Real Estate Investment Trusts

An asset allocation perspective.

Hsuan-Chi Chen, Keng-Yu Ho, Chiuling Lu, and Cheng-Huan Wu

Hsuan-Chi Chen
is a professor of finance at Yuan Ze University in Taiwan.
chenh@saturn.yzu.edu.tw

Keng-Yu Ho
is an assistant professor of finance at National Central University in Taiwan.
kengyuho@cc.ncu.edu.tw

Chiuling Lu
is an associate professor of finance at Yuan Ze University.
fincll@saturn.yzu.edu.tw

Cheng-Huan Wu
is a graduate student in finance at Yuan Ze University.
s918121@mail.yzu.edu.tw

Equity securities, debt instruments, and derivatives have become popular investment or hedging vehicles in the past century, while real estate, the most conventional investment asset, lost its allure in favor of liquid and tradable securities. Not until the 1970s did institutional investors start to show an interest in real estate in the United States (see Bernstein [2003]). Hudson-Wilson, Fabozzi, and Gordon [2003] cite five primary reasons for considering real estate for inclusion in an investment portfolio. The first is reduction in the overall risk of a portfolio when one combines asset classes that respond differently to expected and unexpected events.

Non-redundant financial assets can help improve the completeness of the financial markets and enhance risk-sharing among investors (Huang and Litzenberger [1988] and Ingersoll [1987]). Hudson-Wilson, Fabozzi, and Gordon [2003] show that real estate can play a significant role in a mixed-asset portfolio, enhancing portfolio performance. A complicated and lengthy evaluation process and the illiquidity of real estate often deter individual investment, but real estate investment trusts (REITs) have since the 1960s securitized real estate into tradable assets to broaden the investment spectrum for investors. REITs allow investors to participate in the real estate market without difficulty, and give them an opportunity to improve their investment performance.

Whether the addition of real estate assets can significantly expand the mean-variance efficient frontier

beyond stocks that are already publicly traded, to provide substantial diversification benefits for investors or fund managers, is an intriguing question. We examine the effect of the addition of REITs to portfolios on a mean-variance efficient frontier constructed by benchmark portfolios sorted by firm size and book-to-market ratio.

We are interested in two main questions. First, we want to know whether a REIT portfolio significantly enlarges an investor's investment opportunity set over currently traded stocks. To answer this question, we use mean-variance spanning tests to examine whether adding a REIT portfolio can significantly expand the investment opportunity set for mean-variance investors over a set of benchmark portfolios that are sorted by firm size and book-to-market ratio.

Second, we want to know what characteristics of a REIT portfolio can significantly help gain the benefits of diversification. To examine the relationship between REIT characteristics and expansion of the investment opportunity set, we further divide REITs into different groups based on property type. We also assess whether structural changes affect the efficiency of adding REITs to benchmark portfolios over various subperiods.

MEAN-VARIANCE SPANNING TESTS

For detail on mean-variance spanning tests, readers may consult comprehensive surveys by DeRoon and Nijman [2001] and Kan and Zhou [2001]. A mean-variance spanning test, first introduced by Huberman and Kandel [1987], enables analysis of the effect of the addition of new assets to a set of benchmark assets on the mean-variance frontier. If the mean-variance frontier of a set of benchmark assets and that of the benchmark assets plus a REIT portfolio coincide, then there is *spanning*, and investors will not benefit significantly from the addition of new assets to their current portfolios.

In finite samples, we can test whether an observed shift is statistically significant using regression-based tests of mean-variance spanning. An advantage of these tests is that they are simple to use and easy to interpret. In addition, they provide an economic insight about the value of investing in a REIT portfolio relative to a set of benchmark assets.[1]

In asymptotic and finite-sample statistical tests that we use to examine whether the addition of a REIT portfolio can significantly improve the investment opportunity set, we denote by K the set of benchmark portfolios (non-REIT portfolios that an investor may hold) with return R_{1t}, and by N the set of test assets (the calendar-time REIT portfolio) with return R_{2t}. We estimate the model using ordinary least squares:

$$R_{2t} = \alpha + \beta R_{1t} + \xi_t,\ t = 1, 2, \ldots, T \tag{1}$$

Following Huberman and Kandel [1987], the null hypothesis of spanning is:

$$H_0\colon \alpha = 0_N,\ \delta = 1_N - \beta 1_K = 0_N \tag{2}$$

where 0_N is defined as the zero vector of N elements.

The distributions of the finite-sample F-test statistics, the asymptotic Wald likelihood ratio, and Lagrange multiplier test statistics of the null hypothesis are:[2]

$$\left(\frac{1}{U} - 1\right)\left(\frac{T-K-1}{2}\right) \sim F_{2,(T-K-1)} \tag{3}$$

$$W = T(\lambda_1 + \lambda_2) \overset{A}{\sim} \chi^2_{2N} \tag{4}$$

$$LR = T\sum_{i=1}^{2} \ln(1+\lambda_i) \overset{A}{\sim} \chi^2_{2N} \tag{5}$$

$$LM = T\sum_{i=1}^{2} \frac{\lambda_i}{1+\lambda_i} \overset{A}{\sim} \chi^2_{2N} \tag{6}$$

If we fail to reject the null hypothesis, the addition of a REIT portfolio will not significantly improve the investment opportunity set.[3]

DATA DESCRIPTION

Our sample of real estate investment trusts is collected from the SNL Real Estate Securities Quarterly and the Center for Research in Security Prices (CRSP) database (share code 18). It is composed of 283 REITs over 1980-2002. In a given month, the REIT portfolio is formed by all the publicly traded REITs using either an equally weighted or a value-weighted scheme.

The monthly NAREIT index provided by the National Association of Real Estate Investment Trusts is used to check robustness. The mean monthly return of the NAREIT index during 1980-2002 is 0.93%, and its standard deviation is 3.58%.

Panel A of Exhibit 1 shows the average monthly

EXHIBIT 1

Monthly Returns and Standard Deviations of REIT Portfolios and Benchmark Portfolios (1980-2002)

Panel A. Descriptive Statistics

	Equally Weighted		Value-Weighted	
	Mean (%)	Standard Deviation (%)	Mean (%)	Standard Deviation (%)
All REITs (1980-2002)	**1.11**	**3.75**	**1.15**	**4.67**
REITs 1980-1985	1.90	4.51	2.13	5.91
REITs 1986-1994	0.55	3.65	0.71	4.62
REITs 1995-2002	1.14	3.12	0.91	3.48
REITs by Type				
Diversified	1.36	6.46	1.33	6.42
Health Care	1.23	4.83	1.19	4.50
Hotel	0.47	5.90	0.58	6.61
Industrial	1.01	4.21	0.89	4.90
Mortgage	1.36	7.53	1.35	7.64
Office	0.59	5.28	0.59	4.79
Residential	1.36	5.60	1.22	5.41
Retail	1.23	5.86	1.13	6.44
Self-Storage	1.05	5.57	1.04	5.73
Other	1.09	4.11	1.10	5.21

Panel B. Mean Monthly Returns (and Standard Deviations)—%

		Size									
		Smallest		2		3		4		Largest	
Book-to-Market	Lowest	0.32	(8.43)	0.72	(7.66)	0.90	(7.10)	1.17	(6.44)	1.15	(5.09)
	2	1.24	(7.00)	1.15	(5.86)	1.25	(5.41)	1.18	(5.20)	1.19	(4.93)
	3	1.40	(5.56)	1.40	(4.94)	1.23	(4.74)	1.24	(4.93)	1.13	(4.61)
	4	1.59	(5.05)	1.47	(4.74)	1.31	(4.53)	1.27	(4.38)	1.18	(4.34)
	Highest	1.52	(5.16)	1.38	(5.21)	1.52	(4.88)	1.40	(4.87)	1.23	(4.82)

returns and standard deviations of the REIT portfolios by different time period and property type. We group REITs by different time periods because several structural breaks have occurred in the past two decades, such as the tax reforms in 1986 and in 1992. Another reason is that most REITs conducted initial public offerings after 1993. Consequently, REITs in different time periods may exhibit different characteristics, which partition would reveal.

In Panel A, we see that the earlier REITs, especially those before 1985, have higher mean returns and standard deviations than the more recent REITs. This evidence suggests that REITs perform better during cold periods than hot periods, but investors also have to bear greater risk for higher returns. REIT portfolios have the lowest returns during 1986-1994 after the 1986 tax reforms compared with the other two subperiods of 1980-1985 and 1995-2002.

We further divide the REIT sample into ten categories based on property type. REITs with different property focuses operate differently and bear different risks, and thus should be examined separately. Panel A of Exhibit 1 shows that the mortgage REIT portfolio has the highest mean return and the highest standard deviation. The hotel REITs have the lowest mean return, but a rather high standard deviation.

Finally, for the benchmark portfolios, we use five size and five book-to-market portfolios to form 25 value-weighted size and book-to-market portfolios of NYSE, AMEX, and Nasdaq stocks. The 25 benchmark portfolios are obtained from Kenneth French's website.[4]

Panel B of Exhibit 1 presents the summary statistics of the 25 size/book-to-market portfolios. The portfolio with the largest size and the lowest book-to-market ratio has the same value-weighted monthly return as that of all REITs, but its standard deviation is much higher. The

EXHIBIT 2
Mean-Variance Spanning Tests of REIT Portfolios

	F	LM	LR	W	Wa
Equally Weighted	39.755 (0.000)***	66.598 (0.000)***	76.216 (0.000)***	87.779 (0.000)***	88.583 (0.000)***
Value-Weighted	6.436 (0.002)***	13.515 (0.001)***	13.857 (0.001)***	14.211 (0.001)***	13.100 (0.002)***
NAREIT Index	41.629 (0.000)***	68.953 (0.000)***	79.337 (0.000)***	91.916 (0.000)***	87.899 (0.000)***

**** denotes the 1% significance level.*

F is the finite-sample likelihood ratio test. LM, LR, and W represent the asymptotic Lagrange multiplier, likelihood ratio, and Wald tests, Wa is the GMM Wald test allowing for heteroscedasticity. P-values are in parentheses.

results are similar for the second-smallest size protfolio and the second-lowest book-to-market ratio portfolio.

FULL SAMPLE RESULTS

Significant results for the five tests in Exhibit 2 over 1980-2002 indicate rejection of the spanning hypothesis. In other words, addition of an equally weighted or value-weighted REIT portfolio by investors who already hold the 25 size/book-to-market portfolios improves their investment opportunity set. The results using the NAREIT index as a proxy for REIT investment are similar to those of the equally and value-weighted REIT portfolios. Therefore, we suggest REIT investment brings diversification benefits for mean-variance investors.

Exhibit 3 shows the mean-variance frontiers before and after adding the REIT portfolios to the 25 size/book-to-market benchmark portfolios. We can clearly see a significant shift of the mean-variance frontiers in the cases of the equally weighted REIT portfolios and the NAREIT index.[5]

Our results are similar to those of an Ibbotson Associates study commissioned by NAREIT, which suggests that REITs offer an attractive risk-return trade-off and provide meaningful diversification benefits as an addition to many types of portfolios. Feldman [2003] also finds that investing in REITs leads to more efficient portfolios.

RESULTS FOR PERIODS WITH STRUCTURAL CHANGES

Exhibit 4 presents the results of the mean-variance spanning tests for the addition of REIT investments during the three subperiods based on structural changes in the REITs.[6] Over 1980-1985, mean-variance investors were not able to gain diversification benefits by investing in the equally and value-weighted REIT portfolios and the NAREIT index.

Exhibit 5 shows that the mean-variance frontiers are almost identical both before and after the addition of REIT investments in 1980-1985. Although the second graph in Exhibit 5 shows a slight shift in the mean-variance frontier after addition of the NAREIT index, the result is not statistically significant.

For the other two subsample periods, 1986-1994 and 1995-2002, all the test statistics are significant for the equally and value-weighted REIT portfolios and the NAREIT index. These findings suggest that, after 1985, REIT investment has been able to improve the investment opportunity set for mean-variance investors. Exhibits 6 and 7 show significant expansion of the mean-variance frontiers after the addition of the equally weighted REIT portfolio or the NAREIT index.

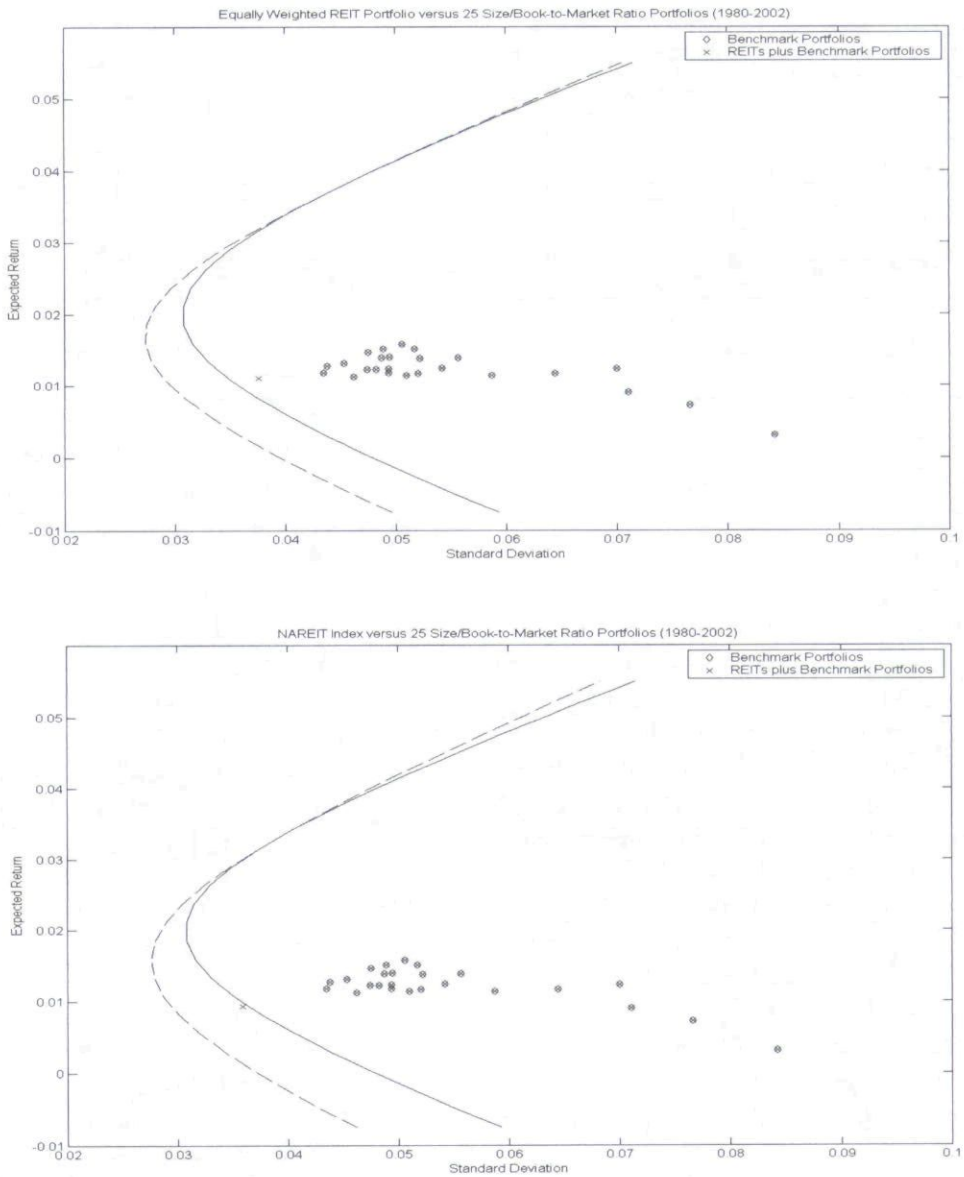
In summary, our findings show that the addition of a REIT portfolio provides no diversification benefits to mean-variance investors when REITs were not popular in the early 1980s. REIT investment, however, has been able to improve mean-variance investment opportunity sets since 1986.

REIT PORTFOLIOS SORTED BY PROPERTY FOCUS

We further divide the REITs into ten groups based on their property focus and examine their effect on the mean-variance efficient frontier. Exhibit 8 reports that the addition of equity REITs such as diversified, health care, hotel, industrial, office, residential, retail, and self-storage

EXHIBIT 3

Mean-Variance Frontiers of Benchmark Assets and Benchmark Assets plus REITs (1980-2002)



REITs can provide diversification benefits.

The addition of mortgage REITs does not significantly change the mean-variance frontier. According to the NAREIT description, mortgage REITs lend money either directly to real estate owners and operators or indirectly through the acquisition of loans or mortgage-backed securities instead of real estate per se. According to our data, mortgage REITs have the highest risk among all types of REITs, which indicates it is unlikely investors can reduce overall investment risk (measured by the global minimum-variance portfolio on the mean-variance frontier). In addition, we find that the added mortgage REIT portfolio has a very small or almost zero weight compared to those of the 25 size/book-to-market benchmark portfolios. This finding suggests there is no role for mortgage REITs in the optimal portfolio.

These characteristics explain why the mean-variance frontiers before and after adding the mortgage REIT portfolio are almost identical and may turn mortgage REITs into a nearly redundant asset class. Consequently, the addition of mortgage REITs cannot expand the mean-variance efficient frontier.

EXHIBIT 4

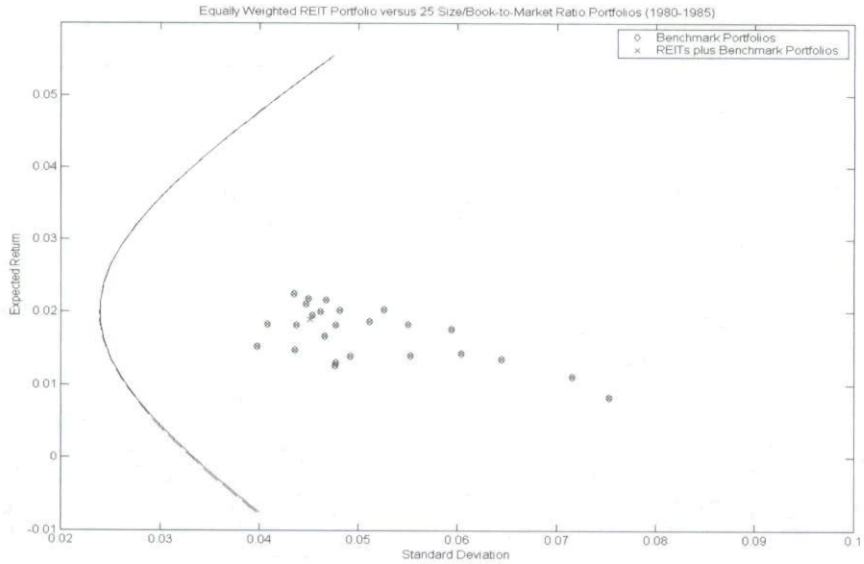
Mean-Variance Spanning Tests of REIT Portfolios by Structural Changes

	1980-1985		1986-1994		1995-2002	
	W	Wa	W	Wa	W	Wa
Equally Weighted	0.531 (0.767)	0.746 (0.689)	59.161 (0.000)***	71.881 (0.000)***	71.264 (0.000)***	93.992 (0.000)***
Value-Weighted	1.364 (0.506)	1.439 (0.487)	11.066 (0.004)***	11.251 (0.004)***	44.774 (0.000)***	53.813 (0.000)***
NAREIT Index	5.425 (0.066)	5.695 (0.058)	59.976 (0.000)***	56.085 (0.000)***	46.150 (0.000)***	48.584 (0.000)***

P values are in parentheses. *** denotes the 1% significance level.

EXHIBIT 5

Mean-Variance Frontiers of Benchmark Assets and Benchmark Assets plus REITs by Structural Changes (1980-1985)



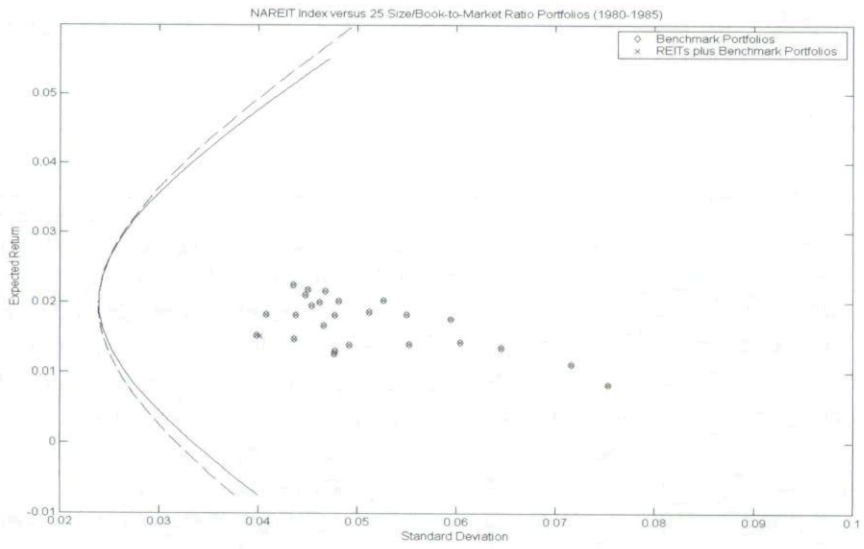
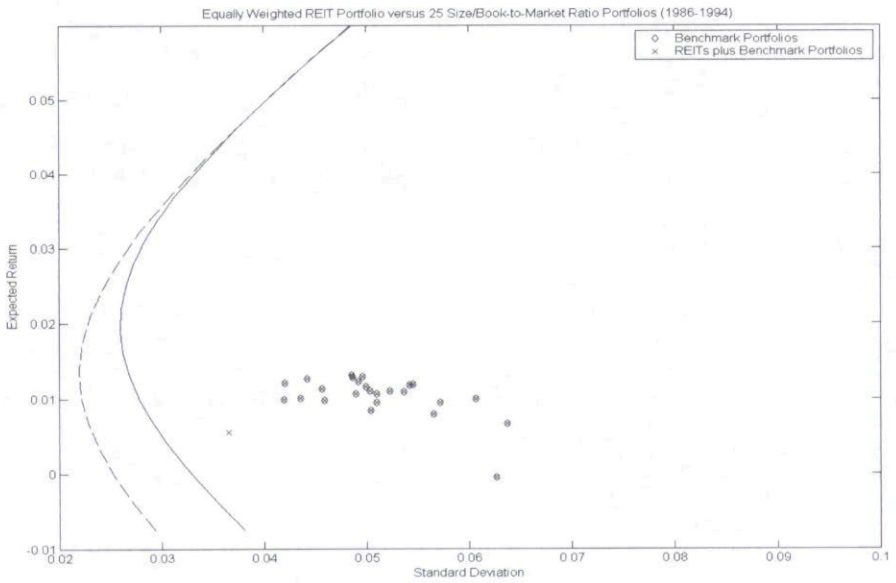
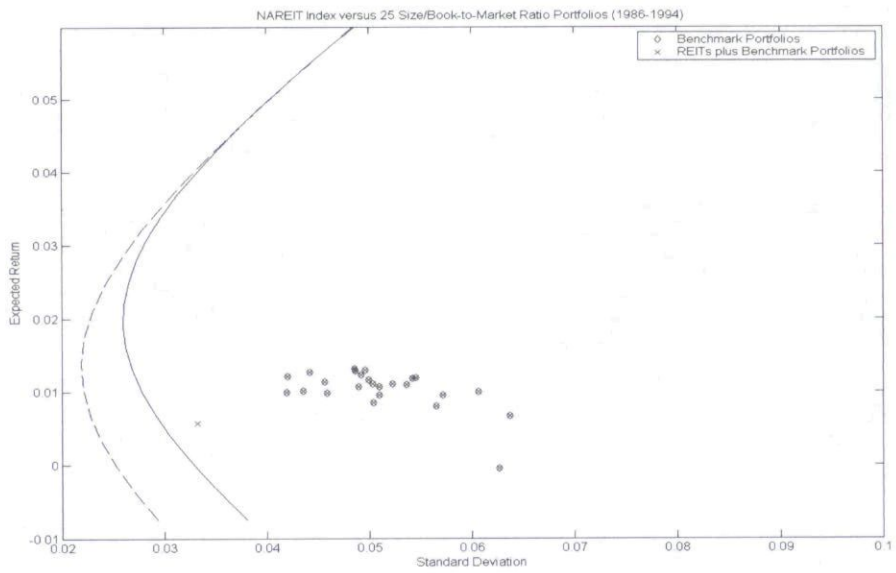


EXHIBIT 6

Mean-Variance Frontiers of Benchmark Assets and Benchmark Assets plus REITs by Structural Changes (1986-1994)





CONCLUSION

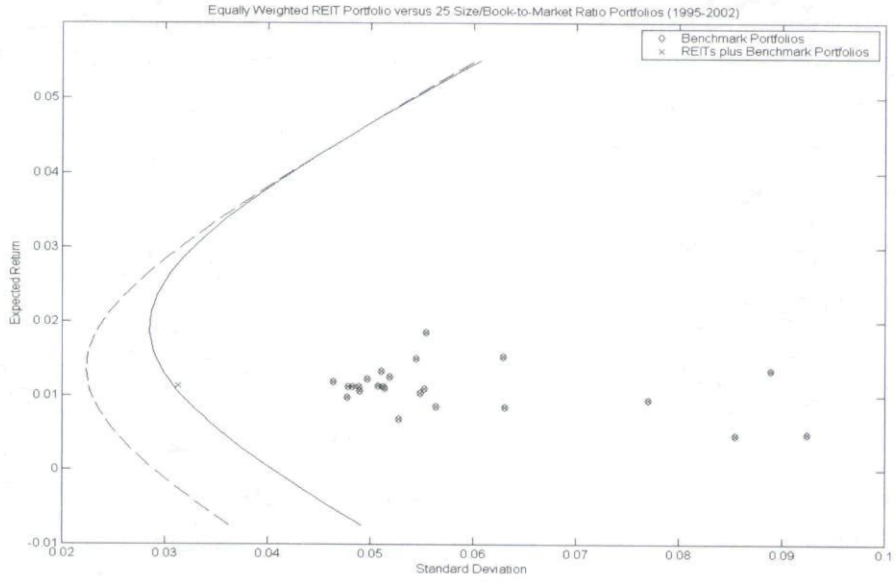
We have examined the effect of including real estate in an investment portfolio from an asset allocation perspective. REITs traded over 1980-2002 on stock exchanges are included in the sample as a real estate market proxy. We use mean-variance spanning tests to examine whether the addition of REITs to portfolios can provide significant diversification benefits over a set of commonly used benchmark portfolios sorted by firm size and book-to-market ratio.

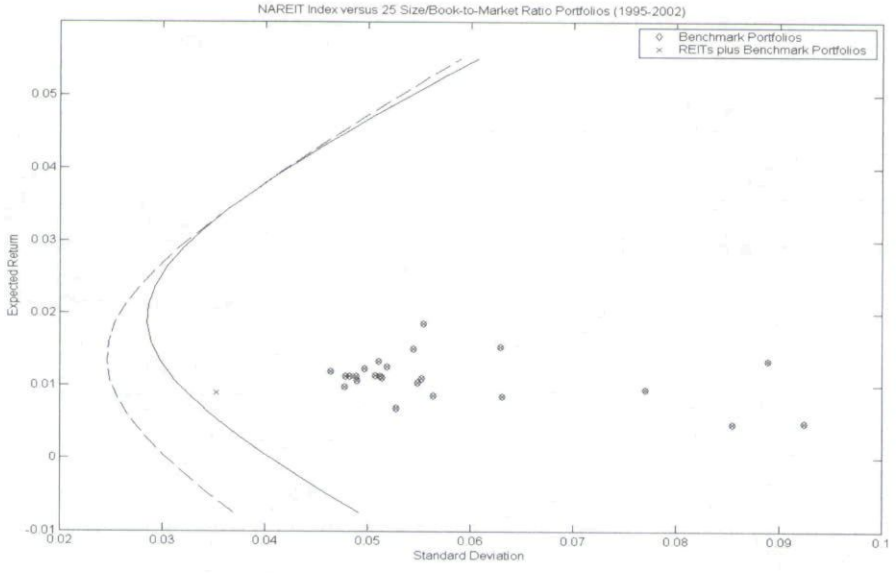
Our empirical results indicate that REITs before 1985 are unable to provide any diversification benefit. The more recent REITs over 1986-2002 do augment the mean-variance frontier and enlarge the investment opportunity set.

We also find that the mean-variance efficient frontiers are almost identical when mortgage REITs are

EXHIBIT 7

Mean-Variance Frontiers of Benchmark Assets and Benchmark Assets plus REITs by Structural Changes (1995-2002)





included in the 25 benchmark portfolios. Equity REITs, such as diversified REITs, health care REITs, hotel REITs, industrial REITs, office REITs, residential REITs, retail REITs, and self-storage REITs, however, are suitable for diversification. Overall, consistent with Hudson-Wilson, Fabozzi, and Gordon [2003], we verify the economic significance of REIT investment from the perspective of asset allocation.

ENDNOTES

The authors are grateful to an anonymous referee, to conference participants at the 2005 FeAT Meeting in Taipei, to seminar participants at National Taiwan University for helpful comments and suggestions, and to Kenneth French for providing data.

[1]An alternative test is the stochastic discount factor (SDF)-based mean-variance spanning test. Kan and Zhou [2001] find that the traditional regression-based approach is better than the

EXHIBIT 8

Mean-Variance Spanning Tests of REIT Portfolios by Property Type

	Equally Weighted		Value-Weighted	
	W	Wa	W	Wa
Diversified	13.100 (0.001)***	11.534 (0.003)***	6.497 (0.039)**	5.233 (0.073)
Health Care	43.039 (0.000)***	40.657 (0.000)***	44.830 (0.000)***	43.892 (0.000)***
Hotel	7.666 (0.022)**	7.823 (0.020)**	5.490 (0.064)	5.231 (0.073)
Industrial	68.094 (0.000)***	84.172 (0.000)***	47.394 (0.000)***	59.784 (0.000)***
Mortgage	0.726 (0.696)	0.661 (0.719)	0.889 (0.614)	0.911 (0.634)
Office	39.022 (0.000)***	43.470 (0.000)***	35.519 (0.000)***	31.894 (0.000)***
Residential	13.916 (0.001)***	8.992 (0.011)**	21.944 (0.000)***	18.159 (0.000)***
Retail	16.178 (0.000)***	17.151 (0.000)***	10.242 (0.006)***	9.313 (0.010)**
Self-Storage	37.188 (0.000)***	29.230 (0.0000***	35.646 (0.000)***	27.427 (0.000)***
Other	54.582 (0.000)***	55.387 (0.000)***	5.494 (0.064)	4.845 (0.089)

*P-values are in parentheses. ** denotes the 5% significance level and *** denotes the 1% significance level. Some REIT portfolios do nt have observations for the entire 276 months.*

SDF-based approach, especially when returns follow a multivariate Student-t distribution.

[2]The likelihood ratio and Lagrange multiplier tests are also used to test for mean-variance spanning, as the Wald test is not the uniformly most powerful test.

[3] $U = |\hat{G}| / |\hat{H} + \hat{G}|$

where we define

$$\hat{G} = \begin{bmatrix} 1+\hat{\mu}_1' \hat{V}_{11}^{-1} \hat{\mu}_1 & \hat{\mu}_1' \hat{V}_{11}^{-1} 1_K \\ \hat{\mu}_1' \hat{V}_{11}^{-1} 1_K & 1_K' \hat{V}_{11}^{-1} 1_K \end{bmatrix}$$

and

$$\hat{H} = \begin{bmatrix} \hat{\alpha}' \hat{\Sigma}^{-1} \hat{\alpha} & \hat{\alpha}' \hat{\Sigma}^{-1} \hat{\delta} \\ \hat{\alpha}' \hat{\Sigma}^{-1} \hat{\delta} & \hat{\delta}' \hat{\Sigma}^{-1} \hat{\delta} \end{bmatrix}$$

We then denote by λ_1 and λ_2 the two eigenvalues of the matrix $\hat{H}\hat{G}^{-1}$. See Kan and Zhou [2001] for further detail.

[4]http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/ data_library.html.

[5]As the results for the value-weighted (VW) REIT portfolio are similar to those of the other two cases, we do not show the graph for the VW REIT portfolio here or hereafter.

[6]Results are similar for the F, LR, and LM tests, so we report only the statistics from the W and Wa tests.

REFERENCES

Bernstein, P. "Real Estate Matters." *The Journal of Portfolio Management: Special Real Estate Issue*, September 2003, p. 1.

DeRoon, F.A., and T.E. Nijman. "Testing for Mean-Variance Spanning: A Survey." *Journal of Empirical Finance*, 8 (2001), pp. 111-155.

Feldman, B.E. "Investment Policy for Securitized and Direct Real Estate." *The Journal of Portfolio Management: Special Real Estate Issue*, September 2003, pp. 112-121.

Huang, C.-F., and R.H. Litzenberger. *Foundations for Financial Economics*. Amsterdam: North-Holland, 1988.

Huberman, G., and S. Kandel. "Mean-Variance Spanning." *Journal of Finance*, 42 (1987), pp. 873-888.

Hudson-Wilson, S., F. Fabozzi, and J. Gordon. "Why Real Estate?" *The Journal of Portfolio Management: Special Real Estate Issue*, September 2003, pp. 12-27.

Ingersoll, J.E. *Theory of Financial Decision Making*. Baltimore: Rowman and Littlefield, 1987.

Kan, R., and G. Zhou. "Test of Mean-Variance Spanning." Working paper, University of Toronto, 2001.