Empirical Modeling of the Relative Impacts of Various Sizes of Shopping Centers on the Values of Surrounding Residential Properties

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Abstract. **This paper examines price differences of identical residential properties located around shopping centers of different sizes. Various models are tested for this purpose. The size of a shopping center is found to have a positive contributory effect on the values of surrounding residential properties as the variable "size of a shopping center" is found to be positive and significant in all models. The results indicate that the value of a residential property at a radial distance from the outer periphery of a larger shopping center is higher as compared to that of an otherwise identical residential property located at the same radial distance from the outer periphery of a smaller shopping center.**

Introduction

This paper examines the effect of different sizes of sources of externalities such as existing shopping centers and/or shopping center complexes on the values of surrounding dwellings. A shopping center simultaneously generates positive externalities such as convenience in shopping, less travel time for shopping, and entertainment possibilities, along with negative externalities such as noise, fumes, pollution, and congestion. This simultaneous generation of positive and negative externalities has a compounding effect on the values of surrounding residential properties.

Recently, shopping centers have been developed with varying sizes ranging from neighborhood and community centers to regional centers, and power centers. The latter are a hybrid of community shopping centers and regional malls. As the size of a center increases, the attractiveness also increases in some proportion and draws a number of shoppers having varied sets of needs to the center. The overall effect of increase in center size is a simultaneous increase in the positive and the negative externalities generated by it.

An interesting issue is how this overall effect of externalities influences the values of surrounding dwellings, in magnitude and direction, as the size of the shopping center varies. This paper endeavours to ascertain the positive contributory effect, if any, on the values of surrounding residential properties as the size of a center alters.

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Literature Review

In the past, no research has been conducted to ascertain the varying size effects of sources of externalities such as existing shopping centers, in magnitude and direction, on the surrounding residential properties. Previous research is basically limited to evaluating the effect of externalities due to various sources on the surrounding land uses. These studies have provided conflicting evidence of the effects of nonresidential land uses on the values of surrounding residential properties. For example, Grether and Mieszkowski (1980) studied the effects of nonresidential land uses on the prices of adjacent housing. These various uses included highways, garden apartments, commercial strips, point commercial, and industrial properties. Their results suggested that nonresidential land use per se had no systematic effect on house values. Similarly, Crecine et al. (1967) found that for a number of areas in Pittsburgh, there was no systematic evidence that the value of single-family homes was negatively affected by the presence of nonresidential land uses in the immediate neighborhood. Bleich, Findley and Phillips (1991) studied the impact of a well-designed landfill on the surrounding property values. The regression results indicated that the prices of homes adjacent to the landfill and in two comparable neighborhoods were all predicted by the same mathematical equation that did not include the landfill variable. There was no statistically measurable impact, either positive or negative, caused by the landfill.

However, Kain and Quigley (1970b), using factor analysis, found a statistical significant negative relationship between nonresidential land use in the neighborhood and residential values. Grieson and White (1989) provided evidence that was consistent with the theory of externality capitalization in the house prices. Using a survey, Delaney and Timmons (1992) found that the market value of residential property can be affected by proximity to high voltage power lines. Similarly, Richardson (1977) suggested an externality rent besides locational rent in the composition of urban rent. Externality rent is due to the fact that a specific site confers advantages in the form of area amenities and pleasant living environments in addition to its accessibility to the CBD (Central Business District).

Because in the past no research has been conducted to evaluate the effect of varying sizes of sources of externalities such as shopping centers on the surrounding residential properties, there is a need for examining this issue. This study, which was conducted in Gainesville, Florida, attempts to ascertain the contributory effect, if any, of the different sizes of shopping centers in terms of their square footage of gross leasable area on nearby residential values.

Theoretical Framework and Hypotheses

In this study, it is postulated that the higher the square footage of gross leasable area of a shopping center, the higher would be the impact on neighboring dwellings. This impact would be twofold. On one hand, in the vicinity of larger shopping centers, the values of surrounding residential properties might be enhanced due to increased levels of convenience, availability of goods and services, and possibility of entertainment. On the other hand, the value of surrounding dwellings might decrease due to increased levels of noise, traffic and congestion. On the whole, when we consider convenience and savings attributes to be highly important for the households, we may conjecture that the coefficient of size of a shopping center would have a positive sign. In other words, the residential properties nearer to a larger shopping center may have higher prices than those nearer to a smaller shopping center.

The coefficients of various house structural variables were postulated to be in accordance with the results of previous studies by Johnson and Phillips (1984), Colwell, Gujral and Coley (1985), Mark (1983), Kain and Quigley (1970b), and Ridker and Henning (1967). That is, lot size, living area, bedrooms, and bathrooms in a house would have positive signs for their coefficients whereas age of the house would have a negative sign.

In this study, the coefficient of radial distance of a house from the outer periphery of a nearby shopping center was hypothesized to be positive as it was postulated that in the vicinity of a shopping center, the impact of negative externalities might be greater on house values as compared to the impact of positive externalities on those values. Similarly, the coefficient of a locational variable such as distance of a house from a nearby park was postulated to be positive. However, coefficients of distances of a house from a nearby school and an employment center were postulated to be negative.

Methodology

For this study, data of residential properties around three shopping centers of varying sizes were collected and various statistical techniques were employed. These centers, namely, Hancock Center, Ridgeway Shopping Center Complex, and Millhopper Shopping Center Complex are in Gainesville, Florida and were selected from the northwest part of Gainesville which is a purely residential area and provided a very interesting feature for the study in that it did not have any heavy industries. The date of data collection for this study was June 1990.[1] The specific features of these centers/complexes are shown in Exhibits 1–3.

Exhibit 1
Hancock Shopping Center[2]

Name of Shopping Center/ (Type)	Gross Leassable Area (GLA) including Anchors in Square Feet	Number of Stores	Parking Spaces	Construction/ Renovation since 1985
Hancock Shopping Center/ (Neighborhood)	47,500	6	100	No

The residential values were collected,[3] truncated and analyzed up to radial distances of 3000 feet from the outer peripheral boundaries of Hancock Center, Ridgeway and

Exhibit 2
Ridgeway Shopping Center Complex

Name of Shopping Center/ (Type)	Gross Leassable Area (GLA) including Anchors in Square Feet	Number of Stores	Parking Spaces	Construction/ Renovation since 1985
Northwood Plaza/ (Neighborhood)	8,500	6	35	No
Ridgeway Village/ (Neighborhood)	40,000	16	100	No

Exhibit 3
Millhopper Shopping Center Complex

Name of Shopping Center/ (Type)	Gross Leassable Area (GLA) including Anchors in Square Feet	Number of Stores	Parking Spaces	Construction/ Renovation since 1985
Millhopper Shopping Center/ (Neighborhood)	80,305	14	400	No
Millhopper Square/ (Neighborhood)	16,749	15	97	No
The Market Place/ (Community)	76,025	18	423	No
Thornbrook Village/ (Neighborhood)	77,112	44	358	No
La Pavilion/ (Neighborhood)	23,000	6	100	No
Unnamed Shopping Center/ (Neighborhood)	21,000	7	50	No

Millhopper Shopping Center complexes respectively.[4] These distances were considered not only to have comparability in the radii around three centers within which data were gathered but also to have a sufficient number of observations to enable us to evaluate the effects of various variables, including varying sizes of these centers, on the surrounding residential values. The properties lying within these circular areas are in close proximity to the nearby shopping center/complex only and not to any other shopping center/complex. The radii of Hancock Center and the Ridgeway and Millhopper Center complexes are approximately 100, 200 and 350 feet respectively. The total number of observations used in this study—143 (61, 53 and 29), from Hancock Center and the Ridgeway and Millhopper complexes respectively—are compiled together to analyze this issue. The basic model hypothesized for this study is

$$SP = f(LA, Lotsz, Sres, Age, AFCP, AFGR, AFSP, AFEP, AFOP, BB, BR, Qlty, NMS, D1, D2, D3, D4, D5, D6, D7, D8, PLAK, SF),$$

where

SP = Selling price of house;
LA = Living area;
$Lotsz$ = Lot size;
$Sres$ = Number of stories;
Age = Number of years from date house was built until date of study;
BB = Number of bedrooms;
BR = Number of bathrooms;
$AFGR$ = Finished garage;[5]
$AFCP$ = Finished carport;
$AFSP$ = Finished screen porch;
$AFEP$ = Finished enclosed porch;
$AFOP$ = Finished open porch;
$Qlty$ = Quality of construction;
NMS = Number of months from date of last sale until date of study;[6]
$D1$ = Radial distance of house from outer peripheral boundary of nearest shopping center;
$D2$ = Road distance of house from outer peripheral boundary of nearest shopping center;
$D3$ = Road distance of house from nearest park;
$D4$ = Road distance of house from nearest elementary school;
$D5$ = Road distance of house from nearest high school;

Exhibit 4
Race in Percentages, by Zip Code Area

Year	Zip Code	White	Black
1987	32605	92.1	4.7
	32606	93.9	3.3
1992	32605	91.3	5.2
	32606	93.2	3.7

Source: *The 1987 Sourcebook Of Demographics and Buying Power for Every Zip Code in the USA*. Arlington, Va.: CACI Marketing Systems, 1987.

D6 = Road distance of house from the university (another major employment area besides the CBD in Gainesville, Florida);
D7 = Road distance of house from CBD;
D8 = Road distance of house from intersection of NW 13th Street and NW 16th Avenue;[7]
PLAK = Locational dummy variable for whether or not property is on lake front;
SF = Square footage of gross leasable area of center or complex.

These variables are included to provide the structural, locational and time-trend measures of each house which may affect its value. All three shopping areas lie within the 32605 and 32606 zip code areas. The quality of neighborhood around each shopping area is approximately the same because the racial composition (see Exhibit 4) and crime rate are approximately identical in these areas. Larger shopping areas are not encompassed by better neighborhoods as compared to smaller shopping areas; thus, the variable "Quality of Neighborhood" is not included in the models for analysis purposes. Similarly, a financing variable is not included as all the properties under study had normal financing.

Various forms of models are tested using multiple regression. The highly correlated variables were excluded from the reduced model.[8] Thus the reduced model is

$$SP = f(LA, Age, AFSP, BR, NMS, D1, DDI, D3, D4, D8, SF, SFDDI), \qquad (a)$$

where

SP = Selling price of house;
LA = Living area;

Exhibit 5
Descriptions of Variables

Variable	Mean	Std Dev.	Minimum	Maximum
SP	63555.38	19078.60	39180.00	158900.00
LA	1431.30	396.4376536	1002.00	3143.00
AGE	11.8902439	5.7117305	2.7000000	31.7000000
BB	2.988	.4268	2.000	5.0000
BR	1.9865526	.3382337	1.0000000	3.5000000
AFSP	1.0926829	.2903419	1.0000000	2.0000000
NMS	29.7043902	12.9809501	8.4000000	104.4000000
D1	2060.47	852.2350242	200.00000	3000.00000
DDI	.000845090	.0010571	.000333222	.0049751
DDISQ	1.8251053E-6	4.9793417E-6	1.1103707E-7	.000024752
D3	5098.64	2967.48	1100.00	11600.00
D4	9286.98	2274.56	5500.00	15400.00
D8	19388.17	6647.88	11430.00	32300.00
SF	137402.99	115753.09	47500.00	294191.00
SFDDI	64.2126158	59.2638524	15.8280573	236.3184080

Source: Author

Lotsz = Lot size;
Sres = Number of stories;
Age = Number of years from date house was built until date of study;
BB = Number of bedrooms;
BR = Number of bathrooms;
NMS = Number of months from date of last sale until date of study;
*D*1 = Radial distance of house from outer peripheral boundary of nearest shopping center;
DDI = $1/(1+D1)$;
*D*1*SQ* = Square of *D*1;
DDISQ = Square of *DDI*;
*D*3 = Road distance of house from nearest park;
*D*4 = Road distance of house from nearest elementary school;
*D*8 = Road distance of house from intersection of NW 13th Street and NW 16th Avenue;
SF = Square footage of gross leasable area of center or complex;
*SFD*1 = *SF***D*1 (interaction term);
SFDDI = *SF***DDI* (interaction term).

Empirical Evidence

The empirical results of the various models are presented in Exhibits 6–13. It is clearly evident from these exhibits that the size of a shopping center has a positive impact on the values of surrounding residential properties. Using a one-tailed test, the coefficient of the square footage of a shopping center is found positive and significant at the 99% confidence level in the linear, the semilog, the log linear, and the inverse models with and without squared distance. This simply shows the robustness of the results concerning the effect of various sizes of the shopping centers on the surrounding dwellings. At a given radial distance from the outer periphery of a shopping center or complex, keeping all the values of other variables constant, the property values are found higher around a larger shopping center as compared to those around a smaller shopping center. This implies that the surrounding property values receive a positive contributory effect as the size measured in terms of square footage of gross leasable area increases, keeping values of other variables constant. The prices of surrounding property values are found to shift upwards with the higher size of a center. In the inverse model, the variable *SFDDI* is found significant, using a one-tailed test, at the 99% level. This implies that, keeping *DDI* or *D*1 constant, the higher the square footage of a shopping center, the higher its impact on the surrounding residential properties.

The variance inflation factors of all the variables in the various models are below 6.0 that illustrate no multicollinearity problem.[9] The results of various models were tested for heteroscedasticity by examining the plots of the residuals with predicted selling prices of all the models. The plot of residuals of the linear model was of funnel shape. Various transformations of the dependent variable were analyzed and the logarithmic transformation was found most suitable. The plots of residuals of the semilog model, the inverse model, and the inverse model with squared distance were

Exhibit 6
Linear Model (Dependent Variable: *SP*)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	*F*-Value	Prob > F
Model	10	32355440340	3235544034	16.903	.0001
Error	132	25267797449	191422707.95		
C Total	142	57623237789			

Root MSE	13835.55955	R^2	.5615
Dep Mean	64526.64336	Adj. R^2	.5283
C.V.	21.44162		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	*T* for H0: Parameter = 0	Prob > | *T* |	Variance Inflation
Intercept	50820.0000	12056.1825	4.215***	.0001	.00000
LA	16.3314	5.2092	3.135***	.0021	1.74846
AGE	−321.1303	264.3472	−1.215	.2266	1.73722
BR	−12457.0000	4058.4934	−3.069***	.0026	1.17578
AFSP	5893.0546	4178.8160	1.410*	.1608	1.56932
NMS	116.1939	95.8814	1.212	.2277	1.12177
D1	.7855	1.7203	.457	.6487	1.61363
D3	−2.7904	.8275	−3.372***	.0010	4.71285
D4	−1.7575	.6768	−2.597***	.0105	1.78902
D8	1.0842	.2518	4.306***	.0001	2.16194
SF	.1513	.0244	6.209***	.0001	5.03002

*significant at 90% level using one-tailed test
**significant at 95% level using one-tailed test
***significant at 99% level using one-tailed test

Source: Author

Exhibit 7
Semi-Log Model (Dependent Variable: *LNSP*)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	*F*-Value	Prob > F
Model	10	5.56563	.55656	17.541	.0001
Error	132	4.18821	.03173		
C Total	142	9.75383			

Root MSE	.17813	R^2	.5706
Dep Mean	11.03704	Adj. R^2	.5381
C.V.	1.61389		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	*T* for H0: Parameter = 0	Prob > | *T* |	Variance Inflation
Intercept	10.86564	.15522	70.003***	.0001	.00000
LA	.00013	.67E-4	1.990**	.0486	1.74846
AGE	−.00490	.00340	−1.440*	.1522	1.73722
BR	−.15223	.05225	−2.913***	.0042	1.17578
AFSP	.04497	.05380	.836	.4047	1.56932
NMS	.00166	.00123	1.342*	.1820	1.12177
D1	.16E-4	.22E-4†	.708	.4803	1.61363
D3	−.34E-4	1.07E-5	−3.225***	.0016	4.71285
D4	−.22E-4	.87E-5	−2.514***	.0131	1.78902
D8	.18E-4	.32E-5	5.493***	.0001	2.16194
SF	.21E-5	.03E-5	6.740***	.0001	5.03002

†E-4 means 10 raised to power -4
*significant at 90% level using one-tailed test
**significant at 95% level using one-tailed test
***significant at 99% level using one-tailed test

Source: Author

Exhibit 8
Log Linear Model (Dependent Variable: *LNSP*)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	*F*-Value	Prob>F
Model	10	5.40325	.54032	16.394	.0001
Error	132	4.35059	.03296		
C Total	142	9.75383			

Root MSE	.18155	R^2	.5540
Dep Mean	11.03704	Adj. R^2	.5202
C.V.	1.64488		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	*T* for H0: Parameter=0	Prob>| *T* |	Variance Inflation
Intercept	7.2793	1.10633	6.580***	.0001	.00000
LNLA	.1697	.10237	1.658**	.0997	1.76083
LNAGE	−.0731	.03439	−2.127**	.0353	2.10003
LNBR	−.2718	.09319	−2.917***	.0042	1.16375
LNAFSP	.0699	.07822	.893	.3734	1.53421
LNNMS	.0484	.03137	1.543*	.1253	1.11117
LND1	.0536	.02595	2.067**	.0407	1.49814
LND3	−.0887	.05431	−1.633*	.1049	4.96937
LND4	−.1881	.08711	−2.159**	.0326	2.12273
LND8	.2312	.07368	3.137***	.0021	2.46399
LNSF	.2206	.04055	5.440***	.0001	4.23595

*significant at 90% level using one-tailed test
**significant at 95% level using one-tailed test
***significant at 99% level using one-tailed test

Source: Author

Exhibit 9
Inverse Model (Dependent Variable: *LNSP*)[10]

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F-Value	Prob>F
Model	10	5.93621	.59362	20.525	.0001
Error	132	3.81763	.02892		
C Total	142	9.75383			

Root MSE	.17006	R^2	.6086
Dep Mean	11.03704	Adj. R^2	.5790
C.V.	1.54084		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob>|T|	Variance Inflation
Intercept	9.41859	.68377	13.774***	.0001	.00000
LNLA	.24464	.09246	2.646***	.0091	1.63677
LNAGE	−.05361	.03197	−1.677**	.0959	2.06884
LNBR	−.29928	.08691	−3.444***	.0008	1.15354
LNAFSP	.12579	.07194	1.749**	.0827	1.47901
LNNMS	.04614	.02932	1.573*	.1180	1.10627
DDI	−270.76099	33.96605	−7.972***	.0001	5.73713
D3	−3.62E-5	9.65E-6†	−3.756***	.0003	4.24189
D4	−2.13E-5	9.04E-6	−2.356***	.0200	2.11469
D8	1.56E-5	3.03E-6	5.134***	.0001	2.07182
SFDDI	.00471	.00062	7.539***	.0001	6.47329

†E-6 means 10 raised to power -6
*significant at 90% level using one-tailed test
**significant at 95% level using one-tailed test
***significant at 99% level using one-tailed test

Source: Author

randomly distributed and showed no trends, suggesting that the error term had constant variance for all levels of independent variables. The best residual plot was of the inverse model.

Exhibit 14 summarizes the adjusted R^2 and F-values of various models. From this exhibit, it is evident that the explanatory powers of various models are quite high. It is clearly evident from all the exhibits that the square footage of the shopping center has a positive contributory effect on the values of surrounding residential properties. In most of the models, using one-tailed tests, the structural variables found significant at or above 90% level are living area, age, number of bathrooms, and finished screen

Exhibit 10
Inverse Model with Squared Distance (Dependent Variable: *LNSP*)[11]

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	*F*-Value	Prob>F
Model	11	5.93846	.53986	18.536	.0001
Error	131	3.81537	.02912		
C Total	142	9.75383			

Root MSE	.17066	R^2	.6088
Dep Mean	11.03704	Adj. R^2	.5760
C.V.	1.54625		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	*T* for H0: Parameter=0	Prob>| *T* |	Variance Inflation
Intercept	9.46306	.70454	13.432***	.0001	.00000
LNLA	.23969	.09447	2.537***	.0123	1.69687
LNAGE	−.05522	.03259	−1.694**	.0926	2.13575
LNBR	−.30007	.08726	−3.439***	.0008	1.15475
LNAFSP	.12660	.07225	1.752**	.0821	1.48138
LNNMS	.04632	.02943	1.574*	.1179	1.10684
DDI	−285.74844	63.74190	−4.483***	.0001	20.06360
DDISQ	3391.72031	12189.39760	.278	.7813	15.15977
D3	−36.27E-6	9.68E-6	−3.745***	.0003	4.24224
D4	−20.77E-6	9.27E-6	−2.240**	.0268	2.20811
D8	15.39E-6	3.10E-6	4.966***	.0001	2.15183
SFDDI	.00470	.00063	7.490***	.0001	6.48851

*significant at 90% level using one-tailed test
**significant at 95% level using one-tailed test
***significant at 99% level using one-tailed test

Source: Author

porch. A negative sign in front of the coefficient for bathroom indicates that keeping living area the same, an increase in number of bathrooms decreases the price of a residential property.

The coefficient of the variable *D*1 is found positive and insignificant in the linear and the semilog models. Thus, from the results of these models, there is no statistical evidence to support the monotonic rise in house prices with distance from a shopping center. However, in the inverse model, the coefficient of *DDI* is found negative, which implies that as *DDI* increases or *D*1 decreases, the property values decrease. In other words, properties nearer to a shopping center have lesser values as compared to properties farther from the shopping center. However, from all these models, it can

Exhibit 11
Linear Model with Squared Distance (Dependent Variable: *SP*)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F-Value	Prob > F
Model	11	34431049640	3130095421.8	17.680	.0001
Error	131	23192188149	177039604.19		
C Total	142	57623237789			

Root MSE	13305.62303	R^2	.5975
Dep Mean	64526.64336	Adj. R^2	.5637
C.V.	20.62036		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	T for H0: Parameter = 0	Prob > | T |	Variance Inflation
Intercept	38440.00000	12145.12670	3.165***	.0019	.00000
LA	16.84474	5.01192	3.361***	.0010	1.75002
AGE	−343.44445	254.30560	−1.351*	.1792	1.73837
BR	−11137.00000	3922.03889	−2.839**	.0052	1.18725
AFSP	6765.52087	4026.82676	1.680**	.0953	1.57563
NMS	96.46612	92.38872	1.044	.2983	1.12615
D1	20.79071	6.07231	3.424***	.0008	21.73748
D1SQ	−.00627	.00183	−3.424***	.0008	23.11226
D3	−2.48080	.80096	−3.097***	.0024	4.77369
D4	−2.24629	.66636	−3.371***	.0010	1.87508
D8	1.20213	.24459	4.915***	.0001	2.20565
SF	.14789	.02345	6.305***	.0001	5.03910

*significant at 90% level using one-tailed test
**significant at 95% level using one-tailed test
***significant at 99% level using one-tailed test

Source: Author

be seen that as *D*1 approaches zero, keeping other variables constant, the price approaches a constant.[12] The price does not decrease towards an asymptote of zero.

The possibility of a non-monotonic price rise is also examined in this study by analyzing various models with squared distance from a shopping center. From the inverse model with squared distance (Exhibit 10), it is evident that *DDI* is significant at 99% level of confidence and *DDISQ* is insignificant. Thus, this model does not invalidate the monotonicity in price rise of residential properties. However, from the linear model with squared distance (Exhibit 11), both *D*1 and *D*1*SQ* are found significant at 99% level. The sign of coefficient of *D*1 is positive and sign of coefficient of *D*1*SQ* is negative. That implies the non-monotonic price rise. In other words, house

Exhibit 12
Semi-Log Model with Squared Distance (Dependent Variable: *LNSP*)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	*F*-Value	Prob > F
Model	11	5.98511	.54410	18.913	.0001
Error	131	3.76872	.02877		
C Total	142	9.75383			

Root MSE	.16961	R^2	.6136
Dep Mean	11.03704	Adj. R^2	.5812
C.V.	1.53677		

Parameter Estimates

Variable	Parameter Estimate	Standard Error	*T* for H0: Parameter = 0	Prob > | *T* |	Variance Inflation
Intercept	10.68964	.15482	69.045***	.0001	.00000
LA	.00014	.00006	2.204**	.0293	1.75002
AGE	−.00522	.00324	−1.610*	.1098	1.73837
BR	−.13346	.04999	−2.669***	.0086	1.18725
AFSP	.05738	.05133	1.118	.2657	1.57563
NMS	.00138	.00118	1.168	.2449	1.12615
D1	.00030	.77E-4	3.877***	.0002	21.73748
D1 SQ	−89.06E-9	.02E-6	−3.819***	.0002	23.11226
D3	−29.96E-6	10.21E-6	−2.934***	.0039	4.77369
D4	−28.86E-6	84.90E-7	−3.397***	.0009	1.87508
D8	19.48E-6	31.20E-7	6.249***	.0001	2.20565
SF	20.66E-7	3.00E-7	6.910***	.0001	5.03910

*significant at 90% level using one-tailed test
**significant at 95% level using one-tailed test
***significant at 99% level using one-tailed test

Source: Author

prices rise with an increase in distance from the nearby shopping center, reach maximum, and then fall.[13] Similar results about non-monotonicity are found in the semilog model with squared distance and the log-linear model with squared distance. However, in this study, no firm conclusion is drawn about the monotonicity of a rise in house prices with distance from a center.

In most of the models, the coefficients of other distance variables such as distance of house from nearest park, *D*3, distance of the house from nearest elementary school, *D*4, and distance of the house from intersection for going to various places of employment, *D*8 are found positive and significant at or above the 90% level of confidence.

Exhibit 13
Log-Linear Model with Squared Distance (Dependent Variable: *LNSP*)

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	*F*-Value	Prob > F
Model	11	5.52346	.50213	15.549	.0001
Error	131	4.23038	.03229		
C Total	142	9.75383			
	Root MSE	.17970	R^2	.5663	
	Dep Mean	11.03704	Adj. R^2	.5299	
	C.V.	1.62818			

Parameter Estimates

Variable	Parameter Estimate	Standard Error	*T* for H0: Parameter = 0	Prob > | *T* |	Variance Inflation
Intercept	9.99986	1.78537	5.601***	.0001	.00000
LNLA	.09198	.10905	.843	.4005	2.03938
LNAGE	−.08315	.03443	−2.415***	.0171	2.14876
LNBR	−.27106	.09224	−2.939***	.0039	1.16377
LNAFSP	.05385	.07787	.692	.4904	1.55184
LNNMS	.05213	.03111	1.676**	.0962	1.11548
LND1	.11481	.04081	2.813***	.0057	3.78075
LND1SQQ	−.00112	.00058	−1.929**	.0558	8.94738
LND3	−.11339	.05527	−2.052**	.0422	5.25155
LND4	−.14363	.08926	−1.609*	.1100	2.27455
LND8	.02325	.13012	.179	.8584	7.84240
LNSF	.16481	.04948	3.331***	.0011	6.43567

*significant at 90% level using one-tailed test
**significant at 95% level using one-tailed test
***significant at 99% level using one-tailed test

Source: Author

Conclusions

The results of this study indicate that the size of a source of externalities, such as an existing shopping center, has a positive contributory effect on the values of surrounding residential properties. Positive price differences are found for residential properties around a larger shopping center as compared to otherwise identical residential properties around a smaller shopping center. The other significant structural variables of a house that are found to affect its value are living area, age, number of bathrooms, and screen porch. No conclusive evidence is drawn about the monotonicity of house prices at various distances from the outer periphery of a center. The other significant locational variables found in this study are distance of house from nearby park, elementary school, and places of employment.

Exhibit 14
Regression Summary of Various Models

Number	Model	Adjusted R^2	F-Value
1	Linear	.5283	16.903
2	Semilog	.5381	17.541
3	Log-linear	.5202	16.394
4	Inverse	.5790	20.525
5	Inverse with squared distance	.5760	18.536
6	Linear with squared distance	.5637	17.680
7	Semilog with squared distance	.5812	18.913
8	Log-linear with squared distance	.5299	15.549

Source: Author

As a possible topic for further research, the author suggests that the empirical evidence found here be tested and analyzed in another city with mainly residential and commercial areas to confirm the effects of varying sizes of the shopping centers on the surrounding residential values.

Notes

[1]There is a little office space in the northwest section of Gainesville around Millhopper Shopping Center. Otherwise, the whole area is purely residential. There is also some small-scale industry in the northeast section. The northwest section provided an ideal place for this research due to the presence of purely residential properties and no industrial activity at all.

[2]Shopping Center Directories, The South 1989 and The South 1990 (National Research Bureau, 1990) contain the necessary information about all the shopping centers in the southern part of the United States.

[3]Hancock Square—a neighborhood shopping center located at the intersection of NW 39th Avenue and NW 22nd Drive; Ridgeway Shopping Center Complex—consisting of two neighborhood shopping centers, Northwood Plaza and Ridgeway Village, is located at the intersection of NW 31st Terrace and 34th Street. The distance between the outer boundaries of Northwood Plaza and Ridgeway Village is less than 300 feet; Millhopper Shopping Center Complex consists of five shopping centers, namely, Millhopper Shopping Center (a neighborhood shopping center opened in 1973), Millhopper Square, The Market Place, Thornebrook Village and La Pavilion, which adjoin each other, and an unnamed shopping center, which lies across the Market Place.

This six-shopping center complex has 294,191 square feet of total gross leasable area, 104 stores and 1,430 parking spaces. This complex is located at the intersection of NW 23rd Avenue and NW 43rd Street. None of the above shopping centers had any major construction/renovation activity since 1986.

[4]The various road distances for this study were calculated by using the Rand McNally Champion Map of Gainesville, Florida (Daytona Beach, Fl.: Rand McNally Champion Map Corporation, n.d.).

[5]*AFGR*, *AFCP*, *AFSP*, *AFEP*, and *AFOP* are dummary variables, values for which are 2, if that feature is present; 1, if that feature is not present. 1 and 2 values were used to test the log-linear form of the model.
[6]The variable *NMS* is used to capture the changes in values of a property over time due to inflation.
[7]This intersection is a common point through which many households travel going to various places of employment scattered around Gainesville.
[8]The highly correlated variables were not considered in the model as these contributed no new information to the equation. Variables such as *lotsize* and *number of stories* were excluded from the model as these were highly correlated to *living area*. Similarly, the variables *finished garage*, *finished carport*, *finished enclosed porch*, and *finished open porch* were excluded as these were highly correlated to *lotsize* and *living area*. The road distance, *D*2 was highly correlated to radial distance, *D*1 and thus was excluded. For the same reason, the road distance to high school, *D*5 was not included as it was highly correlated to road distance from the nearby elementary school, *D*4. Also, the road distance from the University, *D*6 and road distance from the Central Business District, *D*7 were excluded, as these were highly correlated to *D*8, which is the road distance of a house from the common point at the intersection of 13th Street and NW 16th Avenue to various places of employment in Gainesville.

The variable *SFDDI* is included to determine the interaction between distance and size. The interaction variable *SFDDI* (*Square footage* • 1/(1 + *Radial Distance*)) was found to be highly correlated to square footage of a center. The inclusion of *D1SQ* or *DDISQ* in the models caused variance inflation factors to be more than 10.
[9]A more formal method for detecting a multicollinearity problem involves the calculation of variance inflation factors for the individual parameters. Various authors have maintained that a severe multicollinearity problem exists if the largest of the variance inflation factors for the β's is greater than 10. In this study, no variable had a variance inflation factor greater than 6. For further reference, see Mendenhall and Sincich (1986).
[10]The inverse model incorporates the interaction between distance and size. The model is

$$P = a_o X^{a1} e^{a2/(1+d)+a3\ SF/(1+d)},$$

where

P = Selling price,
X = Control variables,
d = Distance to the nearest shopping center,
SF = Nearest shopping center square footage,

or

$$\log P = \log ao + a1 \cdot \log X + a_2/(1+d) + a_3 \cdot SF/(1+d).$$

Distance $(1+d)$ instead of d is considered in the model so that selling price at distance $d=0$ can be evaluated. The result of this model is presented in Exhibit 9.
[11]The inverse model with squared distance explores the possibility that the relationship between price and distance is non-monotonic. That is, negative externalities might dominate in close proximity to a center, but positive externalities might dominate at larger distances. It also explores the possibility of price approaching some positive asymptotic value as distance from the center increases. Similarly, the linear model with squared distance is also examined to explore the above-mentioned possibilities.
[12]The price distance relationship in the linear model can be written as

$$SP = 50{,}820 + .785519 \cdot D1 + \epsilon\,.$$

As $D1$ approaches zero, keeping the values of other variables constant, SP approaches the value of intercept. Thus, the price does not decrease towards an asymptote of zero as $D1$ becomes zero. Similarly, the price-distance relationship in the inverse model can be written as

$$LnSP = 9.4186 - 270.761 \cdot DDI + \epsilon\,,$$

or

$$LnSP = 9.4186 - 270.761 \cdot 1/(1 + D1) + \epsilon\,.$$

From this model, a similar conclusion can be drawn about this relationship.

[13]In the linear model with squared distance, the price-distance equation can be written as

$$SP = 38{,}440 + 20.790710 \cdot D1 - .006265 \cdot D1SQ + \epsilon\,.$$

Therefore, $dSP/D1 = 20.790710 - .012530 \cdot D1$ and $d^2SP/dD1 = -.01253$ or negative. This implies, keeping the values of other variables constant, a maxima to exist in selling prices of houses at various distances from a center.

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