

# Market-Based Approaches to Tree Valuation

By Geoffrey H. Donovan and David T. Butry

**A** recent four-part series in *Arborist News* outlined different appraisal processes used to value urban trees. The final article in the series described the three generally accepted approaches to tree valuation: the sales comparison approach, the cost approach, and the income capitalization approach. The author, D. Logan Nelson, noted that the sales comparison approach has the appeal of being based on observed market transactions.

In this article, we outline the strengths and weaknesses of the sales comparison approach, define what type of value it estimates, and introduce the hedonic price method as an alternative, market-based method for valuing urban trees. We present results from a recent study in Portland, Oregon, that examined the value of street trees using the hedonic price method. The results from our study, although based on the Portland housing market, provide some broader insights into how trees affect house values.

## The Housing Market

Why do house prices vary? (*Location! Location! Location!*) Obviously, location matters, but so do the features of the house and the strength of the housing market at the time of sale.

Location includes characteristics of the neighborhood, such as school district, proximity to amenities, and urban trees. House features include such things as square footage and number of bathrooms. The strength of the overall housing market also significantly affects sales price. When the housing market is strong, house prices rise independently of location and features.

Finally, a number of characteristics unique to the transaction may influence price. For example, a seller may need to sell a house quickly and be willing to accept a lower price, or a buyer may love pink azaleas and, therefore, be willing to pay an unusually high premium for a house with them.

The point is that even with detailed knowledge of house and neighborhood attributes and the strength or weakness of the housing market we cannot predict a house's sales price with certainty.

## Sales Comparison Approach

The principle underlying the sales comparison approach is simple and intuitively appealing: Differences in house prices can be attributed to differences in houses' characteristics. For example, if two houses are identical except that one house has a garage, and the house with the garage sells for \$20,000 more than the house without a garage, then the garage is worth \$20,000. Of course, applying the sales comparison approach in practice is more complicated.

As in our simple example, appraisals are based on recent comparable sales, which are houses with features and neighborhood characteristics that are as similar as possible to the house being appraised. Appraisers

try to obtain sales information on three to five similar properties within the previous six months. Appraisers can seldom find identical sales, so they adjust the sales price of similar houses to account for differences. For example, a house with an extra bathroom or lacking air conditioning may have sold recently, and, using their experience and market data, appraisers adjust the prices accordingly. The accuracy of an appraisal depends on both the number and similarity of the comparable sales used and the accuracy of any adjustments (Cullen 2007).

This brief overview of the sales comparison approach is meant to illustrate three important points:

- Proper application of the sales comparison approach requires specialized skills and current knowledge of the local real estate market.
- Care should be taken when interpreting values estimated by using sales comparisons. Ask an appraiser how many comparable sales they used, when the sales occurred, and how he or she adjusted comparable sales prices.
- Real estate appraisers typically estimate the market value, not the individual characteristics, of houses.

There are some additional concerns if the sales comparison approach is used to estimate the incremental value of house or neighborhood attributes, such as an additional tree or an additional bathroom.

As mentioned previously, no house appraisal method is completely accurate. However, the consequences of appraisal error can differ significantly. Suppose adding a bedroom increases the value of a \$100,000 house to \$110,000. If the appraiser erroneously estimates the value of the house at \$115,000, the house is overvalued by 4.5 percent. However, inferring the value of the additional bedroom as \$15,000 rather than \$10,000 overvalues that new room by 50 percent.

Even when applied correctly, the sales comparison approach should be used only to value an individual tree or small group of trees (it would be impractical to use the sales comparison approach to value all the trees in a neighborhood, for example). Furthermore, because of the small sample size used, it would be inappropriate to extrapolate results from a sales comparison appraisal to other houses. Therefore, the sales comparison approach cannot be used to address larger-scale valuations such as estimating the benefits of all the trees in a city or other large area. The hedonic price method, which also relies on house sales data, is better suited to answering these sort of questions.

## Hedonic Price Method

The hedonic price method estimates the incremental value of house and neighborhood characteristics using a large sample of house sales

(typically, several thousand) and multivariate regression techniques rather than the judgment of the appraiser (Wolf 2004). The results of a hedonic analysis can reveal the marginal impact of individual house and neighborhood characteristics on sales price: a bathroom adds \$15,000, a garage adds \$20,000, and so forth.

However, it is important to realize that results are average effects across the whole sample. Therefore, in much the same way that it is inappropriate to apply the results of a sales comparison appraisal to a larger area, the results from a hedonic model are not as accurate when applied to an individual house.

Previous studies have used the hedonic price method to estimate the value of urban trees. Morales (1980) used the hedonic method to examine the effect of tree cover on house sales in Manchester, Connecticut. He concluded that good tree cover adds 6 percent to the sales price of a house; however, the study has two major limitations. First, the sample size was low (only 60 houses were examined). Second, tree cover was measured as either good cover or not. Anderson and Cordell (1988) studied the effect of front-yard trees on house sales in Atlanta, Georgia. Data on the number of front-yard trees were obtained from Multiple Listing Service photographs of houses for sale. The authors concluded that a front-yard tree added \$422 to the sales price of the house (0.88 percent of mean sales price).

## Hedonic Study of Street Trees in Portland, Oregon

We used the hedonic method to estimate the value of trees planted in the public right of way (hereafter referred to as street trees) in Portland, Oregon (Figure 1). Typically, street trees are in the parking strip (the strip of grass between the road and the sidewalk); in some instances we considered trees planted in a grassy median down the center of the road.

By “value,” we mean the value that accrues directly to an individual home owner and is, therefore, reflected in house price (aesthetic improvements, shade, etc). However, street trees have other values that are not limited to home owners in the immediate vicinity (carbon sequestration, reductions in stormwater runoff, etc.). These values are not captured by the hedonic price method. Therefore, the direct values we estimate should be considered a subset of the full value of a street tree. For a more complete discussion of the range of values provided by street trees, see McPherson et al. (2005).

Portland is a city in northwest Oregon near the confluence of the Willamette and Columbia rivers, with a population of 537,000 (U.S. Census Bureau 2006 estimate). Metropolitan Portland, which includes surrounding

communities, has a population of approximately 2 million (the 23rd largest metropolitan area in the United States). The Willamette River divides the city into eastside and westside Portland. We limited our analysis to eastside Portland because the west side has fewer demarcated parking strips, which makes it difficult to determine whether a tree is on public or private property.

During summer 2007, we visited 3,479 houses that had sold between July 1, 2006, and April 26, 2007. At each house, we recorded the number of street trees that fronted the property. We measured diameter at breast height (dbh) and height of each tree (Figure 2). In addition, we recorded the type of tree [flowering, fruiting, deciduous (nonflowering, nonfruiting), or conifer], whether it was single-stemmed 5 feet from the ground, whether it showed signs of disease, and whether the crown had been severely pruned (typically to keep the crown from power lines). We also recorded data about the house: the number of blocks from a busy street, presence of pavement damage (whether caused by tree roots or not), and a subjective judgment of the house's condition (poor, average, or good).

After collecting onsite data, we collected additional data remotely. Combining tax lot data with aerial photographs, we calculated the crown projection area (CPA) of all previously measured trees. We additionally calculated the CPA of all street trees within 100 feet of the middle of each house's front property line, but not directly fronting the house. We used a geographic information system vegetation layer to calculate the percentage of tree cover on each lot (trees that overhung other properties were not counted; trees that overhung from other lots were counted). Finally, we obtained data about each sales transaction—house characteristics (size, age, number of bathrooms, etc), sales date, and sales price—from the Multnomah County Assessor's Office.

## Study Results

Of the 3,479 houses in the original sample, 113 were eliminated because the address wasn't a single-family residence, we couldn't reliably match aerial photographs and tax lot data, or we simply



Figure 1. Most street trees were in the parking strip, but some were in a grassy median.



Figure 2. This tree is 27 feet tall and has a 15-inch-dbh—the average for our sample.

## Market-Based Approaches to Tree Valuation (continued)

couldn't locate the house. We visited each of the remaining 3,366 houses. Only 1,113 houses had street trees fronting the property. The average tree was 27 feet high, with a dbh of 15 inches, and a CPA of 312 square feet.

We found that two tree characteristics affected house price. First, each tree directly fronting a house added, on average, \$7,593 to the house's price (our model related the number of trees to the natural logarithm of house price, which means that although the absolute contribution of a tree to house price increased as house price increased, that increase was not linear. For reference, the mean house price in our sample was \$293,000).

Second, canopy cover within 100 feet of the middle of a house's front property line, but not including trees that directly front the property, added \$3.25 per square foot of CPA. On average, a house had 0.558 street trees in front of it and 904 square feet of CPA within 100 feet.

When combined, the two tree variables (evaluated at their means) add \$7,020 to the price of a house, which represents 2.4 percent of mean sales price. For comparison, this is equivalent to adding 106 finished square feet to a house. Considering only those houses with street trees in front of them, the average number of street trees is 1.69 per house and the total CPA is 1,814 square feet. For these houses, the two tree variables add \$18,727, or 6.4 percent of mean sales price.

There are 126,176 single-family residences in eastside Portland, and 152,636 in Portland as a whole. Applying the average effect of trees to all eastside houses yields a total value of \$886 million. Extrapolating to westside Portland is more problematic, because we don't know whether the westside housing market or the stock of street trees is fundamentally different. Given these caveats, applying the average tree effect to all houses in Portland yields a total value of \$1.1 billion.

If this increase is also reflected in an increase in a house's assessed value, then trees may increase property tax revenues. In 2007, the property tax rate in eastside Portland was \$21.80 per \$1,000 of assessed value. This was based on a mean assessed value of \$154,500, which is 52 percent of the mean sales price in our sample. Assuming that street trees increase assessed value by the same proportion as they increase sales price, street trees increase property tax revenues in eastside Portland by \$10 million annually and by \$12 million annually in Portland as a whole.

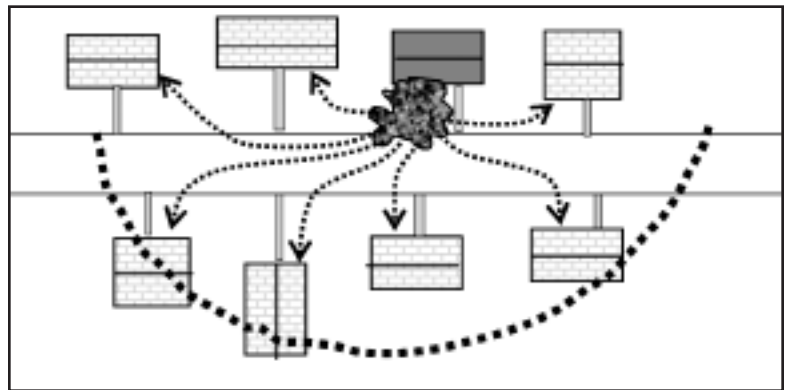
The total benefits of street trees (\$886 million for eastside Portland and \$1.1 billion for the whole city) can be converted into equivalent perpetual streams of annual benefits using a standard financial calculation. If we assume an interest rate of 4 percent, then the total impact of street trees on the housing market translates into annual benefits of \$35 million for eastside Portland and \$43 million for the whole city. The City of Portland estimates that the annual maintenance costs of Portland's street trees are \$4.6 million (includes tree planting and removal costs as well as traditional maintenance costs such as pruning and leaf removal). of which \$3.3 million is borne by private landowners and the remaining \$1.3 million by the City of Portland (Karps 2007). Therefore, when comparing

the total benefits to Portland home owners to total maintenance costs, the benefit-to-cost ratio of Portland's street trees is almost 10 to 1.

Rather than looking at the effect of multiple trees on one house, we can also look at the effect of one tree on multiple houses (Figures 3 and 4). Let us consider a street tree with a CPA of 312 square feet (the average for our sample). This tree adds \$7,593 to the price of the house it fronts. However, it also positively influences the price of houses within 100 feet. In Figure 3, there are seven houses within 100 feet of the street tree (the average for our sample was 7.6 houses). Therefore, a tree with a CPA of 312 square feet adds, on average, \$7,098 to the value of neighboring houses. The total benefit of a tree with a CPA of 312 square feet is \$14,691. Recall that the hedonic method provides results that are averages for a sample. Therefore, the tree in Figure 3 should be viewed as an average tree. The value of a particular tree may differ because of variables not captured in the model.

## Tree Costs and Benefits

Results from our study indicate that the total benefits of street trees in Portland far outweigh their total costs. This suggests that, in Portland, the benefits of increased urban forestry investment are



**Figure 3.** The street tree pictured has a CPA of 312 square feet. It adds \$7,593 to the price of the house it fronts (solid gray house) and \$7,098 to the seven houses within 100 feet giving a total value of \$14,691. The dotted line indicates the tree's 100-ft radius sphere of influence.



**Figure 4.** Although the house in the center doesn't have a street tree, it will benefit from neighboring street trees.

likely to justify the costs. Extrapolating study results to other cities may be problematic, but the statistical methods outlined here are portable to other regions. Ideally, similar hedonic studies would be carried out in cities of different size, climate, demographic makeup, etc. Absent such studies, it would probably be safer to extrapolate results only to cities with similar housing markets, demographics, and stocks of street trees. However, the relative size of the costs and benefits of street trees in Portland suggests that urban forestry investments in other cities may yield substantial benefits.

Our results also show that the benefits of street trees are not limited to the houses they front. (Although our study was limited to street trees, we believe it is likely that the benefits of trees on private property also spill over to neighboring houses.) This result has important implications for tree valuation. Specifically, the value of a tree depends on the scope of the analysis. For example, if an arborist is trying to estimate the damage done to a tree on private property for insurance purposes, then limiting the scope of the analysis to that property is probably appropriate. However, if a municipal arborist is weighing the costs and benefits of maintaining a street tree, then it would be appropriate to consider the total benefits that the tree confers to neighboring houses.

The spillover effects of street trees also have implications for the accuracy of the sales comparison approach. Consider two identical houses, each with an identical tree in its parking strip. The neighbors of the first house have no street trees, whereas the neighbors of the second house all have street trees. If the neighboring trees are not considered, then the sales comparison approach may mistakenly place a higher value on the tree fronting the second house. Therefore, when selecting comparable sales, an appraiser should consider trees in front of neighboring houses.

In summary, although tree valuation methods based on house sales have the advantage of being based on observed market transactions, it is critical that the methods are not blindly accepted. They must be carefully applied, and the results interpreted with equal care.

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*Photos and drawing courtesy of Geoffrey Donovan.*

## European Arboricultural Council Sets Up Shop Online

Recently launched this past June 2008 on behalf of the European Arboricultural Council (EAC), the Council's online web store is fully operational and ready to help arborists throughout Europe stock up on all of the educational material necessary to be successful in the areas of arboriculture and forestry.

The European Arboricultural Council is an organization of tree workers and arborists with the goals of maintaining quality tree management practices, educating and training, and in harmonizing European tree care procedures. Through its new online store, the EAC is looking to expand its reach by making available for purchase a variety of interactive, educational publications.

The EAC web store ([www.ArborShop.eu](http://www.ArborShop.eu)) has several up-to-date and recently published editions of study guides, equipment manuals, booklets on management practices, and much more. Europe-based arborists will have access to purchasing products published by the International Society of Arboriculture, through the EAC web store

as well. CEU compendia, tree climbing guides and CD-ROM items are also available.

The European Arboricultural Council is looking toward expanding their catalogue to include more products and publications, assisting individuals and organizations in the tree care industry.

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