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**TO: Steve Duh, Janet Bebb**  
**FROM: Tom Souhlas, Bryce Ward, and Mark Buckley**  
**SUBJECT: DRAFT HEDONIC ANALYSIS AND LITERATURE REVIEW FOR  
PORTLAND METRO'S INTERTWINE PARK SYSTEM**

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## **I. INTRODUCTION**

Portland-Vancouver metropolitan area's park system (the Intertwine) provides a number of valuable goods and services to residents of and visitors to the Portland metro area.<sup>1</sup> While all of these goods and services are valuable, not all are traded in markets, making their individual values unclear. In this memorandum we estimate one type of value, amenity value, that the Intertwine provides to one population of Intertwine users, homeowners. First, we summarize existing literature describing the various effects that parks, open spaces, green space, and other natural areas have on home values. Second, we describe the results of our preliminary examination of the effects of proximity to the Intertwine on home values in the Portland metro area. This memorandum describes the relationship between the Intertwine and home values within the four county metro region (Clackamas, Clark, Multnomah and Washington).

## **II. BACKGROUND: HEDONIC ANALYSIS AND LITERATURE REVIEW**

Typically, buyers and sellers trade goods and services in markets, where, after numerous exchanges, the values associated with particular goods and services are revealed. Some goods and services, such as the amenities the Intertwine provides, are not traded in markets. When goods or services are not traded in markets, economists must turn to alternative methods to estimate their value.

Hedonic analysis is one of the primary tools economists use to estimate the value to homeowners of amenities not traded in markets. In this memorandum, we describe the results of a hedonic analysis that we conducted to estimate the value homeowners place on some of the amenities the Intertwine provides. Specifically, we compare the sales prices of homes near the Intertwine to the sales prices of similar homes some further distance away (but still in the same neighborhood). If, while controlling for the effects on prices of other factors, we observe higher prices for homes nearer the Intertwine, we can reasonably infer that homeowners value access to the Intertwine (and thus the Intertwine itself) by at least as much as the price differential because buyers would not be willing to pay the higher price if the Intertwine did not provide at least that much value.

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<sup>1</sup> The Portland Metro area extends into Clackamas, Clark, Multnomah, and Washington Counties.

It is important to note that our analysis does not describe all of the economic value provided by the Intertwine. Our estimate is a lower bound to the potential range of the total economic value of the Intertwine. The full value of the Intertwine is higher (and potentially substantially higher) than implied by our estimates of the Intertwine's impacts on home prices. This is because home prices only capture a subset of values provided by the Intertwine, and avoiding payment for these benefits is possible in some cases as well, as described in our discussion.

Our findings are consistent with a large body of conceptual and empirical research. Below, we summarize the recent literature that uses hedonic analysis to estimate the prices and underlying value of the services parks, open space, green space, and other natural areas provide.

Over the past four decades, most studies examining the relationship between parks and home values have found that a home's value, in general, increases as the distance to the nearest park decreases.<sup>2</sup> Of the studies that found a neutral or negative relationship, most indicated that either the parks in question were in poor condition, or methodological limitations produced ambiguous results. Another review of the recent literature found that the impact of park proximity on home values is highly variable, ranging from no noticeable impact on home values to increasing home values by 22 percent.<sup>3</sup>

In many instances, research has focused on specific amenities within parks such as riparian area, water quality, and tree canopy. By and large, the literature suggests that enhanced environmental quality or increased natural habitat have a positive effect on nearby property values.

- A 1999 study in Vancouver, British Columbia, examined the value of riparian areas (the vegetated areas along the banks of rivers and streams) and found that the values of homes adjacent to riparian areas were about 12–15 percent higher than the values of similar, but more distant, homes. The value of homes near but not adjacent to riparian areas were, to a lesser extent, also positively affected.<sup>4</sup>
- A 2000 study examined the impact of water quality on property values in Maryland and found that an increase in fecal coli form concentrations on nearby bodies of water was associated with a decrease in home values.<sup>5</sup>
- This past year, a study here in Portland found that, as the amount of tree canopy within a quarter mile of a home increases, so too does the value of the home.<sup>6</sup> For

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<sup>2</sup> Crompton, J. 2001. "The Impact of Parks on Property Values: A Review of the Empirical Evidence." *Journal of Leisure Research*. 33(1): 1-31.

<sup>3</sup> Nicholls, S. 2004. "Measuring the Impact of Parks on Property Values." *Parks and Recreation*. March.

<sup>4</sup> Quayle, M., and S. Hamilton. 1999. *Corridors of Green and Gold: Impact of Riparian Suburban Greenways on Property Values*. Department of Fisheries and Oceans. Vancouver, British Columbia.

<sup>5</sup> Leggett, C. and N. Bockstael. 2000. "Evidence of the Effects of Water Quality on Residential Land Prices." *Journal of Environmental Economics and Management*. 39:121-144.

<sup>6</sup> Netusil, N., S. Chattopadhyay, and K. Kovacs. 2010. "Estimating the Demand for Tree Canopy: A Second-Stage Hedonic Price Analysis in Portland, Oregon." *Land Economics*. 86(2):281-293.

the average home with an average amount of tree canopy within a quarter mile radius, the tree canopy was found to account for 0.75–2.52 percent of the property’s value.

- A recent study from Minnesota analyzing the value of urban tree canopy found that small increases in tree canopy within a small radius have a larger positive impact on property values than larger increases in tree canopy within a larger radius.<sup>7</sup>
- A 2002 study in central Maryland found that properties within 400 feet of open space sold for 0.5–2 percent more than they would but for the open space.<sup>8</sup>

Other research has focused on the design and use characteristics of parks, green space, and other natural areas. This set of literature has, in general, found that while close proximity to these amenities tends to increase home values, different types of amenities impact home values in different ways.

- A 2006 study in the Minneapolis - St. Paul Metropolitan Area found that the relationship between home values and proximity to open space depends on several other variables including the size of the open space, population density, income levels, crime rates, and distance to the central business district.<sup>9</sup> The authors found that the benefit of being close to a park is higher for homes near the central business district. Similarly, their results show that the amenity value of neighborhood parks is nearly three times higher than average in neighborhoods that are twice as dense as the average neighborhood. The authors also found that proximity to parks is more valuable in high-income neighborhoods.
- In 2000, a study here in Portland demonstrated that the positive effect on property value associated with proximity to a 116-acre golf course was about three times greater than the positive effect associated with proximity to a 20-acre public park.<sup>10</sup> The study also described the potential negative amenities, such as noise and congestion, that may exist adjacent to some types of open space.
- Another Portland-based study in 2001 concluded that, in general, the property value attributable to an amenity depends on the type of amenity and decreases as the distance to the amenity increases.<sup>11</sup> Golf courses, for example, had the highest value (6–21 percent of average property value) followed by natural area parks (15–17 percent), specialty parks (6–11 percent), and urban parks (0.5–3 percent).

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<sup>7</sup> Sander, H., S. Polasky, and R. Haight. 2010. “The Value of Urban Tree Cover: A Hedonic Property Price Model in Ramsey and Dakota Counties, Minnesota, USA.” *Ecological Economics*. 69:1646-1656.

<sup>8</sup> Irwin, E. 2002. “The Effects of Open Space on Residential Property Values.” *Land Economics*. 78(4):465-480.

<sup>9</sup> Anderson, S. and S. West. 2006. “Open Space, Residential Property Values, and Spatial Context.” *Regional Science and Urban Economics*. 36:773-789.

<sup>10</sup> Bolitzer, B. and N. Netusil. 2000. “The Impact of Open Spaces on Property Values in Portland, Oregon.” *Journal of Environmental Management*. 59:185-193.

<sup>11</sup> Lutzenhiser, M. and N. Netusil. 2001. “The Effect of Open Spaces on a Home’s Sale Price.” *Contemporary Economic Policy*. 19(3): 291-298.

Table 1 summarizes the literature described above. In general, many of the amenities associated with parks have a positive effect on the value of nearby residential properties. The effect that parks have on property values varies by the distance between the park and the property, the quality of the park, and other neighborhood and park characteristics.

**Table 1. Summary of the Determinates of Value and Their Effect on Value**

Determinate of Value	Effect on Value
Proximity to park	Increases as distance decreases
Type of park (natural vs. urban vs. specialty)	Increases to varying degrees
Size of park	Increases as size increases, with limits
Condition of the park	Increases as condition improves
Proximity of the park to a central business district	Increases as distance decreases
Density of the neighborhood surrounding the park	Increases as density increases
Income of neighborhood surrounding the park	Increases as income increases

Source: ECONorthwest with data from sources described above

### III. THE INTERTWINE'S IMPACTS ON HOME VALUES

As described above, many studies have shown that, in general, the amenities parks provide positively influence property prices. In other words, people are willing to pay more for a home that is near a park than they are for a similar home more distant to a park's amenities. To identify and estimate the relationship between home values and the Intertwine, we collected data from Clackamas, Clark, Multnomah, and Washington Counties and analyzed how the distance between a home and the Intertwine affected the home's value. In this memorandum, we update and expand on research done by Bolitzer and Netusil (2000), which estimated the relationship in Portland between home values and various types of open space and green space in the early 1990s. In general, our results are similar to those presented in the Bolitzer and Netusil study. We find that some parks influence home values more than others, and that this influence decreases as the distance between a home and a park increases.

Our results, however, remain preliminary, because two issues require further consideration. One, it is possible that some currently omitted variable is affecting our analysis. For instance, if proximity to the Intertwine is correlated with some other valuable attribute of homes or properties that we don't account for (e.g., if homes that are closer to the Intertwine are also more likely to have views), then our analysis will generate inaccurate results because the impact of these unaccounted for factors (e.g. views) will be attributed to the Intertwine. We are still investigating and attempting to rule out any such confounding factors.

Two, we are still investigating how best to model the impact of the Intertwine on home values, given the available data. Economic theory and the existing literature provide some guidance, but these sources do not provide definitive answers regarding the best

way to model these effects. Hence, we continue to investigate and evaluate different alternatives.

In the remainder of this section, we first describe the overall process of data collection, our methodology for analyzing the available data, the data gaps we encountered, and the hurdles we foresee as we continue our analysis. Second, we present and describe preliminary results for our analysis of the Intertwine's effect on home values in Multnomah County. And third, we describe how our analysis will proceed.

## A. Methodology

To begin our analysis, we compiled two datasets: one describing home characteristics, the other describing park characteristics. For the data describing home characteristics, we contacted assessor offices in the four Portland Metro counties. These data describe characteristics (e.g. square footage and number of bedrooms) for each home within the four counties. A significant element of the data-compilation process entailed making certain that the dates from different sources are compatible. Each county collects data on a different group of home characteristics and the ways in which they collect these data vary. One county, for example, may collect data on the number of fireplaces or whether the home has air conditioning whereas another county may not collect these data. We identified these discrepancies and re-categorized the data to help our analysis.

Next, we compiled data describing park characteristics from two sources. One supplied park data for Clackamas, Multnomah, and Washington Counties, the other source supplied park data for Clark County. The park data include the size of each park, as well as a variable indicating park type (e.g. school park, golf course, and neighborhood park).

With the home and park datasets in place, we conducted a spatial analysis, which provided us with three new variables: the distance from each home to the nearest park (by park type), the distance from each home to the nearest park (regardless of park type), and the total area of parkland within one mile of each home.

After compiling the data appropriately, we developed our hedonic regression model. As alluded to above, ideally, a regression of this sort would consider all of the variables that influence home values. With an exhaustive list of home and property characteristics, our regression would accurately describe the effect of a proximate park on an average home's value. In general, while the counties have collected data on *some* home characteristics, they do not have a complete set of data on *all* the variables affecting home value. Each county did provide data on zip codes and neighborhoods for each home. We use these variables to control for neighborhood-wide characteristics (e.g. crime rate, school quality, and property taxes). Still, after controlling for all of the variables with available data, our results may contain the hidden effects of unidentified variables. That is, the effect attributed to parks identified in our analysis may implicitly include the effects attributable to other, unidentified variables.

Specifically, in this initial regression model, we estimate the relationship between the natural log of a home's price and the distance between that home and the nearest park, controlling for the number of square feet in the home, the size of the lot, the number of bathrooms, the age of the home, the year of sale, and its neighborhood or zip code. We

further restrict the analysis to include only single-family homes sold since 2001. We also restrict the sample to include homes with sale prices between \$65,000 and \$1,000,000. Homes sold at very low prices likely reflect non-arms-length transactions (e.g. sales to family members), and homes sold at very high prices are dissimilar to other homes in ways that cannot be controlled for using the available data.

## B. Results

Table 2 summarizes the results from two preliminary regression models for Multnomah County<sup>12</sup>. The first set of results (in the top half of the table) presents the impact of being within 900 feet of various types of open space on home sale prices. On average, homes within 900 feet of a developed park sell for approximately 1 percent more than similar homes in the same neighborhood more than 900 feet from a developed park. Homes within 900 feet of unimproved open space have no difference in price, on average, while homes proximate to cemeteries sell for 2 percent less than similar homes further away from cemeteries. Proximity to golf courses is especially valuable. Homes within 900 feet of golf courses sell for approximately 6 percent more than similar homes further away. The golf course benefits likely combine a combination of ecosystem service, aesthetic, commercial, and recreation benefits, that cannot be separated by this method.

**Table 2: Summary Results of Relationship between Home Price and Distance to Nearest Open Space for Multnomah County, 2001-2010**

<b>Impact within 900 Feet</b>	<b>Coefficient</b>
Within 900 Feet of Developed park site with amenities	0.01***
Within 900 Feet of Open space or natural area without amenities	0.00
Within 900 Feet of Cemetery	-0.02***
Within 900 Feet of Golf course	0.06***
<b>Impact at Various Distances</b>	<b>Coefficient</b>
Less than 100 feet from nearest park	0.018***
100 ft – 400 feet from nearest park	0.010***
400 ft – 700 feet from nearest park	0.007**
700 ft - 1,000 feet from nearest park	-0.000
1,000 ft - 1,300 feet from nearest park	-0.001
1,300 ft - 1,500 feet from nearest park	-0.002
Source: ECONorthwest regression analysis of 78,792 single-family homes sales from Multnomah County Assessors data.	
Notes: Regressions include controls for lot size, home sq. ft., number of bathrooms, year built, sale year, within 900 ft of other park categories, and neighborhood.	
*** indicates statistically significant at the 1% level	
** indicates statistically significant at the 5% level	

<sup>12</sup> Distances ranges based on standard ranges used in the literature, and sufficiently distinct to show variation.

The second set of results (in the bottom half of the table) focuses on proximity to developed parks only and shows how the effects vary as one moves incrementally further away from the park. Homes within 100 feet of the park sell for 1.7 percent more than similar homes greater than 1,500 feet from the park. Homes between 100 and 400 feet from the park sell at a 1 percent premium over similar homes more than 1,500 feet away, and homes between 400 and 700 feet sell at a slightly smaller premium of 0.7 percent. Beyond 700 feet, though, there does not appear to be a premium paid for proximity to parks.

In general, the literature suggests that as the distance between a home and a park decreases, the value of the home should increase (this demonstrates the amenity value parks provide). Our preliminary results appear to support this hypothesis. For the average home price in the shortest distance category, shown in Table 3, the model suggests that approximately \$6600 of the value is attributable to the proximity for a home less than 100 feet from a developed park. The corresponding value for a home 100 to 400 feet from a park would be \$2900, and \$1900 for a home 400 to 700 feet. This model finds no contribution to value attributable to proximity for distances more than 700 feet. Table 3 shows that Multnomah County has more than 77,000 homes within the range experiencing an increase in value from proximity to park land, based on the model's results.

Our preliminary analysis finds that the models for the other three, more rural counties in the project area do not demonstrate a statistically significant relationship between park proximity and property value for the range of model specifications tested, as described above. We believe this is largely due to the fact that park accessibility is so high outside of urban areas there is little need to pay a premium for one house over another, based on park accessibility. For example, 90 percent of homes in Clackamas County are within 1/4<sup>th</sup> of a mile of a developed park.

## C. Discussion

Property owners may value parks and open space for a variety of reasons. Parks and open space may enhance views, improve socializing opportunities, and provide recreational space and amenities, such as playgrounds. For these reasons and others,

**Table 3. Homes Within Proximity to Parks in Multnomah County**

Distance to Developed Park	Number of Homes	Average Price
<100 ft to developed park	6,172	\$365,948
100-400 ft to developed park	34,803	\$288,510
400-700 ft to developed park	36,223	\$276,333
700-1000 ft to developed park	38,819	\$270,828
1000-1300 ft to developed park	36,486	\$258,286
1300-1500 ft to developed park	22,078	\$267,105
>1500 ft to developed park	97,331	\$270,602

Source: ECONorthwest with data from sources described above. Note that prices are unadjusted from the period of data collection, sales since 2001.

economists believe that parks and open space provides amenities for which home buyers are willing to pay.

If the creation or preservation of open space increases buyers' willingness to pay for property in the relevant area, then open space creates value. If we could estimate the total change in buyer' willingness to pay, we would obtain the total value created by the open space available to homeowners. Unfortunately, the data currently available to us do not support calculation of this value.

Instead, we can estimate a lower bound on the value created by open space by observing the price homebuyers actually pay to be near open space.<sup>13</sup> We know that the value created by open space must exceed (and be equal to at the margin) its price otherwise homebuyers wouldn't pay (and the price would fall). Price reflects both supply and demand though, so this lower bound estimate may significantly understate full value. Because people have different willingness-to-pay, there are likely some who pay the market price, but would be willing to pay more. This is considered consumer surplus. The price is a lower bound for the value also because it is possible to "consume" the benefits without paying for them, by living far enough away to not pay, but still walk, bike or drive to them. It also doesn't capture existence values for benefits that do not require visiting the site, such as people who appreciate the benefits for salmon populations that live elsewhere.

The fact that we do not directly observe a price for open space further complicates our efforts. We can only infer the price of open space by statistically comparing similar houses with different open space amenities. This creates a number of challenges.

First, we are not aware of a foolproof method that completely describes the difference in park open space amenities at different houses. Our statistical analysis compares the sales prices of homes with differential access to open space holding constant other characteristics (e.g., house quality, neighborhood quality) for which we have suitable data. The approach requires that similar houses have different open-space amenities and that these differences are accurately and reliably measured. Historically, researchers have used proximity to the nearest park (perhaps by type) or the size of the nearest park to measure the different park amenities available at each house. This approach makes sense if each house is close to a single park and each park offers the same basic amenities. In reality, the vast majority of homes in the Portland area are reasonably proximate to multiple parks and the different parks offer different amenities. If homeowners do not simply consider proximity to the nearest park when evaluating home purchases, then this method may fail to accurately capture the effects of open space on property values.

Second, within the Portland area, standard measures of park proximity do not vary substantially across homes. The vast majority of homes (over 90% in most communities) are relatively close (less than half a mile) to some form of park or open space. If most people travel to parks on foot, the difference between a few feet and half-a-mile might be sufficient to encourage buyers to pay more to live closer to the park. If many users bike

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<sup>13</sup> Put simply, the price homebuyers pay for open space is the difference in purchase price between two homes that are similar in all respects except one is near open space amenities and the other is not.

or drive to the park, however, then the difference between a few feet and half-mile may not produce a significant price differential.

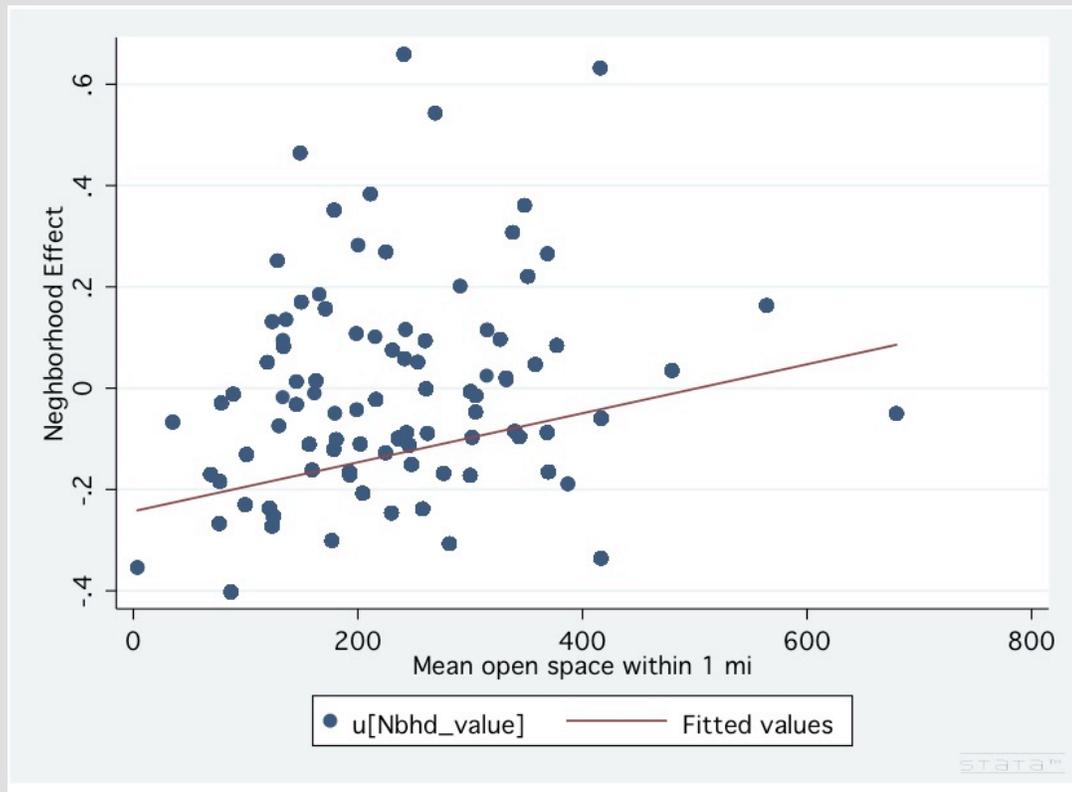
Third, housing values reflect more than basic structural characteristics, park views, and accessibility for which we have data. They reflect the full set of neighborhood characteristics as well. Unfortunately, it is exceedingly difficult to obtain and include all of the appropriate characteristics – particularly local amenities including school quality, crime, views, access to shopping, access to transit, etc. Given the long list of neighborhood characteristics and the difficulty of obtaining data for all of them, one approach to reducing the chances that our results are affected by these factors entails comparing homes within the same neighborhood or community. This approach rests on the assumption that most of these location characteristics are approximately the same within each neighborhood. This approach, however, will underestimate the price of park proximity if buyers also consider park availability at the neighborhood level rather than only for the individual home. That is, buyers might compare homes for park availability between two parts of town, and be willing to pay more for all homes in one neighborhood than another based on that neighborhood’s overall park quality and accessibility.

The data suggest that these neighborhood effects have a significant effect. The premium buyers pay to live in particular neighborhoods is correlated with park and open space amenities. Figure 1 demonstrates the relationship between the neighborhood premium and the average number of acres of open space within a 1-mile radius of the homes in each neighborhood in Clackamas County.<sup>14</sup> The figure demonstrates a clear correlation between neighborhood values and open space area. We find similar relationships in the other Metro counties. To be clear, this figure does not prove that open space causes neighborhood value to increase. Open space area may correlate with other neighborhood characteristics (e.g., school quality, crime, etc.) that affect home prices, and we have not ruled out those possibilities. Regardless, this correlation suggests that within-neighborhood analyses, such as those we’ve presented for Multnomah County, may fail to capture the full impact of open space on property values.

The reality is that the overall density, accessibility, and quality of parks elevate property value throughout the Metro region, and the contribution to value could only be identified by comparing the Metro region to another region with similar amenities other than parks. The standard hedonic techniques are not designed for comparison between regions, but rather within regions. This analysis does not capture the overall contribution of parks to property values for the region, only the share of differentiation within the region. Therefore, it is likely that parks contribute to the value of property in the more rural portions of the Metro study area, and to the overall value of property in the urban areas, but these contributions are not captured by hedonic analysis. People pay a premium and/or accept a wage discount to live in areas with a high quality of life. Research suggests that when compared to an average state, like Connecticut, the quality of life in Oregon is about 6.5 percent higher. Furthermore, when compared to an average city, like Cedar Rapids, Iowa, the quality of life in the Portland-Salem consolidated

<sup>14</sup> Formally, we calculate the neighborhood premium by recovering the fixed effect for each neighborhood from a regression that includes the standard structural controls and city. Neighborhoods, in this case, were determined by assessors at the county-level.

**Figure 1. Relationship Between Neighborhood Effect and Open Space in Clackamas County**



Source: ECONorthwest with data from sources described above.

Note that prices are unadjusted from the period of data collection, sales since 2001. Neighborhood designations are identifiers designated by each county's assessor office, and do not correspond to a specific size, but generally try to group areas by similar community characteristics.

metropolitan statistical area is about 4 percent higher.<sup>15</sup> In this case, a higher quality of life score was based on wage and housing price data. Put simply, individuals in cities and states with high quality of life scores are willing to earn a lower wages and/or pay a higher price for their homes than individuals in cities and states with lower quality of life scores. Individuals also have the choice of living a bit farther from specific amenities and spending time and resources to travel to them. Consequently, the values identifiable in this model provided by the Intertwine are only a subset of the total economic value.

<sup>15</sup> Albouy, D. 2008. *Are Big Cities Really Bad Places to Live? Improving Quality of Life Estimates Across Cities*. NBER Working Paper Series No. 14472.