The Effect of Location Variables on the Gross Rents of Neighborhood Shopping Centers

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Abstract. **An understanding of the impact of location variables on the gross rents of retail centers is of paramount interest to owners of, and lenders to, these properties. Through experience and training, retail real estate appraisers, investors, lenders, leasing brokers, and sales brokers have formed professional opinions of the influence of location variables on gross rents. This article presents a method for modeling the opinions of over 100 of these practitioners. The modeling process can be replicated in alternative geographic settings to provide a current, region-specific assessment of the impact of location variables on the gross rents of neighborhood shopping centers.**

Introduction

Knowledge of the impact of location on retailers' performance is of paramount relevance to the owners of, and lenders to, shopping centers. This is because both the attraction of retail tenants to a location and the ultimate success of their businesses at that location impact the occupancy and gross rental rates that the property can achieve.[1] Consequently, location may affect the property's overall financial performance.

During the last ten years, a substantial number of retail centers have experienced significantly diminished gross income as a result of decreasing occupancy and rental rates. Part of this decline was related to overall regional economic problems. However, the decline was exacerbated by the poor location of many retail centers. Such locational impairments limited the ability of these retail centers to successfully compete with better sited properties.

Many better sited centers can demonstrate good rental performance even in a weakened economic or overbuilt environment. These retail centers earn high rental rates with limited vacancies. Logically, this circumstance must be a function of the strong consumer patronage of the retail tenants at these locations and the consequent sustained attraction of these tenants to the property. Understanding the expected impact of locational variables on consumer patronage and, therefore, on gross rents allows for the identification of the strongest retail center sites.

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A number of research studies have focused on location as a determinant of the performance of retailers in respect to their sales volume.[2] From these studies, a range of location analysis techniques and location variables have been suggested. However, this article approaches the assessment of retail location from an alternative perspective. It focuses on the analysis or decisionmaking of retail real estate practitioners. (The group is defined to consist of five specialties: appraisers, investors, lenders, leasing brokers and sales brokers.) The decisionmaking of these professionals with respect to location should be governed by well-developed practices. It is the expectation of this study that these practices can be modeled by an empirical measurement process.[3]

Foundations of Retail Location Analysis

As noted, a range of analytical techniques to facilitate the assessment of retail locations are available in the marketing literature. These approaches include: mapping, checklist or judgmental methods, analog, multiple regression, and the gravity attraction model with its numerous extensions.[4] The origin of the gravity model primarily was in the work of Huff.[5] Huff expanded and employed the early gravitational concepts of Reilly, in postulating that the drawing power of a retail center is inversely proportional to the distance or travel time to the center from the consumers' point of beginning (i.e., disutility) and directly proportional to the size of the center (i.e., utility).[6] In all other respects, Huff assumed that retail centers generally were homogeneous.

Under more realistic circumstances in which consumers perceive differences between retail centers, the central assumption of Huff causes that approach to be incompletely specified. In actuality, variations in patronage of retail centers may be driven by a number of other relevant variables beyond size and distance.[7] These other variables could include: design/layout; traffic; trade area congruity; tenant mix; competition from other retail centers; visibility; access; and the demographic and other features of the encompassing socioeconomic environment. A number of these location-related variables and their potential impact on retail center performance through gross rents are considered in this study.

Objective of the Study

The objective of this study is to model professional opinions in respect to the impact of location variables on the gross rents of neighborhood shopping centers. Both a basic and a multivariate model are produced. Specifically, the multivariate model forms a structure similar to multiple regression that can be used to compare the relative impact of location variables. For this study, based on initial discussions with over fifteen practitioners, eight location variables were identified. These eight location variables are described in Exhibit 1.

The two models of the impact of location variables on relative gross rents are a reflection of the perceptions of the professionals. Models of professional judgment may be useful in decisions regarding the comparison of neighborhood shopping

Exhibit 1
Location Variables for Neighborhood Shopping Centers

1.	Supermarket anchor (type)
2.	Number of parking spaces per 1,000 square feet of gross leasable building area
3.	Number of households within one-mile radius
4.	Average household income within one-mile radius (1990 dollars)
5.	Daily traffic count for the adjacent street(s)
6.	Percentage visibility of the tenants' signs from the primary street
7.	Percentage visibility of the tenants' signs from the supermarket parking lot
8.	Number of competing neighborhood shopping centers within one-mile radius

Source: Authors

centers.[8] Our models facilitate the identification of neighborhood shopping centers with associated location characteristics that may produce the highest relative gross rents.

The Data

A survey was mailed to a total of 202 real estate practitioners experienced with, and knowledgeable about, the neighborhood shopping center market in the metropolitan Denver area. The survey instrument was extensive, requiring approximately 1½–2 hours to complete. As part of the self-administered survey, respondents were given twenty-four hypothetical neighborhood shopping centers, each containing a different mixture of location variables. Respondents were asked to evaluate each center relative to differences in expected gross rent based on this variety of location variable profiles.

No comprehensive list of individuals with real estate experience in neighborhood shopping centers in metropolitan Denver is available. Therefore, the sample frame for the survey was developed from a group of active local real estate appraisers, investors, lenders, sales brokers, and leasing brokers known to the authors, as well as professionals recommended by these individuals. Many of the survey participants originated from seminars of the International Council of Shopping Centers, which one of the authors attended. Approximately 90% of the sample actually lived in metropolitan Denver. The remainder lived throughout the United States and Canada. In excess of 80% of the survey respondents had six or more years of experience in their field of expertise and more than 50% had eleven or more years of experience.

Limitations

There are several limitations of this research. First, because no comprehensive list of real estate professionals experienced in neighborhood shopping centers was available for metropolitan Denver, the extent to which the results of this survey represent the opinions of all such professionals is unknown. Further, this research reflects the opinions of real estate professionals and not retail tenants of neighborhood shopping centers. Tenants might assess the impact of the location variables differently. However, this modeling approach could be used in a similar fashion with tenants.

Second, although gross rent is a logical proxy of potential neighborhood shopping center performance, it is conceivable that other elements might be used. For example, the occupancy rate might be employed, since a property owner may have an objective to minimize vacancies and, thereby, temporarily accept lower rents. This could be the situation where the property owner is contemplating a sale of the property.[9]

Third, a total of 114 of the 202 surveys were returned, resulting in a response rate of 56.4%. While this level of response is good for a lengthy questionnaire of this type, the extent of non-response bias is unknown. Of the 114 respondents, 24 were lenders, 17 were sales brokers, 21 were leasing brokers, 30 were investors/owners, and 22 were appraisers.

Finally, this study focuses on neighborhood shopping centers in metropolitan Denver. The extent to which the specific findings are representative of metropolitan areas with different economic conditions or size is not known. This study provides, however, a methodology that can be used in other areas to ascertain the perceived importance of various locational variables on neighborhood shopping center gross rents.

Basic Location Decision Model

To construct a basic location decision model, an exercise was applied in the survey in which the respondents considered the eight location-related variables.[10] Specifically, the respondents were asked to rate the influence of each location variable on gross rents without considering simultaneously any other location variable. Influence was rated as follows: 1, very negative; 2, negative; 3, neutral; 4, positive; and 5, very positive. Each of the location variables was described in terms of types or levels (e.g., 1 versus 0 competing centers or less than two versus more than five parking spaces). This was because the impact of each location variable on gross rent may change as that variable's type or level changes. See Exhibit 2 for a description of the types or levels of each variable.

The impact of the levels or types of each location variable on gross rents can be assessed by reviewing the mean ratings shown in Exhibit 2 and its corresponding interpretation on the scale. The data indicates that for each location variable, significant differences in respect to the influence on gross rents exist between the types or levels of that variable. For example, there are significant differences in the ratings of influence between the types of supermarket anchor. Supermarket Type I is considered to have the most positive influence on gross rents followed by Type II, then Type III, and finally Type IV (actually a neutral influence on gross rents). As a second example, there are significant differences in the ratings between the number of parking spaces per 1,000 square feet of building area of the center. Five parking spaces or more are considered to have a strong, positive influence on gross rents. Fewer than three parking spaces is considered to have a negative influence on gross rents.

The basic model shows, in the opinion of the professionals, the types or levels of location variables associated with higher gross rents (i.e., 4.0 rating or better). This model effectively can be used by the practitioner to differentiate on a "first pass basis" centers with the best location characteristics. However, there is a potential dilemma. If

Exhibit 2
Influence of Location Variables on Gross Rent Rated Univariately

Variable and Type or Level	Mean Score	Standard Error
Supermarket Type[a]		
Type IV	3.05	.06
Type III	3.93	.05
Type II	4.35	.05
Type I	4.87	.04
Parking Spaces/1,000 square feet		
Less than 2	1.28	.05
2–3	1.99	.08
3.1–4	2.96	.08
4.1–5	3.99	.06
Over 5	4.35	.07
Households (one-mile radius)		
Under 4,000	1.71	.07
4,001–6,000	2.55	.07
6,001–8,000	3.51	.06
8,001–10,000	4.29	.06
More than 10,000	4.77	.04
Income/Household (one-mile radius)		
Under $16,000	1.80	.07
$16,000–$24,000	2.74	.07
$24,001–$32,000	3.71	.06
$32,001–$40,000	4.32	.06
Over $40,000	4.65	.05
Traffic Count Streets (daily)		
Less than 15,000	1.90	.06
15,001–25,000	2.97	.07
25,001–40,000	3.97	.06
40,001–55,000	4.46	.06
Over 55,000	4.51	.08
Percent Visibility Tenants' Signs from Primary Street		
Less than 44%	1.65	.07
44%–64%	2.38	.07
65%–74%	3.06	.07
75%–84%	3.88	.06
85%–95%	4.51	.05
Over 95%	4.77	.05
Percent Visibility Tenants' Signs from Supermarket Parking Lot		
Less than 44%	1.76	.07
44%–64%	2.44	.08
65%–74%	3.16	.07
75%–84%	3.74	.06
85%–95%	4.35	.06
Over 95%	4.68	.05

Number Competing Centers (one-mile radius)		
2 or more	2.23	.07
1	3.38	.07
0	4.52	.07

Scale: 1 = very negative; 2 = negative; 3 = neutral; 4 = positive; and 5 = very positive

Source: Authors

Note: [a]In the survey, the actual names of each of the four supermarket chains was given. However, these chains are regional specific. The important criterion is that market dominance (i.e., share) ranged from highest (Type I) to lowest (Type IV). Type I (King Soopers) had a 35% share, Type II (Safeway) had a 25% share, Type III (Albertson's) had a 15% share, and Type IV was any independent. Type IVs generally had approximately a 7% share each.

one center was rated all 4.0's and another center was rated all 3.0's, it would be simple to judge the potentially best performing center based on gross rents. But, if each of the two centers showed a mix of ratings, how would the analyst trade off positive aspects for negative aspects? It may be that a rating of "strongly positive" for one type or level of a location variable actually does not mean exactly the same as "strongly positive" for a type or level of another location variable. Independently, the importance of certain levels or types of each location variable may or may not be overstated. With a multivariate model, the practitioner can assess trade-offs by collectively analyzing the variables.

Multivariate Location Decision Model

To describe a decision process in which the location variables are analyzed collectively (with potential for attribute trade-off), an exercise was applied in which twenty-four hypothetical neighborhood shopping centers were presented. Each center had a different composite of the types or levels of eight location variables. A base, hypothetical neighborhood shopping center was used for the comparisons. It was assumed for each of the twenty-four centers, as well as for the base center, that all other potential variables including, but not limited to, the economic environment, construction type, and improvement size, were identical. The respondents were asked to assess the difference (i.e., positive or negative) in the expected gross rent for each of the case centers in comparison to the base center that had a given rent of $10 per square foot. The estimated difference would be the result of the respondent's judgment of the aggregate influence of the eight location variables collectively, in isolation from all other potential location or non-location variables.

The levels or types of the location variables used in Case Centers 1–24 were generated as follows: The types of the categorical variables were chosen to assure orthogonal design. The balance of the variables were covariates produced by the random number generator of BASIC within specified upper and lower bounds to assure conformance with real world circumstances. In other words, there was not a case center with 0 parking spaces or 0 visibility of the tenants' signs from the street.

Tests for randomness of the case characteristics were performed by examining the correlation coefficients between all covariates and by one-way ANOVA of the covariates across levels of the two categorical variables. Since none of these tests was

significant at the .05 level, the conclusion was that the battery of twenty-four cases was bias free in design.

The basic analysis for this exercise required the development of a predictive model for each of the 114 respondents. This model took the form of a linear equation developed individually for each respondent. These equations were determined by use of Analysis of Covariance (ANCOVA).[11] As indicated above, each respondent analyzed twenty-four case shopping centers, based on locational characteristics, in order to determine gross rents which served as the dependent variable. The characteristics of the centers were presented with two factors (i.e., supermarket anchor and number of competing neighborhood shopping centers) in a balanced design, with six covariates.[12] Nonlinearity of other variables in the model was tested, but determined to be nonsignificant. Even though a quadratic term has been employed, the model is still linear in that all terms are additive and not multiplicative.

The supermarket variable contains four types (i.e., Type I, Type II, Type III and Type IV), while the number of the competing shopping centers variable contains three levels (0 competing centers, 1 competing center, and 2 or more competing centers). The reduced model for this design excluded the independent grocery type and the 0 competition level. Using a standard Analysis of Covariance model, a resulting set of thirteen parameters was calculated for each respondent, including a constant term.

The model thus developed is of the form:

$$\text{Rent} = B_0 + B_1x_1 + B_2x_2 + B_3x_3 + \ \ldots\ + B_{12}x_{12}, \tag{1}$$

where:

$x_1 = 1$ if Type I, 0 otherwise,
$x_2 = 1$ if Type II, 0 otherwise,
$x_3 = 1$ if Type III, 0 otherwise,
$x_4 = 1$ if 1 competing center (one-mile radius), 0 otherwise,
$x_5 = 1$ if 2 or more competing centers (one-mile radius), 0 otherwise,
x_6 = parking spaces per 1,000 square feet,
x_7 = households (in 000's) (one-mile radius),
x_8 = household income (in $000's) (one-mile radius),
x_9 = vehicles per day (in 000's),
x_{10} = square root of x_9,
x_{11} = % visibility of tenants' signs from street,
x_{12} = % visibility of tenants' signs from parking lot,

and the corresponding B_i's are the ANCOVA model coefficients associated with each x_i (B_0 is the constant term).

Validity of the Model

Except for the constant in this model, each parameter that was associated with the categorical location variables indicated the increment in gross rent (i.e., added or subtracted) attributed to each level of the variables. Each covariate parameter represents the increment in gross rent added or subtracted for each unit change in the

Exhibit 3
Individual Respondent *R*-Squared

Minimum Observed	.41
10th Percentile	.81
20th Percentile	.85
30th Percentile	.86
40th Percentile	.88
50th Percentile	.90
60th Percentile	.92
70th Percentile	.94
80th Percentile	.95
90th Percentile	.96
Maximum Observed	.99
Mean	.89

Source: Authors

covariates. In this way, the calculated parameters described the location rules by which each respondent determines gross rent per square foot for a neighborhood shopping center.

The validity of the results of this analysis as a model of each individual's decisionmaking process was evaluated by calculating *R*-squared between each respondent's ratings and the ratings across the twenty-four centers predicted by the model developed for that individual. The *R*-squared statistic indicates the percentage of variability in the ratings provided by a given respondent during the exercise that can be replicated by the ANCOVA model results applied to the same case centers. A value of 1.00 would indicate perfect predictive capability of the model for an individual's ratings.

From the process described above, one *R*-squared value was calculated for each of the respondents. A summary of the distribution of the individual *R*-squared values is shown in Exhibit 3. The single worst fit was 41% of the respondent's variation in ratings predicted by the model. However, the median of the *R*-squared distribution indicates that 90% of variation could be explained. These are excellent results, indicating that the model provides a good description of how the individual respondents considered each location variable in determining their ratings of overall gross rent.

Applicability of the Multivariate Model

The location rules of each respondent, as determined above, were substituted for the actual case center ratings. Thus, the analysis was transformed from 114 repeated measures (i.e., respondents) on twenty-four subjects (i.e., shopping centers) to thirteen variables (i.e., the ANCOVA parameters) measured on 114 subjects (i.e., respondents). One example of analysis possible from this approach is the development of an "average" or aggregate decision profile. Descriptive statistics of the model parameters for the total sample are presented in Exhibit 4.

To demonstrate one potential application of this model, actual data from three neighborhood shopping centers in metropolitan Denver was collected. The data in

Exhibit 4
Influence of Location Variables on Gross Rent Rated Multivariately

Variable and Type or Level	Mean Coefficient	Standard Error
Constant Term	$4.2747	$.4358
Supermarket Type		
Type IV	−.7407	.0512
Type III	.0930	.0404
Type II	.1283	.0287
Type I	.5193	.0501
Parking Spaces/1,000 square feet	.1814	.0209
Households (in 000's) (one-mile radius)	.0827	.0130
Income/Household (in $000's) (one-mile radius)	.0531	.0038
Traffic Count Streets (in 000's per day)		
Linear Effect	.0114	.0101
Quadratic Effect	.0237	.1260
Percent Visibility Tenants' Signs from Primary Street	.0113	.0013
Percent Visibility Tenants' Signs from Supermarket Parking Lot	.0085	.0009
Number Competing Centers (one-mile radius)		
2 or more	−.2687	.0366
1	−.0905	.0234
0	.3593	.0433

Source: Authors
Note: Supermarket Type IV and 0 competing centers are omitted from the reduced model evaluated for each respondent. The coefficients shown for these categories represent the complement of the sum of the coefficients of the remaining levels within each factor. In all cases, the coefficients displayed represent the means across the respondents and are expressed in dollars and cents.

Exhibit 5 show the calculations of estimated gross rent per square foot for these three centers based on the aggregate sample profile described in Exhibit 4. Although the model is not expected to predict actual gross rents, overall its prediction of which property should achieve the higher rent and which property should achieve the lower rent accurately reflects the actual rankings, by gross rent, of these three centers.

Conclusions

The methodology presented here provides a means for an empirical assessment of the professionals' perceived impact of location variables on gross rents. In this study, the results of the basic and the multivariate models provide similar conclusions in terms of the directional effects of the location variables, though they indicate greater differences in the impact of each variable. The multivariate approach, however, best

Exhibit 5
Estimated Rent Computation for Actual Centers from Aggregate Model Profile

Variable (Type or Level)	Mean Coeff.	Center 1	Center 2	Center 3	Predicted Rent Center 1	Predicted Rent Center 2	Predicted Rent Center 3
Constant Term	$4.27				$4.27	$4.27	$4.27
Type IV Supermarket	.7407	0	0	0	0	0	0
Type III Supermarket	.093	1	0	0	.09	0	0
Type II Supermarket	.1283	0	1	0	0	.13	0
Type I Supermarket	.5193	0	0	1	0	0	.52
Parking Spaces	.1814	4.2	3.4	2.8	.76	.62	.51
Households	.0827	6.7	2.3	3.9	0.55	.19	.32
Income	.0531	35.79	50.69	25.87	1.90	2.69	1.37
Traffic, Linear Effect	.0114	46.4	19.94	9.53	.53	.23	.11
Traffic, Quadratic Effect	.0237	46.4	19.94	9.53	.16	.11	.07
Signs Visibility, Street	.0113	40	95	50	.45	1.07	.56
Signs Visibility, Lot	.0085	80–	98	90	.68	.83	.76
2 or More Competition	−.2687	0	0	0	0	0	0
1 or More Competition	−.0905	1	1	0	−.09	−.09	0
No Competition	.3593	0	0	1	0	0	.35
Estimated Rent Per Square Foot					$9.30	$10.05	$8.84

Source: Authors

meets the research objective by providing an analytical framework for comparing the relative impact of different location variables on gross rents and consequently the performance of neighborhood shopping centers. The procedure has the added value of meeting the objective in virtually any context (region, center type, and different set of location variables) or from alternative perspectives (tenants or other real estate experts) by replicating the exercise to reflect a specific set of circumstances.

This study represented exploratory research into location analysis by retail real estate professionals. Further research would be valuable in the following areas:

- Replicating the modeling process in areas of varying sizes and economic conditions, other than metropolitan Denver;
- inclusion of the perspective of retail tenants; and
- inclusion of "access" to the set of location variables.

Notes

[1]See, for example, Firstenberg et al. (1988), Hines (1983), Kimball (1991), Losch (1954) and Pearson (1991).

[2]See, for example, Davies (1984), Davies and Rogers (1984), Ghosh and McLafferty (1987), Green and Applebaum (1976), Haynes and Fotheringham (1984), Houston and Stanton (1984), Robbins (1990), Rogers (1984).

[3]As practitioners, the authors believe that it is useful—on two levels—to collect information from other professionals in the field. First, the professionals' opinion with respect to location certainly has been learned and honed over time through application, successes, and failures. Second, in some sense these professionals are "market makers". Their opinions influence their clients, such as retail center tenants and landlords. We believe that understanding the opinions of the professionals will add to the existing literature on shopping center location and rent determination.

[4]See, for example, Applebaum (1966), Bottum (1989), Chapin and Kaiser (1968), Christaller (1966), Converse (1949), Craig et al. (1984), Davies and Rogers (1984), Gautschi (1981), Getis (1968), Goodrich (1989), Haynes and Fotheringham (1984), Lord and Lynds (1981), Martin (1985) and Nelson (1958).

[5]See, for example, Huff (1962).

[6]See, for example, Huff (1962 1963), Reilly (1931).

[7]See, for example, Bottum (1989), Doyle and Fenwick (1974–75), Mayo et al. (1988), and Ordway et al. (1988).

[8]Although the models are not designed to be predictions of actual gross rent for a particular neighborhood shopping center, the models may be useful in ranking potential retail sites.

[9]See Sirmans et al. (1990), pp. 141–51.

[10]The survey respondents were asked in a separate question to name any additional location variables (other than the eight) that they believed to be important. The only additional variable named by a significant number of experts was "driving access." Therefore, it appears that the described location variables generally represent the most important locational determinants of gross rent, in the opinion of the experts.

[11]Analysis of covariance (ANCOVA) blends regression analysis, based on interval-scaled variables, and analysis of variance (ANOVA), based on categorical variables. It is identical to a regression model with "dummy" variables used to represent the levels of the categorical variables.

[12]A quadratic term for traffic volume was added to the analytical model because certain respondents in the survey showed a nonlinear interpretation of traffic volume. Specifically, as traffic increased to certain high levels, there was a diminishing, positive effect on gross rents. This term was determined by taking the square root of the traffic volume presented for each case shopping center.

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