

The Sales Comparison Approach to Tree Valuation and the Value of Portland, Oregon's Street Trees

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1 **Introduction**

2 A recent four-part series in Arborist News outlined different appraisal procedures used to
3 value urban trees. The final article in the series described three approaches to tree
4 valuation: the sales comparison approach, the cost approach, and the income
5 capitalization approach. The author, D. Logan Nelson, noted that the sales comparison
6 approach often produces the most reliable estimates as it is based on observed market
7 transactions. In this article, we outline the strengths and weaknesses of the sales
8 comparison approach. In doing so, we hope to provide readers with a better
9 understanding of the sales comparison approach, which, in turn, will allow them to
10 critically assess sales-comparison appraisals. In addition, we introduce the hedonic price
11 method, which also uses market transactions to value urban trees. However, the marginal
12 value of urban trees is estimated using a well-accepted statistical design that ensures
13 transparency and replicability. We present results from a recent hedonic study in
14 Portland, Oregon that examined the value of street trees using the hedonic price method.
15 The results from our study in Portland provide some interesting insights into how trees
16 affect the housing market.

17

18 ***The Housing Market***

19 Why do house prices vary? (*Location! Location! Location!*) Obviously, location matters,
20 but so do the features of the house and the strength of the housing market at the time of
21 sale. Location includes characteristics of the neighborhood, such as school district,
22 proximity to amenities, and urban trees. House features include such things as square
23 footage and number of bathrooms. The strength of the overall housing market also

1 significantly affects sales price. When the housing market is strong, house prices rise
2 independently of location and features. Finally, a number of characteristics unique to the
3 transaction may influence price. For example, a seller may need to sell a house quickly
4 and so is willing to accept a lower price, or a buyer may love pink azaleas and, therefore,
5 be willing to pay an unusually high premium for a house with them. The point being that
6 even with detailed knowledge of house and neighborhood attributes, and the strength of
7 the housing market, we cannot predict a house's sales price with perfect certainty.

8

9 ***Sales Comparison Approach***

10 The principle underlying the sales comparison approach is simple and intuitively
11 appealing: if two houses differ in only one characteristic, then the difference in the sales
12 prices can be attributed to the difference in the characteristic. For example, if two houses
13 are identical, except that one house has a garage, and the house with the garage sells for
14 \$20 000 more than the house without a garage, then the garage is worth \$20 000. Of
15 course, applying the sales comparison approach in practice is more complicated.

16

17 As in our simple example, appraisals are based on finding recent comparable sales.
18 Comparable sales are houses with features and neighborhood characteristics that are as
19 similar as possible to the house being appraised. To ensure similar market conditions, this
20 often means 3-5 sales within the last six months. Appraisers can seldom find identical
21 comparable sales, so they adjust the sales price of similar homes to account for
22 differences. For example, a house with an extra bathroom or lacking air conditioning may
23 have sold recently, and, using their experience, appraisers adjust the sales prices. The

accuracy of an appraisal depends on the number and similarity of the comparable sales used as well as any adjustments.

This brief overview of the sales comparison approach is meant to illustrate three important points. First, proper application of the sales comparison approach requires specialized skills and knowledge of the local real-estate market. Second, care should be taken when interpreting values estimated using sales comparisons. Ask an appraiser how many comparable sales they used, when they took place, and how they adjusted comparable sales prices. Third, real-estate appraisers typically estimate the market value of houses not their individual characteristics.

There are some additional concerns if the sales comparison approach is used to estimate the marginal value of house or neighborhood attributes: an additional tree or an additional bathroom, for example. In particular, the effect of appraisal error has different consequences. As we discussed earlier, no house appraisal method is completely accurate. However, the consequences of appraisal error differ. Suppose adding a bathroom adds \$10 000 to the value of a \$100 000 house (new value is, therefore, \$110 000). If through appraiser error the value of the house is estimated at \$115 000, the house is over-valued by 4.5 %. However, inferring the marginal value of the new bathroom as \$15 000 over-values the bathroom by 50 %.

Even when applied correctly, the sales comparison approach should only be used to value an individual tree or small group of trees. Furthermore, because of the small sample size

1 used, it would inappropriate to extrapolate results form a sales comparison appraisal to
2 other houses. Therefore, the sales comparison approach cannot be used to answer larger
3 scale valuation questions such as estimating the benefits of all the trees in a city or other
4 large area. To answer this sort question requires a different method, which also relies
5 upon house sales data.

7 ***Hedonic Price Method***

8 The hedonic method estimates the marginal contribution of house and neighborhood
9 characteristics using a large sample of house sales (typically, several thousand) and
10 multivariate regression techniques rather than the judgment of the appraiser. The results
11 of a hedonic analysis can reveal the marginal impact of individual house and
12 neighborhood attributes on sales price: a bathroom adds \$15 000; a garage adds \$20 000,
13 and so forth. However, it is important to realize that results are average effects across the
14 whole sample. Therefore, in much the same way as it is inappropriate to apply the results
15 of a sales comparison appraisal to a larger area, the results from a hedonic model should
16 not be applied to an individual house.

18 Two previous studies have used the hedonic price method to estimate the value of urban
19 trees. Morales (1980) uses the hedonic method to examine the effect of tree cover on
20 house sales in Manchester, Connecticut. He concluded that good tree cover adds 6% to
21 the sales price of a house; however, the study has two major limitations. First, the sample
22 size was low (only 60 houses were examined). Second, tree cover was measured as either
23 good cover or not. Anderson and Cordell (1988) studied the effect of front-yard trees on

1 house sales in Atlanta, Georgia. Data on the number of front-yard trees were obtained
2 from Multiple Listing Service photographs. The authors conclude that a front-yard tree
3 added \$422 to the sales price of the house (0.88 % of mean sales price).

5 **Hedonic Study of Street Trees in Portland Oregon**

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

11 Portland is a city in Northwest Oregon near the confluence of the Willamette and
12 Columbia Rivers with a population of 537 000.¹ Metropolitan Portland, which includes
13 surrounding communities, has a population of approximately 2 million (the 23rd largest
14 metropolitan area in the U.S.). The Willamette River divides the city into Eastside and
15 Westside Portland. We limited our analysis to Eastside Portland, because Westside
16 Portland has fewer demarcated parking strips that make it more difficult to determine if a
17 tree is on public or private property.

19 During the summer of 2007, we visited 3479 houses that had sold between July 1st, 2006
20 and April 26th, 2007. At each house we recorded the number of street trees that fronted
21 the property. We measured the diameter at breast height (DBH) and height of each tree.
22 In addition, we recorded the type of tree (flowering, fruiting, deciduous [non-flowering,
23 non-fruiting], or conifer), whether it was single-stemmed 5 feet from the ground, whether

¹ US Census Bureau 2006 population estimate

1 it showed signs of disease, and whether the crown had been severely pruned (typically to
2 keep the crown from power lines). We also recorded data about the house: the number of
3 blocks from a busy street, presence of pavement damage (whether caused by tree roots or
4 not),² and a subjective judgment of the house's condition (poor, average, or good).

5
6 Having collected on-site data, we collected additional data remotely. Combining cadastral
7 data with aerial photographs, we calculated the crown projection area (CPA) of all the
8 previously measured trees. In addition, we calculated the CPA of all trees within 100 feet
9 (30.48 meters) of the middle of each house's front property line, but not directly fronting
10 the house. We used a GIS vegetation layer to calculate the percentage tree cover on each
11 lot. Finally, we obtained data about each sales transaction: house characteristics (size,
12 age, number of bathrooms etc), sales date, and sales price from the Multnomah County
13 Assessor's Office.

14 15 **Results**

16 Of the 3479 houses in the original sample, 113 were eliminated because the address
17 wasn't a single family residence, we couldn't reliably match aerial photographs and
18 cadastral data, or we simply couldn't locate the house. We visited each of the remaining
19 3366 houses. Only 1113 houses had street trees fronting the property. When present, the
20 average tree was 27 feet high (8.22 meters), 15 inches DBH (381 millimeters), and had a
21 CPA of 312 square feet (28.99 square meters).

22

² In Portland, homeowners are responsible for pavement repairs outside their house.

1 We found that two tree characteristics affected house price. First, each tree directly
2 fronting a house added, on average, \$7593 to house price. Second, canopy cover within
3 100 feet of the middle of a house's front property line, but not including trees that
4 directly front the property, added \$3.25 per square foot (\$34.97 per square meter) of
5 CPA. On average, a house had 0.558 street trees in front of it and 904 square feet (83.98
6 square meters) of CPA within 100 feet (30.48 meters). When combined, the two tree
7 variables (evaluated at their means) add \$7020 to the price of a house, which represents
8 2.4 % of mean sales price. For comparison, this is equivalent to adding 106 finished
9 square feet to a house. Considering only those houses with street trees in front of them,
10 the average number of street trees is 1.69 per house and the total CPA is 1814 square feet
11 (168.53 square meters). For these houses, the two tree variables add \$18 727 or 6.4 % of
12 mean sales price.

13
14 There are 126 176 single-family residences in Eastside Portland, and 152 636 in Portland
15 as a whole. Applying the average effect of trees to all Eastside houses yields a total value
16 of \$886 million. Extrapolating to Westside Portland is more problematic, as we don't
17 know if the Westside housing market or the stock of street trees is fundamentally
18 different. Given these caveats, applying the average tree effect to all houses in Portland
19 yields a total value of \$1.1 billion. If this increase is also reflected in an increase in a
20 house's assessed value, then trees may increase property tax revenues. In 2007, the
21 property tax rate in Eastside Portland was \$21.80 per \$1000 of assessed value. This was
22 based on a mean assessed value of \$154 500, which is 52 % of the mean sales price in our
23 sample. Assuming that street trees increase assessed value by the same proportion as they

1 increase sales price, street trees increase property tax revenues in Eastside Portland by
2 \$10 million annually and by \$12 million annually in Portland as a whole. The total
3 benefits of street trees can be converted into equivalent perpetual streams of annual
4 benefits using a standard financial calculation. If we assume an interest rate of 4 %, then
5 the total impact of street trees on the housing market translates into annual benefits of
6 \$35 million for Eastside Portland and \$43 million for the whole city. The City of Portland
7 estimates that the annual maintenance costs of Portland's street trees are \$4.6 million, of
8 which \$3.3 million is borne by private landowners and the remaining \$1.3 million by the
9 City of Portland (Karps 2007). Therefore, the benefit to cost ratio of Portland's street
10 trees is almost 10 to 1.

11
12 Rather than looking at the effect of multiple trees on one house, we can also look at the
13 effect of one tree on multiple houses (figure 1). Let us consider a street tree with a CPA
14 of 312 square feet (28.99 square meters) (the average for our sample). This tree adds
15 \$7593 to the price of the house it fronts. However, it also positively influences the price
16 of houses within 100 feet (30.48 meters). In figure 1, there are seven houses within 100
17 feet (30.48 meters) of the street tree (the average for our sample was 7.6). Therefore, a
18 tree with a CPA of 312 square feet (28.99 square meters) adds, on average, \$7098 to the
19 value of neighboring houses. The total benefit of a tree with a CPA of 312 square feet
20 (28.99 square meters) is \$14 691. Recall that the hedonic method provides results that are
21 averages for a sample. Therefore, the tree in figure 1 should be viewed as an average tree.
22 The value of a particular tree may vary because of variables not captured in the model.

1 **Discussion**

2 The sales comparison approach is a technique widely used to value houses. It can also be
3 used to estimate the marginal value of trees, but there are some additional concerns when
4 using it for this purpose. In addition, because it relies on such a small sample, it can't be
5 used to answer larger scale valuation questions. We discussed the use of the hedonic
6 method, which is better suited to answering these sorts of questions. However, the
7 hedonic method does require a larger sample of observations (houses to compare), but
8 our experiences have shown that county assessor's offices will readily provide most of
9 the required data at little or no cost.

10

11 Results from our study indicate that the benefits of street trees in Portland far outweigh
12 their costs. This suggests that, in Portland, the benefits of increased urban forestry
13 investment are likely to justify the costs. Extrapolating study results to other cities may
14 be problematic, but the statistical methods employed here are quite portable to other
15 regions. Ideally, similar hedonic studies would be carried out in cities of different size,
16 climate, demographic makeup etc. Absent such studies, it would probably be safer to
17 extrapolate results to cities with similar housing markets, demographics, and stocks of
18 street trees. However, the relative size of the costs and benefits of street trees in Portland,
19 and the consistency our results with other studies, suggest that urban forestry investments
20 in other cities are likely to yield substantial benefits.

21

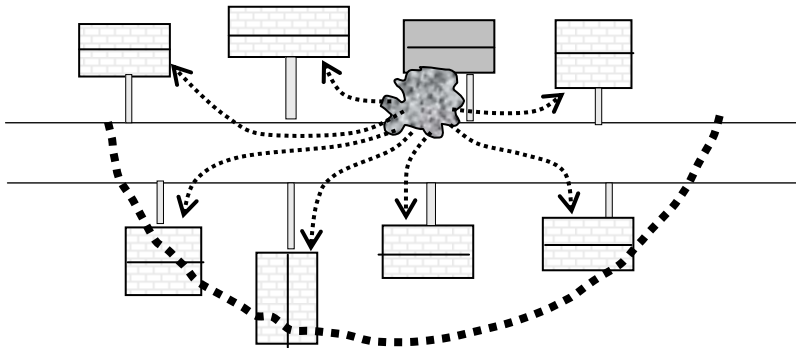
22 Our results also show that the benefits of street trees are not limited to the houses they
23 front (Although our study was limited to street trees, we suspect the benefits of trees on

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 the 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.

In summary, tree valuation methods based on house sales have significant advantages over other valuation approaches. However, it is critical that the methods are not blindly accepted. They must be carefully applied, and the results interpreted with equal care.

1 **Figures**



2

3 **Figure 1:** The street tree pictured has a CPA of 312 square feet. It adds \$7593 to the
4 price of the house it fronts (grey house) and \$7098 to the seven houses within 100 feet
5 giving a total value of \$14 691. The dotted line indicates the tree's 100-foot radius sphere
6 of influence.

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