Systematic Behavior in Real Estate Investment Risk: Performance Persistence in NCREIF Returns

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Abstract: Serial dependence of total annual returns in the NCREIF data base is shown to be statistically significant in the first and fourth quartiles of disaggregated data between 1978 and 1994. More precisely, superior performance is generally followed by continued superior performance, and inferior performance is generally followed by continued inferior performance. In contrast, there is virtually no evidence to support serial dependence in the second or third quartiles, whether combined or taken separately. The empirical rejection of serial independence among real estate returns calls into question the conclusions of research based upon models that incorporate the assumption of serial independence.

Key Words: Investment risk, persistence, systematic behavior, serial dependence

Introduction

This study examines the serial persistence of annual property returns in the NCREIF Property Index between 1978 and 1994 disaggregated into data cells by property type and Metropolitan Statistical Area (MSA). For each year we group annual data cell returns into quartiles, and record the quartile rank for each year in which a quartile rank is also available for the data cell in the subsequent year. We extend this methodology to longer runs by applying the same criteria for performance persistence in the year following a sequence of same-quartile rankings of from two to six years. Then, successful performance persistence is defined as an identical quartile rank in the subsequent year, and unsuccessful performance persistence as a different quartile rank in the subsequent year.

In each case, since the cross-sectional data are divided into quartiles, the theoretical probability of success is 25% if quartile rankings are serially independent. Thus, statistically significant departures from 25% are deemed evidence of persistence.

Analysts have two possible ways to test for performance persistence. One approach involves time-series data, and the other involves cross-sectional data. In this study we choose cross-sectional data for theoretical and practical reasons.

In an empirical study of disaggregated NCREIF data, Young & Graff [1995] found that cross-sectional annual returns were not normally distributed during any year between 1978 and 1992. Further, they found that both the skewness and magnitude of real estate risk changed over time. Thus, time-series data are subject to intractable difficulties of heteroscedasticity, skewness, and nonstationarity which render the conclusions of ordinary parametric tests highly suspect.

In contrast, cross-sectional nonparametric tests avoid these difficulties and, in the real estate context, have the added benefit of providing substantially larger sample sizes upon which to perform tests of statistical significance. Given a choice between cross-sectional or time-series data analysis, we believe that there are sound reasons to opt for more data to improve measures of statistical confidence. In general, we believe that cross-sectional tests have been underutilized by real estate researchers.

There are long-standing precedents for nonparametric tests in performance studies. For example, Jensen [1969] investigated the ability of stock mutual funds (and their managers) to outperform the market in succeeding periods by dividing the performance of funds into two groups, superior and inferior (he found no evidence of serial dependence in mutual fund performance).

Young & Graff found that real estate asset-specific risk was heteroscedastic with time-varying skewness. This finding leads us to conduct a nonparametric test similar to Jensen's, but with more groupings. We use performance quartiles to contrast the extremes (the first and fourth quartiles) with the center (the second and third quartiles).

Data

The data for this study consist of total annual returns between 1978 and 1994 from the NCREIF Property Index.[1] In order to preserve anonymity, NCREIF aggregates data within each MSA so that no fewer than four properties occupy any MSA/property-type cell.[2] Exhibit 1 shows the 50 MSAs that had at least one occurrence of two consecutive years of total returns for some property type. Detroit, Middlesex County (NJ), and New Orleans had the least amount of return data, each with only one cellular string of two consecutive years. The total number of MSAs ranged from 8 in 1978 to 44 in 1991.

In the NCREIF data base there are five property types with sufficient data to disaggregate the MSA-level data further: Office, Retail, Warehouse, R&D, and Apartment. Except for the Apartment data that begin in 1985, property types have data for the entire 1978 to 1994 period.

To analyze performance persistence in time-series data, the number and duration of sequential annual return statistics at the MSA/property-type level of disaggregation becomes important. Exhibit 2 shows the number of sequential returns for each property type at durations ranging from two to seventeen years. Due to relatively small sample size in some data cells occasioned by manager decisions to purchase or sell, and due to the four-property/two-manager NCREIF masking criterion, there are numerous gaps in the sequence of annual returns. Of the 176 individual sequences between 1978 and 1994, 57% were of 6 years duration or less and only 26% were of 10 years duration or longer. Since many of the sequences are non-overlapping, analysts seeking a large sample of time-series performance statistics at the MSA/property-type disaggregation will be disappointed.

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1 As of December 31, 1995, the NCREIF Property Index consisted of 2,322 properties having an estimated aggregate market value of approximately $47.8 billion. By various estimates this represents about one-third of all equity real estate owned by domestic public and private pension plans. For this study, properties having fewer than four quarters of data for a year were disqualified for that year.

2 NCREIF policy prohibits publication of individual property returns in order to preserve the privacy of contributing member firms and their clients. The current rule is that performance data be aggregated so that a minimum of four properties from at least two investment managers occupy the smallest statistical data cell.

Because sample size matters for statistical completeness, some researchers have opted for quarterly data. However, as demonstrated in Graff & Young [1996], Graff [1995], and Newell & MacFarlane [1995], quarterly NCREIF data are beset by problems that unduly complicate analysis and detract from the power of statistical tests.

For these reasons we use cross-sectional data, so the data sets are relatively large for sequences of 2 and 3 years in individual property type quartiles and for sequences of 2 through 4 years for combined property type quartiles. By combining the first and fourth quartiles (the extremes of the distributions) and the second and third quartiles (the central 50% of the distributions), we further enlarge the sample sets to a size at which statistical inferences can be made with substantial validity for sequences ranging from 2 to 6 years.

Test of Persistence

For each year from 1978 to 1994, the total returns for each MSA/property-type cell were assigned a quartile ranking.[3] The data were also disaggregated by property type to examine whether serial dependence was distinguishable along this dimension.

For each MSA/property-type sequential group, we examined serial runs of uniform quartile performance. Serial persistence consisted of a quartile rank in the year following a run of constant quartile rankings. The shortest run was one year, with success defined as performance in the same quartile the following year; the longest run was six years. Thus, successful within-quartile runs ranged from two to seven years.

Our null hypothesis assumes that the quartile in which an MSA/property-type return falls is independent across time.[4] In this case, the probability of returns remaining in the same quartile rank from one period to the next is 25%. Statistically significant departures from 25% are considered evidence of serially dependent performance persistence.

Since the number of cross-sectional returns is usually not divisible by four, the number of data points in the quartiles are not quite equal. Because of the way we defined the quartile breaks, any bias in this regard is toward more second and third quartile designations.

Confidence Interval Estimation

All too often researchers neglect confidence intervals, ending their analysis with the sample statistics. Simple comparisons of relative magnitudes or differences between sample statistics fail to illuminate the central question, which is: are the sample statistics being reported statistically distinguishable from a theoretical value or from one another? To answer this question, one must estimate the appropriate confidence interval.

To ascertain whether quartile performance is serially dependent, we calculate confidence intervals for the binomial distribution under the assumption that the probability of repeating quartile performance is 25%.

In this case, the sample statistic is the percent of sample MSA/property-type returns for which the quartile rank in the subsequent sample period equals the quartile rank during the

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[3] In a separate series of tests not reported here, we arranged the cross-sectional data by quartiles for each property-type and looked for performance persistence separately for each type. The results were essentially the same but somewhat noisier in the first and fourth quartiles.

[4] This statement is less restrictive than the assertion that the MSA returns are independent across time.

immediately preceding series of sample periods. The central question is whether or not the sample statistic is statistically distinct from 25%.

For a q% confidence interval and n samples, the upper end point of the confidence interval is m/n, where the cumulative probability of m or fewer successes is at least $(1+.01*q)/2$ and the cumulative probability of m-1 or fewer successes is less than $(1+.01*q)/2$. Similarly, the lower end point of the confidence interval is k/n, where the cumulative probability of k successes is at least $(1-.01*q)/2$ and the cumulative probability of k-1 or fewer successes is less than $(1-.01*q)/2$.

Since the binomial distribution is discrete, the sample statistic can only assume a finite number of potential values between 0 and 1. Thus, in contrast to smooth probability distributions, there is a positive probability that a sample value for the statistic can equal one of the end points of a q% confidence interval. In order to avoid confusion in such a case about whether or not the sample value is within the confidence interval, the left end point of the q% confidence interval is reported in the exhibits as $(m+1/2)/n$, and the right end point of the confidence interval is reported as $(k-1/2)/n$.[5] Since $(m+1/2)/n$ and $(k-1/2)/n$ cannot occur as sample values (each is midway between two possible sample values for the binomial distribution), each sample value reported in the exhibits is either unambiguously inside or outside each confidence interval.

Findings

We find that performance persistence is statistically significant in the extremes of the cross-sectional distribution of NCREIF returns disaggregated by property type within MSAs for the years 1978 to 1994. By contrast, performance persistence is virtually undetectable in the central 50-percentile range of cross-sectional returns. The power of the statistical tests in the combined extreme first and fourth quartiles is irrefutable evidence of systematic behavior in risk, a finding that invalidates the current formulations of portfolio theory and practice within the real estate asset class that rely upon assumptions of normal distributions and uniform risk across time.

Exhibit 3 shows that persistence of total annual returns within the combined first and fourth quartiles is statistically significant for each of five property types and for all properties taken together following runs of 1 year for Retail and R&D properties, following runs of 1 and 2 years for Warehouse properties, and following runs of 1, 2, and 3 years for Office and Apartment properties. Combining all property types we find that statistical significance of performance persistence occurs following runs of 1, 2, 3, 4, and 5 years. Moreover, among the 15 statistically significant findings shown in Exhibit 3, five are statistically significant at the 99.99999% level, and ten are statistically significant at the 99.9% level.

The results in the center of the return distribution—the combined second and third quartiles—stand in sharp contrast to the results at the extremes. Exhibit 4 shows that Warehouse properties had statistically significant return persistence following a 1-year run at the 99% confidence level and that the combined property data had statistically significant return persistence following 1-year and 2-year runs. All other runs (by property type or for all property types combined) failed to show persistence statistically distinguishable from the theoretical expected value of 25%.

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[5] Since the range of the binomial distribution is the closed unit interval [0,1], in order to avoid confusion the end points of the confidence interval are not expanded by $1/(2*n)$ in the extreme cases $m=n$ or $k=0$.

Exhibits 5 through 8 show the results of success following various runs of 1 to 6 years (for quartiles 1, 4, 2, and 3 respectively) for the combined data set and for data disaggregated by property type.

At the individual property-type disaggregation, we found that first quartile performance (see Exhibit 5) of Retail, Warehouse, R&D, and Apartment properties with 1-year runs produced statistically significant persistence the following year, and that Apartments extended the statistically significant results to runs of 2 and 3 years. Also, we found that fourth quartile performance persistence (see Exhibit 6) of Office properties with runs of 1, 2, 3, and 4 years produced statistically significant results. Warehouse properties with 2-year runs and R&D properties with 1-year runs had statistically significant persistence at the 95% confidence level.

By contrast, we found no statistically significant performance persistence among any property types in the second or third quartiles (see Exhibits 7 and 8). Randomness in the center of the distribution of returns is prevalent, and contrasts sharply with serial dependence at the high and low extremes.

Within each quartile, we combined all samples across property type, and show the results at the bottom of Exhibits 5 through 8. First quartile performance persistence is statistically significant at the 99.99999% level for 1-year runs, and statistically significant at the 99.9% level for 2-year runs. The fourth quartile performance persistence is notably better with statistical significance at the 99.99999% level for runs of 1, 2, and 3 years; at the 99.9% level for runs of 4 years; and at the 95% level for runs of 5 years. Second quartile performance of all samples combined is statistically significant at the 95% level for 1-year runs only, while none of the combined results in the third quartile is significant.

Exhibit 9 shows the results of combining all performance data from each of the four quartiles. The strong evidence of performance persistence is not diluted by combining the weak middle with the strong extremes of the distribution. Indeed, the statistical significance of persistence following a 3-year run improves from the 99.9% level in the combined first and fourth quartile results to the 99.99999% level when all quartiles are taken together.

Finally, the sample performance statistics for runs of two to six years are statistically indistinguishable for the values for one year when sample noise is taken into account, except that the confidence intervals become wider as sample size diminishes.

Conclusion and Implications

Modern Portfolio Theory (MPT) and its antecedent, the Efficient Markets Hypothesis (EMH), seem to have been introduced into real estate to justify the use of particular statistical techniques and portfolio strategies rather than as a consequence of empirical analysis of investment return and risk characteristics. In science, the situation is generally reversed: theories are developed to explain observations.

In the real estate asset class, recent empirical studies by the authors and others have questioned the applicability of MPT or EMH in their current forms.[6] This study is yet another in that vein. If MPT or EMH are valid models for equity real estate, our finding of performance persistence at the extremes of the risk distribution should not have been statistically significant.

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6 Substantial departures from Gaussian normal return distributions have been noted by Liu, et al. [1992], Myer & Webb [1990 & 1993], and Young & Graff [1995].

This empirical research demonstrates conclusively that total returns of properties disaggregated at the MSA/property-type level within the NCREIF data base exhibit serial dependence at the extremes of the distribution. This conclusion is at odds with the prevailing assumption about real estate risk, and calls into question current beliefs and portfolio construction applications.[7] It follows that the conclusions of research based upon models that incorporate the assumption of serial independence are of dubious reliability for real estate investors.

Without exception, having more data is superior to dealing with small sample sizes. Use of NCREIF data with its stringent masking criteria has been criticized by researchers, including the authors. Although we would have preferred individual property returns to aggregated returns, our findings are conclusive without finer-grained data.

At first glance, performance persistence suggests a simple investment decision rule: hold your extreme winners; sell your extreme losers. For investments in the center of the MSA/property-type performance distribution, a more detailed examination of the risk/reward characteristics of each property is appropriate before making portfolio decisions.

Rather than suggest investment decision rules, we believe that the most useful application of these results are in "filter" or "screening" rules that indicate what and where to avoid, and what and where to seek new investment opportunities. While asset selection should dominate asset allocation in general, knowledge of persistence may be used to increase the probability of success in the extreme upper quartile of MSA/property-type aggregate returns and avoid inferior performance in the extreme lower quartile.

If the knowledge of performance persistence suggested here becomes widely accepted by investors, we might expect any value created by awareness of persistence to be dissipated quickly as prices are bid up or down to reflect active buying in known superior MSA/property-type sectors or active retreat from known inferior MSA/property-type sectors. In other words, for an investment strategy based on persistence to succeed, there must be widespread skepticism about its efficacy, or practical obstacles to its timely incorporation into portfolio strategy for most institutional investors.

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7 Virtually all analyses of real estate risk and return proxy risk as the standard deviation of an i.i.d. (independent identically distributed) time series. However, if some real estate return series are serially dependent, then such a risk proxy is invalid.

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Exhibit 1
Number of Property Types with Return Statistics within MSA by Year (maximum of 5)
NCREIF MSA/Property-Type Annual Total Returns—1978 to 1994

MSAs	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94
Anaheim	1	1	2	2	3	4	3	3	3	3	3	3	4	5	5	5	5
Atlanta	1	1	1	1	2	2	3	4	4	4	5	5	5	5	5	5	5
Austin														1	1	1	1
Baltimore				1	1	1	2	2	2	1	1		2	3	4	4	3
Boston					1	2	2	2	2	2	2	2	2	3	3	3	3
Charlotte NC				1	1	1	1			1	1	2	2	2	2	2	2
Chicago	1	1	2	4	4	4	4	4	4	4	4	5	5	5	5	4	4
Cincinnati													2	2	2	2	2
Columbus OH					1	1	1			1	1	1	2	2	2	2	2
Corpus Christi													1	1	1	1	1
Dallas	1	1	1	2	2	3	3	3	4	4	5	5	5	5	5	5	5
Denver		1	2	2	2	3	3	3	3	3	3	3	3	3	3	4	3
Des Moines																1	1
Detroit						1	1	2	3	3	3	3	4	5	5	3	3
Ft Lauderdale								1	1	1	1	2	3	3	3	2	2
Ft Worth		1	1	1	1	1	1		1	1	1	1				1	1
Hartford					1	1	1	1	1	1	1	1	1				
Houston				2	2	2	2	3	4	4	3	3	4	4	4	4	4
Indianapolis					1	1	1				1	1	1	2	2	4	3
Kansas City									1	2	2	2	2	2	2	2	2
Las Vegas													1	1	1	1	1
Los Angeles	2	2	2	2	3	3	3	3	3	3	4	5	5	5	5	4	4
Memphis	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	3	2
Miami								1	1	1	1	1	1	1		1	1
Middlesex NJ																2	2
Milwaukee					1	1				1	1	2	3	3	3	2	2
Minneapolis		1	1	3	3	4	4	3	4	4	3	4	4	4	4	4	4
Nashville					1	1	1	1	1	1	1	1	1	1	1		
New Orleans														1	1		
New York					1	1	1	1	1	1	1	1	1	1	1	1	1
Newark														1	1		
Oakland			1	1	2	2	3	3	3	3	4	4	3	5	5	5	5
Orlando							1	1	1	1	1	1	2	4	4	4	3
Philadelphia				1	1	1	1	2	3	3	3	4	4	4	4	5	5
Phoenix	1	2	2	3	3	4	4	4	4	4	4	5	5	5	5	5	5
Portland OR				2	2	2	2	2	2	1	1	1	3	3	4	4	3
Raleigh NC						1	1	1	1	1	1	1					
Riverside												1	1	2	2	2	2
Sacramento					1	1	1					1	3	4	3	3	2
Salt Lake City									1	1	1	1	1	1	1	1	1
San Antonio									1	1	1	2	2	2	2		
San Diego								1	1	3	4	4	4	5	5	5	5
San Francisco									1	1	1	1	1	4	4	4	3
San Jose	1	2	2	2	3	3	3	3	3	3	3	3	3	4	4	4	4
Seattle					2	2	1	2	2	2	2	2	4	5	5	5	5
St Louis					1	1	2	2	2	2	2	2	3	3	3	3	3
Tampa											1	2	2	2	2	2	2
Tulsa											1	1	1				
Washington DC		2	2	3	3	3	3	3	4	5	5	5	5	5	5	5	5
West Palm Beach														1	3	3	2
Total MSAs	8	12	13	18	28	30	30	28	33	36	39	40	42	44	43	43	43
Total Property Types in MSAs	9	16	20	34	50	58	60	62	73	78	84	95	112	132	134	133	124

Exhibit 2
Number of Sequential Returns of Various Duration by Property Type within MSAs
NCREIF MSA/Property-Type Annual Total Returns—1978 to 1994

Duration	Number by Property Type						Cumulative Totals	
of Returns	Office	Retail	Warehse	R&D	Apartment	Total	Number	Pct
2 years	4	7	6	2	5	24	24	14%
3 years	2	5	4	4	4	14	43	24
4 years	7	4	8	2	6	27	70	40
5 years	3	6	3		5	17	87	49
6 years	4	2	3	1	3	13	100	57
7 years	2	3	2	2	1	10	110	63
8 years	1	2	3	1	1	8	118	67
9 years	4		1	2	1	8	126	72
10 years	2	1	1	1		5	131	74
11 years	2		1	1		4	135	77
12 years	1	1		3		5	140	80
13 years	4	2	1	1		8	148	84
14 years	5	2	2	2		11	159	90
15 years	1		1			2	161	91
16 years	2	1	1	2		6	167	95
17 years		1	8			9	176	100
Total	44	37	45	24	26	176		

Exhibit 3
First and Fourth Quartiles Combined
Performance Persistence in the NCREIF Data Base within MSAs—1978 to 1994

Property Type	Length of Run	No. of Samples	No. of Successes	Percent of Successes	95% Confidence Interval
Office	1	173	93	53.8****	(18.2, 32.1)
	2	81	44	54.3****	(15.4, 35.2)
	3	37	24	64.9***	(9.5, 41.9)
	4	19	13	68.4	(2.6, 50.0)
	5	12	7	58.3	[0.0, 54.2)
	6	6	3	50.0	[0.0, 75.0)
Retail	1	90	35	38.9**	(16.1, 35.0)
	2	31	13	41.9	(8.1, 43.5)
	3	11	3	27.3	[0.0, 59.1)
	4	3	1	33.3	[0.0, 83.3)
	5	1	0	0.0	[0.0, 100.0]
Warehouse	1	139	56	40.3***	(17.6, 32.7)
	2	52	23	44.2**	(12.5, 37.5)
	3	22	10	45.5	(6.8, 47.7)
	4	10	5	50.0	[0.0, 55.0)
	5	5	2	40.0	[0.0, 70.0)
	6	2	0	0.0	[0.0, 100.0]
R&D	1	82	34	41.5**	(15.2, 34.8)
	2	31	9	29.0	(8.1, 43.5)
	3	9	2	22.2	[0.0, 61.1)
	4	2	0	0.0	[0.0, 100.0]
Apartment	1	55	33	60.0****	(13.6, 37.3)
	2	23	15	65.2***	(6.5, 45.7)
	3	9	6	66.7*	[0.0, 61.1)
	4	3	2	66.7	[0.0, 83.3)
All Samples Combined	1	539	251	46.6****	(21.2, 28.8)
	2	218	104	47.7****	(19.0, 31.0)
	3	88	45	51.1***	(15.3, 34.7)
	4	37	21	56.8***	(9.5, 41.9)
	5	18	9	50.0*	(2.8, 47.2)
	6	8	3	37.5	[0.0, 68.8)

* Statistically distinct from 25.0% with 95% confidence
** Statistically distinct from 25.0% with 99% confidence
*** Statistically distinct from 25.0% with 99.9% confidence
**** Statistically distinct from 25.0% with 99.99999% confidence

Exhibit 4
Second and Third Quartiles Combined
Performance Persistence in the NCREIF Data Base within MSAs—1978 to 1994

Property Type	Length of Run	No. of Samples	No. of Successes	Percent of Successes	95% Confidence Interval
Office	1	145	38	26.2	(17.6, 32.8)
	2	32	9	28.1	(7.8, 42.2)
	3	8	4	50.0	[0.0, 68.8)
	4	3	1	33.3	[0.0, 83.3)
Retail	1	106	28	26.4	(16.5, 33.5)
	2	22	6	27.3	(6.8, 47.7)
	3	5	2	40.0	[0.0, 70.0)
	4	1	0	0.0	[0.0, 100.0]
Warehouse	1	180	61	33.9**	(18.6, 31.9)
	2	53	19	35.8	(12.3, 38.7)
	3	16	4	25.0	(3.1, 53.1)
	4	3	0	0.0	[0.0, 83.3)
R&D	1	94	30	31.9	(16.5, 34.6)
	2	25	9	36.0	(6.0, 46.0)
	3	8	5	62.5	[0.0, 68.8)
	4	5	3	60.0	[0.0, 70.0)
	5	3	1	33.3	[0.0, 83.3)
	6	1	0	0.0	[0.0, 100.0]
Apartment	1	32	12	37.5	(7.8, 42.2)
	2	8	4	50.0	[0.0, 68.8)
	3	2	0	0.0	[0.0, 100.0]
All Samples Combined	1	557	169	30.3**	(21.3, 28.8)
	2	140	47	33.6*	(17.5, 32.5)
	3	39	15	38.5	(11.5, 39.7)
	4	12	4	33.3	[0.0, 54.2)
	5	3	1	33.3	[0.0, 83.3)
	6	1	0	0.0	[0.0, 100.0]

* Statistically distinct from 25.0% with 95% confidence
** Statistically distinct from 25.0% with 99% confidence

Exhibit 5
First Quartile
Performance Persistence in the NCREIF Data Base within MSAs—1978 to 1994

Property Type	Length of Run	No. of Samples	No. of Successes	Percent of Successes	95% Confidence Interval
Office	1	42	14	33.3	(10.7, 39.3)
	2	14	5	35.7	(3.6, 53.6)
	3	5	1	20.0	[0.0, 70.0)
	4	1	0	0.0	[0.0, 100.0]
Retail	1	66	30	45.5***	(14.4, 37.1)
	2	28	12	42.9	(8.9, 44.6)
	3	11	3	27.3	[0.0, 59.1)
	4	3	1	33.3	[0.0, 83.3)
	5	1	0	0.0	[0.0, 100.0]
Warehouse	1	79	35	44.3***	(14.6, 34.8)
	2	32	13	40.6	(7.8, 42.2)
	3	12	5	41.7	[0.0, 54.2)
	4	5	2	40.0	[0.0, 70.0)
	5	2	1	50.0	[0.0, 100.0]
	6	1	0	0.0	[0.0, 100.0]
R&D	1	37	16	43.2*	(9.5, 41.9)
	2	15	5	33.3	(3.3, 50.0)
	3	5	1	20.0	[0.0, 70.0)
	4	1	0	0.0	[0.0, 100.0]
Apartment	1	46	30	65.2****	(12.0, 38.0)
	2	20	13	65.0***	(7.5, 47.5)
	3	7	5	71.4*	[0.0, 64.3)
	4	2	2	100.0	[0.0, 100.0]
All Samples Combined	1	270	125	46.3****	(19.8, 30.6)
	2	109	48	44.0***	(17.0, 33.5)
	3	40	15	37.5	(11.3, 41.3)
	4	12	5	41.7	[0.0, 54.2)
	5	3	1	33.3	[0.0, 83.3)
	6	1	0	0.0	[0.0, 100.0]

* Statistically distinct from 25.0% with 95% confidence
*** Statistically distinct from 25.0% with 99.9% confidence
**** Statistically distinct from 25.0% with 99.99999% confidence

Exhibit 6
Fourth Quartile
Performance Persistence in the NCREIF Data Base within MSAs—1978 to 1994

Property Type	Length of Run	No. of Samples	No. of Successes	Percent of Successes	95% Confidence Interval
Office	1	131	79	60.3****	(17.2, 33.2)
	2	67	39	58.2****	(14.2, 36.6)
	3	32	23	71.9****	(7.8, 42.2)
	4	18	13	72.2***	(2.8, 47.2)
	5	12	7	58.3	[0.0, 54.2)
	6	6	3	50.0	[0.0, 75.0)
Retail	1	24	5	20.8	(6.3, 43.8)
	2	3	1	33.3	[0.0, 83.3)
Warehouse	1	60	21	35.0	(14.2, 37.5)
	2	20	10	50.0*	(7.5, 47.5)
	3	10	5	50.0	[0.0, 55.0)
	4	5	3	60.0	[0.0, 70.0)
	5	3	1	33.3	[0.0, 83.3)
	6	1	0	0.0	[0.0, 100.0]
R&D	1	45	18	40.0*	(12.2, 38.9)
	2	16	4	25.0	(3.1, 53.1)
	3	4	1	25.0	[0.0, 87.5)
	4	1	0	0.0	[0.0, 100.0]
Apartment	1	9	3	33.3	[0.0, 61.1)
	2	3	2	66.7	[0.0, 83.3)
	3	2	1	50.0	[0.0, 100.0]
	4	1	0	0.0	[0.0, 100.0]
All Samples Combined	1	269	126	46.8****	(19.9, 30.3)
	2	109	56	51.4****	(17.0, 33.5)
	3	48	30	62.5****	(11.5, 38.5)
	4	25	16	64.0***	(6.0, 46.0)
	5	15	8	53.3*	(3.3, 50.0)
	6	7	3	42.9	[0.0, 64.3)

* Statistically distinct from 25.0% with 95% confidence
*** Statistically distinct from 25.0% with 99.9% confidence
**** Statistically distinct from 25.0% with 99.99999% confidence

Exhibit 7
Second Quartile
Performance Persistence in the NCREIF Data Base within MSAs—1978 to 1994

Property Type	Length of Run	No. of Samples	No. of Successes	Percent of Successes	95% Confidence Interval
Office	1	56	13	23.2	(13.4, 38.4)
	2	11	0	0.0	[0.0, 59.1)
Retail	1	58	16	27.6	(12.9, 37.1)
	2	13	5	38.5	(3.8, 50.0)
	3	4	2	50.0	[0.0, 87.5)
	4	1	0	0.0	[0.0, 100.0]
Warehouse	1	96	33	34.4	(16.1, 34.9)
	2	30	11	36.7	(8.3, 41.7)
	3	8	2	25.0	[0.0, 64.3)
	4	1	0	0.0	[0.0, 100.0]
R&D	1	50	16	32.0	(13.0, 39.0)
	2	14	5	35.7	(3.6, 53.6)
	3	5	3	60.0	[0.0, 70.0)
	4	3	2	66.7	[0.0, 83.3)
	5	2	1	50.0	[0.0, 100.0]
	6	1	0	0.0	[0.0, 100.0]
Apartment	1	22	8	36.4	(6.8, 47.7)
	2	6	3	50.0	[0.0, 75.0)
	3	2	0	0.0	[0.0, 100.0]
All Samples Combined	1	282	86	30.5*	(20.0, 30.3)
	2	74	24	32.4	(14.2, 35.8)
	3	19	7	36.8	(2.6, 50.0)
	4	5	2	40.0	[0.0, 70.0)
	5	2	1	50.0	[0.0, 100.0]
	6	1	0	0.0	[0.0, 100.0]

* Statistically distinct from 25.0% with 95% confidence

Exhibit 8
Third Quartile
Performance Persistence in the NCREIF Data Base within MSAs—1978 to 1994

Property Type	Length of Run	No. of Samples	No. of Successes	Percent of Successes	95% Confidence Interval
Office	1	89	25	28.1	(16.3, 34.3)
	2	21	9	42.9	(7.1, 45.2)
	3	8	4	50.0	[0.0, 68.8)
	4	3	1	33.3	[0.0, 83.3)
Retail	1	48	12	25.0	(11.5, 38.5)
	2	9	1	11.1	[0.0, 61.1)
	3	1	0	0.0	[0.0, 100.0]
Warehouse	1	84	28	33.3	(14.9, 35.1)
	2	23	8	34.8	(6.5, 45.7)
	3	8	2	25.0	[0.0, 68.8)
	4	2	0	0.0	[0.0, 100.0]
R&D	1	44	14	31.8	(12.5, 39.8)
	2	11	4	36.4	[0.0, 59.1)
	3	3	2	66.7	[0.0, 83.3)
	4	2	1	50.0	[0.0, 100.0]
	5	1	0	0.0	[0.0, 100.0]
Apartment	1	10	4	40.0	[0.0, 55.0)
	2	2	1	50.0	[0.0, 100.0]
All Samples Combined	1	275	83	30.2	(19.8, 30.4)
	2	66	23	34.8	(14.4, 37.1)
	3	20	8	40.0	(7.5, 47.5)
	4	7	2	33.3	[0.0, 64.3)
	5	1	0	0.0	[0.0, 100.0]

Exhibit 9
All Quartiles Combined
Performance Persistence in the NCREIF Data Base within MSAs—1978 to 1994

Property Type	Length of Run	No. of Samples	No. of Successes	Percent of Successes	95% Confidence Interval
All Samples Combined	1	1,096	420	38.3****	(22.4, 27.6)
	2	358	151	42.2****	(20.5, 29.7)
	3	127	60	47.2****	(16.9, 33.5)
	4	49	25	51.0***	(13.3, 37.8)
	5	21	10	47.6*	(7.1, 45.2)
	6	9	3	33.3	[0.0, 61.1)

* Statistically distinct from 25.0% with 95% confidence
*** Statistically distinct from 25.0% with 99.9% confidence
**** Statistically distinct from 25.0% with 99.99999% confidence