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Impact on property values of distance to parks and open spaces: An update of U.S. studies in the new millennium

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ABSTRACT
The review of 33 studies generally confirmed findings from a 2001 review: House values rose as proximity to a park increased; properties immediately adjacent to a park sometimes had a lower premium than dwellings a block or two away from it; larger parks had higher premiums, and their influence extended over a longer distance; and substantially greater premiums accrued from passive than from active parks. The results suggested a premium of 8%–10% on properties adjacent to a passive park is a reasonable point of departure, which is lower than suggested by previous guidelines. Four additional insights emerged: Percentage premiums were higher for (a) multifamily or small lots than for single-family homes or large lots and (b) for permanently protected lands than for developable lands; recognition was frequently lacking (c) the heterogeneity of open space and (d) differentials among submarkets. Six managerial conclusions and five guidelines for future research are offered.

KEYWORDS
Property values; parks; open spaces

This article updates findings reported in this journal almost two decades ago (Crompton, 2001), which reached four conclusions. First, there was overwhelming empirical evidence that parks and open spaces contributed to increases in property values. Second, the support extended beyond urban areas to properties that were proximate to large natural areas in rural contexts. Third, while substantial variation in contexts made it infeasible to generalize about the distance over which the proximate influence extended, "there appeared to be wide agreement that it had substantial influence up to 500 feet and that in the case of community sized parks it extended out to 2,000 feet" (Crompton, 2001, p. 29). Fourth, the diversity of contexts also made it infeasible to generalize about the magnitude of the premium, but "a suggested point of departure" was offered:

> A positive impact of 20% on property values abutting or fronting a passive park area is a reasonable starting point guideline. If the park is large (say over 25 acres), well-maintained, attractive, and its uses mainly passive, then this figure is likely to be low. If it is small and embraces some active use, then this guideline is likely to be high. If it is a heavily used park incorporating such facilities as athletic fields or a swimming pool, then the proximate value increment may be minimal on abutting properties, but may reach 10% on properties two or three blocks away. (Crompton, 2001, p. 29)

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With the benefit of hindsight, it is apparent the 2001 review was undertaken at a watershed point in time, because five key methodological developments emerged around the start of the new millennium that ushered in a new era of studies: (a) Hedonic models became more robust, typically incorporating a much more comprehensive range of characteristics. (b) The statistical tools associated with hedonic analysis became progressively more sophisticated, which has allowed the array of potential factors that may contribute to a property's value to be expanded. (c) The development of Geographic Information Systems (GIS) enabled distances between residential dwellings and parks to be measured along street networks, rather than by the less accurate method of straight lines. (d) Most of the studies reviewed in 2001 required researchers to physically visit properties to determine access, so sample sizes were relatively small. This changed with the advent of multi-listing service electronic databases that could be transposed on to electronic maps within a GIS and spatially integrated with the location of parks and other environmental elements. (e) Most analyses used market sales data rather than assessed values, which predominated in the earlier studies. These developments enabled many postmillennium analyses to be "mega studies." This term is coined by the author to describe data sets that are large (often with samples of 10,000 or more properties), are drawn from multiple years, and cover a relatively extensive geographical area.

Studies completed in the new millennium that incorporated a measure of distance from parks to residential dwellings were sought. Three parameters were used to define the review's scope. First, it did not include analyses that measured proximity by proportion of park-like amenities in the proximate area or by views, both of which have emerged in the new millennium as measures that may induce property premiums. Second, while parks were interpreted broadly to incorporate open spaces, forests, wildlife habitats, and natural preserves, the review did not consider findings related to trees (Sander, Polasky, & Haight, 2010) or wetlands (Kaza & BenDor, 2013) since their impact has been reviewed elsewhere. Third, the review was confined to U.S. contexts.

Thirty-three studies were identified after applying these parameters. The studies were undertaken in diverse geographical locations, varied widely in the set of explanatory variables that were included, differed in the specification of variables and the definitions and aggregations of types of green space, and used different functional forms of hedonic analysis. Due to this heterogeneity, a major goal of the article was to offer insights and identify "points of departure" that could inform the decisions of policymakers, planners, appraisers, developers, homeowners, and advocates.

Table 1 lists the 33 studies in chronological order of their publication date and summarizes their geographical context, sample size, and major findings. The review synthesizes the findings under eight headings: direction and magnitude of impact; potential disamenities associated with adjacency; the differing impact of passive and active parks; size of park; size of housing unit or lot; degree of protection; recognition of the heterogeneity of open space; and differentials among submarkets.

Findings from the review

Direction and magnitude of impact

In 23 studies, the preponderance of findings showed a positive proximate premium, while a further seven produced mixed results with instances of an insignificant impact

Table 1. Summary of U.S. Study findings relating to proximate distance to parks.

Author (year)	Setting	Sample size	Findings
Bolitzer and Netusil (2000)	Portland, OR	16,442 single-family homes.	Range of premiums was from 5.3%–7.6% for homes within 100 ft of a park to 1.5%–3.8% for properties 1,301–1,500 ft away. There was no premium for private parks.
Mahan et al. (2000)	Portland, OR	14,485 residential homes	"Improved public parks" had no significant impact on sales price.[b]
Lutzenhiser and Netusil (2001)	Portland, OR	16,442 single-family homes.	Premiums within 1,500 ft of a natural area, specialty park, and urban park were 16.6%, 8.5%, and 1.8%, respectively. They were highest (.1%, 8.6%, and 3.1%, respectively) in the 201- to 400-foot and 401- to 600-foot zones. For both natural and urban parks, premiums increased with size of the park.
Miller (2001)	14 neighborhoood parks in the Dallas/Fort Worth Metroplex	3,200 residences	22% premium adjacent to parks; 85% of total premium accrued within 800 ft of a park; small lot premiums were four times those of large lots; more value is created by a series of small parks than by a single large park of equivalent area.
Shultz and King (2001)	Tucson, AZ	6,277 primarily residential census blocks	Increase in value for large protected areas, golf courses, and Class II wildlife areas; No impact on regional/district parks; increase in value for medium-sized undeveloped natural resource parks, small neighborhood parks, and Class I wildlife habitat parks.
Espey and Owusu-Edusei (2001)	Greenville, SC	4,153 single-family homes	Premium of 6.5% for urban parks. It varied according to distance and attractiveness. For a small basic park the range was from −14% within 300 ft to +15% in the 301- to 500-foot zone.
Kim and Johnson (2002)	McDonald Dunn Research Forest, 11,500 acres, Corvallis, OR	2,095 sales within 1 mile of a forest boundary	One unit of square root distance decreased property price by $123; a house 100 feet from the forest was worth $1,520 more than a house 500 feet away. Characteristics of forest management greatly influenced these mean values.[a]
Thorsnes (2002)	Grand Rapids, MI	431 lot sales 486 house sales	Lots backing up to a forest preserve: vacant lot premiums of 10%–35%; house premiums of 7%. Lots across the street had no substantive premiums.
Cape Ann Economics (2003)	Leon County, FL	6,898 N/A	Premium within 200 ft of a park was $6,015. It decayed to $1,773 at 1,320 ft (0.25 mile). In dense city areas it increased to $14,000 within 200 ft.
Resource Dimensions (2005)	Okanogan County, WA	N/A	Premiums for properties within 0.25 miles of 10 types of open space ranged from 21.57% (scenic vistas) to 6.69% (agricultural range land). They consistently decayed so by the 0.6–1 mile zone they had declined to between 3.01% (greenway buffer) and 6.69% (recreation area).
Mansfield et al. (2005)	Research Triangle Region, NC	11,200 residential sales	Proximity to public and private forests raised sales price; influence of public forests decreased significantly when private forest and parcel greenness were added to the specification. Analyses suggested greater parcel greenness substituted for living a greater distance from a forest.

(*continued*)

Table 1. Continued.

Author (year)	Setting	Sample size	Findings
Cho et al. (2006)	Knox County, TN	15,335 single-family homes	Reduction of 1,000 ft distance to the nearest park led to a significant, but small, increase of $172 (size had no effect). Individual parks showed a range from $840 to –$662. Largest positive effects were in dense areas with small lots, where many residents did not have private transportation. Negative impacts were associated with larger lots, higher income areas, and auto ownership.
Anderson and West (2006)	Minneapolis & St. Paul, MN	24,862 single-family homes	Proximity to parks resulted in higher premiums in high-crime areas; premiums in the city raised prices but had no impact in the suburbs; premiums from special parks increased with their size; premiums from neighborhood parks increased with population density; premiums increased with an area's income levels.
Edwards (2007)	San Francisco, CA	N/A	Dwellings within 500 ft of "significant parks" sold for $125,838 more than those located between 500 and 1,000 ft away.
White and Leefers (2007)	Wexford County, MI	149 nonsubdivision sales; 107 subdivision sales	No premium for proximity to forest areas; $46,000 premium for adjacency to subdivision parks/open space.
Mueller and Loomis (2008)	Areas proximate to five wildfire events in Los Angeles County, CA	2,520 house sales within 1.75 miles of a fire area	After one fire, prices declined by $29,802 to $32,547. After two fires, the additional decline ranged from $16,161 to $21,274. Cumulative decline from two fires was $46,419 to $53,821.
Henderson and Song (2008)	Wake County, NC	14,564 single-family homes	Premiums for locations within 1,500 ft of public open spaces, private open spaces, and golf courses were $5,074, $2,510, and $4,931, respectively. Each foot of distance from a public open space and a golf course led to a loss of value of $3.60 and $1.68, respectively. Premiums for public parks from properties in dense areas with small yards were large. Those from properties with large yards for golf courses were large. Private open spaces did not have statistically significant premiums.
Troy and Grove (2008)	Baltimore, MD	15,600 single-family and townhomes.	A 2.2% decrease in value for each 1% increase in distance. In high-crime areas the effect was reversed: proximity to parks negatively influenced home prices.[a]
Sander and Polasky (2009)	Minneapolis & St. Paul, MN	4,918 single-family homes	Small premiums of $136 for each 100 m from a park up to 1 km, compared to $216, $127, and $119 for each 100 m to a lake, stream, and trail, respectively.
Adelaja et al. (2009)	Oakland County MI	45,424 housing sales	Premiums ranged from 3.1% to 2.2% accrued to properties within 300 m of recreational lands. No significant premiums emerged for properties within 100 m of a passive park, but for those in zones from 100 to 1,500 m the premiums ranged from 2.3% to 6.3%.
Poudyal et al. (2009)	Roanoke, VA	11,125 single-family homes	Significant small premiums showed a 1% decline in park distance and a 1% increase in park size increased sales price by 0.016% and 0.03%, respectively.
Cebula (2009)	Savannah, GA	2,888 single-family homes	14% premium was associated with small urban parks.

Table 1. Continued.

Author (year)	Setting	Sample size	Findings
Embrace Open Space (2009)	Hennepin County, MN	N/A single-family homes	Average premium of 5.2% ($16,320) for parks. No premium in large lot/high-income areas, or on small open space areas under 1 acre.
Bell et al. (2009)	Concord & Sudbury Rivers, MA	1,594 residential properties	Negative premiums were associated with agricultural land and cemeteries. The premium for a wildlife refuge was 6.9%. There were also significant premiums for golf courses and sport/recreational parks, but not for conservation areas.[a]
Sander et al. (2010)	Minneapolis & St. Paul, MN	9,992 single-family homes	Parks produced no significant premium.[b]
Aiello et al. (2010)	Pittsburgh, PN	7,122 single family homes	Being less than 500 ft to a large park created a premium of $34,300 compared to homes between 2,500 and 3,000 ft away. Results of the impact of smaller parks were "inconclusive."
Bark et al. (2011)	Tucson, AZ	6,676 single-family homes	Using a vegetation index along 236 miles of riparian corridor, homeowners preferred greener lots and greener neighborhoods and paid premiums for proximity to greenspace amenities. Properties adjacent to parks ($n = 133$) and those within 1,056 ft of, but not adjacent to, a park had significant negative premiums of 3.3%–3.7% and 2.3%–4.9%, respectively.[a]
Cho et al. (2011)	Pigeon River, NC & TN	595 TN, 497 N.C. single-family homes	Significant premium on properties in one part of a watershed, but insignificant in a different part. A negative premium associated with smaller park <250 acres; a positive premium associated with larger parks >250 acres[a]
Ham et al. (2012)	Pike National Forest, El Paso County, CO	1,536 house sales within two miles and over two miles from the forest	1% decrease in mean distance to the forest increased house values by 6.5%; but living within 2 miles of noise-intensive activities significantly decreased sales price by an average of 6.9% ($17,690).[b]
Kovacs (2012)	Portland, OR	51,055 single family homes	Premiums within a half mile of large regional natural park ranged from 6% to 9%. They peaked at one-third of a mile from the park.
Larson and Perrings (2013)	Phenix, AZ	46,600 single-family homes	A negative premium associated with smaller parks <250 acres; a positive premium associated with larger parks >250 acres.[a]
Lin et al. (2013)	Minneapolis, MN	35,280 single family homes	For both the city as a whole and two of its four quadrants parks had a significant positive premium, but in the other two quadrants they had a negative premium. The effects were more positive for passive parks and more negative for active parks, but differences in the economic and sociocultural characteristics of neighborhoods sometimes resulted in them not adhering to these generalizations
Kashian et al. (2018)	Muskego, WI	6,938 single family homes	14.54% ($39,985) decrease for homes adjacent to a park.[b]

[a]Mixed results: some positive; some negative or insignificant.
[b]Insignificant or negative premiums.

and/or a negative premium accompanying evidence of positive premiums. In three of the analyses, parks had either no significant impact on sales price or a significant negative impact (Kashian, Winden, & Storts, 2018; Mahan, Polasky & Adams, 2000; Sander et al., 2010). In each case, the unexpected findings were attributed to noise, congestion, and reduced privacy being sufficiently disturbing to proximate property owners that they outweighed the positive amenity associated with a park.

Among the seven studies reporting mixed findings, Shultz and King (2001) used an unorthodox operationalization of the dependent variable: "The median value of owner-occupied units and the median value of capitalized rental payments among rental units in a census block … obtained from the Census of Housing" (p. 243). Using census blocks as the unit of analysis rather than individual units, and the use of secondary census data rather than actual sales data, would appear to limit the credibility of the findings. In the remaining six mixed-results studies, the unexpected increases in price with distance from open space were convincingly explained by the authors as emanating from differences among subsegments of their studies, such as divergent economic and sociocultural characteristics of neighborhoods (Lin, Wu, & De Sousa, 2013; Troy & Grove, 2008), negative forms of open space (e.g., cemeteries) (Bell, Boyle, & Neumann, 2009), small size of parks (Cho, Roberts, & Kim, 2011; Larson & Perrings, 2013), or esthetically unappealing (nonirrigated, brown and dry) space (Bark, Osgood, Colby, & Halper, 2011).

When the magnitude of premiums revealed in the studies was estimated and assigned into one of three categories—lower than 4%, 5%–9%, and 10% or higher—the tabulations showed approximately the same number of premiums in each category. The distances over which premiums occurred were similarly varied, but it appears the Crompton (2001) review recommendations for urban environments were generally supported (i.e., substantial influence up to 500 feet and, in the case of community-sized parks, extending out to 2,000 feet).

Potential disamenities associated with adjacency

A majority of studies confirmed that premiums generally were highest for properties closest to a park. However, several analyses did not conform to this expectation. They revealed that properties immediately adjacent to a park sometimes did not show the highest premium. Invariably, the authors attributed this to social and/or environmental disamenities that outweighed the amenity value of locating next to a park. This was the case in the three analyses identified in the preceding, which reported parks had either no significant impact or a significant negative impact on property values (Kashian et al., 2018; Mahan et al., 2000; Sander et al., 2010). Such disamenities were attributed to a variety of nuisances, including congestion, street parking, litter and vandalism, noise and intrusive ballfield lights, and groups engaging in morally offensive activities. In the case of large parks, forests, and open spaces in rural and urban fringe areas, the nuisances cited included animals such as deer, which eat homeowners' landscape plants and cause car accidents, and poisonous snakes, mosquitos, and other insect pests.

Lutzenhiser and Netusil (2001) reported premiums were highest for properties not adjacent to parks. Their analyses differentiated among urban parks, natural parks, and specialty parks. In each case, the largest premiums were in the 201- to 400-foot and

401- to 600-foot zones, respectively, rather than in the immediate 1- to 200-foot zone. For example, a home located 401–600 feet away from a natural area park on average had a $12,621 premium (19.1%), while the average premium for a house adjacent to an urban park was $1,926 (2.7%). A decade later, another Portland study measured the impact of two large regional parks, Forest Park (5,230 acres) and Mount Tabor (190 acres) (Kovacs, 2012). The analysis similarly showed premiums peaked at one-third of a mile from a park.

In Oakland County, Michigan, which is part of the Detroit Metropolitan area, homes within 100 meters of a passive park showed no premium, while those in all other buffer zones up to 1,500 meters had premiums ranging from 2.3% to 6.3%. When the effect of active recreational parks was measured, the premium also was marginally larger for properties one block away from the park than for those abutting it (Adelaja et al., 2009, p. 24).

In Greenville, South Carolina, 24 parks were categorized into four groups based on size, attractiveness, and park amenities (small basic, small attractive, medium basic, medium attractive) (Espey & Owusu-Edusei, 2001). Overall, proximity to these parks had a positive impact on prices. Homes within 1,500 feet of any park sold for 6.5% more than those beyond that distance. However, in three of the park categories, premiums for homes closest to the parks were lower than those on properties located further away. For example, houses within 300 feet of small basic parks showed a negative premium (-14%), while for those between 300 and 500 feet there was a positive premium (15%). A Tennessee study similarly reported parks associated with athletic activity tended to have a negative impact on adjacent property because of the concomitant levels of traffic and noise and possible perceived safety dangers (Cho, Bowker, & Park, 2006).

The differing impacts of passive and active parks

Lutzenhiser and Netusil (2001) classified the 194 public parks and open spaces in Portland, Oregon, into three categories: urban parks, natural area parks, and specialty parks/facilities. Their analyses showed that being within 1,500 feet of a natural area park accounted for $10,648 (16.1%) of a home's sale price. By contrast, the impacts of urban parks and specialty parks/facilities were $1,214 (1.8%) and $5,657 (8.5%), respectively.

A Minneapolis analysis further explored that issue (Lin et al., 2013). Across their five models, variables representing passive facilities were significant and positive in six of 10 possible cases, insignificant in two cases, and significant but negative in two cases. By contrast, variables representing active facilities were significant and positive in 13 of 33 possible cases, insignificant in four cases, and significant but negative in 16 cases. Overall, results supported the generalization that property value effects were more positive when proximity was to passive rather than active parks, but they also demonstrated significant variations can occur among given facilities across a community, that is, that the passive/active dichotomous relationship is not always clear-cut and that finer scales of analyses are required to identify these nuances.

The Oakland County analysis also distinguished between recreational amenity lands and passive oriented lands. It confirmed that premiums for passive parks tended to be

higher, ranging from 2.3% to 6.3%, while those for recreational amenity lands ranged from 2.6% to 3.2% (Adelaja et al., 2009).

Size of park matters

Several studies have reported that size of parks influenced magnitude of premiums. At a macro level, Cho et al. (2011) reported that parks under 250 acres had less impact than those over 250 acres. A similar study in Phoenix, Arizona, compared results of nonspatial and spatial lag models (Larson & Perrings, 2013). The two approaches produced similar findings, showing an unexpected negative impact of proximity to small parks (≤250 acres), which the authors suggested was attributable to many of them including noisy playgrounds and fields, and a positive relationship to large parks (≥250 acres).

Lutzenhiser and Netusil (2001) demonstrated that the larger the size of both natural and urban parks in Portland, the higher was the average house premium. Similarly, results in Pittsburgh showed a green premium existed for all three size categories into which parks were classified (11 small, 13 medium, 12 large). The premium was higher for large parks than it was for medium or small parks, indicating that homes located within 0–500 feet of larger parks sold for $34,300 more than homes that were 2,501–3,000 feet from parks. The results of the impact of smaller parks were "inconclusive," which the authors attributed to their "widely different quality" (Aiello et al., 2010, p. 20). These findings were endorsed by a study in Hennepin County, Minnesota, which reported small open spaces of less than one acre did not generate any premium, but homes within a quarter mile of a large park (over 50 acres) showed a premium of at least 4.8% (Embrace Open Space, 2009).

A study that captured both distance from the nearest park and size of a park reported both variables were statistically significant across the entire study area and its four constituent submarkets (Poudyal, Hodges, & Merrett, 2009). The analysis confirmed that urban residents preferred larger parks to smaller ones. An interaction term between distance to park and size of park was included. Its significant coefficient suggested to the authors that people placed more value on larger parks located further away than on smaller parks nearby.

A contrary finding was reported by Anderson and West (2006), who were surprised to find their analysis revealed the premium associated with a neighborhood park decreased as the park size increased. The authors speculated this may have been caused by some disamenity associated with larger parks that was not measured in their study, such as increased noise or traffic flow. However, they reported the premium from proximity to special parks increased with their size.

Size of housing unit or lot

All nine studies that addressed this issue reported that the percentage premium associated with multifamily or small lot properties was higher than that accruing to single-family or large lot properties. Perhaps the most thoughtful analyses were reported in a study commissioned by a developer, which measured the impact of 14 neighborhood parks on proximate single-family homes in suburban areas of the Dallas-Fort Worth

Metroplex (Miller, 2001). The parks were all between 2.5 acres and 7.3 acres in size, except for two that were 0.5 and 0.3 acres. Homes adjacent to the parks received a median price premium of 22% relative to properties a half mile away. Approximately 75% of the value occurred within 600 feet of a park. In relation to lot size, the analyses revealed the following:

> Small lots place a higher value on proximity to the park than do large lots, perhaps because lot area acts as a substitute for public open space. All else equal, the small lots in a development should cluster around the park. Small lots also value park acreage more, as a percent of sales price, than do large homes. If a range of park sizes exist in a neighborhood, the least expensive homes should border the edge of the largest park. (Miller, 2001, p. 75)

Miller (2001) also explained that narrower lots resulted in higher overall premiums because more homes benefited from being closer to the park. For a given lot area, homeowners were likely to prefer lot depth to lot width, since it best enhanced the backyard's usability. Further, narrower, deeper lots were likely to minimize the cost of infrastructure.

Henderson and Song's (2008) primary focus was on the mediating impact of yard size on the impacts of three types of open space. Coefficients were all significant and positive, indicating premiums of $5,074, $2,510, and $4,931 for locations within 1,500 feet of public open spaces, private open spaces, and golf courses, respectively. However, when the two open space buffers were interacted with yard size, only the coefficient on public open space was significant, indicating the value of being closer to a public open space was larger for properties with smaller yards.

The importance of open spaces in dense urban areas with small lots was reinforced in Savannah, Georgia, where location across from, or adjacent to, a small park or square was found to have a significant positive premium of about 14% (Cebula, 2009). It seems reasonable to postulate that in a dense city center where homes typically have no or only a small yard, small parks offer respite from the hustle and bustle of the street and pleasant, shaded, and relaxing places to sit or stroll.

Given that 18% of the land in Hennepin County was protected open space, it was expected the plentiful supply would result in a relatively small premium being associated with proximity (Embrace Open Space, 2009). An analysis revealed the average premium was 5.2%. However, density of development affected the premium. There was no impact on homes on lots larger than one acre: "In essence, the landowners own their own 'open space' and are therefore less likely to pay a premium for open space bordering their homes" (p. 3).

The differential impact of house/lot size was implied in the results of a county-wide analysis in Leon County, Florida (Cape Ann Economics, 2003). Homes within 200 feet of the nearest park were worth an extra $6,015, while the premium for those between 200 feet and 1,320 feet (0.25 mile) was $1,773. However, when the analysis focused on the most densely populated parts of the county (over 2,500 people per square mile, primarily within the city of Tallahassee), the premiums for parcels within 200 feet of a park rose to approximately $14,000.

In Knox County, Tennessee, Cho et al. (2006) confirmed that higher premiums were associated with smaller residences. They reported the largest positive effects tended to

be within the city, where lots were smaller and residents were less likely to have access to private means of transportation. By contrast, negative effects were more prevalent in areas with larger lots and higher levels of wealth and auto ownership.

In their Minneapolis study, Anderson and West (2006) reported premiums from neighborhood parks increased with population density. While being close to a park in the city raised premiums, parks had no impact on house prices in the suburbs. The authors speculated that "large private lots likely substituted for nearby open spaces and therefore diminished the value of proximity" (p. 777) and noted that "escaping to a park is probably more valuable in the dense clutter of the central city than in the relatively wide-open suburbs" (p. 774).

Degree of protection

Four studies reported the perceived permanency of park/open space was a factor in enhancing premiums. In Portland, Oregon, the city's 194 parks were classified as public or private (Bolitzer & Netusil, 2000). While public parks had a positive effect on house prices, private parks "owned by organizations such as The Trust for Public Land" had no statistically significant effect. These findings were supported by analyses in Wake County, North Carolina. Two specifications were run (actual distance and buffer zones). In all cases they showed open space size was significant and positive for public open spaces and golf courses, whereas the coefficient for private open spaces was only significant and positive in one case (Henderson & Song, 2008).

Great Meadows National Wildlife Refuge, along the Concord and Sudbury Rivers in Massachusetts, is in a predominantly developed area with four towns adjacent to its boundaries (Bell et al., 2009). These communities had a plentiful supply of other types of open space: Conservation lands (1,049), golf courses (11), sport/recreational parks (18), and the wildlife refuge. All four types of open space had a positive influence on property values. However, unlike the other three positive influencers, the conservation areas' premium was not statistically significant. Perceptions of lack of permanency were prominent among the authors' suggested explanations for this result: "Federally protected natural land may be more important to homeowners than natural land protected by local groups, because the federal designation exudes a greater sense of permanence than does locally protected land or private land with conservation easements" (Bell et al., 2009, p. 1017).

Results from the Research Triangle region of North Carolina revealed that proximity to both private and public forests increased sales price. However, the influence of the public forests decreased significantly as measures of private forests were added to the specification, indicating the influence of private forests was lower (Mansfield, Pattanayak, McDow, McDonald, & Halpin, 2005).

Recognition of the heterogeneity of open space

Several of the later postmillennium studies recognized that the practice of bundling all types of open space into a single proximate variable failed to explicitly recognize the

heterogeneity of green spaces. It inappropriately assumed the same premium would be associated with all forms of open space.

This point was demonstrated by Shultz and King (2001), who reported that proximity to large protected areas (two national forests and a national monument), golf courses, and Class II wildlife habitats raised property values; proximity to regional/district parks had no impact; and proximity to medium-sized undeveloped natural resource parks, small neighborhood parks, and a Class I wildlife habitat lowered values. The Class I habitat was more pristine than Class II, but its negative impact was attributed to much of it being close to rivers that were prone to flood.

Resource-based recreation and tourism is a prominent feature of the Okanogan County, Washington, local economy. Four years of residential property sale prices were used to measure the impact of 10 types of open space: greenway buffer, national park/forest, lake/river/stream, recreation area, open space, viewshed/scenic vistas, trails, agricultural lands/range, local/community parks, and wildlife/habitat/natural areas. In all 10 contexts, results consistently showed that as distance from the open space amenity land increased, the property premium decreased. On average, people buying homes and real estate in the study area were willing to pay a premium of 12.8% ($20,262) more per acre for properties within a quarter mile of the amenities than for properties that were not proximate to them. However, the premiums for different types of open space ranged widely from 6.05% ($9,576) and 8.69% ($13,754) for agricultural lands and local/community parks, respectively, to 17.98% ($28,468) and 21.57% ($34,156) for proximity to national park/forest and viewshed/scenic vista, respectively (Resource Dimensions, 2005).

The Great Meadows National Wildlife Refuge study measured the impact on sale prices of six types of open space per 100 meters of proximity (Bell et al., 2009). Negative impacts were revealed for agricultural lands (–$172) and cemeteries (–$279). Conservation lands ($1,353), golf courses, ($494), sport/recreational parks ($1,203), and the wildlife refuge ($623) had positive influences on property values.

Several projects showed the importance of accounting for differences within a forest. An early study reported views of clear-cuts had a negative impact on neighboring property values, while the presence of mature, tall stands enhanced values substantially (Johnson, Brunson, & Kimura 1991). Subsequently, in Corvallis, Oregon, mean values of the proximate impact of an 11,500-acre forest on properties within one mile of its boundaries varied according to characteristics of the forest (Kim & Johnson, 2002), while the negative effects of being proximate to the Angeles National Forest in California after two wildfire events in that forest were also demonstrated (Mueller & Loomis, 2008).

In the Pike National Forest in southern Colorado a comparison was undertaken of hedonic premiums when the forest was viewed as homogeneous with those that differentiated proximity to noise-intensive areas of the forest (areas that allowed motorized vehicle use for recreation and active logging) from quiet recreation areas. In the homogeneous model, a 1% decrease in mean distance to the forest increased house value by 6.4%. However, the adjacency measures in the heterogeneous model indicated that being within two miles of noise-intensive activities significantly decreased house sales prices by an average of 6.9% (0.4% to 13.8%) or, evaluated at the mean house value, –$17,690 (–$1,046 to –$33,255). The authors concluded that "disaggregating by use rather than

assuming the forest is homogeneous provides a clearer picture of the values home buyers place on actual land values … A homogeneous land type overstates the benefits for houses located within two miles of noisy land uses" (Ham, Champ, Loomis, & Reich, 2012, p. 454).

Differentials among submarkets

The Anderson and West (2006) study was a landmark because it was the first to comprehensively investigate the role of neighborhood characteristics and location in influencing park and open space premiums. Since mega studies by definition use averages derived from aggregating the impact of very different neighborhood characteristics across a metropolitan region, there is a tendency to interpret their results as being representative of all neighborhoods. The authors observed that "using the metropolitan area's average effects may overestimate or underestimate the value of open space in particular neighborhoods by a substantial margin" (p. 775). They recognized this was inappropriate, misleading, and likely to lead to erroneous conclusions, and they demonstrated that premiums attached to open space varied across a metropolitan area because population density, neighborhood income, and other characteristics varied.

The inappropriateness of aggregation was illustrated in the same year by Cho et al. (2006) in Knox County, Tennessee. Using the traditional (global ordinary least squares) approach, a reduction in distance to the nearest park of 1,000 feet from an initial distance of one mile resulted in a statistically significant price increase of $172. However, when individual parks were investigated using a locally weighted regression approach, marginal implicit prices were found to vary from $840 to –$662.

A Los Angeles study that empirically investigated the magnitude of error associated with the failure to recognize the diversity of submarkets concluded that "the data strongly reject the assumption that any of the attributes have a common implicit price across census tracts, zip codes, or the neighborhoods. Housing is a bundled good and it appears that markets clear locally with no single implicit price for individual attributes existing globally" (Redfearn, 2009, p. 305). The author noted hedonic analyses were "highly sensitive" to ostensibly innocuous changes in sample area or specification of variables.

The results of two studies done by the same research team in Minneapolis illustrated the potential impact of changes in the definition of a study area. The first study showed a small positive park premium (Sander & Polasky, 2009), but a second study reported no significant impact (Sander et al., 2010). Although the data in both studies comprised only sales of single-family homes in 2005, they differed in geographical coverage. The first included only Ramsey County and used a sample of 4,918 sales, while the second was extended to 9,992 sales by including neighboring Dakota County.

A few years later, another Minneapolis study adopted a much more sophisticated measurement approach (Lin et al., 2013) Analyses were done both on the city as a whole and in its four geographic quadrants. Distance to the nearest park was significant and negative (as expected) for the city as a whole and for two of the four quadrants. However, it was significant but positive for the other two quadrants, demonstrating the

importance of disaggregating data sets drawn from extensive geographic areas into submarkets. The authors suggested the different economic and/or sociocultural backgrounds of populations in the four quadrants accounted for them valuing activities and facilities to different extents.

Further evidence of variations in park premiums associated with different submarkets came from an analysis in Baltimore, Maryland, which investigated the extent to which crime rates mediated park premiums (Troy & Grove, 2008). When considered in isolation, a significant decline in price with distance from a park emerged in all four models developed (suggesting a 2.2% decrease in value with each 1% increase in distance in the log-transformed model). The crime rate variable produced the expected negative impact on sales price. When they interacted, the combined effect of crime and park distance was consistently significant, indicating that in high-crime areas the positive premium was reversed. In areas where crime was relatively low, parks had a positive impact on property values, but when crime levels reached a threshold, the direction of the relationship switched and parks negatively influenced home values.

In contrast to these findings, Anderson and West (2006) in their Minneapolis-St. Paul analysis did not find any reduction of park premiums in high-crime areas. To the authors' surprise they reported that "proximity to parks is more valuable in high-crime areas, indicating that these amenities may buffer against the negative effects of high-crime rates on sales prices" (p. 775). A speculative reason for these differing results may be that Minneapolis is renowned for the excellence of its park system, while in Baltimore park budget cuts resulted in a substantial decline in quality of the city's parks (Troy & Grove, 2008).

Analyses of data from three subdivisions of single-family houses that abutted permanently preserved forest lands in the Grand Rapids metropolitan area, Michigan, demonstrated submarkets may be highly localized (Thorsnes, 2002). The sample comprised 431 lot sales and 486 house sales. The developers sought to maximize the forest preserve asset by constructing a street in each subdivision that was parallel to the border of the preserve to enable the highest number of building lots to back directly onto the preserve. The hedonic analyses revealed the profitability of that strategy. Lots backing directly onto the preserve had premiums among the three subdivisions ranging from 19% to 35%. The range showed the proximity premium varied substantially even when the open space was ostensibly a constant, emphasizing the dangers of applying an average premium in different contexts. However, by contrast, lots on the other side of the parallel street in the three subdivisions showed weak, negative, and no significance, respectively. The forest amenity was highly localized, with little if any benefit extending to the lots across the street. The house sales analyses showed a similar pattern.

In contrast to these relatively high premiums, a study in Wexford County, Michigan, located 100 miles to the north, revealed proximity to forested land did not increase the value of properties (White & Leefers, 2007). The authors attributed this to 73% of the land in Wexford County being forested, compared to 27% in Kent County where the Grand Rapids analysis had been done. The relative scarcity of forested land in the Grand Rapids context created the premium, while its abundance in Wexford County mitigated against a premium.

Conclusions

Results from the 33 reviewed studies varied widely. This reflects methodological differences in the set of explanatory variables; specification of variables; definitions and aggregations of types of green space; inclusion or omission of key independent variables; diversity and definition of geographic locations; and the functional forms of hedonic analyses, which often produce different results from the same data set. Further, it has been observed that "each study deals with a particular open space area or set or areas that are unique to a particular region and time period" (McConnell & Walls, 2005, p. 62). This heterogeneity makes it difficult to compare results across studies, so it is perilous to make generalizations relating to premiums emanating from parks and open spaces. In any given context, they could mislead rather than inform.

Despite this important caveat, a major obligation of a review of this nature is that it should yield insights and/or "points of departure" that are sought by policy makers, planners, appraisers, developers, homeowners, and advocates to inform their decisions. This section identifies six conclusions that emerged from the review.

Figure 1 is an adaptation of a conceptualization initially proposed by Li and Brown (1980). A different version of it appeared in the earlier Crompton (2001) review. The upper half of the figure suggests that premiums associated with proximity and accessibility will decay as distance from a park increases. The lower half proposes that any negative impacts are likely to be limited to properties close to a park, and these will decay more rapidly than positive impacts as distance from the park increases.

The first conclusion from the review is that Figure 1 is a useful way to conceptualize the impact of premiums. Only three of the 33 studies reported an insignificant or

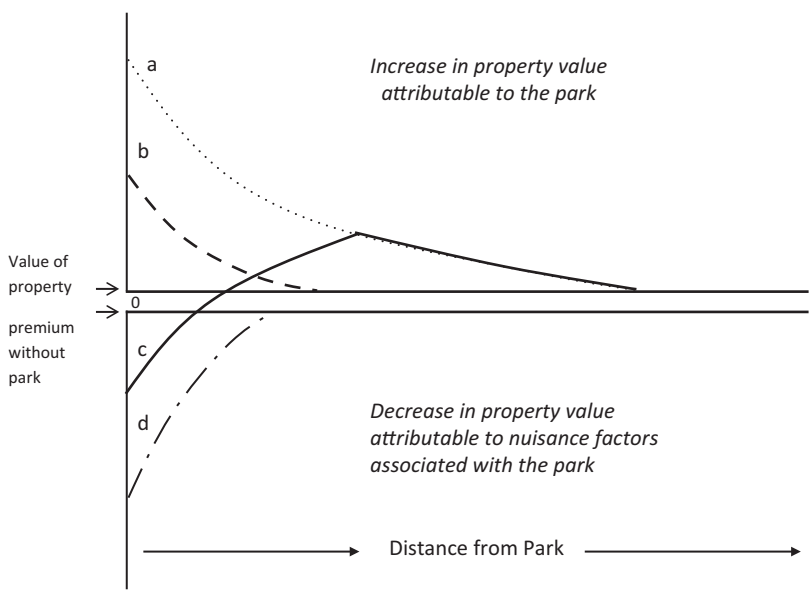

Figure 1. The conceptual model: alternate scenarios reflecting the range of impacts that parks and related amenities may exercise on property values.

negative impact. Most were generally characterized by the "a" and "b" tracks of Figure 1, that is, the magnitude of the positive premium decreased with increased distance. However, several analyses reflected the "c" track, indicating that properties immediately adjacent to a park experienced disamenities such as congestion, noise, street parking, and so on, which nullified amenity benefits, but the disamenity effect disappeared for properties one or two blocks away from the park. A related result that also confirmed a conclusion from the earlier review (Crompton, 2001) was that premiums associated with passive parks invariably were substantially higher than those emanating from active parks.

When the highest premiums reported in each study were tabulated, an approximately equal number were assigned to each of three categories: less than 4%, 5%–9%, and 10% or more. This suggests the recommendation from the 2001 review that 20% on property values abutting or fronting a passive park area as a reasonable starting point guideline was overly generous (Crompton, 2001). A more appropriate starting point guideline on this kind of property would appear to be 8%–10%.

Several studies reported size mattered. The larger the park, the greater was the premium. This is not captured in Figure 1, but tracks "a" and "c," which conceptualize the impacts of larger parks, do show their impact extends over a greater geographical area. This synthesis endorsed a conclusion from the 2001 review that high premiums generally were limited to properties within 500 feet, but for large parks they extended out to 2,000 feet at a relatively low level.

A second conclusion was that the percentage premium associated with multifamily properties or small lots was higher than that associated with single-family or large lot properties. This finding was consistent in all nine studies that addressed this issue. It is explained by privately owned yard space associated with single-family homes serving as a partial substitute for public parks.

A third conclusion emerged from four studies that reported higher premiums accrued from proximity to "permanent" open space, such as parks and lands that were protected by government ownership or had perpetual conservation easements (i.e., have sold their development rights), than for potentially "developable" open space, such as privately owned forest and agricultural land. The premiums essentially measured the effect not only of current land uses, but also of expectations of surrounding land use in the future.

A fourth conclusion stemmed from the tendency to bundle all types of open space into a single proximate variable. This failure to explicitly recognize the heterogeneity of green spaces assumes the same premium is associated with all forms of open space. However, a consistent finding was that premiums for different types of open space varied widely. When a study's dependent variable was aggregated as "open space" or "parks," it meant, for example, cemeteries, athletic fields, and passive parks were all assigned into that single category. Often, the first two showed negative values, so when they were incorporated into a single generic category they countered the positive value of attractive passive parks. Thus, all open space was mischaracterized by a relatively low mean premium. Even when "open space" is disaggregated into categories (local parks, regional parks, cemeteries, athletic fields, forests, and so on), there remains potential for using misleading means since there may be wide variation in quality within categories.

A fifth conclusion emerged because the mega studies embraced more expansive geographical areas. This disregards the reality that urban housing markets invariably consist of multiple submarkets with different subcultures. Proximal neighborhoods may deviate substantially from one another and from a general mean average. The aggregation of neighborhoods with different subcultural characteristics in terms of income, lot size, level of urbanization, different types of housing, ethnic diversity, and so on is inappropriate because it hides wide variations, resulting in regression-to-the-mean values since negative and positive responses in individual neighborhoods counter-balance. If a study shows no significant premium, it is not necessarily evidence that parks had no impact on property values. It is possible the impact was more localized than could be detected in a large mega study. The review consistently illustrated that different premiums were associated with different neighborhoods.

A sixth conclusion that also contributed to smaller premiums than were reported in the earlier review (Crompton, 2001) was a reduction in omitted variable bias, that is, variables that cause spatial variation in sale prices that previously were omitted from hedonic models. This improvement in methodology was enabled by faster computing; access to electronic multi-listing service data and GIS; and more complex, but accurate, statistical tools. Consequently, postmillennium studies were able to include many more potential sources of a property's value in their models. The relatively small number of variables in the earlier models were likely to be highly correlated with variables not included in the models. This resulted in some value being falsely attributed to an amenity included in the study when it really belonging to a somewhat related but different variable that was not included in the model.

Despite these improvements, omitted variable bias remains a concern. Multi-listing services and tax assessors collect only structural data relating to housing units. Variables beyond a property's boundaries that influence price have to be identified, found, assembled, and merged with the structural data sets using common coordinate systems. Researchers will succeed in incorporating some of these identified influences, but gathering a "complete" list of relevant variables is not generally feasible. It is likely that others will be omitted because either they cannot be quantified or they remain unknown to the researcher.

Implications for future research

Five guidelines for future research emerge from the review. First, most of these studies used large sample sizes and had an extensive geographical scope. The most robust and meaningful insights from hedonic analyses are likely to be forthcoming when they are undertaken in localized, homogeneous neighborhoods with smaller data sets. It is a social science aphorism that larger samples are preferable to smaller samples, but in many mega studies the "averaging effect" resulted in artificially low positive and/or negative premiums being reported. Perhaps counterintuitively, this source of inaccuracy is likely to be exacerbated by larger sample sizes because expanding the geographical scope of the sample is likely to draw additional omitted variables and/or more submarkets. Having larger samples composed of data from multiple subpopulations is likely to be an inferior alternative to smaller samples derived by defining the subpopulation(s) of

interest and then collecting data that are representative of them. Disaggregated, more narrowly defined, locally contextualized analyses are required. However, determining the boundaries of submarkets is often a challenging task.

Second, the impact of proximity should be measured not only by distance and accessibility. Measures expressing the amount of open space as a percentage of a neighborhood area within a given radius around a property and addressing the impact on premiums of both street-level and elevated views should be incorporated. If this is not done, then omitted variable bias would likely result in all the premium being inappropriately attributed to distance/accessibility. All three proximity measures—distance, proportion, and view—should be included in a hedonic analysis since residents are likely to attach different values to each of them.

Third, a taxonomy of "parks and open spaces" should be developed that is representative of their various forms in the area of interest. Each of the elements in the taxonomy should be incorporated into a model as a separate variable since green spaces are heterogeneous and their impacts on property values are likely to be different.

Fourth, analyses should include measures of the size of green spaces, whether they are permanent, and their impact on different-sized lots since each of these variables has been shown to influence property premiums.

Fifth, almost all the hedonic analyses reviewed used cross-sectional samples, often sales for a one- or two-year period. In these cases, if the housing market in that limited time period is atypical, then results from the analyses may be atypical. This concern can be ameliorated by incorporating longitudinal changes in the economy and/or in open space provision into the models. This refinement was suggested in an early millennium study in which the author investigated the impact over time of changes in the labor market and in property values of the City of Boulder purchasing 15,000 acres of open space over a 15-year period (Riddel, 2001). More recently, the shift in premiums over time was demonstrated by Walls, Kousky, and Ziyan (2015) in their analysis of the impact of changes in the amount of green cover over a 15-year period on the Meramec River corridor. A similar approach was adopted in Seoul, Korea, where the authors concluded that "the greenbelt effect on a metropolitan land market changes over time. The net effect at any point reflects the facts that greenbelt amenities are congestible, and that the cost of congestion of the area inside the greenbelt changes over time" (Lee & Linneman, 1998, p. 128).

Finally, the overwhelming predominance of significant findings reported in the review arouses concerns about the potential of publication bias, that is, "the tendency of the part of investigators to submit, or the reviewers to accept, manuscripts based on the direction or strength of the study findings" (Scholey & Harrison, 2003, p. 235). Social science research projects with significant results are substantially more likely to be written up and published than are those with null results (Franco, Malhotra, & Simonovits, 2014; Peplow, 2014). The extent of this bias with respect to this review is indeterminable, but its potential existence should nevertheless be acknowledged.

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