The Influence of Trees and Landscaping on Rental Rates at Office Buildings: A Pilot Study in Northeast Ohio

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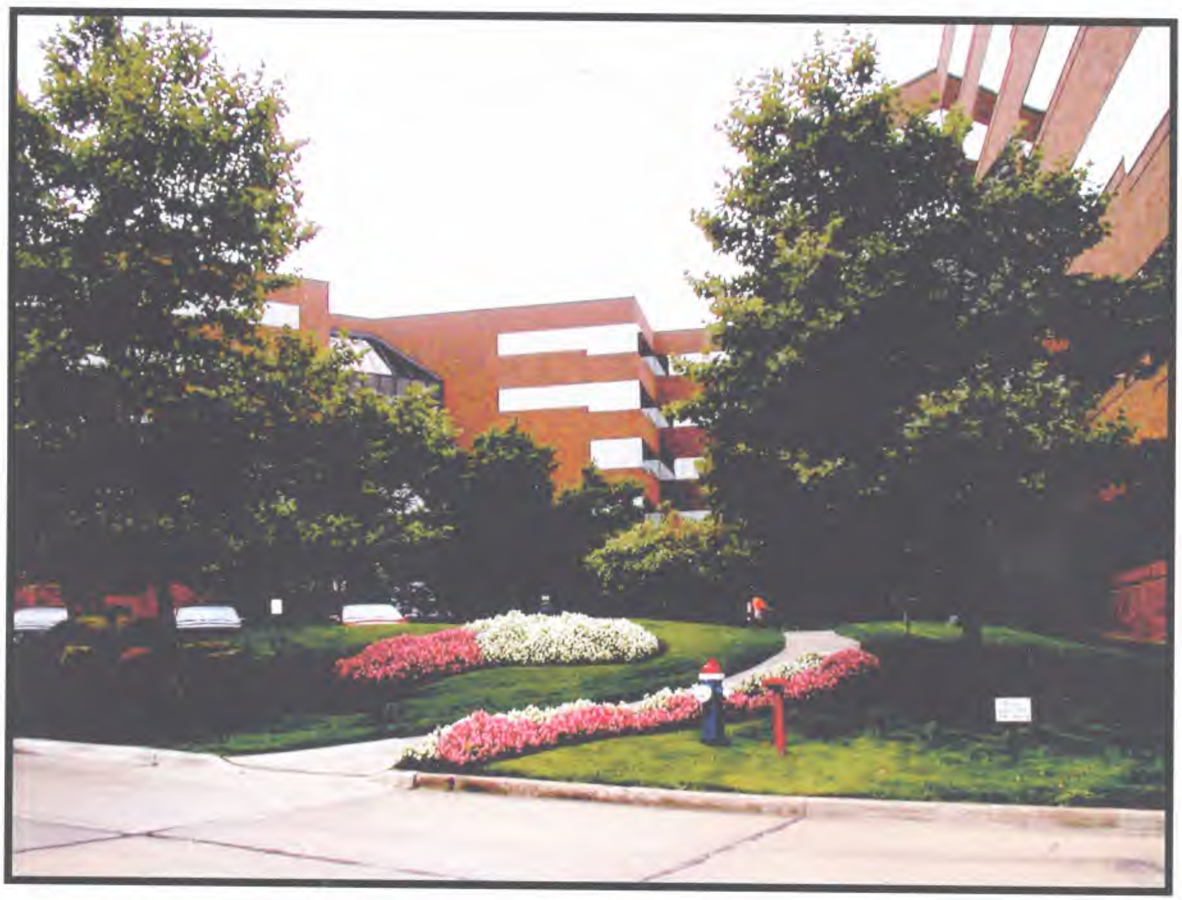

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The Influence of Trees and Landscaping on Rental Rates at Office Buildings: A Pilot Study in Northeast Ohio

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Abstract

The environmental and economic benefits of trees have been studied relative to a variety of interests including their influence on real estate value. This study investigates the effect of trees and landscaping on office rental rates, based on a comparison of 85 office buildings that comprise 270 individual and unique leases in the Cleveland-metropolitan area. Data that describes the quantity, functionality and quality of landscaping was gathered from each of the buildings including landscape maturity, percent ground cover (trees, turf, pavement, etc.) and functional attributes (building shade, noise buffer, space definition, recreation, visual screen and aesthetics).

Multiple regression analysis in the form of a hedonic equation was conducted to isolate the economic effects of landscaping. Office attribute data including lease information, physical attributes, and distance variables were used to calibrate the basic model and landscaping data were added to the hedonic equation to determine if individual and/or interactive variables had any effect on contracted rental rates. The individual analysis of the variables showed a strong positive effect for those buildings with good landscaping aesthetics and building shade provided by trees. Conversely, landscaping that provides a good visual screen produced significant negative impacts on rental rates.

Literature Review

A variety of benefits and costs associated with urban forests and landscape trees have been explored (Dwyer et al. 1992; Nowak 1993; McPherson et al. 1999) including energy conservation (McPherson and Rowntree 1993; Laverne and Lewis 1996; Simpson and McPherson 1996; Simpson 1998), ozone reduction (Nowak et al. In Review), air quality (Scott et al. 1998; Beckett et al. 2000), carbon sequestration (McPherson 1998; McPherson and Simpson 1999), stormwater management (Xiao et al. 1998), social involvement (Sommer et al. 1994; Sommer et al. 1995) and even the impact of trees on the reduction of domestic violence (Sullivan and Kuo 1996). Some of these benefits are quantifiable in terms of economics while others can only be measured by social or environmental values.

Increasing attention has been devoted in the economic and real estate literature to the study and measurement of the impact of environmental externalities on property values (Des Rosier et al., 1999; Taylor & Smith, 2000). Much of this research has focused on the value added through trees and landscaping to residential properties. Peters (1971) was among the first to do so when he reported that shade trees contributed 19 percent ($57,000) to the total appraised value of a 2.8 ha (7 acre) parcel. Payne (1973) used traditional valuation techniques to conclude that the market value of a single-family home received a 7% premium due to aborescent vegetation, provided there were less than 30 trees on the lot. Morales (1980) used regression analysis to compare the sales price of homes with a substantial amount of tree cover to those with no tree cover. The values derived from the regression analysis, showed that good tree cover added about 6% ($2,686) to the property value of the homes. Anderson and Cordell (1988) surveyed 844 single-family residential properties in Athens, Georgia and found that landscaping with trees was associated with a 3.5%-4.5% increase in sales price. Henry (1994) found that homes that received an excellent landscaping rating from a local landscaping professional could expect a sales price of about 4 to 5 percentage points higher (depending on the size of the lot) than equivalent houses with good landscaping. Homes that had a landscaping appeal far below (fair or poor) neighboring homes with excellent landscapes had a sales price 8-10% below equivalent homes with good landscaping appeal. Based on these and other studies, the Council of Tree and Landscape Appraisers (2000) suggests that "well-maintained landscapes can contribute up to 20 percent to the value of an improved residential property."

Morales, Boyce, & Favretti (1976) combined factor analysis and multiple linear regression techniques to study 60 residential sales in Manchester, Connecticut. Four factors were developed that explained 83% of the variation in the data. These explanatory variables reflected location, house size, date of sale and tree cover, respectively. The authors concluded that good tree cover could raise total sale price by as much as 6-9%.

Additional work was conducted by Ulrich (1985), who hypothesized that the liking for urban scenes usually increased when trees and other vegetation were present. Referring to recent research in the field, he concluded that trees and other vegetation could be linked directly to health, and in turn related to economic benefits of visual quality. Compared to research focused on trees in residential areas, there is relatively little literature that reports on the effect of trees on commercial real estate. One study conducted by Wolf (1999) presented 32 photographic scenes of retail properties to two groups of participants (business professionals and consumers) who were asked to rank each scene according to their preference. The scenes that contained trees and landscaping received higher scores for preference from both groups than those scenes with little or few landscape plants. While both groups favored landscaping, the consumer group generally rated scenes with landscape plants higher than did the group of business professionals suggesting that in general, merchants have a lower appreciation for trees than do their customers. The results of this study find that consumers would be willing to pay, on average, a 12% premium for goods purchased in retail establishments that are accompanied by quality landscaping.

While property valuation literature is heavily focused on residential properties, there is a growing body of work that addresses the valuation of office space. Typically the variables used in these analyses fall under one of three classifications: structural, lease, and distance. Clapp (1980) used a sample of 105 office building located in Los Angeles to regress the quoted annual rental rate per square foot of office space on building characteristics and three locational variables: distance to the CBD, average commute time of the building's workers and square footage of office space within a two-block radius. He found all three variables significant and with signs in the expected direction, although distance to the CBD had a substantially greater impact than the others. He inferred from this study that firms are willing to pay a premium for access to face-to-face contact, especially those within the CBD.

Several other studies have attempted to address variation in office rents. Wheaton (1984) studied the impact of inter-jurisdictional tax rates on rent in Boston.

This study included building characteristics as well as the number of transit lines within a mile of the building, number of highways leading in and out of the town in which the building was located, the percentage of households in the town with a college education and the ratio of the office's floor area to the building's floor area. He found that inter-jurisdictional property tax differentials were not borne by office tenants, but rather access to employees was a much more powerful determinant in rent variation.

Vandell and Lane (1989) made an attempt to evaluate empirically the nature of the contribution of architectural quality to the value of buildings. Their model postulated that equilibrium rent (the amount a tenant is willing to pay to rent a space holding all other variables constant) and vacancy frequency and duration behaved as functions of both design and non-design characteristics. They tested the model using disaggregate cross-sectional and longitudinal operating performance and amenity data from a set of 102 class A office buildings in Boston and Cambridge. Data on design quality for the set of buildings was provided by a detailed evaluation of each structure by a panel of architects. Their results confirmed a strong influence of design on rents; structures rated in the top 20% for design quality were predicted to extract almost 22% higher rents than those rated in the bottom 20%. In contrast, the data showed a weak relationship between vacancy behavior and design quality. Finally, good design was shown to cost more to produce on average, but not necessarily in every case.

Glasock, Shirin & Sirmans (1990) analyzed office building rents using data for a five-year period in a medium-sized city. Their results indicated that rent levels respond to various factors in the expected manner: rents vary systematically across classes of buildings and locations, overall market conditions have a significant impact on rents, and contract variations are associated with rent differences. They also presented the first evidence at the building level on the rent-vacancy adjustment process, and were able to show a significant relationship between rent changes and vacancies.

Mills (1992) analyzed 1990 office asking rents in the Chicago metropolitan area. Using a precise measure of the present value of the asking rent of a lease, he analyzed data from 543 offices that contained about 80% of the office space in the metropolitan area. The present value of asking rents was related to many building characteristics and to each building's location, demonstrating that asking rents depend on about fifteen building characteristics and on a careful specification of its location.

Rosen (1974) provided the basic hedonic pricing framework that is most frequently used in property valuation literature. He generalized that the hedonic price function (HPF) covering any good or service consisted of a variety of utility-bearing characteristics. In office valuation literature, the use of hedonic modeling generally requires that structural characteristics be used as the independent variables determining value along with lease and location variables (Bollinger et al. 1998). Examples of structural characteristics are total building square feet, classification of space (class A, B or C), number of floors, building age, and parking. Lease variables include information such as stop clauses, escalation rates, and gross or net lease. Location variables include distance from city center, distance from nearest highway interchange and tax rates. With the exception of stop clause and escalation clause, which will be discussed later, this study includes all of the above variables.

Hedonic Model

Office Variables

The structural and lease data for this study were provided by Grubb & Ellis, a national commercial real estate brokerage firm. Because of the proprietary nature of the data, available office information tends to exhibit differences in the type of characteristics that are recorded from company to company. Each company's records reflect the data they think are most important and reflective of the local market. Therefore, this model contains some variables that are not prevalent in other literature, but nonetheless present important and informative findings to those familiar with the local office market. The variables included in this study but not in other studies include the following: sublease, lease term, medical space and regional classification (west, east, southwest, and south). Because the data were inconsistent, an additional variable "unspecified" was added to denote the lack of regional information for a particular space.

The distance variables, distance from city center and nearest highway interchange, are measured along the street network. Public Square in downtown Cleveland was used as a proxy for city center. Another variable, denoted as multi-lease building, was added as a dummy indicator to account for the spatial relationship between different leases in the same building.

The dependent variable for this study is base (contract) rent. Some studies (Webb & Fisher, 1996) explore the use of effective rents as the dependent variable. Effective rents are estimated from the perspective of the property owners and are defined as the annual-equivalent cash flows of the present value of all cash flows that are explicitly identified in the lease contracts. These include contract rental rate, graduations in the contract rate, tenant improvements, moving allowances, buyout allowances, expense stops, broker commissions, and any other conditions that generate specific dollar receipts for the owner. As a result, effective rents have much more volatility and provide a more accurate and timely representation of trends in the price of space than either asking or contract rent. Because detailed lease-level data were not available and effective rent could not be calculated, base rent was used. Dummy variables serve as indicators for less detailed information such as sublease and net lease to account for variation in the data.

Landscaping Variables

The addition of landscaping variables added another potentially significant component to the make-up of rental rates for office space. Davey Resource Group personnel gathered detailed information for 85 office buildings in the greater Cleveland market. The following functions provided by trees and landscape plants were reported on:

- Visual screening
- Noise attenuation
- Shade to parking areas
- Shade to buildings
- Recreational enhancement
- Space definition
- Aesthetics

The landscaping at each of the 85 office buildings was evaluated for these functions using the classes Good, Moderate, Low or None. Examples of some of these landscaping functions are illustrated in Photos 1 through 6. Dummy variables were used to designate the rank of each observation. Operational definitions and sources for each of the variables that were used can be found in Table I.

At each of the properties the type and amount of land cover was also evaluated. The following land cover classes were used:

- Building
- Pavement
- Turf
- Planting beds
- Tree canopy cover
- Water
- Other

Field personnel recorded the percentage of each land cover class at each property. Land cover percentage was determined by field personnel employing a random number table to select a compass bearing. This bearing was used to pace a transect across the property while recording the cover type at regular intervals of 6 paces. Three random transects were paced at each location, and the dot tallies used to calculate land cover percentages.

In addition to evaluating the functionality of the landscape and recording land cover, the overall landscaping was classified as mature, intermediate, or immature based on the size and age of the trees and other landscape plants. In general, mature landscapes will provide more functional benefits such as shading and noise attenuation than immature landscapes.

Table I: Operational Definitions and Data Source

Variable	Definition	Source
Effective Tax Rate	Effective tax rate of municipality	Cuyahoga County Auditor
East	Zip Codes available on request	Grubb & Ellis
South	Zip Codes available on request	Grubb & Ellis
Southwest	Zip Codes available on request	Grubb & Ellis
West	Zip Codes available on request	Grubb & Ellis
Class A	Class A Office Space	Grubb & Ellis
Class B	Class B Office Space	Grubb & Ellis
Class C	Class C Office Space	Grubb & Ellis
Class Unspecified	No Class Specified	Grubb & Ellis
Medical	Classified as a Medical Office	Grubb & Ellis
Sublease	Space is sublet	Grubb & Ellis
Property Size	Size of building in square feet	Grubb & Ellis
Transaction Size	Size of transaction in square feet	Grubb & Ellis
Execution Date 1995	Lease executed in 1995	Grubb & Ellis
Execution Date 1996	Lease executed in 1996	Grubb & Ellis
Execution Date 1997	Lease executed in 1997	Grubb & Ellis
Execution Date 1998	Lease executed in 1998	Grubb & Ellis
Execution Date 1999	Lease executed in 1999	Grubb & Ellis
Execution Date 2001	Lease executed in 2001	Grubb & Ellis
Lease Term	Lease term in months	Grubb & Ellis
Multiple Leases	More than one lease in building analyzed	Grubb & Ellis
Gross Lease	Owner pays all expenses	Grubb & Ellis
Triple Net Lease	Tenant pays all expenses	Grubb & Ellis
Number of Floors	Number of floors	Grubb & Ellis
Building Age	2001 less year built	Grubb & Ellis
Distance to Public Square	Straight line distance to Public Square	GIS
Nearest HWY Interchange	Straight line distance to nearest highway interchange	GIS
Good Visual Screen	Trees block view of adjacent property	Davey
Good Noise Barrier	Trees block noise from adjacent road	Davey
Good Space Defintion	Trees create spaces for human uses	Davey
Good Building Shade	Trees provide shade to walls & windows	Davey
Good Aesthetics	Landscape plantings well designed & maintained	Davey
Percent Canopy Cover	Percentage of Canopy Cover	Davey
Percent Beds	Percentage of Flower Beds	Davey
Percent Turf	Percentage of Turf	Davey

Photo 1: Landscaping with few functional benefits and low aesthetic value.

Photo 2: Landscaping with no functionality or aesthetic value.

Photo 3: Very few office parking lots in the study area benefit from tree shade.

Photo 4: Trees providing good building shade and good visual screening.

Photo 5: A landscape with moderate functionality and good aesthetics.

Photo 6: One of few examples of a mature landscape.

Analytical Approach and Regression Procedure

The determinants of office rents are investigated by regressing the annual contract rate per square foot of office space in an individual building on sets of explanatory variables that describe the location, typical leasing provisions and physical characteristics of the building. Our theoretical model suggests that landscaping characteristics should enter the model as structural determinants although for the purpose of this study they are listed separately.

Hence the model that was employed in this research is as follows:

$$R = \alpha + \beta_1 S + \beta_2 L + \beta_3 LOC + \beta_4 LAND + \varepsilon$$

Where R is a vector of contract rental rates, α is the regression constant, β_1, β_2, β_3 and β_4 are the estimated coefficient vectors of the structure, lease, location and landscaping characteristics, respectively, and e is the error term that represents the primary source of error when trying to predict the value of rent in the model. The model shows the implicit value of an individual characteristic of the office space. For instance, it shows the value of the space classification (Class A, B or C) as a portion of the total rent of the space.

The analysis for this study was performed in two steps. The first step involved creating a base model using the structural, lease and distance variables. Existing research on office space was used to determine which variables would be used and what their expected sign would be.

Once a satisfactory model was obtained, the landscaping variables were added. The initial addition of these variables was accomplished without any manipulation of the data. The results of this attempt provided little conclusive evidence of the effects of landscaping on rents, possibly due to collinearity, so a Principal Components Analysis (PCA) was conducted and the subsequent PCA-derived factors tested. This was used to determine if any commonalities in the variables could be exploited. The first two components of this analysis accounted for almost 90% of the variance in the model, although the loadings were such that their interpretation was not evident. While PCA typically allows for a more qualified interpretation of the dynamics underlying the price determination process, it did not in this case. The subsequent inclusion of these two components did not lead to better model performance. Therefore, individual landscape variables were analyzed rather than factors.

Using standard regression procedures, several combinations of landscaping arrangements were tested. The variables were subject to various mathematical transformations with the final analysis reflecting intuitive and theoretically satisfying results. The final data set created two dummy variables for each of the functional landscaping attributes (visual screen, noise barrier, space definition, building shade and aesthetics). These variables combined those sites with no or poor functional attributes to create the following variables: poor visual screen, poor noise barrier, poor space definition, poor building shade and poor aesthetics. The other variables created for these functions combined moderate and good functional attributes into the following variables: good visual screen, good noise barrier, good space definition, good building shade and good aesthetics. A decision was made to exclude two of the original variables, which were recreational enhancement and vehicle shade. These were excluded because there was no theoretical basis to associate these factors with rental rates and very few examples of trees or landscape plants that provided these functions were found. Also excluded was the maturity level of the landscaping as it did not offer any consistent explanatory power.

Finally, diagnostic procedures were conducted and were in very acceptable limits. The highest Variance Inflation Factor (VIF) was 6.69 indicating no serious multicollinearity issues. A VIF under 10 is the generally accepted standard. There were no extreme outliers removed from the data because there was no evidence they were not representative of the market. Scatterplots were examined for heteroscedasticity and no fanning was evident. The summary statistics for each of the variables is found in Table 2.

Table 2: Descriptive Statistics

Continuous Descriptors

	Contract Rate	Effective Tax Rate	Property Size	Transaction Size	Lease Term
Minimum	5.25	40.37	10926	240	5
Maximum	25	89.8	426960	134001	120
Mean	16.419148	53.95248	79630.59	4860.622	49.66852
Median	16	54.55	48631	2119	60
Standard Deviation	3.390159	11.07517	56155.7	10594.22	25.39762

	Number of Floors	Building Age	Distance to Public Square	Nearest HWY Interchange
Minimum	. 1	1	6.2745	0.1924
Maximum	15	41	20.4674	3.6723
Mean	4.581481	17.892593	13.210891	0.9130011
Median	4	20	14.399	0.4877
Standard Deviation	2.716949	9.167967	2.865871	0.7536571

Dummy Variables

	South	East	Southwest	West	Class A
Mean	0.2444444	0.3481481	0.3407407	0.06666667	0.6259259
Total N	66	94	92	18	169

	Class B	Class C	Class Unspecified	Medical	Sublease
Mean	0.3148148	0.02962963	0.025925926	0.003703704	0.04074074
Total N	85	8	7	1	11

	Execution Date 1995	Execution Date 1996	Execution Date 1997	Execution Date 1998	Execution Date 1999
Mean	0.1037037	0.1555556	0.1666667	0.12222222	0.1444444
Total N	28	42	45	33	39

	Execution Date 2000	Execution Date 2001	Multiple Leases	Gross Lease	Triple Net Lease
Mean	0.2037037	0.1037037	0.8148148	0.9296296	0.07037037
Total N	55	28	220	251	19

Table 2: Descriptive Statistics (Continued)

Landscape Variables

	Percentage of Beds	Percentage of Canopy Cover	Percentage of Turf
Minimum	0	0	0
Maximum	17.1	35.3	49.1
Mean	6.991481	6.616667	8.068889
Median	6.05	4.7	5.9
Standard Deviation	4.236235	6.689301	9.338476

	Poor Visual Screen	Good Visual Screen	Poor Noise Barrier	Good Noise Barrier	Poor Space Definition
Mean	0.437037	0.562963	0.6851852	0.3111111	0.8333333
Total N	118	152	185	84	225

	Good Space Definition	Poor Aesthetics	Good Aesthetics	Poor Building Shade	Good Building Shade
Mean	0.1666667	0.7407407	0.2592593	0.562963	0.437037
Total N	45	200	70	152	118

Summary of Findings

As can be seen from Table 3, the overall performance of the model is theoretically sound. With eight structural characteristics, eight lease variables, six location variables and eight landscaping variables, the model has an R^2 of .7311. Most of the regression coefficients are consistent in sign and magnitude with theoretical expectations. A few notable exceptions include those leases executed between 1998 and 2001, as the market shows some stagnation during those years. The distance to the city center is also insignificant as is building age. Log-linear forms of these variables were tested, but failed to provide better overall performance. These variables remained in the equation because they are consistent with other literature, as did property size, transaction size and number of floors. An attempt was made to include the effective age of the building (2001 less year of renovation) rather than the building's physical age, but inconsistency in the data excluded its use.

The inclusion of the landscaping variables provides interesting results. As would be expected, landscaping with a good aesthetic value added approximately 7% to the average rental rate of a building. Good building shade was also highly valued, positively impacting rental rates by about 7%. Each of these is significant at the 95% level and the percentage increase is consistent with residential literature. Landscaping which functions as a noise barrier or that provides good space definition has no measurable impact, nor does incremental increases in the amount of canopy cover, turf or flower beds. Somewhat surprising was the negative impact of landscaping that provided a good visual screen. Resulting in a loss in rent of approximately 7.5%, this number is significant at the 95% level and has t-value of —2.4080.

Table 3: Regression Results

Coefficients[a]				
	Value	**Std. Error**	**t value**	**Pr(>|t|)**
Intercept	21.1998	2.1694	9.7724	0.0000
Effective Tax Rate	-0.0945	0.0187	-5.0434	0.0000
South	-0.3629	0.6171	-0.5881	0.5570
Southwest	-3.5438	0.5700	-6.2176	0.0000
West	-3.7426	0.6782	-5.5185	0.0000
Class B	-2.5238	0.4463	-5.6554	0.0000
Class C	-5.2548	0.8575	-6.1278	0.0000
Class Unspecified	-7.4825	0.8967	-8.3448	0.0000
Medical	1.0223	2.0149	0.5074	0.6124
Sublease	-2.2496	0.6214	-3.6201	0.0004
Property Size	0.0000	0.0000	0.2231	0.8236
Transaction Size	0.0000	0.0000	-1.9624	0.0509
Execution Date 1995	-1.8024	0.4692	-3.8410	0.0002
Execution Date 1996	-1.6486	0.4426	-3.7253	0.0002
Execution Date 1997	-0.9999	0.4075	-2.4536	0.0149
Execution Date 1998	-0.0575	0.4513	-0.1275	0.8987
Execution Date 1999	0.7174	0.4285	1.6744	0.0954
Execution Date 2001	0.5569	0.4563	1.2205	0.2235
Lease Term	0.0133	0.0058	2.2963	0.0225
Multiple Leases	0.3419	0.3785	0.9033	0.3673
Triple Net Lease	-3.7001	0.5671	-6.5246	0.0000
Number of Floors	0.1428	0.1087	1.3137	0.1902
Building Age	-0.0154	0.0217	-0.7132	0.4764
Distance to Public Square	0.1318	0.0997	1.3210	0.1878
Nearest HWY Interchange	0.6114	0.2810	2.1757	0.0306
Good Visual Screen	-1.3015	0.5405	-2.4080	0.0168
Good Noise Barrier	0.4816	0.3316	1.4521	0.1478
Good Space Defintion	0.0204	0.5288	0.0386	0.9693
Good Building Shade	1.0778	0.4986	2.1615	0.0317
Good Aesthetics	1.1574	0.5701	2.0301	0.0435
Percent Canopy Cover	-0.0371	0.0325	-1.1389	0.2559
Percent Beds	0.0479	0.0398	1.2045	0.2296
Percent Turf	-0.0048	0.0191	-0.2497	0.8030

Residual standard error: 1.873 on 237 degrees of freedom
Multiple R-Squared: 0.7311
F-statistic: 20.13 on 32 and 237 degrees of freedom, the p-value is 0

a. Dependent Variable: Contract Rate

Conclusions

This report investigates the effect of landscaping on the base rent of office buildings and is based on a detailed field survey of 85 buildings consisting of 270 individual and unique leases. All buildings are located within Cuyahoga County and are considered a part of the Cleveland, Ohio metropolitan area. Conducted during the summer of 2001, this survey focuses on the landscaping visible from all sides of a property and captures 11 different attributes dealing with ground and tree cover including functional aspects, maturity and amount of landscaping. Some of the attributes were discarded due to the lack of theoretical justification or explanatory impact. The remaining landscaping features were then added to an array of structural, lease and distance variables to determine the effects of landscaping and trees on office rental rates.

It appears that landscaping does have a positive impact on rental rates, although quality is essential. As would be expected, landscaping that is aesthetically pleasing provides an increase in office rental rates (Vandell & Lane, 1989). This is consistent with residential literature that shows a positive impact of 3-6% (Henry, 1994). The effect of good building shade is also consistent with literature that shows a 6-9% increase in residential property values (Morales, Boyce, & Favretti, 1976). Finally, the effect of trees that provide a good visual screen negatively impacts rental rates. At first blush, it appears that this is contrary to intuitive judgment, but when compared to Payne's (1973) conclusions regarding excessive tree cover it becomes much more palatable. This may indicate that office tenants value visibility over privacy.

In conclusion, our research findings are consistent with other literature on the subject. The model shows a clear relationship between quality landscaping and office rental rates.

Suggestions for Further Research

The current study has some limitations, as conclusive as it might appear. First, the data set could be expanded to include office space represented by firms other than Grubb & Ellis. The use of a single broker could produce potentially biased results, although the proprietary nature of the data effectively limits the ability to obtain information from a variety of sources. Second, a comparative study of the effects substantial, mature tree cover to sites with no tree cover should also be conducted, rather than attempting to draw conclusions from a percentage increase in the amount of landscaping. This study was unable to define "substantial" due to a lack of variation in the amount of canopy cover at the observed sites although we were able to qualify the effectiveness of that cover. Third, a study of neighborhood characteristics may also provide insight into the importance of landscaping and tree cover. For instance, sites located in heavily wooded neighborhoods or near parks may charge higher rents than those that are not. Finally, a cost-benefit analysis should be conducted to determine the effect of planting and maintenance costs on the overall model.

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