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Impacts of Regional Parks on Property Values in Texas

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EXECUTIVE SUMMARY: The ability to place dollar estimates on the values and benefits provided by parks is becoming increasingly vital to public park providers as competition for local, state, and national resources continues to intensify. One way of calculating at least a portion of this value is the hedonic pricing method, a technique that enables the estimation of the impact of one or more parks on the prices of surrounding properties. In this study, the hedonic pricing method is applied to four large parks in Bastrop County, near Austin, Texas. The study of the property price impacts of regional and rural, rather than traditional urban, parks has been especially limited in the literature, yet it is these spaces that are often most at threat from continued suburbanization and other forms of urban sprawl.

Analysis of the four parks—both individually and as a group—revealed that these large, public open spaces had no statistically significant impact on property prices in the rural county in which they are located. Potential explanations for this lack of significance include the relatively large amount of undeveloped open space (whether publicly or privately owned) in the area, as well as the rather large size of lots compared to those in the typical American city. Combined, these factors suggest that the premium associated with living in close proximity to a public open space in a predominantly rural area might be limited by the large supply of this commodity. As suburban development continues to spread outward from Austin, however, and the quantity of truly rural land continues to be diminished, it seems likely that the willingness of Bastrop County residents to pay a property price premium for a home proximate to one of the four parks analyzed may increase. Longitudinal analysis of the magnitude and composition of property prices over an extended period would enable closer examination of this hypothesis. For land managers, whether working in urban or rural settings, these results suggest the need to carefully monitor changes in the amount and distribution of public open space available to their constituents. The association of public open space with an increase in surrounding property prices also provides a useful argument in favor of the designation or continued protection of such spaces, most notably as a result of the increase in property tax revenues that they generate for the local taxing entities.

KEYWORDS: Regional parks, property prices, hedonic analysis

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Introduction

The benefits of parks and other open spaces to society are many and varied, pertaining to numerous aspects of our everyday lives (see, e.g., Crompton, 2001a; Drescher & Franco-Wills, 1997; Woolley, Rose, Carmona, & Freedman, 2004). From an environmental perspective, green spaces may help mitigate flood hazards, reduce erosion, filter pollutants, provide shade, lessen local air temperatures and noise, and screen unattractive views (Dwyer, McPherson, Schroeder, & Rowntree, 1992). They also serve as habitat for wildlife, outdoor classrooms for students of all ages, and field laboratories for researchers. Parks and public open spaces provide opportunities for recreation, whether active or passive, organized or spontaneous, and engaged in individually or in groups. Research also suggests that trees and greenery help build stronger neighborhoods in which residents interact more often, develop closer community ties, and feel safer (Kuo, Sullivan, Coley, & Brunson, 1998).

Visits to parks and other natural areas have been shown to offer numerous psychological and physiological benefits, as first identified by Ulrich (1981) and Ulrich and Addoms (1981) and more recently reaffirmed by, for example, Godbey, Roy, Payne, and Orsega-Smith (1998) and Parsons, Tassinary, Ulrich, Hebl, and Grossman (1998). The ability of parks and open spaces to help improve mental and physical fitness may also contribute to reduced health care costs, an issue of increasing concern in contemporary U.S. society. Assessment of the relationship between access to park and recreation amenities, physical activity, and human health is reflected in the rapidly growing active living research literature (e.g., Huston, Evenson, Bors, & Gizlice, 2003; Powell, Martin, & Chowdhury, 2003, Sallis, Bauman, & Pratt, 1998; U.S. Department of Health and Human Services, 1996).

Linear green spaces, or greenways, offer extended lengths of trail for recreation and exercise, as well as alternative, nonmotorized routes of transportation between home, work, and other community facilities (Morris, 2002; see also the special issue dedicated to greenways in *Landscape and Urban Planning*, volume 68, issues 2-3, May 2004). Large green spaces on the urban fringe, greenbelts, serve as barriers to urban sprawl and provide clearer delineations between the city and surrounding rural areas. Benedict and McMahon (2002) use the term “green infrastructure” to describe the interconnected network of natural places in both urban and rural settings whose protection they believe crucial to the success of future land conservation and smart growth efforts.

The existence of an attractive system of green spaces within a community has also been linked to a variety of economic benefits (see, e.g., Lerner & Poole, 1999; Crompton, 2001a). Research has shown that such amenities help attract new residents, as well as leisure visitors and retirees, all of whom can have a substantial economic impact on an area. Similarly, the availability of an attractive parks and recreation system can be a significant influence on the (re)location decisions of footloose firms (Crompton,

Love, & More, 1997). Park systems also employ local people and generate revenue through concessions and user fees. According to research commissioned by the American Farmland Trust (Miller, 1992) and replicated by, for example, the Commonwealth Research Group (1995), open space can play an integral role in a community's fiscal well-being. Specifically, Miller analyzed the costs and revenues associated with the provision of community services across three broad land use categories (residential, commercial / industrial, and farm / forest / open space) in 58 communities in 18 different states. This analysis revealed that the median cost, per dollar of revenue raised, to provide public services in these 58 communities was $0.29 for commercial / industrial, $0.37 for farm / forest / open space, but $1.15 for residential, suggesting that maintaining open spaces may be more preferable from an economic perspective than encouraging residential development, since the cost of servicing them is substantially lower.

While the many environmental, social, recreational, health, and economic benefits of the existence of parks and open space are easy to describe in qualitative terminology, many are much harder to value quantitatively. Yet, in the face of continued fiscal cutbacks, and especially in light of recent world events that have placed a new emphasis on public safety and security, it has become increasingly critical for public service providers to be able to substantiate their worth to communities in economic terms. For park and recreation providers, this entails the ability to place dollar values on the many benefits noted above.

One method of estimating at least a portion of the benefits generated by the existence and use of green spaces is through their impacts on surrounding property values. The property value approach to the analysis of one or more parks' economic impact assumes that the benefits associated with these amenities are capitalized into surrounding property prices, what Crompton (2001b, 2004) calls the proximate principle. In fact, real estate prices reflect the aggregate value of all locational advantages and disadvantages of a home's site, with the benefits (positive externalities) associated with desirable amenities or land uses balanced against the costs (negative externalities) of undesirable uses. As such, home prices are assumed to provide a measure of homeowners' preferences regarding proximity to a variety of amenities, including work, shopping centers, schools, and parks (Millington, 1994).

In a review of the empirical evidence relating to the proximate principle (the potential willingness of home buyers to pay a property price premium for a property located in close proximity to an open space or park), Crompton (2001b) concluded that only 5 of the 30 studies examined were not supportive of this principle. Further, his analysis suggested that some of these atypical results were attributable to methodological deficiencies rather than the park itself. However, only 5 studies were identified in the review as relating to nonurban areas, and, as he observed, findings relating to urban or suburban settings may not be useful for generalizing to rural contexts. As he noted:

> State and national parks typically are not established and operated primarily to provide benefits to local residents. Their mandate is much broader so their economic contributions are likely to arise from visitor expenditures in the area, rather than be captured in proximate real estate values. Nevertheless, it seems likely that the proximate principle will apply, at least in some cases, even though such an impact may be perceived as incidental to the mission of these parks. (p. 22)

Some of the equivocation expressed in this conclusion probably relates to basic economic rules that govern the production of goods. Like all other goods, the premiums that people are prepared to pay for a property proximate to a park or open space are likely to be influenced by the available supply of this commodity, i.e., the number and total acreage of parks and other public open spaces. If such amenities are relatively abundant, that is, the supply is good, then the premiums are likely to be relatively small or nonexistent. Thus, in rural areas there may be no need to pay a premium because land is relatively abundant, thereby facilitating the purchase of relatively large home lots with extended private yards. This contrasts with urban areas where space is limited, lot size tends to be reduced, and demand for access to public open space is likely to be heightened. In addition to the tendency for larger lot sizes in rural areas, the informal use of privately owned, undeveloped open space is also more likely, again increasing the supply of open space in rural areas relative to urban communities. The scarcity of open space in urban areas is therefore likely to increase both the price of land and the premium payable for a home proximate to a park or open space more than in rural settings.

Review of Literature

Impacts of Large, Rural Parks on Property Values

Analyses of the impacts of open spaces on surrounding property values and the local government tax base remain relatively scarce. A comprehensive review of the literature revealed fewer than 40 such studies since 1939 (Nicholls, 2002). These studies covered a range of open space types, from children's playgrounds and traditional neighborhood parks, to greenways and golf courses. Large regional, state, or national parks, however, emerged as especially understudied. Indeed, only 7 analyses addressing this type of park were located, the most recent of which was published in 1996. Table 1 summarizes their study areas and findings.

One of the earliest studies of the property value impacts of large rural parks is also indicative of the relatively rudimentary analysis techniques often utilized through the 1970s (Epp, 1971). The study focused on the impact of 15 parkland acquisitions by the U.S. Army Corps of Engineers and Pennsylvania State Parks on the aggregate values of property in the townships in which they were located. Assessed property values were tracked for an 11-year period commencing 5 years prior to the park land acquisitions. The aggregate value of property in the townships in which the

Table 1
Impacts of Regional Parks on Property Values and Property Tax Bases: A Summary of Previous Studies

Author(s)	Year	Study Area	Amenity(ies)	Impact on Property Values and/or Tax Base
David	1968	Wisconsin	Public land	Adjacency had a significant positive impact on land value
Barron & Jansma	1970	Pennsylvania	Public land	Increases in the amount of public land had no negative impact due to removal of property from the property tax base
Epp	1971	Pennsylvania	Fifteen state parks and their land acquisitions	Location in a township containing a park was associated with an increase in value; the loss of taxable land caused by the establishment of these parks was more than offset by the increases in value on the remaining residential properties
Vrooman	1978	New York	One state park	Adjacency had a significant positive impact on land value
Gamble & Downing	1982	New England	State parks	Significant decline in value with distance
Brown & Connelly	1983	New York	Six state parks	Significant decline in value with distance in two cases, insignificant relationship for other four parks
Gartner, Chapelle, & Girard	1996	Michigan	Public land	Adjacency had a significant negative impact on property values

parks were located was compared to a control sample, the value of all other properties in the counties in which they were located. It was assumed that the control areas represented the property values that would have prevailed had the parks not been acquired. No consideration was paid to any other characteristics of the properties that might have influenced their value over the time period analyzed.

To enable comparison across areas and through time, a dollar value index was created with a value of 100 at the year of acquisition. In the 5 years prior to acquisition, the average value of the index for the 15 townships in which parkland would later be acquired was 84, while the average value in the control areas was 90. In the 5 years following acquisition, these averages rose to 115 for the townships and 108 for the control areas, suggesting to the author that the parks had a positive impact on the value of land surrounding them. Epp then used these results to demonstrate that the loss of taxable land caused by the establishment of these 15 parks was more than offset by the increase in value on the remaining properties and, thus, that there had been no negative impact on local government revenue. This finding supported that of Barron and Jansma (1970), who showed that increases in the amount of public land in a three-county area of northwestern Pennsylvania had no negative impact on the fiscal capacity of local government due to removal of part of the property tax base.

Vrooman (1978) investigated determinants of private land values around Adirondack Park, New York. He analyzed prices of 284 pieces of vacant, forested property sold between 1971 and 1973 using linear

multiple regression analysis, a technique that enabled consideration of a variety of potential influences on value and removed the need for a control area against which to compare the sites of interest. This analysis allowed Vrooman to determine that parcels adjacent to state-owned land fetched up to $20 more per acre than did parcels adjacent to private property. Other significant influences on land value identified by the regressions were accessibility, topography, and land use classification, though the explanatory power of these models were quite low (R^2 did not exceed .60).

David (1968) and Gartner, Chapelle, and Girard (1996) both incorporated a measure of the impact of adjacency to public lands on property values in their analyses of Wisconsin and Michigan, respectively. David's study indicated that, while property was in general more expensive in areas where there were no publicly owned lands nearby, the most expensive private properties were located adjacent to public lands. Gartner et al. found that adjacency to public land had an unexpectedly negative impact on private property values. They attributed this result to trespass problems associated with living next door to land on which the public was free to recreate, as well as to the tendency of residents in the area to prefer not to be too secluded. Survey results indicated that most respondents in the area desired relatively close contact with neighbors, rather than to be surrounded by unoccupied land.

Brown and Connelly (1983) compared the effects of six state parks in New York (Green Lakes, Saratoga Spa, Cumberland Bay, Watkins Glen, Keewaydin, and Wellesley Island), ranging in location from suburban to rural and in size from 180 acres to 2,636 acres, on surrounding residential property values. Both correlations and regressions were run on sales prices of properties within 10 miles of each facility; the independent variable of interest in each case was distance to the park. For four of the six parks (Green Lakes, Saratoga Spa, Cumberland Bay, and Wellesley Island), no relationship was found between distance to the park and selling price. The authors attributed this result to the fact that many of the lots analyzed were relatively large and included recreational facilities such as swimming pools. Proximity to a state park did not, therefore, have a large enough influence on values beyond lot and house characteristics to enter the regressions, the authors conjectured.

In the other two cases, the relationship between park distance and sales price was negative and significant, indicating decreasing values with increasing distance from the park. While statistically significant, these declines were not substantial, however. Prices around Watkins Glen State Park decreased by $50 with each additional 100 feet of distance from this amenity; around Keewaydin State Park, the decline was $72 per 100 feet. Both parks were situated in rural areas where lots were in general likely to be relatively large, a situation similar, therefore, to the other four parks Brown and Connelly analyzed. The authors explained the significance of distance to these two parks by their higher levels of local usage compared to local use levels at the other four facilities.

Gamble and Downing (1982) included a similar "distance to state park" variable in their study of property values around nuclear power plants in New England. Linear regression results indicated a $350.37 decline in price with each mile property was located from the park. This amount equates to a decrease of $6.64 per 100 feet, a considerably smaller estimate than Brown and Connelly's.

Impacts of Other Large Open Spaces on Property Values

Given the limited number and inconclusive nature of those studies assessing the property price impacts of large public parks in rural areas, review of the evidence with respect to other large open spaces would appear warranted. Large public parks in urban areas, and large nonpark open spaces in suburban and rural areas, are considered.

Large urban parks. To the authors' knowledge, only four studies have analyzed the impacts of large natural areas in urban communities. Hammer, Coughlin, and Horn (1974) studied the effect of a single 1,294-acre park on sales prices of 336 properties in Philadelphia. They found a positive relationship between sales price and properties located on corner lots or side-on to the park but a negative coefficient for abutting properties. The authors attributed this negative effect to the annoyances and disturbances potentially associated with residing directly adjacent to a heavily used public area.

Bolitzer and Netusil (2000) and Lutzenhiser and Netusil (2001) both assessed the impacts of various types of green spaces on 16,402 single-family homes in Portland, Oregon. Bolitzer and Netusil's (2000) consideration of the impact of 193 public parks, 2 private parks, 8 golf courses, and 15 cemeteries (of all sizes) on the prices of these 16,402 homes indicated that the existence of an open space within 1,500 feet of a residence significantly increased its value, by an average of $2,105. The property value impact was also found to increase significantly with the size of the amenity; each additional acre of open space increased sales price by $28.33.

Lutzenhiser and Netusil (2001) further differentiated the open spaces in the study area, allowing comparison of the premiums associated with natural areas, traditional urban (neighborhood) parks, specialty parks, golf courses, and cemeteries. Of these 5 types, natural areas had the most substantial positive impact on nearby properties' prices; homes located within 1,500 feet of a natural area averaged an increase in price paid of $10,648, compared to $1,214 for urban parks, $5,657 for specialty parks, $8,849 for golf courses, and an unstated (and statistically insignificant) impact for cemeteries. Further analysis suggested that a natural area would have to exceed a size of 258 acres in order to maximize its positive property price impact. While relatively large in an urban context, such an area is not necessarily directly comparable to the typical regional or state park, which may reach into the thousands of acres.

Most recently, Nicholls and Crompton (in press) investigated the impact on property prices of Barton Creek Greenbelt and Wilderness Park,

a 1,771-acre natural area to the west of downtown Austin, Texas. Their analysis suggested that this amenity can have significant positive impacts on proximate properties' sales prices. Adjacency to the greenbelt produced significant property premiums in two of the three neighborhoods analyzed, of over $44,000, or 20% of the sales price, in one case and close to $15,000 (6%) in the second case. Physical access had a significant, positive impact in one case but was insignificant in two others. No negative impacts were recorded.

Large (nonpark) open spaces in suburban and rural areas. Willis and Garrod (1992, 1993) investigated impacts of three different types of woodlands (broadleaved, larch and pine, and all other conifers) on the values of 1,100 homes throughout Great Britain. Only properties located in the same one-kilometer Ordnance Survey grid square as Forestry Commission woodlands were selected, and the impact on values of a 1% increase in the proportion of each type of woods within the area was assessed. A statistically significant positive impact of £42.81 per property was recorded for the addition of an extra 1% of broadleaved woodland, while a one-unit increase in the presence of conifers resulted in a significant, £141 decline in observed price. While Forestry Commission land may be open to public usage, it does not, however, afford the same range of recreational opportunities as more open public lands. Thorsnes (2002) also reported the impacts of proximity to forested land on residential sales values, in this case three suburban forest preserves in Grand Rapids, Michigan. His analysis suggested that vacant lots backing onto the preserves sold for premiums of $5,800 to $8,400, or about 7%, representing 19 to 35% of lot prices.

Several authors have investigated the impacts of wetlands on the sales prices of properties. Doss and Taff (1993) found a statistically significant positive relationship between proximity to scrub shrub and open water wetlands, and property values in Ramsey County, Minnesota. Proximity to forested and emergent vegetation wetlands had a negative impact on nearby property prices, however. Similarly, Mahan, Polasky, and Adams (2000) analyzed the sales price impacts of various wetlands, in this case in Portland, Oregon. They found that increasing proximity to a wetland, as well as an increase in the size of that wetland, both had a positive impact on sales value. Again, while of interest, these findings cannot be related directly to those that have analyzed publicly accessible, parklike open space, due to the differences, in visual character, accessibility, and the range of recreational opportunities provided, between these different open space types.

Hobden, Laughton, and Morgan (2003) provide evidence of the impacts of various types of green space on four suburban neighborhoods in Surrey, British Columbia. Their analyses suggested that most types of green space do have a positive impact on adjacent property values. The largest positive impact was found for green space with a pathway; the largest negative impact, in contrast, was indicated for green space with an easement. This study did not address the impact of distance to the green

space, however, since direct adjacency was the only form of proximity considered.

Summary of Literature and Study Rationale

Based on the results of the studies explored, it appears that the property price impacts of proximity to larger parks in rural settings remain unclear. Advantages such as country-like views and access to recreational opportunities appear to be counteracted in some instances by problems such as trespass, as well as residents' desire for relatively close human contact. In addition, lots in rural areas tend to be larger, thus offsetting to some extent the direct benefit of the large supply of open space nearby. Yet it is these larger parks, often located at the fringe of urban areas or in the rural hinterland, that are at the greatest risk from development pressure as suburban expansion continues.

The rate of land development in the United States is faster today than ever before. As noted by Benedict and McMahon (2002), 2.3 million acres of open space were converted to single-family housing each year between 1993 and 1997. Further, "between 1982 and 1997, the amount of urbanized land in the United States increased by 47 percent . . . During this same period, the nation's population grew by only 17 percent" (The Brookings Institution, as sited in Benedict & McMahon, 2002, p. 10). These figures suggest a powerful paradox in U.S. society, as noted by Hobden, Laughton, and Morgan (2003), namely, that as the desire among American citizens to live in a county-like setting without immediate neighbors increases, so the development pressure on these same open spaces is also set to rise.

According to Benedict and McMahon (2002), the key to both sustainable community growth and effective conservation lies in the concept of green infrastructure, which itself involves a proactive, systematic, multifunctional and large-scale approach to land conservation and which "repositions open space protection from a community amenity to a community necessity" (p. 3). Fundamental to a complete and successful green infrastructure system are "hubs," medium- to large-sized natural areas, such as state parks and regional preserves, which are then linked or connected by natural corridors. At a minimum, suburbanization and other forms of sprawling development place increasing levels of environmental stress on the land surrounding regional park amenities; at worst, it may lead to fragmentation of habitat (which reduces plant and animal diversity and degrades ecological quality) and ultimately cause such spaces to fall victim to development themselves. Thus, further analysis of these areas, including assessment of the positive economic impact they may offer to surrounding communities and comparison of this impact with those of alternative land uses, seems highly warranted.

Analysis of property prices and calculation of the proportion of that price attributable to the availability or proximity of public open space is an important means of assessing the perceived level of supply of public open space within an area, as demonstrated by the willingness of local residents

to pay a premium price for a property that possesses that characteristic. In cases where residents do appear willing to pay such a premium for residential properties located in close proximity to public open space, it is then possible to calculate the contribution of the existence of these spaces to the local property tax base, and to compare this contribution to the cost of their acquisition and maintenance. In cases where the contribution to the tax base exceeds the cost of acquisition (and maintenance), protection of the open space can be considered to imbue a direct and positive economic impact on a community.

In response to the small number of relatively dated studies addressing the property price impacts of larger public open spaces, and recognizing the potential for various methodological improvements made possible by advances in statistical and geospatial techniques, the purpose of this study was to ascertain the effect on surrounding property prices of four regional parks in Bastrop County, Texas. In the next section, the methods employed in this study are discussed, including a more complete description of the study area and of the hedonic pricing technique used in the analysis. This is followed by presentation of the study's results. The paper concludes with a discussion of these findings, their implications, and suggestions for future research.

Methods

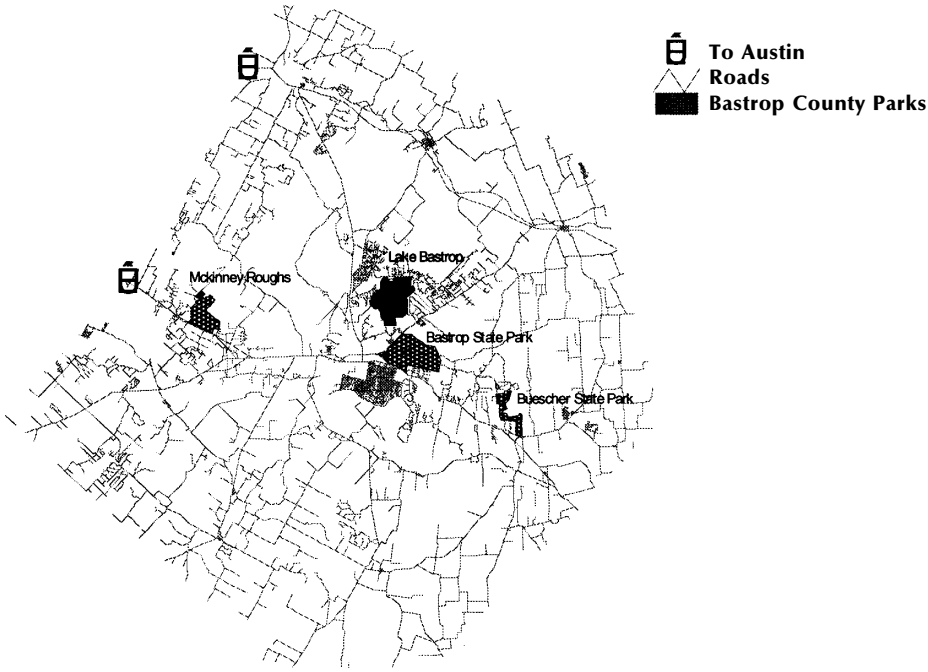
Study Area

Bastrop County is located southeast of the city of Austin and was home to approximately 58,000 residents at the 2000 census (U.S. Census Bureau, n.d.). The county contains two large open space facilities operated by the Lower Colorado River Authority, Lake Bastrop and McKinney Roughs, and two state parks, Bastrop and Buescher (Figure 1). Lake Bastrop offers two separate recreational sites on the 906-acre lake, at the North and South Shores Parks. Both offer access to boating, fishing, swimming, hiking, and picnicking, as well as overnight camping. McKinney Roughs Nature Park is an 1,100-acre preserve incorporating 16 miles of trail and an Environmental Learning Center; it offers day use only. Daily entry fees are $3 per adult at both Lake Bastrop and at McKinney Roughs (Lower Colorado River Authority, 2004). Bastrop and Buescher State Parks comprise 4,521 acres (3,504 acres at Bastrop and 1, 017 acres at Buescher), and are linked by a 12-mile scenic route. Both parks offer a full range of outdoor recreational activities, including an 18-hole golf course and swimming pool at Bastrop. The standard entry fee for a single day's use is $3 per adult (Texas Parks and Wildlife Department, 2004).

The Hedonic Pricing Method

Calculation of the proportion of a home's price attributable to its location relative to a green space is possible using an economic technique known as the hedonic pricing method (HPM). This approach is based on the concept that goods themselves are not regarded as direct objects of

Figure 1
Bastrop County Parks



utility; rather, as suggested by Lancaster (1966) and further developed by Rosen (1974), utility is derived from the intrinsic properties or characteristics of those goods. Thus, the price of a home can be disaggregated according to the various utility-bearing attributes that constitute it, and a value estimated for each. The price paid for the home therefore represents the individual prices and quantities of each of the various utility-bearing attributes that it exhibits.

The factors that influence property prices can be separated into six broad categories of characteristics: (i) physical or structural features of the individual property, for example, lot size; house size; numbers of living rooms, bedrooms, bathrooms, fireplaces, and garages; age of structure; and existence of a swimming pool; (ii) neighborhood conditions, for example, socioeconomic characteristics of neighboring residents and the quality of neighboring structures and streets; (iii) community conditions, for example, school and tax districts; (iv) locational factors, for example, proximity or accessibility to various (dis)amenities including waste sites, power lines, highways, shops, work, churches, schools, and parks; (v) environmental factors, for example, the view from the property, and levels of pollution and noise; and (vi) macroeconomic market conditions at the time of sale,

for example, the month and year of sale, number of days on market, and interest rate.

The hedonic model is operationalized using standard multiple regression techniques in which property prices are regressed on measures of these properties' attributes. The regression model used to empirically estimate the prices of properties' attributes may be expressed as:

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

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 represents estimates of relevant attributes' implicit marginal prices after differentiation. Regression coefficients are thus interpreted as implicit marginal prices of, or willingness to pay for, each of the individual attributes considered in the regression.

The hedonic approach is subject to several assumptions. The property market analyzed is assumed to be at or near equilibrium (i.e., supply and demand are approximately matched), and home-buyers are expected to maximize their utility subject to budgetary constraints. Home-buyers are assumed willing and able to choose from among all available properties in the area analyzed, that is, it is treated as a single market for housing services. Buyers and sellers are assumed to possess perfect knowledge of the market, and there must 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 are assumed constant, with the only variations existing between their preferences for a particular bundle of home characteristics.

Data and Analysis

The dependent variable in this study was the selling price of the homes analyzed. The independent variables used included attributes (i) relevant to the study area, in terms of the amenities that might have an influence on house prices, and (ii) that could either be obtained from a relevant source or computed using existing data.

Sales data for all properties sold in Bastrop County in the years 2000 and 2001 were provided to the researchers by the Austin Board of Realtors. During this period, 559 single-family homes were sold, of which 380 were included in the analyses. In addition to multiple cases of incomplete data, approximately 20 homes were excluded so as to reduce the skewed nature of the independent variables' distributions. Only homes up to 100 years of age and on lots up to 10 acres were included in the analyses. Year of sale was entered as a dummy variable, with properties sold in 2000 the base (0) case against which sales in 2001 were compared. Community condition was represented by the school district in which each home was located (Bastrop, Elgin, or other).

Bastrop County does not contain any major amenities or facilities that might be expected to impact property values significantly besides the four open spaces under consideration. Its main locational advantage is its proximity to the city of Austin; thus, the distance between each property and Austin was calculated for entry as an independent variable. GIS layers (of streets, property lines, and the four open spaces) were obtained from the Bastrop County Appraisal District. All spatial analyses were carried out in ArcView GIS version 3.2.

Each home's proximity to each of the four parks under consideration was measured in a straight line from the park's boundary. While the actual travel distance, as measured along the street network, would have been a preferable measure, the quality of the GIS layer provided was of insufficient quality to support this type of analysis. There were insufficient cases of direct adjacency to one of the green spaces to enable consideration of adjacency as a form of proximity. In addition to each home's distance to each park, two additional proximity measures were recorded: distance to the nearest park, and a dummy variable representing whether the home was located within one-half mile of one or more parks. Proximity to Austin was also measured in a straight-line fashion.

The hedonic model specified in this study contained variables representing four major groups of characteristics that influence property prices, namely, structural conditions, community conditions, location, and time of sale. Though we had hoped to include a variable representing whether each property enjoyed a view of one of the four parks, too few properties exhibited this characteristic to enable its effect to be analyzed. Table 2 illustrates the final set of dependent and independent variables, as well as the expected coefficient sign of each (i.e., whether this variable was expected to have a positive, negative, or statistically insignificant impact on sales price).

Prior to final specification of the models, the independent variables were examined for collinearity using correlation matrices; tolerance and variance inflation factors were also inspected. Relevant plots of residuals and predicted values were examined for normality, linearity, and homoscedasticity; though not presented here, they are available from the first author. Statistical analyses were carried out using the Statistical Package for the Social Sciences (SPSS), version 12.0. A linear functional form was employed, whereby the coefficients on the independent variables can be directly translated into their dollar impact on sales price.

Results

Table 3 presents descriptive statistics for each variable entered into the regression analyses. Table 4 lists correlation coefficients for the seven proximity variables, six of which relate to the four green spaces and one to the city of Austin. Reflecting the relatively close proximity of the four green spaces to one another, the coefficients were in most cases too high to allow all four parks to be entered into a single regression. To avoid the problem

Table 2
Description of Dependent and Independent Variables

Variable Group	Variable Name	Variable Description	Variable Type*	Expected Sign#
Dependent	SALES	Sales value of property (in dollars)	C	-
Independent: Structural	LOT	Lot size (in acres)	C	+
	AGE	Age of house at time of sale	C	-
	HOUSE	Heated area of house (in square feet)	C	+
	STORS	Number of stories	C	I/+
	LIVE	Number of living rooms	C	I/+
	BEDS	Number of bedrooms	C	I/+
	BTHS	Number of bathrooms	C	I/+
	FIRES	Number of fireplaces	C	I/+
	GARS	Number of garages	C	I/+
	POOL	Existence of swimming pool	D	I/+
Independent: Time of Sale	2001	Properties sold in year 2001	D	+
Independent: Community	EISD	In Elgin Independent School District	D	Unknown
	BISD	In Bastrop Independent School District	D	Unknown
Independent: Location	DAUS	Distance to Austin	C	-
	DMCK	Distance to McKinney Roughs (in miles)	C	I/-
	DLB	Distance to Lake Bastrop (in miles)	C	I/-
	DBSP	Distance to Bastrop State Park (in miles)	C	I/-
	DBUSP	Distance to Buescher State Park (in miles)	C	I/-
	DALL	Distance to nearest park in county (in miles)	C	I/-
	1/2 ALL	Location within 1/2 mile of park	D	I/+

* C indicates continuous variable, D indicates dichotomous (dummy) variable; # expectations based on review of approximately 100 previous hedonic property price analyses, I indicates insignificant

Table 3
Descriptive Statistics for Bastrop County Hedonic Models

Variable	Mean	Standard Deviation	Minimum	Maximum
SALES	125357.16	51588.54	22,222.00	350,000.00
LOT	1.58	1.97	0.09	10.00
AGE	18.94	18.07	1.00	99.00
HOUSE	1694.34	569.09	280.00	4,274.00
STORS	1.20	0.40	1.00	2.00
LIVE	1.27	0.47	1.00	3.00
BEDS	2.99	0.68	1.00	5.00
BTHS	1.87	0.50	1.00	4.00
FIRES	0.64	0.51	0.00	2.00
GARS	1.26	1.06	0.00	6.00
POOL	0.12	0.32	0.00	1.00
2001	0.36	0.48	0.00	1.00
EISD	0.22	0.42	0.00	1.00
BISD	0.70	0.46	0.00	1.00
DAUS	11.44	5.99	1.75	27.50
DMCK	9.74	3.99	0.25	21.75
DLB	6.91	4.97	0.25	18.00
DBSP	7.20	6.06	0.25	18.00
DBUSP	12.45	6.69	0.50	24.75
DALL	4.42	4.49	0.25	14.00
1/2 ALL	0.09	0.28	0.00	1.00

Table 4
Correlation Coefficients for Park and Austin Proximity Variables

	DAUS	DMCK	DLB	DBSP	DBUSP	DALL	_ALL
DAUS	1.0	0.31**	-0.67**	-0.82**	-0.94**	-0.64**	0.17**
DMCK		1.0	0.06	0.07	-0.17**	0.43**	-0.05
DLB			1.0	0.93**	0.83**	0.77**	-0.26**
DBSP				1.0	0.94**	0.85**	-0.26**
DBUSP					1.0	0.77**	-0.21**
DALL						1.0	-0.28**
_ ALL							1.0

* Correlation significant at 0.05, ** correlation significant at 0.01

of multicollinearity, each park was considered in a separate regression, as were the two additional proximity measures, creating a total of six regression models. Though reported in the table, the coefficients between proximity to each of the four individual parks and the two aggregated proximity measures (nearest park and half mile to a park) were inconsequential. Since the latter two variables were formulated as alternative measures of proximity to the former four, it was never intended to enter any combination of these variables into a regression simultaneously.

Of further concern was the high level of correlation between distance to three of the parks (Lake Bastrop, Bastrop, and Buescher) and distance to Austin. To enable comparison between the four individual models, the latter variable was not entered into any of these regressions, nor was it included in the model representing distance to the closest amenity. However, given the lack of collinearity between distance to Austin and a home's location within a half mile of any one of the parks, this final model was run both with and without the Austin variable. No other indications of multicollinearity among the independent variables were noted.

Table 5 presents full results of the first model, which included the variable measuring proximity to McKinney Roughs. Since results on all the independent variables other than the relevant green space maintained approximately the same coefficient across all six models, with no change in direction (positive to negative, or *vice versa*) or shift in level of significance, only the results for the other five green space variables and model statistics are presented in the bottom portion of Table 5.

Based on the results of previous studies, as summarized in Table 1 (p. 91), the four green spaces were expected to exert an insignificant or positive impact on surrounding sales values. Therefore, we anticipated that the coefficients on the green space proximity measures would be insignificant or negative for the five continuous distance variables, indicating no change or a decrease in home value with distance from the green space(s), and insignificant or positive for the dummy variable measuring location within a half mile.

Model One: McKinney Roughs

As indicated in Table 5, proximity to McKinney Roughs had no statistically significant impact on property values in Bastrop County. The

Table 5
Results of Bastrop County Regression Analyses

Variable	–	Standard Error	t(significance)	VIF[1]	Tolerance[2]
Constant	-5029.31	12822.41	-0.39	-	-
LOT	3631.36	749.61	4.84**	1.20	0.83
AGE	-456.84	88.26	-5.18**	1.22	0.82
HOUSE	55.03	3.71	14.84**	2.37	0.42
STORS	3912.14	3729.90	1.05	1.21	0.83
LIVE	-1235.85	3389.26	-0.37	1.41	0.71
BEDS	1241.32	2645.68	0.47	1.77	0.57
BTHS	5119.36	3662.37	1.40	1.81	0.55
FIRES	12487.18	2974.96	4.20**	1.27	0.79
GARS	8738.08	1475.23	5.92**	1.33	0.75
POOL	-729.04	4687.48	-0.16	1.24	0.81
2001	7154.36	2870.49	2.49*	1.05	0.96
EISD	7036.86	6057.89	1.16	3.50	0.29
BISD	5596.67	6503.81	0.86	4.88	0.21
DMCK	-319.79	450.77	-0.71	1.77	0.57
Coefficients for Alternative Measures of Greenbelt Proximity					
Variable	–	Standard Error	t(significance)	VIF[1]	Tolerance[2]
DLB	498.07	340.34	1.46	1.57	0.64
DBSP	189.14	333.25	0.57	2.23	0.45
DBUSP	89.72	304.08	0.30	2.26	0.44
DALL	-386.90	589.99	-0.66	3.85	0.26
1/2 ALL	-9152.62	4936.63	-1.85	1.07	0.94
Model Statistics	Model 1 (McKinney Roughs): adjusted R^2 = 0.74, F = 78.00, significance = 0.00 Model 2 (Lake Bastrop): adjusted R^2 = 0.74, F = 78.47, significance = 0.00 Model 3 (Bastrop State Park): adjusted R^2 = 0.74, F = 77.95, significance = 0.00 Model 4 (Buescher State Park): adjusted R^2 = 0.74, F = 77.89, significance = 0.00 Model 5 (nearest park): adjusted R^2 = 0.74, F = 77.98, significance = 0.00 Model 6 (park within one half mile): adjusted R^2 = 0.74, F = 78.84, significance = 0.00				

[1] VIF = variance inflation factor (a value up to 10.0 is typically considered acceptable); [2] varies from 0 to 1, higher values are preferable; * indicates significance at 0.05, ** indicates significance at 0.01

most influential factors on sales price (those significant at .01) were house and lot size, age of the property, and numbers of fireplaces and garages. Sales price increased with house and lot size, and the numbers of fireplaces and garages, but decreased with age, as expected. The only other significant influence ($p \leq 0.05$) was the year of sale, with homes sold in 2001 selling for over $7,000 more than those sold in 2000. The numbers of stories, living rooms, bedrooms, and bathrooms were all insignificant influences, as was the existence of a swimming pool and the school district in which the home was located. Overall, the model performed well, with an adjusted R^2 equaling .74 (F = 78.00, p = .00).

Model Two: Lake Bastrop

Proximity to Lake Bastrop also had no significant impact on the sales prices of homes in the study area. Other than for the substitution of the green space under consideration, the model remained essentially unchanged, with an adjusted R^2 equaling .74 (F = 78.47, p= .00).

Model Three: Bastrop State Park

Homes close to Bastrop State Park sold for no significantly greater or lesser amount than those more distant from this amenity. Again, the model remained otherwise unchanged, with an adjusted R^2 of .74 (F = 77.95, p= .00).

Model Four: Buescher State Park

Buescher State Park also had no effect on the prices of surrounding properties. There was no discernible change in the coefficients on the structural, time, and community variables or in the explanatory power of the model (adjusted R^2 = .74, F = 77.88, p = .00).

Model Five: Nearest Park

Rather than the effect of any single park on surrounding property prices, this model tested the impact of the four parks as a group. However, a property's proximity to the closest of the amenities had no statistically significant impact on prices. The regression model was unaffected by the addition of this variable (adjusted R^2 = .74, F = 77.98, p = .00).

Model Six: Park Within One Half Mile

The final model tested the impact of a home's location within a half mile of the boundary of any one (or more) of the four parks. Again, the green space variable emerged as an insignificant influence. There was little change in the rest of the model, with the adjusted R^2 once again equaling 0.74 (F = 78.84, p = .00).

When the variable representing the distance between each home and the city of Austin was entered into the regression, this distance had no significant impact on property prices in the area (t = -0.63, p = .53). While the county as a whole probably does benefit from its proximity to the state's capital city, this finding suggests that the difference in distance between the closest and farthest homes is currently immaterial as a determinant of sales prices. All other variables in the model retained their original sign, approximate magnitude, and level of significance (adjusted R^2 = .74, F = 78.06, p = .00).

Discussion

The impacts of the four large open spaces on surrounding property prices were consistently insignificant, providing little conclusive evidence to add to that provided by the seven most relevant studies reviewed above (*Impacts of Large, Rural Parks on Property Values* section). Nevertheless, this lack of significant impact remains an important finding. It is quite feasible that, in predominantly rural areas in which there is a large supply of open space, whether publicly or privately owned, and whether recreational or agricultural in nature, large parks do indeed exert an insignificant impact on property prices due simply to the abundant supply of undeveloped land. While not strictly public in nature, local residents may nevertheless enjoy or at least perceive informal access to much of the private open space in the county, further diluting the individual effect of the truly public amenities. In addition, lots in rural areas tend to be larger than those in urban communities, providing additional support to the idea that rural residents might not be required or be willing to pay a premium for a property in close proximity to a public open space, unlike their urban counterparts. This may especially be the case in this particular study area,

which enjoys good access to four large public open spaces, totaling over 6,500 acres, within its administrative boundaries. Though the authors are unable to provide any hard data to support this statement, the amount of public open space within the county is probably above the average level, at least compared with other inhabited counties on the eastern side of the nation.

As suburban development continues to spread outward from Austin, however, and the quantity of truly rural land continues to be diminished, it seems likely that Bastrop County property prices may begin to reflect a premium for proximity to the four parks analyzed. Suburban development can be expected to simultaneously increase the demand for open space and decrease its supply, and market prices will likely shift to reflect this situation. This argument is supported by the findings of Cheshire and Sheppard (1995), who analyzed both private and public open spaces in two towns in England. These authors found that positive property price premiums were detected only in cases of open space scarcity; where open space was in abundant supply, no significant property price impact was indicated.

The preceding discussion raises the question of the influence of open space type on property values. As noted by Irwin (2002), open space is a heterogenous good, that is, it varies by use, cover, ownership, and development potential. Our analysis did not allow any of these factors to be differentiated, since the only open spaces considered were the four public parks. Recent research (Irvin & Bockstael, 2001; Irwin, 2002) does, however, suggest that open space cover and ownership may indeed impact the magnitude of premiums suburban and rural residents are willing to pay for proximate home locations. Specifically, these authors found that the largest and most significant positive impacts were associated with privately owned, protected land, for example, agricultural easements or conservation areas, and nonmilitary public open space, whereas public space utilized by the military had no significant effect. These findings were all relative to maintaining the land as developable, privately owned pasture. (We thank an anonymous reviewer for bringing these papers to our attention.)

Longitudinal analysis of the magnitude and composition of property values over an extended period would enable closer examination of the above hypothesis regarding the likelihood of future property premiums for open space proximity, and the foregoing analyses provide a useful baseline against which future findings may be contrasted. The finding of a significant association between a price premium and a property's location in close proximity to or with a view of open space can provide a useful argument in favor of the protection of such areas, most notably due to the increase in property tax revenues that they thereby generate. This is especially the case where these increases in tax revenue exceed the costs of open space acquisition and maintenance. In such cases, not only does the entire local population stand to benefit from the environmental and recreational benefits provided by these spaces, but it may be shown that their preservation is less expensive than allowing residential development and use.

The finding of no significant impact on property prices does not suggest that Bastrop County residents do not place any kind of value on these four amenities; rather, it indicates only that it is currently unnecessary to pay a price premium to own property in close proximity to any of these parks, most likely due to the abundant supply of undeveloped open space in the area. It is important to note that analysis of the impacts of certain amenities on surrounding property prices using the HPM technique does not capture the full range of values that might be associated with the existence of a public green space. Types of value that may not be captured by the hedonic pricing technique include existence (the benefits nonusers of a resource derive from simply knowing that the site exists, as wildlife habitat, for example, or as a geological or ecological feature) and bequest (that value associated with preserving a resource for use by future generations) (Loomis & Walsh, 1997). Preservation and passive use benefits can be measured using contingent valuation, a survey-based technique that ascertains an individual's willingness to pay for the continued protection of a resource.

The hedonic method employed also fails to place a value on nonlocal use of open space amenities. Though rural residents may not currently be required to pay a significant premium to own property in very close proximity to a large public open space, the value that both rural and urban residents place on being able to access it within a reasonable driving distance may nevertheless be substantial. The direct benefits received by users of an amenity may be calculated using techniques such as the travel cost method, and this may be especially appropriate for larger amenities that draw visitors from a wider catchment area than nearby residences alone.

Therefore, despite the finding of insignificance in this study, state and regional park managers should not interpret these findings to mean that local residents and other users do not value the amenities and services they provide. Rather, they might consider the utilization of a wider range of valuation techniques than the HPM alone. This is especially important given the growing susceptibility of rural lands to development pressure. Further analysis of the full range of benefits offered by large regional parks, including identification of the willingness of residents to pay a premium for home sites located in close proximity to them and quantification of the other values placed on them by both local and nonlocal residents, is highly warranted. The placement of dollar values on these environmental, recreational, health, and economic benefits is a vital step toward provision of conclusive evidence in favor of open space protection, development of an effective green infrastructure network, and smarter community growth.

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