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Retail Proximity and Residential Values or Do Nearby Stores Really Run Down Property Values?

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Abstract: Common knowledge tells us that locating retail sites near houses will run down the house's value. This common knowledge has lead to highly segregated land use patterns and automobile dependency. But, does locating near a store really adversely affect residential values. In this study we find that it is true for only very short distances – about 200 to 300 feet. After that, for about a quarter of a mile, proximity to stores - contrary to popular wisdom – actually increases residential value.

Local zoning hearings across the county resound with the arguments of homeowners objecting to proposed new nearby commercial development fearing that noise, nighttime lights, traffic, trash, and other nuisances will run-down the value of their homes (Hotaling, and Hooper, 2001; Raun, 1997). Often, objections such as these, based on "conventional wisdom" and "common knowledge," but otherwise unsubstantiated, tend to carry the day, preventing integration of residential and commercial land uses.

Does being close to commercial uses really run-down housing values? The question is not inconsequential. Home ownership is one of the most important, if not the most important, means available to U.S. families for accumulation of wealth. Homeowners seek to protect their investments. Decisions that positively or negatively affect residential value should be taken seriously. Yet, others criticize the resulting land use segregation and auto dependency as a source of urban decline. (Duany, Plater-Zybek, and Speck, 2000)

Urban Economic Theory

Two conflicting strains of urban economic theory bear on the question of the effect of proximity to commercial use on residential prices. Microeconomic theory applied to urban land holds that land values are determined by transportation costs. Generally, as distance to an “attractor” use (e.g. work or shopping) decreases, transport cost decreases and land cost increases (Muth, 1969). There is a trade-off between land cost and transportation cost. Consequently, residential properties located closer to retail use should, all else being equal, have a higher price than residential property farther away because travel cost to the retail use is lower.

An opposing strain of theory predicts prices will decrease with proximity because of negative externalities associated with commercial development. An “externality” is a “consequence of an economic activity that spills over to affect a third party” (Miller, 1999, p. 95). Thus, noise and traffic congestion generated by a shopping area are negative externalities that may adversely affect neighboring residences. Zoning ordinances seek to minimize the effect of negative externalities by segregating land uses from one another and imposing design controls to minimize spill-over of diseconomies (Mills, 1979).

Review of Studies on Proximity: Residential to Commercial

Popularly, the nature and magnitude of the diseconomies associated with proximity of residential development to commercial uses are often seen to be quite large and threatening. However, there has been little direct investigation of the question of the price effect of residential proximity to commercial uses. Much of the literature that does exit deals only with other types of non-residential land uses and/or includes commercial uses as a control when studying the effects of other type of land uses. Not surprisingly, given the two strains of theory, the results are mixed. This section looks at both appraisal literature and empirical literature.

Appraisal Literature

Real property appraisal literature is not conclusive. For example, a large real property appraisal firm states that the value of a new single-family residential property is lower when it is adjacent to commercial development. (Hosch, and Koehlinger, 1997) Yet a directed appraisal study finds, in a specific instance, that there is no negative impact on homeowners' property values when a neighborhood type retail project is built nearby. (Crafts, 1998)

Standard real property appraisal textbooks give no specific guidance regarding the impact of commercial development on residential values, but generally reflect the notion that there is a positive influence. "Residential locations, whether for homes or multiple units, are enhanced when they are ... well supplied with shopping..." (Kahn, and Case, 1977) Boykin and Ring (1993) also write that nearby retail development is desirable.

Empirical Literature

Almost exclusively formal studies of the price effect of non-residential uses on residential prices rely on hedonic price modeling as developed by Griliches (1961), Lancaster (1966), and Rosen (1974) The results of these studies are generally inconclusive. There is no clear pattern of either positive or negative effects of proximity to non-residential uses on the price of housing.

Crecine, Davis, and Jackson (1967) Grether and Mieskowski (1980) are unable to find any systematic evidence of externalities - or negative influence on residential property values - from the presence of other types of land uses.   Crecine et al., speculate that the findings may result from (1) the possibility that negative externalities extend only "next door" or (2) that zoning may be effective.

There is research that finds a positive effect on housing price rising from proximity to non-residential land use. In Seattle, Franklin and Waddell (2003) show that access to commercial and university uses is positively associated with residential sales prices, while proximity to local schools and industries is negatively associated with sale prices. In separate studies of the effect the presence of heavy rail transit stations on residential values, Grass (1992), in Washington D.C., Bowes and Ihlanfeldt (2001), and Nelson and McClesky (1990), also in Atlanta, all find significant <u>positive</u> impacts. While not directly addressing commercial properties, these studies of proximity to transit stations do show the positive influence of convenient access. In addition, Grass (1992) and Bowes and Ihlanfeldt (2001) find the positive effect extends ¼ mile, a distance commonly accepted as "walking distance".

On the other hand, there are studies that find a negative price effect in the relation between housing and non-residential uses. Frew and Jud (2003) find that an increase in level of commercial activity in the "neighborhood" (zip code), measured by total payroll in the zip code, is associated with a reduction in residential property value. Another study of multi-family housing, this one in Brasilia, also shows mostly negative results. Proximity to specific types of commercial uses is used as a group of control variables.

All are found to have negative price effects except fruit and vegetable markets and gas stations. (Batalhone, Nogueira, and Mueller, 2002) Mahan, Polasky and Adams (2000), find a negative relation between residential values and proximity to commercial uses. The study area covers very large distances; the average distance form a house to a commercial use is over 1,200 feet with the maximum distance extending to over 7,500 feet. Their results show, surprisingly, that as distance increases between commercial and residential uses, residential price increases. They speculate that disamenity effects such as congestion and noise override the positive effect of convenience.

Cao and Cory (1981) construct a theoretical model that test the effect of the proportion of nearby non-residential uses on single-family residential property values. Contrary to Frew and Jud (2003) their results show that over ranges of low proportions of non-residential uses, increasing the amount of industrial, commercial, multi-family and public land-use activity in a neighborhood tends to increase surrounding residential property values.

Reviewing several studies, Mills (1979) notes that for “most nonresidential activities studied, the [price] effects [of proximity] seem remarkably small. Coefficients are frequently insignificant and occasionally have the wrong sign. Even when significant, most effects are found to be small and decline rapidly with distance” (Mills, 1979, p. 521)

Clearly, evidence concerning the impact of proximity to non-residential land-uses on residential property values is inconsistent. In theory, there are potentially both positive and negative effects; mixed results are an understandable outcome. In what has become a classic study, Li and Brown (1980) provide a model that explicitly tries to capture and measure both the positive and negative effects. Their assumption is that positive price arising from accessibility and negative price effects associated with externalities are both present to one degree or another and that both are less intense with distance. There is an assumption that the effects of negative externalities will disappear more quickly than the positive effects of convenience as distance increases. They have only Euclidian, or straight-line, measures of distance from single-family houses to various non-residential uses available. Based on their assumptions of positive and negative influences and the longer reach of the positive influence, convenience is proxied by a logarithmic transformation of the Euclidian distance and disamenities are proxied by negative exponential transformations of the Euclidian distance. They illustrate their assumptions with their Figure 1, which is copied and included as Figure 1 here.

FIGURE 1 about here.

Testing their model with a sample of 781 single-family sales in 15 Boston suburbs they have significant results of the type expected for both accessibility and externalities. "Empirical findings suggest that proximity to certain non-residential land uses affects housing prices by having a positive value for accessibility and a negative value for external diseconomies (congestion, pollution, and unsightliness). Furthermore, visual quality and noise pollution have impacts on housing prices" (Li, and Brown, 1980, p. 125) and positive effects have greater range than negative effects.

These studies bring out several important points. First, there are inconclusive results. Second, both positive and negative externalities on residential prices arising from proximity to non-residential uses tend to be small and tend to dissipate rapidly with distance (Mills, 1979) There are also some findings that negative effects dissipate more rapidly over distance than do positive effects. (Bowes, and Ihlanfeldt, 2001; Li, and

Brown, 1980; Nelson, and McClesky, 1990) One implication is that the effect occurs at a neighborhood level over short distances. But, this is contradicted by Mahan, et al.'s (2000) finding of effects reaching over much larger distances and that at these greater distances the price effect of distance is positive. Third, even though many investigators use neighborhoods as their basic study area, the physical characteristics of neighborhoods are often not included. Cao and Cory (1981) produce a study that looks at physical and land use aspects of neighborhoods. Their findings regarding the effect of mixing non-residential and residential uses are significant, but are contradicted by Frew and Jud. (2003) Beyond that, no one has included the neighborhood design relationship between residential and commercial development. Differences in neighborhood composition and design may help us understand the disparate results of the various studies. Last, these studies are hampered to a large extent by data limitations. For example, all the studies that use measure of distance use only a straight-line distance. Many used assessed values or census values rather than actual sales values, and most are limited by data availability for structural, neighborhood, and location characteristics. Most had relatively few observations, Li and Brown (1980), for example, had only 781. However, with the recent, and still not widespread, use of computer based mass appraisal systems (CAMA) by tax assessors and geographic information systems (GIS) we can address such limitations.

The next section outlines the hedonic models used in the empirical study and the way this study will not only "tease apart" the positive and negative effects of distance, but also introduces considerations of neighborhood layout. Section 3 explains the data and area from which the data is drawn. Section 4 reports the estimates and discusses the implications for how markets value street layout. Section 5 concludes.

The Empirical Model

We use an hedonic model to uncover how proximity to retail uses affects house value. The study by Li and Brown (1980) provides the base for this work. But, rather than imposing assumptions about effects with mathematical transformations on straight-line distance, this study uses actual travel distance on streets from individual houses to the nearest retail use to proxy for convenience and actual straight-line distance from individual houses to the nearest retail use to capture the effect of disamenities. Travel, obviously, is tied to streets and street distances. Disamities, e.g. noise, will travel on a straight line. Because the effect of some retail site disamenities may be a function of visual exposure rather than only simple distance, the model includes visibility of retail sites from individual houses (Li, and Brown, 1980). We also control for proximity to other types of non-residential uses and for important aspects of neighborhood design with variables measuring the proportion of nonresidential use (Cao, and Cory, 1981) and residential density (Grether, and Mieszkowski, 1980; Li, and Brown, 1980) of the surrounding census tract.

In addition, the study area includes neighborhoods with different design characteristics. Jo (1996), Franklin and Waddell (2003), and Song (2005) point out that the pre-war neighborhood design – typically highly interconnected grids and integrated land uses– is profoundly different from post-war design – isolated, long, curving, non-connected streets terminating in cul-de-sacs and segregated land uses. Highly integrated grid system neighborhoods may have high values associated with both positive and negative influences similar, for example, to the situation described by Li and Brown (1980). On the other hand, the effect of intentional isolation inherent in cul-de-sac designs may be very effective in reducing the impact of disamenities, but may also impose lengthy travel distances reducing the positive influence of convenience.

The basic hedonic model to be estimated is:

$$P = \alpha + \beta_1 S + \beta_2 E + \beta_3 N + \beta_4 R + \beta_5 D + \beta_6 M + \varepsilon$$

where:

P = Sales price;

S = Structural attributes and market conditions;

E = Environmental amenities of location;

N = Distance and direction[1] to the closest non-residential uses except retail;

R = Travel distance and direct distance and direction to retail;

D = Residential density of census tract;

M = Non-residential mix of census tract;

Travel distance and direct distances to retail are the specific variables of interest.

Structural attributes include living area, bedrooms, bathrooms, age, and house condition. We also include as property descriptors the lot size and cubic time trend of sales dates to capture market cycle effects on selling price. Environmental amenities of location include whether or not the property has a view of the mountains, skyline, or water and whether or not the property enjoys a waterfront location. A measure of school quality is also included as a location amenity. We include distances in quadratic form and direction to the main CBDs in the urban area, as well as expressway access. The models also include distances and direction from the property to the nearest non-retail nonresidential sites (government, office, hotel, etc.). Finally, the models include the price effect of distance to retail, distances between the five nearest retail sites, residential density, and proportion of nonresidential uses in the neighborhood. As specified above, distance to retail is taken in both travel distance and straight-line distances. All distance measures as well as density and proportion of nonresidential use are entered in quadratic form to allow for curvilinear relations. (Grether, and Mieszkowski, 1980) The distance between the five nearest retail sites is included as a further control for convenience.

The Study Area and Data

The study area is a swath of census tracts in King County, Washington running from Puget Sound north of Seattle's downtown to the eastern urban growth boundary, east of Redmond. Lake Washington bisects the study area. Census tracts are used as neighborhoods. The Seattle portion of the total sample, west of the lake, includes 28 census tracts and approximately 43,650 parcels. The Kirkland/Redmond portion with 10 tracts and approximately 15,150 parcels is east of the lake. There are 19,085 observations on the west side and 6,740 on the east.

The portion of the study area west of Lake Washington in Seattle is older with smaller houses and lots developed on a gridiron pattern. The portion of the study area east of Lake Washington is the Kirkland/Redmond area, which is an edge city as defined by Garreau (1991), dominated by a curvilinear/cul-de-sac street pattern.

As shown in Table 1, the two sample areas used in this study differ greatly. They display significantly different social and development characteristics. One, the Seattle sample, has fewer children, more professionals, a larger portion of non-automobile commuters, longer commuting times, and older and smaller houses on smaller lots. In contrast, the east sample is an automobile oriented edge city. The Seattle side was developed at a time when there was more dependence on public transit and walking; the gridiron neighborhood street layout reflects the pedestrian orientation of the times. The edge city side has an auto-oriented design featuring lower density development, less connectivity in the street patterns and lavish inclusion of cul-de-sacs in neighborhood layout. Land uses are integrated in the Seattle side, but are highly segregated in the Kirkland/Redmond side.

TABLE 1 about here

The data covers single-family sales transactions in the period from January 1989 through October 2003. Observations include all residential sales during this period in the study area. We cull observations with assessor's comments, missing values, or obvious errors. Table 1 reports the summary statistics for the two samples used in the estimation.

Data sources include the King County Tax Assessor Database, school test scores reported on the Seattle Times web page (*School Guide*) and attendance area maps from Seattle and Lake Washington School Board web pages (*Lake Washington School District #414: Elementary School Boundary Map*, ; *Neighborhood Attendance Reference Areas*). We calculate other variables such as land use mixes, densities, distances, and directions, using the King County GIS map and tax assessor's data.

Because the areas differ in so many ways, the study is able to use two sub-samples, one for the area west of the lake, and one for the area to the east. Several differences are particularly important to this study (Table 1). Note especially the distances between residences and retail sites. Residences on the west side are more likely to be exposed to negative spillovers from retail uses – noise, light pollution, etc. - than residences on the east, simply because they are considerably closer. On the other hand, more residences on the west side are within walking distance of retail, about ¼ mile. (Bowes, and Ihlanfeldt, 2001; Duany et al., 2000; Garreau, 1991; Grass, 1992) The average travel distance between residences and the nearest retail on the east side, 3,636 feet, is well beyond this comfortable walking distance. Additionally, the remarkable differences between the street an land use patterns described above allow us a crude ability to control for these features by separating the study area at the lake. Figures 2 and 3 show the street layouts and retail land use patterns in the two parts of the study area.

FIGURES 2 AND 3 about here

The Tax Assessor's data contains a wide range of structural (floor area, lot size, etc) and environmental measures (view, waterfront location, etc.). Very important are the sales price, sales date, and assessor's notes indicating arm's length transactions. The sales date is expressed with cubic time trend variables to remove the effects of market phases and the secular effects of inflation through the study period.

Other variables from various sources include neighborhood school quality (Clark, and Herrin, 2000; Kain, and Quigley, 1970; Li, and Brown, 1980), measured with elementary school standardized test scores (*Iowa test: Reading*); distance and direction to major business centers (Batemen, Day, Lake, and Lovett, 2001), distance and direction to the nearest non-residential uses (Batalhone et al., 2002), neighborhood residential density (Grether, and Mieszkowski, 1980; Li, and Brown, 1980), and the proportion of neighborhood non-residential uses (Cao, and Cory, 1981).

The principal variables of interest are the straight-line and the travel distance (using the street layout), and their squared terms, from each residential site to the nearest retail. These variables capture competing effects on property value. Shorter travel distances should be capitalized positively into housing price due to convenience. Straight-line distance should have a negative effect to the extent that negative spillovers travel a straight-line from a nonresidential site (Li, and Brown, 1980). We include *Visible nonresidential use*, a dummy variable gathered from field observations, to capture negative externalities that are strictly visual.

Empirical Results

The main empirical results explained in this section are the following: 1) There are areas where proximity to retail sites has a significant effect on residential values and there are areas where the effect of proximity is insignificant. 2) In those areas where proximity to retail significantly affects house value, the positive effect of accessibility tends to outweigh the negative externality effect from retail sites. 3) In those areas where there is no retail proximity effect, its absence appears to arise from highly segregated land uses and street layouts that result in greater straight-line and travel distances

As a whole, the estimates are as expected; at the least, they reveal nothing idiosyncratic or surprising in the data.[2] In theory, the positive influence of retail sites on house value comes from easy access. Preliminary estimates reveal that the appropriate measure of access is walking distance (1,400 feet). Therefore, the observations are split into those that are within walking distance of the nearest retail and those that are farther away for both samples on either side of Lake Washington. Preliminary analysis also indicates possible heteroskedasticity; robust standard errors are used in all cases.

Our preliminary analysis shows that negative influences rising from retail sites do not extend beyond a short distance (about 700 feet in the west and about 950 feet in the east). Therefore, we include the straight-line distance that captures the effects of negative externalities for houses within 1,400 feet of the nearest retail. The hedonic models for houses beyond 1,400 feet of nearest retail do not include these variables (see also Li and Brown (1980)).

Table 2 reports the regressions for observations west and east of the lake within walking distance of the nearest retail use and table 3 reports for those observations west and east of the lake beyond walking distance.

TABLES 2 AND 3 about here

Table 2 shows that in the west side sample for observations within 1,400 feet of a retail site, the principal variables of interest, *Travel distance to retail* and *Straight distance to retail* and their squares, are all significant, jointly significant, and are of the expected sign.

On the west side, an area with gridiron street patterns and more integrated land uses, for houses within walking distance of retail, an increase in travel distance reduces housing price, as expected, as it reflects poorer accessibility to the retail location. Figure 4 illustrates the gross effect of travel distance on house value implied in the accessibility estimates. According to these estimates, the positive residential price effect of $9,822 next to a retail site diminishes to zero at a travel distance of 1,269 [3] feet from the closest retail use, as illustrated by the Travel Distance curve.

FIGURE 4 about here

At the same time, the coefficients on straight-line distance and its square in Table 2 show that increasing straight-line distance increases house price. This is consistent with the notion that the negative externalities associated with retail proximity decline with greater straight-line distance from the site. These coefficient estimates imply that the negative externalities coming off a retail site tend to lower the prices of neighboring houses by $14,453. The effect declines with greater distance and diminishes to zero at a straight-line distance of 717 feet from the closest retail use, as illustrated by the Straight Distance curve in Figure 4.[4]

The solid curve in Figure 4 portrays the calculated net effect of travel and straight-line distances on property value. The most interesting result of this plot is that the net effect of retail proximity is positive – residential prices are enhanced, not diminished - beyond about 235 feet, peaking at about 560 feet, and finally playing out at about 1,260 feet. As an aside, six hundred feet is often considered an optimum distance for the length of a shopping mall and 1,400 feet is considered a maximum walking distance. The net effect curve is remarkably consistent with these distances.

The relationship between travel distance and straight-line distance in this setting is very similar to that assumed by Li and Brown (1980). The difference here is that we have been able to actually calculate travel distance and straight-line distance from houses to retail sites and show the complex effects with in a relatively simple way. The positive and negative influences are both present, as predicted by theory. Clearly, the negative externalities from retail sites do not reach as far as the positive effect of convenience. The negative externalities have only a very short reach and dominate convenience for only a very short distance. After that, the positive convenience effect dominates over distances commonly considered as within walking distance.

In the East sample of houses within walking distance of retail, also reported in Table 2, none of these distance variables are individually significant. The complicated interplay between travel distance and straight-line distance seen in the West sample is not present the East sample. This by itself is not surprising given the automobile dependent structure of the area east of Lake Washington and the much greater distances, both travel and straight-line, from houses to retail sites.

Table 3 reports results west and east of Lake Washington for observations beyond walking distance. The negative effects of proximity to retail sites do not extend to this distance. As discussed earlier, straight-line distances and their squares are not included in these two models. In general, we expect to see house price decline with increasing travel distance to retail, and that is the case in the West sample. Surprisingly, though, price increases with travel distance in the East sample. This is the same odd result reported by Mahan et al (2000). We have no explanation for this apparently anomalous result. We do note that the average distance between houses and retail sites in this eastern area beyond walking distance is over ¾ of a mile compared to only ½ mile in the western sub-sample. Mahan et al speculate that the result may arise from effects of negative externalities arising from retail sites. The results of this study show that to be improbable. Yet, this result has appeared in two separate studies; it deserves further exploration.

Conclusions

The results of this study are relevant to urban economic theory, understanding the results of previous studies, and public policy.

The study is based on two seemingly conflicting tenants of urban economic theory. One, that residential property values are enhanced by reducing travel cost (here, travel distance) to sites of commerce, and two, that disamenities spilling off retail sites will reduce value of nearby residential properties. This study provides evidence to support both theories and, further, provides evidence that they work together in complex ways. Lastly, this study supports the theory (advanced as an assumption) by Li and Brown (1980) that the positive effects of convenience extend further than the negative effects of disamenities.

A major finding of this study is summarized in Figure 4; positive and negative residential price effects can both be found in relation to proximity to retail sites. But, this effect was found only in a pedestrian oriented setting. They were found in the part of the study area that is built on gridiron street patterns among houses that are within walking distance of retail sites. Other settings provided different results. For the most part, we find no relation between proximity to retail and residential price among houses not within walking distance of retail sites. Further, houses not in gridiron type neighborhoods tend not to be within walking distance of retail sites. Previous studies do not describe or distinguish settings in this way. It is quite possible that the differences we see in the results of previous studies are due to the effects of different settings, as we have found here.

In this study we have been able to look at neighborhood settings – street and land use patterns – only in a very broad way by distinguishing between parts of a metropolitan area that were built using different patterns. Several investigators are exploring to methods to measure or index street layout and its effects. (see, for example, Hillier, 1999; Jo, 1996; Song, and Knapp, 2003b) Application of these methods to the present study will undoubtedly be interesting.

Last and most importantly, this study addresses the question we began with, “Does being close to commercial uses really run-down housing values?” In this study the negative effect is limited to a very short distance – about 700 feet. But, the negative effect is offset by a by the positive effect of convenient access, creating a net positive price effect at less than 300 feet from retail sites. Planning and zoning officials, and concerned homeowners for that matter, do not need to segregate residences from commercial areas by distances of a quarter mile or more, as seen in the western portion of our study area, to protect residential values from retail disamenities. Much shorter distances will suffice. In the west sample, homes located within a quarter mile – and beyond about 300 feet - of retail sites actually see enhanced value. While the post WW II curvilinear and cul-de-sac neighborhood layouts and highly segregated land uses common to the eastern part of the study area seem to protect property values from the adverse effects of proximity to retail sites, they have also rob residential properties of the value enhancing convenience of easy access to retail activities.

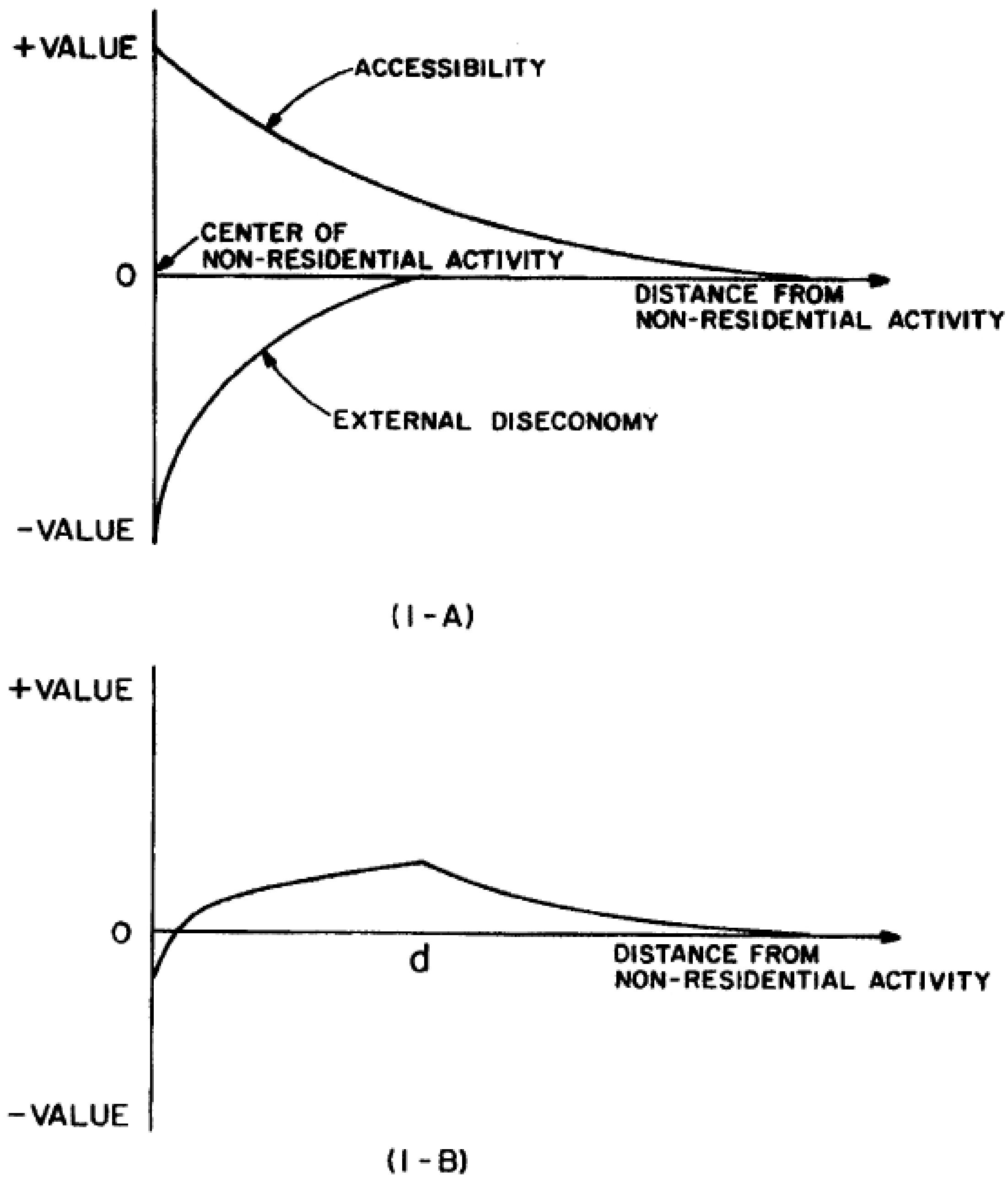

Figure 1: The Predicted "Effects on Housing Value Due to Non-Residential Activity" from Li and Brown (1980) page 127

Figure 2: Street and Retail Patterns West of Lake

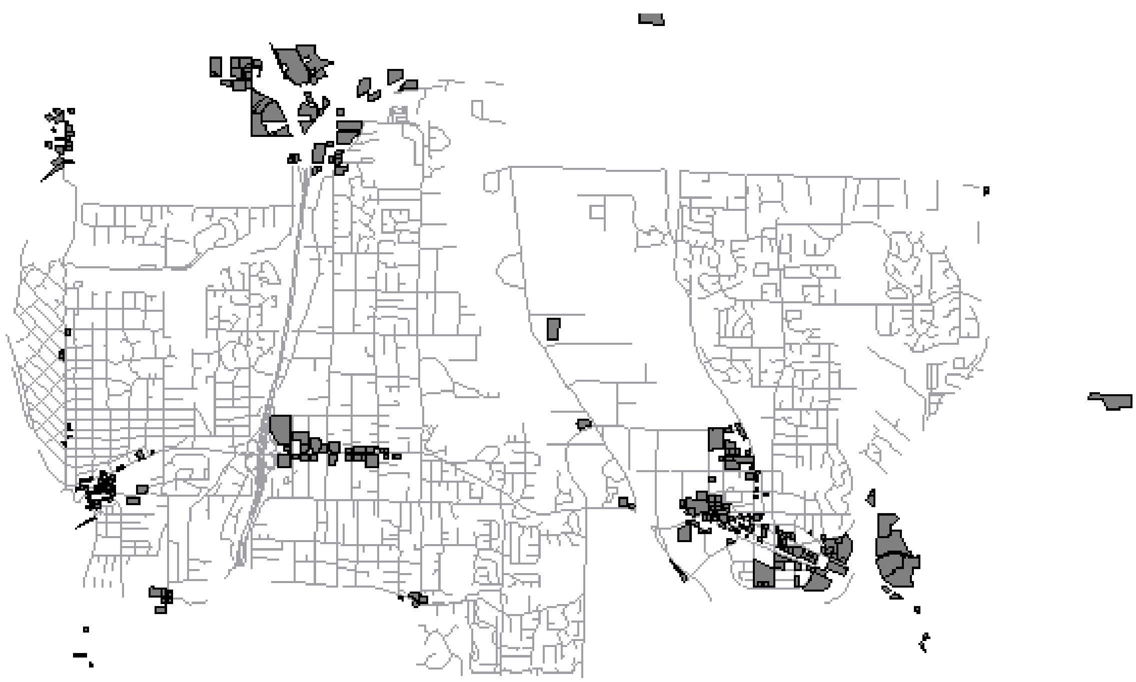

Figure 3: Street and Retail Patterns East of Lake

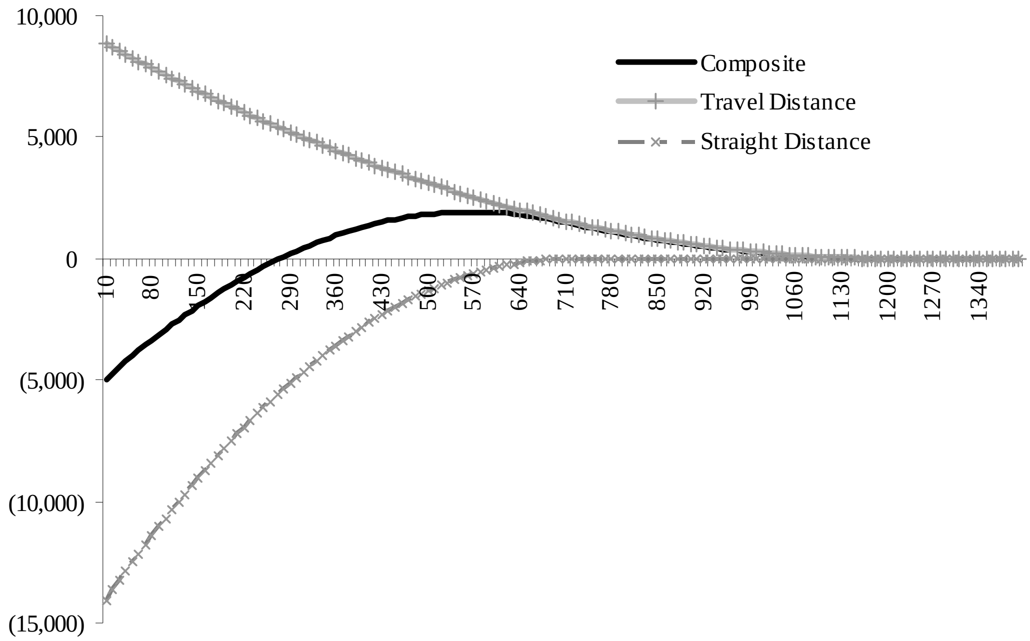

Figure 4:
Effect of Travel and Straight-Line Distances on the West Side Less Than 1,400 Feet

Table 1: Comparison of Neighborhood Measures in the West and East Areas

	West		East		Comparison	
	Mean	Std Dev	Mean	Std.Dev	t	P>t
Straight distance: retail	903.82	617.47	2,393.51	1,172.27	50.97	0.0000
Street distance: retail	1,231.16	899.68	3,610.46	1,811.32	103.43	0.0000
Average distance: nearest 4 retail	791.23	615.23	2,044.25	1,984.93	50.97	0.0000
Distance: nearest apartment	587.27	546.39	1,410.21	985.77	65.10	0.0000
Distance: nearest cultural/entertainment	851.45	546.30	1,454.40	950.37	49.29	0.0000
Distance: nearest government facility	2,741.76	1,260.27	4,129.55	2,183.50	49.36	0.0000
Distance: nearest hotel	4,645.05	2,184.54	6,748.41	2,633.96	58.80	0.0000
Distance: nearest office	894.85	698.11	2,111.34	1,827.61	53.29	0.0000
Distance: nearest hospital	4,555.04	1,639.11	7,460.14	2,438.68	90.82	0.0000
Distance: nearest industry	581.96	417.55	798.26	545.28	29.64	0.0000
Distance: nearest elementary school	1,122.44	662.53	1,452.78	921.84	27.05	0.0000
Square feet: house	1,603.43	655.88	1,991.80	706.49	39.52	0.0000
Number Bedrooms	3.03	1.09	3.35	0.79	25.22	0.0000
Number bathrooms	1.75	0.85	2.43	0.83	56.99	0.0000
Square feet: Lot	5,102.96	2,218.49	10,189.12	8,719.62	47.35	0.0000
Residential Density (population/residental and apartment acre)	24.91	7.75	14.08	3.13	-160.00	0.0000
Non-Residential Mix (proportion of non-residential land use)	13.93	8.11	12.76	5.71	-12.87	0.0000

Source: Derived from King County Tax Data and King County GIS map

Table 2: Regression Results in the West and East Areas, Walking Distance

Proximity to Retail, Other Non-Residential Uses, Density, and Mix of Uses Added

	West of the Lake					East of the Lake				
		Obs	16266				Obs	1482		
		R-squared	0.7189				R-squared	0.7147		
Sale Price	Coef.	Robust Std. Err.	t	Sig	Joint Sig	Coef.	Robust Std. Err.	t	Sig	Joint Sig
Trend	-12642.01	1320.316	-9.57	**		-29942.48	8062.595	-3.71	**	
Trend^2	2662.004	186.4988	14.27	**		4769.4	1112.832	4.29	**	
Trend^3	-66.2788	7.826396	-8.47	**		-116.5393	45.28288	-2.57	**	
Square feet living area	43.55913	6.288336	6.93	**		34.24243	54.43032	0.63		
Square feet living area^2	0.0033399	0.0031668	1.05			0.0184659	0.0157789	1.17		
Bedrooms	2894.603	4137.222	0.7			17994.79	16990.99	1.06		
*Sq ft living area * Bedrooms*	-0.6727626	2.426228	-0.28			-12.87341	8.740351	-1.47		
Bathrooms	6726.645	1190.043	5.65	**		1397.404	7496.882	0.19		
Age	-684.5852	115.7405	-5.91	**		-2856.576	618.2426	-4.62	**	
Age^2	4.90016	0.9069302	5.4	**		26.37444	5.328375	4.95	**	
Condition	10797.83	837.1799	12.9	**		210.816	4176.82	0.05		
Square feet lot	4.634935	0.6703514	6.91	**		1.833417	1.895069	0.97		
Square feet lot^2	0.000122	0.0000358	3.41	**		0.0000132	0.0000416	0.32		
No view	-40559.01	2592.232	-15.65	**		-22208.68	10705.49	-2.07	*	
Water front location	78141.75	19947.95	3.92	**		92394.62	16981.4	5.44	**	
Iowa test: Reading	-603.9723	76.84967	-7.86	**		2624.369	771.2158	3.4	**	
Distance Seattle CBD	-33.0262	5.517714	-5.99	**		-738.9096	136.9749	-5.39	**	
Distance Seattle CBD^2	-0.0005995	0.0000837	-7.16	**		0.0080574	0.0015261	5.28	**	
Direction Seattle CBD	9648.595	1892.341	5.1	**		-215364.2	47321.73	-4.55	**	
Distance Bellevue CBD	-71.16474	11.63838	-6.11	**		-386.7435	78.92906	-4.9	**	
Distance Bellevue CBD^2	0.0010118	0.0001174	8.62	**		0.0029478	0.0011871	2.48	*	
Direction Bellevue CBD	48162.42	5398.031	8.92	**		-14902.67	4122.641	-3.61	**	
Distance expressway	-0.4712214	0.6645286	-0.71			-12.17012	15.66198	-0.78		
Distance expressway^2	-0.0001258	0.0000753	-1.67			-0.0020863	0.0017481	-1.19		
Direction expressway	-118.1088	14.06331	-8.4	**		321.1605	169.7644	1.89		
Distance apartment	26.3152	4.624501	5.69	**		-18.7749	25.0988	-0.75		
Distance apartment^2	-0.0085042	0.0035138	-2.42	*		0.0063215	0.012948	0.49		
Direction apartment	1.641837	4.636727	0.35			20.66474	31.72201	0.65		
Distance cultural use	-4.295663	3.968961	-1.08			21.48054	20.49276	1.05		
Distance cultural use^2	0.0037924	0.0022383	1.69			-0.0008652	0.009114	-0.09		
Direction cultural use	2.148293	4.278779	0.5			-18.63458	38.00594	-0.49		
Distance government use	-13.10704	1.574794	-8.32	**		33.18352	11.55378	2.87	**	
Distance government use^2	0.003218	0.0002881	11.17	**		-0.0058228	0.0016082	-3.62	**	
Direction government use	-17.4315	5.244399	-3.32	*		-24.99656	39.07468	-0.64		
Distance hotel	8.113027	1.273826	6.37	**		-15.02718	19.76954	-0.76		
Distance hotel^2	-0.0006004	0.0001434	-4.19	**		0.0016617	0.0011136	1.49		
Direction hotel	41.81344	6.289632	6.65	**		71.50027	39.52745	1.81		
Distance office	-7.572652	5.058797	-1.5			9.529762	19.06174	0.5		
Distance office^2	0.0057071	0.0023552	2.42	*		-0.0026926	0.0042793	-0.63		
Direction office	-4.977747	5.379175	-0.93			19.90511	35.75721	0.56		
Distance hospital	10.47729	1.725138	6.07	**		-18.60807	23.14842	-0.8		
Distance hospital^2	-0.0012325	0.0001953	-6.31	**		0.001476	0.0012197	1.21		
Direction hospital	-37.26409	5.179622	-7.19	**		-9.577188	37.03387	-0.26		
Distance industry	17.19655	5.333504	3.22	**		87.98806	33.6794	2.61	**	
Distance industry^2	-0.0094268	0.0033202	-2.84	**		-0.0428189	0.0223525	-1.92		
Direction industry	-3.005991	5.159863	-0.58			-20.61905	30.29458	-0.68		
Distance school	-0.7316971	3.15332	-0.23			-50.15286	25.13188	-2	*	
Distance school^2	0.0012425	0.0012468	1			0.0149741	0.0067342	2.22	*	
Direction school	8.143111	4.632248	1.76			-5.486657	55.64939	-0.1		
Travel distance to retail	-15.47458	6.424141	-2.41	*	**	21.26829	13.90681	1.53		**
Travel distance to retail^2	0.0060947	0.0021264	2.87	**		-0.0014529	0.0021939	-0.66		
Straight distance to retail	40.31395	9.336806	4.32	**	**	-45.09297	41.12117	-1.1		
Straight distance to retail^2	-0.028112	0.0051603	-5.45	**		0.0051569	0.0220376	0.23		
Direction to retail	13.13045	5.050088	2.6	**		10.4373	30.34563	0.34		
Average distance between retail	-1.799716	3.572368	-0.5		**	29.55547	24.68725	1.2		
Average distance between retail^2	-0.0009447	0.0017476	-0.54			-0.002799	0.0049065	-0.57		
Traffic noise	-13625.49	738.9345	-18.44	**		-8046.215	4999.382	-1.61		
Visible nonresidential use	-4316.507	1438.217	-3	**		8124.517	11103.87	0.73		
Density	-2535.633	609.4001	-4.16	**	**	20964.91	11235.57	1.87		
Density^2	49.01772	9.064638	5.41	**		-738.7198	365.2998	-2.02	*	
Proportion of nonresidential use	271.3762	292.9371	0.93			-9863.947	6920.97	-1.43		
Proportion of nonresidential use^2	-2.081571	6.79524	-0.31			317.8384	191.2207	1.66		
Intercept	-4374434	865820.8	-5.05	**		7.54E+07	1.55E+07	4.87	**	

*** = significant at .01 or better, * = significant at .05*

Table 3: Regression Results in the West and East Areas, Beyond Walking Distance

Proximity to Retail, Other Non-Residential Uses, Density, and Mix of Uses Added

	West of the Lake					East of the Lake				
		Obs	2819				Obs	5258		
		R-squared	0.7703				R-squared	0.7378		
Sale Price	Coef.	Robust Std. Err.	t	Sig	Joint Sig	Coef.	Robust Std. Err.	t	Sig	Joint Sig
Trend	-14095.91	3818.209	-3.69	**		-3866.299	2926.956	-1.32		
Trend^2	3060.231	539.6425	5.67	**		1490.618	451.6095	3.3	**	
Trend^3	-81.17348	22.38572	-3.63	**		-21.64452	20.17245	-1.07		
Square feet living area	29.65779	10.98574	2.7	**		59.55973	21.05144	2.83	**	
Square feet living area^2	0.0049319	0.0029802	1.65			0.0084855	0.0078318	1.08		
Bedrooms	-111.9183	6078.285	-0.02			16904.7	10605.66	1.59		
*Sq ft living area * Bedrooms*	-0.4147998	3.161537	-0.13			-9.102657	5.186321	-1.76		
Bathrooms	13805.13	3292.325	4.19	**		88.52894	2817.02	0.03		
Age	-2204.885	363.9528	-6.06	**		-3651.876	319.3372	-11.44	**	
Age^2	18.1641	3.020659	6.01	**		31.66168	3.784561	8.37	**	
Condition	11742.96	2617.825	4.49	**		4580.952	2956.627	1.55		
Square feet lot	3.746172	1.201508	3.12	**		1.403082	0.2774627	5.06	**	
Square feet lot^2	0.000119	0.0000346	3.44	**		-5.08E-06	1.55E-06	-3.26	**	
No view	-61131.9	5193.34	-11.77	**		-49966.74	8234.925	-6.07	**	
Water front location	54073.08	16716.44	3.23	**		61044.95	13999.52	4.36	**	
Iowa test: Reading	1976.994	413.3759	4.78	**		1322.097	275.1027	4.81	**	
Distance Seattle CBD	-172.0125	39.82798	-4.32	**		-18.60216	64.73696	-0.29		
Distance Seattle CBD^2	0.0008289	0.0004246	1.95			-0.0000904	0.000692	-0.13		
Direction Seattle CBD	2174.821	7510.218	0.29			16944.03	23462.56	0.72		
Distance Bellevue CBD	-255.5795	65.84858	-3.88	**		-0.1168893	26.92182	0		
Distance Bellevue CBD^2	0.0028174	0.0007923	3.56	**		0.0005482	0.0002353	2.33	*	
Direction Bellevue CBD	95552.94	34817.57	2.74	**		5272.978	1440.7	3.66	**	
Distance expressway	-21.16048	3.867954	-5.47	**		5.430751	4.047245	1.34		
Distance expressway^2	-0.0001305	0.0003142	-0.42			0.0003422	0.0003705	0.92		
Direction expressway	-76.48656	36.09807	-2.12	*		111.3156	31.38152	3.55	**	
Distance apartment	23.93849	9.605371	2.49	*		-18.83464	5.6571	-3.33	**	
Distance apartment^2	-0.001605	0.0036584	-0.44			0.0014695	0.001236	1.19		
Direction apartment	-40.01514	16.47489	-2.43	*		24.89796	13.16486	1.89		
Distance cultural use	15.75696	10.39214	1.52			-4.319675	6.676849	-0.65		
Distance cultural use^2	-0.0126457	0.00381	-3.32	**		0.0028177	0.0021777	1.29		
Direction cultural use	-29.45185	17.67146	-1.67			9.329165	12.93192	0.72		
Distance government use	-9.632196	10.47877	-0.92			6.282653	4.674453	1.34		
Distance government use^2	0.0013905	0.0016048	0.87			0.0000659	0.0004335	0.15		
Direction government use	38.30753	31.43001	1.22			37.74477	22.40889	1.68		
Distance hotel	-1.756703	6.30038	-0.28			-11.91945	7.951627	-1.5		
Distance hotel^2	-0.0000686	0.0005913	-0.12			0.0004213	0.0005379	0.78		
Direction hotel	-4.41384	28.43541	-0.16			-27.36434	22.13737	-1.24		
Distance office	36.48231	10.52448	3.47	**		-5.494085	4.43773	-1.24		
Distance office^2	-0.0124423	0.0030528	-4.08	**		0.000026	0.0008585	0.03		
Direction office	14.61174	22.27879	0.66			5.993622	16.85024	0.36		
Distance hospital	-6.114928	6.81921	-0.9			27.86918	7.384081	3.77	**	
Distance hospital^2	0.0001932	0.0006889	0.28			-0.0013703	0.00041	-3.34	**	
Direction hospital	9.028741	24.39583	0.37			-52.51383	21.92467	-2.4	*	
Distance industry	0.1756562	16.96548	0.01			-9.381801	7.432293	-1.26		
Distance industry^2	0.0008634	0.0077891	0.11			-0.0015704	0.0030226	-0.52		
Direction industry	15.22224	21.14602	0.72			41.26741	10.41802	3.96	**	
Distance school	-4.534615	12.6691	-0.36			-8.674555	6.960652	-1.25		
Distance school^2	0.005555	0.0035648	1.56			0.0037531	0.0020522	1.83	*	
Direction school	44.26193	23.65942	1.87			5.019182	13.39685	0.37		
Travel distance to retail	-23.33955	10.40798	-2.24	*	**	17.10371	5.335861	3.21	**	**
Travel distance to retail^2	0.0050281	0.0014624	3.44	**		-0.0012262	0.0005368	-2.28	*	
Average distance between retail	-9.02712	8.701611	-1.04			-10.10509	4.008771	-2.52	*	**
Average distance between retail^2	0.0039144	0.0033934	1.15			0.0011218	0.0006595	1.7		
Traffic noise	-15427.81	3070.36	-5.02	**		-7398.6	2273.109	-3.25	**	
Visible nonresidential use	9945.596	14143.28	0.7			20798.64	24431.66	0.85		
Density	8089.888	4184.964	1.93			-3366.887	4506.661	-0.75		
Density^2	-162.6797	78.54066	-2.07	*		74.1332	152.3086	0.49		
Proportion of nonresidential use	424.1037	1250.754	0.34		**	-4930.608	3055.657	-1.61		
Proportion of nonresidential use^2	-32.87497	28.7201	-1.14			141.4179	86.51022	1.63		
Intercept	-689858.8	3444954	-0.2			-3867044	7521426	-0.51		

*** = significant at .01 or better, * = significant at .05*

[1] Direction from individual observations to various places is used to precisely locate observations in space. These variables provide an acceptable control for spatial collinearity. The direction is expressed as the azimuth from the observed single-family sale to a given non-residential use and is calculated by the same GIS extension that calculates the straight-line distance.

[2] The effect of school quality (Iowa test: Reading) is not significant in the west sample (contrary to expectations), but highly significant in the east side sample. Franklin and Waddell (2003), using school quality as a control, had a similar result. In the Seattle School District, children do not necessarily attend the nearest school, but in the district on the east side of the lake, they do. The insignificant result on the west side is understandable and the significant result on the east side is as expected. This result adds to our confidence in the model.

[3] Prices and distances are calculated using the general form:

$$P = \beta_1 D + \beta_2 D^2$$

Optimizing distance with

$$\frac{\delta P}{\delta D} = \beta_1 + 2\beta_2 D$$

and substituting back to get Price

$$P = \beta_1 D + \beta_2 D^2$$

Optimizing distance with

$$\frac{\delta P}{\delta D} = \beta_1 + 2\beta_2 D$$

and substituting back to get Price

[4] Dropping the V*isible nonresidential use* from the regression (not shown) significantly increases the straight-line distance coefficient from 37.75 to 42.02 (t = -41.5835). Thus, we are confident that the straight-line term is picking up more than just the visual negative externalities when *Visible nonresidential use* is included in the model.

Bibliogrphy

Batalhone, S., J. Nogueira, and B. Mueller. (2002). *Economics of Air Pollution: Hedonic Model and Smell Consequences of Sewage Treatment Plants in Urban Areas*. Brasilia: University of Brasilia.

Batemen, I., B. Day, I. Lake, and A. Lovett. (2001). *The Effect of Road Traffic on Residential Property Values: A Literature Review and Hedonic Pricing Study*. Norwich: University of East Anglia; Economic and Social Research Council; University College London.

Bowes, D. R., and K. R. Ihlanfeldt. (2001). "Indentifying the Impacts of Rail Transit Stations on Residential Property Values". *Journal of Urban Economics* 50, 1-25.

Boykin, J. H., and A. A. Ring. (1993). *The Valuation of Real Estate (4th ed)*, Englewood Cliffs, N.J.: Prentice-Hall.

Cao, T. V., and D. C. Cory. (1981). "Mixed Land Uses, Land Use Externalities, and Residential Property Values: A Reevaluation". *Annuals of Regional Science* 16, 1-24.

Clark, D. E., and W. E. Herrin. (2000). "The Impact of Public School Attributes on Home Sale Prices in California*". *Growth and Change* 31, 385-407.

Crafts, J. M., MAI, SRA. (1998). "Impact of Commercial Development on Adjacent Residential Properties". *Appraisal Journal* 65, 6-11.

Crecine, J. P., O. A. Davis, and John E. Jackson. (1967). "Urban Property Markets: Some Empirical Results and Their Implications for Municipal Zoning". *Journal of Law and Economics* 10, 79-99.

Duany, A., E. Plater-Zybek, and J. Speck. (2000). *Surban Nation: the Rise of Sprawl and the Decline of the American Dream*, New York: West Point Press.

Franklin, J. P., and P. Waddell. (2003, July 31, 2002). *A Hedonic Regression of Home Prices in King County, Washington, using Activity-Specific Accessibility Measures.* Paper presented at the TRB 2003 Annual Meeting, Washington, D.C.

Frew, F., and G. D. Jud. (2003). "Estimating the Value of Apartment Buildings". *Journal of Real Estate Research* 23, 77-86.

Garreau, J. (1991). *Edge Cities: Life on the New Frontier*: Doubleday.

Grass, R. G. (1992). "The Estimation of Residential Property Values Around Transit Station Sites in Washington, D.C." *Journal of Economics and Finance* 16, 139-146.

Grether, D. M., and P. Mieszkowski. (1980). "The Effects of Nonresidential Land Uses on the Prices of Adjacent Housing: Some Estimates of Proximity Effects". *Journal of Urban Economics* 8, 1-15.

Griliches, Z. (1961). Hedonic Price Indexes for Automobiles: An Econometric Analysis of Quality Changes. In *The Price Statistics of the Federal Government*. Princeton, New Jersey: National Bureau of Economic Research.

Hillier, B. (1999). "The Hidden Geometry of Deformed Grids: or, Why Space Syntax Works, When It Looks as Though It Shouldn't". *Environment and Planning B: Planning and Design* 26, 169-191.

Hosch, S. T., and D. V. Koehlinger. (1997). "How Residential Properties are Impacted by Adjacent Commercial Uses". *Valuation Viewpoint* 1, www.shenehon.com/library/valuation_viewpoint/resident.html.

Hotaling, L., and R. Hooper. (2001, September 13, 2001). TWSA to Move Forward with Purchase of Morris Property. *Sylva Herald*.

Jo, S.-K. (1996). *A Balance Between Pedestrian and Vehicular Movement in Relation to Street Configuration.* Unpublished Doctoral Dissertation, Georgia Institute of Technology, Atlanta.

Kahn, S., H., and F. E. Case. (1977). *Real Estate Appraisal and Investment (2nd ed.)*, New York: Ronald Press.

Kain, J. F., and J. M. Quigley. (1970). "Measuring the Value of Housing Quality." *Journal of the American Statistical Association* 65, 532-548.

Lake Washington School District #414: Elementary School Boundary Map. Retrieved August 10, 2004, from http://www.lkwash.wednet.edu/lwsd/images/schools/BoundariesEL.gif

Lancaster, K. J. (1966). "A New Approach to Consumer Theory". *Journal of Political Economy* 74, 132-157.

Li, M. M., and J. Brown. (1980). "Micro-Neighborhood Externalities and Hedonic Housing Prices". *Land Economics* 56, 125-141.

Mahan, B. L., S. Polasky, and R. M. Adams. (2000). "Valuing Urban Wetlands: A Property Price Approach". *Land Economics* 76, 100-113.

Miller, R. L. (1999). *Economics Today:1999-2000 Edition*, Reading, Massachusetts: Addison-Wesley.

Mills, E. S. (1979). Economic Analysis of Urban Land-Use Controls. In P. Miezkowski & M. Straszheim (Eds.), *Current Issues in Urban Economics* (pp. 511-541). Baltimore: Johns Hopkins University Press.

Muth, R. F. (1969). *Cities and Housing*, Chicago: University of Chicago Press.

Neighborhood Attendance Reference Areas. Retrieved September 12, 2004, from http://www.seattleschools.org/area/facilities-plan/geo/refarea/ref_area.xml

Nelson, A. C., and S. J. McClesky. (1990). "Improving the Effects of Elevated Transit Stations on Neighborhoods". *Transportation Research Record* 1266 173-180.

Raun, A. (1997, August 19, 1997). Panel Rejects Plan for Lake Rezoning: Neighbors Oppose Commercial Plans. *Hastings Tribune*.

Rosen, S. (1974). "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition". *Journal of Political Economy* 82, 34-55.

School Guide. Retrieved September 12, 2004, from http://schoolguide.seattletimes.nwsource.com/

Song, Y. (2005). "Smart Growth and Urban Development Pattern: A Comparative Study". *International Regional Science Review* 28, 239-265.

Song, Y., and G.-J. Knapp. (2003b). *The Effects of New Urbanism on Housing Values: A Quantitative Approach*. College Park, MD: National Center for Smart Growth Research and Education, University of Maryland.