Spatial Filtering: Concentration or Dispersion of NCREIF Institutional Investment†

Abstract. Investors seeking to construct a portfolio of real estate properties wrestle with the trade-off between the benefits of wide-area spatial diversification versus the benefits of efficient management of properties within a small area. This study traces the acquisition and holding patterns of five types of unleveraged properties at the county level of NCREIF investors for the years 1985 and 1993. The results suggest that these investors believe they capture the systematic risk of the national real estate portfolio and sufficiently diversify away the unsystematic risk by concentrating their holdings within a small core of counties. In 1993 NCREIF investors had 45% of their holdings in fifteen counties that had 15% of the nation’s population and employment.

Introduction

Over the last decade, real estate has evolved from an individually micro-managed asset to an asset class to which portfolio analysis can be applied. The debate continues, however, as to the trade-off between the benefits of the spatial diversification of properties versus cost-effective asset management. This study measures the extent that institutional investors who are NCREIF members practice portfolio diversification across the nation’s 3000 plus counties for five major property types: apartments, retail properties, research and development (R&D) facilities, office buildings, and warehouses. Is institutional investment in real estate spatially broad or narrow?

If investment is directed primarily to a small number of core counties, that acquisition strategy implies that investors believe that these counties capture most of the systematic risk of the national real estate portfolio. This set of counties of investment serves as a proxy for the national real estate market.

In previous studies, the Russell/NCREIF property data set has been used to test the risk/return characteristics of properties held by institutions in the aggregate at the regional level. In contrast, this research focuses on the transaction and holding activity at the county level.

Background

Historically, real estate analysts lacked a volume-based transactions series to generate market prices and returns. With the emergence of the Russell/NCREIF index (now the
NCREIF Classic Property Index) in the late 1970s, analysts began to focus on these data for institutionally held properties as a major source for real estate performance measures. The NCREIF Classic series currently reports the quarterly returns of 1700 unleveraged properties.1

Hartzell, Hekman and Miles (1986) were among the first to show that based on the NCREIF data the national real estate portfolio could be diversified geographically and by property types. Clauretie (1988) showed that residential mortgage portfolios should be diversified at the metropolitan level to reduce the impact of default risk. Malizia and Simons (1991) suggest that the property series could be combined with economic base information to construct an improved efficient portfolio of real estate. Mueller (1993) further disaggregated the NCREIF data geographically and using various external economic data concluded that growth proxies assist in the search for the efficient real estate frontier.

States were grouped by the Russell/NCREIF group into four major regions and eight geographic divisions. Divisions were the smallest spatial area of analysis in earlier studies, although Mueller (1993) concluded that the use of nine economic base clusters of metropolitan areas should aid in the construction of efficient portfolios. Using mainly correlation analysis, each study concluded that returns did vary by geographic area, by property type and over time. Pagliari, Webb and Casino (1995) recognized that the construction of the mean-variance efficient portfolio of NCREIF properties depends upon a weighted combination of assets across property types and geographic areas over time.

None of these studies, however, addressed the question of what might be the ideal number and mix of individual properties to reach the efficient frontier. In striving to achieve a performance matching this efficient frontier, the portfolio manager must search for the “right” combination of properties across property types and geographic regions over time.

In contrast to the equity/bond portfolio manager, the real estate portfolio manager is faced with the transaction and management costs of constructing and maintaining a portfolio of non-fungible assets. To handle these unique real estate transaction/management costs, asset managers evaluate the cost and benefits of alternative management strategies: in-house versus third-party management, and widely dispersed properties versus “local” properties in the portfolio. This study answers how the NCREIF members have allocated their portfolio spatially.

The Theory
The real estate investor acquires and disposes of properties by type and location over time so that the expected return for his portfolio is

$$r_p = \alpha_p + \beta_p I + \delta_p,$$

in which:

- $r_p$ = return on the portfolio,
- $\alpha_p$ = a constant,
\( \beta_p \) = the beta of the portfolio,  
\( I \) = an index of the property returns, ignoring transaction and asset management costs, and  
\( \delta_p \) = a component of the return, \( r \), that is due to both management/transaction costs, and unsystematic risk.

Further, \( \delta_p \) is defined as:

\[
\delta_p = \gamma_0 + \gamma_p f_1 + \epsilon_p ,
\]

in which:

\( \gamma_p f_1 \) = a factor, the return component that constitutes management and transactions costs, and  
\( \epsilon_p \) = the unsystematic risk.

For a given risk preference, the investor seeks to construct a portfolio that captures the systematic risk of the national institutional portfolio, \( \beta I \), and that minimizes transaction/management costs, \( \gamma_p f_1 \).

In tempering the unsystematic risk, the institutional investor seeks to maximize returns when the marginal cost (\( \delta c \)) of management/transaction over the number of changing assets, the individual properties, equals the marginal return (\( \delta r \)) on the portfolio as assets (\( \delta A \)) change over space and time:

\[
\frac{\delta r}{\delta A} = \frac{\delta c}{\delta A} .
\]

At some point, the investor determines (a) when there is sufficient diversification across counties to capture the systematic risk, and (b) whether abnormal returns are possible with further diversification beyond the core locations. If abnormal returns are perceived as not possible then the investor must minimally diversify to reduce the unsystematic risk. In general (Elton and Gruber, 1981) when assets are positively correlated, the amount of risk reduced as assets (\( N \)) are added through diversification is represented by:

\[
\sigma_p^2 = \frac{1}{N} \sigma_j^2 + \frac{N-1}{N} \sigma_{sk} ,
\]

in which:

\( \sigma_p^2 \) = variance of the portfolio.

This diversification formula is not linear in solution. Initially the addition of new assets dramatically reduces the variance of the portfolio and as new assets are added, the incremental reduction decreases dramatically. Because most U.S. stocks over time are positively correlated, the general rule considers that most of the systematic risk is reduced in the portfolio when the number of stocks total fifteen or more.
The dilemma facing the real estate asset manager is that he/she must evaluate the decrease in variance risk against the increase in management cost should a property be acquired in a different geographic area. The investment community continues to debate how to minimize portfolio's unsystematic risk that diversification cannot reduce. One school says that the investor cannot outguess the market and that the market is a random walk, where minimal diversification reduces the unsystematic risk. Other schools of thought say that through better information and careful analysis (fundamental and/or technical) the use of spatial filtering may result in abnormal returns because the investor has insight into the nature of the unsystematic risk.

In the United States, the real estate investment opportunities are spatially broad across 323 metropolitan areas and over 3000 counties. The value of U.S. commercial real estate is estimated to be at a minimum one trillion dollars. In contrast the market value of the properties reported by the Russell/NCREIF (Classic) Index of 1993 totalled slightly more than 23 billion dollars.

For real estate, institutional investors deploy a range of investment strategies, most requiring costly information. Each strategy, however, recognizes that unlike fungible securities, the acquisition, holding and disposition of real estate, a physical asset, requires intensive analysis and management during all phases.

The real estate portfolio can be considered only semi-efficient because little public pro forma data is available for individual projects. Because of real estate's illiquidity, investors must anticipate holding real estate assets longer than financial assets. The long horizon period may cause investors to rely either on their individual assumptions or industry consensus about the future more than do traders of other assets.

How do the institutional investors reconcile the need for portfolio spatial diversification versus the benefits of efficient management?

Two possible answers to this question are:

- **Spatial Core Solution.** This hypothesis states that because of information constraints and management costs, investors will assume that a group of core locations (counties and metropolitan areas) captures the systematic risk of the real estate portfolio and that minimal spatial diversification reduces the unsystematic risk. The result is that investment is primarily directed to a group of core locations prominently covered by analysts.

- **Spatial Filtering Solution.** This hypothesis says that while a group of core locations represents the systematic risk of the real estate portfolio, institutional investors have an advantage of information technology and management efficiencies that allow them to diversify spatially beyond the core locations. The result is that investment significantly expands into non-core locations. This research seeks to find which of these two approaches was practiced by NCREIF investors.

**The Research Program**

The data set is the descriptions of over 3000 Russell-NCREIF acquisitions and disposition from 1976 through 1994 that includes the county where the property is located, the acquisition date, disposition date if it occurred, the square footage of the property, and the type of property. The types of property include apartments, retail properties, research and development facilities, office buildings, and warehouses.
The following were computed for each county:

- Square footage of acquisitions from 1976 through 1994 of each property type; total footage for all acquisitions from 1976 through 1994.
- Footage of each property type held by NCREIF members in 1985; footage of each property type held in 1993. Total square footage of all property held by NCREIF members in 1985; footage of all property held in 1993.
- Its rank by total square footage based on the percentage of square footage of all property types in that county for 1993. The percentage of each property type in that county for 1993.

This analysis focuses on the timing and location of the acquisitions as measured by square footage. In contrast, the study by Shilton, Stanley and Tandy (1996) measured the number of property transactions for two decades and the number of properties held by NCREIF members in 1985 and 1993.

The Results

NCREIF members invest in core locations more than would be justified by population or total employment. The cumulative percentage of NCREIF-held property by county does not parallel the cumulative percent of 1985 population by county and 1986 employment by county. (Only counties designated as urban counties, population of 25,000 or more, are used in the computation.) NCREIF members concentrated their investment in selected primary core locations at a rate double that of the population and employment concentrations (Exhibit 1). Fifty percent of the 1993 inventory of NCREIF properties was found in the top twenty counties; over 60% was found in the top thirty counties. For 1985 these percentages were even greater.

Disaggregation of the 1993 summary totals into property types revealed that NCREIF members consistently favored the primary core locations across each property type (Exhibit 2). The top thirty counties for all apartment, office, R&D, and retail activity accounted for all inventories greater than two million square feet per county and warehouse activity over three million square feet. Because warehouse activity is nearly double that of any other property type, the scale for warehouse activity (right y-axis) on Exhibit 2 is double the scale of the left y-axis. Summarily the bulk of NCREIF investment by each property type in 1993 was directed toward the top-ranked thirty counties. The number thirty is used because the inventory concentration reflected in the NCREIF index is analogous to the equity bellwether companies of the stock market’s Dow Jones average.

Statistically, the major cutoff points occur after the first seven counties and after the next fourteen. (Only the first-ranked 100 counties of the over 300 counties in which NCREIF owned property in 1993 were used in this statistical clustering test.) Exhibit 3 identifies the cluster group membership. Between these three cluster groups the differences in the mean and standard deviation for each property type are statistically significant. These three groups of the top 100 counties differed in both the magnitude of inventory and the spread across property types (Exhibit 4). Further decomposition of the top-ranked first group of seven counties reveals that each member of this group is unique in the size of the holdings and distribution pattern. Investment occurred in each of the property types in these counties: Los Angeles (California), Dallas (Texas), Orange
Exhibit 1
Footage, Population and Employment

Counts Ranked by 1993 Square Footage

- 1993 Square Footage
- Population, 1985
- Employment, 1986
Exhibit 2
Square Footage by Property Type

Top Fifty Counties in 1993 Footage

- Apartments
- Office
- R&D
- Retail
- Warehouses
(California), Santa Clara (California), Cook (Illinois), Maricopa (Arizona), and Fulton (Georgia). However, the second-ranked fourteen counties are generally similar in size of investment, but investment did not occur in each of the property types.

In 1993, three contiguous California counties, Los Angeles, Orange and San Bernadino, accounted for over 13% of the total NCREIF investments and 25% of the warehouse investment. California counties were the repository of one-fifth of the NCREIF inventory. Two contiguous Illinois counties, Cook and Du Page (Chicago Metro) accounted for over 6% of the investments. Showing the consistent bias from 1985 through 1993 of NCREIF members against the Northeast, Philadelphia, with less than 1% of the 1993 total investment, is the only county appearing in the top thirty.

From 1985 through 1993, as Exhibits 5 through 8 illustrate, NCREIF properties were concentrated in the primary core locations. During this period, however, members had cast their investments over a wider geographic area. Between 1985 and 1993, NCREIF investors moved out of fifty-three counties and into seventy-three new counties (Shilton, Stanley and Tandy, 1996).

### Exhibit 3
**1993 Percentage of Holdings in Each County**

<table>
<thead>
<tr>
<th>County</th>
<th>Apts (%)</th>
<th>Office (%)</th>
<th>R&amp;D (%)</th>
<th>Retail (%)</th>
<th>Wrhs (%)</th>
<th>Total</th>
<th>Group</th>
<th>Number</th>
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</thead>
<tbody>
<tr>
<td>Los Angeles, CA</td>
<td>.20</td>
<td>5.87</td>
<td>7.24</td>
<td>6.85</td>
<td>14.33</td>
<td>7.82</td>
<td>1</td>
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<tr>
<td>Dallas, TX</td>
<td>1.68</td>
<td>5.37</td>
<td>5.04</td>
<td>.47</td>
<td>7.48</td>
<td>4.53</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Orange, CA</td>
<td>1.29</td>
<td>2.86</td>
<td>5.32</td>
<td>3.56</td>
<td>6.72</td>
<td>4.22</td>
<td>1</td>
<td></td>
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<tr>
<td>Santa Clara, CA</td>
<td>.18</td>
<td>.72</td>
<td>17.26</td>
<td>1.07</td>
<td>3.85</td>
<td>4.04</td>
<td>1</td>
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<td>Cook, IL</td>
<td>1.06</td>
<td>6.58</td>
<td>3.36</td>
<td>1.13</td>
<td>2.75</td>
<td>3.15</td>
<td>1</td>
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<td>Du Page, IL</td>
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<td>2.88</td>
<td>.58</td>
<td>6.53</td>
<td>3.02</td>
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<td>Maricopa, AZ</td>
<td>5.82</td>
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<td>1.74</td>
<td>.94</td>
<td>2.79</td>
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<td>Fulton, GA</td>
<td>6.86</td>
<td>1.52</td>
<td>.54</td>
<td>.83</td>
<td>3.48</td>
<td>2.73</td>
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<tr>
<td>Harris, TX</td>
<td>2.72</td>
<td>7.12</td>
<td>.67</td>
<td>.84</td>
<td>.78</td>
<td>2.51</td>
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<td>King, WA</td>
<td>2.74</td>
<td>1.68</td>
<td>2.63</td>
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<td>Alameda, CA</td>
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<td>.80</td>
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<td>.58</td>
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<td>1.82</td>
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<td>St. Louis, MO</td>
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<td>1.75</td>
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<td>1.45</td>
<td>1.80</td>
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<tr>
<td>San Francisco, CA</td>
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<td>6.27</td>
<td>.06</td>
<td>.62</td>
<td>.27</td>
<td>1.59</td>
<td>3</td>
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<tr>
<td>San Diego, CA</td>
<td>.30</td>
<td>2.46</td>
<td>1.81</td>
<td>1.96</td>
<td>1.22</td>
<td>1.55</td>
<td>2</td>
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<td>Hennepin, MN</td>
<td>.79</td>
<td>1.38</td>
<td>2.19</td>
<td>.18</td>
<td>2.34</td>
<td>1.49</td>
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<tr>
<td>Fairfax, VA</td>
<td>3.64</td>
<td>1.89</td>
<td>1.92</td>
<td>.24</td>
<td>.12</td>
<td>1.38</td>
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<tr>
<td>Orange, FL</td>
<td>1.96</td>
<td>1.14</td>
<td>1.40</td>
<td>.52</td>
<td>1.21</td>
<td>1.23</td>
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<td>San Bernadino, CA</td>
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<td>.00</td>
<td>.00</td>
<td>.37</td>
<td>3.47</td>
<td>1.18</td>
<td>3</td>
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<td>Mecklenburg, VA</td>
<td>.28</td>
<td>2.05</td>
<td>1.74</td>
<td>1.87</td>
<td>.13</td>
<td>1.11</td>
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<td>.00</td>
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<td>1.55</td>
<td>2.22</td>
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<td>.82</td>
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<td>.00</td>
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<td>.36</td>
<td>.03</td>
<td>1.55</td>
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<td>1.22</td>
<td>1.01</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Broward, FL</td>
<td>2.86</td>
<td>.67</td>
<td>.60</td>
<td>.37</td>
<td>.66</td>
<td>.97</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Montgomery, MD</td>
<td>.65</td>
<td>.43</td>
<td>2.16</td>
<td>.44</td>
<td>1.24</td>
<td>.96</td>
<td>3</td>
<td></td>
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<td>Philadelphia, PA</td>
<td>1.04</td>
<td>2.92</td>
<td>.00</td>
<td>.42</td>
<td>.00</td>
<td>.89</td>
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<td></td>
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<td>Dade, FL</td>
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<td>.71</td>
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<td>.87</td>
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<td>San Mateo, CA</td>
<td>.60</td>
<td>.57</td>
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<td>1.66</td>
<td>.00</td>
<td>1.46</td>
<td>1.91</td>
<td>.00</td>
<td>.81</td>
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</table>
Exhibit 4
Cluster Group Characteristics

Group 1: Counties ranked 1 through 7, and 15th based on total square footage.
Group 2: Counties ranked 8, 9, 10, 11, 12, 14, 16, 17, 19, 20, 22, 23, 25, 32.
Group 3: All others through rank 100.

Groups clustered on 1993 square footage of apartments, office, R&D, retail, and warehouse footage in county.

<table>
<thead>
<tr>
<th>Group</th>
<th>Apts</th>
<th>Office</th>
<th>R&amp;D</th>
<th>Retail</th>
<th>Warehouse</th>
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<td>1</td>
<td>755,406</td>
<td>2,582,527</td>
<td>2,893,726</td>
<td>1,070,947</td>
<td>5,545,151</td>
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<tr>
<td>2</td>
<td>1,008,803</td>
<td>1,612,185</td>
<td>698,971</td>
<td>459,363</td>
<td>1,213,006</td>
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<tr>
<td>3</td>
<td>357,805</td>
<td>338,956</td>
<td>181,531</td>
<td>368,302</td>
<td>392,883</td>
</tr>
<tr>
<td>Total</td>
<td>481,995</td>
<td>700,308</td>
<td>473,872</td>
<td>437,958</td>
<td>925,205</td>
</tr>
</tbody>
</table>

The “rule of 15” for minimal systematic diversification (Elton and Gruber, 1981) seems to apply to NCREIF property investment. Though the top fifteen investment counties accounted for only 15% of the population and total employment, these counties account for 45% of the investment inventory for 1993. The top thirty counties, representing twenty-six distinct metropolitan economic regions, account for 60% of the NCREIF inventory.

The implication of this study is investors seek to minimize the factor cost of management, \( \gamma_p F_1 \), (equation 2). The investors rely on the assumption that a basket of counties will not only capture the systematic risk, but also sufficiently reduce the unsystematic risk, \( \varepsilon_p \) of the portfolio. Given the spatial concentration of the NCREIF-held properties, and by using the regional and metropolitan NCREIF return series, and under limiting assumptions, the implied managerial efficiency (costs) of this factor for different levels of spatial dispersion can be simulated (Shilton and Stanley, 1995).
Exhibit 5
NCREIF Apartment Holdings, 1985 and 1993

Holdings in Sq. Ft

- 5000000
- 2500000
- 1250000

Apt 85
Apt 93
Exhibit 6
NCREIF Office Holdings, 1985 and 1993

Holdings in Sq. Ft

- 15,000,000
- 7,500,000
- 3,750,000

Off/R&D 85
Off/R&D 93
Exhibit 7
NCREIF Retail Holdings, 1985 and 1993

Holdings in Sq. Ft

7500000
3750000
1875000

Retail 85
Retail 93
Exhibit 8
NCREIF Warehouse Holdings, 1985 and 1993

Holdings in Sq. Ft

- 20000000
- 10000000
- 5000000

Warehouse 85
Warehouse 93
Conclusions

Institutional investors appear to favor certain counties (metropolitan areas) in their acquisition strategies. While an initial exploratory venture into the degree of spatial dispersion, the study suggests that thirty or fewer counties are perceived as sufficient to obtain the benefits of diversification. Population size or total employment within the counties or metropolitan areas do not explain the degree of institutional emphasis in their acquisitions. Other factors including personal income levels, past growth, and the amenity levels may need to be incorporated.

Because of the proprietary nature of the NCREIF data, individual returns measures are not available to test the efficiency of this spatial core diversification strategy. The reasons for and the effects of this limited diversification on the risk and returns of the portfolio remain to be answered.

But for now, more eyes will turn to the “Top 30 Counties” in institutional activity to assess the state of real estate investment.

Note

1NCREIF also prepares an index for leverage properties held by its members. Those properties numbered over 400. Initial statistical tests indicate that these properties do not differ spatially from the unleveraged properties.

References


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