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The Impact of Greenways on Property Values: Evidence from Austin, Texas

Sarah Nicholls
Departments of Community, Agriculture, Recreation, & Resource Studies, and Geography
Michigan State University

John L. Crompton
Department of Recreation, Park and Tourism Sciences
Texas A&M University

The effect of greenways on surrounding residential property values remains somewhat of an unknown quantity. Though several studies have ascertained that nearby residents tend to view greenways as positive or neutral amenities that increase or have no discernible impact on property values and saleability, these results are mostly based on anecdote rather than actual market data. Using the hedonic pricing method, this study demonstrates that greenways may indeed have significant positive impacts on proximate properties' sales prices. Adjacency to a greenbelt produced significant property value premiums in two of three neighborhoods. Physical access to a greenbelt had a significant, positive impact in one case, but was insignificant in two others. No negative greenway impacts were recorded.

KEYWORDS: *Greenways, property values, hedonic pricing.*

Introduction

While many of the advantages of public green spaces are highly intuitive and easy to describe, they are often difficult to quantify. Much evidence supporting the provision of parks remains anecdotal; the need persists to convert the many suppositions regarding predominantly intrinsic open space benefits into objective, quantitative estimates of their worth. Though urban open spaces traditionally have been publicly provided amenities for which no price has been established in the market, they are increasingly being evaluated in terms of their dollar contributions to communities (Crompton, 2001a). It has, therefore, become necessary for park and recreation agencies to investigate the use of techniques which allow monetary estimates to be assigned to the values derived from public open spaces.

Address correspondence to: Sarah Nicholls, Department of Community, Agriculture, Recreation, & Resource Studies, Michigan State University, 131 Natural Resources Building, East Lansing, MI 48824-1222. Email: nicho210@msu.edu.

Author Note: Sarah Nicholls is an Assistant Professor with a joint appointment between the Departments of Community, Agriculture, Recreation, & Resource Studies (formerly Park, Recreation & Tourism Resources), and Geography, at Michigan State University. John L. Crompton is a Distinguished Professor in the Department of Recreation, Park and Tourism Sciences at Texas A&M University.

In times of budgetary cutbacks and other financial constraints, the ability to demonstrate the economic values of public parks and open spaces may be especially crucial, to their continued existence, further development or rejuvenation, and designation. Indeed, many park systems were initially developed based to a considerable extent upon expectations of their direct and indirect economic contributions to city tax revenues, New York City's Central Park being the earliest example (Dunn, 1911; Olmsted, 1919; Nolen and Hubbard, 1937; Adams, Lewis, and McCrosky, 1974).

When an open space is provided at a cost to taxpayers, the ability to demonstrate that an economic return will accrue, and that such amenities can be considered as investments, not taxes, is imperative for providing agencies. Unless the benefits of parks and open spaces, both tangible and intangible, can be quantified, it is unlikely that such amenities will be perceived as the "highest and best" use of anything other than the most marginal of lands. As noted by Mott (1961, in Wonder, 1965, p. i), the "need for concrete evidence to indicate that parks are good business and that the purchase of park lands for future use is good business for a city," remains powerful.

This paper demonstrates empirical estimation of the economic value of a greenway in Austin, Texas, through analysis of its impacts on surrounding property prices. This type of analysis is based on use of the hedonic pricing method and allows measurement of two types of greenway value: physical proximity and aesthetics (view). In the first part of the paper, the proximate principle is introduced and previous analyses of the relationships between greenways and property values are reviewed. The hedonic pricing approach is then described and more specific methodological issues summarized. Results, discussion and conclusions are then presented. It is hoped that the paper stimulates further consideration of the adoption of hedonic and other economic techniques in the valuation of the many tangible and intangible benefits—recreational, environmental, physical and mental health, and aesthetic—associated with the provision of park and recreation areas, most notably in our cities.

The Proximate Principle

As described by Crompton (2001b), the proximate principle suggests that the value of a specified amenity is at least partially captured in the price of residential properties proximate to it. Assuming that home locations adjacent or near to an open space such as a greenway are considered desirable, the extra dollars that home buyers are willing to pay to acquire such a residence represent a capitalization of the land into proximate property values. As a result of this rise in value, the owners of such homes typically are required to pay increased property taxes. If the yearly increment of value attributable to the greenway of all additional taxes paid for all proximate properties is calculated, this sum may be sufficient to cover the annual cost of acquiring, developing, and even maintaining the land. Enhancement of the tax base, above and beyond costs of facility acquisition, development, and maintenance, represents a net gain to a city's annual income. Thus, in addition to the private gains enjoyed by those living in close enough proximity to open spaces to directly derive benefits from them, the entire community may indirectly profit from the increases in municipal expenditures and improvements in public services enabled by heightened tax earnings. In addition, community residents living outside the zone of a greenway's proximate influence have access to the facility without paying additional taxes for the privilege.

Greenways and Property Values in America

A greenway is a linear open space established along a natural corridor such as a riverfront or stream valley, an abandoned railroad right-of-way, a canal, a scenic road or some other linear route (Little, 1990). Greenways have been described as "fingers of green that reach out from and around and through communities all across America" (President's Commission on Americans Outdoors, 1987, p. 142).

The development of greenway networks in America has been somewhat controversial, and disagreement as to their potential impacts on the value of adjacent properties is a prominent element in the debate. Proponents of greenways argue that these amenities offer a host of benefits to surrounding communities. In addition to the environmental, social, aesthetic, recreational and health advantages offered by many types of public open space, the linear nature of greenways enables them to offer routes for alternate means of transportation, an especially useful asset in congested urban areas. As a result of these benefits, supporters argue, greenways are likely to increase nearby property values and, hence, augment property tax revenues.

Opponents, however, have identified a host of negative externalities. They include invasion of the privacy of those residents whose properties directly adjoin greenways, concern regarding the numbers of strangers who will be passing through local neighborhoods, and fears of increased noise, littering, trespass, and vandalism. As a result, opponents claim, property prices will decline and the property tax base may be adversely affected. The negative effects on values recorded for properties backing on to urban parks by Weicher and Zerbst (1973) and Hammer, Coughlin & Horn (1974) appear to lend support to these arguments. Both sets of authors attributed the substantial declines in value they found associated with home locations backing on to a public green space to loss of privacy and other disturbances. Such problems are in addition to the permanent removal of land from the tax rolls and the subsequent loss of potential properties' contributions to municipal tax revenues, which, opponents argue, leads to reduced spending on other local services (Little, 1990).

Previous Empirical Studies

Any enhanced value of residence proximate to a greenway derives primarily from visual access to a view of the amenity and/or physical access to the recreational opportunities it offers. Though there is a growing amount of work relating to the impact of parks on property values (Crompton, 2001b), the literature relating to the proximate influence of greenways is sparse. One of the first studies to analyze the impacts of greenways on adjacent and nearby property values is also the only one to date to calculate their actual dollar impacts on sales prices using multiple regression (also referred to hereafter as "hedonic") methods. Correll, Lillydahl, and Singell's (1978) examination of property values within 3,200 feet of three greenbelts in Boulder, Colorado, revealed that, on average, values fell $4.20 with each additional foot of distance from a greenbelt, a statistically significant decline. The average price of a property adjacent to a greenbelt was $54,379, while the average at a distance of 3,200 feet from such an amenity was only $41,206.

These aggregated figures obscured substantial differences in results among the three trails. While the decline in value with each foot from the amenity was a significant $10.20 in one case, in the second the $3.00 decline per foot was insignificant, while in the third a significant increase of $3.40 per foot from the trail was found. The authors partially explained these differences by the timing and planning of the greenbelt purchases in relation to residential construction around them. In the first case (the $10.20 decline), the greenbelt had been established for four to seven years at the time of the analysis, and had preceded residential development. Moreover, development was planned to take maximum advantage of the greenbelt in terms of neighborhood design and the position of houses relative to the greenway corridor. In the third case (the $3.40 increase), however, the greenbelt was relatively new and separated from nearby residences by a major access road. This road, though not specifically incorporated into the regression analysis, may have been considered a significant disamenity by nearby residents due to noise, traffic and safety concerns. Therefore, the positive relationship between distance from the greenbelt and property price may well have reflected the negative impact of proximity to the road rather than any negative impact of the greenbelt.

The remaining studies of the effects of greenways on property values have been restricted to ascertaining residents' perceptions of these impacts. In addition, most have reported only whether residents thought the greenway had increased, decreased, or had no effect on values and/or salability, rather than indicating impacts in actual dollar terms. Table 1 summarizes the results of these perceptual studies. It illustrates the consistently high proportion of residents, across a diverse range of geographic settings, who considered proximity to a greenway to increase values and/or salability, or to have no noticeable impact, positive or negative. In most cases, less than 10% of respondents felt greenway proximity decreased sales value or salability.

In all but one of the studies reviewed above, results refer to residents' perceptions of properties' values and salability, rather than to actual market conditions. Moreover, most of these studies were not verified by the scientific review process (only two of the papers reviewed appeared in a refereed journal; the remaining studies represent consultant and in-house agency reports,

TABLE 1

Perceived Effects of Greenways on Surrounding Property Values and Salability: A Summary of Results, 1978-1995

				Perceived Impact of Greenway on Property Values or Salability (by proportion of respondents)*		
Author and Year	Study Area	Near or Adjacent?	Values or Salability?	Decreased	No Change	Increased
East Bay Regional Park District (1978)	San Francisco, CA	Adjacent	Values	Trail 1: 7% Trail 2: 4%	Trail 1: 48% Trail 2: 72%	Trail 1: 36% Trail 2: 18%
Puncochar & Lagerway (1987)	Seattle, WA	Adjacent	Values	8%	40%	22%
			Salability	9%	27%	44%
		Near	Values	7%	48%	30%
			Salability	9%	24%	52%
Mazour (1988)	Minnesota	Adjacent	Values	Trail 1: 0% Trail 2: 7%	Trail 1: 50% Trail 2: 31%	Trail 1: 50% Trail 2: 62%
Murphy (1992)	Santa Rosa, CA	Adjacent	Values	8%	69%	23%
			Salability	17%	49%	33%
Moore, Graefe, Gitelson & Porter (1992)	Dubuque, IO	Adjacent	Values	14%	73%	14%
		Near	Values	2%	90%	8%
		Both	Salability	16%	50%	34%
	Tallahassee, FL	Adjacent	Values	11%	74%	16%
		Near	Values	2%	77%	21%
		Both	Salability	12%	50%	38%
	San Francisco, CA	Adjacent	Values	3%	44%	53%
		Near	Values	1%	52%	47%
		Both	Salability	4%	22%	74%

TABLE 1
(Continued)

Author and Year	Study Area	Near or Adjacent?	Values or Salability?	Perceived Impact of Greenway on Property Values or Salability (by proportion of respondents)*		
				Decreased	No Change	Increased
PKF Consulting (1994)	Maryland	Both	Values	7%	30%	63%
Alexander (1995)	Highline Canal	Adjacent	Values	0%	72%	14%
		(SFH)	Salability	0%	57%	43%
		Adjacent	Values	0%	50%	42%
		(TCA)	Salability	8%	42%	33%
		Near	Values	6%	48%	32%
		(SFH and TCA)	Salability	4%	52%	31%
	Weir Gulch	Adjacent	Values	20%	20%	40%
		(SFH)	Salability	20%	20%	60%
		Near	Values	0%	43%	43%
		(SFH and TCA)	Salability	0%	36%	50%
	Willow Creek	Adjacent	Values	0%	0%	100%
		(SFH)	Salability	0%	50%	50%
		Near	Values	9%	47%	35%
		(SFH and TCA)	Salability	0%	50%	50%
Tedder (1995)	Cary, NC	Adjacent	Values	3%	42%	55%

*When proportions do not add up to 100%, indicates some proportion of residents reported they did not know as their answer.
+SFH = single family homes, TCA = townhomes, condominiums, and apartments

and unpublished student theses) and no studies of this issue appear to have been conducted since 1995. As noted by Crompton (2001c, p. 129), "These data are weak surrogates offering only general impressions whose accuracy cannot be verified, rather than the quantifiable dollar impacts that are needed to enlighten the debate."

Since only one analysis of the impacts of greenways on recorded property values is available for review, it is appropriate to briefly consider similar studies of other types of environmental amenity. Brown and Pollakowski (1977) provided one of the earliest such studies, which considered the property value impacts of the existence, and width, of waterfront greenspace in residential neighborhoods in Seattle, Washington. While of interest from a methodological perspective, greenspace located directly adjacent to the water cannot be considered comparable to non-waterfront greenspace amenities. As demonstrated by Nicholls (2002), studies of the impacts of views of, and access to, water-based features such as oceans, rivers and lakes have consistently revealed their effects to be overwhelmingly positive and of significant magnitude, whereas the impacts of non-waterfront greenspace remain far less well established, hence, the focus on this type here.

A handful of studies, e.g., Weicher and Zerbst (1973) and More, Stevens, and Allen (1982, 1988) have used multiple regression methods to calculate the property value impacts of home location proximate to neighborhood-style parks in urban areas. Results were mixed, with impact appearing to depend on the spatial relationship between the park and the property, and the level of use and/or development of the park. Weicher and Zerbst (1973), for example, compared properties adjacent to and facing a park with those adjacent to but backing onto a park, as well as adjacency to different levels of recreational use/development. According to the authors, properties facing developed areas of a park suffered reductions in value due to the loss of a scenic view and its replacement with people, noise, traffic, and so on. Properties facing attractive open space commanded premiums of up to several thousand dollars. However, properties backing onto the same kind of open space were likely to see no change in their value, or a decrease. The authors explained this decline by the loss of privacy and increased disturbance likely to be felt by residents whose back yards adjoin a public park, especially if the area overlooked was more heavily used or tended to serve as a gathering place, particularly for less desirable purposes.

Impacts of proximity to, or views of, traditional neighborhood-style parks may not be the same as those of larger, greener spaces, however, which tend to exhibit lower levels of development and a more diverse range of recreational, aesthetic, environmental and other benefits. Only three studies have analyzed the impacts of larger and/or natural amenities, and, though none are specifically labeled "greenways," their results are of interest here. Hammer et al. (1974) studied the effect of a single, 1,294-acre park on sales prices of 336 properties in Philadelphia. As expected, the relationship between sales price and properties located on corner lots or side-on to the park were positive. However, a negative coefficient was obtained for abutting properties.

These findings support those of Weicher and Zerbst (1973). In both studies, properties adjacent to a park, but separated from it by a street, received gains in their values, while those backing on to a park held their value or suffered a loss. As did Weicher and Zerbst, Hammer et al. attributed this negative effect to the annoyances and disturbances potentially associated with directly adjoining a public use area.

Bolitzer and Netusil (2000) and Lutzenhiser and Netusil (2001) presented analyses of the same set of 16,402 single-family home sales in Portland, Oregon, though using different definitions and categories of greenspace. Bolitzer and Netusil (2000) found that the 193 public parks analyzed had a significant, positive impact on nearby property values; existence of such a park within 1,500 feet of a residence increased its sale price by $2,262 according to a linear regression model, and $845 according to a semi-log form. Property value impact was also found to increase significantly with the size of the amenity. Lutzenhiser and Netusil (2001) found that natural areas (compared to urban parks, specialty parks, golf courses, and cemeteries) had the most substantial positive impact on nearby properties' prices; homes located within 1,500 feet of a natural area enjoyed statistically significant property premiums, of an average of $10,648, compared to $1,214 for urban parks, $5,657 for specialty parks, $8,849 for golf courses, and no significant impact for cemeteries.

Hedonic Pricing

The proximate principle described above can be operationalized and measured using an economic technique known as hedonic pricing. Theoretical foundations for the hedonic pricing method were laid in the 1960s and 1970s by authors such as Lancaster (1966) and Rosen (1974). According to Lancaster, goods themselves should not be regarded as direct objects of utility; rather, Lancaster proffered, utility is derived from the intrinsic properties or characteristics of those goods. Only by recognizing such multiple characteristics, Lancaster argued, can the many intrinsic qualities of individual goods be incorporated into analyses.

Rosen (1974) expounded upon Lancaster's suggestions, specifying a model in which, "Observed product prices and the specific amounts of characteristics associated with each good define a set of implicit or "hedonic" prices" (Rosen, 1974, p. 34), and the total value of a good therefore depends upon the quantities of each of the various utility-bearing attributes that constitutes it. This model consists of a vector of a good's characteristics, $z = (z_1, \ldots, z_n)$, and an hedonic function, $p(z)$. The hedonic model is operationalized through use of classical multiple regression techniques in which prices of the good of interest are regressed on measures of its attributes. Regression coefficients can be interpreted as implicit marginal prices of, or willingness to pay for, these attributes.

According to the hedonic approach, the factors that influence property prices can be divided into up to six broad groups of characteristics: (i) physical or structural features of the individual property; (ii) neighborhood conditions; (iii) community conditions; (iv) locational factors; (v) environmental factors; and (vi) macroeconomic market conditions at the time of sale. These factors, with examples of each, are represented as a model diagram in Figure 1. The price of a property at any point in space and at any given time is, therefore, a result of complex interactions between multiple individual attributes within each of the six broad groups of influences identified.

The regression model used to empirically estimate attribute prices may be expressed as:

$$P = \beta_1 + \beta_S X_S + \beta_N X_N + \beta_C X_C + \beta_L X_L + \beta_E X_E + \beta_T X_T + \mu \qquad (1)$$

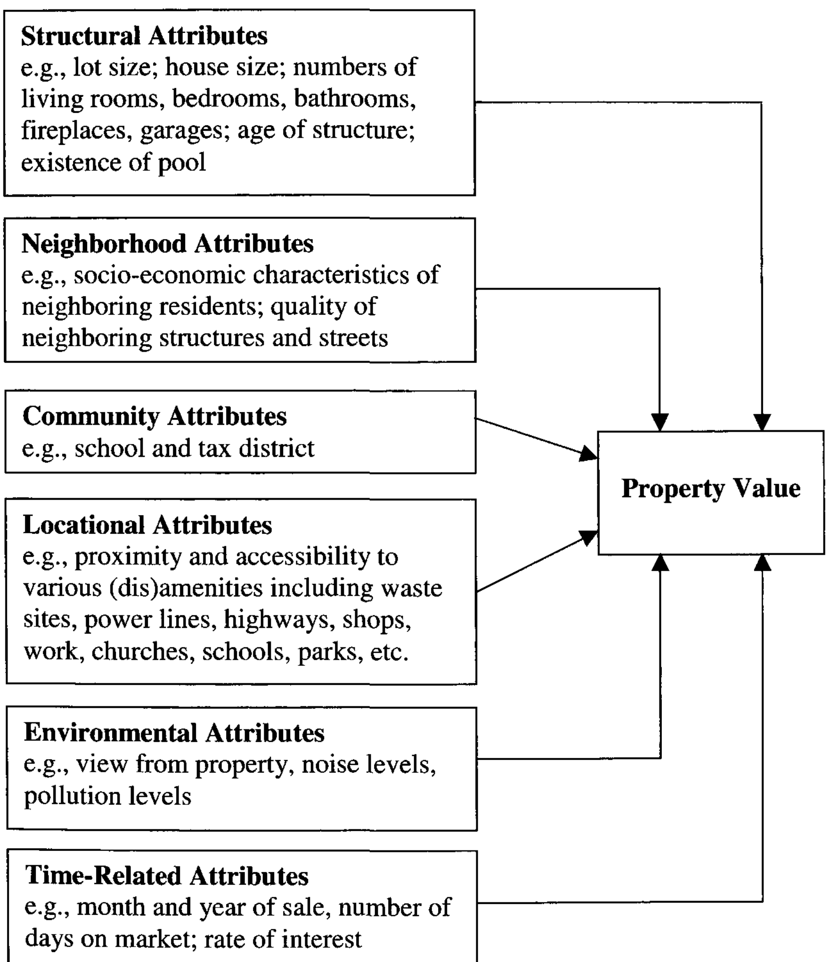

Figure 1. Diagrammatic representation of hedonic property value model.

where: P represents observed property prices; X_S is the vector of structural attributes; X_N is the vector of neighborhood attributes; X_C is the vector of community attributes; X_L is the vector of locational attributes; X_E is the vector of environmental attributes; X_T is the vector of time attributes; μ represents the stochastic disturbance term; β_1 represents the constant term; and β_x represent estimates of relevant attributes' implicit marginal prices after differentiation.

The hedonic approach is subject to several assumptions. The property market under analysis is assumed to be at or near equilibrium, and homebuyers are expected to maximize their utility subject to budgetary constraints. The residential area used to model the relationship between property values and their individual components must be treated as a single market for housing services, such that homebuyers are assumed willing and able to choose from among all available properties in that area. Adair and McGreal (1987) empirically demonstrated the need to limit both the extent of the spatial area studied, and the variability of the properties within it, in order to produce more reliable estimates of property attributes' values. Perfect knowledge of the market is assumed amongst both buyers and sellers, and there must also be sufficient variation within each attribute such that the full range of attribute choices is offered. Buyers' perceptions of the existence and quantity of each of these attributes must be constant, the only variations existing between their preferences.

Methods

Study Area

Barton Creek Greenbelt and Wilderness Park in Austin, Texas, was selected for analysis. This 1,771-acre natural area to the west of downtown includes 7.5 miles of multi-use trails, as well as various parking and restroom facilities. Three major residential areas border the greenbelt, and these neighborhoods were each examined separately since each contained a different set of locational amenities for inclusion in the hedonic model.

Study area selection was based on several factors, both theoretical and practical. Relatively homogenous and compact study areas were needed to satisfy the requirements of hedonic pricing theory. The site analyzed consisted of three well-defined neighborhoods (named Barton, Lost Creek, and Travis), clearly separable from other subdivisions either spatially or in terms of residents' and properties' characteristics. Selection of such areas also allowed extraneous community-level characteristics to be controlled for since properties were located within the same geographic sub-areas (such as school and tax zones). Thus, of the six groups of property value influences recognized in the hedonic pricing literature, neighborhood and community variations were not investigated. Selection of the study area was also guided by data availability. Due to the somewhat sensitive nature of property sales information, and the need to obtain large volumes of GIS-ready data, the strategic choice of a study area in terms of pre-existing relationships with relevant agencies greatly facilitated data collection.

Variables

Sales price (adjusted to 1999 levels to account for year of sale) was used as the dependent variable. Independent variables fell in three groups of property value influence (structural, locational, and environmental). Though many potential structural variables exist, in practice their inclusion was subject to their availability from the data provider, the Austin Board of Realtors. Locational and environmental variables included those pertaining to the greenbelt, as well to other amenities within the study area. Table 2 illustrates the variables utilized in the study and includes expectations on the coefficient of each. Sample size was dependent upon the number of properties within each neighborhood sold in the three-year period from 1999 to 2001; sample size equaled 224 properties in the Barton area, 240 in Lost Creek, and 236 in Travis.

As Table 2 suggests, the value of the greenbelt was measured in two ways, to allow estimation of both its aesthetic and recreation/transportation

TABLE 2
Description of Dependent and Independent Variables

Variable Name	Variable Description	Expected Sign on Coefficient	Type of Variable*
SALES	Sales value of property (in dollars)	N/A	C
LOT	Lot size (in square feet)	+	C
AGE	Age of house at time of sale	–	C
HOUSE	Heated area of house (in square feet)	+	C
STORS	Number of stories	+	C
LIVE	Number of living rooms	+	C
BEDS	Number of bedrooms	+	C
BTHS	Number of bathrooms	+	C
FIRES	Number of fireplaces	+	C
GARS	Number of garages	+	C
POOL	Existence of swimming pool	+	D
CDS	Location on cul-de-sac	+	D
CNER	Location on corner lot	–	D
ONGRN	Location on greenbelt	+	D
VGRN	View of greenbelt	+	D
DGEN	Distance to greenbelt entrance (in feet)	–	C
GEN1/2	Greenbelt entrance within ½ mile	+	D
DPSEN	Distance to park-school entrance (in feet)	–	C
DBRN	Distance to bridge to downtown (in feet)	–	C
DHWN	Distance to highway entrance (in feet)	–	C
VPOW	View of power line	–	D
GATED	Location in gated community	+	D
DPREN	Distance to park/recreation area entrance (in feet)	–	C
DSEN	Distance to school entrance (in feet)	–	C

*C indicates continuous variable, D indicates discrete (dummy) variable worth to nearby residents. Aesthetic value was measured using two variables, direct adjacency to the greenbelt and view of the greenbelt (to account for topography in two of the three sub-areas that allowed non-adjacent properties to maintain clear views of the amenity). Physical proximity was also represented in two fashions, a continuous measurement of the distance between each property and the nearest entrance to the greenbelt, and a dummy variable to ascertain the value of location within one-half mile of an entrance. Since these two variables represent alternative formulations of essentially the same concept, they were considered separately rather than adding both to the same regression. Thus, for each study area, two regressions were computed.

All distances to all amenities considered were measured along the street network using a geographic information system (GIS). Alternative measures of distance are available (straight-line to boundary of greenbelt, straight-line to nearest greenbelt entrance, etc.), and comparison of the regression results obtained using each of these measures will form the basis of a future paper. It is argued here, however, that street network distance provides the most realistic measure of separation between two points (house and greenway entrance).

Regression Analysis

Standard multiple regression procedures were utilized. Collinearity between independent variables was identified using correlation matrices; tolerance and variance inflation factors (VIFs) were also examined. Relevant plots of residuals and predicted values were examined for normality, linearity and homoscedasticity. Full correlation matrices and plots are not presented here due to space limitations, though they are available from the first author. Linear forms were found statistically appropriate in all cases. While more complex, non-linear functional forms are available (log-linear, Box-Cox, etc.), only the linear was used since it is the most meaningful and practical to interpret.

Methodological Caveat

As suggested above, greenways offer many benefits, of an environmental, recreational, transportation, aesthetic and health-related nature. Unfortunately, no one method exists with which to measure all such benefits simultaneously. Rather, different methods best suit specific types of advantage. Thus, while hedonic pricing can provide a direct estimate of the value of views of, and proximity to, a greenway, thereby allowing estimation of such an amenity's aesthetic and recreational value for properties and homeowners within the study area delineated, other citizens' values and other types of benefit are ignored. For example, the value of recreational use by residents beyond the study area is not assessed; health benefits associated with physical activity on a greenway trail are not considered; and, environmental and passive use benefits such as the reduction of runoff and erosion, the existence and bequest values of the land and the species supported on it, and aesthetic benefits received by non-local residents (e.g., passers-by on their journeys to and from school or work) are not captured.

Results

Since three sub-areas each containing different locational and environmental amenities were delineated within the broader case study location, and within each distance was conceptualized in two separate fashions, six sets of regression analyses were run. Table 3 illustrates average values for all variables within each sub-area.

Regressions on Continuous Measure of Distance to Greenbelt

The first set of regressions (Table 4) was run using the actual street network distance between each sold property and the nearest greenbelt entrance as the measure of proximity. In all three areas, signs on all statistically

TABLE 3

Average (Mean (Median)) Values of Variables within Each Case Study Area

Variable	Barton Area Average Values (Mean (Median)) $n = 224$	Lost Creek Area Average Values (Mean (Median)) $n = 240$	Travis Area Average Values (Mean (Median)) $n = 236$
SALES	219836.16 (202950.00)	356221.05 (324500.00)	233368.67 (230384.50)
LOT	9909.78 (8539.00)	16943.15 (14330.00)	8961.53 (8800.00)
AGE	42.96 (46.00)	15.31 (17.50)	10.27 (5.00)
HOUSE	1575.03 (1478.50)	2778.19 (2664.00)	2304.64 (2278.50)
STORS	1.28 (1.00)	1.85 (2.00)	1.39 (1.00)
LIVE	1.54 (2.00)	2.04 (2.00)	1.89 (2.00)
BEDS	2.88 (3.00)	4.04 (4.00)	3.64 (4.00)
BTHS	1.73 (2.00)	2.63 (3.00)	2.18 (2.00)
FIRES	0.49 (0.00)	1.14 (1.00)	1.03 (1.00)
GARS	1.06 (1.00)	2.05 (2.00)	2.03 (2.00)
POOL	0.08 (0.00)	0.25 (0.00)	0.07 (0.00)
CDS	0.05 (0.00)	0.25 (0.00)	0.09 (0.00)
CNER	0.21 (0.00)	0.15 (0.00)	0.17 (0.00)
ONGRN	0.04 (0.00)	0.07 (0.00)	0.20 (0.00)
VGRN	0.15 (0.00)	0.50 (1.00)	N/A
DGEN	3219.40 (3149.00)	5244.25 (5709.50)	2623.10 (2078.58)
GEN1/2	0.36 (0.00)	0.15 (0.00)	0.67 (1.0)
DPSEN	2503.13 (2105.00)	N/A	N/A
DBRN	9882.08 (10198.55)	N/A	N/A
DHWN	N/A	5465.25 (5992.00)	8179.66 (8666.67)
VPOW	N/A	0.23 (0.00)	N/A
GATED	N/A	0.09 (0.00)	N/A
DPREN	N/A	N/A	1890.44 (1883.86)
DSEN	N/A	N/A	6230.17 (6127.10)

TABLE 4
Regression Results for Three Study Areas (Continuous Measure of Distance)

	Barton Area				Lost Creek Area				Travis Area			
Variable	β	SE[1]	$t^{(sig)}$	VIF[2]	β	SE[1]	$t^{(sig)}$	VIF[2]	β	SE[1]	$t^{(sig)}$	VIF[2]
Constant	127156.89	21730.61	5.85**	—	81016.56	42610.30	1.90	—	−3636.54	29319.06	−0.12	—
LOT	1.36	0.61	2.22*	1.86	2.30	0.36	6.45**	1.21	4.50	1.13	3.98**	1.56
AGE	−232.21	214.72	−1.08	2.20	−3591.86	781.35	−4.60**	2.76	−2073.75	322.60	−6.43**	3.88
HOUSE	49.39	8.71	5.67**	4.37	63.15	9.99	6.32**	3.14	35.08	7.27	4.82**	4.92
STORS	−2594.70	5544.73	−0.47	1.63	−2682.55	7643.23	−0.35	1.32	−2929.26	4824.12	−0.61	2.13
LIVE	−1789.54	5093.63	−0.35	1.42	7393.28	6239.73	1.19	2.32	457.08	2878.58	0.16	2.03
BEDS	—[3]	—[3]	—[3]	—[3]	−3664.84	6731.26	−0.54	1.81	3206.57	3871.98	0.83	2.10
BTHS	28296.435	5812.41	4.87**	2.52	22147.26	6996.55	3.17**	2.11	23725.86	5252.48	4.52**	1.93
FIRES	−63.457	5310.66	0.01	1.65	6792.29	9844.54	0.69	1.31	4103.48	8846.79	0.46	1.12
GARS	6730.90	2970.18	2.27*	1.38	13302.27	13401.83	0.99	1.29	15574.58	8024.15	1.94*	1.13
POOL	26353.91	9640.04	2.73**	1.31	25259.54	8134.02	3.11**	1.09	−1350.12	6603.58	−0.20	1.12
CDS	−18943.58	10916.50	−1.74	1.10	13056.78	9232.56	1.41	1.41	120.32	6332.85	0.02	1.30
CNER	373.97	6117.23	0.06	1.14	12769.53	10005.16	1.28	1.14	−2418.34	4862.69	−0.50	1.25
ONGRN	44332.19	13880.31	3.19**	1.49	1737.58	16245.06	0.11	1.55	14777.04	4424.89	3.34**	1.20
VGRN	13760.58	8191.02	1.68	1.53	6398.47	8359.98	0.77	1.56	N/A	N/A	N/A	N/A
DGEN	−3.90	2.46	−1.59	1.70	−3.97	1.81	−2.20*	1.44	1.13	2.32	0.63	5.71
DPSEN	1.68	1.75	0.96	1.28	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DBRN	−5.68	0.93	−6.84**	1.56	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DHWN	N/A	N/A	N/A	N/A	−1.76	1.58	−1.11	1.43	0.02	1.28	0.99	3.82
VPOW	N/A	N/A	N/A	N/A	23009.35	9861.07	2.33*	1.55	N/A	N/A	N/A	N/A
GATED	N/A	N/A	N/A	N/A	45753.88	16442.78	2.78**	1.93	N/A	N/A	N/A	N/A
DPREN	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.95	3.31	0.56	4.19
DSEN	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.19	1.29	0.36	3.90
Model	Adjusted R^2 0.73, F 38.69, significance 0.00				Adjusted R^2 0.75, F 40.81, significance 0.00				Adjusted R^2 0.73, F 38.31, significance 0.00			

[1]SE = standard error, [2]VIF = variance inflation factor, [3]Variable excluded due to excessive collinearity, *indicates significance at 0.05, **indicates significance at 0.01

significant structural variables were in the direction expected and they are not elaborated upon further here. In the Barton study area, a property's location directly adjacent to the Barton Creek Greenbelt was associated with a statistically significant, $44,332 rise in property value, representing 12.2% of the average value of all homes adjacent to this amenity and 20.2% of the average of all homes in the Barton area. The variable representing a view of the greenbelt did not reach significance at a 0.05 level. Similarly, distance to the nearest greenbelt entrance had no significant impact on property prices. Distance to the bridge to downtown was significant, however, with each foot of distance from the bridge resulting in a $5.68 decline in value.

In the Lost Creek area, opposite results emerged. While adjacency to the greenbelt had no significant impact on sales value, prices did fall significantly with distance to the nearest greenbelt entrance (by $3.97 a foot). Again, view of the greenbelt was an insignificant factor. Other significant locational and environmental factors were view of the high voltage power line ($23,009 increase in value, representing 5.4% of the average value of all homes with such a view and 6.5% of the average of all homes in the area) and location in a gated community ($45,754 increase in value, 8.2% of the average value of all homes in such a location and 12.8% of the average of all homes in the area). As Table 4 shows, location on the greenbelt in the Travis area had a significant, positive impact on sales prices (of $14,777, 5.7% of the average value of all similarly positioned homes and 6.3% of the average of all homes in the Travis area). View was not an applicable factor in this area since the topography did not allow for non-adjacent properties to enjoy a greenbelt vista. The coefficient on distance between each property and the nearest entrance to the greenbelt was insignificant.

Regressions on Half-Mile Measure of Distance to Greenbelt

Identical regressions were then run for each area, but with a dummy variable to represent those properties located within a half-mile street network distance of the nearest greenbelt entrance. In all three cases, as Table 5 shows, this half-mile distance variable failed to reach significance (the full

TABLE 5
Coefficient on Half-Mile Distance to Greenbelt Variable in Three Study Areas

Area	Unstandardized Coefficients β	Unstandardized Coefficients SE[1]	Standardized Coefficient β	t	Sig.[2]	Adjusted R^2 of Model
Barton	7765.27	6956.75	0.06	1.12	0.27	0.73
Lost Creek	6795.77	10722.83	0.02	0.63	0.53	0.75
Travis	−5082.33	5559.93	−0.05	−0.91	0.36	0.73

[1]SE = standard error, [2]Sig. = significance

regression results are not replicated since there were no substantial changes in the coefficients on any of the other variables). Coefficients on the variable representing adjacency to the greenbelt remained significant and positive in the Barton and Travis areas (at 47397.29 and 14905.83, respectively), and insignificant in Lost Creek. Coefficients on the greenbelt view variable remained insignificant in both relevant cases.

The lack of significance indicated by any of the half-mile dummy terms suggested (to our anonymous reviewers, whom we thank for their suggestions) experimentation with finer increments of distance that represented a compromise between the relatively coarse, half-mile dummy and the very fine, continuous measure discussed above. As a result, a final set of regressions was computed using one-quarter mile increments of distance from the greenbelt. Results (distance dummies only, there were no substantial changes in any other coefficients) are illustrated in Table 6. In each case, the value of location in the quarter-mile bands listed is compared to location beyond the greatest distance given, i.e., beyond three-quarters of one mile in the Barton and Travis areas, and beyond one and one quarter miles in the Lost Creek region. Dummies representing location adjacent to the greenbelt and a view of the greenbelt were excluded from these analyses.

In the Barton and Travis areas, none of the distance bands appeared to be statistically significant. In Lost Creek, in contrast, location within one-quarter mile of a greenbelt entrance was associated with a significant,

TABLE 6
Coefficients on Quarter-Mile Dummy Variables in Three Study Areas

	Unstandardized Coefficients		Standardized Coefficient			
Area	β	SE[1]	β	t	Sig.[2]	Adjusted R^2 of Model
Barton						
0-¼ miles	21433.68	15576.08	0.07	1.38	0.17	
¼-½ miles	17356.81	10782.62	0.10	1.61	0.11	0.61
½-¾ miles	10507.30	8503.79	0.07	1.24	0.22	
Lost Creek						
0-¼ miles	46085.99	18681.44	0.10	2.47	0.01	
¼-½ miles	−45384.40	18416.57	−0.10	−2.46	0.01	
½-¾ miles	−577.69	16302.76	−0.00	−0.04	0.97	0.71
¾-1 miles	28715.08	14247.30	0.09	2.02	0.05	
1-1 ¼ miles	−1397.57	12227.61	−0.01	−0.11	0.91	
Travis						
0-¼ miles	−12770.80	15516.70	−0.08	−0.82	0.41	
¼-½ miles	−17557.04	12016.46	−0.15	−1.46	0.15	0.58
½-¾ miles	−2332.45	11459.71	−0.01	−0.20	0.84	

[1]SE = standard error, [2]Sig. = significance

$46,086 increase in property value, and properties located between three-quarters and one mile away also experienced a significant increase in value, of $28,715. Properties in the one-quarter to one-half mile band saw statistically significant declines in value, however, of $45,384. Substantial declines in adjusted R^2 were seen in the Barton and Travis models (relative to the previous two sets of regressions), though there was little change for Lost Creek.

Discussion

Adjacency to the greenbelt produced significant property value premiums in two of three neighborhoods, though properties with a view of the greenbelt, but that were not directly adjacent to it, saw no significant rise in value in either case where this was a relevant factor. The relationship between distance to the nearest greenbelt entrance and sales price was negative and significant, as expected, in only one instance; in the other two cases, there was no significant association. Location within a half-mile distance of the nearest greenbelt entrance, tested as an alternative conceptualization of the distance variable, failed to reach significance in any area. Similarly, the testing of one-quarter mile increments produced insignificant findings in eight of eleven instances. In no case did visual or physical access to a greenway have a significant, negative impact on surrounding property prices.

Since no other studies were identified which have calculated the effect of greenbelt adjacency on actual sales values, comparison with previous results is not possible. However, the coefficients found do support the opinions of local property owners, that such adjacency is likely to result in either no significant, or a positive, impact on values, rather than in a decrease. The lack of positive impact of greenbelt adjacency in the Lost Creek area is intriguing, especially in light of the significant positive effect of having a view of the high voltage power line which runs through this neighborhood. Though counter-intuitive, this finding might be explained by the dramatic topography and dense vegetation prevalent in this area. Homes directly adjacent to the greenbelt in Lost Creek are in almost all cases located on the edges of deep, thickly vegetated ravines which offer neither recreational access nor especially attractive views. Homes located further back from the greenbelt boundary, and on higher ground, command sweeping views of both Austin and the greenbelt. In many cases, this view also includes the power line. While proximity to a high voltage power line has typically been found to exert a negative or neutral impact on sales values in previous studies incorporating this variable (e.g., Des Rosiers, Bolduc, and Thériault, 1999; Gregory and von Winterfeldt, 1996), in this instance it may be conjectured that the beauty of the green space in the majority of the viewshed outweighs the intrusion of the power line into a portion of it. The finding of significant positive impacts of greenbelt adjacency in the other two study areas also fits the argument that physical characteristics may be influential; in both the Barton and Travis areas, the topography is less steep and the vegetation consists of more mature oak trees and open grassy areas, and less dense scrub. Thus, adjacency to the greenbelt in the Barton and Travis areas might imbue more, or more obvious, visual advantages on homeowners than does adjacency in Lost Creek.

The finding of substantial positive impacts associated with greenbelt adjacency in the Barton and Travis areas, which was, in all cases, represented by properties backing onto the amenity, does contradict the findings of Weicher and Zerbst (1973) and Hammer et al. (1974), who both found backing onto large parks to have no impact on, or reduce, property values. In the present study, however, the amenity under consideration typically exhibits very low levels of development, and use tends to occur at some distance from adjoining properties, whereas the previous studies' sites were both relatively developed and subject to higher levels of use. The significance of physical adjacency to the greenbelt as the primary source of positive property value impact in the Barton and Travis areas, compared to other forms of proximity, is further illustrated by the lack of significance of the quarter and half-mile dummy variables, as indicated in Tables 5 and 6.

At the time of investigation (2001-2002), the number of properties located adjacent to the Barton Creek Greenbelt equaled 157 in the Barton area and 452 in the Travis area. Thus, the economic impact, in terms of increased property values on which additional property taxes can be levied, of the Barton Creek Greenbelt can be estimated at $13.64 million ($6.96 million in the Barton area and $6.68 million in the Travis area, based on the lower of the two coefficients reported for this variable in each area, depending on measure of distance used). These calculations include neither the effects of new construction in either of these areas since the analyses were conducted, nor any impacts on properties located in neighborhoods adjoining the greenbelt that were not selected for study, of which there are several. Moreover, they include only impacts on directly adjacent properties, with no consideration of non-adjacent users. Hence, the current value of the greenbelt, in terms of its positive impact on all local property values, may be substantially larger than that suggested.

Correll et al. (1978) explained their greenway distance findings (of a significant decline in value with distance in one case, an insignificant relationship in the second case, and a significant increase in the third) by the timing and planning of the greenbelt purchases in relation to residential construction around them. In Austin, all residential construction has occurred around the greenbelt, hence this explanation is irrelevant. While the Lost Creek area did exhibit the expected relationship, a significant, $3.97 decline in property value with each foot from the nearest greenbelt entrance, in Barton and Travis the coefficient on the distance variable appeared insignificant. Potential explanations are as follows.

In the Barton area, neither distance to the greenbelt nor distance to the park-school recorded significant results. Distance to the bridge to downtown Austin was highly significant, however. Since Barton was the closest neighborhood to downtown examined, and based on the availability and popularity of alternative forms of transportation in this city, it may be that Barton residents tend to be downtown workers who like to walk or bike to work. In this case, distance to downtown would be an important factor to them. Moreover, the Barton neighborhood enjoys easy access to many green spaces besides the greenbelt, which may dilute the value of proximity to this specific amenity. The City of Austin prides itself on its open space amenities, describing itself as a "City Within a Park" (Austin Parks and Recreation Department, 2001), and the downtown area is particularly well served with outdoor recreational opportunities.

The Travis results appear less simple to explain. Other than location adjacent to the greenbelt, no locational variables appeared to have a significant impact on property values. Closer examination of a map of the area revealed one potential problem with the dataset, however. The distance variable was computed by measuring the street network distance between each sold property and the nearest official entrance to the greenbelt. In Barton and Lost Creek, identification of official entrances was enabled by the physical layout of the greenbelt; in Barton, the belt is fenced and entry is only possible at designated points, while in Lost Creek entry at points other than signed entrances is prevented by the steep terrain and dense vegetation. In the Travis area, however, the topography is gently undulating and there is no fence around the greenbelt. Entry is possible at multiple points along the greenbelt boundary. Thus, consideration of official entry points only may have distorted the results. Given the size of the neighborhood and number of potential places of entry, a more accurate representation of use would only be possible through observation or surveying, activities beyond the scope of this study. Nevertheless, these findings do highlight the influences that variables such as topography, vegetation and use patterns may have on the value of a green space amenity to local residents, and suggest the need for careful field observation of the spatial relationships between green spaces and properties.

Conclusion

Empirical assessment of the extent to which greenways impact property values and, hence, the local tax base is an important contribution to the debate on their economic effects. Though previous research has demonstrated more support than opposition among residents' and realtors' perceptions of the impact of greenways on property value and salability, only one analysis based on actual sales prices has been reported in the literature. The analyses presented here suggest that greenways may indeed positively affect proximate properties' sales prices, in the most positive case to the extent of one fifth of value, resulting in millions of dollars of increases in prices and subsequent enlargement of the property tax base.

As demonstrated by Little (1990), linear green spaces, of which greenways are a prime example, maximize the number of properties that can be positioned adjacent or nearby to them. As a result, a higher number of properties' values are enhanced and the impact on the property tax base is greater. In addition to the multiple environmental, social, aesthetic, health and recreation benefits they provide, greenways can also be considered highly efficient from an economic standpoint. From the perspective of urban planning, such amenities should, therefore, be recognized as valuable components of well-designed urban areas.

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