Graphic Detail

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Tree Equity Scores and Housing Choice Voucher Neighborhoods

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Abstract

Urban greenery has considerable advantages to populations, particularly mental and physical health benefits. Tree canopy in urban areas is linked to reductions in surface temperature, reductions in chronic illnesses, improvements in air quality, and more. A new dataset, the Tree Equity Score, is a metric that describes the intersection between urban tree canopy cover and socioeconomic factors. This analysis examines Tree Equity Scores in six cities chosen on the basis of their participation in the C40 Cities Climate Leadership Group, then evaluates if differences exist between neighborhoods where Housing Choice Voucher households are present and neighborhoods where they are absent. In five of six cities, Tree Equity Scores are higher in neighborhoods where Housing Choice Voucher households are absent.

Background

Co-benefits of urban greenery[1] have been associated with greater physical and mental well-being, ecosystem services, social support, and even economic opportunities (Beyer et al., 2014; Bowler et al., 2010; Maas et al., 2006). Those benefits often are realized locally but distributed unequally, spurring environmental justice conversations about the need for more equitable green planning. Housing Choice Voucher (HCV) households frequently live in low-opportunity neighborhoods, and previous studies have shown that lower-income neighborhoods tend to have less greenery than higher-income neighborhoods (Locke et al., 2021). The purpose of this analysis is to further explore the relationship between HCV presence in block groups and Tree Equity Scores (TES).

Data

The HCV program subsidizes housing for more than 2.2 million low-income households (HUD, n.d.). HCV households have the potential to choose their own rental location but often remain spatially concentrated, particularly in areas of poverty and low opportunity (McClure, Schwartz, and Taghavi, 2015). HCV households are present in 72.7 percent–82.2 percent of block groups in the six cities included in this analysis, reflecting findings in previous HCV location research (Devine et al., 2003; McClure, Schwartz, and Taghavi, 2015).

The TES was released in November 2020 by American Forests[2] to identify neighborhoods that have sufficient (or insufficient) tree coverage to ensure that neighborhoods equitably experience the benefits of green space (American Forests, n.d.). The TES incorporates environmental data such as existing tree canopy and surface temperature along with socioeconomic data into its formula.[3] Tree Equity Scores are adjusted by American Forests in each city to account for local biomes.

This study analyzed HCV and TES data in Boston, Los Angeles, New York City, Portland (Oregon), Seattle, and Washington, D.C. These six cities were chosen because they have chosen to participate in the C40 Cities Climate Leadership Group (C40), an initiative for cities committed to tackling climate change and driving urban action that improves the health, well-being, and economic opportunities of urban citizens (C40 Cities, n.d.). These cities have committed to inclusive climate action goals set forth by the Paris Agreement.[4] Because of those commitments, the authors believe that analysis of low-income rental subsidized households and urban green equity is particularly relevant.

Analysis

Exhibit 1 visualizes the distribution of TES values for each city, delineated by the presence of HCV households in the block group as box and whisker plots. Outliers are shown as dots outside the whiskers. Values for the TES skew toward a score of 100 because this score represents "acceptable"

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[1] *Urban greenery* is defined by the U.S. Environmental Protection Agency as "all vegetated land, including agriculture, lawns, forests, wetlands, and gardens. Barren land and impervious surfaces such as concrete and asphalt are excluded."

[2] American Forests, founded in 1875, is the oldest nonprofit environmental conservation organization in the United States.
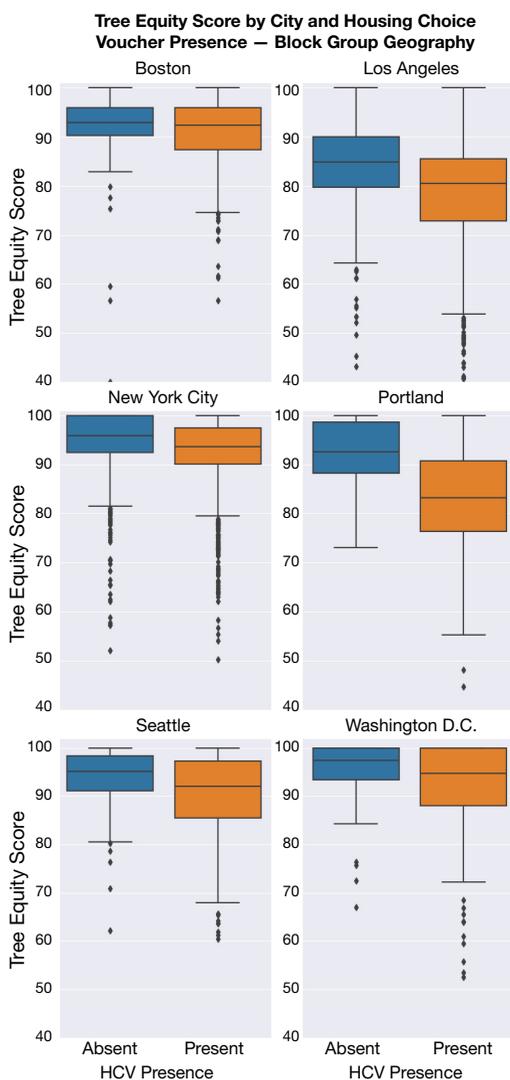
[3] The socioeconomic data include income, employment, race, age, climate, health, existing tree canopy, surface temperature, and population density.

[4] C40 Cities commit to limiting global temperatures to 1.5 degrees Celsius above preindustrial levels.

tree equity. The TES formula does not produce a "perfect" tree equity score; therefore, a wide range between tree equity scores is not as apparent. All cities had lower TES values in their HCV-present block groups than HCV-absent block groups, suggesting that HCV neighborhoods tend to have lower mean TES and higher variance in TES than non-HCV neighborhoods. Los Angeles had the lowest median TES in HCV-present and HCV-absent neighborhoods. Boston showed a minimal difference (0.6) in the median TES between HCV-present and HCV-absent neighborhoods. Portland HCV-absent neighborhoods had the lowest median TES compared with HCV-present neighborhoods.

Exhibit 1

Box Plot of Tree Equity Scores by City and Housing Choice Voucher Presence

Tree Equity Score by City and Housing Choice Voucher Presence — Block Group Geography

HCV = Housing Choice Voucher.
Source: American Forests, n.d., with calculations and visualizations created by the authors

Because of the patterns observed from visual inspection of the distributions in the box plots, a comparison was made between the TES means of each group in each city. The TES means were bootstrapped at the 95th confidence interval to produce non-parametric 95th-percent confidence intervals for TES mean scores to determine if the values between HCV-present and HCV-absent neighborhoods are different (Pezzullo, 2013). This method was used instead of more traditional measures because of the non-normal distributions and unequal numbers of observations in each group. The results are shown in exhibit 2. In five of the six cites, the confidence interval values for TES means between HCV-present and HCV-absent block groups do not overlap; each pair of distributions is statistically significant, therefore the difference in TES means in each city is significant at the 0.05 level. Only in Boston, which had the lowest difference in TES medians (shown in the box plot in exhibit 1), did the means confidence intervals overlap, suggesting that no significant difference exists in TES values between HCV-present and HCV-absent neighborhoods in Boston. Portland had the largest gap between HCV-present and HCV-absent neighborhoods. Portland also had the largest difference in visual analysis of the box plot set and the largest difference between confidence interval sets, suggesting that Portland has relatively greater discrepancy between TES values across neighborhoods.

Exhibit 2

Bootstrap Means (95th Confidence Interval)

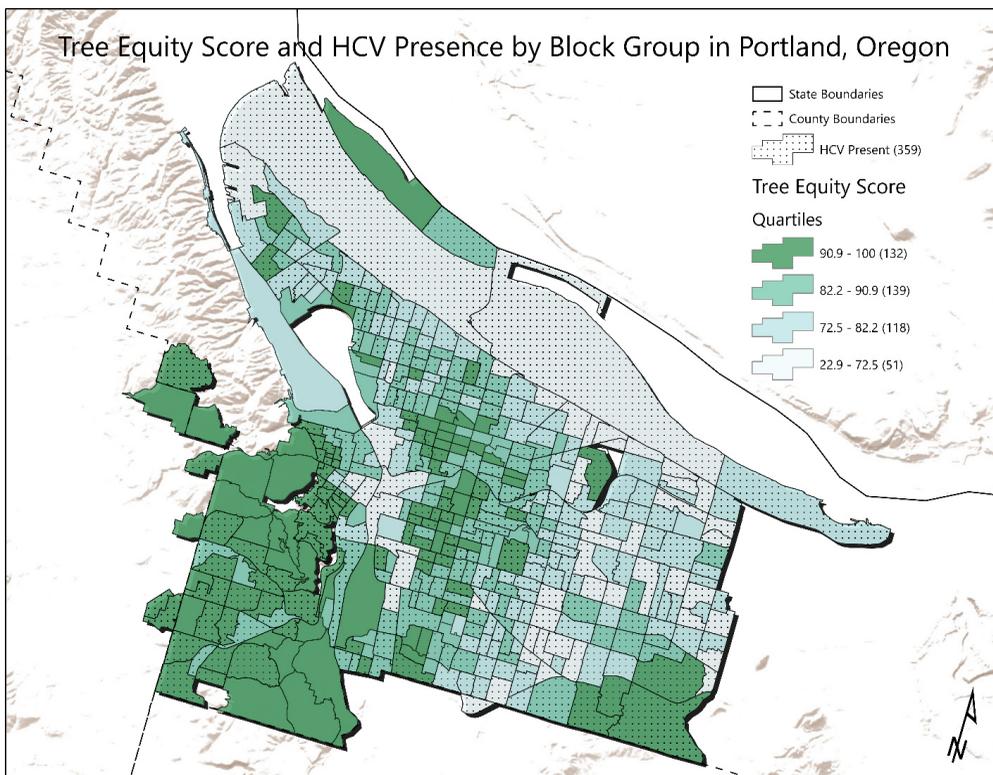| City	Bootstrapped TES Means			
	HCV-Present Block Groups		HCV-Absent Block Groups	
	2.5 Percentile	97.5 Percentile	2.5 Percentile	97.5 Percentile
Boston	90.37	91.67	89.70	93.19
Los Angeles	78.53	79.39	83.17	84.62
New York City	92.97	93.29	94.57	95.12
Portland	82.17	84.21	90.78	93.64
Seattle	89.81	91.53	92.65	95.26
Washington, D.C.	91.47	93.25	93.80	96.58

HCV = Housing Choice Voucher. TES = Tree Equity Score.
Source: Bootstrapped 95th Confidence Interval for Tree Equity Score by city and presence of HCV households from Tree Equity Score values

Exhibit 3 maps TES values and the presence of HCV households in Portland. The choropleth symbology indicates TES value; darker colors refer to higher TES. The dotted symbology indicates the presence of HCV households in a block group. A significant amount of greenery in Portland is west of downtown. This area contains several large parks, Lewis & Clark College, the Hoyt Arboretum, and the Oregon Zoo. The average TES value in the South Hills (Southwest Portland) and Forest Parks (Northwest Portland) neighborhoods is 95–100, and those neighborhoods have little to no HCV presence. Southwestern and northwestern Portland contains many of the wealthiest neighborhoods, which aligns with previous studies showing a correlation between neighborhood greenery and neighborhood incomes (Wolch, Byrne, and Newell, 2014). Outside those wealthy neighborhoods, most other neighborhoods in Portland have HCV households. Tree Equity Score values vary in those neighborhoods, but the majority have a score of 85 or less.

Exhibit 3

Tree Equity Score and HCV Presence by Block Group in Portland, Oregon
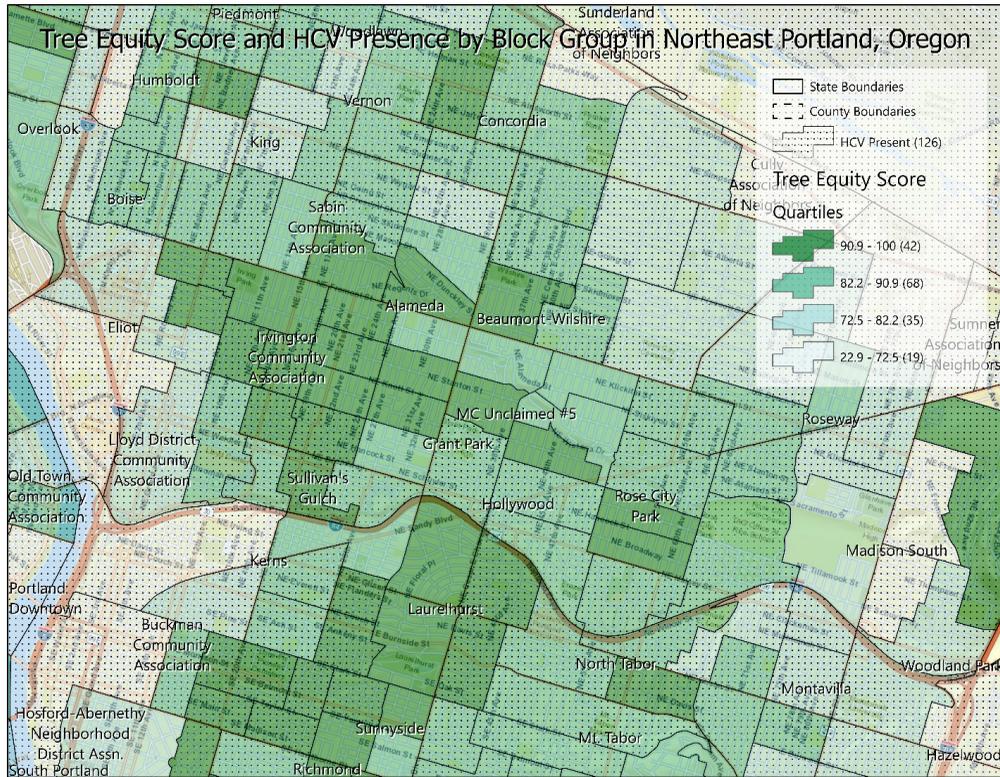

HCV = Housing Choice Voucher.
Note: Tree Equity Score is mapped by quartiles regardless of the presence of HCV neighborhoods.
Sources: Tree Equity Score; HUD Longitudinal Files

Exhibit 4 focuses on Northeast Portland, where many block groups do not have any HCV households and have higher TES values. Northeast Portland was formerly a working-class area but has experienced renewed interest in the area due to its proximity to downtown Portland and other amenities. Between the King and Alameda neighborhoods is the Alberta neighborhood, not shown with a label because its name is not included in Portland's neighborhood spatial layer. This neighborhood, historically known as Albina, was a once a small, predominantly Black community that was disenfranchised (Gibson, 2007) and has experienced intense gentrification over the past several decades (Sullivan and Shaw, 2011). Alameda has higher TES values and no HCV households, whereas King has lower TES values and HCV households.

Exhibit 4

Tree Equity Score and HCV Presence by Block Group in Northeast Portland, Oregon

HCV = Housing Choice Voucher.
Note: Tree Equity Score is mapped by quartiles regardless of the presence of HCV neighborhoods.
Sources: Tree Equity Score; HUD Longitudinal Files

Conclusion

Given the wealth of research indicating that HCV households locate in low-quality neighborhoods, it is unsurprising that HCV households are not only spatially concentrated in neighborhoods of poverty but also neighborhoods with low tree equity. Five of the six cities analyzed had TES values higher in HCV-absent neighborhoods compared with HCV-present neighborhoods. Given the noted benefits to urban greenery and the consistent disparity between HCV-present and HCV-absent neighborhoods, this analysis suggests that further investigation is necessary to demonstrate the benefits of greenery where America's most vulnerable low-income renters live.

Notes

Housing Choice Voucher data were retrieved from the 2018 Longitudinal Household file, an annual snapshot of Public and Indian Housing Information Center/Tenant Rental Assistance Certification System database. TES data was retrieved from the American Forests Tree Equity Score, which

contained tree canopy data from various sources and socioeconomic data from the 2018 American Community Survey 5-Year Estimates. More information about the Tree Equity Score can be found here: https://www.treeequityscore.org/methodology/.

Acknowledgments

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