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Analysis

The value of urban tree cover: A hedonic property price model in Ramsey and Dakota Counties, Minnesota, USA

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ABSTRACT

Urban tree cover benefits communities. These benefits' economic values, however, are poorly recognized and often ignored by landowners and planners. We use hedonic property price modeling to estimate urban tree cover's value in Dakota and Ramsey Counties, MN, USA, predicting housing value as a function of structural, neighborhood, and environmental variables, including tree cover, using a spatial simultaneous autoregressive (SAR) error model. We measure tree cover as percent tree cover on parcels, and within 100, 250, 500, 750, and 1000 m. Results show that tree cover within 100 and 250 m is positive and statistically significant. A 10% increase in tree cover within 100 m increases average home sale price by $1371 (0.48%) and within 250 m increases sale price by $836 (0.29%). In a model including both linear and squared tree cover terms, tree cover within 100 and 250 m increases sale price to 40–60% tree cover. Beyond this point increased tree cover contributes to lower price. Tree cover beyond 250 m did not contribute significantly to sale price. These results suggest significant positive effects for neighborhood tree cover, for instance, for the shading and aesthetic quality of tree-lined streets, indicating that tree cover provides positive neighborhood externalities.

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1. Introduction

Trees in urban areas provide a wide range of benefits including protection against soil erosion, provision of habitat for wildlife, local air quality improvements, reductions in the urban heat island effect, energy savings through building shading and insulation, carbon sequestration, and reductions in stormwater runoff (Dwyer et al., 1992; Sailor, 1995; Laverne and Lewis, 1996; Scott et al., 1998; Simpson, 1998; Simpson and McPherson, 1996; McPherson et al., 1999, 2005; Beckett et al., 2000; Xiao et al., 1998; Brack, 2002; Nowak and Crane, 2002; Maco and McPherson, 2003; Nowak et al., 2006a). Urban tree cover also provides cultural benefits that lead to improved quality of urban life as trees may improve the scenic quality of a city neighborhood, provide privacy, reduce stress, shelter residents from the negative effects of undesirable land uses, and improve retail areas by creating environments that are more attractive to consumers (Dwyer et al., 1991; Sheets and Manzer, 1991; Hull, 1992; Laverne and Winson-Geideman, 2003; Westphal, 2003; Wolf, 2005; Ellis et al., 2006). These local benefits of urban tree cover, although generally recognized, are often poorly understood by local policy-makers and may be negatively impacted by local policies or the lack thereof.

Urban trees may also generate more widespread benefits. Cultural benefits arguably extend at least to neighborhoods and environmental benefits may accrue to the entire urban area (e.g., reduction of the urban heat island effect) or beyond (e.g., carbon sequestration). Tree planting, therefore, is likely to generate positive externalities and decision-making by private landowners will likely result in too few trees being planted.

Despite the range of benefits and the likelihood of positive externalities, most urban areas do little to maintain or expand tree cover. Several cities have programs to encourage tree planting. For example, the Los Angeles Department of Water and Power's Trees for a Green LA Program provides free shade trees to city residents (http://www.ladwp.com/ladwp/cms/ladwp000744.jsp). Other cities make use of zoning regulations to regulate urban tree cover. For example, St. Paul, MN requires a permit to remove or plant trees directly bordering public streets, Boston, MA requires public hearings to remove healthy shade trees in public areas, and Portland, OR requires permits to remove trees on both public and private properties. However, most cities do not have programs to encourage tree planting and restrictions on tree cutting, if they exist, generally only apply to trees in public areas and along roadways and not to trees on private property.

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Table 1
Summary of previous studies of the economic value of urban trees.

Study	Measurement used	Location	Method	Results
Anderson and Cordell (1988)	Number of large, small, pine, and hardwood trees in front yards of residential single family properties	Athens, Georgia, USA	Hedonic property price	Trees were found to be associated with a 3.5%–4.5% increase in homes sales price
Brack (2002)	Number, health, and size of trees planted in streets and parks	Canberra, Australia	Calculated dollar value of trees in terms of energy reduction, pollution mitigation, and carbon sequestration	Planted trees were estimated to have a combined value in terms of energy reduction, pollution mitigation, and carbon sequestration of US$20–67 million during the 2008–2012 time period
Dombrow et al. (2000)	Dummy variable to indicate single family residential properties that had mature trees	Baton Rouge, Louisiana, USA	Hedonic property price	The presence of mature trees on a parcel contributed about 2% to home sale prices
Garrod and Willis (1992)	Percentage of forested areas of broadleaved trees, larch, Scots pine, Corsican pine, and other conifers on Forestry Commission lands for homes located in 1 km squares	Great Britain	Hedonic property price	Broadleaved trees positively impacted home sales prices while coniferous trees negatively impacted home sale prices
Holmes et al. (2006)	Damages from exotic forest pest as indicated by hemlock health and percent deciduous, coniferous, and mixed forest types on parcels and within 0.1 km, 0.5 km, 1 km buffers of parcels	Sparta, New Jersey, USA	Hedonic property price	Deciduous cover within 0.5 km and 1 km of homes positively impacted property values, coniferous cover within 0.5 km enhanced property values, and mixed forests within 0.5 km and 1 km of homes negatively impacted property values; hemlock health significantly positively impacted property values
Jim (2006)	Detailed data on size, species, health, structure, appearance, rarity, and habitat of heritage trees	Hong Kong	Expert method (developed by author)	Values for individual heritage trees ranged from HK$3.0 million to HK$4.39 million depending on tree species and characteristics
Maco and McPherson (2003)	Tree survey data	Davis, California, USA	Calculated total annual expenditures for urban forest management (e.g., planting, tree maintenance, damage mitigation) and total benefits (through direct and implied valuation) of urban forests (energy savings, atmospheric carbon reduction, stormwater runoff reductions, air quality improvement, and aesthetic) for use in benefit–cost analysis	Benefits ($1.7 million) exceeded costs ($449,353) by $1,248,464 annually for an average benefit of $52.43 per publicly maintained tree. The benefit–cost ratio was 3.78:1.
Mansfield et al. (2005)	Percentage of residential single family parcel that was forested, acres of forest on a parcel, percentage of forested land within 400 m, 800 m, and 1600 m buffers around parcel, distances to private and institutional forests	Research Triangle, North Carolina, USA	Hedonic property price	Proximity to both forest types and proportion of parcel that was forested increased home sales prices, increasing forest cover on parcel by 10% adds less than $800 to home sales prices while adjacency to private forests add more than $8000
McPherson et al. (1999)	Survey data for street and park trees	Modesto, California, USA	Calculated total annual expenditures for urban forest management (e.g., planting, tree maintenance, damage mitigation) and total benefits (through direct and implied valuation) of urban forests (energy savings, atmospheric carbon reduction, stormwater runoff reductions, air quality improvement, aesthetic) for use in benefit–cost analysis	Benefits were valued as follows: aesthetic — $1,455,636, air quality improvement — $1,442,036 ($15.82/tree), energy savings — $1,000,560 ($10.97/tree), stormwater runoff reductions — $616,139 ($6.76/tree), carbon sequestration — $449,445 ($4.93/tree), total — $4,964,816 ($54.44/tree). Costs totaled $2,623,384. The benefit–cost ration was 1.89:1.
McPherson et al. (2005)	Tree survey data	Fort Collins, Colorado; Cheyenne, Wyoming; Bismark, North Dakota, Berkeley, California; and Glendale, Arizona, USA	Calculated total annual expenditures for urban forest management (e.g., planting, tree maintenance, damage mitigation) and total benefits (through direct and implied valuation) of urban forests (energy savings, atmospheric carbon reduction, stormwater runoff reductions, air quality improvement, and aesthetic) for use in benefit–cost analysis for each city	Benefits were valued as follows: aesthetic — $21–$67/tree, stormwater runoff reduc tion — up to $28/tree, energy savings — up to $15/tree, carbon reduction — $1–$2/tree, air quality improvement — $—0.57–$1.52/tree, total — $31–$89/tree. Benefits exceeded costs in all cities with benefit–cost ratios ranging from 1.37:1 to 3.09:1.
Morales et al. (1976)	Binary variable to indicate whether home had good or poor tree cover	Manchester, Connecticut, USA	Hedonic property price	Tree cover increased property values by 6% ($2686)
Morales (1980)	Binary variable to indicate whether a property has good tree cover or not	Manchester, Connecticut, USA	Hedonic property price	Tree cover increased property values by 6%
Morales et al. (1983)	Binary variable to indicate whether a property had mature tree cover or not	Greece, New York, USA	Hedonic property price	Trees on wooded lots added 10%–17% to home sale prices
Nowak et al. (2006b)	Number of trees, species, and canopy cover	Minneapolis, MN	Calculated dollar value of trees in terms of air pollution mitigation and carbon sequestration	Urban forest's carbon storage is valued at $46 million and annual carbon sequestration valued at $164,000. Tree and shrubs together remove $1.9 million worth of air pollution per year. Total structural value of the area's forests is estimated at $756 million.
Nowak et al. (2006c)	Number of trees, species, and canopy cover	Washington, D.C.	Calculated dollar value of trees in terms of air pollution mitigation and carbon sequestration	Urban forest's carbon storage is valued at $9.7 million and annual carbon sequestration valued at $299,000. Trees remove $2.5 million worth of air pollution per year. Total structural value of local forests is estimated at $3.6 billion.

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