The Long-Term Advantages to Incorporating Indirect Securities in Direct Real Estate Portfolios

Executive Summary. *This study examines the long-term diversification opportunities potentially available to real estate managers from using firstly real estate investment trusts and secondly international real estate securities as a diversification tool. The results show that when optimal direct real estate portfolios are used as the base, while indirect securities do gain allocations in the extended optimal portfolios, the improvement in performance is not statistically significant. However, when the national NCREIF Index is used, thereby assuming a diversified direct market portfolio, significant results are obtained.*

by Simon Stevenson*

Introduction

Numerous studies have examined the potential diversification benefits available to institutional fund managers from investing in the direct market. The rationale behind such an argument is primarily concerned with the low correlation the asset tends to have against the mainstream capital market asset classes, and the relatively attractive risk-return characteristics of real estate.[1] However, little research has turned this argument around and examined the potential benefits for a real estate portfolio manager from allocating part of their portfolio to capital market assets, and in particular indirect real estate vehicles such as real estate investment trusts (REITs). The rationale behind the diversification opportunities available remain, however, additional benefits also occur. While the real estate manager potentially benefits from obtaining enhanced diversification opportunities, the manager also benefits due to the inclusion of a liquid asset in the portfolio. At an active management level, indirect securities could be used to quickly alter exposure in the portfolio and provide the fund with a liquid asset, as an alternative to cash, that is real estate related. Yet despite these potential advantages, evidence would indicate that in many cases real estate fund managers do not manage equity real estate positions, nor are they viewed as part of the real estate portfolio. Worzala and Bajtelsmit (1997) surveyed sixty-seven real estate portfolio managers, finding that approximately half of the funds surveyed consider REITs to be part of the real estate portfolio, while the other half viewed the

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securities as being part of the common stock portfolio.

Using the Gibbons, Ross and Shanken (1989) methodology, this article assesses the potential improvements in performance resulting from extending United States real estate portfolios, based on both sector and regional diversification, into indirect securities, first at a national and then an international level. The initial analysis incorporates the three REIT sectors, namely equity REITs, mortgage REITs and hybrid REITs. The use of the sectors rather than an overall measure of the REIT sector should also allow a clearer analysis of potential benefits, in particular from the mortgage sector. The analysis then incorporates non-American real estate securities. This section of the paper in effect has a two-fold focus. First, it extends the preceding analysis by examining the benefits from extending a direct real estate portfolio into indirect securities. Second, it builds on the existing literature, such as Eichholtz (1996a), Liu and Mei (1998) and Stevenson (2000), to examine the potential benefits from diversifying internationally in an indirect real estate portfolio. The perceived benefits from international diversification in the indirect sector also relates to the often-found reluctance of managers to diversify into overseas markets. Studies such as Newell and Worzala (1995) and Worzala and Newell (1997) have found that real estate portfolio managers tend to concentrate in their domestic markets, with a large number having no foreign holdings. The requirement for more direct and active management of real estate, the in-depth knowledge required of local legislation and the generally high cost of the investment, all further contribute to the small scale of international portfolios. However, the use of foreign indirect vehicles may provide an alternative means in obtaining some degree of exposure to international markets.

The remainder of the article is constructed as follows. Initially a brief review of the relevant existing literature is presented, while the data requirements and the methodology adopted in this study are then discussed. The following section provides details of the domestic and international empirical tests, while the final section provides concluding comments.

Literature Review

Previous studies that have examined the relationship between the direct and indirect real estate markets have tended to find little commonality in the relationship.[2] Liu, Hartzell, Greig and Grissom (1990) find evidence that the direct real estate market is segmented in terms of the capital markets, while they cannot reject the hypothesis that REITs are integrated with common equities. Evidence with regard to the integration of REITs and common stocks has also been found in studies such as Mei and Lee (1994) and Li and Wang (1995). Ling and Naranjo (1999) use multi-factor asset pricing techniques to examine whether there is any evidence of integration between direct real estate, REITs and common stocks. As with previous studies, REITs are found to be integrated with non-real estate equities, however, no such evidence is found in relation to the direct market, even when this data is adjusted for smoothing. Quan and Titman (1999) examine the relationship between common stocks and both capital and rental values for selected city office markets in seventeen countries. The results indicate that on a short-term annual basis, the direct market is not related with the respective domestic equity market. However, when the data is amalgamated and examined over longer horizons, commonalities are evident. An alternative approach in the analysis of the inter-relationship between direct and indirect real estate and the common equity market is to use cointegration methods. A number of recent studies have utilized such approaches, generally finding little evidence of integration between the direct and indirect property sectors (*e.g.*, Wilson, Okunev and Webb, 1998).[3]

A further issue that has been examined in the literature and is of relevance in terms of the current study is whether there are any causal relationships between the indirect and direct markets. Articles such as Myer and Webb (1994), Barkham and Geltner (1995, 1996) and Seiler, Webb and Myer (1999) find evidence of the indirect market leading the direct, indicating that real estate securities incorporate information into prices quicker than appraised values. The relevance of this issue to the current study revolves around the fact that

indirect securities could therefore be used as timing devices in picking up market movements in advance of when they are incorporated into appraised values. In addition, such evidence highlights the apparent segmentation of the two markets and the diversification opportunities that may occur from using indirect securities within the context of a direct real estate portfolio.

Giliberto (1990) and Giliberto and Testa (1990) both examine the potential benefits in diversification that may occur from the inclusion of indirect securities in a direct market portfolio, however the statistical significance of performance improvements was not estimated. Eichholtz (1996a) compared the relative benefits of diversifying internationally into both real estate securities and equities, finding that real estate stocks provided greater diversification opportunities than common stocks. Liu and Mei (1998) also found that property stocks provided some degree of incremental diversification benefits on an international scale. While the authors reported that currency fluctuations accounted for a larger proportion of return variability in comparison to common stocks, even if the currency risk is hedged real estate firms do provide incremental diversification benefits. Gordon, Canter and Schuin (1998) add further supporting evidence in that the inclusion of international property stocks increases the efficiency of international equity portfolios substantially. Eichholtz, Huismand, Koedijk and Schuin (1998) adopt a slightly different approach and examine whether continental factors are a factor in the diversification opportunities that may occur with international real estate security investment. The study finds evidence of continental factors present in both Europe and North America, however no such corresponding evidence is found in relation to the Asia Pacific-Rim region.

Stevenson (2000) examines the diversification benefits available from international investment in real estate securities from the perspective of ten international markets using the Gibbons, Ross and Shanken (1989) model. The results show that when local returns are used, under an assumption of perfect hedging ability, the improvement in performance resulting from diversification is statistically significant. If however, it is assumed that the fund manager does not partake in any hedging strategy, with spot foreign exchange rates used throughout, the results are only significant for three of the ten markets, namely, Japan, the Netherlands and Singapore. In the remaining cases, diversification of an indirect portfolio does not provide statistically significant improvements in performance. Stevenson (2001) concentrates on the issue of out-of-sample performance, finding that by addressing the issue of estimation error, either through the use of Bayes-Stein estimators or the minimum-variance portfolio, improved out-of-sample performance may occur. The analysis is based on rolling portfolios. When transaction costs are incorporated into the analysis, the minimum variance portfolio continues to out-perform the Bayes-Stein, tangency and equally weighted portfolios at statistically significant levels.[4]

Data and Methodological Framework

The primary data sources are the NCREIF and NAREIT indices, with the analysis conducted on a quarterly basis from 1976 to 1998. The analysis initially begins from the perspective of an American real estate fund. We calculate the optimal real estate portfolios, using the NCREIF sector indices first and then the regional indices. These alternative starting points are then expanded by the introduction of the indirect securities. Initially, the three NAREIT sectors are introduced. The analysis is then extended to incorporate international real estate securities from a total of ten markets namely Australia, Belgium, Canada, France, Hong Kong, Italy, Japan, the Netherlands, Singapore and the United Kingdom.[5] For each of the ten markets the Datastream real estate indices are used. Due to the well-observed home bias effect in international diversification, the international tests are also re-calculated with the constraint that the foreign markets have a maximum allocation of 25% of the overall indirect allocation (see Cooper and Kaplanis, 1992; and Tesar and Werner, 1995).[6]

All of the data is analyzed on a quarterly basis, while with regard to the international markets the data is analyzed on the basis on local returns, thereby implicitly assuming perfect currency hedging ability. It should be noted that the relaxation

of this assumption would lead to alternative findings; however, the advantage to such an approach is that no assumption is required concerning the nationality of the fund. Stevenson (2000) finds that in the context of real estate security portfolios, as with existing evidence with equities, the assumed nationality of the investor can lead to significant differences in both the composition and performance of the optimal portfolios. Throughout the empirical tests, it is assumed that investors cannot partake in short selling. While obviously this is impossible in the direct real estate market, the fact that many institutions are restricted in this regard with respect to capital market assets makes the assumption realistic. A final issue in relation to the assumptions made with concern to the estimation of the optimal portfolios is that of appraisal smoothing. Recent articles such as Lai and Wang (1998) have argued that the use of appraisal-based returns may result not in a lower variance, but a higher variance than that of the underlying properties. However, even if one accepts this argument, the problem of cross-autocorrelation and temporal aggregation, as demonstrated in articles such as Brown and Matysiak (2000) and Geltner (1993a), necessitates that the tests are re-examined using some form of unsmoothed series. For the purposes of this articles, a simple first order autoregressive model is used to adjust for potential biases in the direct market return series' (see Blundell and Ward, 1987).[7]

In order to formally assess the improvement in performance from extending the portfolios in the alternative scenarios, we utilize the methodology proposed by Gibbons, Ross and Shanken (1989). This method compares the performance, in terms of the maximum Sharpe ratios obtained, with the original and extended data sets. Previous studies to have utilized this approach in the context of real estate include Rubens, Louten and Yobaccio (1998), Cheng and Liang (2000) and the aforementioned Stevenson (2000). Rubens et al. examine whether the inclusion of real estate into a capital market portfolio results in a significant improvement in performance. The findings indicate that whether real estate is adjusted for smoothing or not, any improvement in performance resulting from its inclusion is not statistically significant. Chen and Liang (2000) use the procedure to compare the ex ante and ex post performance of optimal portfolios. The authors find that optimal direct market portfolios significantly outperform naive strategies in sample, but not so on an out-of-sample basis. The Gibbons et al. (1989) test can be formulated as:

$$F = \frac{\frac{(T - N_2)}{N}(\hat{\theta}_2^2 - \hat{\theta}_2^2)}{(1 + \hat{\theta}_1^2)} \tag{1}$$

Where $\hat{\theta}_1$ is the initial maximum Sharpe ratio, $\hat{\theta}_2$ is the maximum Sharpe ratio from the expanded data set, T is the number of observations, N_1 is the number of core assets, N_2 is the number of total assets and N can be defined as $N_2 - N_1$. The statistic has a F-distribution with $(T - N_2, N)$ degrees of freedom. As the above test assumes that short selling can occur, simulations are necessary to approximate the F distribution. We follow the procedure adopted by Glen and Jorion (1993), and utilized by Stevenson (2000) in relation to real estate securities, to approximate the distribution. Initially, the historical returns, variances and covariances are calculated, with the returns modified so that the null hypothesis concerning the mean variance efficiency of the initial set of assets is satisfied. The optimal portfolio of N_1 assets that maximizes the Sharpe ratio is calculated, allowing only positive weights. The expected returns on the additional assets are than forced to be proportional to their beta relative to this market. This ensures that the optimal portfolio is the same for the sample of N_1 and N_2 assets. The set of simulated returns is obtained by drawing T random samples of joint returns from a multivariate standard normal distribution with these parameters. This provides a new vector of means and a new covariance matrix. The optimization is performed as before and the value of the F-Statistic recorded. In total, this process is repeated 1,000 times in order to estimate the empirical distribution of the statistic.

Empirical Analysis

Exhibit 1 provides details of the summary statistics of the various domestic series analyzed, while Exhibit 2 reports the correlation coefficients of the direct markets against the various indirect series. Exhibit 3 provides the full correlation matrix

Exhibit 1
Summary Statistics

		Average	Std. Dev.	Variance
NCREIF	All	2.15	1.84	3.39
	Offices	1.92	2.85	8.13
	Retail	2.12	1.61	2.59
	Industrial	2.27	1.75	3.06
	East	2.56	2.60	6.74
	South	1.83	1.73	2.99
	Midwest	1.99	1.64	2.71
	West	2.20	2.22	4.91
NCREIF Corrected	All	2.20	4.21	17.74
	Offices	1.98	5.18	26.81
	Retail	2.13	2.54	6.47
	Industrial	2.30	4.59	21.05
	East	2.60	5.09	25.89
	South	1.83	3.25	10.55
	Midwest	2.01	2.34	5.49
	West	2.21	2.89	8.35
Indirect Real Estate	EREITs	3.94	6.62	43.79
	MREITs	2.38	8.96	80.19
	HREITs	3.15	8.79	77.22
	Australia	5.13	13.84	191.54
	Belgium	2.87	11.30	127.64
	Canada	2.92	17.69	313.04
	France	2.34	16.18	261.81
	Hong Kong	5.19	22.78	519.07
	Italy	3.88	15.25	232.42
	Japan	1.37	16.11	259.42
	Netherlands	1.59	6.19	38.26
	Singapore	3.51	19.83	393.28
	U.K.	3.58	10.84	117.51

Notes: Exhibit 1 provides details of the summary statistics for each of the series analyzed over the entire sample period of 1976–1998.

among the different assets used in the empirical tests. It can be seen that the summary statistics do provide mixed evidence with regard to the attractiveness of including indirect vehicles such as REITs in a direct market portfolio. While in most cases the indirect vehicles do provide higher average returns, it is clearly noticeable that the volatility of the securities is far higher than either the original or the unsmoothed direct indices. Indeed, in a number of cases the indirect markets have lower returns as well as higher volatilities than the direct markets. However, the evidence from Exhibit 2 does reveal that the correlation coefficients with the direct market are either low positive or negative. This also applies to the majority of the international markets as well as the REIT sectors, the main exception being Canada, which has relatively high positive coefficients with the NCREIF and all of the sub-markets. It can be seen that the correlation coefficients between the alternative indirect markets are also relatively small, the highest being 0.56 being that between Hong Kong and Singapore (see Exhibit 3).

Exhibit 4 displays the optimal real estate portfolios that will act as the base portfolios throughout the empirical tests. The portfolios are created using both the sector and regional submarkets of the NCREIF database and are re-calculated with constraints. The rationale behind this is clear from the unconstrained portfolios that run into the common problem of corner solutions. The sector portfolios are split purely between the retail and industrial sectors, with a zero allocation in the office sector. Likewise, the regional optimal portfolios are dominated by the South and Midwest, with a nominal allocation in the West and a zero allocation in the East. The problem of corner solutions is well documented in the portfolio theory literature, and is of particular concern in this case due to the fact that those submarkets with small or zero allocations tend to be those that would comprise a major component of many institutional real estate portfolios. The sector portfolio is then re-estimated with a minimum allocation of 20%, while a figure of 15% is used with regard to the regional portfolio. While the figures imposed are by their nature arbitrary, the use of such constraints should provide some indication of the impact for fund managers pursuing a diversified policy and will avoid the problem of corner solutions. An alternative means of approaching this issue is to use the actual overall NCREIF index as the base real estate portfolio. The use of the national index will ensure that on the basis of either sector or regional diversification, the portfolio mirrors that held by national institutional investors.

Exhibits 5 through 7 detail the optimal portfolios and the F-statistics for performance improvement resulting from the inclusion of indirect vehicles. Exhibit 5 reports the findings when domestic REITs are incorporated. It is apparent that due to the high volatility estimates of the REIT sectors that their potential role in the tangency portfolios is limited, with the indirect sector obtaining a maximum allocation of 10.4% when the constrained sector portfolio is examined. In none of the cases examined is the *F*-Statistic estimated

Exhibit 2
Direct vs. Indirect Correlation Coefficients

	NCREIF	Offices	Retail	Industrial	East	South	Midwest	West
All REITs	−0.03	0.00	−0.15	0.00	−0.14	0.13	−0.01	0.00
EREITs	0.04	0.07	−0.10	0.05	−0.04	0.16	0.02	0.05
MREITs	−0.06	−0.04	−0.13	−0.01	−0.18	0.09	0.01	−0.04
HREITs	−0.07	−0.04	−0.20	−0.03	−0.16	0.10	−0.08	−0.03
Australia	−0.04	−0.03	−0.12	−0.01	−0.08	0.00	−0.06	0.01
Belgium	−0.04	−0.04	0.05	−0.04	−0.01	0.02	0.04	−0.10
Canada	0.19	0.11	0.24	0.17	0.12	0.19	0.15	0.19
France	0.06	0.04	0.10	0.01	0.03	0.07	0.06	0.05
Hong Kong	−0.05	−0.15	0.05	−0.06	−0.08	0.02	0.02	−0.06
Italy	0.17	0.18	0.10	0.13	0.23	0.13	0.15	0.10
Japan	0.07	0.04	0.11	0.11	0.02	0.09	0.12	0.07
Netherlands	0.03	0.02	−0.01	0.05	0.02	0.08	−0.02	0.03
Singapore	−0.09	−0.07	−0.15	−0.09	−0.05	−0.05	−0.18	−0.07
U.K.	0.09	0.11	0.04	0.03	0.18	0.06	0.10	0.01

Notes: Exhibit 2 reports the correlation coefficients between each of the direct and indirect markets examined over the entire sample period of 1976–1998.

found to be statistically significant at conventional levels, indicating that while REITs do obtain a place in the optimal portfolios, the resulting improvement in performance is not significant. Even in the case where the adjusted NCREIF indices are used, to account for possible smoothing in the data, the statistics are not significant, although the allocation to REITs does rise quite substantially. It should also be noted that although all three sub-NAREIT sectors are examined, only EREITs obtained any presence in the tangency optimal portfolios. Exhibits 6 and 7 report the corresponding tests with the extension to an international scenario. A number of issues become clear in these cases. Firstly, that the total allocation to the indirect sector is virtually identical as with the domestic case, with international markets largely acting as a replacement to REITs, rather than the direct market. This is also the case when the allocation in international markets is constrained to take account of home bias, with any reduction in the foreign allocation largely reverting back to the REIT sector. As with the domestic tests, none of the reported *F*-Statistics prove to be significant, however, given the movement in the allocations, as mentioned earlier, this is not that surprising.[8]

The F-tests are also re-calculated with fixed allocations in the indirect sector. This analysis is undertaken due to the high volatility observed in the indirect market and that the use of the tangency portfolios means that REITs and international securities are therefore always going to struggle to obtain substantial allocations in the optimal portfolios. For this section of the analysis, we combine the previously calculated direct and indirect sector optimal portfolios. It can be clearly seen from Exhibits 8 and 9 that in each scenario, using both the regional and sector data, that the introduction of both domestic and foreign securities does not result in a significant improvement in performance. The results are also re-estimated using the overall NCREIF index rather than the estimated optimal portfolios based on both the regional and sector data, however, similar results are also found.[9]

As discussed, the estimated optimal allocations with regard to the direct market are relatively undiversified; with small or zero allocations in key submarkets that would tend to play important roles in institutional portfolios. Because of the corner solutions obtained, the tests are re-calculated using the NCREIF overall index rather than the

Exhibit 3
Correlation Matrix

	NCREIF	Offices	Retail	Industrial	East	South	Midwest	West	Australia	Belgium	Canada	France	Hong Kong	Italy	Japan	Netherlands	Singapore	U.K.	All REITs	EREITs	MREITs	HREITs
NCREIF	1.00																					
Offices	0.94	1.00																				
Retail	0.74	0.53	1.00																			
Industrial	0.94	0.88	0.65	1.00																		
East	0.90	0.86	0.68	0.80	1.00																	
South	0.80	0.70	0.48	0.72	0.63	1.00																
Midwest	0.81	0.67	0.85	0.76	0.73	0.58	1.00															
West	0.93	0.90	0.62	0.93	0.73	0.68	0.66	1.00														
Australia	−0.04	−0.03	−0.12	−0.01	−0.08	0.00	−0.06	0.01	1.00													
Belgium	−0.04	−0.04	0.05	−0.04	−0.01	0.02	0.04	−0.10	0.18	1.00												
Canada	0.19	0.11	0.24	0.17	0.12	0.19	0.15	0.19	0.30	0.20	1.00											
France	0.06	0.04	0.10	0.01	0.03	0.07	0.06	0.05	0.27	0.45	0.11	1.00										
Hong Kong	−0.05	−0.15	0.05	−0.06	−0.08	0.02	0.02	−0.06	0.42	0.02	0.33	−0.02	1.00									
Italy	0.17	0.18	0.10	0.13	0.23	0.13	0.15	0.10	0.16	0.19	0.27	0.32	0.08	1.00								
Japan	0.07	0.04	0.11	0.11	0.02	0.09	0.12	0.07	0.36	0.40	0.21	0.33	0.18	0.18	1.00							
Netherlands	0.03	0.02	−0.01	0.05	0.02	0.08	−0.02	0.03	0.24	0.44	0.43	0.37	0.21	0.12	0.36	1.00						
Singapore	−0.09	−0.07	−0.15	−0.09	−0.05	−0.05	−0.18	−0.07	0.47	0.09	0.37	−0.01	0.56	0.23	0.19	0.34	1.00					
U.K.	0.09	0.11	0.04	0.03	0.18	0.06	0.10	0.01	0.45	0.27	0.39	0.21	0.33	0.25	0.34	0.40	0.50	1.00				
All REITs	−0.03	0.00	−0.15	0.00	−0.14	0.13	−0.01	0.00	0.43	0.27	0.41	0.28	0.23	0.30	0.39	0.34	0.28	0.41	1.00			
EREITs	0.04	0.07	−0.10	0.05	−0.04	0.16	0.02	0.05	0.42	0.25	0.39	0.34	0.26	0.32	0.46	0.33	0.30	0.44	0.94	1.00		
MREITs	−0.06	−0.04	−0.13	−0.01	−0.18	0.09	0.01	−0.04	0.35	0.26	0.37	0.06	0.29	0.13	0.28	0.30	0.19	0.27	0.83	0.67	1.00	
HREITs	−0.07	−0.04	−0.20	−0.03	−0.16	0.10	−0.08	−0.03	0.45	0.22	0.39	0.27	0.25	0.28	0.32	0.38	0.36	0.43	0.93	0.83	0.76	1.00

Notes: Exhibit 3 reports the full correlation matrix between all of the assets analyzed over the period 1976–1998.

Exhibit 4
Real Estate Portfolios

	Offices (%)	Retail (%)	Industrial (%)	East (%)	South (%)	Midwest (%)	West (%)	Mean	Variance	Std. Dev.
Sector Portfolio	0.00	54.39	45.61	0.00	0.00	0.00	0.00	2.19	2.30	1.52
Region Portfolio	0.00	0.00	0.00	0.00	33.80	61.46	4.75	1.95	2.27	1.51
Constrained Sector Portfolio	20.00	58.99	21.01	0.00	0.00	0.00	0.00	2.11	2.74	1.66
Constrained Region Portfolio	0.00	0.00	0.00	15.00	22.39	47.61	15.00	2.07	2.69	1.64

Notes: Exhibit 4 provides details on the allocations estimated for the sector and regional portfolios based on the respective NCREIF indices. It is assumed that short-selling cannot occur. The constrained sector portfolios limit the minimum allocation to 20%, while a minimum allocation constraint of 15% is used for the regional portfolios. The summary statistics for the portfolios are in-sample. These portfolios provide the alternative base portfolios on which performance improvement is assessed.

Exhibit 5
Domestic Real Estate and REIT Portfolios

	Offices (%)	Retail (%)	Industrial (%)	East (%)	South (%)	Midwest (%)	West (%)	REITs (%)	Mean	Variance	*F*-Statistic
Panel A: Original Real Estate Data											
Sector Portfolio	0.00	57.36	33.42	0.00	0.00	0.00	0.00	9.22	2.33	2.16	2.06
Region Portfolio	0.00	0.00	0.00	3.42	23.26	59.83	4.71	8.78	2.16	2.41	1.48
Constrained Sector Portfolio	13.44	60.87	15.28	0.00	0.00	0.00	0.00	10.42	2.30	2.45	2.23
Constrained Region Portfolio	0.00	0.00	0.00	3.42	23.26	59.83	4.71	8.78	2.16	2.41	3.92
Panel B: Unsmoothed Real Estate Data											
Sector Portfolio	0.00	77.68	0.00	0.00	0.00	0.00	0.00	22.32	2.53	5.64	8.38
Region Portfolio	0.00	0.00	0.00	0.00	0.00	56.39	26.73	16.88	2.39	4.93	5.25
Constrained Sector Portfolio	11.46	53.48	11.46	0.00	0.00	0.00	0.00	23.61	2.55	6.72	3.75
Constrained Region Portfolio	0.00	0.00	0.00	12.18	12.18	37.85	18.99	18.80	2.45	5.74	2.69

Notes: Exhibit 5 reports summary allocations for the optimal direct portfolios with the addition of domestic real estate securities. It is assumed that short-selling cannot occur. The *F*-Statistic provides details of the Gibbons, Ross and Shanken (1989) test for performance improvement.

sector and regional optimal portfolios. As would be expected, due to the fact that the NCREIF itself is suboptimal to the estimated optimal portfolios, the results differ quite substantially from those already discussed. It can be seen from Exhibit 10 that in the domestic case, while large *F*-Statistics are obtained, in neither the original or unsmoothed case is the statistic significant. This is primarily due to the small number of assets in both the original and expanded cases. However, when the analysis is extended to incorporate the international real estate securities, significant results are found. Therefore, if the analysis is taken from the basis of a diversified national direct market portfolio, the introduction of a combination of REITs and foreign securities does lead to an improvement in performance. This is also the case when the original NCREIF index is used and the allocation to indirect vehicles is less than 10%.

Conclusion

This study examines whether inclusion of indirect real estate securities can provide significant improvements in performance of direct market real estate portfolios. The analysis, undertaken using the Gibbons, Ross and Shanken (1989) approach, finds mixed evidence. When the analysis is based on optimal real estate portfolios, the inclusion of both REITs and international real estate securities does not result in significant improvements. This is the case when the portfolios are estimated simultaneously or on a sequential basis. However,

Exhibit 6
Direct Real Estate and Real Estate Securities Portfolios

	Offices (%)	Retail (%)	Industrial (%)	East (%)	South (%)	Midwest (%)	West (%)	REITs (%)	Int. RE Securities	Mean	Variance	*F*-Statistic
Panel A: Original Real Estate Data												
Sector Portfolio	0.00	57.09	33.27	0.00	0.00	0.00	0.00	7.36	2.28	2.36	2.15	0.90
Region Portfolio	0.00	0.00	0.00	1.96	23.45	60.69	4.84	5.97	3.09	2.16	2.32	0.73
Constrained Sector Portfolio	13.36	60.48	15.26	0.00	0.00	0.00	0.00	8.24	2.67	2.33	2.45	1.23
Constrained Region Portfolio	0.00	0.00	0.00	13.42	13.42	49.19	13.42	7.15	3.42	2.28	2.66	1.02
Panel B: Unsmoothed Real Estate Data												
Sector Portfolio	0.00	76.87	0.68	0.00	0.00	0.00	0.00	15.40	7.06	2.57	5.35	1.52
Region Portfolio	0.00	0.00	0.00	0.00	0.00	55.85	26.12	10.48	7.55	2.39	4.54	1.60
Constrained Sector Portfolio	11.29	52.70	11.29	0.00	0.00	0.00	0.00	14.69	10.04	2.58	6.24	1.45
Constrained Region Portfolio	0.00	0.00	0.00	12.00	12.00	38.01	17.97	11.83	8.21	2.48	5.37	1.32

Notes: Exhibit 5 reports summary allocations for the optimal direct portfolios with the addition of domestic and international real estate securities. It is assumed that short-selling cannot occur. The *F*-Statistic provides details of the Gibbons, Ross and Shanken (1989) test for performance improvement.

Exhibit 7
Constrained Direct Real Estate and Real Estate Securities Portfolios

	Offices (%)	Retail (%)	Industrial (%)	East (%)	South (%)	Midwest (%)	West (%)	REITs (%)	Int. RE Securities	Mean	Variance	*F*-Statistic
Panel A: Original Real Estate Data												
Sector Portfolio	0.00	57.09	33.27	0.00	0.00	0.00	0.00	7.36	2.29	2.36	2.15	0.90
Region Portfolio	0.00	0.00	0.00	2.48	23.08	61.03	4.20	6.91	2.30	2.17	2.34	0.72
Constrained Sector Portfolio	13.37	60.57	15.17	0.00	0.00	0.00	0.00	8.24	2.66	2.33	2.45	1.23
Constrained Region Portfolio	0.00	0.00	0.00	13.40	13.40	49.14	13.40	8.00	2.67	2.29	2.67	1.01
Panel B: Unsmoothed Real Estate Data												
Sector Portfolio	0.00	79.49	0.51	0.00	0.00	0.00	0.00	15.00	5.00	2.54	5.24	2.31
Region Portfolio	0.00	0.00	0.00	0.00	0.00	56.40	25.62	13.49	4.50	2.41	4.69	2.11
Constrained Sector Portfolio	12.00	56.00	12.00	0.00	0.00	0.00	0.00	15.00	5.00	2.53	6.14	1.68
Constrained Region Portfolio	0.00	0.00	0.00	12.00	12.00	38.35	17.66	15.00	5.00	2.51	5.54	1.63

Notes: Exhibit 7 reports summary allocations for the optimal direct portfolios with the addition of domestic and international real estate securities. It is assumed that short-selling cannot occur. To take account of issues such as home bias, the international real estate securities are constrained to a maximum of 25% of the overall real estate security allocation. The *F*-Statistic provides details of the Gibbons, Ross and Shanken (1989) test for performance improvement.

the optimal direct market portfolios estimated are corner solutions, with a limited presence in key institutional markets such as offices, the East and the West. The tests are therefore re-estimated using the actual NCREIF Index as the base portfolio in order to more accurately portray institutional portfolios. In this scenario, the inclusion of a mix of both domestic and international securities does lead to significant results. These results are also consistent whether the direct market data is adjusted for smoothing or not.

It should be acknowledged that the analysis conducted in this article is primarily based on the premise of long-term diversification. One key issue that is not covered by the preceding analysis is the potential benefits from using indirect vehicles as short-term timing devices. This is perhaps the greatest potential benefit for a real estate fund manager considering REITs, and other indirect vehicles, as portfolio assets. The high volatility found in the indirect sector is always going to mean that risk-adjusted asset allocation results are going to

Exhibit 8
Combination of Sector Real Estate and REIT Portfolios

	Optimal Portfolio	NCREIF
Panel A: Domestic REITs		
5% REITs	4.39	12.49
10% REITs	4.00	12.14
15% REITs	1.76	10.16
20% REITs	−1.58	7.20
25% REITs	−5.38	3.83
30% REITs	−9.24	0.40
Panel B: REITs and International Securities		
5% REITs	0.64	1.70
10% REITs	0.75	1.79
15% REITs	0.66	1.72
20% REITs	0.44	1.52
25% REITs	0.13	1.24
30% REITs	−0.23	0.92
Panel C: REITs and Constrained International Securities		
5% REITs	0.64	1.70
10% REITs	0.74	1.79
15% REITs	0.66	1.72
20% REITs	0.44	1.52
25% REITs	0.12	1.24
30% REITs	−0.24	0.92

Exhibit 8 reports the *F*-Statistics on the assumption that fixed allocations are given to the indirect markets. The already estimated optimal portfolios for both the direct and indirect assets are combined in line with the fixed allocation in real estate securities. Therefore, the portfolios tested may not necessarily be optimal in themselves.

Exhibit 9
Combination of Regional Real Estate and REIT Portfolios

	Optimal Portfolio	NCREIF
Panel A: Domestic REITs		
5% REITs	2.62	6.56
10% REITs	2.78	6.72
15% REITs	1.27	5.28
20% REITs	−1.27	2.88
25% REITs	−4.28	0.04
30% REITs	−7.39	−2.91
Panel B: REITs and International Securities		
5% REITs	0.40	0.91
10% REITs	0.56	1.06
15% REITs	0.55	1.06
20% REITs	0.41	0.92
25% REITs	0.18	0.71
30% REITs	−0.09	0.45
Panel C: REITs and Constrained International Securities		
5% REITs	0.40	0.91
10% REITs	0.56	1.06
15% REITs	0.55	1.05
20% REITs	0.40	0.92
25% REITs	0.17	0.70
30% REITs	−0.10	0.44

Exhibit 9 reports the *F*-Statistics on the assumption that fixed allocations are given to the indirect markets. The already estimated optimal portfolios for both the direct and indirect assets are combined in line with the fixed allocation in real estate securities. Therefore, the portfolios tested may not necessarily be optimal in themselves.

Exhibit 10
Performance Improvement from the NCREIF Index

	NCREIF	REITs	International	Mean	Variance	*F*-Statistic
Panel A: Domestic REITs						
Smoothed	0.88	0.12	0.00	2.36	3.34	22.07
Unsmoothed	0.57	0.43	0.00	2.94	15.08	27.76
Panel B: REITs and International Securities						
Smoothed	0.87	0.09	0.04	2.39	3.26	4.31*
Unsmoothed	0.57	0.25	0.19	2.92	13.03	3.85**
Panel C: REITs and Constrained International Securities						
Smoothed	0.87	0.10	0.03	2.39	3.28	5.45*
Unsmoothed	0.56	0.33	0.11	3.00	13.94	5.50**

Notes: Exhibit 10 reports summary allocations when the inclusion of indirect securities is allowed. The base direct market portfolio used for these tests is the national NCREIF index rather than the estimated optimal portfolios. This approach is used in order to avoid corner solutions. The *F*-Statistic provides details of the Gibbons, Ross and Shanken (1989) test for performance improvement.
* Significant at the 10% level.
** Significant at the 5% level.

be biased towards the direct market, however, such tests will not accurately pick up the short-term market timing benefits that investors could obtain. In such a case, a portfolio manager could use individual funds both to switch the exposure of the portfolio and to use indirect vehicles to gain access to markets where there are limited investment opportunities.

Endnotes

1. See for example Ross and Zisler (1991) and Kalberg, Liu and Grieg (1996).
2. Other papers to have examined the role and characteristics of REITs include Norman, Sirmans and Benjamin (1995), while Corgel, McIntosh and Ott (1995) provides an extensive review of the literature on REITs.
3. Further studies to have examined various aspects of this issue include Liu and Mei (1992), Gyourko and Keim (1992) and Pagliari and Webb (1995).
4. See also studies such as Gordon and Canter (1999) and Eichholtz (1996b), which have examined the relative stability of first, the correlation coefficients between real estate securities and common stocks and the stability of the covariances between international property stock markets.
5. Throughout this article, historical data is used in the construction of the estimated optimal portfolios. This obviously suffers from the bias that the parameters used are known with certainty and are not necessarily an accurate representation of future return and risk parameters. An alternative approach would be to estimate expected parameters for input into the optimization procedure. In addition, the article does not estimate the statistical significance of the estimated allocations, rather it relies on the estimated allocations. Articles that have examined this issue in a real estate context include Gold (1996), Liang, Myer and Webb (1996) and Ziobrowski, Cheng and Ziobrowski (1997).
6. While the figure used in the constrained tests to take account of home bias is arbitrary, it should provide an indication of the impact of the imposition of such constraints. In addition, as many real estate funds do not have any international exposure, whether in the direct or indirect markets, accurate constraints would limit international coverage to at most a minimal percentage.
7. Other alternative approaches to the issue of smoothing include the partial information model of Geltner (1993b) and the Latent Variable approach as used in Ling, Naranjo and Nimalendran (2000). As the primary purpose of the study is not the issue of smoothing, it was felt sufficient to use a single alternative approach in this regard.
8. In terms of the allocation into the international markets, the international portfolio is relatively undiversified, with the majority of the allocation being concentrated in Australia, Belgium and Singapore. In some of the scenarios examined, Hong Kong, Italy and the Netherlands also obtain allocations. The undiversified nature of these allocations should also be taken into account, especially as a number of the larger international markets do not obtain an allocation in any of the scenarios, the prime example being the U.K. The detailed results in terms of the allocations to individual international markets are available from the author on request.
9. As these tests use already estimated optimal portfolios and the allocations within the direct and indirect real estate portfolios are fixed, it can be seen that in a number of circumstances the *F*-Statistic estimated is negative. This finding indicates that the inclusion of high REIT allocations results in poorer performance of the portfolio.

References

Barkham, R. and D. Geltner, Price Discovery in American and British Property Markets, *Real Estate Economics*, 23, 1995, 21–44.

——., Price Discovery and Efficiency in the UK Housing Market, *Journal of Housing Economics*, 1996, 5, 41–63.

Blundell, C. F. and C. W. R. Ward, Property Portfolio Allocation: A Multifactor Model, *Land Development Studies*, 1987, 4, 145–56.

Brown, G. R. and G. A. Matysiak, Sticky Valuations, Aggregation Effects and Property Indices, *Journal of Real Estate Finance and Economics*, 2000, 14.

Chen, P. and Y. Liang, Optimal Diversification: Is it Really Worthwhile?, *Journal of Real Estate Portfolio Management*, 2000, 6:1, 7–16.

Cooper, I. A. and E. Kaplanis, Home Bias in Equity Portfolios, Inflation Hedging and International Capital Market Equilibrium, *Review of Financial Studies,* 1994, 7, 45–60.

Corgel, J. B., W. McIntosh and S. H. Ott, Real Estate Investment Trusts: A Review of the Financial Economics Literature, *Journal of Real Estate Literature*, 1995, 3, 13–43.

Eichholtz, P. M. A., Does International Diversification Work Better for Real Estate than for Stocks and Bonds, *Financial Analysts Journal*, 1996a, January–February, 56–62.

——., The Stability of the Covariances of International Property Share Returns, *Journal of Real Estate Research*, 1996b, 11, 149–58.

Eichholtz, P. M. A., R. Huisman, K. Koedijk and L. Schuin, Continental Factors in International Real Estate Returns, *Real Estate Economics*, 1998, 26, 493–510.

Geltner, D., Temporal Aggregation in Real Estate Return Indices, *Journal of the American Real Estate and Urban Economics Association*, 1993a, 21, 141–166.

——., Estimating Market Values from Appraised Values without Assuming an Efficient Market, *Journal of Real Estate Research*, 1993b, 8, 325–45.

Gibbons, M., S. Ross and J. Shanken, A Test of the Efficiency of a Given Portfolio, *Econometrica*, 1989, 57, 1121–52.

Giliberto, M., Global Real Estate Securities: Index Performance and Diversified Portfolios, *Salomon Brothers Bond Market Research*, 1990, February, 1–9.

Giliberto, M. and B. Testa, Global Property Share Performance by Geographic Region, *Salomon Brothers Bond Market Research*, 1990, August, 1–6.

Glen, J. and P. Jorion, Currency Hedging for International Portfolios, *Journal of Finance,* 1993, 48, 1865–86.

Gold, R. B., The Use of MPT for Real Estate Portfolios in an Uncertain World, *Journal of Real Estate Portfolio Management*, 1996, 2, 95–106.

Gordon, J. N. and T. A. Canter, International Real Estate Securities: A Test of Capital Markets Integration, *Journal of Real Estate Portfolio Management*, 1999, 5, 161–70.

Gordon, J. N., T. A. Canter and J. R. Webb, The Effect of International Real Estate Securities on Portfolio Diversification, *Journal of Real Estate Portfolio Management*, 1998, 4, 83–92.

Gyourko, J. and D. Keim, What Does the Stock Market Tell Us About Real Estate Returns?, *Journal of the American Real Estate and Urban Economics Association*, 1992, 20, 457–85.

Kalberg, J. G., C. H. Liu and D. W. Grieg, The Role of Real Estate in the Portfolio Allocation Process, *Real Estate Economics*, 1996, 24, 359–77.

Kandel, S. and R. Stamburgh, A Mean-Variance Framework for Tests of Asset Pricing Models, *Review of Financial Studies*, 1989, 2, 125–56.

Lai, T. Y. and K. Wang, Appraisal Smoothing: The Other Side of the Story, *Real Estate Economics*, 1998, 26, 511–36.

Li, Y. and K. Wang, The Predictability of REIT Returns and Market Segmentation, *Journal of Real Estate Research*, 1995, 10, 471–82.

Liang, Y., F. C. Myer and J. R. Webb, The Bootstrap Efficient Frontier for Mixed-Asset Portfolios, *Real Estate Economics*, 1996, 24, 247–56.

Ling, D. and A. Naranjo, The Integration of Commercial Real Estate Markets and Stock Markets, *Real Estate Economics*, 1999, 27, 483–515.

Ling, D., A. Naranjo and M. Nimalendran, Estimating Returns on Commercial Real Estate: A New Methodology using Latent-Variables Models, *Real Estate Economics*, 2000, 28, 205–32.

Liu, C. H., D. Hartzell, W. Greig and T. Grissom, The Integration of the Real Estate Market and the Stock Market: Some Preliminary Evidence, *Journal of Real Estate Finance and Economics*, 3, 261–82.

Liu, C. H. and J. Mei, The Predictability of Returns on Equity REITs and their Co-Movement with Other Assets, *Journal of Real Estate Finance and Economics*, 1992, 5, 401–18.

——., The Predictability of International Real Estate Markets: Exchange Rate Risk and Diversification Opportunities, *Real Estate Economics*, 1998, 26, 3–39.

Mei, J. and A. Lee, Is there a Real Estate Risk Premium?, *Journal of Real Estate Finance and Economics*, 1994, 9, 113–26.

Meyer, F. C. N. and J. R. Webb, Statistical Properties of Returns: Financial Assets versus Commercial Real Estate, *Journal of Real Estate Finance and Economics*, 1994, 8, 267–82.

Newell, G. and E. Worzala, The Role of International Property in Investment Portfolios, *Journal of Property Finance,* 1995, 6, 55–63.

Norman, E. J., G. S. Sirmans and J. D. Benjamin, The Historical Environment of Real Estate Returns, *Journal of Real Estate Portfolio Management*, 1995, 1, 1–24.

Pagliari, J. L. and J. R. Webb, A Fundamental Examination of Securitized and Unsecuritized Real Estate, *Journal of Real Estate Research*, 1995, 10, 381–426.

Quan, D. C. and S. Titman, Do Real Estate Prices and Stock Prices Move Together? An International Analysis, *Real Estate Economics*, 1999, 27, 183–208.

Ross, S. and R. Zisler, Risk and Return in Real Estate, *Journal of Real Estate Finance and Economics*, 1991, 4, 175–90.

Rubens, J. H., D. A. Louton and E. J. Yobaccio, Measuring the Significance of Diversification Gains, *Journal of Real Estate Research*, 1998, 16, 73–86.

Seiler, M J., J. R. Webb and F. C. N. Myer, Are EREITs Real Estate?, *Journal of Real Estate Portfolio Management*, 1999, 5, 171–82.

Stevenson, S. International Real Estate Diversification: Empirical Tests using Hedged Indices*, Journal of Real Estate Research*, 2000, 19, 105–31.

Stevenson, S., Bayes-Stein Estimators and International Real Estate Asset Allocation*, Journal of Real Estate Research*, 2001, forthcoming.

Tesar, L. L. and I. M. Werner, Home Bias and High Turnover, *Journal of International Money and Finance*, 1995, 14, 467–92.

Wilson, P., J. Okunev and J. R. Webb, Step Interventions and Market Integration: Tests in the US, UK and Australian Property Markets, *Journal of Real Estate Finance and Economics*, 1998, 16, 91–123.

Worzala, E. and V. L. Bajtelsmit, Real Estate Asset Allocation and the Decision Making Framework used by Pension Fund Managers, *Journal of Real Estate Portfolio Management*, 1997, 3, 47–56.

Worzala, E. and G. Newell, International Real Estate: A Review of Strategic Investment Issues, *Journal of Real Estate Portfolio Management*, 1997, 3, 87–96.

Ziobrowksi, A. J., P. Cheng and B. J. Ziobrowski, Using a Bootstrap to Measure Optimum Mixed-Asset Portfolio Composition: A Comment, *Real Estate Economics*, 1997, 25, 695–706.