All REITs, Treasury Bills, Livingston (measure of expected inflation, 6/12 month forecast), AR Model show the descriptive stats for all varaiables analyzed from 1972 - 1992, 172 - 1981, and 1982 -1992. Reflecting the bull market in the 1980s, both market indices reveal impressive gains only in the latter time period. Equity REITs perfomed better in the more recent ("low infanflation") subperiod while mortgage and hybridREITs performed better in the first ("high inflation") subperiod, thus obfuscating REIT performance against actual inflation.	Find out about the AR(1) model

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Yobaccio E, Rubens JH, Ketcham DC	The inflation-hedging properties of risk assets: the case for REITS Journal of Real Estate Research		Inflation hedge	4 estimates for expected inflation are used, 6/12 month Livingston forecasts, time series predictions using AR model and short-term interest rates(TBs). The inflation hedging effectiveness of REIT returns is analyzed using each measure of expected inflation and both the market-value and equal-weighted index.	Investors make decisions based upo estimates of future economic conditions, it is appropriate to examine REIT return performance given an information set containing estimates of expected inflation.			REITs tend to mirror equity results against inflation and unexpected inflation. Hedging effectiveness was mixed for both inflation components, but performance was markedly worse against unexpected inflation. Secondly , in nearly all instances, REIT returns acted as a perverse hedge against unexpected inflation.Beta which estimates the systematic risk relative to changes in the real market return, is positive and highly significant. The coeficients on expected inflation are positive and near 1, espacially the case for mortgage REITs. This indicates that REITs offered some hedging potential against expected inflation. However, the coefficients of unexpected inflation are negative, and most significantly are different from 1.In in the high inflation period(1972 - 1981), the hypotheses that the coefficients of unexpected inflation were equal to 1 (indicating perfect hedging capability) could not be rejected for equity, mortgage, or hybrid REITs, primarily because of large standard errors. In low inflation period, the hypothesis that REITs were a perfec	
Yobaccio E, Rubens JH, Ketcham DC	The inflation-hedging properties of risk assets: the case for REITS Journal of Real Estate Research		Inflation hedge					The results were remarkably robust irrespective of the type of REIT returns or the measure of expected inflation utilized.Results indicate that REITs act poor hedge against any measure of inflation(actual, expected, or unexpected) with the poorest performance relative to unexpected inflation.In this respect, REIT returns mirrored results involving equity returns in general and would seem not to be proxies for direct investment in real estate. REITs indicate that real estate , at best, acts as a partial hedge against expected inflation and a perverse hedge against unexpected inflation.	
Chatrath A, Lian Y	Reits and Inflation: Along -Run perspective () Journal of Real Estate Research Vol no	REITs tend to behave like other equities with respect to inflation hedging-characteristics	Inflation hedge		Examine the inflation hedge in the long run and also investigate the apperent lack of a positive relationship between general rpices and REITs returns in prior studies arises from the impact stock market movements have on REITs.		It is now well documented that stock returns worldwide are either negatively or unrelated to inflation. Only a few studies, indicate that REITs possess some inflation-hedging properties. Someargued for partial hedge against inflation. Authors also find that REITs act as a perverse hedge against unexpected inflation and that REITs have some ability to hedge the expected inflation		
Hudson-Wilson S, Fabozzi FJ, Gordon J	Why Real Estate? - An expanding role for institutional investors		Inflation hedge		Concern about disinflation and deflation have risen in the asset markets, particularly the commodities market. Real estate returnshave a complicated relationship to inflation.	Past inflation is partially embedded in rents set previously because every seller of rental space, wishes to keep price level or rising in real terms. Thus net operating income (NOI) is partly a function of past inflation, rising if past inflation has been greater, and falling (or rising less) if past inflation has been tame. The speed with which inflation affects NOI, or the time lag necessary to capture inflation's impact on current NOI, depends on the structure of leases.	Inflation impacts the capital value in two ways. First, it impacts current NOI, which feeds through to value via capitalization rate. This feed is espacially strong for retail assets. Conventional wisdom has held that real estate performs as an inflation hedge. This means that if inflation is greater than expected, real estate returns will compensate for the surprise and will help offset negative response of the other assets in the portfolio As real estate fell into disfavour through the 1980s crash, this rational was discredited and compounded by low inflation.	The impact of past inflation, appropriately lagged, is positive for all four major property types. The direct capital value impact of inflation is significantly positive for apartment and office properties, but not significantly from zero for warehouse. Thus the empirical assessement shows that private equity real estate is a very useful, partial inflation hedge. That said, it is also clear that the degree of inflation-hedging is not uniform across the property types. As is the case with most debt, real estate debt is not good inflation hedge because unexpected inflation and noncomitant increases in nominal interest rates negatively hit the value of CMBS. REITs will capture some of the benefits of the inflation hedge but are less successful transmitter of this value than private equity because of links to the stock market, which is generally damaged by inflation. So, if inflation hedging is a key reason why an investor chooses an allocation to real estate, that investor must tilt the portfolio toward private equity real estate.	
Mueller GR, Pauley KR	The effect if Interest-Rate Movements on REITs		Inflation hedge			Mullineaux and Chew studied inflation and found that real estate is a partial hedge to inflation. The dividend yield on REITs is positively related to both expected and unexpected inflation.			
Rubens JH, Bond MT, Webb JR	The inflation-hedging effectiveness of real estate. The Journal of Real Estate Research Vol No	Real estate has been regarded as one of the best inflation hedges of the past years	Inflation hedging	The study examines the inflation-hedging effectiveness of residential real estate or farmland as inflation hedges, as individual assets and as portions of mean/variance effiecient portfolios. Further, the returns will be divided into the appreciation and income components as expositional aid. Return measures will be regressed against actual, expected and unexpected inflation.The hedging effectiveness is better examined by diving the two inflation components.Portfolios are constructed consisting of real estate and government bonds to examine the benefits of including real estate in inflation hedging portfolios. The study extends these previous research by updating time.Further more the return components are seperated into income and appreciation. The division of the return stream helps ascertain the portion of the total return that determines the hedging effectivenes of the asset. Finally mean-variance efficient portfolios are constructed to determine additional hedging benefit accrued from including real estate	Investors expect a resurgence of inflation to higher levels in the near to immediate future	Hartzell performed two tests to examine the hedging effectiveness of a comingled fund from 1973-1983 that contains business real estate. Both test involve using Tbs as the basis for expected inflation. One test is based on nonconstant real rate that moves according to an integrated moving average process and the other on asset returns and inflation.In efficient markets, the nominal rate of return on asset incorporates the best possible estimate of expected future inflation.Fama test for hedging effectiveness of various asset financial assets against both expected and unexpected inflation. TBs are used as proxy for the expected rate of inflation. The measure of unexpected inflation is the difference between actual inflation and bill rate. The study uses the Livingston price expectations (LPE) as a measure of expected inflation. LPE is a forecast by business economists.	During periods of inflation, certain financial instruments not only do not protect the investor, but actually perform as a perverse hedge, l.ie. Decrease in value as inflation increases.		Focus on business real estate

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Rubens JH, Bond MT, Webb JR	The inflation-hedging effectiveness of real estate. The Journal of Real Estate Research Vol No		Inflation hedging		Mean-variance portfolios. Nominal rate of interest is comprised of appropriate equilibrium real interest rate and expected inflation premium		There is no consensus on the best method to estimate inflationary expectations. Both the survey-based data (LPE) and regression generated data appear to be acceptable proxies for expected inflation.	Only residential estate is a complete hedge against inflation. TBs are the only other asset exhibiting at least some hedging effectiveness. All other financial and real assets have standard errors so large that their hedging effectiveness is indeterminant. When examined against expected inflation as measured by the LPE, there are few more positive hedges. Only Treasury bills and business real estate provided a complete hedge against expected inflation.They find that commercial real estate is a complete hedge against both expected and unexpeted inflation. Regression estimates for each type of inflation against the asset returns.	Regression analysis between real estate and inflation
Rubens JH, Bond MT, Webb JR	The inflation-hedging effectiveness of real estate. The Journal of Real Estate Research Vol No		Inflation hedging	Expected returns were treated as a constant, a Beta Coefficient, Standard Error and R squared is calculated and the type of inflation hedge is determined.A 95% confidence interval was used to test whether a particular investment is a complete, partial or indeterminant hedge.				All total returns measures provided a positive real return. Furthermore, the market was fairly accurate in its assesement of inflation over the time period. Unexpected inflation, the difference between the CPI and the LPE data, shows that inflation was generally underestimated throughout the 1960s and 1970s, but overestimated in recent years.	
Mueller GR, Pauley KR	The effect if Interest-Rate Movements on REITs		Interest rates	Explores the historical relationship between interest-rate movements and REIT prices to determine what, if any impact interest rates movements have had on REIT prices. Monthly changes in interest rates, as measured by price data from Federal Government three month TB, 10 year bonds,Long government bonds and compared to monthly changes in the S&P 500 Price Index, Wilshire Real Estate Index(includes REITs).Correlations between these different indices is calculated from 1972-1993.		Chen and Zang looked at sensitivity to interest rates and inflation using regression model. They used a small sample of mortgage and equity REITs, and found that equity REITs were not sensitive interest rates, but only to changes in expected inflation.	Means and standard deviations are calculated to provide relative comparisons and correlations then calculated. The asset with the lowest correlation would usuaaly be a good candidate for risk reduction in portfolio through increased diversification.	The matrix shows that NAREIT Equity Index had a low correlation with interest-rate movements over the time period studied This was true for short, medium and long term interest rates as the correlations were low and negative for all.	
Chun GH, Sa-aadu J, Shilling JD	(2002) The role of real estate in an institutional investors portfolio revisited. Department of land economy, University of Cambridge		low consumption	While research is divided as to whether smoothing bais exist and wether it can be appropriately corrected, it seems that the issue is more of concern when comparing direct real estate with market based securities.Geltner desmoothing applied.	Predictability of real estate returns and a hedge against low consumption				
Hoesli M and Hamelink F	The maximum drawdown as a risk measure:The Role of Real Estate in the optimal portfolio revisited University of Geneva	Portfolios optimized in the Return/MaxDD space, rather than Return/SD yield a much lower MaxDD, while only slightly higher SD for the same level return.	MaxDD	Investigate the role of real estate in a mixed-portfolio when maximum drawdown (MaxDD), rather than the SD, is used as a measure of risk. The MaxDD is defined as the loss suffered when an asset is bought at a local maximum, and sold at the next local maximum, and sold at the next local minimum. The study extends MaxDD framework to the multi-asset setting	Institutional investors allocate substantially lower weight to real estate than that reported in the literature.	Several studies argued for instance that the weight which should be allocated to real estate is much more in line with the actual institutional weight when asset-liability is considered, or when real estate market imperfections are considered. Some authors also stress that weights are reported with error, and hence Bayes-Stein estimators was suggested to address the issue of errors. By doing so, the calculated portfolio allocations have been shown to be more stable than when classical mean variance is used.	The empirical analysis is conducted from the perspective of a Swiss pension funds who are faced with legal constraints on the weights that can be allocated to the various asset categories and pertains to the period 1979-02	Argue that the MaxDD concept is one of the most natural measures of risk, and that such framework can help reconcile the optimal allocations to real estate and effective allocations by institutional investors. The reduction in MaxDD is highest for portfolios situated halfway on the efficient frontier,typically close to those held by pension funds. Also the reported weights are much more in line with the actual weights to real estate by institutional investors.	
Hoesli M and Hamelink F	The maximum drawdown as a risk measure:The Role of Real Estate in the optimal portfolio revisited University of Geneva		MaxDD	Empirical analysis is undertaken using Swiss pension funds data for the period 1979-02.Ceilings have been set for pension funds to ensure that they do not take too much.Four possible outcomes: both markets up,both markets down, the asset is up and real estate is down, the asset is down and real estate up. Target return is required. The target is normally set to the minimum return that the investor would be willing to accept, typicall the risk-free rate on bonds.		The application of MaxDD is in line with Sing and Ong, and use downside risk as their measure of risk and show that the allocation to real estate does not change substantially.Too few few investors appreciate the implications of the co-movement between investments that leads to correlation between assets. A breakdown of the imperfect correlation between direct real estate and the other asset classes to illustrate where the benefits originate.		The results suggest that for 70% of the time direct real estate would have contributed little to the return performance of alternative assets. Returns from direct real estate only offset the losses in the alternative asset about 30% of the time.However the increase in performance occures when the alterantive asset showed negative returns.Addition of direct real estate always leads to reduction in portfolio risk, espacially on the downside.By using the a four-quadrant table for each asset class, it is possible to see to what extent the investor really gains from holding direct real estate when it is most needed, i.e. where the losses in the asset class are offset by gains in direct real estate.Direct real estate mitigates the losses when both down and has limited upside. Thus if the goal is offsetting losses, then the results show that direct real estate may have been some benefit	
Hoesli M and Hamelink F	The maximum drawdown as a risk measure:The Role of Real Estate in the optimal portfolio revisited University of Geneva		MaxDD						Define the objectives of the portfolio

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Gold RB	Why the efficient frontier for real estate is fuzzy Journal of Real Estate Portfolio Management		MPT		Strict interpretation of MPT defines a portfolio as efficient and inefficient portfolio only if, it lies directly on the frontier. Any change in expected returns, risk, and or correlation between assets could potentially trigger a reallocation decision. However in the real world, real time changes in portfolio allocations are generally regarded as impractical. Data limitations: Data availability varies significantly across asset classes.Illiquidity also makes direct comparisons between real estate and other asset more difficult.How much of areturn premuim is required to compensate real estate investors for illiquidity.Smoothing effect boosts real estate's apperant risk-adjusted return and dampens its correlation with other assets. All else equal, have a tendency to artificially raise equity real estate's share within a mixed-asset portfolio.	MPT takes advantage of the diversification effect provided by multiple and less than perfectly correlated assets, allowing minimization of unsystematic risk and choice of exposure to systematic risk for any given level of return. Efficient market theories suggest that investors are not rewarded for bearing unsystematic risk and therefore should seek to minimize its presence.	In their pursuit of reduced unsystematic risk, investors diversify their holdings across assets that less than perfectly correlated asset returns have on volatility.Diversification is only relevant when risk/uncertainty is present.	MPT provides investors with an infinite number of efficient portfolios. Each of the portfolios along the efficient frontier provides the best expected returns for a given level of risk.	
Lee S	When does real estate improve portfolio performance, University of Reading, Centre for Real Estate Research,Reading	MPT methodologies hides where the reduction in risk originate	MPT	Traditionally most analysis considers the correlation between direct real estate and the alternative asset classes in examiningthe risk reducing benefits of adding property to increase diversification. The overThe returns are broken into positive and negative returns. This study examines the risk and return effects that would have been realised by a hypothetical investor who elected to add direct real estate to their existing assets. The assets are 60/40-equity/bond portfolio.Quarterly data returns for direct real estate,FTA index,government bonds from 1977 ; 2002all correlation coefficient is an average of a large number of concurrent asset movements in many economic and financial environments.	When does a holding in direct real estate contribute this increase in portfolio performance		Means and standard deviations are calculated to provide relative comparisons and correlations then calculated. The asset with the lowest correlation would usuaaly be a good candidate for risk reduction in portfolio through increased diversification.	Traditional methods of portfolio analysis based on the long run correlation averages fails to indentify in which periods real estate helps to reduce portfolio risk.The results suggest that for 70% of the time direct real estate would have contributed little to the return performance of alternative assets. Returns from direct real estate only offset the losses in the alternative asset about 30% of the time.However the increase in performance occurs when the alterantive asset showed negative returns.Addition of direct real estate always leads to reduction in portfolio risk, espacially on the downside.	
Lee S	When does real estate improve portfolio performance, University of Reading, Centre for Real Estate Research,Reading		MPT		Covariance of an investment	The lower the covariance of an investment with a portfolio, the higher its contribution to reducing risk of the portfolio, and so the greater the attrativeness of the investment to the portfolio.			
Lee S	The return due to diversification of real estate to US mixed asset portfolio:A paper presented to the 10th Annual European Real Estate Society,2003		MPT					Those assets that show the greatest RDD should show the greatest contribution to the compound return of the portfolio	
Yobaccio E, Rubens JH, Ketcham DC	The inflation-hedging properties of risk assets: the case for REITS Journal of Real Estate Research		Nominal rates of interest	Fisher model: nominal rate if interest is comprised of an appropriate equilibruim real interest rate and the expected inflation premuim. Fama and others extended the Fisher relationship to risky assets. Implicit in the model is the notion that the real return on the risk asset is independent of the level of expected inflation. During periods of high inflation or disinflation, investors may become more risk averse, and expect higher real returns on risk assets.				Park et al. Use two measures of expected inflation, a generalised Fisher equation from Fama and the Livingstone Price Expectations series. They find that REITs generally exhibit the same perverse hedging characteristics as common stock, although REITs appeared to be a partial hedge against anticipated inflation when using the LPE series against both expected and unexpected inflation.	
Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995		REIT performance				REIT Act of 1960 granted tax-exmpt status to REITs.After a slow start in the late 60s,and early 70s, rise rose almost 2000% from 1968-1973. The growth was fuelled by demand forconstruction and develoment financing. The boom was financed by funds borrowed through short-term commercial paper. Because of the large spreads between the rates for C&D loans and short term interest rates, most REITs made very high returns. As interest rates rose in 1972 the previously large spreads began to disappear, and eventually became negative after the oil crises in 1973. The NAREIT dropped by about 56.2%. REIT experienced structural changes during the late 1970 and 80s. Leverage was reduced from 64% in 1972 to 55% in 1984. In nominal terms, the industry's total assets rose from historical low of \$7.00 billion in 1980 to \$61.05 billion in 1993. Market capitalisation of the industry increased by 330% in nominal terms and 25% in real terms for the period 1972-1993.	Several studies show that actual returns from	

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Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995		REIT performance	Jensen performance measure index, is used to estimate the performance of REIT portfolios.Jensen is based on the CAPM. It compares the performnce of a security or a portfolio to the standard performance benchmark, the security market line. By assuming that the CAPM holds period by period, and that returns on securities generated by the market model, Jensen derived a linear expression between the realized returns on any security and its systematic risk, the realized returns on the market portfolio, the risk-free interest rate and random error. The Jensen index is used in performance studies because it measures performance based upon a simple and realistic benchmark, a passive manged portfolio that invests in savings accounts and the stock market portfolio. A positive and significant jensen index indicates a superior performance of a REIT portfolio relative to this portfolio (REITs outperforms), while negative is vice versa.	Methodological flaws from previous studies, use of unrepresentative sample periodsand use of S&P index as performance benchmark. Previous studies covered short period and inferences about REITs over a short period of time presents a serious problem in a volatile industry.The problem exists because of boom burst period in the REIT history.Secondly the S&P 500 has been used as a proxy for stock amrket portfolio. The S&P 500 is not a representative performancne benchmark because it does not include small stocks and most REITS are small cap	In the long term, it should be expected that the REIT industry portfolio would perform similarly to the stock market portfolio adjusted for risk, if the market is efficient and the CAPM holds.	Studies suggest that REITs performed poorly in the 70s. Ohters foud that REITs provided less than average returns during 1973-1976 recession period.Burns and Epley were slightly differnet, however. They investgated whether the efficient frontier of mixed-asset portfolios that consisted of REIT stocks and other common stocks dominated the efficient frontier for a single asset type and the S&P 500 for the for the period 1970 - 1979. . . Titman and Warga also found that the performance of REITs stocks is not significantly different from that of market portfolio over the period 1973-1982.They calculated and compared both CAPM and APT based on Jensen index. Studies since the 1980s have come to differenent conclusions	Summary of findings on the performance of REITs is inconclusive. The outcomes from REIT performance studies seem to be highly sensitive to the sample period studied.Burns and Eply found that the mixed-asset efficient frontier did dominate both, with respect to mean and variance at every risk and return level. Titamn and Warga found that both indexes for the entire period studied were not statistically different from zero.The market risk-adjusted returns on REIT stocks are about the same as the returns on the market index.	
Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995		REIT performance				The portfolio that most closely resembles the stock market portfolios in the US is the stock constructed by the CRSP. Overall, five of eight REIT portfolios have higher volatility per unit of mean return, measured by the coefficients of variation, six of eight portfolios have lower total risk-adjusted excess returns, measured by sharpe ratio	Equity REITs tend to perform better than hybrid and mortgage REITs.	
Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995	To test whether the difference in performance between REIT portfolios and a passive strategy of investing in the stock market portfolio and savings is statistically significant	REIT performance	Summary of mean, varaince , co variance and sharpe index is calculated.				All REIT portfolio performed similarly to the CAPM benchmark.REIT portfolios have larger Jensen indexes than their mortgage couterparts. This evidence clearly indicates that the REIT portfolios carry a smmler market risk than the stock market portfolio.	
Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995		REIT performance	8 REIT portfolios are constructed based on ex ante feasible for all,equity, debt and hybrid REITs.2 portfolios based on equally weighted and value weighted strategies are constructed.The REIT study includes 255 REIT stocks. Centre for Research Security Prices(CRSP) stock market portfolio is used. The portfolio is equally weighted and the CRSP portfolio will be used.Stability over time.Summary of mean, varaince , co variance and sharpe index is calculated. The study is broken into six year periods, 1970-1975, 1976-1981, 1982-1987, 1988-1993. They respond relatively well to the historical fluctuations of the real estate market, the boom and burst in the early 70s and recovery late 70 and expansion in the 80s and REIT tax reform in 1986. Mean returns and SD for each subperiod was calculated. T-test conducted for each subperiod.		The application of the Jensen index requires that the market portfolio, be ex-ante efficient and includes, theoretically, all available assets on the market.A comparison of statistics suggest that the performance of REIT stocks is about the same as or slightly poorer than that of the stock market portfolio over the sample period.	The portfolio that most closely resembles the stock market portfolios in the US is the stock constructed by the CRSP. Overall, five of eight REIT portfolios have higher volatility per unit of mean return, measured by the coefficients of variation, six of eight portfolios have lower total risk-adjusted excess returns, measured by sharpe ratio. On a systematic risk-adjusted basis, REIT performance was also unstable over time.Examination of Jensen indexes, suggest that there are substantial variations in the systematic risk-adjusted performance for different subperiods. The equally weighted debt/euity REIT outperformed the stock market portfolio at 10% significantly during 1970-75. Both equally value weighted signifiacntly outperformed at 5% in the 1976-81 subperiod.	REITs performed differently in different subperiods. 1970-75, all equally weighted REIT portfolio earned a negative return, and the following 3 subperiods the equally weighted portfoliohad positive returns. All eight REIT portfolios had the highest mean returns in the 1976-1981 subperiod. T- test results indicate that the mean returns are indeed significantly different between subperiods 70 - 75, 76 -81 for seven of the eight. Equally weighted portfolios equity REIT performed significantly worse in 1982-1987, than in 1976-1981. Jensen index suggest that there are substantial variations in the systematic risk-adjusted performance in the different subperiods. Studies focus on short time periods and come to different conclusions. Findings on short-term peromance in any subsequent periods, nor are they reliableindicators of the long-term performance of REITs stocks.	
Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995		REIT performance	T-test results				On a systematic risk-adjusted basis, REIT performance was also unstable over time.Examination of Jensen indexes, suggest that there are substantial variations in the systematic risk-adjusted performance for different subperiods. The equally weighted debt/euity REIT outperformed the stock market portfolio at 10% significantly during 1970-75. Both equally value weighted signifiacntly outperformed at 5% in the 1976-81 subperiod.	
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva		Returns and risk	Asset returns are shrunk to global mean of each asset class. BS is applied for various levels of risk. For countries with appraisals concerns, desmoothing variant called Geltner is used		This is a variant of the repeat sales method whereby pairs are formed with appraised values and transaction price. Repeated- regression method.	Summary of statistics for the various asset classes	Stocks constitute the highest return and risk asset class, while cash exhibits low return and risk parameters. Bonds appear to have a higher return and risk than cash. Real estate securities varies quite substantially from different countries across	
Gold RB	Why the efficient frontier for real estate is fuzzy Journal of Real Estate Portfolio Management		Returns and risk	Alternative approach to applying MPt to asset allocation.	Unique problems that real estate presents to practitioners of MPT	In the world of asset allocation, risk is divided into two components: Systematic and unsystematic risk. Systematic risk is the force to which all investments within market are subject and which therefore must be borne by all investors. Unsystematic risk is confined to to the perculiarities of an individual investment and may be diversified away.Market vacancy, production and inflation are all part of systematic risk, while location, building age, tenant mix, and timing of lease rollovers are all examples of unsystematic risk.			

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Han J, Liang Y	Historical Performance of REITs Journal of Real Estate Research Vol 10 No 3 1995	Whether REITs performed differently from the market portfolio, on a risk-adjusted basis, over the 1970-1993 period and whether REIT performance varies over time.	Returns and risk	Evaluate the long term performance of REITs and stability over time and investigate the sensitivity of Jensec index.	Characteristics : In today's illiquid real estate market, REITs have attracted more and more attention as a liquid real estate investment vehicle, even from institutional investors such as pension funds. Determine whether outcomes of REIT performance studies are sensitive to the choice of performance benchmarks and REIT samples	REITs are important vehicles in direct real estate ownership. Because such a high level of both resources and knowledge is required, REITs do not require the large and long term financial commitment typical of direct real estate investment. The ownership of most REITs can be easily transferred with very low transaction costs, since shares of most REIT stocks are publicly traded. REITs provide a mechanism to pool resources of private investors to gain the economic benefits of commercial real estate.	Unlike the apparently superior performance of unsecuritized real estate, most researchers' findings on REITs' performance, especially equity REITs, have been mixed, relative to the stock market portfolio. Other studies found that the performance of REIT stocks was worse than, or comparable to, the market portfolio; others found REITs outperformed the stock market and the debate over REIT performance continues.	REIT performance varied over time. This study found that the use of unrepresentative S&P 500 index as a performance benchmark tends to overstate REIT performance. The inconclusive findings are not a surprise, due to the short sample periods used in the previous studies for an industry prone to boom and bust. The S&P 500 index, which contains large capitalization stocks, has been used as the performance benchmark for the majority of previous studies, even though REITs are small capitalisations.	
Norman E.J, Sirmans GS, Benjamin JD	Historical Environment of Real Estate Returns Journal of Real Estate Portfolio Management Vol No		Returns and risk	Comprehensive review of the existing literature		A review of the extensive existing literature reveals that comparisons of nominal real estate returns on other assets has produced mixed results.	Most studies show that provide a comparison show that real estate has higher absolute returns than debt (such as bonds). The performance of real estate, in comparison to common stocks, is mixed. When comparing general real estate returns with returns from stocks or bonds, most studies agree that trends in returns from both groups are not consistent.	Slightly more than half of the studies that provide a direct comparison show a higher average return for stocks than for real estate. Some research demonstrated that real estate investments have outperformed debt and other fixed income securities, while other research finds that common stocks have outperformed real estate investments. On a risk-adjusted basis, most of the literature shows that real estate investments have a higher return per unit of risk than common stocks. When absolute risk of the investment is analyzed, the results are nonconclusive. Several studies show that actual returns from real estate outperform returns from other investments, such as stocks and bonds.	
Norman E.J, Sirmans GS, Benjamin JD	Historical Environment of Real Estate Returns Journal of Real Estate Portfolio Management Vol No		Returns and risk				When comparing general real estate returns with returns from stocks or bonds, most studies agree that trends in returns from both groups are not consistent.	Several studies show that actual returns from real estate outperform returns from other investments, such as stocks and bonds.	
Lee S	When does real estate improve portfolio performance, University of Reading, Centre for Real Estate Research, Reading	Adding direct real estate to the other asset should result in lower portfolio risk especially on the downside	Smoothing	Adding a direct real estate holding of 5 to 20% to asset classes and calculating the risk the return of the resultant portfolio in the 4 quadrants. Calculate the overall average return and two measures of risk, standard deviation and semi-standard deviation, a measure of downside risk.				Adding real estate direct real estate to another asset class would probably lower overall returns, but may increase increase returns when it is most needed when the alternative asset shows negative returns. The most benefit comes when the asset class shows negative returns, as expected. When holding 20% in direct real estate to an equity portfolio, when equities have negative returns and direct real estate is showing positive performance, the gain (reduction in risk loss) in return is 36.9%... Even in worst cases when both markets are showing negative returns there is a reduction in the loss for the portfolio of 12.4%. Direct real estate reduces the upside potential of asset classes but compensates the investor by reducing the risk.	
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance, Volume 6 no 3 pp 60-83 1995	Reconsider "Case for real estate in a multi-asset portfolio"	Returns and risk	Summary of statistics Expected return of portfolio, standard deviation and parameters from 1971-1993(22 years)	Extreme results may arise when such an optimizing model is applied to a multi-asset portfolio including property, with some assets taking zero weights while others have large allocations		Potential contribution to diversification that real estate can provide. Risk return characteristics		
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance, Volume 6 no 3 pp 60-83 1995		Smoothing	Smoothed property returns (unconstrained) 3 asset classes. Maximum return, maximum risk portfolio places all of the portfolio in equities. Property rapidly appears appears in the mix, rising to a maximum of 70.5 at the minimum-risk end of the frontier. Along most of the frontier, the portfolio consists of only real estate and stocks, until bond replace stocks at the low risk end of the frontier	1. Unrealistic results stem from the fact that, most measures of property return are appraisal rather than market based, the volatility of property returns has been considerably understated. The case for property is therefore needs to be reassessed with more acceptable data in a more representative context	The case for real estate can be made better by the application of representative constraints on asset weight and by adjusting the property data series to compensate for appraisal bias.		Property seems to have desirable low risk as measured by standard deviation. The level of risk is lower than the mean return. This contrast with the market-based returns of equities and bonds and provides first indication that property are not actual market returns. The addition of cash alters the situation. Cash takes the position of property and property moves down to the position of bonds in 3 asset portfolio. The resultant efficient frontiers are unrealistic and academic. It is unlikely that an institution will invest 82%	Comment on discount to premium to NAV. Smoothing variant not defined
Chatrath A, Lian Y	Reits and Inflation: Along -Run perspective () Journal of Real Estate Research Vol no		Securitized			The evidence from unsecuritized real estate has been far more favourable. Rubens find that residential, commercial and farmland real estate provide at least partial hedges against inflation.	Inflation decomposition technique allow for a stochastic trend component in the inflation proxies	Prior findings	
Chatrath A, Lian Y	Reits and Inflation: Along -Run perspective () Journal of Real Estate Research Vol no		Securitized	Adds the two (problem) and also extend prior studies by conducting standard regression tests on the short-run relationship between REIT returns and the permanent and temporary components of inflation	Smoothing bias causes the divergence between REITs and unsecuritized real estate or could it also be the result of the behaviour of REITs themselves. It is now well documented that REITs have a substantial stock market component, and stock returns have tended to be negatively related to the rate of inflation	The evidence from unsecuritized real estate has been far more favourable. Rubens find that residential, commercial and farmland real estate provide at least partial hedges against inflation.	Inflation decomposition technique allow for a stochastic trend component in the inflation proxies		
Gold RB	Why the efficient frontier for real estate is fuzzy Journal of Real Estate Portfolio Management		Securitized		While stocks are constantly marked to market expectations for future equity real estate are normally derived from a limited dataset. Second, transaction times, while extremely short in the stock and bond markets, can be exorbitantly long for direct real estate. In a mixed portfolio, transaction times can have a significant impact on expected returns. Institutional investors need to be convinced that expected shifts in risks and returns are permanent, not transitory				
Lee S	The return due to diversification of real estate to US mixed asset portfolio: A paper presented to the 10th Annual European Real Estate Society, 2003		Smoothing	Data desmoothed			A mixed-asset portfolio was constructed, without real estate and its compound return, contribution return and RDD calculated. The weightings are selected to represent a typical institutional portfolio.		

Author	Research Report/Source/Year of Review	Research Hypothesis	Research Area	Research Methodology	Research problem	Literature Review - Theory	Empirical Research	Findings/Conclusions	Comments
Hoesli M and Hamelink F	The maximum drawdown as a risk measure:The Role of Real Estate in the optimal portfolio revisited University of Geneva		Smoothing	While research is divided as to whether smoothing bias exist and whether it can be appropriately corrected, it seems that the issue is more of concern when comparing direct real estate with market based securities. Geltner desmoothing applied.				Direct real estate shows the lowest risk. The correlation between the three assets and real estate are all zero and significantly lower than between bonds and equities. Consequently adding direct real estate to these assets should significantly reduce portfolio risk	There is no desmoothing process that is perfect and the choice of method may bias the results
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance, Volume 6 no 3 pp 60-83 1995		Smoothing	Results using desmoothed	The errors accumulate than cancel one another. The expected return of the efficient frontier portfolio is overstated, while its risk is understated. 2ndly efficient portfolios risk and return misestimated, but this will be the wrong portfolio. Impose upper and lower bounds on the proportion of the portfolio allocated to any single asset, as would be expected in a real world situation			As theta is increased, the risk of property, measured by the standard deviation increases considerably, more than doubling in value from the smoothed case. Property now significantly positively correlated with equities and bonds, although less significant between bonds and equities. This indicates that property would still remain attractive in the MPT optimizer	BS has an intuitive appeal, in that returns are shrunk towards an asset class global mean, implying less dependence on the specific national returns.
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva		Smoothing	Returns are smoothed, unlike many studies. Total returns are reconstructed by adding the actual income return to the desmoothed data		For international real estate, exchange rate changes are discussed. Consider unhedged and hedged returns		In Sweden and the Netherlands, real estate stocks exhibit a lower return than cash, while their standard deviation is quite high. In France, the return on real estate stocks is only marginally higher than that on cash. In the US and UK, the return on real estate securities lies between that of stocks and bonds, but the standard deviation of securities real estate is higher than that of common stocks. Switzerland is the only country in which mean-variance efficiency is not violated, the standard deviation on real estate stocks lies between that of stocks and bonds, but the indirect real estate return is only marginally higher than that on bonds. Australia the return and risk parameters of real estate securities are favourable: the return is higher than stocks, while standard deviation lies between that of bonds and stocks. UK and Netherlands exhibit lower return than bonds, but a higher return than cash	
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva		Smoothing	BS estimators are performed for various levels of standard deviation for direct real estate. Four levels of standard deviation are considered. Compute the distance between the standard deviation of real estate with raw returns and standard deviation of desmoothed.				When real estate securities are compared to the desmoothed direct real estate investments, the levels of risk appear quite comparable in 5 of the 7. US and UK, the standard deviation of indirect real estate is substantially higher than that of desmoothed real estate data.	
Lee S	When does real estate improve portfolio performance, University of Reading, Centre for Real Estate Research, Reading		Smoothing	While research is divided as to whether smoothing bias exist and whether it can be appropriately corrected, it seems that the issue is more of concern when comparing direct real estate with market based securities. Geltner desmoothing applied.				Direct real estate shows the lowest risk. The correlation between the three assets and real estate are all zero and significantly lower than between bonds and equities. Consequently adding direct real estate to these assets should significantly reduce portfolio risk	There is no desmoothing process that is perfect and the choice of method may bias the results
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance, Volume 6 no 3 pp 60-83 1995		Smoothing	Appraisal-based data, Smoothed property returns (constraint) Property limited to not more than 20% . Viable for asset class, stocks between 40-60%, range of UK pension holding for the last 25 years. And next, cash is constraint at 6%.				Property because of risk/return characteristics, rapidly rises to constrained maximum, equities remain constant, but fall from constrained maximum to the constrained minimum. Bonds unconstrained strats from 40% falls rapidly as property rises to maximum and rise to 40%. Property because of risk/return characteristics, rapidly rises to constrained maximum, equities remain constant, but fall from constrained maximum to the constrained minimum. Bonds unconstrained strats from 40% falls rapidly as property rises to maximum and rise to 40%.	Constraining: what's the ideal world is unknown as a result of market imperfections
Byrne P & Lee S	Is there a place for property in the multi-asset portfolio Journal of Property Finance, Volume 6 no 3 pp 60-83 1995		Smoothing	Appraisal-based data, Smoothed property returns (constraint) Property limited to not more than 20% . Viable for asset class, stocks between 40-60%, range of UK pension holding for the last 25 years. And next, cash is constraint at 6%. Appraisal data leads to smoothing in the return series, and to an understatement of the true risk. Desmoothing result in poorer risk/return attributes and therefore lower weight to property even in unconstrained portfolio	The consequence is an overallocation to property relative to other asset classes. Approaches to removing smoothing are considered		Summary of statistics for the various asset classes	It should be noted that the risk/return characteristics of the constrained portfolio are markedly different when compared with the unconstrained case. The minimum variance is higher by 62 bpts, although the risk is considerably higher at 9.16%, compared with 2.45% for the unconstrained, a rise of 670 bpts.	Research report focuses on appraisal data
Kuhle JL	Portfolio Diversification and Return Benefits - Common Stocks vs REITs Journal of Real Estate Vol No	The portfolio risk level, measured by portfolio SD, for equity real and mortgage REIT portfolios is not significantly lower than the risk level for common portfolios.	Total portfolio Risk	Overall performance of portfolios is determined by a return/risk ratio. The various ratios are then tested for each category to determine if significant differences exist. The research consists of ex-post monthly prices and dividends for a total of 82 firms. Period under review 1980 -1985. Monthly return values were then used to create portfolios of various size within five portfolio categories. 1. Equity REIT portfolios 2. Mortgage REIT portfolios 3. Common Stocks portfolios 4. Mixed portfolios of equity REITs and Common Stock 5. Mixed portfolios of mortgage REITs and common stock. Within each category, a total of 600 portfolios were created containing various levels of assets. 50 random portfolios were created containing 12 assets of each and portfolios were equally weighted. SD was also calculated on the basis of equal weighting			The effects of portfolio diversification on risk was analyzed. The amount of total risk reduction occurring for the five portfolio asset categories when the total number of assets in the portfolios are increased from one to twelve. The results suggest that as the total assets in various portfolios are increased, a substantial reduction in risk results.	The amount of total portfolio risk reduction occurring for the five portfolio asset categories when the total number of assets are increased from one to twelve. The results suggest that as the total assets in various portfolios are increased, a substantial reduction in risk results. The absolute magnitude of SD for REITs is less than that for common stocks. Mixed-asset categories (number of REIT asset included in portfolio ranges from 1 to 11). The magnitude of the portfolio SD can be significantly reduced by including REIT stocks in portfolios of common stock. In addition, the magnitude in risk reduction is greater for mixed portfolios of common stock plus equity REITs than for mixed portfolios of common stock and mortgage REITs	

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Kuhle JL	Portfolio Diversification and Return Benefits - Common Stocks vs REITs Journal of Real Estate Vol No		Total portfolio Risk	The Z test was used to determine the statistical difference between various portfolio categories. 95% confidence was selected in calculating a critical value of 1.64 .				At an alpha level of 5%, the hypothesis will be rejected if the Z score registers above 1.64The calculated Z score are all above 1.64. The implication, under assumptions of normal distribution, is that risk levels of common stocks portfolios are substantially higher than the risk levels of equity and mortgage REIT portfolios. Therefore, these results suggest that a typical investor might be better off holding portfolios comprised of equity REITs rather than portfolios of common stocks	
HOESLI M, Lekander J and Witkiewicz W	International evidence on real estate as a portfolio diversifier International Centre for Financial Management and Engineering University of Geneva		Total portfolio risk	For each of the seven countries, an investigation of the impact of including direct domestic real estate in portfolios containing financial assets and real estate. The impact is measured by the reduction in risk that results from including domestic real estate. Weight allocated is analysed.				When BS model applied, domestic real estate returns appear negatively correlated to bonds except Netherlands. A negative relation is also found between domestic real estate and international bonds, except for Netherlands and Switzerland where the relationship is positive. In contrast, real estate appear negatively correlated with both domestic and global stocks. The only exception is Australia where correlation is negative	BS has an intuitive appeal, in that returns are shrunk towards an asset class global mean, implying less dependence on the specific national returns.

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Gold RB	Why the efficient frontier for real estate is fuzzy Journal of Real Estate Portfolio Management	Adding direct real estate to the other asset should result in lower portfolio risk especially on the downside	Bootstrap ping	Rather than dealing with the difficulty associated with of using MPT-based asset allocation models because of the associated data problems, many institutions peg real estate allocation within a mixed-asset portfolio at some constant percentage. Within real estate property type, and geographic allocation decisions are often accomplished by using even more generic approaches. To illustrate uncertainty is a factor for asset allocators, total returns for Office, retail, apartment and industrial were recreated using bootstrapping	The problem is less acute for stock and bond returns, not only because they are high-frequency, transactional based series, but because data are available for longer periods	Bootstrapping was considered the most appropriate methodology for recreating the true distribution of future returns, given limited historical private real estate data, and therefore limited volatility of the series.	Generally, the bootstrap methodology has a tendency to more evenly distribute the intra-asset weightings within a portfolio. Assets with largest weights will have their allocations reduced, while assets with the smallest weights will receive a higher allocation. A base efficient frontier is created using a sixty-month holding period with an illustrative dataset of expected property type performance and correlations		