

**SYSTEMATIC RISK AND
DIVERSIFICATION IN THE
EQUITY REIT MARKET**

by

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Systematic Risk and Diversification in the Equity REIT Market

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Abstract

This paper employs stock market-based data to examine the systematic risk and diversification properties of publicly traded equity real estate investment trusts (REITs). A unique data sample is created by combining firm return data with information on their property type holdings and the location of their investments. A number of interesting findings arise from this work: (1) the systematic risk of equity REITs appears to vary by the type of property in which they invest, with beta being significantly higher for retail-oriented REITs than for REITs owning industrial and warehouse properties; (2) the stock market data provide no evidence that REIT diversification across property types or broad geographic regions actually results in meaningful diversification as reflected in a standard market-based measure--the R^2 from a simple market model regression; and (3) a very simple measure of diversification, the number of properties owned by the REIT, is positively correlated with the R^2 from a simple market model regression; a REIT's stock return variance of total return also is systematically lower the greater the number of properties owned by the firm.

I. Introduction

This paper examines the relations between the types and locations of properties owned by equity REITs and market-based measures of systematic risk and diversification. Almost all previous analyses of these issues employ appraisal-based series such as the Russell-NCREIF Property Index (RNPI).¹ The burgeoning interest in the equity REIT market in general, accompanied by the recent passage of 'look through' provisions for institutional investors in REITs, warrants an analysis of risk and diversification issues with stock market-based data.

The National Association of Real Estate Investment Trusts' (NAREIT) **REIT Sourcebook** is used to compile a cross section data base on the book value of equity REIT investments by property type and geographic location for 1992. These data are then merged with stock return, capital structure, and market capitalization information obtained from the Center for Research in Security Prices (CRSP) files at the University of Chicago and Standard & Poor's **Compustat** files.

Three important findings about systematic risk and diversification in the equity REIT market arise from our study:

1. Systematic risk appears to vary across firms depending upon the types of properties they own. In particular, a REIT owning only retail properties tends to have a beta almost 50% larger than that of a REIT specializing in industrial properties. This finding has important implications for investors and for pension plan consultants. Investors clearly should interpret with caution the higher returns on retail properties over recent years, as part of the return appears to be compensation for greater systematic risk. For institutional investor consultants responsible for evaluating real estate advisor performance, the finding suggests that care should be taken so that

¹See for example Hartzell, Hekman, & Miles (1986) and the citations therein. Geltner's (1989, 1991) analysis of and correction for smoothing in the appraisal-based data significantly alters the total variance of real estate's return, but not its basic diversification characteristics.

advisors are rewarded only for added return per unit of systematic risk. Advisors should not be rewarded solely because they recommend relatively high return property types if the recommendation also brings more systematic risk to the portfolio.

2. There is no evidence that diversification across property type or geographic region is related to a market-based measure of diversification--the R^2 from a simple market model regression. We interpret this as evidence in support of some critics' views that such diversification strategies are 'naive'. We also find no meaningful impact for diversification across economic regions in the stock market data. However, data limitations make it premature to conclude that this particular strategy also is 'naive'.

3. A very simple index of diversification, the number of properties owned by the REIT, is the only one that is positively correlated with the market model R^2 . In addition, the total risk of the firm, as measured by the REIT's return variance is significantly lower the greater the number of properties owned by the firm.

The remainder of the paper is organized as follows. The underlying data used in the analysis are described in the next section. Section III then presents the empirical tests and discusses the key findings. A brief summary concludes the paper.

II. Data Description

Our data sample consists of tax-qualified, publicly traded equity REITs listed in the **REIT Sourcebook**, published by the National Association of Real Estate Investment Trusts (NAREIT). The **REIT Sourcebook** also provides the investment cost of the firms' properties as well as describes the types of properties owned and the states in which they are located.

We divide each firm's investments into one of six possible property type categories:

Health Care, Industrial/Warehouse, Office, Residential, Retail, and Other. The Other category includes hotels, land, and specialty properties such as resorts.

The state-level data are aggregated in one of two ways in order to analyze geographic diversification. The first is into the four Russell-NCREIF Property Index regions--East, Midwest, South, and West. The other aggregation is based on the eight economic regions identified by Hartzell, Shulman, & Wurtzbach (1989). Those authors suggested that there is no *a priori* reason for investors to expect true economic diversification to be determined by broad geographic breakdowns. Hartzell, Shulman, & Wurtzbach (1989) argued that, sometimes even within a single state (e.g., California), business activity was systematically different enough across sub-regions that some diversification benefits could be achieved just by spreading investment dollars across the different regions of the state. Their analysis led them to divide the nation into eight economic regions which are listed in Figure 1 in the Appendix. Those economic regions include New England, Mid-Atlantic Corridor, Old South, Industrial Midwest, Farmbelt, Mineral Extraction, Southern California, and Northern California.

Cross sections of firms are available for 1990 and 1992. Prior to the 1990 edition, the **REIT Sourcebook** does not provide detailed firm-level information on property type and location. All empirical results reported in this paper are based on the 1992 cross section.² A list of the 1992 sample of firms and their distribution of holdings by property type and geographic region is available from the authors upon request.

The property type and location data are merged with return and capital structure

²The results using the 1990 REIT data are very similar. The samples are very similar as there was little new firm creation between 1990 and 1992. In addition, the nature of properties that an individual REIT owned and where they were located changed relatively little over this time period. Calendar year 1993 saw an explosion of new firms going public. Unfortunately, the new firms do not have long enough trading histories to permit reasonable estimation of betas and market-based diversification measures, a necessary condition for inclusion in our data base.

information for each firm. Monthly returns for equity REITs traded on the NYSE and AMEX are obtained from the Center for Research in Security Prices (CRSP) Monthly Stock File. Daily returns on firms traded over the counter on NASDAQ are obtained from the CRSP NASDAQ Daily Stock File. These daily returns are compounded to generate monthly returns. The CRSP files are also the source of all other stock market return data used in the paper. The book value of long-term debt, is obtained from Standard & Poor's **Compustat Files**. Market values of the debt generally are not available because the debt is not publicly traded.

A series of measures of systematic risk and diversification are created from these data. A REIT's asset beta is our market-based measure of systematic risk. This is created for each equity REIT from the results of a series of simple market model regressions using monthly returns for the five years from 1988-1992 as shown in equation (1),

$$(1) R_{i,t} = \alpha_i + \beta_i R_{m,t} + \epsilon_{i,t}$$

where $R_{i,t}$ represents the monthly return on REIT i in month t , $R_{m,t}$ is the return on the market portfolio in period t where the market is defined as the Standard & Poor 500 Composite Index, α_i is the regression intercept, β_i is the estimated equity beta of REIT i , and $\epsilon_{i,t}$ is the standard error term.

Because equation (1) does not control for leverage, it does not estimate each REIT's asset beta (β_A). The equity beta (β_E) that is estimated in equation (1) is unlevered by assuming a value of 0.2 for the debt beta (β_D) of each firm. If D and E are the REIT's book value of debt and market value of equity, respectively, then the firm's asset beta is derived as in equation (2),

$$(2) \beta_A = \{D/(D+E)\}\beta_D + \{E/(D+E)\}\beta_E.^3$$

Following the financial economics literature, the R-squared values from the simple market model in equation (1) are used as a market-based measure of firm diversification. Nonmarket-based diversification measures are also constructed for comparison purposes. The simplest measure is the number of properties owned by the REIT, which is denoted as NPROP in the tables below.

More complex property type and regional diversification measures akin to Herfindahl indexes of industry diversification are also created. The nature of these Herfindahl-type indexes is shown in equation (3)

$$(3) \quad D_j = \sum_{i=1}^N w_i^2$$

where N is the number of property type (or locational) categories, w_i is the fraction of the REIT's total book value invested in property type or location category i, and j equals 'prop', 'geog', or 'econ' to signify whether the index applies to property types, geographic regions, or economic regions.

The D_{prop} index is based on the distribution of firm investment in the six property type categories noted above: Health Care, Industrial/Warehouse, Office, Residential, Retail, and Other. If a REIT invested all of its assets in malls, the weight for the Retail property type

³The standard formula would include another term for the differential tax treatment of corporate debt and equity. No such term is needed here because REITs are not subject to tax at the trust level. Given the relatively low betas of most REITs, the assumption of $\beta_D = 0.2$ implies that their debt is relatively risky. The so-called 95% payout rule makes it difficult to retain earnings so that a given amount of leverage on a REIT is riskier than for an otherwise similar firm with a standard corporate charter. We experimented with varying the assumed level of β_D . The results reported below are not sensitive to reasonable changes in β_D .

category would be one with all other weights equal to zero. The resulting value of D_{prop} would also equal one. Thus, this diversification measure decreases in value as the number of property type categories in which the REIT invests increases.

Two indexes are constructed to investigate regional diversification. The first, D_{geog} , is the most traditional measure of so-called 'naive' locational diversification, and is based on the four Russell-NCREIF regions--East, Midwest, South, and West. As with the property type index, if a REIT concentrated all its ownership in a single region, D_{geog} would equal 1, with ownership more spread out across regions being associated with a lower value for D_{geog} . The second location-oriented index, D_{econ} , is based on the eight economic regions identified in Hartzell, Shulman, & Wurtzbech (1989). Once again, the index construction guarantees that the value of D_{econ} decreases with increasing ownership across economic regions.⁴

III. REIT Diversification by Property Type, Geographic Region, and Economic Region

This section examines in greater detail the impacts of strategies by which equity REITs diversify themselves across property types and location. The diversification measures described in Section II are compared to the market model R^2 . The relations of these diversification measures with the total risk of the REITs (where total risk is defined to be the standard deviation of monthly returns and is denoted as $RSIGMA$) are also studied in order to help gauge whether diversified property holdings are associated with lower variance in returns.

Table 1 reports summary statistics for each of these measures. The R^2 values from the market model regressions for each REIT range from 0.00 to 0.33, with a median value of just over 6%. The average monthly return standard deviation over 1988-1992 ($RSIGMA$) varies

⁴See Appendix Tables A.1-A.3 for summary statistics on REIT betas, capital structures, and market capitalization when grouped by property type category, geographic, and economic region, respectively.

widely across the 52 REITs in the sample, as does the number of properties owned by each REIT (NPROP). Firm property portfolios range in size from 2 to 282, with 42 being the mean number of properties owned. The measure of diversification across property type, D_{prop} , ranges from 0.27 to 1.0 (complete specialization). This variable's mean is 0.71, with a similar median value. There is greater diversification across both geographic and economic regions as indicated by the lower median values of 0.51 for D_{geog} and 0.53 for D_{econ} .

The relation between these variables is illustrated by the Spearman rank correlation coefficients for each pair of variables presented in Table 2.⁵ The strong negative correlation of NPROP with RSIGMA (-0.44, p-value=0.00) indicates that REIT returns vary less as the number of properties owned increases. The positive correlation between NPROP and R^2 (0.36, p-value=0.01) suggests that owning more properties increases diversification. Finally, the significantly negative correlation (-0.64, p-value=0.00 in row 1 of the table) between the market model R^2 and RSIGMA suggests that REITs with a high return variance tend not to be well diversified.

Negative correlations should result between the R^2 value and the three other constructed indexes if they represent true diversification by equity REITs. However, we find that each of the correlations is small in absolute value and none approaches standard levels of statistical significance. These results are consistent with the conclusion that so-called naive diversification along property type and broad regional lines truly is naive.

Institutional investors in the direct property investment market are known to follow sophisticated economic region diversification strategies mapped out by their real estate advisors. This makes the insignificant relation between D_{econ} and R^2 more perplexing. There are a

⁵Rank correlations were computed instead of product moment correlations because there is no reason to assume that the relation between any of the measures is linear.

number of possible explanations for this (non)relation that warrant study by future research. It could be that diversification across the eight economic regions also is naive. If so, investors will soon stop paying for such advice. However, it also could be that a simple market model does not adequately capture the nature of risk in real estate markets, even securitized ones. If so, the R^2 value is a poor proxy for economic diversification. Lastly, the nature of our data introduces noise into the relation between D_{econ} and R^2 . The reason is that the REIT Sourcebook provides property location data at the state level, not by local market. The Hartzell, Shulman, & Wurtzebach (1989) regional segmentation splits a number of states across regions so that we had to arbitrarily assign some REITs' investments to a given economic region.⁶

In sum, no firm conclusion can be reached about whether economic region diversification truly makes a firm more diversified. Standard geographic and property type diversification appear to result in no real diversification, at least as measured by the stock market. Only the number of properties owned is significantly related to diversification. A greater number of properties is also strongly associated with a lower firm return variance.

IV. Determinants of Systematic Risk

This section examines whether the systematic risk of equity REITs varies across property type and geographic location. Parametric and nonparametric analyses are performed. The parametric test involves regressing the equity REIT betas on the distribution of either property type or geographic region holdings. The nonparametric analysis uses Spearman rank correlations to gauge the relation between beta and property type or geographic concentrations.

⁶States encompassed by two economic regions include California, Michigan, Wisconsin, New York, and Pennsylvania. If we could not identify a given REIT's (say) Pennsylvania holdings to a specific market in the state, we arbitrarily assigned it to one of the two economic regions spanning the state. To the extent our assignments were wrong, we introduce an errors-in-variables problem that only can be solved by better quality local data.

IV.A. Property Type Analysis

The simplest relation between beta and property type is examined via the regression in equation (4)

$$(4) \beta_i = \alpha_0 + \alpha_1 \%HealthCare_i + \alpha_2 \%Industrial/Warehouse_i + \alpha_3 \%Office_i + \alpha_4 \%Residential_i + \alpha_5 \%Retail_i + \epsilon_i,$$

where β_i is either the equity or asset beta for firm i over the 1988-1992 period, the α 's are regression coefficients, $\%HealthCare$ represents the percentage of firm i 's investment in health care facilities in 1992 (with all other property type categories similarly defined), and ϵ_i is the standard error term. The Other property type category is the omitted category against which the included property types are measured.

The results of estimating (4) are reported in the top two rows of Table 3. They suggest that the greater the percentage of investment in retail properties, the higher is the firm's beta. Only the coefficient on the percentage of investments in retail properties is statistically significant at conventional confidence levels and only in the regression using the asset beta. However, even in the equity beta regression, the retail coefficient is the largest and the most statistically significant (p-value = 0.13).

One potential criticism of this specification is that it does not control for firm size. The last two rows of Table 3 present the results of augmenting equation (4) with a variable measuring the log of the REIT's equity market capitalization (LMKTVAL). Firm size is quite statistically significant, but its coefficient is positive, not negative as would be expected based on the work by Banz (1981) and Keim (1983). The larger REITs have higher betas. It may be that this variable is controlling for leverage effects arising from the larger firms having better access to the debt market. Accounting for firm size almost halves the size of the $\%Retail$ coefficient and reduces its statistical significance. In the asset beta regression, this coefficient's p-value is

0.07.

The Spearman rank correlation coefficients reported in Table 4 reinforce the indication that retail-oriented REITs have higher betas. For both asset and equity betas, the correlations are by far the strongest and most statistically significant with the firms' percentages of retail property investment.⁷

The economic, as well as statistical, significance of these findings also needs to be examined. While one should always be careful about extrapolating away from means, the regression coefficients of 0.31 on %Retail and 0.01 on %Industrial/Warehouse (see the second row of Table 3) imply that a REIT owning all retail properties has an asset beta that is 0.30 greater than a REIT owning all industrial and warehouse properties.

Given that the asset betas for most REITs are typically well below 1.0, the implied difference in beta is relatively large. The data reported in Appendix Table A.1 provide another indication of the relative size of the differences in beta. That table somewhat arbitrarily classifies each REIT into one of the six property types if 50% or more of the firm's investment dollars are concentrated in one of the relevant property types. Firms are labelled 'Unclassified' if they do not specialize in any one property type. On average, the firms in the portfolio of retail-oriented REITs have the highest estimated equity and asset betas. Their equity betas tend

⁷It should be noted that the regression results themselves do not allow us to reject the null hypothesis that the property type coefficients from equation (4) are all equal to one another. Given the limited data (recall that there are only 52 firms in our cross section), we can only conclude with high statistical confidence that the coefficients are not all equal to zero. F-tests were also performed for pairwise comparisons of the %Retail coefficient (α_5) with those on the other property types (α_1 - α_4). The data always rejected the null at better than the 5% level in any specification that the largest and smallest coefficients (i.e., those on %Retail and %Industrial/Warehouse) are equal. Thus, retail-oriented REITs do appear to have more systematic risk than REITs specializing in industrial and warehouse properties. There may well be other meaningful differences across property types that our limited data base does not allow us to discern. The rapidly growing size of the equity REIT market should solve this data problem in a few years.

to be over 40% greater than those on Industrial & Warehouse REITs (0.56 versus 0.32, see Appendix Table A.1).

It is possible that the greater systematic risk of retail-oriented REITs is at least partially due to a unique feature of retail leases. These leases typically are the only ones with percentage rent clauses that result in the landlord directly sharing in the cash flow variance of his or her tenants.⁸ The tenants themselves tend to have very procyclical cash flows because aggregate spending is closely correlated with disposable income. Stock market returns also are related to the health of the economy and disposable income, further increasing the covariance between returns to retail REITs and the broader stock market.⁹

The retail sector of the commercial property market has performed relatively well in recent years, but our finding suggests that investors also must consider the added systematic risk of retail REITs before increasing their portfolio allocations to this property sector. For example, **The Russell-NCREIF Real Estate Performance Report** for the fourth quarter of 1993 reports that the retail subindex of the Russell-NCREIF Property Index is the best performer of all property types from 1979-1993, averaging a 9.13% total annual return. This is over 50 basis points higher than that of the next best performer, the warehouse subindex at 8.60% per annum. The results from Table 3 indicate that at least some of the retail property sector's higher return simply reflects compensation for the greater systematic risk of the property type.¹⁰

⁸See Chiang, Lai, & Liu (1986) for a formal theoretical foundation of this hypothesis. Using a contingent claims framework, they conclude that percentage rent clauses will generate greater systematic risk.

⁹Myer & Webb (1994) suggest that the returns of retail stocks (i.e., publicly traded retailers) and retail-oriented REITs are contemporaneously correlated, even after controlling for the market return.

¹⁰Another note of caution is still in order regarding the generality of the result. The REIT market included no firms owning regional and superregional malls until late 1992. Calendar year 1993 saw a rush of such firms to the public markets, with more following in early 1994.

The results in Table 3 also imply that industry consultants who are responsible for evaluating the performances of institutional investors' real estate advisors should take care that the advisors are not rewarded solely for having recommended relatively high return retail properties to their clients. Because performance measurement should be done on a risk-adjusted basis, the differential systematic risk of certain property types must be taken into account.

IV.B. Geographic Region Analysis

Regression specifications similar in form to that in equation (4) are estimated to determine whether beta also varies systematically with firms' geographic dispersion of properties.

$$(5) \beta_i = \alpha_0 + \alpha_1 \%East_i + \alpha_2 \%Midwest_i + \alpha_3 \%South_i + \alpha_4 LMKTVAL_i + \epsilon_i,$$

where the equity and asset betas are as described above, $\%East_i$ represents the percentage of firm i 's investments in the East region of the country (with the other regional variables similarly defined), $LMKTVAL_i$ is the log of the equity market capitalization of firm i , and ϵ is again the error term. The West region is the omitted geographic category against which regional effects are measured.

The results of equation (5) are reported in Table 5, with the associated Spearman correlation coefficients in Table 6. Only the coefficient on $\%East$ is close to being statistically significant at standard confidence levels, but virtually all the explained variance is due to the size variable. However, the Spearman rank correlation coefficients in Table 6 do indicate a

Thus, we do not know if the superregional mall owners will covary as strongly with the market as do the owners of community, neighborhood, and strip centers who were in our sample in 1992.

significant relation between REITs focused on the East region and beta.

Tables 7 and 8 report the analogous findings when the explanatory variables in equation (5) are the percentage of REIT investment value in the Hartzell, Shulman, & Wurtzebach (1989) economic regions rather than the Russell-NCREIF geographic regions. The differential economic region effects on beta are measured with respect to the Mid-Atlantic Corridor, the omitted category. Most of the coefficients are negative (significantly so in the asset beta regression in Table 7), indicating that REIT betas are higher if the firm invests primarily in the Mid-Atlantic Corridor. However, the nonparametric examination with the Spearman rank correlation coefficients does not indicate a particularly strong or statistically significant relation between beta and ownership concentration in any but the New England economic region.

In sum, the data suggest a weak association of greater systematic risk with investments in the eastern part of the country, but better data clearly are needed to investigate this issue more fully.¹¹

V. Summary and Conclusions

This paper investigated whether the property type and locational distribution of REIT assets are reflected in market-based measures of systematic risk and diversification. Three noteworthy results arise from our investigation:

(1) Firm betas vary depending upon the property type in which the REIT tends to concentrate its ownership. Specifically, retail-oriented REITs have significantly higher betas than do REITs owning primarily industrial and warehouse properties. This suggests that investors and industry

¹¹Future research with larger data sets should try to examine the independent effects of the property type and regional variables. We can report that the retail and East region returns are uncorrelated. Thus, it is highly unlikely that a regional effect explains the relatively high betas on the retail-oriented REITs.

consultants should cautiously interpret the relatively high long-term returns on retail-oriented REITs, as part of their higher return appears to be compensation for the greater systematic risk associated with owning this property type.

(2) Diversification by property type and broad economic region is unrelated to a stock market-based measure of diversification. More interesting is the fact that we find no stock market impact of REIT diversification by economic region. Unfortunately, insufficient data prevent us from determining whether these more sophisticated diversification strategies are themselves naive.

(3) However, we find that REITs owning a larger number of properties tend to be more diversified, with higher market model R^2 values and lower variances in their stock returns.

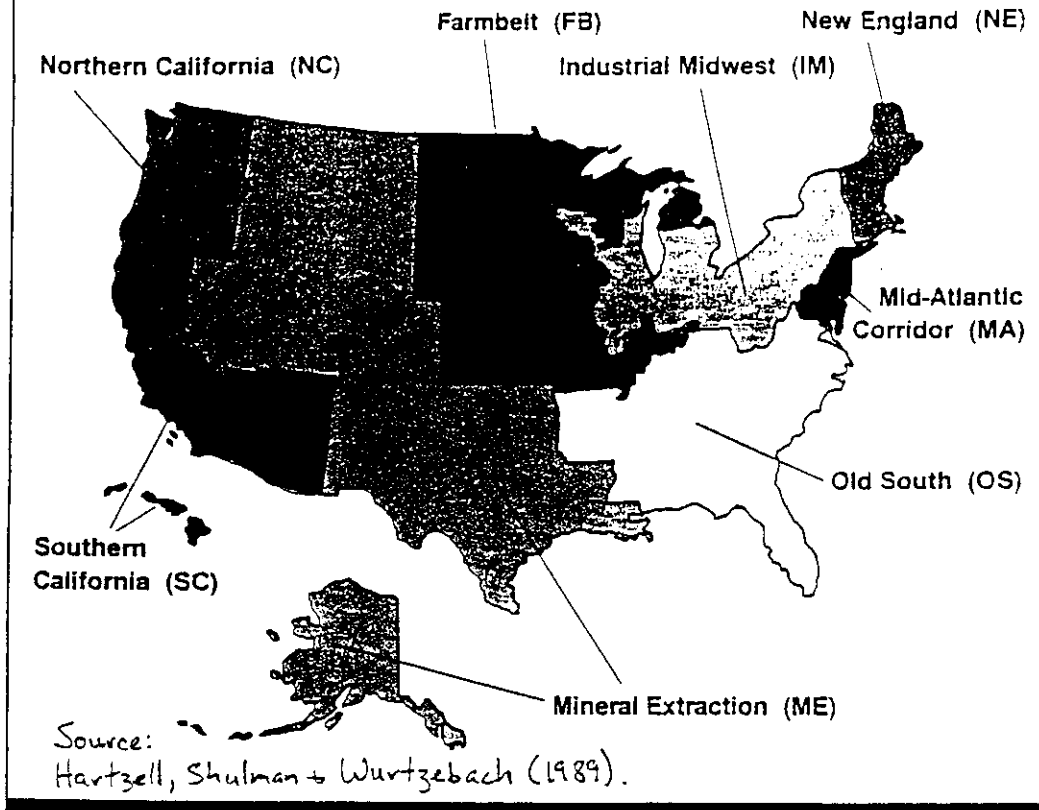
In the future, larger samples from a much bigger equity REIT market should help researchers more accurately measure any differences in systematic risk across property type or location. Larger samples will also allow richer specifications to be estimated. Finally, future research should try to work with local market data to determine whether diversification efforts via economic regions are reflected in REIT market pricing patterns.

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FIGURE 1

Eight-Region Segmentation



Region	Northern California	Southern California	Mineral Extraction	Farmbelt	Industrial Midwest	Old South	New England	Mid-Atlantic Corridor
Region code	NC	SC	ME	FB	IM	OS	NE	MA
State	OR WA	CA AZ NV	ID MT WY UT CO NM OK TX LA AK	ND SD MN NE IA KS MO WI	MI IL IN OH WV	AR TN MS AL GA FL NC SC KY VA	ME NH VT MA CT RI	NY PA NJ MD DC DE

Note:
 CA: Northern California region is in the Northern California; southern California region is in the Southern California.
 NV: Northern Nevada is in the Northern California; southern Nevada is in the Southern California.
 WI: Northern Wisconsin is in the Farmbelt; southern Wisconsin is in the Industrial Midwest.
 MI: Northern Michigan is in the Farmbelt; southern Michigan is in the Industrial Midwest.
 VA: Arlington area is in the Mid-Atlantic Corridor; the rest of the Virginia State is in the Old South.
 NY: New York City area is in the Mid Atlantic Corridor; the rest of the New York State is in the Industrial Midwest.
 PA: Philadelphia area is in the Mid Atlantic Corridor; the rest of the Penn State is in the Industrial Midwest.

TABLE 1:
Equity REIT Diversification by Property Type & Region

This table reports summary statistics of diversification measures of equity REITs. The R-squared value is computed from the market model regression using monthly returns over the five-year period 1988-1992. RSIGMA is the standard deviation of monthly returns over the same five-year period. NPROP is the number of properties owned by the REIT. D_{prop} is a diversification measure computed as

$$D_{prop} = \sum_{i=1}^N w_i^2$$

where N is the number of property type categories and w_i is the fraction of the REIT's total value invested in category i. The possible property type categories are Health Care, Industrial, Office, Residential, Retail, and Other. D_{geog} is a similar measure that examines diversification across geographic regions. The possible regions are East, Midwest, South, and West. D_{econ} is a similar measure that examines diversification across economic regions. The possible regions are New England, Mid-Atlantic Corridor, Old South, Industrial Midwest, Farmbelt, Mineral Extraction Area, Southern California, and Northern California.

Variable	Mean	Std Dev	Median	Minimum	Maximum
R-squared	0.07	0.07	0.06	0.00	0.33
RSIGMA	0.09	0.05	0.08	0.03	0.23
NPROP	41.9	47.9	29.0	2	282
D_{prop}	0.71	0.26	0.70	0.27	1.00
D_{geog}	0.62	0.29	0.51	0.27	1.00
D_{econ}	0.54	0.28	0.53	0.13	1.00

TABLE 2:
Spearman Rank Correlations of Equity REIT Diversification Measures

This table reports the Spearman rank correlations of several diversification measures of equity REITs. The R-squared value is computed from the market model regression using monthly returns over the five-year period 1988-1992. RSIGMA is the standard deviation of monthly returns over the same five-year period. NPROP is the number of properties owned by the REIT. D_{prop} is a diversification measure computed as

$$D_{prop} = \sum_{i=1}^N w_i^2$$

where N is the number of property type categories and w_i is the fraction of the REIT's total value invested in category i. The possible property type categories are Health Care, Industrial, Office, Residential, Retail, and Other. D_{geog} is a similar measure that examines diversification across geographic regions. The possible regions are East, Midwest, South, and West. D_{econ} is a similar measure that examines diversification across economic regions. The possible regions are New England, Mid-Atlantic Corridor, Old South, Industrial Midwest, Farmbelt, Mineral Extraction Area, Southern California, and Northern California. P-values are in parentheses.

	R-squared	RSIGMA	NPROP	D_{prop}	D_{geog}	D_{econ}
R-squared	1.00	-0.64 (0.00)	0.36 (0.01)	0.08 (0.55)	0.01 (0.93)	-0.02 (0.88)
RSIGMA		1.00	-0.44 (0.00)	0.04 (0.80)	-0.21 (0.13)	-0.21 (0.15)
NPROP			1.00	0.04 (0.76)	-0.12 (0.39)	-0.22 (0.11)
D_{prop}				1.00	-0.22 (0.09)	-0.19 (0.16)
D_{geog}					1.00	0.78 (0.00)
D_{econ}						1.00

**Table 3:
The Relation Between Systematic Risk and Property Type for Equity REITs**

This table reports the results of the regressions examining the relation between the type of property owned by a REIT and the REIT's equity and asset betas. Each REIT's equity beta was computed by performing an ordinary least squares regression of the REIT's monthly return against the return on the S&P500 index over the five-year period 1988-1992. The equity betas were then unlevered to compute asset betas for each firm. The estimated model is from equation (3) in the text and is sometimes augmented with a firm size variable to yield the following specification:

$$\beta = a_0 + a_1\%HEALTH + a_2\%INDUS + a_3\%OFFICE + a_4\%RESID + a_5\%RETAIL + a_6LMKTVAL + \epsilon$$

where: β is the REIT's equity or asset beta; %HEALTH, %INDUS, %OFFICE, %RESID, and %RETAIL are the proportions of the REIT's assets invested in Health Care, Industrial, Office, Residential, and Retail facilities, respectively; the Other property type category is omitted to avoid singularity; and LMKTVAL is the log of the REIT's equity market capitalization. Numbers in parentheses are t-statistics. Coefficients marked with a double asterisk (**) are significant at the 5 percent level or better; those with a single asterisk (*) are significant at the 10% level or better.

Dependent Variable	Intercept	%HEALTH	%INDUS	%OFFICE	%RESID	%RETAIL	LMKTVAL	Adjusted R ²
	a ₀	a ₁	a ₂	a ₃	a ₄	a ₅	a ₆	
Equity beta	0.31 (1.62)	0.17 (0.78)	-0.10 (-0.44)	-0.12 (-0.53)	0.20 (0.71)	0.32 (1.53) ^a		0.13
Asset beta	0.18 (1.42)	0.22 (1.58)	0.01 (0.05)	0.07 (0.44)	0.27 (1.49)	0.31** (2.21)		0.14
Equity beta	-0.05 (-0.43)	0.08 (0.44)	-0.17 (-0.88)	0.15 (0.84)	0.08 (0.33)	0.20 (1.13)	0.04** (2.28)	0.28
Asset beta	0.03 (0.38)	0.09 (0.83)	-0.08 (-0.63)	0.04 (0.34)	0.12 (0.73)	0.16* (1.89)	0.02** (2.27)	0.35

Note: ^aCoefficient significant at the 13% level.

Table 4:
Spearman Rank Correlation Coefficients
Between β and Property Type

This table reports the Spearman rank correlations of each REIT's equity and asset betas with the percentage of its assets invested in each property type. P-values are in parentheses.

Property Type	Equity Beta Rank Correlation Coefficient	Asset Beta Rank Correlation Coefficient
Health Care	0.09 (0.54)	0.16 (0.26)
Industrial & Warehouse	-0.15 (0.27)	-0.08 (0.56)
Office	-0.20 (0.15)	-0.09 (0.55)
Residential	0.15 (0.29)	0.25 (0.08)
Retail	0.34 (0.01)	0.32 (0.02)
Other	0.03 (0.86)	-0.01 (0.93)

**Table 5:
The Relation Between Systematic Risk and Geographic Region for Equity REITs**

This table reports the results of the regressions examining the relation between the geographic region in which a REIT invests and the REIT's equity and asset betas. Each REIT's equity beta was computed by performing an ordinary least squares regression of the REIT's monthly return against the return on the S&P500 index over the five-year period 1988-1992. The equity betas were then unlevered to compute asset betas for each firm. The estimated model is of the form

$$\beta = a_0 + a_1\%EAST + a_2\%MIDWEST + a_3\%SOUTH + a_4LMKTVAL + \epsilon$$

where: β is the equity or asset beta; %EAST, %MIDWEST, and %SOUTH are the proportions of the REIT's assets invested in the east, midwest, and south, respectively (the west region is omitted to avoid singularity); and LMKTVAL is the log of the REIT's equity market capitalization. Numbers in parentheses are t-statistics. Coefficients marked with an asterisk (*) are significant at the 5 percent level.

Dependent Variable	Intercept	%EAST	%MIDWEST	%SOUTH	LMKTVAL	Adjusted R ²
	a ₀	a ₁	a ₂	a ₃	a ₄	
Equity beta	-0.16 (-1.23)	0.24 (1.85)	0.12 (0.81)	0.15 (1.06)	0.05* (4.25)	0.30
Asset beta	-0.01 (-0.16)	0.14 (1.70)	0.04 (0.38)	0.03 (0.37)	0.03* (4.61)	0.34

Table 6:
Spearman Rank Correlation Coefficients Between
B and Geographic Region

This table reports the Spearman rank correlations of each REIT's equity and asset betas with the percentage of its assets invested in each geographic region. P-values are in parentheses.

Geographic Region	Equity Beta Rank Correlation Coefficient	Asset Beta Rank Correlation Coefficient
East	0.32 (0.02)	0.32 (0.02)
Midwest	0.09 (0.51)	0.02 (0.89)
South	0.06 (0.65)	0.01 (0.97)
West	-0.22 (0.12)	-0.14 (0.34)

**Table 7:
The Relation Between Systematic Risk and Economic Region for Equity REITs**

This table reports the results of the regressions examining the relation between the economic region in which a REIT invests and the REIT's equity and asset betas. Each REIT's equity beta was computed by performing an ordinary least squares regression of the REIT's monthly return against the return on the S&P500 index over the five-year period 1988-1992. The equity betas were then unlevered to compute asset betas for each firm. The estimated model is of the form

$$\beta = a_0 + a_1\text{PNCA} + a_2\text{PSCA} + a_3\text{PMINEX} + a_4\text{PFARM} + a_5\text{PINDMW} + a_6\text{POLDS} + a_7\text{PNEWENG} + a_8\text{LMKTVAL} + \epsilon$$

where: β is the equity or asset beta; PNCA, PSCA, PMINEX, PFARM, PINDMW, POLDS and PNEWENG are the proportions of the REIT's assets invested in the Northern California, Southern California, Mineral Extraction, Farmbelt, Industrial Midwest, Old South, and New England regions, respectively (the Mid-Atlantic Corridor region is omitted to avoid singularity); and LMKTVAL is the log of the REIT's equity market capitalization. Numbers in parentheses are t-statistics. Coefficients marked with an asterisk (*) are significant at the 5 percent level.

Dependent Variable	Intercept	PNCA	PSCA	PMINEX	PFARM	PINDMW	POLDS	PNEWENG	LMKTVAL	Adjusted R ²
	a ₀	a ₁	a ₂	a ₃	a ₄	a ₅	a ₆	a ₇	a ₈	
Equity Beta	0.23 (1.04)	-0.69 (-0.98)	-0.40 (-1.95)	-0.21 (-0.96)	-0.40 (-1.47)	-0.37 (-1.33)	-0.22 (-0.92)	0.11 (0.31)	0.04* (4.21)	0.33
Asset Beta	0.39* (2.93)	-0.64 (-1.53)	-0.36* (-2.98)	-0.33* (-2.58)	-0.47* (-2.90)	-0.39* (-2.34)	-0.32* (-2.18)	-0.35 (-1.56)	0.03* (4.51)	0.43

Table 8:
Spearman Rank Correlation Coefficients Between
 β and Economic Region

This table reports the Spearman rank correlations of each REIT's equity and asset betas with the percentage of its assets invested in each economic region. P-values are in parentheses.

Economic Region	Equity Beta Rank Correlation Coefficient	Asset Beta Rank Correlation Coefficient
Northern California	-0.05 (0.73)	-0.07 (0.63)
Southern California	-0.23 (0.11)	-0.10 (0.48)
Mineral Extraction	0.01 (0.95)	-0.01 (0.97)
Farmbelt	0.28 (0.05)	0.13 (0.37)
Industrial Midwest	0.02 (0.89)	0.02 (0.90)
Old South	0.28 (0.06)	0.24 (0.10)
Mid-Atlantic Corridor	0.24 (0.09)	0.15 (0.29)
New England	0.34 (0.02)	0.33 (0.02)

**Appendix Table A.1:
Summary Statistics of Systematic Risk in Equity REITs by
Property Type**

This table reports the median values of systematic risk, equity market capitalization, and leverage by property type for equity REITs. Each REIT's equity beta was computed by performing an ordinary least squares regression of the REIT's monthly return against the return on the S&P500 index over the five-year period 1988-1992. The equity betas were then unlevered to compute asset betas for each firm. REITs were classified into a particular property type category if at least 50% of their assets were of that type. REITs that did not have at least 50% of their assets invested in a single property type were assigned to the Unclassified category.

Property Type	Number of REITs in category	Equity Beta	Asset Beta	Debt-to- Equity Ratio	Equity Market Capitalization \$MM
Health Care	8	0.48	0.39	0.22	337
Industrial & Warehouse	7	0.32	0.27	4.65	7.9
Office	9	0.27	0.22	0.65	2.0
Residential	2	0.41	0.37	0.30	287
Retail	15	0.56	0.42	0.61	181
Other	2	0.30	0.18	2.0	28
Unclassified	13	0.31	0.32	0.70	43

**Appendix Table A.2:
Summary Statistics of Systematic Risk in Equity REITs by
Geographic Region**

This table reports the median values of systematic risk, equity market capitalization, and leverage by geographic region for equity REITs. Each REIT's equity beta was computed by performing an ordinary least squares regression of the REIT's monthly return against the return on the S&P500 index over the five-year period 1988-1992. The equity betas were then unlevered to compute asset betas for each firm. REITs were classified into a particular geographic region category if at least 50% of their assets were in that region. REITs that did not have at least 50% of their assets invested in a single geographic region were assigned to the Unclassified category.

Geographic Region	Number of REITs in category	Equity Beta	Asset Beta	Debt-to- Equity Ratio	Equity Market Capitalization \$MM
East	11	0.57	0.53	0.12	253
Midwest	5	0.20	0.20	0.77	28
South	9	0.42	0.30	1.65	36
West	11	0.32	0.29	0.43	121
Unclassified	20	0.43	0.34	0.70	76

Appendix Table A.3: Summary Statistics of Systematic Risk in Equity REITs by Economic Region

This table reports the median values of systematic risk, equity market capitalization, and leverage by economic region for equity REITs. Each REIT's equity beta was computed by performing an ordinary least squares regression of the REIT's monthly return against the return on the S&P500 index over the five-year period 1988-1992. The equity betas were then unlevered to compute asset betas for each firm. REITs were classified into a particular economic region category if at least 50% of their assets were in that region. REITs that did not have at least 50% of their assets invested in a single economic region were assigned to the Unclassified category.

Economic Region	Number of REITs in category	Equity Beta	Asset Beta	Debt-to- Equity Ratio	Equity Market Capitalization \$MM
Northern California	0	-	-	-	-
Southern California	8	0.32	0.29	0.29	123
Mineral Extraction	7	0.42	0.34	0.84	77
Farmbelt	3	0.20	0.20	1.60	27
Industrial Midwest	2	0.29	0.28	0.53	348
Old South	6	0.46	0.35	0.80	58
Mid-Atlantic Corridor	4	0.67	0.60	0.00	185
New England	1	0.57	0.23	13.5	2.0
Unclassified	25	0.45	0.35	0.67	43
