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The impact on property prices of the proportion of park-like space in the proximate area

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\textbf{ABSTRACT}

The paper reviewed 22 studies that investigated the impact on house prices of proportion of open space in the proximate area. The expected significant relationship was found in at least one model in 21 of these analyses, providing empirical confirmation of the intuitive recognition that increasing the amount of greenery and open space in a neighbourhood is likely to increase property values. Most of this premium was associated with greenery within 400 metres of a dwelling. There was evidence to suggest that if the amount was relatively low, then the premium was likely to be higher than if greenery and open space were abundant. If much of the open space in proximate areas was permanently protected, then premiums were higher than in areas where the land could be developed at some point in the future.

Empirical studies measuring the impact of parks on the tax base have a long tradition starting with the annual reports of the Commissioners of Central Park from 1858 through 1873 documenting the purported impact of that seminal park on values of property in its surrounding wards (Board of Commissioners, 1875). Until the 1990s, this body of work used distance and accessibility of residences from a park as the metric for measuring impact. In the early 1990s, two additional measures of proximity emerged: views and proportion of green space in a given area. This paper offers a systematic review of the literature that has investigated the impact on residential property values of proportion of park-like space in the proximate area.

The social merit of parks is widely accepted, but many elected officials who are under pressure not to raise taxes from their taxpayers often regard them as costly investments from which there is no economic return. Anecdotally, this is refuted by actions in the real estate market which consistently demonstrate many people are willing to pay a premium to be proximate to a park or green space. In effect, this represents a “capitalization” of the value of “greenscape” to proximate land owners. The higher assessed values of these properties mean their owners pay higher property taxes, which represent a return to the public treasury. The objectives of this review were to identify: (i) the magnitude (if any) of premiums to residential property values associated with the amount of green...
landscapes in a neighbourhood; (ii) the distance within which the presence of greenery and open space had an impact; and (iii) the influence of degree of permanency associated with the greenery on property premiums.

A recent review article identified 33 studies published in the new millennium that used this measure (Crompton & Nicholls, 2020). The authors reported results that varied widely, but they overwhelmingly confirmed the positive impact of parks on property values. In 23 of the studies the preponderance of findings showed a positive proximate premium, while a further seven produced mixed results with positive premiums in some instances but an insignificant impact and/or a negative premium in others. In three of the analyses parks had either no significant impact on sales price or a significant negative impact. 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. The authors concluded, “A premium of 8–10% on properties adjacent to a passive park is a reasonable point of departure” (p. 127).

Another recent paper identified 27 studies that reported the impact of views on property values (Crompton & Nicholls, 2019). The authors excluded iconic views and water views from their review, because “they are atypical of most people’s housing options and atypical of premiums that ‘ordinary’ views command” (p. 2). Among the 17 studies that reported the impact of street-level views, only five reported substantial premiums which ranged from 4.9% to 9.29%; four found either a small increase in value; five reported no impact; and three showed a negative impact, but in all three cases the view was of forest lands and not parks. Hence, the premiums were much lower than the 8–10% emanating from the distance measure. There were 10 studies reporting the impact of elevated views, but nine of them were undertaken in China. The authors suggested that differences in cultural values and urban design characteristics made it unwise to generalize findings to the U.S.

This paper complements findings emerging from the impacts of distance and views by reviewing the results of 22 studies that investigated the impact on residential prices of proportion of park-like space in the proximate area. Studies were identified from a comprehensive search of the literature dating from 1992 in the fields of land economics, resource economics, landscape architecture, and urban planning. “Snowball” searches extended the search by using the references from those studies to studies reported in other fields.

The authors of these studies recognized the mosaic of landscapes that surround a property – a neighbourhood’s character, ambience, and pattern of land use – is likely to influence house price. This effect is usually measured, by specifying the amount of open space as a percentage of a neighbourhood area or within a given radius around a property. Analyses using this measure focus on the broader availability of open space within an area, rather than on the more specific measure of distance and access to defined parks. Table 1 gives a summary of the studies’ findings.

The pioneering studies

The early proximate proportion studies were mostly undertaken in rural areas, where land use was more diverse than in urban areas. The approach was pioneered in two studies in England by the same authors in 1992 (Garrod & Willis, 1992a, 1992b).
Table 1. Summary of findings relating to proportion of open space in the proximate area.

<table>
<thead>
<tr>
<th>Author (year)</th>
<th>Setting</th>
<th>Sample size</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>The pioneering studies</td>
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<tr>
<td>Garrod and Willis (1992a)</td>
<td>Rural areas centred around Forest of Dean, Gloucestershire, England</td>
<td>2000 residential sales over a 5-year period</td>
<td>The average value of houses located in 1 km grid squares which had at least a 20% woodland cover was raised by 7–10%.</td>
</tr>
<tr>
<td>Garrod and Willis (1992b)</td>
<td>Residences located in a 1 km square containing Forest Commission land in Great Britain</td>
<td>1000 residential sales in a 1-year period</td>
<td>Increases in percent of land covered in broad leaved trees resulted in higher house prices; increases in the percent of land planted in conifers (mainly Sitka spruce) led to lower prices; percent planted in larch, Scots pine, and Corsican pine had no effect.</td>
</tr>
<tr>
<td>Cheshire and Sheppard (1995)</td>
<td>Darlington and Reading, England</td>
<td>350 houses 490 houses</td>
<td>Lower availability of amenity land open to the public in Darlington led it to have a higher impact on sales prices (£83–£50) per percentage point of open space in a 1 km square grid; the percentage point premium for closed amenity land (private woodland and farm land) was £101 in Reading and £0 in Darlington.</td>
</tr>
<tr>
<td>Tyrväinen (1997)</td>
<td>Joensuu, Finland</td>
<td>1006 apartments</td>
<td>A higher percentage of area that was forested in a housing district was associated with increased apartment prices.</td>
</tr>
<tr>
<td>Tyrväinen and Miettinen (2000)</td>
<td>Salo, Finland</td>
<td>590 terraced houses</td>
<td>The proportion of forest land in a housing district had no impact on sales price.</td>
</tr>
<tr>
<td>Geoghegan et al. (1997)</td>
<td>7 counties in Patuxent Watershed, Central MD</td>
<td>1 year’s residential sales transactions</td>
<td>Within 0.1 km, increasing proportion of open space positively impacts land values; within 1 km, it negatively influences land values.</td>
</tr>
<tr>
<td>Geoghegan (2002)</td>
<td>Howard County, MD</td>
<td>5599 residential sales</td>
<td>Both permanently protected and developable land had a significantly positive impact on house prices, but the permanent protected premium was three times larger than the developable premium.</td>
</tr>
<tr>
<td>Geoghegan et al. (2003)</td>
<td>Howard, Carroll, and Calvert Counties, MD</td>
<td>10,135 residential sales</td>
<td>In Howard County, both permanent and developable open space had a statistically significant positive impact within both the 100 m and 1600 m buffers. In Carroll County, there was no significant impact within either buffer. In Calvert County, there was a positive significant impact only in the 1600 m buffer.</td>
</tr>
<tr>
<td>Leggett and Bockstael (2000)</td>
<td>Anne Arundel County, MD</td>
<td>1183</td>
<td>Proportion of open space was positively significant (.1 level) in 3 of 6 model specifications when market price was used.</td>
</tr>
<tr>
<td>Acharya and Bennett (2001)</td>
<td>New Haven County, CT</td>
<td>&gt;4000</td>
<td>Increase in percent of open space within a quarter and a one-mile radius led to increase in property value; but as the percentage increased, the magnitude of the premium increase declined.</td>
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<th>Author (year)</th>
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<tr>
<td>Irwin and Bockstael (2001)</td>
<td>Four counties in Central MD</td>
<td>55,799</td>
<td>Two different models both showed that privately owned non-developable land and publicly owned land had a significantly positive effect on price, but the models gave mixed results for private developable land.</td>
</tr>
<tr>
<td>Irwin (2002)</td>
<td>Four counties in Central MD</td>
<td>55,799</td>
<td>The percentage of land in a 400 metre buffer zone around each house in six categories of open space showed the premium for privately protected open space (2.6%) was greater than for publically owned land (1.7%) and both were higher than for privately owned, potentially developable cropland, pastureland, and forests.</td>
</tr>
<tr>
<td>Ready and Abdalla (2005)</td>
<td>Berks County, Southeastern PN</td>
<td>8090</td>
<td>Forested, publically owned open space had the highest premium; and privately owned open space in grass, crops, and pasture also had a positive impact. Protected private land had minimum impact. Its positive values were offset by the negative values of intensive animal production facilities.</td>
</tr>
<tr>
<td>Song and Knaap (2004)</td>
<td>Washington County, Portland, OR</td>
<td>4134</td>
<td>Houses in neighbourhoods with a relatively large percentage of land devoted to public parks had higher prices.</td>
</tr>
<tr>
<td>Henderson and Song (2008)</td>
<td>Wake County, NC</td>
<td>14,564</td>
<td>Premium for each additional 1% of public open space within ¼ mile was $11.26 compared to $4.53 and $8.50, respectively for open space and golf courses. Interaction with yard size was significant for public open space indicating premiums were higher for properties with smaller yards.</td>
</tr>
<tr>
<td>Netusil (2013)</td>
<td>Portland, OR. Single family residences</td>
<td>26,038</td>
<td>No significant differences in the impact on sales prices of public and private ownership in the open space land within a ¼ mile buffer (i.e. natural parks, specialty parks or golf courses); public ownership of water resources (stream and wetland ownership) resulted in significantly higher sales price than privately owned water resources.</td>
</tr>
<tr>
<td>Walls et al. (2015)</td>
<td>Within a 5-mile buffer of the 108 mile Meramec Greenway in St. Louis County, MO</td>
<td>103,705</td>
<td>Increased premiums of 2%, 1.4%, and 0.6% associated with increases in percent of farmland, grassy recreational lands, and forests, respectively.</td>
</tr>
<tr>
<td>Baranzini and Schaerer (2011)</td>
<td>Geneva, Switzerland</td>
<td>Monthly rental of 12,932 apartments</td>
<td>Each additional hectare of natural land and urban park within 1 km, added 0.07% and 0.06% to monthly rents, respectively.</td>
</tr>
<tr>
<td>Czembrowski and Kronenberg (2010)</td>
<td>Lodz, Poland</td>
<td>9346 apartment sales</td>
<td>An additional 1% of greenery increased an apartment’s sale price by 0.1% on average.</td>
</tr>
</tbody>
</table>
Since no detailed public records of house sales are available in the UK, the authors’ data were obtained from a large financial institution that retained data on all residences for which the company approved mortgages over a 5-year period. The data set included a 1-kilometre grid reference for the 2000 rural properties that comprised the sample (towns and cities were excluded). The first analysis reported the average value of houses was raised by 7–10% if the 1-kilometre grid in which they were located had at least a 20% woodland cover (Garrod & Willis, 1992a).

Using a different data set but the same methodology, the authors’ second analysis challenged the implicit assumption that “woodland” was a homogeneous variable, with a generalizable effect on property values irrespective of the type of woodland (Garrod & Willis, 1992b). The authors assigned the percentage of area in each grid occupied by:

Table 1. Continued.

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</thead>
<tbody>
<tr>
<td>Kong et al. (2007)</td>
<td>Jinan City, China</td>
<td>Apartment sales in 120 residential developments</td>
<td>Each 1% increase in proportion of greenspace added 2.1% to the price.</td>
</tr>
<tr>
<td>Jim and Chen (2007)</td>
<td>Guangzhou, China</td>
<td>512 representative apartment sales from 312 developments</td>
<td>Percent increases in greenspace in densely populated old town had a significant positive impact on apartment prices; there was no impact in new town areas which had more generous amounts of greenspace.</td>
</tr>
<tr>
<td>Hoshino and Kuriyama (2010)</td>
<td>Tokyo, Japan</td>
<td>Monthly rentals of 2370 single-room dwellings</td>
<td>Amount of park area within 450 metres was significantly positive; amount within 1 km was significantly negative.</td>
</tr>
<tr>
<td>Innovations</td>
<td>Los Angeles, CA</td>
<td>259 single family homes.</td>
<td>Aggregate amount of greenspace within a 200–300 ft buffer zone was statistically significant in raising property value by 0.076%; the amounts in the 300–400 and 400–500 buffer had no significant impact on property price.</td>
</tr>
<tr>
<td>Heckert and Mennis (2012)</td>
<td>Philadelphia, PA</td>
<td>747 matched parcels</td>
<td>Greening blighted lots with grass and trees had a strong positive effect on property values in moderately distressed areas, but not in highly distressed neighbourhoods.</td>
</tr>
<tr>
<td>Asabere (2014)</td>
<td>Lower Gwynedd Township</td>
<td>1502 single family house sales in a five year period</td>
<td>An average premium of 5.2% for homes in 19 cluster developments attributable to number of acres of permanent open space in a cluster subdivision.</td>
</tr>
<tr>
<td>King and Anderson (2004)</td>
<td>Stratified sample of 29 towns in Vermont</td>
<td>Proportion of land in perpetual conservation easements</td>
<td>Although Perpetual conservation easements taking land off the tax rolls reduced revenues communities in the short term; over the longer term they resulted in an increase in tax revenues as they increased property values.</td>
</tr>
<tr>
<td>Zhang and Dong (2018)</td>
<td>Beijing, China</td>
<td>22,331 sales in 2370 housing estates</td>
<td>A horizontal green view index measured amount of street-visible greenery within a 400 metre buffer; there was a significant positive relationship with apartment prices.</td>
</tr>
</tbody>
</table>
broadleaved woodland; (ii) larch, Scots pine, and Corsican pine; and (iii) all other conifers, mainly Sitka spruce. Overall, the analyses revealed that Sitka spruce depressed house prices by approximately £141 for every unit increase in relative cover, while broad-leaved trees added approximately £43 per unit increase in relative cover. The negative impact of conifers was explained by the importance attributed to light in northern European winters where daylight is confined to 6–8 hours. If mature conifers block that light, then they are likely to be perceived as disamenities.

This finding highlighted the fallacy of treating open space, parks, forests, wetlands, et al. as homogeneous variables. It demonstrated that different impacts are likely to occur not only between major categories of open space, but also within each of those categories. It also highlighted the challenges of accommodating the differing goals of open space suppliers. While broadleaved trees brought amenity benefits to homeowners and developers, they were incompatible with the timber production mission of the Forestry Commission which mandated conifers be planted. However, the results suggested that decreasing the relative proportions of Sitka spruce near residential areas, and replacing it with Scots pine, Corsican pine and larch would reduce the environmental disamenity.

These pioneering efforts were followed by another English study that embraced the new methodology. It measured the proportions of open amenity land to which public access was authorized and closed amenity land with no provision for public access (which was primarily comprised of farmed land and woodland). The analyses were done in the relatively wealthy town of Reading and the much poorer community of Darlington. The mean percentages of open land per kilometre in the two communities were 18.6% and 8.5%, respectively; while for closed land they were 7.8% and 9.1%. Even though it was a poorer community, the lower availability of open land in Darlington led to it having a higher impact on sales price (£83 compared to £50) per percentage point increase; the per percentage point increase premium for closed land was £101 in Reading, but zero in Darlington (Cheshire & Sheppard, 1995).

Soon after, a Finnish team adopted the approach in two towns. It was noted that trees and forests, as a dominant element of the vegetation, form an essential part of the visual image of a typical Nordic town (Tyrväinen, 1997). In Joensuu, a higher percentage of area that was forested in a housing district was associated with increased apartment prices. However, when the same proportionate measure was used in the town of Salo, it did not emerge in the hedonic model as a primary explanatory variable (Tyrväinen & Miettinen, 2000).

Limitations imposed by the secondary data sets available to the English pioneers meant that they had to place each property in a one-kilometre grid square, then measure the percentage of woodland or open space in the grid. This created an aggregate coverage measure that was used for all properties in a square kilometre. The first U.S. researchers to embrace the new proximate proportionality measure were able to take advantage of U.S. data that facilitated disaggregation, so the coverage measure was unique to each property (Geoghegan et al., 1997). The variables included a measure of the percentage open space (forestry and agriculture) within buffers of 0.1 km (“what can be seen from one’s house”) and 1.0 km (“within a 20-minute walk from each parcel”).

The authors concluded: “We find empirical evidence that the nature and pattern of the land uses surrounding a parcel have an influence on the price, implying that people care very much about the patterns of landscape around them” (p. 263). Within a tenth of a
kilometre radius, the proportion of open space positively and significantly impacted land values, but within a 1-kilometre buffer this variable significantly and negatively influenced land prices. The authors suggested this result indicated:

Individuals value open space as a view from their house, but that they prefer more diverse land uses at the larger scale. For example, this could be interpreted that individuals prefer to be able to walk to other important land uses from their houses, such as commercial land uses for local shopping. (Geoghegan, 2002, p. 93)

The lead researcher of that pioneering study in the U.S. followed it with two analyses which investigated whether differential premiums were associated with proximity to “permanent” open space, such as parks and lands that are protected with perpetual conservation easements (i.e. have sold their development rights); and “developable” open space, such as privately-owned forest and agricultural land. This essentially measured the effect of both current land uses and future expectations of surrounding land use. The first study involved a sample from Howard County, Maryland, (which is in the Baltimore-Columbia-Towson Metropolitan Statistical Area) using a buffer zone of 1600 metres. Both measures had a significantly positive impact on house prices, but the permanent open space premium was three times the magnitude of the developable open space and was statistically more significant (Geoghegan, 2002).

The second analysis extended the geographic area of the sample to include Carroll and Calvert Counties in Maryland, as well as Howard County (Geoghegan et al., 2003). Maryland had an aggressive state funded programme for purchasing perpetual permanent development rights on farmland which prohibited nonfarm uses for current and all future owners. The definition of permanent open space in this study incorporated these lands, together with conservation lands owned by private organizations such as land trusts, golf courses, cemeteries and county and federal park land. The developable open space was comprised of agricultural and forested lands that did not have protective easements on them. The proportions of each land use within buffer zones of 100 and 1600 metres were measured. The results were mixed. In Howard County, the results replicated those of the previous study with the 1600-metre buffer. This was expected since the analyses were conducted on the same sample, but they were also replicated at the 100 buffers with both being statistically significant and the permanent premium being higher. In Calvert County, the statistical significance was limited to the 1600 buffer, while in Carroll County neither type of open space was significant at either buffer. The authors explored several potential explanations for the mixed findings but remained “perplexed by the result” (p. 42). The wide variation in the findings reinforces the recognition that impacts on property values are highly dependent on location-specific factors.

Two other studies were undertaken in this same time period in the U.S. On the western shore of Chesapeake Bay, an analysis that measured the percentage of land within three-quarters of a mile that was open space or forest (publicly or privately held) reported the effect of the proportion of open space on market price was significant (but only at the 10% level) in three of the six model specifications (Leggett & Bockstael, 2000). In New Haven County, Connecticut, authors measured the percentage of land classified as open space around each of over 4,000 houses in 13 towns sold over a 5-year period within radii of ¼ (“visual distance”) and 1-mile (“walking distance that defines a neighbourhood”). The open space variable incorporated agricultural land,
forest, marsh and wetlands (Acharya & Bennett, 2001). The results, “suggested that open space is an important feature of neighbourhoods” (p. 271), since an increase in the percent of open space within both radii resulted in a significant increase in the value of property. The increase was at a decreasing rate, that is, as the percentage of open space increased, the magnitude of the increase in premium on property values declined.

Subsequent studies

The focus of Geoghegan et al. (2003) on identifying the different impact of permanent and non-permanent protected open space was embraced by two studies using a large sample of owner-occupied residences in central Maryland. In the first, the authors used two different modeling approaches to analyze three open space variables measuring the percentage of surrounding land in a 400-metre buffer that was in: (i) private developable open space; (ii) private non-developable open space under conservation easements; and (iii) public open space (Irwin & Bockstael, 2001). They did not differentiate between different types of open spaces. Both models showed the second and third categories significantly and positively affected housing prices, with the largest premium emanating from private easement conservation lands. However, they produced mixed results for the proportion of privately owned and developable open space in a neighbourhood. In one model, it was found to have a negative but insignificant effect on price, while in the other it had a significantly positive effect.

The second study (Irwin, 2002) disaggregated the three open space categories into six categories: privately owned (i) crop land, (ii) pastureland, (iii) forests, and (iv) conservation lands protected from development by easements or non-profit conservation organization ownership; (v) publicly owned by a non-military government entity; and (iv) military owned (Fort Meade was in the study area). The percentage of land in the 400-metre buffer surrounding each house that was in each of those six categories was measured. The premium was greatest for houses proximate to easement protected lands (2.6%) and publicly owned non-military land (1.7%). It was suggested that the privately protected land yielded a higher premium than the publicly owned land, because the latter was available to people from outside the local area. They may generate a spillover nuisance cost by reducing privacy and increasing congestion which was not present on privately owned open space. Premiums declined for the three private non-protected uses. The results suggested the premium for open space was influenced more by it being non-developable than by particular features of the landscape. The analyses showed, that “surrounding open space significantly influences the residential sales price of houses, and that different types of open space have differing effects” (p. 478).

The first five of these categories were used in a study undertaken in Berks County in southeastern Pennsylvania (Ready & Abdalla, 2005). Again, the percentage of land within a 400-metre buffer was measured that was open space, multi-family units, single family residences, commercial, and industrial. The largest positive impact was forested, publicly owned open space. It was substantially higher than the other four land use categories. However, privately owned open space in grass, pasture and crops also had a positive impact. In contrast to the Maryland study, open space protected by easements was significantly less valued than non-easement protected land. The authors explained this finding by suggesting:
The purchase of a conservation easement may not in and of itself drive neighbouring house prices down. Rather, conservation easements may tend to be associated with a certain type of open space (actively farmed, productive farmland) that may be less desirable as a close neighbour. (p. 324)

In both the Maryland and the Berks County studies the premium values were small. This may be a function of three factors: (i) the self-cancelling effect on mean values of open space positive effects being offset by disamenity valuation associated with proximity to some forms of agriculture, such as large scale intensive animal production facilities; (ii) averaging the proximate premium over 400 metres because most proximate value is likely to be captured within 150 metres and the value decay beyond that distance is substantial, so that at 400 metres it is likely to be close to zero; and (iii) some parts of the study areas were rural with zoning ranging from 1 to 5 acre minimum lot size, so the supply of private open space was relatively plentiful.

Song and Knaap (2004) in a Wake County, North Carolina, study of mixed use developments, incorporated a proportion measure as well as a distance measure of proximity and concluded that prices increased “for houses that are closer to public parks or are located in neighbourhoods with a relatively large percentage of land devoted to public parks” (p. 675). In a subsequent Wake County study, the lead author used two different specifications to evaluate the impact of the percentage of public open space, private open space, and golf course areas within ¼ mile of each property in the sample. Coefficients were positive in all six cases. The premium for each additional one percent of public open space within ¼ mile was $11.26. For private open space and golf courses, the premiums were $4.53 and $8.50, respectively. Thus, the public lands premium was 250% higher than the premium for private lands (Henderson & Song, 2008).

In Portland, Oregon, Netusil (2013) suspected that private entities were less likely to offer permanent protection to open space than public entities. Consequently, she hypothesized single family residences within a ¼ mile buffer of each property that had relatively large proportions of open space and water resources would have a greater impact on sales price if they were publicly rather than privately owned. This hypothesis was confirmed in the case of water resources (streams and wetlands). She suggested this may reflect differences in accessibility, quality of the resources, and beliefs about future management. However, there was no significant difference in the impact on sale prices of public and private ownership of open space in the form of natural areas, specialty areas or golf courses.

The most sophisticated and exhaustive study of the influence of different types of open space using a proportion measure was undertaken in southern St. Louis County, Missouri (Walls et al., 2015). The sample of 130,702 comprised all properties that sold more than once between 1988 and 2012 within a 5-mile buffer of the 108-mile Meramec Greenway. The measure of proximity was percentage of farmland, forest, and grassy recreational lands within a 200-metre buffer area around each property. Three models were used: Property fixed effects, pooled model with census tract fixed effects, and pooled model with census tract and sale year fixed effects. The 200-metre buffer was an easy walkable distance, providing a measure of accessible open space (similar results were obtained when a 400-metre buffer was used). Most studies are cross-sectional, that is, they report influence at a point in time. This study represented
an important advance because it was longitudinal, measuring percentage of land cover area at three time periods: 1992, 2001, and 2006, so the influence of changes in the natural proximate landscape over time could be measured. The authors reported:

Looking at the property fixed-effects model [which was the authors’ preferred model], all of the measures of proximity to natural areas appear to increase home values: The greater the percentage of a 200-metre buffer around a property in either farmland, grassy recreational lands, or forest, the higher the sale price; however, all the impacts are fairly modest. A 10% increase in farmland, recreational grasslands, and forest cover in the buffer increased sale prices by 2 percent, 1.4 percent, and 0.6 percent, respectively. (p. 12)

They went on to note that only the farmland coefficients were statistically significant. The repeat sales and fixed-effect approach controls for unobserved attributes of the house and/or location. It works because the model assumes a constant premium, so the influence of changes in the natural proximate landscape over time could be measured. However, changes in the supply/availability of open space – for example, loss of it to development – make it likely that premiums will change over time (Riddel, 2001; Smith et al., 2002).

Two studies in Europe and three in south-east Asia added to the literature and suggested that the positive impact of local greenery was generalizable beyond the U.S. In Geneva, the impacts on monthly rental rates of amount of surface area of urban parks and area defined as “natural” (including trees and forests, agriculture and water, but not parks) within a 1 kilometre radius of apartment buildings, were measured. Both variables demonstrated significant positive effects, with each additional hectare of natural land use and urban park within 1 km adding 0.07% and 0.06% to rents, respectively (Baranzini & Schaerer, 2011). In Lotz, Poland, the percentage of green space in a 500-metre radius which was used to represent the “general ambient condition” of an apartment’s neighbourhood had a statistically significant impact. On average, an additional 1% of greenery increased the apartment sale price by .01% (Czembrowski & Kronenberg, 2010).

In Jinan City, China, Kong et al. (2007) reported that apartments with a higher percentage of green space within 300 metres had higher house values, with 1% of green space adding 2.1% to the price. The effect was confirmed by a similar result when the number of green spaces within 500 metres was used as an alternate measure. Results from Guangzhou, China, reinforced the likelihood of premiums being linked to level of available greenery. The old town and new town areas of Guangzhou are radically different. Whereas the old town is densely populated with very little green space, the modern high-rise apartments in new town areas are provided with much more generous amounts of green space. The shortage of old town green spaces meant that a higher proportion of green space within a residential precinct had a significant positive impact on apartment prices, whereas in new town areas the impact was insignificant (Jim & Chen, 2007).

The amount of park area within a 450 metre and 1 kilometre radius of each of the 2370 single room dwellings that comprised the sample were used to represent access to neighbourhood parks in Setagaya Ward, Tokyo, Japan. The dependent variable was the monthly rent. The variable representing park space within 450 metres was significant and positive, whereas that representing park space within 1 kilometre was significant
and negative. The authors noted these results were consistent with those reported by Geoghegan et al. (1997) but struggled to reconcile them. However, the magnitude of the coefficients was small and several other factors were more influential in determining rents (Hoshino & Kuriyama, 2010).

Innovative adaptations of the proximate open space proportionality measure

Five studies used adaptations of the measure which demonstrate its potential beyond the fairly standardized form reported in the previous studies reviewed.

An unusually inclusive measure of green space was used by Conway et al. (2010). Their analysis of 259 single family homes sold in an 18-month period in the Vermont corridor, an older region in central Los Angeles, used aerial photographs to digitize the amount of greenspace within three buffer zones around each property. “Green area” embraced the street and private tree canopy, parks and private lawns, landscaped areas, and other types of green cover such as sports fields and cemeteries. The area within 200 feet was excluded since it was likely to include a property’s lot. The three buffers consisted of concentric rings. Their radii, with the median amount of green area shown in parenthesis, were: 200–300 ft (0.8 acre), 300–400 ft (1.13 acres), 400–500 ft (1.46 acres). Thus the median greenspace coverage within a 500 ft radius was 3.4 acres – about the size of a small neighbourhood park. The model’s coefficients were .076, .068, and .004 for the three buffer zones, respectively, indicating there was a decay pattern. That is, the same amount of green space had a larger effect on the sale price when it was located closer to a property. The 200–300 ft coefficient was significant indicating that increasing greenspace inside that ring would increase the property value by 0.076%. The other two rings were not statistically significant and were probably too far from houses in the sample to have a noticeable impact.

Philadelphia’s economic base, and consequently population, had substantially declined, so there were 40,000 empty, blighted lots and abandoned properties. The city implemented a programme of greening these areas, keeping them mowed, and ringing them with trees. This was a minimalist treatment designed to improve the physical condition and aesthetics of blighted neighbourhoods. These vegetated open spaces were not parks and remained in private ownership. Heckert and Mennis (2012) evaluated the impact of this programme on property values with a difference-in-differences method which is a nonparametric estimation technique rather than regression. This approach investigates whether an intervention influences an outcome over time by comparing observed differences in a treatment sample that receives the intervention with a control sample from the same population that does not receive the treatment.

The 747 parcels treated over a 7-year period were carefully matched with a sample drawn from 17,471 untreated parcels that also qualified for the programme, but to that point had not been treated. The sample paired each treatment parcel with three untreated parcels which had similar contextual characteristics. The results showed the “magnitude of the influence of the programme on property values varied substantially” (p. 3021). In distressed areas of the city the programme had a positive effect on nearby property values, but this positive effect did not occur in non-distressed areas. When the distressed area data were analyzed separately, it was found the positive effect was
strong in the moderately distressed areas, but not in highly distressed neighbourhoods. The authors ascribed this to those areas being overwhelmed by so many other negative issues that greening vacant lots was relatively insignificant in enticing potential home buyers or developers to invest in them.

The attraction of cluster developments is that they group residences relatively densely, so yard maintenance is not required. They compensate for the lack of private open space by leaving a portion of the site as permanent open space whose use is either restricted to owners of property in the development, or available to all members of the public. The efficacy of this strategy was tested in the 11,000 population Lower Gwynedd Township, Pennsylvania. The impact of the number of acres of permanent open space in 19 cluster-style subdivisions was assessed in a hedonic analysis which revealed a premium of 5.2% on average was attributable to the open space. This was the highest contributor to the overall premium associated with cluster developments. The author concluded: “The empirical findings of the study provide empirical support for organic, green-by-design residential development” (Asabere, 2014, p. 254).

To this point, all the studies reviewed have investigated the impact on individual house sale prices, but a Vermont study used a proportion measure to estimate the impact of perpetual conservation easements on communities’ effective tax rates. Easements transfer some of land’s value to a non-profit entity that does not pay property taxes. Since the cost of city services does not decline, it seems likely there will be property tax increases on all taxable properties in the jurisdiction. However, the permanent open space they provide may be capitalized into the value of nearby properties, which may offset any decrease in the tax base caused by easements.

The Vermont analysis selected a stratified sample of 29 towns drawn from the state’s 251 towns, and calculated the proportion of land in each community that was in private conservation. The percentages ranged from under 1% to over 10%. The authors analyzed the effect of conservation easements over an eight-year period. The results are summarized in Table 2. They showed easements increased tax rates in the very short term, but over the longer term they led to decreases in the tax rate. The shift over time was explained by land prices increasing as the supply of developable land decreased, and/

<table>
<thead>
<tr>
<th>Model</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Year 6</th>
<th>Year 7</th>
<th>Year 8</th>
<th>Total/Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990–1999</td>
<td>$8.40</td>
<td>16.80</td>
<td>6.70</td>
<td>19.60</td>
<td>11.70</td>
<td>5.20</td>
<td>−1.90</td>
<td>0.10</td>
<td>$8.33</td>
</tr>
<tr>
<td>1995–1999</td>
<td>$15.80</td>
<td>11.10</td>
<td>−10.10</td>
<td>4.30</td>
<td>−10.90</td>
<td>−25.70</td>
<td>−20.70</td>
<td>−27.00</td>
<td>$7.90</td>
</tr>
</tbody>
</table>

The annual and total 8-year tax cost of a 100-acre easement on a hypothetical $100,000 property is shown in the table. In the 8-year model (1990–1999), it cost the owner of the property $66.60, or $8.33 per year. In the model based data from only the latter five years, the same easement saves the owner an average of $7.90 per year. The models provide different results because it was not until the latter half of the 1990s that many Vermont residents became aware of development threats and, therefore, the benefits of living in towns with more conservation land. This structural shift in the real estate market accelerated the capitalization of guaranteed open-space into surrounding property values.

The wealth of town land owners increased as a result of the easement, but in the illiquid form of property equity. Ceteris paribus, the portion of town expenditures originally assessed on the conserved land must be shifted to other properties, meaning landowners whose property values increased as a result of the easement probably pay more in property taxes than before the easement. Residents nearest the easement will experience the greatest increase in annual tax bills but, for many, the increase in their property’s equity will offset the higher bills.

or increased demand for developed and developable land with proximity to the amenities provided by the conserved property (King & Anderson, 2004).

The innovative adaptation created by researchers in Beijing, China, was the creation of a horizontal green view index (HGVI) to measure the ambience of neighbourhoods in the city. It was designed to measure whether street-visible greenery around residential developments had an impact on housing prices. The mean value of all HGVI street views within a 400-metre buffer was incorporated into a hedonic analysis. It had a significant and positive relationship to house prices. The authors concluded that high-quality streetscapes neighbouring a residential unit added a premium to apartment prices (Zhang & Dong, 2018).

Discussion

The paper reviewed 22 studies that investigated the impact on house prices of proportion of open space in the proximate area. They were summarized in Table 1. The study’s first objective was to identify the magnitude (if any) of premiums. The expected significant relationship was found in at least one model in 21 of these analyses, providing empirical confirmation of the intuitive recognition that increasing the amount of greenery and open space in a neighbourhood is likely to increase property values. While the measures used in many of the analyses meant it was not possible to express the magnitude of the premium in percentage terms, for the most part they were relatively small compared to those associated with the 8–10% distance premium reported by Crompton and Nicholls (2020), and more consistent with those attributed to views typically in the 1–3% range (Crompton & Nicholls, 2019).

Two studies suggested the amount of open space in a neighbourhood appeared to influence the magnitude of premiums associated greenery. If the open space was relatively low, then the premium for greenery was likely to be higher than if open space was abundant (Cheshire & Sheppard, 1995; Jim & Chen, 2007). However, in contrast, Song and Knaap (2004) reported higher prices in neighbourhoods with a relatively large percentage of land devoted to public parks.

The second objective referred to the distance within which the “greenscape” had an impact. Most of the premium was generated within 400 metres. This range is greater than that reported in the synthesis of distance metric studies (Crompton & Nicholls, 2020). This may reflect an increased range for attractive “walkability” from a residence, compared to access to a specific park.

With regard to the third objective assessing differences in premium associated with permanent and temporary greenscape, the premiums for proximate areas that were permanently protected were higher than those without this guarantee (Geoghegan, 2002; Irwin, 2002; Irwin & Bockstael, 2001). Perhaps the only counter-intuitive finding was reported by King and Anderson (2004). They reported that although encouraging private sector permanent protection through the use of conservation easements in the short term was likely to lead to reduced revenues to local jurisdictions because the land value was either removed from the tax rolls or reduced, in the long term the enhanced value of properties created by the protected open space was likely result in an increase in their tax revenues.

A key methodological insight emerging from the review is the necessity to recognize that open space, parks, forests, wetlands etc. are likely to have different impacts and not to treat them as a homogenous single variable. This is likely to be embraced in future studies. The diversity of new approaches to measuring the impact of proximate
“greenscape” described in the last section of the paper suggests that, methodologically, this literature can reasonably be characterized as embryonic.

This systematic review of findings using the relatively new metric of proportion of open space, demonstrates that it has an impact on property values that complements and supplements the other proximate measures of distance and views. A clear implication is that all three measures of proximity – distance, view and proportion – should be included in hedonic analyses, since residents are likely to attach different values to each of them.

**Disclosure statement**

No potential conflict of interest was reported by the author(s).

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