Power Lines, Visual Encumbrance and House Values: A Microspatial Approach to Impact Measurement

Authors François Des Rosiers

Abstract This research looks at the impact of high-voltage transmission lines (HVTL) on surrounding property values, using a microspatial approach. It is based on a sample of 507 single-family houses sold over the 1991–96 period in the City of Brossard, in the Greater Montreal area, Canada. Findings suggest that although severe visual encumbrance due to a direct view on a pylon or conductors does exert a significantly negative impact on property prices with depreciations ranging from 5% to well in excess of 20%, being adjacent to the easement will not *necessarily* cause a house to depreciate and may even increase its value in similar proportions where proximity advantages exceed drawbacks.

Introduction

Over the past two decades, environmental issues have drawn greater attention in the economic and real estate literature, particularly with respect to their impact on property prices. Despite its inherent weaknesses (Rosen, 1974), the hedonic approach remains the most reliable tool for measuring environmental negative externalities since it brings out buyers' disutility stemming from any perceived hazard through their actual pricing behavior. Using multiple regression analysis, it can indeed isolate the respective market value contribution of each attribute of the residential bundle, physical as well as neighborhood-related. For that reason, numerous environment-oriented hedonic analyses have been performed on the residential market since the early 1980s. The vast majority of them deals with issues such as air and sea water pollution (Diamond, 1980; Brookshire, Thayer, Schultze and D'Arge, 1982; Palmquist, 1984, 1988; Graves, Murdoch, Thayer and Waldman, 1988; Murdoch and Thayer, 1988; Kask and Maani, 1992; and Mendelsohn et al., 1992), the nearby presence of landfill, incinerator and nuclear plant sites (Nelson, 1981; Gamble and Downing, 1982; Smith and Desvousges, 1986; Cartee, 1989; Michaels and Smith, 1990; Zeiss, 1989, 1990; Mundy, 1992; Nelson, Genereux and Genereux, 1992; and Ketkar, 1992), as well as airport and highway proximity (Nelson, 1980; O'Byrne, Nelson and Seneca, 1985;

Pennington, Topham and Ward, 1990; and Uyeno, Hamilton and Biggs, 1993). The impact of chemical contamination (Ford and Gilligan, 1988), the proximity of a pipeline (Kask and Maani, 1992; and Simons, 1999), the presence of trees in the neighborhood (Orland, Vining and Ebreo, 1992) and the impact of earthquakes (Murdoch, Singh and Thayer, 1993) have also been investigated. Finally, Des Rosiers, Bolduc and Thériault (1999) analyze the impact of drinking water quality on house prices. A recent literature review by Boyle and Kiel (2001) provides a relatively comprehensive picture of the environmental hedonic price studies performed over the past decades.

Using hedonics, this analysis looks at the impact of high-voltage transmission lines (HVTL) on surrounding property values through a micro-spatial approach. The study is based on a sample of 507 single-family houses sold over recent years in the City of Brossard, a municipality located in the Greater Montreal area, Canada, on the south shore of the Saint-Lawrence River, and aims at sorting out both positive and negative effects resulting from immediate proximity to, as well as view on, a HVTL corridor. It also provides the possibility to test for the actual impact of the media coverage of the 1992 Floderus and Ahlborn and Feychting reports, two well-publicized Swedish epidemiological studies on electromagnetic fields (EMF)-induced health hazards.

Power Lines, Health Hazards and House Values

While the house price issue remains by itself a major research topic, it can hardly be isolated from the underlying EMF issue. Since the early 1970s, more than forty studies have investigated the EMF-induced risks of leukemia and brain cancer among both adult and child populations (Hydro-Quebec, 1996; and Saint-Laurent, 1996). In spite of some indications that children regularly exposed to transmission lines might be at risk, none of these studies can support any scientific evidence of a causal relationship between EMF exposure and cancer. Yet, as recently documented by Goeters (1997), the U.S. Government—via the Department of Energy and under the 1992 National EMF Research and Public Information Dissemination (RAPID) Program—openly encouraged states to adopt safety regulations with respect to the building and improvement of HVTLs in residential neighborhoods. Besides the status quo, three strategies were put forward, namely the ‘‘Prudent Avoidance’’ solution, the adoption of EMF intensity standards and a moratorium on any new installations. Similarly, the fear, though statistically unfounded, of any potential health hazard for nearby residents resulted over the past decade in a series of court cases whereby financial compensations were demanded for a hypothetical loss in value of affected properties, as a consequence of the ‘‘cancerphobia’’ syndrome. While no compensations had been granted until the early 1990s (McEvoy, 1994), two court decisions by the New York State’s Court of Appeal and the Court of Appeal of Kansas, Texas, have since stated that evidence of fear in the marketplace and ensuing economic damage to the property should be admissible as a ground for compensation, irrespective of the reasonableness of the fear (Rikon, 1996). This corroborates Mitchell's (2000) assumption as to the importance of a loss of marketability in the assessment of environmentally-induced economic damages. The issue, though, remains open as an accurate measurement of the economic damage to EMF-affected properties is still flawed by methodological bias (Bryant and Epley, 1998).

While several analytical approaches are currently being used to measure HVTL impacts on real estate values (Furby, Slovic, Fischhoff and Gregory, 1988; Furby, Gregory, Slovic and Fischhoff, 1988; Rhodeside and Harwell, 1988; Priestley and Evans, 1990; Delaney and Timmons, 1992; Kung and Seagle, 1992), it has understandably become a hot research area for hedonics as studies by Colwell and Foley (1979), Kinnard, Geckler, Geckler and Mitchell (1984), Colwell (1990), Kinnard (1990), Ignelzi and Priestley (1991), Kroll and Priestley (1991), Hamilton and Carruthers (1993), Hamilton and Schwann (1995), Kinnard and Dickey (1995), Callanan and Hargreaves (1995), Kinnard (1996) and Kinnard, Geckler and DeLottie (1996, 1997), among others, demonstrate. In short, most studies conclude that proximity to a HVTL per se does not necessarily lead to a drop in the value of surrounding properties and that other physical as well as neighborhood attributes prevail in the price determination process. Wherever negative impacts are at stake, these vary, by and large, between 1% and 6% of value at a 200 ft. distance, 9% in the case of improvements to existing lines (Ignelzi and Priestley, 1991) and between 6% and 9% of value at a distance of 50 ft. (Colwell and Foley, 1979; and Colwell, 1990). Moreover, detrimental effects tend to disappear beyond 400 ft. (650 ft. (Hamilton and Schwann, 1995). Similarly, where new lines are installed or existing lines modified, drops in value lessen over time and tend to fade away after four to ten years (Kroll, 1994: quoted by Kinnard, 1996). Kinnard (1988: quoted by Kinnard, Geckler and DeLottie, 1997) even identifies price increases for properties adjacent to a HVTL. In contrast, immediate proximity to, or direct view on, a pylon does cause house prices to drop, from 5% at a 50 m., or 160 ft., distance to more than 27% at 10 m., or 33 ft. (Callanan and Hargreaves, 1995; and Hamilton and Schwann, 1995). Finally, with respect to the media coverage of the 1992 the Swedish epidemiological studies, no significant price impacts were detected by authors.

To conclude, several factors must be considered when assessing the impact of HVTL structures on residential areas and the extent of visual encumbrance affecting homeowners: the distance and immediate proximity to, as well as the view on, both lines and pylons, the type and height of structures, the quality of easement landscaping and, finally, the surrounding topography, which may enhance or reduce negative externalities. According to Kinnard and Dickey (1995), several aspects of the phenomenon need to be clarified, namely the spatial delimitation of price effects, the very notion of proximity to HVTL structures and households' behavioral discrepancies between submarkets. Furthermore, considering the nonlinear, and possibly nonmonotonic, pattern of the price-distance hedonic relationship, the choice of a continuous functional form—sophisticated though it might be—remains problematic; hence the need for a microspatial investigation approach.

Study Area Description, Data Bank and Analytical Approach

This study is based on a sample of 507 single-family houses of which 257 town cottages sold in the City of Brossard between February 1991 and November 1996. Covering a territory of seventeen square miles, Brossard had a population of 69,000 by 1996. The study area, which is between 800 and 1,600 ft. wide, includes three distinct residential neighborhoods, which are referred to as sectors *R*, *S* and *T* after street denominations, and is bounded by three major highways, with a 315 Kv. transmission line running through its center. Mean house price stands at $225,924 (Can$), $160,209 and $115,260 in neighborhoods *R*, *S* and *T*, respectively, the overall average for the global sample reaching $169,600. The HVTL corridor itself is about two miles long and 200 ft. wide, with IVA (Improved Visual Appearance) conical steel pylons reaching, in most cases, between 155 and 175 ft. in height; within the study area, there are twenty-six pylons. The span between pylons varies from 650 to 1100 ft., minimal clearance between conductors and ground level standing from a low of 37 ft. to a high of 63 ft. While the neighborhood topography is flat with little tree planting around the HVTL structure, a cycling path is designed along its east side.

A major feature of this case study is the asymmetrical location of the line, which is within 150 ft. of the eastern boundary of the easement, as opposed to 50 ft. on the west side. Overall, 383 houses have a limited, moderate or pronounced rear, side or front view on the line, with thirty-four being directly adjacent to it. The average distance to the external boundary of the HVTL easement stands at 248 m., which is roughly 810 ft. As for the data bank, it includes some twenty-five property descriptors pertaining to physical, neighborhood, environmental, access, fiscal and sales time attributes as well as a series of HVTL-related descriptors: linear distance to the line and easement as well as dummy distance variables (50 and 100 m. increments); dummy variables to control for pylons' position relative to houses that are adjacent to the easement (house facing pylon, located one, two or three lots away from pylon, or mid-span located); and a series of interactive dummy descriptors to account for the combined extent of the view on the HVTL structures and the orientation of the property with respect to the easement. Finally, with two-thirds of the sample referring to post-1992 transactions—that is, 184 pre-1993 sales, 166 1993 and 1994 sales and 157 post-1994 sales—, interactive dummies are used to test whether properties adjacent to the HVTL easement have seen their market value affected as a result of the wide media coverage of the Swedish epidemiological studies. The operational definition of physical, fiscal, location and HVTL-related attributes are displayed in Exhibit 1.

Standard and stepwise regression procedures are successively used in the analysis. While both linear and log-linear functional forms are used, HVTL distance variables are also applied to several transformations including logarithmic, square root, inverse, quadratic and gamma. The analysis is first performed using the global sample. The market is then segmented and the east and west areas, the

Exhibit 1 | Operational Definition of Variables

Variable	Codification	Operational Definition
APPAGE	M	Apparent age of the property, in years.
LOTSIZE	M	Lot size, in square meters.
LIVAREA	M	Living area or the property, in square meters.
BASMTAREA	M	Finished basement area, in square meters.
OTHSIDING	D	Siding of the property, other than stone or brick.
LANDSCAPING	D	Presence of an above average landscaping.
LAMKITCAB	D	Presence of laminated kitchen cabinets.
HARDWOOD	D	Presence of hardwood floors.
AIRCONDND	D	The property is equipped with a central air conditioned system.
BUILT-IN	R	Number of built-in features in the kitchen.
EXCAVPOOL	D	Presence of an excavated swimming pool.
GARPLACES	M	Number of garage places.
ELECDOOR	D	The garage is equipped with an electric door.
BUNGALOW	D	The property is a one-story, single-family house.
SINGLATT	D	The property is an attached, single-family house.
ROW	D	The property is a row house.
SPLIT	D	The property is a split-level, single-family house.
SECTR2	D	The property is located in sector R2.
SECTR3	D	The property is located in sector R3.
SECTR4	D	The property is located in sector R4.
SECTR5	D	The property is located in sector R5.
SECTR6	D	The property is located in sector R6.
SECTS2	D	The property is located in sector S2.
SECTS3S4	D	The property is located in sector S3 or S4.
SECTT2	D	The property is located in sector T2.
EFFTXRATE	M	Effective tax rate of the property.
MONTHS	M	Number of months elapsed between January 1st 1991 and transaction date.
SERVICES	D	The property is located in a service area.
D_EASMT	M	Linear distance to HVTL easement.
D_LINE	M	Linear distance to line itself.
D(L)*	M	Optimal (value maximizing) distance from line.
D(E)*	M	Optimal (value maximizing) distance from easement.
LND_E	M	Natural logarithm of distance to HVTL easement.
LND_L	M	Natural logarithm of distance to line.
INVD_L	M	Inverse of distance to line.

Exhibit 1 | (continued)

Operational Definition of Variables

Variable	*Codification*	*Operational Definition*
SQRD_E	M	Square root of distance to HVTL easement.
SQRD_L	M	Square root of distance to line.
D0_EASMT	D	The property is adjacent to the HVTL easement.
D1_EASMT	D	The property is within 50 m. from the easement.
D2_EASMT	D	The property is between 51 and 100 m. away from the easement.
D3 EASMT	D	The property is between 101 and 150 m. away from the easement.
D4_EASMT	D	The property is between 151 and 200 m. away from the easement.
D5_EASMT	D	The property is between 201 and 300 m. away from the easement (reference).
D6_EASMT	D	The property is between 301 and 400 m. away from the easement.
D7_EASMT	D	The property is between 401 and 500 m. away from the easement.
D8_EASMT	D	The property is beyond 500 m. from the easement.
ADJPOST92	D	The property is adjacent to the HVTL easement and was sold after 1992.
ADJ9394	D	The property is adjacent to the easement and was sold in 1993 or 1994.
ADJPOST94	D	The property is adjacent to the easement and was sold after 1994.
FRONTVIEW	D	The property has a front view on the HVTL structures.
REARVIEW	D	The property has a rear view on the HVTL structures.
SIDEVIEW	D	The property has a side view on the HVTL structures.
LIMVIEW	D	The property has a limited view on the HVTL structures.
MODVIEW	D	The property has a moderate view on the HVTL structures.
PROVIEW	D	The property has a pronounced view on the HVTL structures.
FACNGPYL	D	The property is facing a pylon.
1LOTPYL	D	The property is one lot away from a pylon.
2LOTPYL	D	The property is two lots away from a pylon.
3LOTPYL	D	The property is three lots away from a pylon.
MIDSPAN	D	The property is located at mid-span.
12LOTPYL	D	The property is one or two lots away from a pylon.
3LOTMID	D	The property is three lots away from a pylon or located at mid-span.

Exhibit 1 | (continued)

Operational Definition of Variables

Variable	*Codification*	*Operational Definition*
LV_FRONT	D	The property has a limited front view on the HVTL structures.
LV_SIDE	D	The property has a limited side view on the HVTL structures.
LV_RRSIDE	D	The property has a limited rear or side view on the HVTL structures.
MV_FRONT	D	The property has a moderate front view on the HVTL structures.
MV_REAR	D	The property has a moderate rear view on the HVTL structures.
PV_FRONT	D	The property has a pronounced front view on the HVTL structures.
PV_REAR	D	The property has a pronounced rear view on the HVTL structures.
PV_SIDE	D	The property has a pronounced side view on the HVTL structures.

Notes:
M = Metric variable;
R = Rank variable; and
D = Dummy variable.

three distinct residential neighborhoods as well as the lower and upper-price submarkets are considered alternately.

Major Findings

Overall Models' Performances

Detailed regression results for the linear and log-linear forms applied to the global sample using subsectors and HVTL dummies (Models 1 and 4) are reported in Exhibit 2. As can be seen, both explanatory and predictive performances are excellent thanks to highly detailed geographic descriptors, with an adjusted R^2 of .951 (linear) and .968 (log-linear) and relative prediction errors of 9.3% and 7.2%, respectively. F-values are in excess of 400 in either case. While all regression coefficients are significant at the 0.05 level, most of them display significance levels that fall well below the 0.01 threshold and their sign and magnitude are in

Exhibit 2 | Full Regression Result for the Global Sample—Linear and Log-linear Forms

	Linear Form (Model 1)				Log-linear Form (Model 4)			
Variable	Parameter Estimate ($)	*t*-Value	Prob.	VIF	Parameter Estimate	*t*-Value	Prob.	VIF
Intercept	139,261	18.91	0.0001	0.00	12.0257	298.92	0.0001	0.00
APPAGE	−1,177	−6.39	0.0001	2.12	−0.0121	−10.24	0.0001	4.48
LOTSIZE	61	7.54	0.0001	3.18	0.0003	8.26	0.0001	3.32
LIVAREA	574	26.77	0.0001	3.61	0.0022	19.32	0.0001	5.06
BASMTAREA	91	5.14	0.0001	1.19	0.0006	7.44	0.0001	1.25
OTHSIDING	5,999	2.35	0.0194	1.32	—	—	—	—
LANDSCAPING	9,933	3.67	0.0003	1.57	0.0305	2.51	0.0124	1.61
LAMKITCAB	—	—	—	—	−0.0204	−2.34	0.0199	1.87
HARDWOOD	12,293	4.54	0.0001	1.58	—	—	—	—
AIRCONDND	—	—	—	—	0.0263	2.78	0.0057	2.10
BUILT-IN	4,225	4.09	0.0001	1.46	0.0177	3.95	0.0001	1.40
EXCAVPOOL	7,597	3.24	0.0013	1.23	0.0615	5.75	0.0001	1.31
GARPLACES	—	—	—	—	0.0266	3.53	0.0005	2.74
ELECDOOR	4,469	2.21	0.0274	1.31	—	—	—	—
BUNGALOW	—	—	—	—	−0.0752	−5.44	0.0001	2.24
SINGLATT	−20,621	−8.17	0.0001	2.06	−0.2394	−18.85	0.0001	2.66
ROW	−30,950	−8.25	0.0001	2.00	−0.3355	−14.43	0.0001	3.93
SPLIT	−28,336	−3.18	0.0016	1.21	−0.0429	−3.44	0.0006	1.40
SECTR2	—	—	—	—	0.0966	2.88	0.0041	5.94

Exhibit 2 | (continued)

Full Regression Result for the Global Sample—Linear and Log-linear Forms

	Linear	Form (Model 1)			Log-linear	Form (Model 4)		
Variable	Parameter Estimate ($)	*t*-Value	Prob.	VIF	Parameter Estimate	*t*-Value	Prob.	VIF
SECTR3	−28,029	−7.96	0.0001	1.46	−0.1413	−7.18	0.0001	2.33
SECTR4	11,621	4.10	0.0001	2.07	0.1024	5.85	0.0001	4.05
SECTR5	26,075	6.44	0.0001	1.76	0.1582	7.25	0.0001	2.60
SECTR6	32,675	8.23	0.0001	1.52	0.1533	7.16	0.0001	2.25
SECTS2	—	—	—	—	0.0621	4.69	0.0001	2.64
SECTS3S4	—	—	—	—	0.0785	6.31	0.0001	1.87
SECTT2	8,534	2.96	0.0032	1.29	0.0543	3.70	0.0002	1.71
EFFTXRATE	−57,075	−18.32	0.0001	1.50	−0.2847	−18.68	0.0001	1.83
MONTHS	—	—	—	—	−0.0007	−4.19	0.0001	1.25
SERVICES	—	—	—	—	0.0335	2.57	0.0104	1.89
FACNGPYL	−16,559	−2.44	0.015	1.10	−0.0954	−3.15	0.0017	1.12
12LOTPYL	15,332	2.72	0.0067	1.04	0.0711	2.79	0.0055	1.06
LV_SIDE	5,646	2.78	0.0056	1.48	—	—	—	—
LV_RRSIDE	—	—	—	—	0.0279	3.37	0.0008	1.52
MV_REAR	6,499	2.25	0.0248	1.10	0.0356	2.76	0.0060	1.12
K:		23				29		
Adj. R^2		0.9508				0.9678		
F-Value:		426.34				525.07		
SEE%:		9.27				7.20		

line with theoretical expectations. In either functional form of the global model, the particularly high stability of the hedonic prices pertaining to living area, property type (Model 4) and effective tax rate are noteworthy. Finally, no excessive multicollinearity is detected via the VIF indicators, although the log-linear form brings out two sets of highly correlated variables—namely *APPAGE* with *SECTR4* on the one hand and *LIVAREA* with *SECTR2* on the other hand. By and large, and in spite of differences in the variable selection among models, the performances achieved with the global sample are quite representative of those arrived at overall.

Turning to HVTL-related descriptors, it should first be kept in mind that positive or negative contributions to property values, as reflected in the coefficients of dummy variables, should always be interpreted in the light of omitted dummies. For instance, the impact of a limited or moderate view on HVTL structures as measured from Models 1 and 4 is only positive in relation to the impact exerted by a pronounced view, which in this case is used as the default attribute and, therefore, commands no price adjustment. The findings leave little doubt as to the main conclusion of this study: the position of a property along a HVTL structure highly influences its marketability and, therefore, exerts a significant impact on its value. The statistical evidence that emerges simply reproduces the market behavior of homeowners as to their trade-off between, on the one hand, perception of HVTL health hazards and, on the other hand, positive as opposed to negative externalities linked to the presence of a nearby transmission line. As will now be analyzed in detail, studies that essentially focus on the distance to a HVTL structure fail to consider such behavioral patterns, which can only be captured through a microspatial approach.

The following analysis summarizes the full regression results of the study with respect to HVTL-related attributes, although Exhibit 3 only reports partial results for a selection of all fifty models developed. While other non-HVTL coefficients are not shown, overall model performance indicators (adjusted R^2 as well as relative Root MSE, or *SEE%*) are displayed for each model, together with the number of independent variables (K) used in the analysis. Specific comments relative to the functional form resorted to, the use of spatial sectors or sub-sectors and the type of HVTL descriptors included in the equation are also reported. Furthermore, for each submarket, mean house price, number of cases, as well as number of adjacent properties are indicated. Both explanatory and predictive performances are quite good in all cases, with adjusted R^2 fluctuating from a low of 85.7% (Upper Third Segment, Model 48) to a high of 97.3% (East Area, Model 10) and reaching, on average, 92.1%. As for the *SEE%*, it stands at around 6% to 8% of the mean price, with upper and lower limits at 11% (East Area, Model 12) and 5.1% (Lower Third Segment, Model 42) respectively. Finally, all models have been tested for multicollinearity through variance inflation factors (VIFs), a reliable diagnosis. Except for a few descriptors, no severe collinearity was detected, which translates into highly stable and consistent parameters in terms of both signs and magnitudes. Thus, for the vast majority of regression coefficients

Exhibit 3 | Impact of HVTL Attributes on Property Values—Summary of Regression Results

						HVTL Attributes			
Model Number & Market Segment	Comments	# Cases / # Adj.	# Ind. Var. (*K*)	Adj. R^2	SEE%	Variable	Coeff.	Prob.	% of Mean Price
Global Sample	Mean house price = $169,600	507 / 34							
1	Linear / subsectors / HTLV dummies		23	0.9508	9.27	*FACNGPYL*	−16,559	0.0150	−9.8
						12LOTPYL	15,532	0.0067	9.2
						LV_SIDE	5,646	0.0056	3.3
						MV_REAR	6,499	0.0248	3.8
2	Linear / subsectors / HTLV dummies		24	0.9507		*FACNGPYL*	−16,551	0.0151	−9.8
						1LOTPYL	16,771	0.0703	9.9
						2LOTPYL	14,790	0.0400	8.7
						LV_SIDE	5,642	0.0057	3.3
						MV_REAR	6,490	0.0252	3.8
3	Linear / sectors / HTLV dummies		24	0.9555	8.52	*FACNGPYL*	−0,083	0.0192	−8.0
						1LOTPYL	0,119	0.0142	12.6
						LV_RRSIDE	0,039	0.0001	4.0
4	Linear / subsectors / HTLV dummies		29	0.9678	7.2	*FACNGPYL*	−0,095	0.0017	−9.1
						1LOTPYL	0,071	0.0055	7.4
						LV_RRSIDE	0,028	0.0008	2.8
						MV_REAR	0,036	0.0060	3.6
5	Linear / sectors / HTLV dummies		30	0.9678	7.2	*FACNGPYL*	−0,095	0.0018	−9.1
						1LOTPYL	0,100	0.0160	10.5
						2LOTPYL	0,054	0.0929	5.5
						LV_RRSIDE	0,028	0.0009	2.8
						MV_REAR	0,035	0.0064	3.6

Exhibit 3 | (continued)

Impact of HVTL Attributes on Property Values—Summary of Regression Results

						HVTL Attributes			
Model Number & Market Segment	Comments	# Cases / # Adj.	# Ind. Var. (*K*)	Adj. R^2	SEE%	Variable	Coeff.	Prob.	% of Mean Price
6	Linear / sectors / HTLV dummies		26	0.9418	10.08	*FACNGPYL*	−20,388	0.0060	−12.0
	Dummy distance (easement)					*3LOTMID*	−7,939	0.0501	−4.7
						LV_SIDE	4,866	0.0269	2.9
						D2_EASMT	−8,992	0.0004	−5.3
						D3_EASMT	−6,872	0.0083	−4.1
7	Linear / sectors / metric distance (line)		20	0.9369	10.49	*LND_L*	2,323	0.0245	—
East Area	Mean house price = $167,704	257 / 19							
8	Linear / subsectors / HVTL dummies		17	0.9594	9.64	*1LOTPYL*	27,263	0.0207	16.3
						LV_SIDE	11,065	0.0002	6.6
10	Log-linear / subsectors / HTVL dummies		20	0.9734	7.26	*1LOTPYL*	0,123	0.0164	13.1
						LV_RRSIDE	0,026	0.0160	2.7
11	Linear / sectors / HTVL dummies		22	0.9552	10.13	*3LOTMID*	−12,857	0.0188	−7.7
	Dummy distance (easement)					*LV_SIDE*	8,673	0.0097	5.2
						D1_EASMT	−14,029	0.0028	−8.4
						D2_EASMT	−20,464	0.0001	−12.2
						D3_EASMT	−7,853	0.0756	−4.7

Exhibit 3 | (continued)

Impact of HVTL Attributes on Property Values—Summary of Regression Results

Model Number & Market Segment	Comments	# Cases / # Adj.	# Ind. Var. (*K*)	Adj. R^2	SEE%	HVTL Attributes: Variable	Coeff.	Prob.	% of Mean Price
13	Linear / sectors / HVTL dummies		17	0.9522	10.46	*1LOTPYL*	32,446	0.0117	19.3
	Metric distance (line)					*LV_SIDE*	15,287	0.0001	9.1
						D_LINE	22,154	0.0003	
West Area	Mean House price = $171,550	250 / 15							
14	Linear / sectors / HVTL dummies		21	0.9417	8.43	*FACNGPYL*	−36,158	0.0001	−21.1
						MIDSPAN	12,682	0.0711	−7.4
						LIMVIEW	12,090	0.0001	7.0
						MODVIEW	10,637	0.0014	6.2
						PROVIEW	11,344	0.0089	6.6
17	Log-linear / sectors / gamma (line)		16	0.9455	8.17	*LND_L*	0,051	0.0005	—
						D_LINE	−0,416	0.0001	—
						D(L)*	0,123	MAX	—
18	Log-linear / sectors / gamma (easement)		16	0.9450	8.22	*LND_E*	0,019	0.0017	
						D_EASMT	−0,273	0.0001	
						D(E)*	0,070	MAX	
Neighborhood *R*	Mean house price = $225,924	186 / 10							
20	Log-linear / subsectors / HVTL dummies		20	0.9535	7.69	*FACNGPYL*	−0,080	0.1009	−7.7
						LV_RRSIDE	0,044	0.0011	4.4
						MV_REAR	0,108	0.0001	11.4
						PV_REAR	0,061	0.0292	6.2

Exhibit 3 | (continued)

Impact of HVTL Attributes on Property Values—Summary of Regression Results

						HVTL Attributes			
Model Number & Market Segment	Comments	# Cases / # Adj.	# Ind. Var. (*K*)	Adj. R^2	SEE%	Variable	Coeff.	Prob.	% of Mean Price
21	Linear / metric distance (L)		11	0.9117	9.95	*SQRD_L*	27,776	0.0092	—
Neighborhood *S*	Mean house price = $160,209	155 / 9							
22	Linear / subsectors / HVTL dummies		20	0.9343	6.54	*FACNGPYL*	−37,540	0.0021	−23.4
						1LOTPYL	25,323	0.0211	15.8
						2LOTPYL	17,890	0.0286	11.2
						3LOTPYL	−25,116	0.0265	15.7
						MIDSPAN	−13,595	0.0217	8.5
						LV_RRSIDE	5,153	0.0328	3.2
24	Log-linear / subsectors / HTLV dummies		20	0.9461	5.85	*FACNGPYL*	−0,186	0.0055	−17.0
						1LOTPYL	0,197	0.0016	21.8
						3LOTPYL	−0,123	0.0455	−11.6
						MIDSPAN	−0,063	0.0447	−6.1
						LV_RRSIDE	0,034	0.0108	3.3
26	Linear / metric distance (line)		15	0.9249	6.99	*1NVD_L*	−2,89	0.0040	—
Neighborhood *T*	Mean house price = $115,260	166 / 15							
27	Linear / subsectors / HVTL dummies		18	0.9411	5.98	*FACNGPYL*	−18,484	0.0012	−16.0
						MODVIEW	2,403	0.0565	2.1
29	Log-linear / subsectors / HVTL dummies		18	0.9432	5.57	*FACNGPYL*	−0,126	0.0032	−11.9
						REARV	0,024	0.0443	2.4
						MV_FRONT	0,052	0.0108	5.3
						D1_EASMT	0,041	0.0341	4.2

Exhibit 3 | (continued)

Impact of HVTL Attributes on Property Values—Summary of Regression Results

Model Number & Market Segment	Comments	# Cases / # Adj.	# Ind. Var. (*K*)	Adj. R^2	SEE%	HVTL Attributes: Variable	Coeff.	Prob.	% of Mean Price
30	Linear / metric distance (line)								
Lower Half Segment	Mean house price = $116,692	257 / 18	20	0.9403	6.02	*INVD_L*	−8,900	0.0900	—
32	Log-linear / sectors / HVTL dummies		20	0.8778	6.74	*FACNGPYL*	−0,137	0.0012	−12.8
						LIMVIEW	0,032	0.0137	3.3
						MODVIEW	0,024	0.0346	2.5
						PROVIEW	0,055	0.0002	5.7
	Log-linear / sectors / HVTL dummies Metric distance (easement)		19	0.8810	6.65	*FACNGPYL*	−0,140	0.0006	−13.0
						D_EASMT	−0,107	0.0001	
Upper Half Segment	Mean house price = $223,990	250 / 16							
36	Linear / sectors / HVTL dummies		15	0.8858	9.43	*1LOTPYL*	52,039	0.0163	23.2
						LV_SIDE	9,216	0.0019	4.1
39	Log-linear / subsectors / HVTL dummies		21	0.9258	7.13	*1LOTPYL*	0,148	0.0358	16.0
						2LOTPYL	0,088	0.0357	9.2
						LV_RRSIDE	0,039	0.0001	4.0
						MV_REAR	0,033	0.0683	3.3
40	Linear / sectors / metric distance (easement)		13	0.8845	9.48	*SQRD_E*	17,745	0.0130	—

Exhibit 3 | (continued)

Impact of HVTL Attributes on Property Values—Summary of Regression Results

Model Number & Market Segment	Comments	# Cases / # Adj.	# Ind. Var. (*K*)	Adj. R^2	SEE%	HVTL Attributes: Variable	Coeff.	Prob.	% of Mean Price
Lower Third Segment	Mean house price = $104,643	168 / 12							
43	Log-linear / sectors / HVTL dummies		19	0.8699	5.45	*FACNGPYL*	−0,139	0.0009	−13.0
						REARV	0,038	0.0031	3.8
						SIDEV	0,040	0.0003	4.1
						LV_FRONT	0,048	0.0034	4.9
45	Linear / sectors / metric distance (easement)		17	0.8598	5.36	*D_EASMT*	−9,808	0.0008	—
Upper Third Segment	Mean house price = $250,597	171 / 13							
47	Log-linear / subsectors / HVTL dummies		15	0.8889	7.27	*LV_SIDE*	0,041	0.0006	4.2
						PV_SIDE	−0,056	0.0978	−5.4
48	Linear / sectors / dummy distance (easement)		15	0.8574	8.81	*D0_EASMT*	−15,778	0.0211	−6.3
						D1_EASMT	−17,115	0.0172	−6.8
						D2_EASMT	−18,979	0.0012	−7.6
						D3_EASMT	−13,404	0.0180	−5.3
50	Log-linear / sectors / metric distance (line)		15	0.8759	7.69	*LND_L*	0,030	0.0001	—

pertaining to physical, neighborhood or environmental attributes, statistical significance stands well below the 0.01 threshold.

Impact of Immediate Proximity to a HVTL Easement

In most market segments considered, the residential property that is both adjacent to a HVTL easement and facing a pylon (*FACNGPYL*) experiences a significant drop in value due to the visual encumbrance. This drop, which averages 9.6% (that is, between −8.0% and −12%) of mean house price in the global sample (Models 1–7), reaches 21% (most significant estimate) in the west area (Models 14–18) where a 50 ft. setback with respect to the HVTL easement is found. In the east area, however (Models 8–13), characterized by a 150 ft. setback, a direct view of a pylon had no significant impact on prices. The negative impact of facing a pylon strongly varies among sectors: whereas it stands at 7.7% (not significant at 0.05) of mean sale price in neighborhood *R* (Models 19–21), it amounts to between 12% (log-linear form) and 16% (linear) in neighborhood *T* (Models 27–30) and exceeds 23% in neighborhood S (Models 22–26). A direct view on a pylon is also detrimental to properties belonging to the lower end of the market (Models 31–35 and 41–45), whose value drops by roughly 10% to 15% (most significant estimates) depending on the market segment and functional form used. While impacts are seemingly more difficult to capture for upper-price properties (Models 36–40 and 46–50), findings nevertheless suggest price drops in the 15%–20% range after one sale (case # 436), located in the east area, is removed from analysis (not presented here).

In contrast, a property located one or two lots away from a pylon (*12LOTPYL*) usually benefits from a market premium, which mirrors the improved visual clearance and increased intimacy thus generated. Results obtained with the global sample show price increases between 7.4% and 9.2% of mean house value. However, the rise proves substantially higher for properties located one lot away from a pylon (*1LOTPYL*, between 10.5% and 12.6%) than for those located two lots away (*2LOTPYL*, 8.7%). For adjacent properties belonging to the east area, being one lot from a pylon translates into a premium in the 13%–19% range whereas no significant price impact is detected in the west area: due to a reduced setback, the pronounced visual encumbrance tends to cancel out proximity advantages. In turn, the premium is significant at a two-lot distance (10.3%). Similarly, a 13% price rise is generated in neighborhood *S* for adjacent houses located one or two lots away from a pylon; again, the impact is substantially higher (16%–22%) at a one lot distance. The same pattern emerges in the upper-half segment where the premium stands between 16% and 23% of mean house price at a one lot distance, as opposed to roughly 9% two lots away.

Finally, a property located three lots from a pylon or at mid-span (*3LOTMID*) will, by and large, experience a significant price drop as a consequence of the visual encumbrance caused by conductors in the HVTL corridor section with low minimal clearance relative to ground level. Results obtained with the global sample suggest a 4.7% depreciation, as opposed to 7.7% in the east area. In the west area, a mid-span location (*MIDSPAN*) results in a 7.4% price drop. Similarly, in neighborhood *S*, a property located three lots away from a pylon or at mid-span will loose somewhere between 6% and 16% of its market value.

In order to test for the net effect of immediate HVTL proximity on house values, model results derived from the global sample as well as from east and west areas were applied to the 34 adjacent cases in the study. Overall, proximity advantages and negative impacts tend to cancel each other out (+0.2% of mean house value), with an average 3.4% gain for the nineteen east area units against a 4.0% loss for the fifteen properties located on the west side of the easement. Exhibit 4 provides a convenient visualization of the impacts of HVTL structures on the market value of adjacent properties.

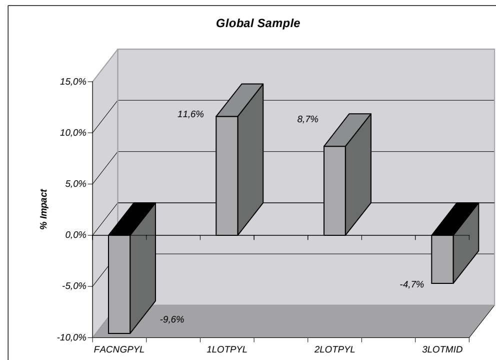
Impact Linked to the Visibility of HVTL Structures and the Orientation of the Property

Findings suggest that far from being a drawback, a view on the HVTL structures translates in most cases into higher values, due to the improved visual clearance it implies. Thus, in the global sample, houses with a limited or moderate, rear or side view on the corridor benefit from a market premium of around 2.8%–3.8% of mean price. A similar pattern is obtained for both east and west areas where a positive impact emerges for a limited, side view (east area, 5.2%–9.1%) and for a limited, rear or side view (east and west areas, 2.7%–4.3%). In the west area, the premium reaches 5.1% of mean price for a rear, moderate view on the HVTL corridor while even a pronounced, front view results in a 7.2% price rise. By and large, a view on the west corridor, be it limited, moderate or pronounced and irrespective of the orientation of the house, translates into a market premium in the 6%–7% range.

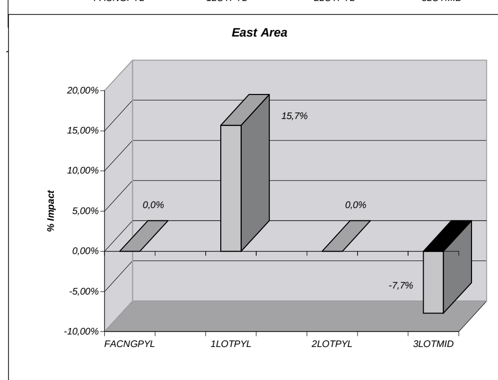
An analysis by neighborhood generates similar findings, with a limited, rear or side view on the HVTL corridor resulting in value rises of between 3.2% and 4.4%, depending on neighborhood and functional form used. In neighborhood *R*, the positive impact of a rear exposure even reaches 11.4% of mean price for a moderate view, as opposed to 6.2% for a pronounced one. In neighborhood *T*, a moderate, front view also generates a premium of roughly 5%. Results derived from the price segmentation, finally, corroborate the findings. For the lower price segments of the sample, a market premium of between 2.1% and 5.8% of mean price, depending on extent of exposure and building orientation, is associated with a rear, side or front view on the corridor. In contrast, while properties belonging to the upper-price segments of the market also seem to benefit from a limited or moderate visual exposure on the lines, a pronounced, side view on HVTL structures depreciates values by some 8.7% (upper-third segment). This suggests that owners of luxury houses tend to be more sensitive than others to the potential visual encumbrance resulting from the nearby presence of a HVTL.

Exhibit 4 | Impact of HVTL Structures on the Market Value of Adjacent Properties

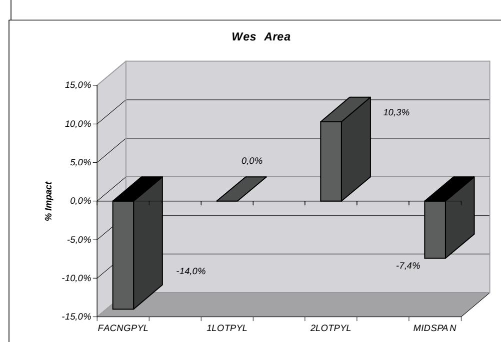
	HVTL Attribute	% Impact
Global Sample		
House facing pylon:	*FACNGPYL*	*-9,6%*
One lot away from pylon:	*1LOTPYL*	*11,6%*
Two lots away from pylon:	*2LOTPYL*	*8,7%*
Three lots away from pylon or mid-span location:	*3LOTMID*	*-4,7%*



	HVTL Attribute	% Impact
East Area (150 ft. setback to HVTL)		
House facing pylon:	*FACNGPYL*	*n.s.*
One lot away from pylon:	*1LOTPYL*	*15,7%*
Two lots away from pylon:	*2LOTPYL*	*n.s.*
Three lots away from pylon or mid-span location:	*3LOTMID*	*-7,7%*



	HVTL Attribute	% Impact
West Area (50 ft. setback to HVTL)		
House facing pylon:	*FACNGPYL*	*-14,0%*
One lot away from pylon:	*1LOTPYL*	*n.s.*
Two lots away from pylon:	*2LOTPYL*	*10,3%*
Mid-span location:	*MIDSPAN (sig. 0.07)*	*-7,4%*



N.B.:
Percentage price impacts reported here are an average of all significant coefficients derived from various functional forms and should herefore be viewed as indicators only. Besides, they reflect "gross" location impacts due to a view on pylons and conductors alone.

Impact of Distance to Line or Easement

While resorting to a continuous distance-to-line or distance-to-easement function yields highly significant coefficients, it only provides an overview of the behavioral pattern relative to the nearby presence of a HVTL and does not allow for the microspatial, and relatively complex, aspects of the phenomenon under investigation to be adequately considered. In contrast, the use of dummy distance variables does. With respect to the global sample, findings indicate that properties located within 50–150 m. (roughly 165–500 ft.) of the HVTL easement, which face some degree of visual encumbrance without benefiting from the advantages of an immediate proximity, experience drops in value in the 4.1% (325–500 ft.) to 5.3% (165–325 ft.) range. A similar pattern is found in the east area where locating within 50 m., or 165 ft., of the easement results in a 8.4% depreciation, which rises to over 12% for properties located further away (50–100 m., or 165–325 ft.). This negative impact is substantially reduced (−4.7%), while not statistically significant, for houses located within the 100–150 m. (325–500 ft.) buffer and fades away beyond that limit. However, results derived from neighborhood *T* suggest that cheaper properties located nearby the easement without being adjacent to it (that is, within 50 m., or 165 ft.) still enjoy increased visual clearance, which translates into a market premium of roughly 4.2%. Finally, luxury properties (upper-third segment) seem, yet again, to be more sensitive to visual encumbrance. The proximity impact proves negative for both adjacent properties (−6.3%) and non-adjacent ones located within 150 m. (500 ft.) of the HVTL easement. As with other market segments, the maximum negative impact (−7.6%) is reached between 50 m. and 100 m. (165–325 ft.) and lessens thereafter to disappear beyond 150 m. (500 ft.).

To summarize, coefficients derived from distance attributes suggest that net visual encumbrance, defined as the difference between, on the one hand, drawbacks resulting from visual encumbrance and, on the other hand, proximity advantages, reaches a maximum between 50 and 100 m. (165–325 ft.) from the easement external boundary, and diminishes quickly thereafter to fade away beyond 150 m. (500 ft.).

Impact of the Media Coverage of Swedish Epidemiological Studies

Following Kinnard, Geckler and DeLottie's (1997) study, it proved interesting to assess the impact of the 1992 Swedish epidemiological studies on EMF-induced health hazards. Thus, three interactive, dummy control variables were added to the global model, in addition to the trend descriptor. In so doing, it becomes possible to bring out any difference in households' market behavior characterizing the 1993–94 period as well as post-1994 sales of HVTL-adjacent properties. While findings from the linear model suggest that a negative impact might actually apply for the 1993–94 period, the log-linear form, in turn, produces positive coefficients,

Exhibit 5 | Synopsis of HVTL Attributes' Impact on Surrounding Property Vales

Variable	Global Sample	East Area	West Area	Neighborhood *R*	Neighborhood *S*	Neighborhood *T*	Lower Half Segment	Upper Half Segment	Lower Third Segment	Upper Third Segment
FACNGPYL	−(***)		−(***)	−(*)	−(***)	−(***)	−(***)	−(***)[a]	−(***)	−(***)[a]
1LOTPYL	+(**)	+(**)			+(***)			+(**)		
2LOTPYL	+(**)		+(**)		+(**)			+(**)		
3LOTPYL					−(**)					
MIDSPAN			−(*)		−(**)					
12LOTPYL	+(***)				+(***)					
3LOTPYL	−(**)	−(**)			−(***)					
FRONTV									+(**)	
REARV						+(**)			+(***)	
SIDEV									+(***)	
LIMVIEW			+(***)				+(**)			
MODVIEW		−(**)	+(***)			+(*)	+(**)			
PROVIEW			+(***)				+(***)			
LV_FRONT									+(***)	
LV_SIDE	+(***)	+(***)						+(***)		+(***)
LV_RRSIDE	+(***)	+(***)	+(***)	+(***)	+(**)			+(***)		
MV_FRONT						+(**)				
MV_REAR	+(**)		+(***)	+(***)				+(*)		
PV_FRONT			+(**)							

Exhibit 5 | (continued)

Synopsis of HVTL Attributes' Impact on Surrounding Property Vales

Variable	Global Sample	East Area	West Area	Neighborhood *R*	Neighborhood *S*	Neighborhood *T*	Lower Half Segment	Upper Half Segment	Lower Third Segment	Upper Third Segment
PV_REAR				+(**)			+(**)			
PV_SIDE										−(**)
D0_EASMT										−(**)
D1_EASMT		−(***)				+(**)				−(**)
D2_EASMT	−(***)	−(***)								−(***)
D3_EASMT	-(***)	-(*)								−(**)
D_LINE	+(**)	+(***)	+(***)	+(***)	+(***)	+(*)				+(***)
D_EASMT			+(***)				−(***)	+(**)		

Note: (*)Regression coefficient significant at the 10% level.
(**)Regression coefficient significant at the 5% level.
(***)Regression coefficient significant at the 1% level.
[a]Sale #436 (East Area) removed from calculations.

with a magnitude that increases over time. Since none of the resulting parameter estimates emerge as being statistically significant at the 0.05 level, it can be concluded that the Swedish studies had virtually no measurable impact on house prices, which corroborates previous findings.

Conclusion

This research looks at the impact of HVTL on surrounding property values, using a microspatial approach. In accordance with Hamilton and Schwann (1995), Callanan and Hargreaves (1995) and Kinnard, Geckler and DeLottie (1997) studies, the findings suggest that severe visual encumbrance due to a direct view on a pylon does exert a significantly negative impact on property prices. Overall, the price reduction stands at roughly 10% of mean house value (global sample), but it averages 14% in the study area where the setback between the power line and the lot boundary is only 50 ft. (west area). While properties belonging to the lower end of the market experience price reductions in the 10%–15% range, findings also suggest price drops of around 15%–20% for upper-price properties. In one neighborhood (*S*), the depreciation even reaches 23%. Similarly, a direct view on the conductors will usually reduce property values by 5%–10%; in some cases though, the market discount exceeds 15%.

However, being adjacent to the easement will not *necessarily* cause a house to depreciate. It may even increase its value in similar proportions—that is, between 7% and 22%—where proximity advantages (enlarged visual field, increased intimacy) exceed drawbacks. Such findings are in line with those of a perception study by Saint-Laurent (1996) suggesting, on the one hand, that HVTL-induced risks are ranked by households far behind other known health hazards and, on the other hand, that proximity advantages for adjacent residents largely outweigh inconveniences. In this study, proximity advantages and negative impacts for adjacent properties tend to cancel each other out (+0.2%), as shown by a simulation performed on the thirty-four adjacent cases in the study.

Turning to non-adjacent, but visually exposed, properties, findings suggest that far from being a drawback, a view on the HVTL structures translates in most cases into higher values, due to the improved visual clearance it implies. Thus, in the global sample, houses with a limited or moderate, rear or side view on the corridor benefit from a market premium of roughly 3% to 4% of mean price. As for negative visual impacts, where applicable, they tend to decrease rapidly with distance, and are no more significant beyond 150 m. (500 ft.). Findings also suggest that net visual encumbrance reaches a maximum for houses located between 50 and 100 m. (165 and 325 ft.) from the easement boundary—with values dropping by some 5%–12% of mean price—and tends to disappear beyond 150 m. (500 ft.).

Finally, as found by Kinnard, Geckler and DeLottie (1997), no significant price change can be detected for adjacent properties following the media coverage of the 1992 Swedish epidemiological studies on EMF-induced health hazards.

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François Des Rosiers, Laval University, Canada or Francois.Desrosiers@fsa.ulaval.ca.