THE JOURNAL OF REAL ESTATE RESEARCH

Spatial Concentration of Institutional Property Ownership: New Wave Atomistic or Traditional Urban Clustering

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***Abstract*. NCREIF investors acquire property in counties that meet socioeconomic filtering criteria. In contrast to atomistic predictions, these investors acquire their apartment buildings, offices, retail facilities, and warehouses in density clusters. These clusters follow a model of a negative exponential demand curve, a model that previously explained the technologically caused density gradient of urban areas. Institutional investors signal their belief that clustering of properties is a value dimension.**

Introduction

Futurists contend that spatial urban concentrations are anachronisms. This study is an initial test of whether or not a group of major investors, the members of the National Council of Real Estate Fiduciaries (NCREIF), share this futuristic attitude in spatially locating their acquisitions.

This research examines the degree to which NCREIF members were cognizant of the clustering of socioeconomic and highway time/distance characteristics within zipcodes at the county level when they acquired property from 1974 through 1993.

Which acquisition strategy did these investors follow:

H_1: **Futuristic Atomistic Patterns**. NCREIF members invest in counties and across zipcodes primarily according to non-spatial social and economic criteria. The result is that there is little observed spatial clustering. Urban physical clustering is no longer relevant in sustaining investment value, but inclusion in high economic-socio attribute areas is. No discernible spatial clusters of investment occur. This strategy assumes that "edge cities" will further decentralize.

H_2: **Traditional Socioeconomic, Infrastructure Density Clustering.** NCREIF members follow both specific socioeconomic criteria and spatial infrastructure clustering criteria that replicate the urban density model in their investment activity. The result is that clusters of institutional properties appear in certain counties and among certain contiguous zipcodes of those counties. Urban clustering is relevant in sustaining value.

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H_0: **Random Investment.** Investment at the county level is not a function of socioeconomic attributes. Discernible spatial patterns are not observed and therefore clustering is not a relevant factor in investment strategy.

Background

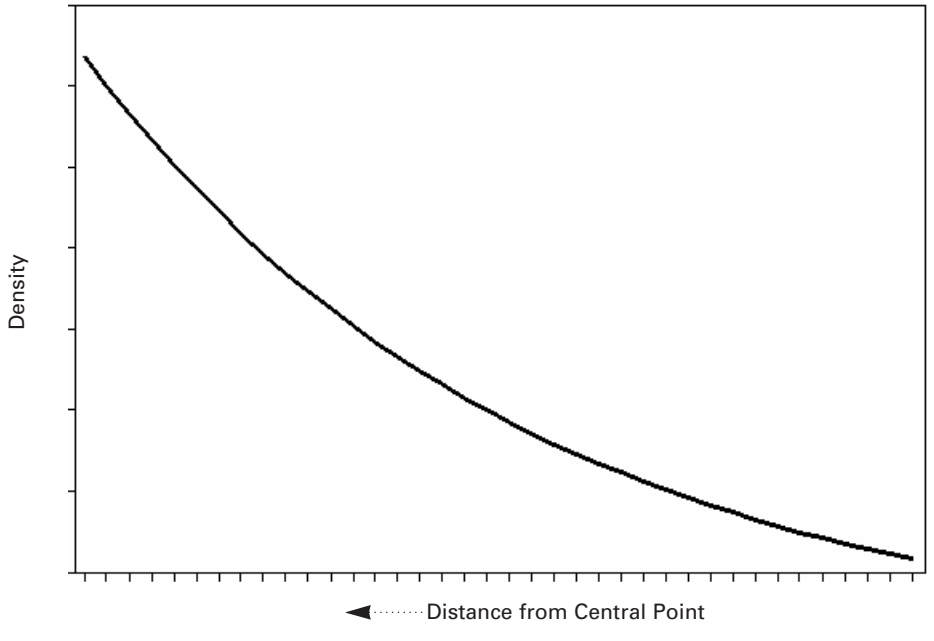
Prior to the advent of the freeway, urban accessibility was limited to primary urban central points. Constrained by the limits of transportation, the central place emerged as the center of primary demand and the point of the highest ground rent. Because of the central place, the area was densely built. Although dense building was costly, the area was solvent because many people were willing to pay the high rents to be at that location. As one left the central place, the demand decreased. The negative exponential rent/density gradient function (Mills, 1970; Muth, 1969) explained the urban land density (see Exhibit 1):[1]

$$D(p)=D_0\, e^{-\lambda p}\,, \tag{1}$$

where:

$D(p)$ = the density at distance p from the central point;
D_0 = the maximum density at the central point;
λ = a set of factors; and
p = the distance from the central point.

Exhibit 1
Urban Density/Demand Curve



The set of factors for *lambda* consist of the array of physical and socioeconomic factors that determine the function.

The introduction of the interstate system and other local freeways created the opportunity for numerous central points or nodes. Edge city proponents substantially modify the central place demand rent theory. They argue that transportation and technological advances obviate the need for a central place. The freeway infrastructure weaves numerous hexagonal market areas each with its own central point that has equal access to other points and the former predominant city central point. The common theme of "edge" cities is they are areas of high socioeconomic population characteristics. Postsuburbanites further alter the "edge city" concept by emphasizing the physical randomness of these hexagonal functionally unique market areas. Are institutional investors leading or lagging social preferences in their investment activity? The demise of the production of physical goods with high marginal transportation costs and the rise of service goods with low marginal transportation costs reduce the need for the physical clustering of ancillary activities. As the dense clusters disappear the spatial hierarchy of economic activity centers and property development and investing flattens and becomes atomistic, fulfilling the prophecy of Mills and Lav (1964). Activity is now dispersed evenly across the post-suburban landscape or along the linear edge city freeway. Spatial activity (density) should no longer be modeled by the negative exponential curve function.

If the advanced technology no longer imposes cost constraints upon location, what forces would cause spatial clustering? In the examination of housing preference, Muth (1969) observed that the introduction of amenities explained the density and pricing patterns of housing. Even though the cost of transportation was high for the upper income family, the positive attributes of the house and the immediate surrounding area overcame this transportation cost. The exponential negative demand curve was now a function of not only distance but of the amenities and homogeneity of the area. Social considerations, not technology, determined what activities would be grouped together.

Armstrong (1972), Pivo (1993), Rubin, Wagner and Kramer (1978), and Shilton and Webb (1991) trace the decoupling of the central city from the rest of the metropolitan economic base and the grouping of office employment from the central city to the less dense suburb—the linear city phenomenon. This literature and market reviews reinforce the idea that real estate opportunities are viewed as a function of the professional (FIRE) and technical employment, high-income and younger population profiles and areas that new infrastructure improvements will provide room for development.

The real estate investment opportunities are spatially broad in the United States with over 300 metropolitan areas and 3,140 counties. Estimates of the value of U.S. commercial real estate range from one trillion dollars or more. The 1993 market value of the properties reported by Russell/NCREIF total slightly more than 23 billion dollars.

In contrast to the recent discussions about the dispersion of major real estate activity, Shilton, Stanley and Tandy (1996) found that over the 1974–1993 period institutional investors surveyed by Russell/NCREIF focused their property transactions within approximately 10% of the 3,140 counties in the United States. This research seeks to identify if there are distinct socioeconomic and time/distance characteristics that constitute a new era demand gradient curve.

Research

The Data

Two sets are of data were used. To test the rationale for the preference for a limited set of counties over the period from 1974 through 1993, the following county datasets were used:

- the square footage and number of properties by property types held each year in a county;
- 1980 and 1986 population;
- percentages of the population by age;
- percentages of the labor force in manufacturing, retail manufacturing, retail, FIRE, or service;
- household and income characteristics; and
- size of counties.

To test the demand gradient clustering at the zipcode level, a GIS system was used to join the county socioeconomic data with the zipcode datasets:

- square footage and number of properties by the five major property types;
- corporate headquarters;
- freeway highway mileage;
- zipcode area;
- distance to primary CBD from zipcode; and
- dummy variables for each of the fifteen largest MSAs.

The zipcode test was limited to zipcodes in which there was a NCREIF property in 1993.

It is assumed that property transactions would occur in urban areas. A generalized definition of an urban county is one with a population of 25, 000 or more; of the 3,140 counties in the United States, 1452 have a population of 25,000 or more. Of these 1452 counties, 310 were counties of NCREIF transactions. Thirty of these 310 counties commanded 61% of the transactions. Sharp socioeconomic differences occur across counties.

The testable hypotheses are as follows:

H_1: Atomistic or Not. A logistics approach answers the question of whether there is a difference between the counties selected for transactions and those not. If there is a difference, the logistics approach discerns those socioeconomic attributes that add to the probability that a county was a scene of a NCREIF transaction. It is hypothesized that this class of investors follows economic and amenity criteria that imply that above-average growth, FIRE employment, growth in population, and high income would be determinants. For this test all transactions for the period 1974 through 1993 are used.

Because of the problems of multicollinearity with a discriminant model, the logistic model is used to parsimoniously trace the socioeconomic variables that influence transactions. The logistic model is used to describe

the two possible sets of events: no transaction in a county, and the event that transaction occurred in a county. The logistic model is defined as:

$$\log \frac{Prob\,(event)}{Prob\,(no\ event)} = B_0 + B_1 X_1 \ldots + B_p X_p \,. \tag{2}$$

The logistic coefficients B_x are interpreted as the change in the log odds as the independent variables change one unit. Conventionally the logistic equation is expressed in terms of odds:

$$\frac{Prob\,(event)}{Prob\,(no\ event)} = e^{B} e^{B_1 X_1} \ldots e^{B_p X_p} \,. \tag{3}$$

H_2: County Clustering or Not. If there is a preference for certain types of counties for investment, then it is hypothesized that through using an ordinary least squares multiple regression approach, the volume of NCREIF activity in an area is a function of the degree of population growth, income level and FIRE employment. The volume of transaction activity is a continuous function that satisfies the requirements of an OLS regression approach. For this test, the square footage acquisition of each property type from 1974 through 1993 was used.

A variation of this hypothesis is that the ranking and impact of these variables will differ according to property type. The percentage of FIRE employment will affect office transaction; the income of the area will affect retail transactions.

H_3: Demand Gradient or Not (zipcode level). The locational aspect of the demand gradient approach is that the footage of property type held in 1993 follows a negative exponential curve in which the attributes are the county socioeconomic and zipcode characteristics. For this analysis the sum of each property type held in 1993 was calculated per zipcode. The demand gradient tests the effect of aggregation.

Transforming equation (1), the testable form for the OLS regression is:

$$\ln(\ln D) = \ln(V_1) + \ln(V_2) + \ldots . + \ln(V_x) \,, \tag{4}$$

in which:

D = square footage of invested property in a zipcode;
V_x = the variables, in log form, the county socioeconomic characteristics and the zipcode characteristics.

A key test of the reasonableness of this log-log regression is whether or not the constant *alpha* (D_0 in equation (1)) is the highest footage for a zipcode of that property type.

Results

Atomistic

The odds that a NCREIF institutional transaction occurred depend upon a large population in the county—constrained by a lower level of density, a high percentage of persons between 25 and 34, and a high per capita income level, and the percentage of people in retail activity (Exhibit 2). Based on the *R*-statistic, the two most influential variables are Population and Per Capita Income. The average population for NCREIF counties was 449,612 compared to 71,416 for the non-NCREIF counties; per capita income was $11,400 for NCREIF counties and $8,926 for non-NCREIF counties. NCREIF counties had 2% more of their population in the 25-to-34 age group than non-NCREIF counties.

The emergence of the percentage of persons employed in retail employment as an indicator is unexpected because previous theory does not incorporate retail activity as a stimulus in changing the economic base structure. One thought is that retail employment may represent the degree of middle class consumption that signifies robust economic activity.

County Clustering

Population size and population per square mile were the only significant common variables across the regression tests for the individual property types of warehouses, offices, R&D buildings, retail properties, and apartments that were acquired from 1974 through 1993 (Exhibit 3).

Exhibit 2
Logistics Regression: Determinants of the Likelihood of a NCREIF Transaction Occurring in a County, 1974–1993

	Variables in the Equation					
Variable	*B* Coeff.	S.E.	Wad	*d*	Signif.	*R*
Population	8.e-06	9.e-07	74.1939	1	.0000	.2190
PopSqMile	−.0002	4.e-05	14.1877	1	.0002	−.0900
Pop25–34	.1751	.0471	13.7967	1	.0002	.0885
HouseHlds	6.e-06	4.e-06	2.2270	1	.1356	.0123
PerCapInc.	.0004	6.e-05	36.5708	1	.0000	.1515
%RetailEmp	8.1862	2.4458	11.2022	1	.0008	.0782
Constant	−10.6995	.8820	147.1690	1	.0000	

	Chi-Sq.	*d*	Signif.
Model *Chi*-Sq.	678.885	6	.0000
Improvement	11.097	1	.0009

In the logistics regression, the *R*-statistic measures the degree of the partial correlation between each dependent variable (transactions or none) and the independent variables. As the variable increases, *R* indicates that the likelihood of the event occurring increases. The *R*-statistic is based on the Wad statistic. The Wad statistic is the square of the function of the coefficient divided by its standard error and has a *chi*-square distribution.

Exhibit 3
Variables that Influence the Square Footage of Each Property Type, County Level; Regression Results

	Office	R&D	Retail	Wrhs	Apt
R^2	.60	.31	.65	.61	.21
F stat	82.8	35.6	302.9	158.7	17.9
	Coefficient, Variables Significant for Property Type				
Populat	1.05	.63	.45	2.21	.257
PopChng			2.21		
PopSqMile	-28.3	-30.0	-23.3	-79.5	-27.1
%FIREemp	7953749		1011484		
HouseHld			-1.07		
%PopEld			-1033.5		9573
%Pop25–34	91623	57649	8555	95348	
Pers/HH			-62468		
CapInc85			-6.39		27.5
%ManufEmp		1264045			
%ServEmp					1601479

Note: All entered coefficients and statistics are significant at the 95% or greater confidence level.

Warehousing is a predominant property type in the NCREIF transaction series and it can be considered one of the more universally distributed property types. Warehouse transaction occur in populated counties of a large size so that population per square mile is reduced (the south and west), with a high concentration of persons in the age group of 25 to 34, but not to per capita income level, and linked to manufacturing concentration. Although not meeting the regression 5% significance level, the percent employment in manufacturing cannot be discounted.

Only the test for office transaction buttressed the anecdotal image that the high flyer of real estate was professional employment. Obviously those counties that have a high degree of office (FIRE) employment would attract office transactions—but these favored office counties were not necessarily those with the highest income. The income variable is not of any explanatory value.

Exhibit 4
Correlations among Property Types, Transaction Unit - County

	Footage				
Correlations:	Wrhs	Retail	R&D	Office	Apt
Wrhs	1.0000				
Retail	.6725**	1.0000			
R&D	.6554**	.4824**	1.0000		
Office	.6843**	.5250**	.4625**	1.0000	
Apt	.3976**	.3903**	.4117**	.4912**	1.0000

Two-tailed significance: *–.01; **–.001.

In retrospect, the institutional investors pinpointed those emerging technological areas in R&D transactions. The percentage of employment in manufacturing appears as a contribution to R&D transactions, suggesting a high tech synergism. The results from the retail regression test are conflicting. The institutional investor desires a good market base (Population) but not necessarily dense (PopSqMile, Househlds and Pers/HH), and seeks a growing market of new migration (PopChng), with young people, professional people, but not at the highest income level (CapInc85).

The apartment investor seeks a large population base, with good income, and increases in the population over time and those that work in the service industries. Demographic emphasis is obscured because the pool of people that might go into apartments was statistically split between the 25- to 34-group and the 35- to 44-group.

Correlation among Property Types

What emerges is that a cluster of key variables—population, density and the young adult cohort—influence the transaction activity of these investors over time (as summarized in Exhibit 8). Unique factors were obviously related to a specific property type. A high level of FIRE employment is a factor in office transactions and retail transactions.

Transactions of one property type tend to influence transactions of other property types (Exhibit 4). Warehousing transactions are most positively correlated with other property types.

The Demand Gradient (*Zipcode Level*)

As the railroads were a major determinant in urban growth and change so is the system of 80,000 miles of interstates and major freeways. The importance of highway access for property investment by NCREIF members is confirmed with that observation that freeways lace themselves through 81% of the zipcodes in which transactions occurred from 1974 through 1993. For the testing of the spatial density curve, however, only those 985 zipcodes in which NCREIF members held property in 1993 were used. The NCREIF investors are following those populated counties where the workers are at the beginning of the more productive years in the growing employment sector (services).

The ownership of properties clusters along the demand gradient curve (Exhibit 5). The degree of aggregation (i.e., the slope of density) of total footage of all property types across zipcodes is a positive function of the percentage of persons between 35 and 44 years of age in the county, the number of corporate headquarters in the zipcode, the county population, and percentage of persons employed in the service industries, and negatively related to the size of the zipcode and, unexpectedly, the percentage of persons employed in finance, insurance and real estate (FIRE). Because the regression *F*-statistic is significant for each property type the testable question is significant. Although the coefficients are significant, the *R*-square is poor, indicating the need to incorporate other variables that will explain the differences across the metropolitan areas. The significance of the structural form of the testable hypothesis is also confirmed because the constant, interpreted as the log of the log of the average maximum density is an approximate fit. The central point of each cluster is the maximum square footage.

Exhibits 6–10 illustrate that there are generic small-area building block clusters that evolve into the sector, ring and/or node urban forms across metropolitan areas.

Exhibit 5
Demand Gradient, Zipcode and County Characteristics, All Properties, 1993

Dependent Variable: TOTAL FOOTAGE
(sum of footage of all investment property in a zipcode)

Adj R^2	.07914
Std Error	.10831

Analysis of Variance

	D	Sum of Sqs	Mean Square
Regression	6	.92639	.15440
Residual	843	9.88939	.01173

F = 13.16131 Signif. F = .0000

	Variable	B SE B	*Beta*	*T*	Signif. *T*
% ServEmp	.030564	.017235	.102500	1.773	.0765
Ziparea	−.013677	.004462	−.133400	−3.065	.0022
% Pop 35–44	.116044	.032387	.124342	3.583	.0004
Totlhdgq in Zip	.040105	.011184	.126155	3.586	.0004
County Pop.	.022855	.004687	.227922	4.876	.0000
% FIREemp	−.020896	.012393	−.100868	−1.686	.0922
(Constant)	1.847228	.107029		17.259	.0000

Total Cases = 985

Durbin-Watson Test = 2.04077

The impact of the presence of headquarters as a proxy for central point is illustrated by the observation that 49% of the zipcodes (484) in which there is institutional investment are also home to a corporate headquarter. Conversely, one third of all headquarters (1797) of corporations listed on the three exchanges are located in the zipcodes where institutional property is located.

The number of headquarters within a zipcode and income level for the county generates the basis for office investment (Exhibit 11). This test included only the 290 zipcodes in which an office property was located in 1993. The clustering effect of headquarters in zipcodes where institutions owned property was pronounced in several cities such as Boston.

Properties are clustered tighter and not as contiguous to major freeways as indicated by the importance of the highway/ziparea accessibility variable. This variable is the ratio of freeway mileage in the zipcode over the area of the zipcode. Access is a concern because the square footage of the property in the zipcode is inversely related to the travel time to the central business district. Not unexpectedly, offices were not located in counties with a high degree of manufacturing employment.

For retail investing, the results are somewhat contradictory. Acquisitions flow to where there is a higher percentage of FIRE employment, areas where there are the working age families age 35 to 44, but not to the highest per capita income areas, or young families.

Exhibit 6
NCREIF Holdings by Zipcode
Los Angeles SMA

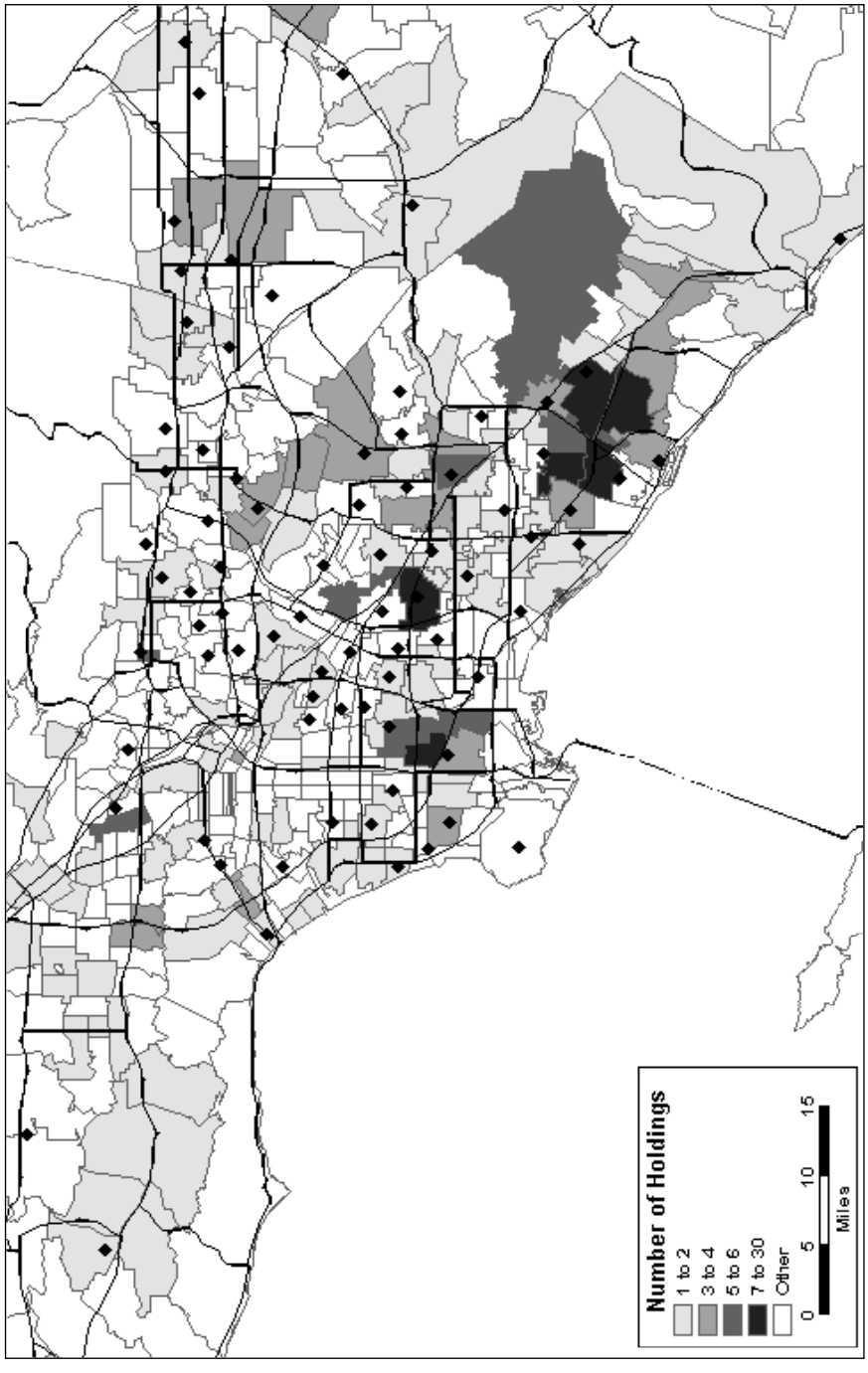


Exhibit 7
NCREIF Holdings by Zipcode
Washington D.C. SMA

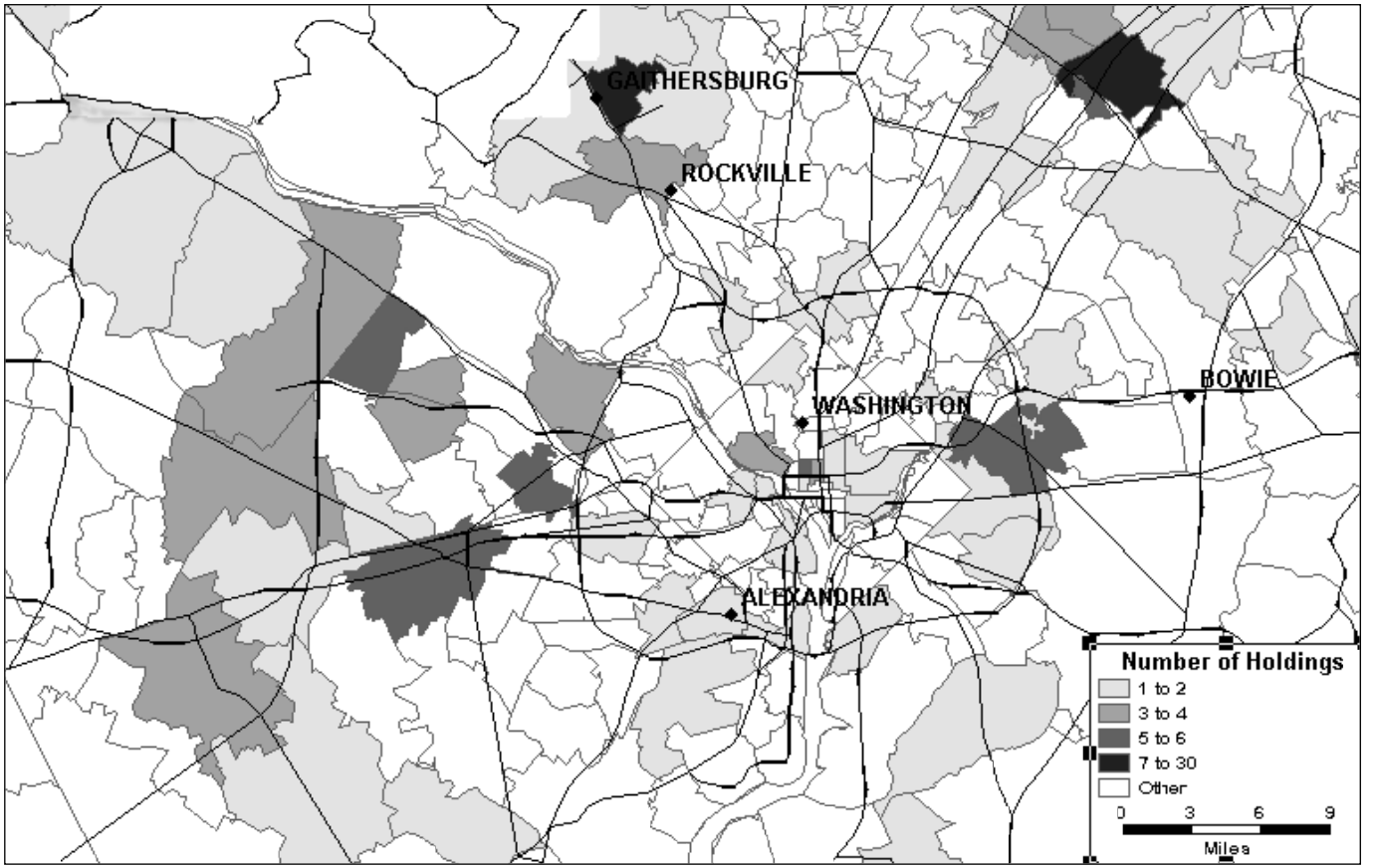


Exhibit 8
NCREIF Holdings by Zipcode
Denver, SMA

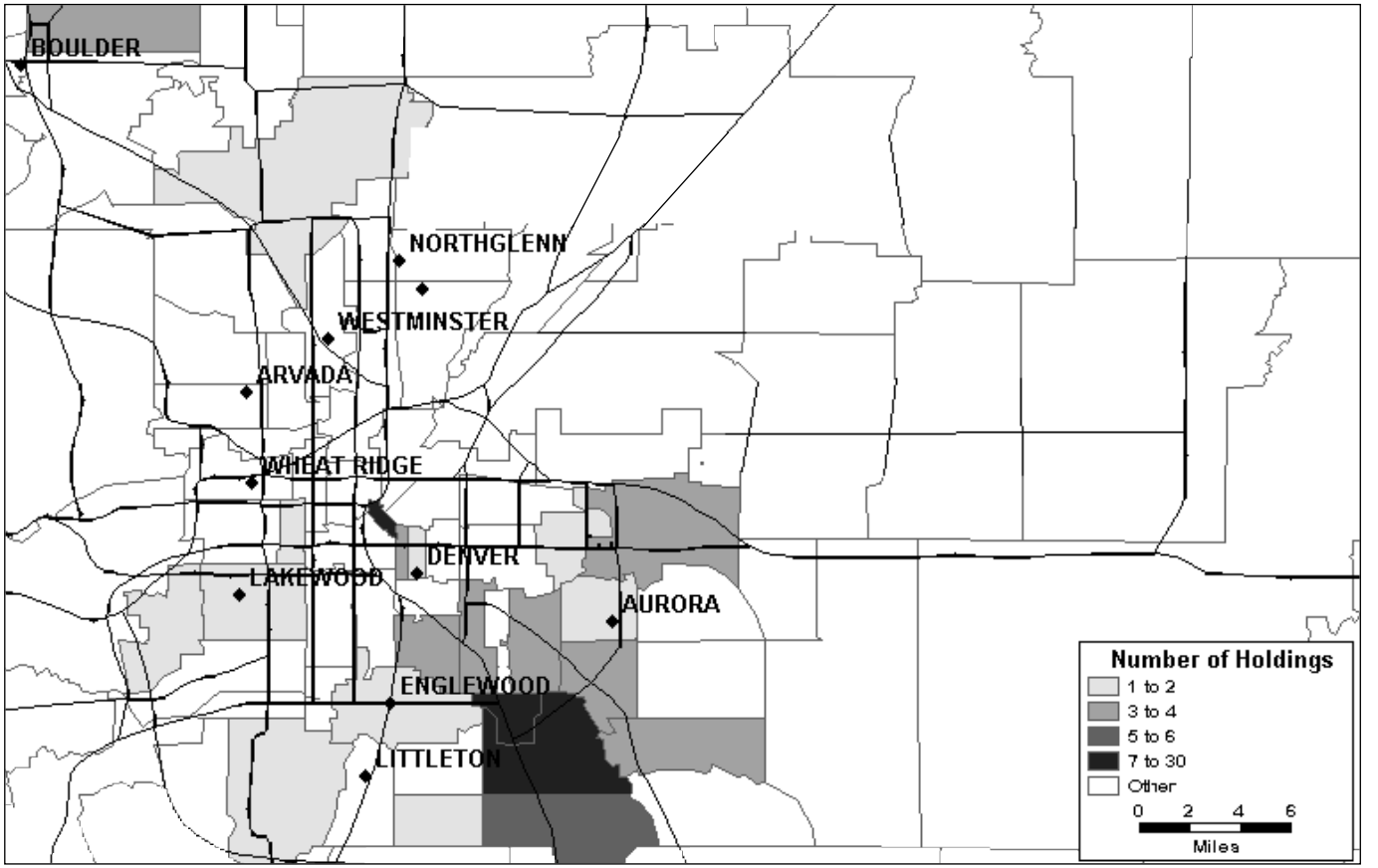


Exhibit 9
NCREIF Holdings by Zipcode
Chicago SMA

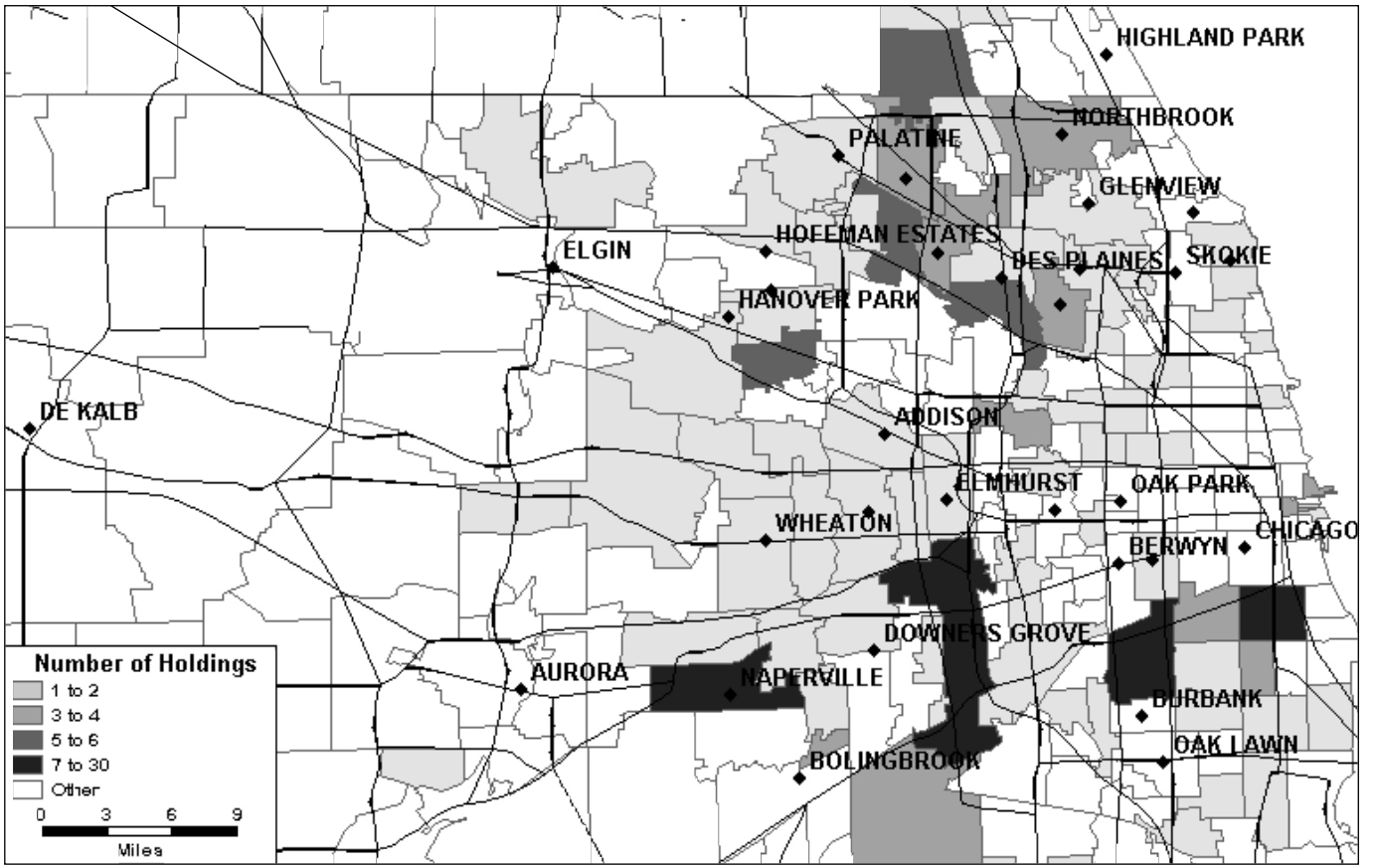


Exhibit 10
NCREIF Holdings by Zipcode
Dallas–Fort Worth SMA

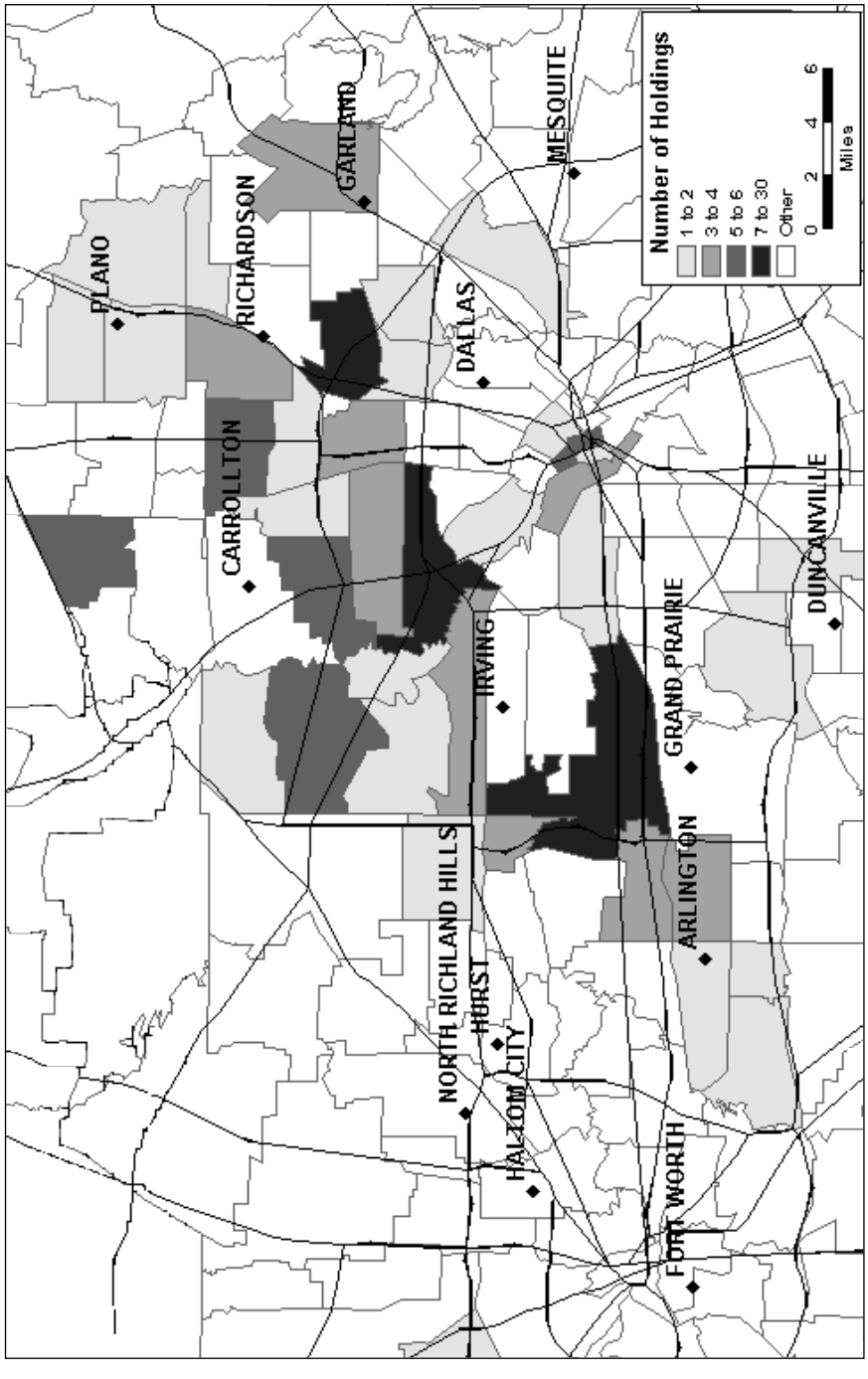


Exhibit 11
Variables That Influence the Demand Density of Each Property Type within Zipcodes of a County; Regression Results

	Office	Retail	Wrhs	Apt
R^2	.14	.05	.08	.08
F stat	6.02	3.14	2.86	4.45
	Coefficient, Variables Significant for Property Type			
TravelTIme	−.015			.010
Hiwy/zip	−.019			
Totlhdgq	.030			
%FIREemp		.093	−.024	
%Popunder5			.205	
%Pop5–14			−.170	
Pers/HH		.719		
CapInc85		−.223		
%ManufEm	−.015			
%RetailEmp				.054

Note: All entered coefficients and statistics are significant at the 95% or greater confidence level.

No infrastructure variables are of importance, probably due to the inappropriateness of these variables for retail siting.

The relocation of warehousing to the outer rings of the areas is evidenced by the significance of the positive relationship between zipcode square footage of warehouses and the distance to the central business district. while warehousing would not necessarily be compatible with areas of a high degree FIRE employment, the lower cost of land values for warehousing corresponds to the lower cost of housing for young families.

Areas with high migration and on the periphery of developed areas, resulting in longer travel times, are the results of the apartment testing. Again retail employment as a proxy for the changing employment profile is significant for explaining the investments in apartments. The low constant reflects that apartment acquisitions are not as concentrated within zipcodes as other property types, a pattern that typifies the spatial diversity of most residential patterns.

Conclusions

Although the United States is a wide, expansive country, the institutional investors of NCREIF have directed their investments to those counties and zipcodes that serve as central points that meet the criteria of minimum population size, per capita income, and the young adult population cohort. NCREIF investors also acquire their investments in multi-nucleated clusters, a shadow replication of the clustering found in central cities. As a structural form the negative exponential demand density function still holds in explaining the pattern of clustering, though more work needs to be done in creasing the specification of the variables (the *lambda* factor) to increase the robustness of the equation

Additionally the investors rely on a limited proxies of demand for each specific property type—corporate headquarters for offices (but surprisingly *not* sensitive to

income), concentrations of manufacturing employment (implied as high technology) for warehousing, and a percent of population in the growing retail sector for apartments. Investors agree most on their filters for office employment and apparently least on their choices for apartments.

At the micro-level of zipcode analysis, investors tend to cluster their investments in areas that can be explained by demand gradient analysis based upon distance factors and socioeconomic attributes. For each property type, the investors appear to agree on common attributes and factors in making their acquisitions.

If one agrees that institutional investors are setting future real estate patterns, then these institutions are transforming the demand gradient generated by a limited infrastructure to a new demand gradient based on both infrastructure criteria of highway access and travel times and socio and economic criteria—a perceptual demand curve.

Note

[1]For a summary of twentieth century theories of land use economics, see W. Alonso, *Location and Land Use,* Cambridge, Mass.: Harvard University Press, 1964, Chap. 1.

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Fordham Graduate School of Business funded this research and we thank Price Waterhouse for providing some of the data. We appreciate the comments of the participants at the 1996 AREUEA and ARES sessions and three anonymous reviewers. Maps of additional metropolitan areas can be found at the Fordham GBA Real Estate Center web site or from the authors.