features

The Effects of an Oil Pipeline Rupture on Single-Family House Prices

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abstract

This study quantifies the effects of environmental contamination on residential property values. An oil pipeline rupture occurred on the Patuxent River in Maryland in Spring, 2000. Hedonic and predictive regression analysis were used on 2,300 single-family house sales before and after the spill. For the first sales season after the rupture, results show a statistically significant reduction in price of over 10% for interior properties with homeownership rights in oiled community beaches. The effect of the pipeline spill on waterfront property was also evaluated. All three waterfront sales sold for less, but there were too few sales to justify statistical significance at the 90% confidence level.

On April 7, 2000, an oil pipeline ruptured in Prince George County in southern Maryland, about 30 miles from Washington, DC. Potomac Electric Power Company's (Pepco) pipeline management company detected and confirmed the leak from a 12-mile branch of the 51-mile underground pipeline. The leak consisted of number 2 fuel oil, which is similar to home heating oil, and a slight amount of heavier, number 6 oil. Over 120,000 gallons of oil were released, about half of which was eventually recovered.[1]

The leaking pipeline delivers fuel to Pepco's Chalk Point Generating Station, the largest power plant in Maryland. The plant uses coal, oil, and natural gas to generate electricity. It is one of six power plants that serve Washington, DC and the Maryland suburbs, and it provides electricity to the Southern Maryland Electric Cooperative.

The oil initially leaked into Swanson Creek and the surrounding marsh area. Unusually high winds and rain blew the oil into the Patuxent River, which separates Prince George and Calvert counties. Before it could be contained, a plume of oil had flowed downstream, impacting approximately 10 miles of Patuxent River shoreline.[2] Tidal activity and winds also drove the oil upstream past the power plant.

The impact of the pipeline spill on surrounding property values is of concern to property owners in the area affected by the spill. The primary purpose of this study is to determine to what degree the value of properties with rights to the water (both waterfront properties and interior properties with homeownership rights on oiled communal beachfront properties) has been affected. The impacts of the rupture and release of oil on property values are addressed using hedonic and predictive regression analyses techniques. This study employs the use of traditional valuation variables, as well as variables to account for spatial relationships between the observations.

1. H. Byrd et al., *Chalk Point Oil Spill: Lost Recreational Use Value Report,* an unpublished report of the paper Chalk Point Trustees (February 2001): 3.
2. At least 16 articles appeared in the *Baltimore Sun* between April 8 and May 19, 2000 regarding the spill. *The Washington Post* also provided substantial press coverage, with four articles appearing in October 2000 and additional articles in the preceding months.

The main hypothesis of this study is that the homes in the study area have experienced a reduction in property value. Consistent with empirical research and theory, the results of this research indicate that interior properties with beach rights in the area affected by the spill experienced a statistically significant reduction in property values in excess of 10% for the first sales season (about six months after the incident) at the 95% level of confidence. In addition, the oil spill appears to have reduced the sales volumes of homes in the area. Only three waterfront homes sold during the first sales season after the incident, and all three sold at a discount. These results are statistically significant approaching, but just below, a 90% level of confidence.

Literature Review

The use of hedonic modeling in determining property values is well documented. G.C. Haas has been recognized as producing the first hedonic application in 1922, although he did not coin the term. Haas' application was on agricultural land prices with a particular focus on distance to the city center and size.[3]

Rosen established the theoretical framework for the hedonic method used for property valuation, which analyzes the impact of a particular characteristic on property values.[4] The hedonic technique allows a particular feature of a structure or the surrounding environment to be valued individually, while holding the effects of all other features on sales price constant. The price function is summarized by:

$$P = \alpha + \beta_1 S + \beta_2 N + \beta_3 D \qquad (1)$$

where:

P = the price of the house,
S = a vector of structural characteristics,
N = a vector of neighborhood characteristics, and
D = a vector of date-related transaction characteristics.

Any other items of interest (e.g., environmental factors) could readily be modeled by adding a variable to Equation 1. The value of a particular characteristic is calculated by differentiating the implicit price function with respect to the given characteristic.[5]

In property valuation literature, the use of hedonic modeling generally requires that structural characteristics be used as the independent variable's determining value.[6] Examples of these characteristics are living area, number of bathrooms, lot size, type of heating, and condition of the structure. These attributes comprise the bundle of characteristics a rational consumer is willing to assume given their income constraint.

Neighborhood variables also have an effect on residential market behavior and outcomes.[7] Neighborhood variables are influences associated with geographic location and include both adjacency and neighborhood effects. Adjacency effects capture the spatial spillover effects of adjacent features. For instance, a river view adjacent to a home would be a positive externality. Neighborhood effects encompass the overall neighborhood characteristics such as accessibility, socioeconomic context, and other demographic information.

Other researchers have integrated Geographic Information Systems (GIS) into a hedonic model to capture the effects of neighborhood variables in an effort to explain residential values within a 30-mile radius of Washington, DC.[8] Using landscape indices that included measures of open space, diversity, and fragmentation of land use, the authors developed a model explaining land and housing values. In doing so, they were able to capture how individuals value the diversity and fragmentation of land use around their homes. The authors used data from the same geographic area that is used in this study.

Neighborhood residential investment such as new construction has a positive effect on nearby property values. Thus, those properties located near sites of neighborhood investment have higher values than those located far away.[9] Other studies have elaborated on this approach using hedonic price regression with spatially lagged variables generated using a GIS to capture the effect of residential investment on nearby property values. In their study,

3. Peter F. Colwell and Gene Dilmore, "Who Was First? An Examination of Early Hedonic Study," *Land Economics* (75: 4, 1999): 620–626.
4. S. Rosen, "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition," *Journal of Political Economy* (82, 1974): 34–55.
5. Jeffrey J. Pompe and James R. Rinehart, "Beach Quality and the Enhancement of Recreational Property Values," *Journal of Leisure Research* (27: 2, 1995): 143–154.
6. Larry Dale, et al., "Do Property Values Rebound from Environmental Stigmas? Evidence from Dallas," *Land Economics* (75: 2, 1999): 311–326; Chengri Ding, Robert Simons, and Esmail Baku, "The Effects of Residential Investment on Nearby Property Values: Evidence from Cleveland, Ohio," *Journal of Real Estate Research* (19: 1–2, 2000): 23–48.
7. Ayse Can, "GIS and Spatial Analysis of Housing Mortgage Markets," *Journal of Housing Research* (9: 1, 1998).
8. Jacqueline Geoghegan, Lisa A. Wainger, and Nancy E. Bockstael, "Spatial Landscape Indices in a Hedonic Framework: An Ecological Economics Analysis Using GIS," *Ecological Economics* (23, 1997): 251–264.
9. Robert A. Simons, Roberto Quercia, and Ivan Maric, "The Value Impact of New Residential Construction and Neighborhood Disinvestment on Residential Sales Prices," *Journal of Real Estate Research* (15: 1–2, 1998): 147–162.

> Studies conclude that property contaminated with petroleum sustains a 14% to 16% reduction in sales price when the contamination becomes known.

GIS was used to link parcel data with neighborhood data derived from the 1990 U.S. Census. They concluded that new residential investment positively impacts existing properties in the immediate vicinity (one block or 300 feet).[10]

The effects of environmental contamination on property values is well documented. Two recent literature review articles have provided a comprehensive perspective on multiple regression analysis and environmental contamination in real estate.[11] Studies exist quantifying the effects of landfills, groundwater contamination, toxic waste sites, and high voltage lines on property values.[12] These studies generally show a negative relationship between property values and the environmental impact. As expected, the farther an individual property is located from the impact, the smaller the effect. The magnitude of the environmental externality also is important in its effect on property values. For instance, one would anticipate that property located adjacent to a Superfund site would experience a greater loss of value than a site located adjacent to a leaking underground storage tank.

Also prevalent in the literature are the effects of petroleum underground storage tank leaks on adjacent properties. These studies conclude that property contaminated with petroleum sustains a 14% to 16% reduction in sales price when the contamination becomes known.[13] Other research on a pipeline rupture shows that non-contaminated, easement-holding properties not directly contaminated by a petroleum pipeline rupture sustain a loss in value. This reduction, attributed to the expectation that another rupture may occur, indicates a 5.5% loss in sales price for single-family homes and 2% to 3% loss for multifamily units. The research also shows that a price reduction continues for several years after the event.[14]

Study Area

The study area consists of approximately ten miles along both shores of the Patuxent River in suburban Washington, DC (Figure 1). It encompasses three counties: St. Mary's, Calvert, and Charles, and numerous subdivisions within these counties. Housing of various types comprise the area, including single-family houses, townhouses, apartments, and condominiums. While the majority of these units are on small- to medium-sized lots, there are a number of farms, commercial properties, and industrial facilities with larger land areas. New construction and lot sales also dot the landscape.

Data

The data was obtained from the Property View database from the state of Maryland. The database links property maps to the Maryland State Department of Assessments and Taxation in order to provide property data for the purpose of taxation. The data set includes location information such as parcel number, address, and subdivision. Structural variables such as number of bathrooms, fireplaces, square footage, and lot size also are included. Transaction variables such as trade date and season are included. It also addresses more subjective data such as the condition of the structure in ranges from low to very good.

Median household income was obtained from the 1990 U.S. Census at the tract level. This research focuses on the modeling of single-family detached houses in the middle of the local market based on price and lot size. Townhouse, commercial, industrial, and farm sales were excluded from this hedonic

10. Ding, Simons, and Baku, Ibid.

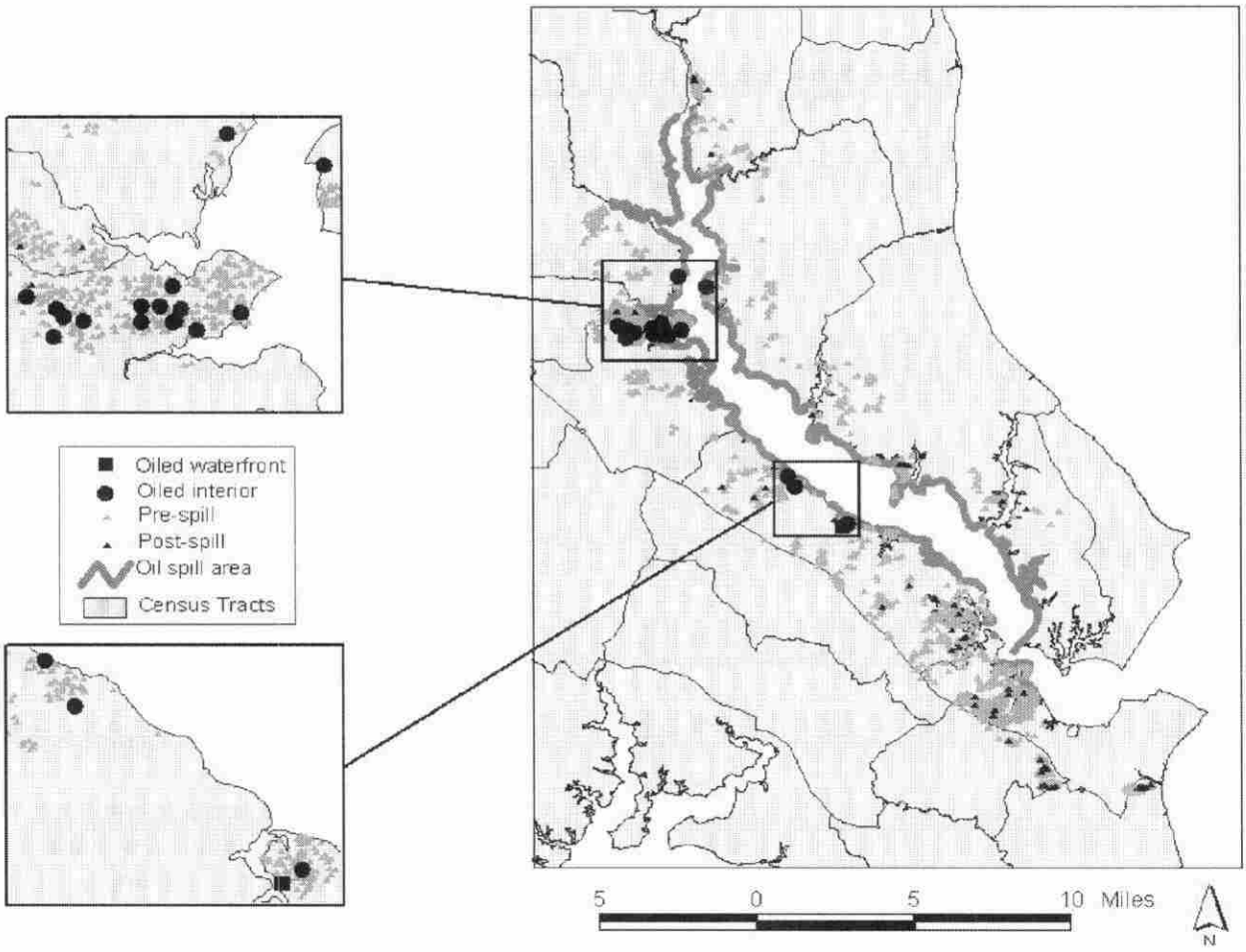
11. Thomas Jackson, "The Effects of Environmental Contamination in Real Estate: A Literature Review," *JREL* (9, 2001): 93–116; Melissa Boyle, and Katherine Kiel, "A Survey of House Price Hedonic Studies of the Impact of Environmental Externalities," *JREL* (9, 2001): 117–144.

12. A. C. Nelson, J. Genereux, and M. Genereux, "Price Effects of Landfills on House Values," *Land Economics* (54, 1993): 359–365; William G. Page and H. Rabinowitz, "Groundwater Contamination: Its Effects on Property Values and Cities," *Journal of the American Planning Association* (Autumn 1993): 473–481; Mark Dotzour, "Groundwater Contamination and Residential Property Values," *The Appraisal Journal* (July 1997): 279–285; J. E. Kohlhase, "The Impact of Toxic Waste Sites on Housing Values," *Journal of Urban Economics* (20: 1, 1991): 1–26; and Peter Colwell, "The Effect of High Voltage Overhead Transmission Lines on Residential Property Values," *Journal of Real Estate Research* (1990): 117–127.

13. Robert A. Simons, William Bowen, and Arthur Sementelli, "The Effects of Underground Storage Tanks on Residential Property Values in Cuyahoga County, Ohio," *Journal of Real Estate Research* (14: 1–2, 1997): 29–42; Robert A. Simons, William Bowen, and Arthur Sementelli, "The Price and Liquidity Effects from Gas Stations on Adjacent Contaminated Property," *The Appraisal Journal* (April 1999): 186–194.

14. Robert A. Simons, "The Effect of Pipeline Ruptures on Noncontaminated Residential Easement-Holding property in Fairfax County," *The Appraisal Journal* (July 1999): 255–263.

Figure 1 Patuxent River, MD and Pipeline Spill Impact Area



analysis because they constitute other distinct markets. The data set was evaluated for missing fields, and some observations were removed. Properties that had no recorded consideration paid or consideration below $40,000 were deleted, as were those with consideration over $400,000.

Properties built over 100 years ago were left out of the data set. Sales that transferred prior to 1990 also were deleted so the focus would be on sales during the past 10 years. Those houses with lots greater than five acres were removed because their size was too large. Similarly, the study analyzed houses between 770 and 3,000 square feet. Care was taken to include only arm's-length transactions by deleting transactions among individuals with the same last name. Any sales that had missing key structural variables (e.g., lot size, square footage) were deleted. The original data set contained over 10,200 properties, of which about 2,900 were immediately affected by the oil spill. The number of single-family, detached house sales was eventually reduced to 2,295 for the purposes of statistical modeling.

The broader Patuxent River study area contains approximately 300 properties that were sold after the spill occurred on April 7, 2000. Of this group, 35 homes were in the area where oil deposits had contaminated the waterfront. Three of these homes were waterfront properties, the remainder having ownership rights to an impacted beach area. This group consists of properties sold from May 15, 2000 to October 1, 2000. May 15, 2000 (rather than an April 8 post-spill date) was chosen as the commencement date for sales to allow for contract maturation. By using May 15 as our commencement date, we are assured that transactions were executed after the spill date. The post-spill sales in the area contaminated by oil were coded with a dummy variable and are the focus of this study. Table 1 contains descriptive statistics on the sales used in this study. The mean sales price was $128,619, mean land area was

Table 1 Descriptive Statistics

Mean Sales Price Waterfront = $238,187
Mean Sales Price Interior = $128,619

Variable	Minimum Value	Maximum Value	Mean Value
Land area (sq ft)	4,007	216,504	44,486
Age (years)	2	90	24
Building area (sq ft)	770	2,992	1,540
Full baths	0	4	1.72
Half baths	0	3	.33
Fireplaces	0	4	.5
Total porch (sq ft)	0	2,105	238
Total garage (sq ft)	0	2,417	285
Total asc. structure ($)	0	56,136	1,322
HH income in tract ($)	33,032	61,218	45,136

Variable	Number of Occurrences
Waterfront	204
Calvert county	277
Charles county	56
x2000	204
x1999	286
x1998	290
x1997	270
x1996	257
x1995	178
x1994	220
x1993	164
x1992	162
x1991	115
x1990	141
April/May/June	766
Oct/Nov/Dec	501
Jan/Feb/March	415
DG low cost	8
DG economy	130
DG avg good VG	452
Air combined sys	1654
Space or no heat	17
Waterfront w/oil	3
Interior w/oil	32

44,486 square feet (just over an acre), and the average age of a house was 24-years.

Data Analysis

Hedonic Model

The statistical method used to measure the effects of the spill on property values is a multivariate hedonic regression model. This method regresses the transaction price of a composite good against that good's characteristics. The model employs house sales from the 1990–2000 period, using ordinary least squares (OLS) to isolate the effects of each independent variable on sales price while holding the other variables constant. There are four types of variables: structural, neighborhood, date/time of sale, and environmental (affected by the oil spill). Structural variables include square feet, lot size, waterfront property status, unit age in 2000, central air, heat type, number of fireplaces, garage size, full and partial bathrooms, and additional structures (such as boat docks and pool houses). Neighborhood variables include median household income and a county dummy variable to account for differing school districts. Date variables account for the sales season and the year of sale. The environmental variable identifies those sales with rights in waterfront property contaminated by oil that sold after the May 15 cut-off date subsequent to the pipeline rupture. Therefore, the equation for the regression model is as follows:

$$P = \alpha + \beta_1 S + \beta_2 N + \beta_3 D + \beta_4 E + \epsilon \qquad (2)$$

where:

P = a vector of house transaction prices,
α = the regression constant,
β_1 = the estimated coefficient vector for the structure, S,
β_2 = the estimated coefficient vector for the neighborhood, N,
β_3 = the estimated coefficient vector for the date of transaction, D,
β_4 = the estimated coefficient vector for environmental contamination status, E, which is a vector containing an environmental variable for ownership rights to water-front properties and interior properties with rights in oiled beaches that occurred after the spill, and
ϵ = an error term.

These variables reflect the effect of the spill on residential market values, while holding the other variables in the model constant. Thirty-five sales with rights in contaminated waterfront property occurred after the May 15 cut-off date.

Hedonic Model Results

The results of the hedonic model, including the post-spill data, are presented in Table 2. An R^2 of just over .70 was achieved, which is consistent with other housing valuation literature reviewed in this paper. Regression diagnostic issues also were investigated. The diagnostic test used for multicollinearity was the variance inflation factor, and all variables fell below the acceptable level of 10. For heteroscedasticity, the scatter plots showed negligible fanning.

The model reveals the impact that individual variables have on property values. It develops a framework showing how different structural and neigh-

Table 2 Hedonic Regression Results

	Value	Std. Error	*t* value	Pr(>|*t*|)
(Intercept)	29,419.1955	7,064.2609	4.1645	0.0000
WATERFRONT	86,053.7201	2,720.4435	31.6322	0.0000
Calvert County	8,220.5716	2,592.4383	3.1710	0.0015
Charles County	16,904.9971	4,768.7865	3.5449	0.0004
LAND AREA	0.1020	0.0187	5.4579	0.0000
AGE	-170.5293	55.3557	-3.0806	0.0021
SQFTSTRC	17.8313	1.8244	9.7736	0.0000
x2000	4,133.4460	3,151.7257	1.3115	0.1898
x1998	-1,261.9751	2,685.2236	-0.4700	0.6384
x1997	-5,194.4669	2,736.9492	-1.8979	0.5078
x1996	-9,779.5534	2,782.9382	-3.5141	0.0004
x1995	-10,755.2019	3,080.9782	-3.4908	0.0005
x1994	-12,908.8206	2,898.2710	-4.4540	0.0000
x1993	-12,947.7867	3,160.0767	-4.0973	0.0000
x1992	-15,989.4133	3,181.5427	5.0257	0.0000
x1991	-18,448.5244	3,638.6362	-5.0702	0.0000
x1990	-28,851.3783	3,311.5907	-8.7122	0.0000
APRIL.MAY.JUNE	-758.6109	1,804.4274	-0.4204	0.6742
OCT.NOV.DEC	-2,276.3645	1,965.2834	-1.1583	0.2469
JAN.FEB.MARCH	-4,002.0664	2,083.2470	-1.9211	0.0548
DG.LOW.COST	-10,314.3996	12,698.4899	-0.8123	0.4167
DG.ECONOMY	-10,192.4064	3,061.5703	-3.3291	0.0009
DG.AVG.GOOD.VG	21,011.2959	2,321.6041	9.0503	0.0000
AIR.COMBINED.SYSTEM	5,473.3139	1,784.6175	3.0669	0.0022
NO.OR.SPACE.HEAT	-21,270.9852	8,916.3907	-2.3856	0.0171
BATHS.FULL	9,976.7022	1,538.7070	6.4838	0.0000
BATHS.HALF	5,824.7581	1,647.3059	3.5359	0.0004
FIRE1.NUMB	9,509.0623	1,549.6624	6.1362	0.0000
FIRE2.NUMB	18,758.1309	4,162.1518	4.5068	0.0000
TOTAL.PORCH	19.4782	3.0777	6.3289	0.0000
TOTAL.GARG	18.7234	2.4725	7.5728	0.0000
TTL.ASCSTR	1.7933	1.0675	10.7056	0.0000
Median HH income	0.8441	0.1295	6.5159	0.0000
Waterfront w/oil	-28,373.2512	18,828.6910	-1.5069	0.1320
Interior w/oil	-14,390.1733	6,293.2380	-2.2866	0.0223

Residual standard error: 32,010 on 2,252 degrees of freedom
Multiple R^2: 0.7006
F-statistic: 155.0, the *p*-value is 0

borhood variables are valued. Most of the variables are significant at the 99% confidence level. The direction of the impact associated with each variable is consistent with this theory. For example, each square foot of building space adds $18 and the addition of a full bath adds $9,976 to the sales price of a house. Central air adds an additional $5,473 and the first fireplace in a home adds $9,509. Waterfront properties have a value of $86,054 over nonwaterfront properties. Not all variables were positive. For instance, age has a negative impact on the value of a home equal to $171 for each year of age of the house. Neighborhood and county variables also were statistically significant, as were some of the date dummy variables.

Results of the Spill on Oiled Properties

The oil spill is shown to have a negative impact of $14,390 on the sales price of interior, single-family houses with property rights in contaminated waterfront property. This has a *t*-statistic of -2.29 and is statistically significant at above the 95% confidence level. Given that the average value for a home in the subject area is $128,600, the resulting percentage loss is about 11%. This result is the main finding of this study.

The price reduction effect of the spill on waterfront properties is less clear due to the limited number of waterfront sales that occurred post-spill. Overall, examination of local REALTOR® Multiple Listing Service (MLS) data reveals that houses in five of the larger impacted subdivisions in the area experi-

> "The purpose of the predictive regression is to predict the price for each of the sales that occurred post-spill, then compare them to the actual sales price."

enced a reduction of over 40% in 2000 compared with the same time period in 1999. Assuming no substantial variation in regional markets, it is reasonable to connect this reduction in transactions largely to the oil spill. Only three waterfront sales occurred during the first sales season. Of these waterfront properties that sold, the average discount was $28,400 or approximately 12% of the value of a waterfront home. These results approach, but (at 87% confidence) do not attain, statistical significance at the 90% confidence level.

Spatial Autocorrelation

House price data is often spatially correlated; that is, houses located near each other often sell for similar prices. This is not surprising since (according to the old saying) the three most important factors in determining the price of real estate are location, location, and location. When data exhibit spatial autocorrelation, analysts often turn to an explicitly spatial regression framework. There are many spatial approaches that have been put forth in theoretical and empirical research, including pure and mixed auto-regressive models, spatial filtering approaches, geographically weighted regression, generalized least squares approaches, and multi-level modeling.[15] This study uses a mixed regressive-autoregressive model with the following standard procedure. Starting with the most appropriate OLS model (like the one in Table 2), the spatial structure of the regression residuals is analyzed using a variogram that shows the distance over which spatial process, unaccounted for in the current regression variables, is playing a role in the regression. It reveals whether, and over what distance, the residuals exhibit spatial autocorrelation. From the variogram, it was determined that the relevant distance was 700 feet.

Thus, for a given house in the dataset, any other house that sold both before that given house and was within 700 feet of that given house was found to exert a price effect on that given house. Only houses that sold before a given sale were included in order to be consistent with the way sellers and buyers use information about local market conditions. The magnitude and significance of that price-effect is revealed in the spatial regression, similar to the manner in which the magnitude and significance of the coefficient on, for example, building square footage, would be determined in a standard OLS hedonic application.

Although this spatial estimation strategy can also impact the sign, significance, and magnitude of the other regression parameters, the OLS results presented here are qualitatively similar to those of the spatial analyses, both in terms of the relevant regression coefficients and the corresponding predictive regression calculations. The model R^2 was essentially unchanged from the OLS model. The spatial autocorrelation coefficient, r, was found to be positive and significant, indicating that sales of surrounding houses positively impact house price. In particular, the coefficient on the oiled interior properties reflected a $11,819 discount and was statistically significant at $p < 0.10$. The coefficient on the oiled waterfront properties yielded a damage estimate of over $13,000, but as in the OLS model, failed to reach conventional levels of significance, likely due to the limited data (n = 3). Thus, even after accounting for the effects of spatial autocorrelation, interior properties with rights in waterfront beaches contaminated with oil still sustained a loss of over 8% in the first year of sales, holding all else constant.

Predictive Regression

A predictive regression analysis was used to supplement the hedonic model. Unlike hedonic regression that provides an estimate of the average market reduction, the purpose of the predictive regression is to predict the price for each of the sales that occurred post-spill, then compare them to the actual sales price. The difference, if negative, would be an indication of the loss attributable to the spill. Table

15. L. Anselin, *Spatial Econometrics: Methods and Models* (Dordrecht, Kluwer, 1988); J. P. LeSage, *Spatial Econometrics* (Regional Research Institute, West Virginia University, 1999); A. Getis, "Spatial Filtering in a Regression Framework: Examples Using Data on Urban Crime, Regional Inequality, and Government Expenditures," *New Directions in Spatial Econometrics,* ed. L. Anselin and R. Florax (Berlin: Spriger-Verlag, 1995): 172–88. Weighted regression was addressed by C. Brunsdon, A. S. Fotheringham, and M. E. Charlton, "Geographically Weighted Regression: A Method for Exploring Spatial Nonstationarity," *Geographical Analysis* (28: 4, 1995): 281–298. GLS was covered by T. C. Bailey, and A. C. Gatrell, *Interactive Spatial Data Analysis* (Essex, England: Longman, 1995) and K. Jones and N. Bullen, "A Multilevel Analysis of the Variations in Domestic Property Pieces: Southern England 1980–1987," *Urban Studies* (30, 1993): 1409–1426.

3 contains the results of this analysis. Twenty-three of the interior properties sold for less than the predicted value and nine sold for more than the predicted value. As for sales that occurred above the predicted value, this may be accounted for by activities that took place outside the model and for which current data is unavailable (e.g., remodeled kitchen). The average of these numbers shows a reduction of 10.9% in property value for the interior properties. The waterfront properties had similar results: all three sold for less than the predicted value. The waterfront properties incurred an average of a 12.6% reduction in value.

Conclusions

The effect of the Pepco oil spill on residential property values has negatively affected house values in the impact area that sold during the six months after the spill date. This study concludes that interior single-family homes with rights to Patuxent River community beaches have incurred a loss of value over $14,000, which equates to 10.9%, after the rupture of Pepco's oil pipeline in April, 2000. This figure is statistically significant at a 95% level of confidence. The limited number of waterfront sales sustained a loss in value of $28,373, which is statistically significant at just below a 90% confidence level.

Table 3 Predictive Regression

Interior Observation	Predictive	Actual	Actual – Predictive	Difference in Percent
1	$149,725.12	$139,000.00	$(10,725.12)	-7.16%
2	$148,023.22	$155,000.00	$6,976.78	4.71%
3	$122,487.16	$92,000.00	$(30,487.16)	-24.89%
4	$148,841.50	$137,500.00	$(11,341.50)	-7.62%
5	$123,891.95	$137,900.00	$14,008.05	11.31%
6	$145,678.11	$156,000.00	$10,321.89	7.09%
7	$116,712.13	$67,000.00	$(49,712.13)	-42.59%
8	$121,152.42	$118,500.00	$(2,652.42)	-2.19%
9	$99,019.86	$114,800.00	$15,780.14	15.94%
10	$168,491.55	$176,900.00	$8,408.45	4.99%
11	$126,764.03	$120,000.00	$(6,764.03)	-5.34%
12	$124,679.25	$125,000.00	$320.75	0.26%
13	$123,984.55	$102,000.00	$(21,984.55)	-17.73%
14	$136,193.72	$110,000.00	$(26,193.72)	-19.23%
15	$105,264.34	$75,000.00	$(30,264.34)	-28.75%
16	$137,845.14	$129,650.00	$(8,195.14)	-5.95%
17	$149,981.08	$144,000.00	$(5,981.08)	-3.99%
18	$122,965.76	$119,000.00	$(3,965.76)	-3.23%
19	$123,666.32	$104,200.00	$(19,466.32)	-15.74%
20	$156,600.67	$128,000.00	$(28,600.67)	-18.26%
21	$122,431.17	$110,000.00	$(12,431.17)	-10.15%
22	$146,404.92	$115,000.00	$(31,404.92)	-21.45%
23	$148,148.09	$112,000.00	$(36,148.09)	-24.40%
24	$115,328.72	$94,601.00	$(20,727.72)	-17.97%
25	$105,447.30	$72,500.00	$(32,947.30)	-31.25%
26	$123,205.80	$130,000.00	$6,794.20	5.51%
27	$135,385.56	$140,000.00	$4,614.44	3.41%
28	$118,636.84	$117,000.00	$(1,636.84)	-1.38%
29	$165,502.91	$85,000.00	$(80,502.91)	-48.64%
30	$133,386.00	$89,500.00	$(43,886.00)	-32.90%
31	$100,214.93	$81,500.00	$(18,714.93)	-18.67%
32	$98,990.43	$106,000.00	$7,009.57	7.08%
Average Loss Interior				**-10.9%**
Waterfront Observation				
1	$226,909.94	$184,000.00	$(42,909.94)	-18.91%
2	$244,016.92	$235,000.00	$(9,016.92)	-3.70%
3	$218,194.57	$185,000.00	$(33,194.57)	-15.21%
Average Loss Waterfront				**-12.6%**

Prior to the spill, there is no indication of any other market disturbances that may have impacted property values. Interestingly enough, the Chalk Point Trustees report that quantified the loss in recreational value resulting from the oil spill found a reduction in visitation of about 10% over the first year. This figure mirrors the results from this study regarding property damages.[16]

The implications are that local property assessors in the study area (and potentially those assessors faced with similar situations elsewhere) should discount the residential values for property tax purposes to account for reduction in value attributable to the spill. Whether or not these effects are temporary or permanent has not yet been determined and depends on a number of factors. Appraisers should be aware that residential sales affected by the spill are trading for a discounted price, and consider this issue when selecting comparable sales for the market approach to value for properties in the impact area.

This analysis raises several issues for future research, including the effects of the spill on other property types such as residential lots, upper-end residential houses, and nonresidential property, how the impacts are manifest over time, and how property values in the proximity of the impacted sites are influenced. Another impact not always considered is the loss of liquidity (longer marketing time, lower transaction rates, and failed sales). An analysis should be conducted to determine how the liquidity of the homes has been affected. Initial analysis of 2000 post-spill residential sales shows that the number of sales in the five largest subdivisions in the impact area is reduced by over 40% from the same period in the previous year.

This case has generated legal action on behalf of the homeowners to recover property damages. In the interim, homeowners in the impacted area should consider requesting a reduction in assessed value and their property tax.

An analysis should be conducted that quantifies the effects of the oil spill on property values over time. Intuitive judgment suggests that the impact from the spill may diminish, although it is too soon to conclude that it will, and if it does, how quickly. Additionally, a comparable analysis of sales in similar markets in the Potomac River region may shed light on this issue. Further research is necessary to provide insight on these topics.

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16. Byrd et al., Ibid.