FEATURES

The Price Effects of HVTLs on Abutting Homes

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ABSTRACT

This article reports findings of an empirical study of Portland, OR, and Seattle, WA, housing markets. It examines the price effect of abutting high-voltage transmission line (HVTL) rights of way. The results are based on an examination of a rich sample of single-family home sales occurring in 2005, 2006, and half of 2007. It adds to an understanding of residential HVTL proximity price effects in a number of ways: it revisits the Portland and Seattle housing markets during a different market period; it relies on data from a seller's market in the housing market cycle; it relies on richer and larger data sets than prior research in these markets; it confirms many findings of a previous study concerning how abutting homes are affected by HVTLs; and it provides a new perspective on the Seattle market by investigating the HVTL price effect on higher-priced homes. It also buttresses the idea that all markets do not react in the same way to HVTL proximity.

The Bonneville Power Administration (BPA) was created in 1937 to market electricity generated at the then new Bonneville Dam on the Columbia River. In fulfillment of its mission, BPA now operates a system of 15,000 circuit miles[1] of high-voltage transmission lines (HVTLs). BPA's 300,000-square-mile service area includes the states of Washington, Oregon, and Idaho as well as parts of extreme northeastern California, western Montana, northern Nevada, extreme northwestern Utah, and far western Wyoming. BPA is a federal agency within the US Department of Energy and operates as a nonprofit entity, selling wholesale power to the region's utility companies at cost. It provides about one-third of the electricity used in the Pacific Northwest region.

Although a high percentage of its HVTLs cross open and agricultural land in these western states, they also run throughout the urbanized western regions of Oregon and Washington in and around dense housing markets in Portland and Seattle. Also, BPA is adding HVTLs to its grid to keep up with population growth in the Pacific Northwest, especially in the urban centers of Portland and Seattle. Its HVTLs primarily range in voltage from 69 kV to 1,000 kV,[2] although the most frequently occurring line voltages are 115 kV (23.4% of the HVTLs), 230 kV (35.0% of the HVTLs), and 500 kV (31.1% of the HVTLs). The HVTLs abutting the study properties range from 115 kV to 500 kV.

BPA rights of way consist of HVTL easements maintained to prevent line damage from trees, other forms of vegetation, and structural improvement interference. Benefits of right of way management include reducing the possibility of adverse electrical impacts on the environment. BPA rights of way also provide amenities to the cities they cross. BPA permits the construction of parks and trails in some locations on its fee title property. Alternatively, many of its easements are jointly used by abutting property owners, who own the underlying fee title, for gardening or other agrarian purposes subject to BPA's need for maintenance access.

1. A *circuit mile,* as the name implies, is the distance covered by a circuit. A transmission right of way often accommodates more than one circuit. For example, a right of way containing three circuits would include three circuit miles for each right-of-way mile.
2. A *kV* is a kilovolt (1,000 volts).

This study was undertaken to gain further understanding regarding the effect of BPA's HVTL rights of way on abutting single-family home prices. The sample data was sufficient to derive precise market price equations via multiple linear regression analysis for both Portland and Seattle. In addition, due to where the rights of way are located in the Seattle area, there are enough higher-priced home sales in the Seattle sample to facilitate a study of HVTL proximity effects on homes averaging $1 million in price, in comparison to HVTL effects on more typically priced homes. Lastly, the study looks at price movement in response to changing market conditions over the 2½ year study period to determine whether or not HVTL abutting homes appreciated in value at a rate different from non-HVTL abutting homes.

Given the moderate marine climate in Portland and Seattle, it is not unusual for power line visibility from abutting homes to be fully or partly obscured by trees. This differs from many areas of the country where trees grow smaller, less vigorously, or not at all. As a result, the findings of this study relate best to the portion of the service area located west of the Cascade Mountains where the marine climate prevails and large trees are abundant. There are nevertheless differences between the Portland sample and the Seattle sample. In particular, lot sizes are typically much smaller in the Portland sample (roughly 6,500 square feet, compared to roughly 1 acre on average in Seattle). Therefore, Portland homes cover a much greater proportion of the typical lot, leaving less room for HVTL view-blocking trees. For this reason alone, the Portland results are not applicable to Seattle and the Seattle results are not applicable to Portland.

The study is organized as follows. A literature review places the study into the context of prior research and information regarding HVTL rights of way. The data is presented next, including descriptive statistics tables comparing the treatment sample (abutting properties) to the control sample (non-abutting properties) for each market. These tables illustrate the extent to which the affected and unaffected property sales are as similar as possible in all other respects. The data presentation is followed by data analyses, including a full-sample Portland home price model, a full-sample Seattle home price model, Seattle high-priced and typically priced subsample price models, and a discussion of price appreciation rates by abutting and non-abutting homes in each market. A summary statement of findings and conclusions is included as the last section of the article.

Literature Review

The literature review presented here, in chronological order by topical classification, sets the context for the current HVTL property price effect study. Prior articles and studies are sorted into three topics for the purposes of discussion and relevance to the present study—informational articles, surveys and case studies, and statistical methods (mostly linear regression) applied to sample data. Inquisitive readers might want to also read Pitts and Jackson[3] for an entrée into a more comprehensive literature review.

Informational Articles

Rikon[4] focuses on the 1993 New York Court of Appeals ruling in *Criscuola v. Power Authority of the State of New York* concerning the reasonableness of the basis of a price response to fear of electromagnetic field (EMF) health effects. Rikon notes that the court ruled if there is market evidence of a price effect in the after condition, then the price effect is compensable. Bryant and Epley[5] cast a wider net in their summary of legal precedent regarding compensation from the real or perceived effects of exposure to EMFs, which culminates in the *Criscuola* case. According to these authors, legal precedent relieves appraisers of the need to assess whether market behavior is rational or not (if this need ever actually existed), and frees them to base their conclusions solely on market data.

Tikalsky and Willyard[6] chime in on the health issue, stating "extensive research has yet to establish a link between health risks and EMF." In addition, they provide a historical study of HVTL structure design over three decades and how design relates to "public perception of transmission lines." In 2008,

3. Jennifer M. Pitts and Thomas O. Jackson, "Power Lines and Property Values Revisited," *The Appraisal Journal* (Fall 2007): 323–325.
4. Michael Rikon, "Electromagnetic Radiation Field Property Devaluation," *The Appraisal Journal* (January 1996): 87–90.
5. James A. Bryant and Donald R. Epley, "Cancerphobia: Electromagnetic Fields and Their Impact in Residential Loan Values," *Journal of Real Estate Research* 15, no. 1/2 (1998): 115–129.
6. Susan M. Tikalsky and Cassandra J. Willyard, "Aesthetics and Public Perception of Transmission Structures," *Right of Way* (March/April 2007): 34–38.

Holisko[7] adds a list of factors that affect the impact of power lines and design elements to consider as ways to mitigate the impact. He notes that diverse impacts stem from differences in development density, right of way width (power line distance), right of way amenities, and topography. Tree cover is important as well, although not included in Holisko's list.

These legal perspectives, as well as personal experience with high-voltage transmission lines, led to the study's focus on the "what" rather than the "why" of HVTL home price effects. In addition, differences in development density and related tree cover (among other factors) between the Portland and Seattle Study Areas, suggested that there would not be similar results for these markets.

Surveys and Case Studies

In 1967, Kinnard reported on a survey of owners of residential properties located in subdivisions either abutting power line right of way easements or encumbered by them.[8] His findings were based on 361 responses from residents of 15 subdivisions located in Hartford, Connecticut. He also surveyed appraisers, builders, real estate sales professionals, and lenders. Kinnard's main findings were (1) the value of most residential properties is unaffected by overhead electric transmission lines, (2) overhead electric lines do affect land development by reducing density due to larger lots being typical of abutting and encumbered properties, and (3) real estate sales professionals and appraisers expressed more negativity toward power line proximity than actual market participants. Reese[9] put a public voice to appraiser negativity toward power lines in his response to the Kinnard article while also posing two important questions: (1) are survey responses valid, and (2) are survey methods powerful enough to measure and control for all of the factors affecting market value?

In 1992, Kung and Seagle[10] analyzed 47 responses to a survey of homeowners living near power lines. They also analyzed a small sample of four home sales near the same power lines and seven home sales located in the same neighborhood but not near the power lines. They did not control for differences in elements of comparison prior to computing and comparing price per square foot differences—a troubling issue foreseen by Reese in 1967 extending here to Kung and Seagle's small sample empirical analysis. In addition, their survey questionnaire included strong language linking power line proximity to cancer, resulting in a predictable response.

Delaney and Timmons[11] surveyed a random sample of residential appraisers holding the Appraisal Institute's RM designation, obtaining 219 usable responses. In summary, appraiser opinions reported by them were (1) proximity to power lines reduces home value by about 10% and (2) reasons for the value diminution are unattractiveness, health concerns, and sound. Surveyed appraisers also noted that developers attempt to mitigate power line effects on sales activity through price reductions, larger lot sizes near the lines, and creation of buffer zones. Delaney and Timmons make a tacit assumption that the opinions of the responding appraisers on the effects of HVTLs are an accurate reflection of market response, which may or may not be true (see Kinnard). However, use of random sampling methods does support the validity of their results in so far as they represented the opinions of RM designated appraisers at that time.

Chapman[12] provides a different perspective on the effects of HVTLs by examining industrial properties. He reports on more than 100 interviews of property owners, brokers, and property managers. Based on his interviews, Chapman finds no basis for consequential damages to industrial properties based on proximity to HVTLs. He also provides an informative discussion of property rights issues and remainder parcel configuration issues that can arise when appraising industrial properties in an eminent domain setting. He speaks to the issue of the difficulty of doing matched pairs (and by implication the benefit of multiple linear regression analysis) when there are numerous property characteristics to control.

7. Gary Holisko, "Developing Near Transmission Lines?" *Right of Way* (July/August 2008): 32–36.
8. William N. Kinnard, Jr., "Tower Lines and Residential Property Values," *The Appraisal Journal* (April 1967): 269–284.
9. Louie Reese, "The Puzzle of the Power Line," *The Appraisal Journal* (October 1967): 555–560.
10. Hsiang-te Kung and Charles F. Seagle "Impact of Power Transmission Lines on Property Values: A Case Study," *The Appraisal Journal* (July 1992): 413–418.
11. Charles J. Delaney and Douglas Timmons, "High Voltage Power Lines: Do They Affect Residential Property Value?" *Journal of Real Estate Research* 7, no. 3 (Summer 1992): 315–329.
12. Dean Chapman, "Transmission Lines and Industrial Property Value," *Right of Way* (November/December 2005): 20–27.

Most recently, Chalmers[13] employs case study methods to investigate HVTL effects on generally large land parcels located across west-central Montana. Properties studied were classified as agricultural production land, agricultural land with a recreation influence, agricultural land with high recreation and natural feature amenities, rural residential subdivisions with either less than or greater than five-acre lots, large rural residential acreages, and rural residential tracts (cabin sites). The author concludes that properties oriented toward residential use are more vulnerable to a (negative) HVTL price effect, larger properties are less vulnerable, and when a market provides more purchase alternatives (substitute properties) HVTL-impacted properties are more apt to experience a price effect. Price effect evidence presented by Chalmers is primarily anecdotal, a consequence of a paucity of data and information due to the rural nature of the power lines' locations and difficulties inherent in obtaining information in a non-disclosure state.

Credible and reliable results are much more difficult to obtain using survey and case study methods. As these studies reveal, (1) survey methods exhibit inherent difficulty controlling for all of the factors affecting market value, (2) the opinions of market participant proxies (brokers, lenders, and appraisers) may not accurately represent the opinions of buyers and sellers, and (3) case study evidence is mostly anecdotal in nature.[14] For these reasons, revealed-preference analyses (e.g., regression modeling of actual market prices) are much more popular for addressing these questions today than stated-preference methods (e.g., questionnaires, contingent valuation methods, and case studies). Revealed-preference (price) analyses are used here. The database is relatively large and regression modeling allows control for many property characteristics and takes advantage of the method's statistical power.[15]

Statistical Modeling

Colwell and Foley[16] and Colwell[17] analyzed 200 home sales located in Decatur, Illinois. The Colwell and Foley study found that proximity to an HVTL reduced sale price and that lots encumbered by a power line easement tended to be larger than unencumbered lots. Colwell's later study looked at the same data as the earlier study, finding that the HVTL price effect diminished over time. This finding is rationalized by observed tree growth (screening), changing attitudes, and reduced uncertainty regarding the effects of an HVTL. Both analyses relied on multiple regression equations relating the natural log of sale price to elements of comparison, capturing the effects of home and site characteristics, changing market conditions, varying neighborhoods, and proximity to an HVTL.

Hamilton and Schwann[18] analyzed 12,907 transactions from four neighborhoods in Vancouver, Canada, occurring over the 1985—1991 period. The study found a 6.3% diminution in value for homes in close proximity to power lines and towers. An important aspect of this study is the rich (large and detailed) sample, which enabled the authors to investigate the effects of numerous elements of comparison and to examine many functional forms for the regression equation. Price equations were found to be heteroskedastic, and estimation methods were used to account for this and derive credible estimates of statistical significance. The article is silent, however, concerning whether the power lines are on easements or fee title land, the prevailing topography, prevalence or lack of tree screening, and the like.

Cowger, Bottemiller, and Cahill[19] used matched pairs to test for significant HVTL proximity effects. They examined 296 matched pairs consisting of a home sale abutting an HVTL right of way paired with a sale of a highly similar, nearby home unaffected by an HVTL. They used *t*-tests to examine differences between pairs in mean price per square foot, finding that HVTL proximity had no impact on home price.

13. James A. Chalmers, "High-Voltage Transmission Lines and Rural, Western Real Estate Values," *The Appraisal Journal* (Winter 2012): 30–45.
14. Note also that Bryant and Epley, cited earlier, question the viability of survey-based, stated-preference measures due to difficulties in an survey respondent estimating "his/her reaction without the pressure of the transaction, negotiation and financial commitment."
15. Statistical power can be thought of as the ability to isolate and assess the significance of small price movements.
16. Peter F. Colwell and Kenneth W. Foley, "Electric Transmission Lines and the Selling Price of Residential Property," *The Appraisal Journal* (October 1979): 490–499.
17. Peter F. Colwell, "Power Lines and Land Value," *Journal of Real Estate Research* 5, no. 1 (Spring 1990): 117–127.
18. Stanley W. Hamilton and Gregory M. Schwann, "Do High Voltage Electric Transmission Lines Affect Property Value?" *Land Economics* 71, no. 4 (November 1995): 436–444.
19. J. R. Cowger, Steven C. Bottemiller, and James M. Cahill, "Transmission Line Impact on Residential Property Values," *Right of Way* (September/October 1996): 13–17.

The study did not analyze or control for the impact of lot size differences between affected and unaffected properties, nor did it control for minor differences in other elements of comparison. These potential weaknesses were addressed in a follow-up study by Wolverton and Bottemiller,[20] where multiple regression modeling was used to control for element of comparison disparities. The follow-up study confirmed the "no-effect" conclusion of the earlier matched pairs analysis.

Des Rosiers[21] used a microspatial approach involving 50 multiple linear regression models, which found disparate power line effects, ranging from negative 23% to positive 22%. However, the primary result was a 9.6% reduction in value for a home adjacent to a power line and facing a pylon. The regression models used included both nominal price and natural log of price as dependent variables. The data consisted of 257 sales transactions located in three neighborhoods of Brossard, Quebec, differentiated by mean price—CN$225,924, CN$160,209, and CN$115,260. The HVTL pylons were described as being of "enhanced visual appearance" conical steel; however, the pylons and power lines were highly visible and mostly unscreened by vegetation.

Chalmers and Voorvaart[22] analyzed 1,286 single-family residential transactions located in four study areas in the northeastern United States. They regressed the natural log of sale price on housing characteristics, year of sale, and neighborhood subareas. Their study found no significant price effect from proximity to, or visibility of, HVTLs. They did investigate whether or not higher-valued properties were affected, operationalizing "higher valued" as prices in excess of the median price.

Jackson[23] examined rural agricultural and recreational land located in Wisconsin. He used regression modeling to compare online (HVTL power line proximate) sales to offline sales (more than one-quarter mile from an HVTL power line). Although the models indicated online sale prices 1.1% to 2.4% lower than offline sale prices, the differences were not statistically significant—meaning one cannot reject the null hypothesis of no power line price effect. The article also provides guidance for identifying variations in types of power line intersections—such as edge position, clipping, middle position, and diagonal position—that could be useful for appraisal report-writing purposes.

The data set in the study reported on in this article is a rich one, allowing examination of and control for numerous price effects stemming from market conditions, seasonality, topography, lot size, lot configuration, landscaping, building characteristics, and location (school districts, high schools, neighborhoods, counties, state, and zip code). Multiple linear regression analysis is used, with the natural log of price as the dependent variable. This functional form is the most prevalent in the literature, and it provided the most predictive precision.

The results were examined for heteroskedasticity (non-constant regression error variance) and none were found, unlike the data examined by Hamilton and Schwann. In addition, higher-valued homes in Seattle were investigated (similar to what was done by Chalmers and Voorvaart), operationalizing "higher valued" as the upper price quartile. This resulted in a more price-differentiated higher-priced subsample than the greater-than-median-priced subsample selected by Chalmers and Voorvaart. Finally, the study investigated price change over time for HVTL-affected properties versus unaffected properties, confirming the earlier results reported by Wolverton and Bottemiller.

Data

Sample data covered a 2½ year period spanning 2005, 2006, and the first half of 2007. Some non-abutting sales were included from outside of this time frame when they were deemed to have been most comparable to a nearby HVTL-abutting sale. In these few, exceptional instances the out-of-range sales were either from late 2004 and comparable to a nearby early 2005 sale or from early in the third quarter of 2007 and comparable to a nearby second quarter 2007 sale.

20. Marvin L. Wolverton and Steven C. Bottemiller, "Further Analysis of Transmission Line Impact on Residential Property Values," *The Appraisal Journal* (July 2003): 244–252.
21. Francois Des Rosiers, "Power Lines, Visual Encumbrance and House Values: A Microspatial Approach to Impact Measurement," *Journal of Real Estate Research* 23, no. 3 (2002): 275–301.
22. James A. Chalmers and Frank A. Voorvaart, "High-Voltage Transmission Lines: Proximity, Visibility, and Encumbrance Effects," *The Appraisal Journal* (Summer 2009): 227–245.
23. Thomas O. Jackson, "Electric Transmission Lines: Is There an Impact on Rural Land Values?" *Right of Way* (November/December 2010): 32–35.

The data collection protocol involved identifying a sufficient number of HVTL-abutting sales in each study area (Portland and Seattle) then searching for at least two, and preferably three, non-abutting sales from the same neighborhood and time frame as similar in square footage, lot size, and other elements of comparison as possible. This resulted in a "treatment" sample of HVTL-abutting homes and a "control" sample of non-HVTL-abutting homes. Tables 1 and 2 illustrate that the data collection effort was successful in its attempt to acquire highly similar treatment and control samples. In the analytical phase of the study, any remaining variation in elements of comparison between sample and within each sample was controlled for by use of a multiple regression model using an "Abutting HVTL" dummy variable to distinguish the HVTL price effect, all else being equal.

Sales were eliminated from consideration if the recorded title transfer relied on a deed that indicated something other than a market transaction. Also, each property ultimately included in the data set had been sold through the multiple listing service, a good indication that the transaction occurred in the open market. In conclusion, there is high confidence that the data satisfies the goal of the treatment and control subsets being as identical as possible, except for the treatment sales abutting a HVTL right of way.

Portland Study Area Sample

The Portland Study Area sample included 538 home sales: 152 treatment sales (HVTL abutting) and 386 control sales (non-HVTL abutting) located in three Portland metro-area counties—Washington County and Clackamas County in Oregon and Clark County in Washington. As shown in Table 1, central tendencies and dispersions for numerical variables were highly similar across control (non-abutting) and treatment (abutting) data subsets. The same holds true for categorical (dummy) variable proportions.

Data were assembled from numerous sources. Two secondary data sources were county tax assessment records and each area's multiple listing service (MLS). Primary data sources were property inspection (noting the appearance of each home viewed from the fronting street), aerial photographs, and recorded documents. In addition, assessor quality and condition ratings were cross-referenced with MLS descriptions and photographs included in the MLS database. Lot shape was confirmed by recorded plat, aerial photography, and field inspection. Lot topography and landscape quality were field assessed. Landscape quality assessments were verified as being consistent with the date of sale by examining exterior MLS photos to determine if the landscape had been altered after the sale date.

Other variables not listed in Table 1 include the sale's municipal address, each sale's school district and serving high school, market area's name (neighborhood), and zip code. The sample data also included cell phone tower visibility, the type of exterior and roof finish, existence of nearby parks, and membership in a homeowner's association. Distribution across treatment and control properties was similar for these additional variables as well. Nearly all of the additional variables (except for a few select location identifiers) proved to be statistically insignificant and were not included in the final models reported here.

Seattle Study Area Sample

The Seattle Study Area sample included 568 suburban home sales: 153 treatment sales and 415 control sales—all located in King County, WA (none were within the Seattle city limits).[24] As shown in Table 2, central tendencies and dispersions for numerical variables were highly similar across control (non-abutting) and treatment (abutting) data subsets. The same holds true for categorical (dummy) variable proportions.

As in Portland, data collection relied on secondary sources (county tax assessment records and MLS) and primary data collection (property inspection from the fronting street, aerial photographs, and recorded documents). Assessor quality and condition ratings were relied on and cross-referenced with MLS descriptions and photographs included in the MLS database. Lot shape was confirmed by recorded plat, aerial photography, and field inspection. Lot topography and landscape quality were field assessed, and the landscape was cross verified by exterior MLS photos to determine if it had been altered after the sale date.

Also similar to Portland, other variables not listed in Table 2 include the sale's municipal address, each sale's school district and serving high school, market

24. Bonneville Power has no transmission line rights of way within Seattle's city limits. Seattle is totally within King County, as are the suburbs studied here. These suburbs are considered to be part of the Seattle Metropolitan Area, and are included in the Seattle MSA, although they are outside of the Seattle city limits.

Table 1 Descriptive Statistics for Portland Area Sample Data, Control and Treatment Groups

Variable	Control Mean	Control Std. Deviation	Treatment Mean	Treatment Std. Deviation
Price	$294,048	$74,812	$291,122	$72,210
State of Oregon	0.648	**	0.665	**
State of Washington	0.352	**	0.335	**
Clark County, WA	0.352	**	0.336	**
Clackamas County, OR	0.042	**	0.040	**
Washington County, OR	0.606	**	0.625	**
2004 Sale	0.008	**	0.000	**
2005 Sale	0.301	**	0.270	**
2006 Sale	0.505	**	0.474	**
2007 Sale	0.187	**	0.257	**
Living Area (sf)	1,775	514	1,748	498
Lot Size (ac)	6,455	1,904	6,700	2,772
Bedrooms	3.380	0.580	3.360	0.560
Bathrooms	2.310	0.390	2.310	0.420
Age at Sale (yrs)	15.320	10.750	13.840	9.330
Garage (cars)	2.030	0.350	1.990	0.270
Fireplaces	0.852	0.496	0.783	0.473
Pool	0.005	**	0.013	**
Hot Tub	0.044	**	0.079	**
Deck	0.386	**	0.434	**
Patio	0.609	**	0.572	**
Outbuilding/Shed	0.158	**	0.204	**
Central Air Cond.	0.560	**	0.599	**
Fair Quality	0.005	**	0.013	**
Below Avg. Quality	0.067	**	0.086	**
Avg. Quality	0.738	**	0.737	**
Above Avg. Quality	0.109	**	0.059	**
Good Quality	0.080	**	0.105	**
Fair Condition	0.008	**	0.013	**
Below Avg. Condition	0.021	**	0.000	**
Avg. Condition	0.785	**	0.790	**
Above Avg. Condition	0.036	**	0.033	**
Good Condition	0.150	**	0.165	**
Poor Landscape	0.016	**	0.000	**
Fair Landscape	0.109	**	0.158	**
Avg. Landscape	0.733	**	0.691	**
Good Landscape	0.143	**	0.153	**
Level Site	0.749	**	0.645	**
Gentle Slope	0.184	**	0.283	**
Moderate Slope	0.062	**	0.072	**
Steep Slope	0.003	**	0.000	**
Rectangular Lot	0.676	**	0.763	**
Cul-de-Sac Lot	0.135	**	0.105	**
Corner Lot	0.145	**	0.053	**
Irregular Lot	0.044	**	0.072	**
Flag Lot	0.000	**	0.007	**
Quarter 1 Sale	0.218	**	0.178	**
Quarter 2 Sale	0.345	**	0.401	**
Quarter 3 Sale	0.251	**	0.263	**
Quarter 4 Sale	0.187	**	0.158	**

* Totals for any particular construct may not add to 100% due to rounding.
** Sample standard deviations are not included for 0,1 dummy variables.

Table 2 Descriptive Statistics for Seattle Area Sample Data, Control and Treatment Groups

Variable	Control Mean	Control Std. Deviation	Treatment Mean	Treatment Std. Deviation
Price	$483,435	$333,165	$502,261	$418,691
2005 Sale	0.506	**	0.497	**
2006 Sale	0.386	**	0.366	**
2007 Sale	0.108	**	0.137	**
Living Area (sf)	2,249	909	2,305	965
Lot Size (ac)	1.030	1.49	1.550	2.37
Bedrooms	3.580	0.68	3.620	0.77
Bathrooms	2.390	0.66	2.410	0.69
Age at Sale (yrs)	21.160	13.47	19.370	13.44
Garage (cars)	2.430	1.11	2.410	1.06
Fireplaces	1.330	0.74	1.350	0.73
Pool	0.019	**	0.000	**
Hot Tub	0.147	**	0.118	**
Deck	0.639	**	0.634	**
Patio	0.605	**	0.556	**
Outbuilding/Shed	0.080	**	0.053	**
Greenhouse	0.017	**	0.046	**
Sports Court	0.017	**	0.020	**
Apt./MLS[a]	0.051	**	0.026	**
Below Avg. Quality	0.075	**	0.105	**
Avg. Quality	0.518	**	0.500	**
Above Avg. Quality	0.241	**	0.222	**
Good Quality	0.123	**	0.105	**
Very Good Quality	0.034	**	0.052	**
Below Avg. Condition	0.051	**	0.085	**
Avg. Condition	0.692	**	0.654	**
Above Avg. Condition	0.222	**	0.190	**
Very Good Condition	0.034	**	0.072	**
Fair Landscape	0.082	**	0.118	**
Avg. Landscape	0.706	**	0.712	**
Good Landscape	0.190	**	0.131	**
Exc. Landscape	0.022	**	0.039	**
Level Site	0.451	**	0.490	**
Gentle Slope	0.378	**	0.353	**
Moderate Slope	0.194	**	0.150	**
Steep Slope	0.022	**	0.007	**
Rectangular Lot	0.554	**	0.510	**
Cul-de-Sac Lot	0.142	**	0.163	**
Corner Lot	0.135	**	0.052	**
Irregular Lot	0.142	**	0.242	**
Flag Lot	0.027	**	0.033	**
Quarter 1 Sale	0.207	**	0.170	**
Quarter 2 Sale	0.316	**	0.333	**
Quarter 3 Sale	0.272	**	0.268	**
Quarter 4 Sale	0.205	**	0.229	**

a Mother-in-law suite.
* Totals for any particular construct may not add to 100% due to rounding.
** Sample standard deviations are not included for 0,1 dummy variables.

area's name (neighborhood), and zip code. The sample data also included cell phone tower visibility, the type of exterior and roof finish, existence of nearby parks, membership in a homeowner's association, and gated entries. With one exception, distribution across treatment and control properties was similar for all variables. The exception is lot area, which averaged 1.03 acres for non-HVTL abutting properties and 1.5 acres for HVTL-abutting properties.[25] Use of multiple regression modeling in the analytical phase controlled for any differences between treatment and control groups to isolate and measure the HVTL proximity effect on price. Similar to the Portland data, most of the additional variables (except for a few select location identifiers) proved to be statistically insignificant.

Analysis

Portland Study Area Analysis

As illustrated in Table 3, the price effect of abutting a HVTL transmission line was found to be negative and statistically significant in the Portland Study Area. The magnitude of the effect was $(e^{-0.016615} - 1) \times 100\% = -1.65\%$ for the average priced treatment group (abutting) home in the study area. Given the Portland Study Area treatment group's $291,122 average sale price, the Portland treatment group's typical home would have sold for $4,884 more if not abutting an HVTL.[26]

The adjusted R^2 for Portland Study Area multiple regression analysis is 92.9%. The analysis indicates significantly lower 2004 prices and significantly higher prices in 2006 and 2007 in comparison to 2005. Double-digit percentage increases in price over the study period are consistent with the seller's market the Portland area experienced during this time. In addition, the market exhibits the sort of cyclicality expected in a northern climate, with significantly higher market prices during non-winter quarters.

As expected, the improved living area of the home is the most significant element of comparison for the price model. Bedroom and bathroom variables are opposite in sign, which is not unusual for these sorts of models given the high correlations among bedroom counts, bathroom counts, and a home's improved living area. Property condition and landscaping quality both affect sale price, as do lot size and property age. The significance of the age squared element of comparison indicates a nonlinear improvement depreciation rate. It appears that swimming pools may not be advantageous from a market price perspective in this market, whereas hot tubs do show a positive price effect.

The Portland Study Area real estate market is made up of numerous submarkets, and several of them are associated with significantly different home prices. The Rock Creek, Northwest Portland, Southwest Beaverton, Scholls Ferry, and Mt. Vista submarkets all indicate significantly higher-than-average prices. In Forest Grove and Covington-Orchards, prices tend to be significantly lower than average. In addition, after controlling for submarket identification, a Beaverton School District location provides an additional price increment. At a more macro-location level, prices tend to be higher in Clackamas County, OR, and lower in Clark County, WA (Vancouver), in comparison to the base location (Washington County, OR).

Seattle Study Area Analysis

As shown in Table 4, the price effect of abutting an HVTL was also negative and statistically significant for the Seattle Study Area sample. The magnitude of the effect was $(e^{-0.02459} - 1) = -2.429\%$ for the average-priced treatment group (abutting) home in the study area. Given the Seattle Study Area treatment group's $502,261 average sale price, the Seattle treatment group's typical abutting home would have sold for $12,504 more if not abutting an HVTL.[27]

The adjusted R^2 for Seattle Study Area multiple regression analysis is 93.5%. The analysis indicates significantly higher prices in 2006 and 2007 in comparison to 2005. As in Portland, double-digit percentage increases in price over the study period are consistent with the seller's market the Seattle area experienced during this time. In addition, the Seattle market also exhibited the sort of cyclicality expected in a northern climate, with significantly higher market prices during non-winter quarters.

Again, improved living area of the home is the most significant element of comparison for the price model. As in the Portland model, bedroom

25. Larger HVTL-abutting lots are not unusual, given the data descriptions included in many of the articles cited in the literature review.

26. $\frac{291{,}122}{(1 - 0.0165)} - 291{,}122 = 4{,}884$

27. $\frac{502{,}261}{(1 - 0.02429)} - 502{,}261 = 12{,}504$

Table 3 Multiple Regression Analysis of the Natural Log of Sale Price, Portland Study Area

Predictor	Coefficient	*t*–Statistic	*P*–Value
Constant	11.73260000	320.64	0.000
Abuts HVTL	–0.01661500	–2.61	0.009
2004 Sale	–0.16722000	–4.13	0.000
2006 Sale	0.12987800	19.06	0.000
2007 Sale	0.17290100	19.24	0.000
Quarter 2	0.03179700	3.94	0.000
Quarter 3	0.05439400	6.04	0.000
Quarter 4	0.06355800	6.40	0.000
Age	–0.00444460	–5.85	0.000
Age Squared	0.00003131	2.96	0.003
Lot Size (ac)	0.42296000	5.01	0.000
Fair Landscape	–0.02980600	–3.26	0.001
Good Landscape	0.04986000	5.64	0.000
Above Avg. Condition	0.04020000	2.58	0.010
Good Condition	0.03544300	3.98	0.000
Living Area (sf)	0.00028992	25.02	0.000
Bedrooms	–0.01217100	–1.59	0.113
Baths	0.03968000	3.44	0.001
Garage (cars)	0.04602000	4.51	0.000
Central AC	0.01409400	2.21	0.027
Pool	–0.05634000	–1.64	0.102
Hot Tub	0.02659000	2.14	0.033
Rock Creek Market	0.03855000	2.64	0.009
NW Portland Market	0.06520000	4.88	0.000
Forest Grove Market	–0.07477000	–4.05	0.000
SW Beaverton Market	0.08464000	4.41	0.000
Scholls Ferry Market	0.03421000	1.84	0.066
Covington–Orchards Market	–0.07356000	–1.95	0.052
Mt. Vista Market	0.12579000	3.22	0.001
Beaverton School Dist.	0.07845900	8.02	0.000
Clackamas County	0.11841000	7.02	0.000
Clark County	–0.10052000	–9.82	0.000

S = 0.0640650 R^2 = 93.3% R^2(adj) = 92.9%

and bathroom variables are opposite in sign as a consequence of the high correlations among bedroom counts, bathroom counts, and improved living area. Property quality, property condition, and landscaping quality affect sale price here, as does lot size. Unlike Portland, a visible cell phone antenna ($n=55$) was a significant negative influence on price in the Seattle market.

The Seattle Study Area sample covers a much wider price range than the Portland data. Therefore, some of the significant elements of comparison may actually be more applicable either to higher-priced homes or to more typically priced homes, entering the regression equation via significance in a given price segment but not in the other (this phenomenon is studied in more detail later in the article).

Table 4 Multiple Regression Analysis of the Natural Log of Sale Price, Seattle Study Area

Predictor*	Coefficient	*t*–Statistic	*P*–Value
Constant	12.03530000	348.58	0.000
Abuts HVTL	–0.02459000	–2.07	0.039
2006 Sale	0.16855000	15.48	0.000
2007 Sale	0.21629000	11.95	0.000
Quarter 2	0.03103000	2.10	0.036
Quarter 3	0.06668000	4.18	0.000
Quarter 4	0.07266000	4.38	0.000
Living Area (sf)	0.00025187	21.93	0.000
Garage (cars)	0.02904600	5.47	0.000
Lot (ac)	0.05042200	12.96	0.000
Moderate Slope	–0.02618000	–1.79	0.074
Creek River or Lake View	0.10392000	3.10	0.002
Rural Land View	–0.09454000	–1.94	0.052
Fair Landscape	–0.02911000	–1.62	0.106
Good Landscape	0.04146000	2.77	0.006
Exc. Landscape	0.29246000	7.99	0.000
Bedrooms	–0.02395300	–2.66	0.008
Bathrooms	0.03472000	2.75	0.006
Pool	0.06714000	1.52	0.130
Barn	0.13152000	6.05	0.000
Above Avg. Quality	0.05190000	3.85	0.000
Good Quality	0.08680000	4.32	0.000
Above Avg. Condition	0.03614000	2.61	0.009
Cement Fiber Board and Masonry	0.03089000	1.94	0.053
Torch Down Roof	–0.09631000	–1.94	0.053
Cell Phone Ant. Visible	–0.06327000	–3.46	0.001
Federal Way	–0.08459000	–3.22	0.001
Maple Valley	–0.03311000	–1.74	0.082
Issaquah	0.14206000	4.92	0.000
Sammamish	0.16244000	4.52	0.000
Lake Washington SD	0.24369000	15.63	0.000
Snoqualmie Valley SD	0.15103000	3.54	0.000
Auburn SD	–0.05125000	–2.88	0.004
Issaquah HS	0.13107000	2.51	0.012
Skyline HS	0.11901000	3.52	0.000
Cedar Crest HS	0.26239000	4.83	0.000
Woodinville HS	0.34840000	2.92	0.004
Inglewood HS	–0.28170000	–2.26	0.024
ZIP98045	–0.07825000	–1.44	0.149
ZIP98010	0.17823000	2.54	0.011
ZIP98059	0.06275000	1.34	0.181
ZIP98023	0.04924000	1.59	0.112

S = 0.115197 R^2 = 94.0% R^2(adj) = 93.5%

*Unlike the Portland Study Area model, there is no age variable in this model because age was highly correlated with the quality and condition variables. The age variable was insignificant in the presence of the data's quality and condition variables, and the standard error of the regression was lower without the age variable in the model (i.e., the model provides more precise price estimates without an age variable).

Examples of these sorts of variables include some of the geographic location identifiers, torch down roofing,[28] swimming pools, and a cement fiber board and masonry exterior finish.

Unlike Portland's multistate and multicounty data, all of the Seattle transactions were in the same state (WA) and the same county (King). Although named submarkets exist in the Seattle Market, city name, school district, and high school influences provide more precise price models, accompanied by zip code micro-location information. However, the significant location identifiers proved to vary between higher-priced homes and more typically priced homes.

Seattle Study Area—Higher-Priced Home Market

For the Seattle Study Area, the higher-priced home market was operationalized by isolating and analyzing the upper price quartile of the data (25% of the sample with a mean treatment group sale price of $1,035,105). As shown in Table 5, for higher-priced homes the effect of abutting an HVTL right of way was a much greater percentage of price and the effect was more significant than for the data as a whole, $(e^{-0.11906} - 1) \times 100\% = -11.225\%$. Given the Seattle Study Area higher-priced home subset's $1,035,105 average treatment group sale price, the Seattle Study Area's typical abutting, higher-priced home would have sold for $130,882 more if not abutting an HVTL.[29]

Table 5 Multiple Regression Analysis of the Natural Log of Sale Price, Seattle Study Area, Higher-Priced Homes

Predictor	Coefficient	*t*–Statistic	*P*–Value
Constant	12.48510000	126.59	0.000
Abuts HVTL	–0.11906000	–3.34	0.001
2006 Sale	0.17862000	5.39	0.000
2007 Sale	0.23082000	4.85	0.000
Living Area (sf)	0.00020814	8.23	0.000
Garage (cars)	0.04791000	4.01	0.000
Lot (ac)	0.03763200	5.43	0.000
Rural Land View	–0.33530000	–2.68	0.009
Good Landscape	0.09738000	3.04	0.003
Exc. Landscape	0.25137000	5.28	0.000
Bedrooms	–0.05165000	–2.47	0.016
Bathrooms	0.03153000	1.12	0.266
Fireplace	0.03115000	1.50	0.137
Pool	–0.11282000	–1.81	0.074
Barn	0.14622000	2.74	0.007
Above Avg. Quality	–0.07293000	–2.00	0.049
Cell Phone Ant. Visible	–0.09878000	–1.05	0.296
Issaquah	0.16150000	2.73	0.008
Sammamish	0.32308000	5.71	0.000
Lake Washington SD	0.14799000	4.49	0.000
Cedar Crest HS	0.18930000	2.54	0.013
Inglewood HS	–0.39710000	–2.45	0.016
ZIP98010	0.19440000	1.34	0.185

S = 0.139418 R^2 = 89.8% R^2(adj) = 87.1%

28. A colloquial expression identifying a multi-ply, flat, rubberized asphalt roof.

29. $\frac{1,035,105}{(1 - 0.11225)} - 1,035,105 = 130,882$

The magnitude of this effect also suggests that the significant –2.429% HVTL price effect for the full Seattle data set was impacted by inclusion of higher-priced homes in the full sample.

Many of the quality, condition, and location elements of comparison are not evident in this more-parsimonious, higher-priced home model—often as a consequence of there being no sales exhibiting the missing characteristics (e.g., no homes with fair landscaping and no homes located in Federal Way). Cell phone antenna visibility loses significance (presumable due to relatively larger average lot size), and city address, school district, and high schools are reduced to a few relevant locations.

The adjusted R^2 is 87.1% for the Seattle Study Area higher-priced home multiple regression analysis. The analysis indicates significantly higher prices in 2006 and 2007 in comparison to 2005, similar to the larger Seattle data set. Unlike the Portland data and the larger Seattle data set, seasonal cyclicality was not a significant factor for the higher-priced home market.

Seattle Study Area—More Typically Priced Home Market

For the purposes of this analysis, the Seattle Study Area's more typically priced home sample consists of the lower three price quartiles of the data (75% of the sample with a mean treatment group sale price of $366,866). As shown in Table 6, the effect of abutting an HVTL right of way was a much smaller percentage of price and statistically insignificant for typically priced Seattle Study Area homes, $(e^{-0.006415} - 1) \times 100\% = -0.6415\%$. If statistically significant, this percentage would amount to –$2,369 for homes in the subsample's average-priced treatment group.[30] However, due to the small *t*-statistic of –0.65, there is no strong statistical evidence to support the existence of an HVTL effect for more typically priced homes in the Seattle Study Area. The small magnitude and lack of significance of this effect suggests that the apparently significant –2.429% HVTL price effect for the full Seattle data set was almost entirely the result of including higher-priced homes in the full Seattle Study Area sample.

The adjusted R^2 is 87.3% for Seattle Study Area's more typically priced homes multiple regression analysis. The analysis also indicates significantly higher prices in 2006 and 2007 in comparison to 2005, similar to the larger Seattle data set. Like the Portland data, seasonal cyclicality was a significant factor for the Seattle more typically priced home market, and in contrast with Portland, cell phone tower visibility did have a significant negative impact on home price.

Analysis of Price Sensitivity to Various HVTL Voltages

The Portland sales data and the Seattle sales data include treatment (HVTL-abutting) effects from a variety of power line voltages. Four levels of line voltage are present in the Portland data—115 kV, 230 kV, 345 kV, and 500 kV. Whereas, three levels are present in the Seattle data—230 kV, 345 kV, and 500 kV. HVTL voltage distributions among the treatment sales are summarized in Table 7.

Two additional regression models were developed, replacing the "Abuts HVTL" variable in the models shown in Tables 3 and 4 with interaction variables representing the maximum line voltage present at each abutting (treatment) sale. All other variables were left unchanged. The result is an indication of the HVTL proximity effect broken down by line-voltage category. Line voltage is a variable of interest because voltage affects the tower type and configuration, width of right of way, and amount of line noise.[31]

Since the kV interaction variables fully capture the "Abut HVTL" effect in both regression models, R^2 and adjusted R^2 remained the same as reported in Tables 3 and 4, and the full list of variable coefficients and significance levels are unchanged. Results of the kV category effects are included in Table 8.

As shown in Table 8, the data do not support the idea that price effects are greater or more significant when a home abuts a higher-voltage HVTL. Although the Portland results in Table 8 suggest a lesser price effect from higher-voltage lines, there are too few higher-voltage abutting sales in the Portland data to support the credibility of this counter-intuitive indication.

The Seattle results in Table 8 also suggest a counter-intuitive result—a greater and more significant price effect associated with the Seattle

30. $\frac{366{,}866}{(1 - 0.006415)} - 366{,}866 = 2{,}369$

31. Higher voltages are associated with larger towers, wider rights of way, and greater line noise.

Table 6 Multiple Regression Analysis of the Natural Log of Sale Price, Seattle Study Area, More Typically Priced Homes

Predictor	Coefficient	*t*–Statistic	*P*–Value
Constant	12.07930000	87.44	0.000
Abuts HVTL	–0.00641500	–0.65	0.517
2006 Sale	0.16601800	18.13	0.000
2007 Sale	0.21829000	14.64	0.000
Quarter 2	0.02720000	2.26	0.024
Quarter 3	0.07700000	5.96	0.000
Quarter 4	0.07728000	5.84	0.000
Living Area (sf)	0.00021149	17.10	0.000
Garage (car)	0.02019100	4.17	0.000
Lot (ac)	0.05990600	12.63	0.000
Fair Landscape	–0.03319000	–2.42	0.016
Bedrooms	–0.00993700	–1.20	0.231
Bathrooms	0.02874000	2.42	0.016
Pool	0.39380000	4.33	0.000
Barn	0.11218000	5.63	0.000
Above Avg. Quality	0.07294000	6.24	0.000
Good Quality	0.11901000	5.88	0.000
Above Avg. Condition	0.03663000	2.97	0.003
Cement Fiber Board and Masonry	0.02538000	1.76	0.079
Torch Down Roof	–0.09667000	–2.36	0.019
Cell Phone Ant. Visible	–0.0564300	–3.93	0.000
Federal Way	–0.08896000	–4.43	0.000
Maple Valley	–0.06119000	–3.94	0.000
Issaquah	0.07793000	3.63	0.000
Lake Washington SD	0.25318000	18.17	0.000
Auburn SD	–0.05947000	–4.17	0.000
Issaquah HS	0.21774000	4.82	0.000
Skyline HS	0.20463000	9.28	0.000
ZIP98010	0.16664000	2.65	0.008
ZIP98023	0.05955000	2.52	0.012

S = 0.0872944 R^2 = 88.1% R^2 (adj) = 87.3%

Table 7 Treatment Sales, HVTL Frequency Distributions by Line kV

Portland Data		Seattle Data	
HVTL kV	**Frequency**	**HVTL kV**	**Frequency**
115 kV	41	115 kV	0
230 kV	89	230 kV	80
345 kV	12	345 kV	3
500 kV	10	500 kV	70

Table 8 HVTL Proximity Price Effect by Line Voltage Category

Line Voltage	Coefficient	*t*-Statistic	*P*-Value
Portland Data			
115 kV	–0.01285	–1.14	0.253
230 kV	–0.02099	–2.66	0.008
345 kV	–0.00628	–0.31	0.759
500 kV	–0.00293	–0.13	0.897
Seattle Data			
Line Voltage	**Coefficient**	***t*-Statistic**	***P*-Value**
230 kV	–0.03535	–2.29	0.023
345 kV	+0.03275	0.42	0.677
500 kV	–0.01457	–0.88	0.381

Dependent variable is natural log of price.

data's lowest line voltage. This result is misleading, because 87% of the higher-priced, most-affected home sales reported in the Seattle data (analyzed in Table 5) are abutting 230 kV lines. Therefore, the 230 kV variable in the Seattle regression model reported in Table 8 serves as a proxy for the much greater, higher-priced home HVTL effect in Seattle.

Market Conditions Adjustment and HVTL Proximity

Rates of price change for 2005 to 2006 and 2005 to 2007 were isolated for HVTL-abutting and non-HVTL abutting properties in both Portland and Seattle. These were isolated and estimated by running multiple regression models identical to those shown previously for "abutting" and "non-abutting" subsets of each study area's data. Table 9 includes coefficients on 2006 and 2007 market conditions adjustment coefficients for each study area, using a 2005 base year (the data did not include enough 2004 sales to allow meaningful 2004 comparisons).

As Table 9 shows, there was very little difference in percentage change in price from 2005 to 2006 and from 2005 to 2007 for HVTL-abutting and non-HVTL-abutting homes in either the Seattle or Portland Study Areas. Rates of price change during the 2005—2007 study period were not materially affected by HVTL proximity, having been slightly greater in Portland for HVTL-abutting properties and slightly less in Seattle for HVTL-abutting properties in 2006, but greater in 2007. Therefore, HVTL proximity price effects appear to have been limited to the sale price as of the date of the transaction, with no material effect on rates of price change. Figure 1 provides a graphic representation of these market condition adjustment percentages.

Findings and Conclusions

Results from the Portland Study Area represent a refinement to the earlier work by Wolverton and Bottemiller[32] by provision of a more precise model, principally due to the current study's data set allowing for better statistical control of the pricing influence of the city's market areas (neighborhoods) and school districts. The resulting improved precision, in terms of smaller regression error, uncovers the significance of the HVTL price effect, which was not evident in the prior study. In addition, this study confirms the earlier Portland area finding of no appreciable difference in the price response to changing market conditions for HVTL-abutting and non-abutting homes.

The Seattle study is unique in regard to its breadth of home price coverage (25% of the data having a mean price of approximately $1 million). Like the Portland portion of this study, the Seattle area data benefits from inclusion of a wealth of location data, including municipalities, school districts, market areas (neighborhoods), high schools, and zip codes. At first blush, the Seattle findings appear to be consistent with the Portland analysis—a small, significant, negative HVTL price effect. However, when the higher-priced homes and more typically priced homes are analyzed separately the price effects are found to be quite different. The

32. Wolverton and Bottemiller, "Further Analysis of Transmission Line Impact on Residential Property Values."

Table 9 Market Conditions Coefficients for HVTL Abutting and Non-Abutting Homes

	Coefficient	*t*–Statistic	*P*–Value
Seattle Study, HVTL Abutting			
2006 Sale	0.14140	7.31	0.000
2007 Sale	0.21984	7.27	0.000
Seattle Study, Non-HVTL Abutting			
2006 Sale	0.16813	12.99	0.000
2007 Sale	0.20509	9.36	0.000
Portland Study, HVTL Abutting			
2006 Sale	0.13520	9.98	0.000
2007 Sale	0.17971	10.15	0.000
Portland Study, Non-HVTL Abutting			
2006 Sale	0.128525	16.25	0.000
2007 Sale	0.171420	16.33	0.000
2007 Sale	0.171420	16.33	0.000

Dependent variable is natural log of sale price, convert to percentages using $[e^{coef} - 1] \times 100\%$

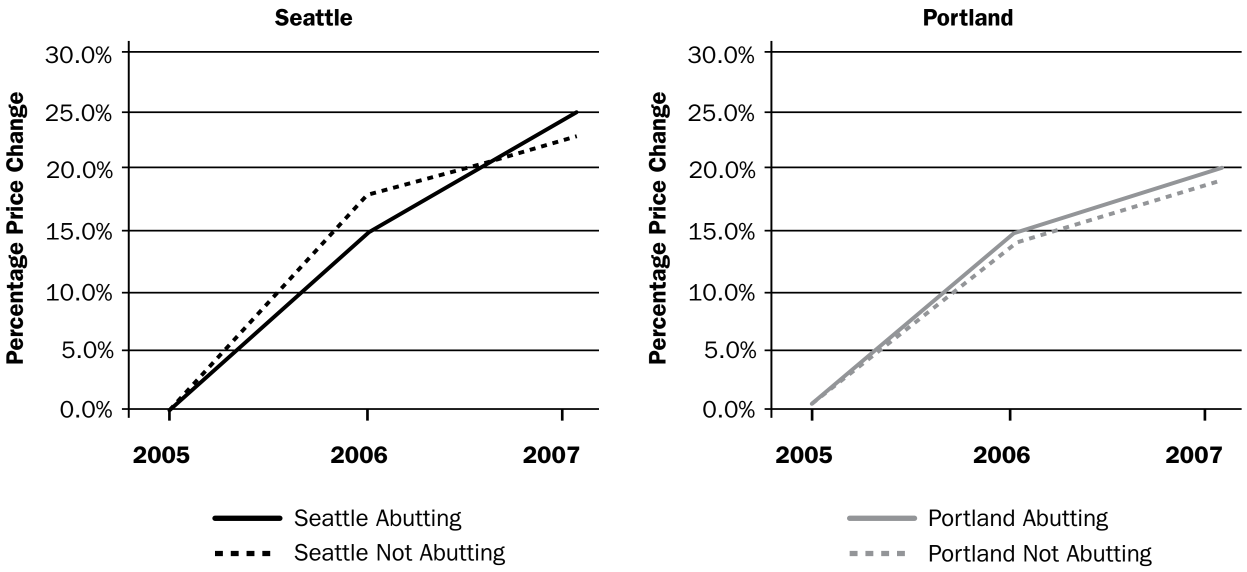
data for more typically priced homes reveal a very small negative and statistically insignificant HVTL price effect. One cannot conclude that the HVTL price effect differs from zero for this subset of the data. Conversely, the negative HVTL price effect for the higher-priced Seattle Study Area homes is substantial and highly significant. Finally, as in Portland, there is no evidence that HVTL proximity affected the rate of change in home prices in the Seattle area during the study period.[33]

These outcomes, like all studies of this sort, are derived from sample data intended to be representative of their markets. Such samples are not generalizable to other markets due to differences in climate, government, terrain, vegetation, and local attitudes toward HVTL proximity and views. Furthermore, as the relatively high market price appreciation rates herein indicate, these markets could be described as occurring during an up-sloping segment of the real estate price cycle. One should not necessarily expect similar buyer and seller pricing behavior during other segments of the market cycle—such as balanced markets with very little price movement over time or under-demanded markets evidenced by falling prices.

Additionally, there are material differences between the Portland market and the Seattle market. Portland is a multicounty, multistate housing market; Seattle is not. The choice of state of residence in the Portland area determines income tax rates and sales tax rates. No such dynamic occurs in Seattle. Also, Portland's Washington County is highly urban whereas Clackamas County (OR) and Clark County (WA) are less so. In contrast, Seattle's King County includes urban, suburban, and exurban lands. The Seattle sale data locations are almost exclusively suburban, and some of the higher-priced homes are at the suburban fringe where land uses rapidly transition into an exurban environment. Therefore, the Portland findings are not directly applicable to Seattle, and the Seattle findings are not directly applicable to Portland. The most stark, and revealing difference between the data from these two markets is the much larger percentage-of-price effect exhibited for higher-priced homes in Seattle. It seems more likely that this effect is more attributable to home price than it is to city location (Seattle versus Portland). Unfortunately, there is no available Portland data for testing this supposition.

33. For completeness, standard errors were examined for evidence of heteroskedasticity and none was apparent. To further ensure that the results were credible, each regression model was also estimated using White's heteroskedasticity consistent covariances and the findings were unchanged from those reported here.

Figure 1 Market Conditions Adjustment Percentages



The study's regression equations also reflect what appraisers generally find to be axiomatic. Location matters in these two housing markets. Unlike investment income, housing is not fungible. Families care about the state, county, city, school district, high school service area, and neighborhood they live in. In addition, all else being equal, improved living area is usually the most important factor in home price. Furthermore, living area, bedroom counts, and bathroom counts are highly correlated. The appraisal "Principal of Balance" is confirmed by these correlations, and when room counts depart from market norms for a given floor area, SF-BR-BA balance is disturbed. Also, the analyses found here highlight the importance of market condition adjustments. When prices are varying by 20% to 25% over a brief 2½ year period, market condition adjustments quickly add up to meaningful amounts of money. Lastly, markets often exhibit a significant amount of seasonal cyclicality. Therefore, a winter season sale may not be comparable to a summer season sale absent a seasonality adjustment, regardless of longer term market condition effects.

Considerable research has been conducted regarding the price effects of HVTL proximity. This study adds to an understanding of this complex phenomenon in a number of ways: it takes a second look at Portland and Seattle during a different market period; it focuses on a seller's market segment of the market cycle; it offers a first-ever empirical HVTL study of the Seattle upper-priced housing market; and it confirms findings of a previous study regarding how abutting and non-abutting homes react to changing market conditions. The study also confirms that all markets do not react in the same way to HVTL proximity. Portland appears to differ from Seattle, and higher-priced homes in Seattle differ from more typically priced Seattle homes. Given this finding, it would be beneficial if a future study were to compare higher-priced custom homes with typically priced homes in other locations to determine if this result can be confirmed elsewhere.

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Web Connections

Internet resources suggested by the Y. T. and Louise Lee Lum Library

Electric Power Research Institute
http://my.epri.com

Environmental Impacts of Transmission Lines, Public Service Commission of Wisconsin
http://psc.wi.gov/thelibrary/publications/electric/electric10.pdf

Federal Energy Regulatory Commission—Transmission Line Siting
http://www.ferc.gov/industries/electric/indus-act/siting.asp

US Department of Energy
http://www.energy.gov

US Energy Information Administration
http://www.eia.gov/