ENVIRONMENTAL RISK PREMIUMS AND PRICE EFFECTS

IN COMMERCIAL REAL ESTATE TRANSACTIONS

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Funding for this paper was provided in part by The Appraisers Research Foundation.

April 15, 2005

ABSTRACT

This paper examines the effects of environmental contamination on the sales prices and income capitalization rates for retail centers sold in southern California from 1994 to 2004. The sales are analyzed through two sets of statistical models. The first, with property characteristics, location and date of sale as predictors, estimates price reductions for contaminated properties sold before or during remediation of 30% to 35%. The second set of models use variables associated with the income capitalization approach to value, net operating income and the overall income capitalization rate, and find risk related price reductions of 16% to 17% for contaminated properties prior to cleanup. All of the models indicate that the value of these properties fully recovers after cleanup. One model even finds a significant price premium in the after condition. Lastly, the model based on income capitalization rates quantifies an environmental risk premium of 197 basis points over rates for comparable but uncontaminated properties.

Keywords: Environmental risk, contaminated property valuation, commercial real estate

INTRODUCTION

Most formal, empirical analyses of the impacts of environmental contamination on sales prices and property value have focused on residential real estate (Jackson, 2001). With one or two exceptions, studies of non-residential properties have been based on case studies. This study quantifies these impacts on commercial properties through a series of multiple regression models based on 120 sales of retail centers in southern California, including twenty-three sales of contaminated or previously contaminated properties. Risk related effects are distinguished from price reductions due to costs for planned remediation. In addition, this analysis specifically quantifies environmental risk as an income capitalization rate premium for properties sold prior to remediation. As will be explained, sales involving contaminated properties transact at higher capitalization rates to compensate for the increases risks associated with the properties' environmental condition.

The commercial properties for this study are contaminated source sites, rather than sites affected by an external source, as is typically the case with residential properties. As source sites for soil or groundwater contamination, the price and value of commercial properties may be affected by both risk and cost. Environmental risk for commercial real estate is the investment and lending risk related to uncertainties concerning cleanup requirements, liabilities and other factors. The effect of these risk factors is sometimes referred to as "stigma." As risk increases, income is discounted or capitalized, through higher required rates of return, into lower prices and values. Commercial real estate prices can also be directly reduced by estimated remediation costs that are to be paid by the buyer of such properties from future property cash flows. Where remediation costs have been estimated and such estimates are available, the sales prices will be adjusted to focus on effects of environmental risk.

LITERATURE

Published studies of the effect of environmental contamination on the sales prices of improved commercial properties have been largely based on case studies. These studies include Page and Rabinowitz (1993), who use a case study approach to evaluate the impacts of groundwater contamination on the value of six commercial and industrial properties in Pennsylvania, California and Wisconsin. In another application of the case study approach, Patchin (1994) analyzes eight commercial and industrial case studies, finding a range of property value impacts from 21% to 94%. Bell (1998) presents a framework for evaluating a variety of "detrimental conditions" including environmental contamination. Bell's framework calls for the valuation of a property as if there were no contamination, called the "benchmark" and then compare this to the "as is" value of the property in its actual, contaminated state. Bell distinguishes between value effects due to remediation costs and the effects of additional risk attributable to contamination, referred to in Bell's framework as either "project incentive" or "market resistance." Bell analyzes eight case studies involving industrial and commercial properties impacted by soil contamination, and finds reductions in sales prices ranging from 10% to 51%.

The impacts of contamination on commercial property transaction rates and financing have been studied by Simons and Sementelli (1997), who compare commercial properties with leaking underground storage tanks (LUSTs) and properties with non-leaking tanks that have been registered with the state of Ohio (RUSTs) to other commercial properties. They find that both LUST sites and RUST sites transact at significantly lower rates than uncontaminated commercial properties. Simons, Bowen and Sementelli (1999) also analyze the effects of leaking underground storage tanks in Cleveland on adjacent commercial properties. The authors use a paired sales analysis, comparing a sale before contamination was discovered and a resale after the contamination was known. Based on an analysis of six such sales, they conclude that the average diminution in value due to the contamination was from 28% to 42%.

Thus far, empirical studies of price effects of contamination on non-residential properties have focused on industrial real estate. Jackson (2002) addresses the issue of varying impacts of contamination over the remediation cycle through an analysis of 140 industrial property sales in the southern California area. In a series of multivariate regression analyses, he found that before or during cleanup prices were reduced from 27.8% to 30.5%. After remediation, there was no discernable effect on the prices of previously contaminated properties. An earlier study of industrial property impacts is provided by Guntermann (1994), who estimated the parameters of a price model using 153 sales of unimproved industrial land in the Phoenix, Arizona area. The sales included landfills (source sites) as well as industrial land located proximate or adjacent to landfills. Guntermann found that the landfill sites sold for 53% less than other industrially zoned land.

Lastly, one published example of the application of regression techniques to commercial real estate, albeit not contaminated, is by Saderion, Smith and Smith (1994). Using data on apartment property sales in Houston from 1978 to 1988, the authors estimate the parameters for three models: (1) a “standard hedonic” with price as a function of property and market characteristics, including year of sale categorical variables; (2) an income model with income capitalization rates as a function of net operating income and the year of sale variables; and (3) a combined model with price as a function of property and market

characteristics, year of sale, and net operating income. The models are estimated in logarithmic form. The combined model produced the best fit with an R^2 of 0.926. The income model had a lower explanatory power, with an R^2 of 0.752, although the t-statistic for net operating income of 27.97 indicates that it is a highly significant predictor.

RESEARCH FRAMEWORK

In this paper, data on over ten years of sales of contaminated retail centers before and after remediation are analyzed and compared to the prices of similar but uncontaminated properties. This analysis will provide statistical evidence as to the extent of any risk related reductions in sales price that could be attributed to the effects of the environmental condition of the properties as of their date of sale. In addition, environmental risk premiums are quantified through increases in income capitalization rates for contaminated properties sold prior to remediation. The analyses utilize multiple regression analysis, whereby the effects of other variables such as property size, age, location and date of sale are statistically held constant in order to isolate the independent effects of environmental condition on sales price and income capitalization rates.

Based on the literature cited and other information, the following research hypotheses will be formally tested using the regression procedure:

H_1: *Reductions in property value (relative to baseline risk levels and prices for similar but uncontaminated properties) vary with the remediation status of the contaminated property.*

H_2: *Contamination related risk premiums and adverse property value impacts disappear subsequent to remediation and clean up.*

The property value impacts suggested in these hypotheses will be measured through reductions in average sales price for commercial properties that sold before, during and after cleanup of contamination as well as increases to income capitalization rates (environmental risk premiums). The statistical models will test the null hypothesis that there is no difference between the prices and capitalization rates of the

contaminated and previously contaminated properties in comparison to similar properties that are uncontaminated. In the alternative, the models and their parameter and statistical significance estimates will provide support for the research arguments and thesis implicit in these hypotheses. However, due to the relatively small number of sales occurring during cleanup, sales occurring before and during cleanup will be combined into a single category. Sales occurring after cleanup will remain a separate category.

The base model specification in linear form, with no transformations to the dependent or independent variables, is as follows:

$$P = \beta_O + \beta_1 X_1 + ... + \beta_n X_n + \beta_{n+1} ENV_1 + ... + \beta_{n+1+p} ENV_p + \beta_{n+1+p+1} LOC_1 + ... + \beta_{n+1+p+1+r} LOC_r + \beta_{n+1+p+1} YEAR_1 + ... + \beta_{n+1+p+1+r} YEAR_r + \epsilon,$$

where,

P	=	the sales price of the property, adjusted for remediation costs for unremediated properties,
β_O	=	a constant term,
$X_1...X_n$	=	a vector of continuous non-environmental property characteristics such as building size, age, etc.,
$ENV_1...ENV_p$	=	a vector of discrete variables indicating the environmental status of the property at the time of sale,
$LOC_1...LOC_r$	=	a vector of discrete terms indicating the location of the property to capture effects due to market conditions that vary by location,
$YEAR_1...YEAR_r$	=	a vector of discrete terms indicating the property's year of sale, to capture effects due to market conditions over time, and
ϵ_i	=	a random error term.

Alternative specifications will be used in the set of models based on net operating income and income capitalization rates.

DATA COLLECTION

The assembly of the sales data for this analysis began with an initial search of the records of a commercial sales data service for the southern California area. This search was for the purpose of identifying sales of

commercial properties that had been previously contaminated. The analysis of these sales and the question to which the analysis was addressed was whether or not there was any remaining effect of previous contamination on sales price. The southern California area was selected because of the size of the commercial real estate market and frequency of transactions. In addition, the data vendor, CoStar, Inc. (CoStar), has assembled an extensive sales database for the area. This database is one of the most extensive of its kind in the U.S.

The sales search procedure consisted of two steps, done with the assistance of the CoStar market research staff in San Diego. The first step involved a key word search on the descriptive information on the full database for the southern California area, including Los Angeles, Orange, San Diego, Riverside, San Bernardino and Ventura counties. Among the key words were: remediation, contamination, toxic, environmental, synthetic, fibers, chemical, asbestos, radioactive, waste, lead, oil, petroleum, crude oil, and diesel. Several hundred sales were identified on this search. The description segment that keyed the identification was reviewed in greater detail. Sales that only involved asbestos, sales of land only, sales of gasoline service stations, and sales for which the primary environmental issue was contamination from an adjacent property were not retained for further analysis.

The second step in the data collection process was to match the selected contaminated property sales to a number of comparable properties that sold without existing or previous contamination. The goal was to match each contaminated sale to at least four or five uncontaminated comparables. Comparability was assessed on the basis of property type (strip centers and neighborhood centers), location, size of improvements, date of sale, and age of improvements. CoStar geographically codes its sales data by county and by a number of subareas, or submarkets, within each county. For example, San Diego County has 20 subareas and Orange County has 12 subareas. Los Angeles County is divided into five main subareas: north, east, west, central and south, and there are smaller subareas within each of these. Los Angeles County east has eight smaller subareas and the other Los Angeles County subdivisions have seven smaller subareas each. Accordingly, each contaminated sales property was matched to other

properties of the same type within each of these smaller subareas. In most of the smaller subareas, all of the available uncontaminated property sales of the same property type as the contaminated property sale were selected. In areas with more data, sales of similar age and size were targeted.

Lastly, the statistical models developed for this study used a multivariate technique that requires each sale to have valid, non-missing data on all of the variables used in the multiple regression procedure. Thus, any sale that did not meet this criterion was excluded from the analysis. At the time of initial data collection efforts, the specification of the final statistical models was not known, so data on a number of sales was collected but was subsequently excluded. The final data set for the sales price analysis is summarized in Exhibit 1. The sales are listed by geographic area and by environmental status.

(Exhibit 1 about here)

RETAIL CENTER BASE MODELS

Descriptive statistics for the data utilized in the retail center base models are summarized in Exhibit 2. The data in this table reflects the averages, standard deviations, minimums and maximums for all 120 sales in the model and on the variables in the model's final specification. As can be seen, the overall average sales price is $2,383,499. This sales price represents an adjusted amount. The prices were adjusted by adding buyer paid remediation costs to the nominal sales price. A buyer would reduce the price to be paid by the amount that they would have to pay to remediate the property. In this way, cost effects, or reductions in selling price due to remediation costs, would be eliminated to the extent possible, and the analysis will focus on risk related effects, or reductions in sales price resulting from perceived environmental risk. Another variable used in the base model regression analyses is termed parking ratio, defined as the number of parking spaces per 1,000 square feet of gross building area. Centers with greater parking for their size could have an advantage in offering more convenient access for potential customers, and therefore could have a higher value and price.

(Exhibit 2 about here)

The statistical analysis and parameter estimates for the retail center base model are presented in Exhibit 3. The model's fit to the retail center sales data is indicated by its adjusted R^2 of 0.845. The variables associated with the physical characteristics of the properties, building square footage, age at time of sale and the parking ratio are all shown to be statistically significant at the 0.05 level. Additional square footage is shown to add $85.37 to sales price, while the properties on average are reduced by $17,840 for each year of age. Chronological age is likely serving as a proxy for condition, functional obsolescence and other factors related to accrued depreciation. The model estimates the significance of the parking ratio variable at the 0.01 level, and depicts its positive effect on sales price. None of the location variables were significant. Year of sale in 1999 and in 2003 are significant in this model.

(Exhibit 3 about here)

The estimates in Exhibit 3 for the two environmental condition variables indicate that retail centers that sold before or during cleanup of existing environmental contamination had an average price discount of $823,987, which is significant at the 0.004 level. The model estimates for centers that sold after cleanup indicates a price premium of $604,042, which is significant at the 0.075 level. This suggests that after remediation and when sold "clean," these properties not only regain their unimpaired values but can sell at premiums to similar uncontaminated properties. Perhaps the market's knowledge of and increased certainty about the environmental condition of these now remediated properties reduces environmental risk perceptions. Lastly, with an average price for the uncontaminated retail centers of $2,329,347, the model's estimates suggest a 35.4% reduction in sales price due to contamination for properties sold before or during cleanup. The price premium for the previously contaminated properties suggests a 25.9%

premium after cleanup relative to comparable uncontaminated properties. These initial findings will be examined further through alternative model specifications.

Exhibit 4 presents a slightly different specification of the base model for this analysis. In this specification, the covariates of building square footage, age and the parking ratio are transformed using a power transformation estimated through a nonlinear model and bootstrap re-sampling procedure. A more detailed discussion of the bootstrap re-sampling procedure may be found in Jackson (2002). The transformations suggested by the nonlinear model were statistically significant at the 0.05 level. Transformation of the dependent variable, sales price into logarithmic form was not shown to improve the model's fit. After performing the indicated power transformations to the independent variables, the base model was re-estimated with the results shown in Exhibit 4. As can be seen, the adjusted R^2 has increased to 0.872, all of the covariates achieve significance at higher levels and five of the sale year categorical variables are significant at either the 0.10 or 0.05 levels. Again, the estimate for the *BEFORE* condition variable is statistically significant at the 0.05 level, but indicates a slightly smaller average price reduction of $710,802, or 30.5%, relative to comparable but uncontaminated properties. The coefficient for the *AFTER* condition parameter is not significant at the 0.10 level, although it is still positive and reflects a price premium.

(Exhibit 4 about here)

RETAIL CENTER ECONOMIC MODELS

The preceding sections have analyzed sales price with models focusing on the physical characteristics of the improvements, including their size and configuration, as well as their location and date of sale. These models were somewhat similar to the "standard hedonic" specification referred to by Saderion, Smith and Smith (1994). Saderion, Smith and Smith also suggest the use of such variables as net operating income and income capitalization rates. These variables are usually highly correlated with the value of income-

producing commercial real estate. The overall income capitalization rate, noted by the symbol R_O, reflects the relationship between net operating income and sales price and is considered to be the rate at which income is capitalized into value. As noted, it reflects the risk associated with a particular property investment. Conceptually, the capitalization rate could be viewed as the reciprocal of a price-earnings ratio. Net operating income (NOI) is simply the net of property revenues less operating expenses. Dividing NOI by R_O equals property value. Alternatively, the ratio of NOI to property value, or sales price as an indicator of value, is R_O. These variables form the basis of the income capitalization approach to value that is frequently used by the market to price and value income producing commercial real estate. The income approach is also supported in the literature as an appropriate approach for valuing contaminated commercial properties and estimating the diminution in value due to contamination (see Jackson 2001). Thus, consideration of these variables in this study is appropriate and well founded from conceptual and practical perspectives.

Exhibit 5 presents descriptive statistics for the economic models. Since net operating income and income capitalization rates were not available for all of the 120 sales used in the base models, 75 sales are used in these analyses, including 12 contaminated retail centers that sold before or during remediation and 7 sales of previously contaminated properties that sold after remediation. It should be noted that the after condition sales included some properties that were undergoing long term monitored natural attenuation, which has been shown to be an "after" condition elsewhere (Jackson, 2004). In Exhibit 5, the average sales price for these 75 properties is $2,329,247. Net operating income averages $238,249 and the mean income capitalization rate is 9.62%. While not shown in Exhibit 5, the mean capitalization rate for the 56 uncontaminated properties was 9.30%. For the contaminated properties that sold before or during cleanup, the rate was 11.64%, and the rate for the previously contaminated retail centers sold after cleanup was 8.73%. Even in this unadjusted data, we see the pattern of increased risk before or during cleanup, and reduced risk after cleanup.

(Exhibit 5 about here)

Net Operating Income (NOI) Model

The first of the two models presented in this section analyzes price as a function of NOI, location, year of sale, and the two environmental condition variables. The dependent variable in the model specification is the logarithm of sales price as this form was found to best fit the data. In addition, NOI has been re-specified through a power transformation estimated by a nonlinear model using a bootstrap procedure. As shown in Exhibit 6, this model specification has an adjusted R^2 of 0.96, indicating that these variables explain 96% of the variation in sales price. The significance and explanatory power of this simple model highlights the strong relationship between NOI and sales price. The re-specified NOI variable is significant at the 0.0001 level and sale year 2004 is significant at the 0.007 level.

(Exhibit 6 about here)

The parameters of interest for the two research hypotheses, sales before remediation and sales after cleanup, show the same pattern found in the second base model specification. That is, the effect of contamination before cleanup is statistically significant and the effect after cleanup is not significant. For the centers in the NOI model, the effect before cleanup is to reduce sales price by 15.9%, calculated by raising the parameter estimate for *BEFORE* of -0.1730 to the power of base e and then subtracting the result from one and multiplying by 100. The coefficient for the sales in the *AFTER* condition is not significant at any level. Thus, the null hypothesis of no effect is rejected in favor of the first research hypothesis that before cleanup contamination affects price. On the other hand, the NOI model estimate for price effects after cleanup indicate that he null hypothesis cannot be rejected, supporting the second research hypothesis: *Contamination related risk premiums and adverse property value impacts disappear subsequent to remediation and clean up.* Risk premiums, though, are more directly addressed in the following section.

Capitalization Rate Model

The next of the two economic models does not directly analyze sales prices or differences in sales price. Instead, the income capitalization rates of the 75 retail centers are modeled as a function of the location and year of sale variables and the environmental condition of the properties as of their date of sale. The same environmental condition categorical variables are used in this capitalization rate model with a value of one corresponding to a contaminated property sale that occurred with the specified environmental condition. Again, the reference group for the two environmental variables is the uncontaminated property sales. Accordingly, the *BEFORE* parameter estimate, for properties sold with unremediated contamination as shown in Exhibit 7, represents the increase the capitalization rate for this environmental condition relative to the capitalization rates for the uncontaminated properties. From another perspective, this coefficient corresponds to the environmental risk premium for properties with unremediated contamination. Accordingly, with a coefficient of 0.01967, the risk premium is approximately 197 basis points. This premium corresponds to the additional return (unleveraged) required to compensate for the risk and uncertainty associated with a contaminated commercial sold prior to cleanup.

(Exhibit 7 about here)

As also shown in Exhibit 7, the 197 basis point risk premium estimated in the capitalization rate model is significant at the 0.001 level. The estimate for the *AFTER* cleanup condition is not significant. The null hypothesis for this model, that environmental condition has no effect on income capitalization rates, can be rejected for the *BEFORE* cleanup condition, in favor of an alternative hypothesis, that prior to remediation contamination increases environmental risk and its effect in reducing sales prices (through higher capitalization rates).

Lastly, the environmental risk premium can be used to calculate a corresponding sales price reduction. Adding the 196.7 basis point risk premium to the 9.30% capitalization rate (R_O) for uncontaminated

properties equates to an adjusted capitalization rate (adjusted R_O) of 0.11247, or 11.25%. With an average net operating income of $243,285 (calculated by applying the R_O of 9.30% to the average sales price for the uncontaminated properties in this analysis of $2,615,968), the 197 basis point risk premium equates to a price reduction of $453,434, or 17.3%. The 17.3% price reduction, as estimated in this manner through the capitalization rate model, is slightly higher than the 15.9% reduction in sales price estimated through the NOI model.

CONCLUSIONS

All of the statistically significant sales price effects estimated through the preceding analyses were based on parameter estimates that attained significance at the 0.05 level or better were due to the environmental condition of the contaminated properties before or during remediation. The effect of contamination on sales price after remediation was found in most of the models not to be statistically significant. Therefore, research hypothesis H_1, that prices and risks *vary with the remediation status of the contaminated property* is clearly supported in this analysis. Further, hypothesis H_2, that *risk premiums and adverse property value impacts disappear subsequent to remediation and cleanup* is also clearly supported in all of the analyses and property types. However, and as previously noted, one of the base models estimated a statistically significant ($p = 0.075$) price premium for previously contaminated and remediated properties relative to otherwise comparable but uncontaminated properties.

As noted, the analyses presented herein resulted in estimates of reductions in sales prices of contaminated properties before cleanup ranging from 15.9% to 17.3% for the economic models from 30.5% to 35.4% for the base models. These estimates can be compared to the limited number of published empirical studies of commercial and industrial property impacts due to contamination or hazards. The first was by Page and Rabinowitz (1993), who analyzed six contaminated commercial properties in Pennsylvania, California and Wisconsin and found a range of property value reductions from 10% to 50%. Another study is by Patchin (1994), who analyzed eight “case studies” and found a range of reductions in value from 20.9% to 93.7%. More recently, Bell (1998) analyzed eight commercial and industrial properties and

found risk related reductions in price from 10% to 51%. Bell's results indicate an average reduction of 27%. Simons (1999) also used a case study approach to analyze the effects of proximity to leaking underground storage tank sites in Cleveland. Simon's study of six commercial properties found an average reduction of 28% to 42%, depending on the weighting of the results. Lastly, Jackson (2002) found that the sales prices of contaminated, source site industrial properties were reduced from 27.8% to 30.5%. The other study of industrial properties cited herein, by Guntermann (1994), found that industrial land used as a municipal landfill sold for 53% less than other industrially zoned land in the Phoenix, Arizona area.

Finally, even though the estimates from the current study fall well within the ranges suggested in the literature, the difference in the estimated sale price effects between the base models (30.5% and 35.4%) and the economic models (15.9% and 16.9%) would suggest these specifications might be measuring slightly different constructs. One explanation is that the NOI parameter in that model may have captured some of the contamination effects that were reflected in the *BEFORE* parameter in the base models, if environmental risk also reduced NOI. This would not, however, explain the risk effects estimated in the capitalization rate model, since it does not include the NOI variable. The capitalization rate model offers the most direct measure of environmental risk of the specifications used herein, given its definition and usage by the market in pricing risk. Another explanation is that the sales price adjustment for remediation costs (adding known future costs to be paid by the buyer) may not have completely accounted for all future costs used to establish sales price, as buyers may have discounted the sales price for anticipated but unreported costs. Indeed, one of the elements of environmental risk is uncertainty about future remediation costs, so these effects may overlap. This would, of course, have no influence on the post-remediation findings and conclusions.

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Exhibit 1
Summary of Commercial Property Sales Data

	Uncontaminated Property Sales	Contaminated Property Sales, Before or During Remediation	Contaminated Property Sales, After Remediation	Totals
Los Angeles East *(LAEAST)*	10	1	2	13
Los Angeles North *(LANORTH)*	12	1	1	14
Los Angeles South *(LASOUTH)*	36	5	3	44
Los Angeles West *(LAWEST)*	7	1	0	8
Orange County *(ORANGE)*	19	3	1	23
San Diego County *(SANDIEGO)*	13	4	1	18
Totals	97	15	8	120

Note: Data on retail center sales analyzed in base models, excluding sales with missing data. Sales occurred from 1994 to 2004.

Exhibit 2
Descriptive Statistics for Retail Center Property Sales

Variable	Mean	Standard Deviation	Minimum	Maximum
Sales price	$2,383,499	$2,166,325	$260,000	$9,540,000
Building square footage *(BLDGSF)*	21,913	22,913.30	2,399	106,684
Building age in years at time of sale *(AGE)*	20.64	14.74	0.00	77.00
Parking ratio *(PRATIO)*	3.80	1.55	0.00	9.74
Los Angeles East *(LAEAST)*	0.1083	0.3121	0.00	1.00
Los Angeles North *(LANORTH)*	0.1167	0.3224	0.00	1.00
Los Angeles South *(LASOUTH)*	0.3667	0.4839	0.00	1.00
Los Angeles West *(LAWEST)*	0.0667	0.2505	0.00	1.00
Orange County *(ORANGE)*	0.1917	0.3953	0.00	1.00
San Diego County *(SANDIEGO)*	0.1500	0.3586	0.00	1.00
Sale in 1994 *(S1994)*	0.0083	0.0913	0.00	1.00
Sale in 1995 *(S1995)*	0.0167	0.1286	0.00	1.00
Sale in 1996 *(S1996)*	0.0250	0.1568	0.00	1.00
Sale in 1997 *(S1997)*	0.0417	0.2007	0.00	1.00
Sale in 1998 *(S1998)*	0.2833	0.4525	0.00	1.00
Sale in 1999 *(S1999)*	0.1250	0.3321	0.00	1.00
Sale in 2000 *(S2000)*	0.0250	0.1568	0.00	1.00
Sale in 2001 *(S2001)*	0.0417	0.2007	0.00	1.00
Sale in 2002 *(S2002)*	0.2167	0.4137	0.00	1.00
Sale in 2003 *(S2003)*	0.1750	0.3816	0.00	1.00
Sale in 2004 *(S2004)*	0.0417	0.2007	0.00	1.00
Sale with contamination before or during remediation *(BEFORE)*	0.1250	0.3321	0.00	1.00
Sale after remediation of previous contamination *(AFTER)*	0.0667	0.2505	0.00	1.00

Note: Data on 120 retail center property sales with non-missing data on all variables in regression model. Twenty-three properties had existing or previous contamination and 97 were uncontaminated.

Exhibit 3
Base Model Parameter Estimates, Linear Specification

Variable	Parameter estimate	t-statistic	p-value
Intercept	-655,458.22	-0.81	0.419
Building square footage *(BLDGSF)*	85.37 **	20.92	0.0001
Building age in years *(AGE)*	-17,839.87 **	-2.74	0.007
Parking ratio *(PRATIO)*	157,433.19 **	2.62	0.010
Los Angeles East *(LAEAST)*	330,501.89	0.70	0.486
Los Angeles North *(LANORTH)*	223,180.52	0.52	0.605
Los Angeles South *(LASOUTH)*	-106,848.65	-0.28	0.777
Orange County *(ORANGE)*	203,470.54	0.49	0.623
San Diego County *(SANDIEGO)*	-655,955.35	-1.53	0.129
Sale in 1994 *(S1994)*	568,697.43	0.54	0.592
Sale in 1996 *(S1996)*	622,346.58	0.78	0.438
Sale in 1997 *(S1997)*	477,850.15	0.63	0.531
Sale in 1998 *(S1998)*	718,852.56	1.02	0.308
Sale in 1999 *(S1999)*	1,239,029.75 *	1.68	0.096
Sale in 2000 *(S2000)*	809,891.84	0.99	0.327
Sale in 2001 *(S2001)*	1,274,349.40	1.53	0.130
Sale in 2002 *(S2002)*	1,168,366.77	1.63	0.106
Sale in 2003 *(S2003)*	1,630,442.01 **	2.27	0.025
Sale in 2004 *(S2004)*	894,142.12	1.10	0.275
Sale with contamination before or during remediation *(BEFORE)*	-823,986.54 **	-2.95	0.004
Sale after remediation of previous contamination *(AFTER)*	604,042.12 *	1.80	0.075
Adjusted R^2	0.845		
F-value	33.54		
p-value	0.001		

Note: Los Angeles west and sale year 1995 were reference categories for location and sale year. ** and * indicate significance at the 0.05 and 0.10 level, respectively.

Exhibit 4
Base Model Parameter Estimates after Transformations to Covariates

Variable	Parameter estimate	t-statistic	p-value
Intercept	-469,111.51	-0.672	0.503
Building square footage *(BLDGSF $^{0.6256}$)*	6,602.96 **	22.576	0.001
Building age in years *(AGE $^{0.2830}$)*	-673,335.99 **	-4.289	0.001
Parking ratio *(PRATIO $^{15.02}$)*	0.0000000048 **	4.116	0.001
Los Angeles East *(LAEAST)*	550,093.04	1.275	0.205
Los Angeles North *(LANORTH)*	-61,479.29	-0.156	0.877
Los Angeles South *(LASOUTH)*	4,301.09	0.013	0.990
Orange County *(ORANGE)*	493,386.05	1.314	0.192
San Diego County *(SANDIEGO)*	-489,063.31	-1.253	0.213
Sale in 1994 *(S1994)*	877,773.23	0.910	0.365
Sale in 1996 *(S1996)*	521,669.80	0.719	0.474
Sale in 1997 *(S1997)*	653,752.55	0.917	0.362
Sale in 1998 *(S1998)*	717,157.70	1.097	0.275
Sale in 1999 *(S1999)*	1,326,048.26 *	1.933	0.056
Sale in 2000 *(S2000)*	1,344,151.52 *	1.742	0.085
Sale in 2001 *(S2001)*	1,241,258.72	1.617	0.109
Sale in 2002 *(S2002)*	1,425,284.90 **	2.120	0.037
Sale in 2003 *(S2003)*	1,796,134.46 **	2.652	0.009
Sale in 2004 *(S2004)*	1,526,008.84 **	2.046	0.043
Sale with contamination before or during remediation *(BEFORE)*	-710,802.49 **	-2.79	0.006
Sale after remediation of previous contamination *(AFTER)*	486,506.67	1.52	0.133
Adjusted R^2	0.872		
F-value	41.50		
p-value	0.001		

Note: Covariates of BLDGSF, AGE, and PRATIO transformed on the basis of nonlinear regression of $PRICE = \beta_0 + \beta_1 (BLDGSF)^{\beta 2} + \beta_3 (AGE)^{\beta 4} + \beta_5 (PRATIO)^{\beta 6} + other\ variables + \varepsilon$. Nonlinear model produced estimates of $\beta_2 = 0.6256$, $\beta_4 = 0.2830$, and $\beta_6 = 15.02$ and had an adjusted R^2 of 0.89. ** and * indicate significance at the 0.05 and 0.10 level, respectively.

Exhibit 5
Descriptive Statistics for Retail Center NOI and Capitalization Rate Models

Variable	Mean	Standard Deviation	Minimum	Maximum
Sales price	$2,636,165	$2,078,609	$260,000	$9,100,000
Net Operating Income *(NOI)*	$238,246	$171,073	$34,020	$812,250
Income Capitalization Rate *(CAPRATE)*	9.62%	0.0200	3.41%	16.25%
Los Angeles East *(LAEAST)*	0.1333	0.3422	0.00	1.00
Los Angeles North *(LANORTH)*	0.1467	0.3562	0.00	1.00
Los Angeles South *(LASOUTH)*	0.3600	0.4832	0.00	1.00
Los Angeles West *(LAWEST)*	0.0400	0.1973	0.00	1.00
Orange County *(ORANGE)*	0.1733	0.3811	0.00	1.00
San Diego County *(SANDIEGO)*	0.1467	0.3562	0.00	1.00
Sale in 1994 *(S1994)*	0.0133	0.1155	0.00	1.00
Sale in 1995 *(S1995)*	0.0133	0.1155	0.00	1.00
Sale in 1996 *(S1996)*	0.0400	0.1973	0.00	1.00
Sale in 1997 *(S1997)*	0.0533	0.2262	0.00	1.00
Sale in 1998 *(S1998)*	0.2800	0.4520	0.00	1.00
Sale in 1999 *(S1999)*	0.1600	0.3691	0.00	1.00
Sale in 2000 *(S2000)*	0.0133	0.1155	0.00	1.00
Sale in 2001 *(S2001)*	0.0133	0.1155	0.00	1.00
Sale in 2002 *(S2002)*	0.1867	0.3923	0.00	1.00
Sale in 2003 *(S2003)*	0.1733	0.3811	0.00	1.00
Sale in 2004 *(S2004)*	0.0533	0.2262	0.00	1.00
Sale with contamination before or during remediation *(BEFORE)*	0.1600	0.3691	0.00	1.00
Sale after remediation of previous contamination *(AFTER)*	0.0933	0.2929	0.00	1.00

Note: Data on 75 retail center property sales with non-missing data on all variables in regression model. Twelve properties had existing or previous contamination and 7 were uncontaminated.

Exhibit 6
NOI Model Parameter Estimates
Logarithmic Specification with Covariate Transformation

Variable	Parameter estimate	t-statistic	p-value
Intercept	-92.379 **	-30.260	0.0001
Net Operating Income *(NOI $^{0.009004708}$)*	95.758 **	34.750	0.0001
Los Angeles East *(LAEAST)*	0.1420	1.052	0.297
Los Angeles North *(LANORTH)*	-0.0775	-0.618	0.539
Los Angeles South *(LASOUTH)*	-0.0332	-0.288	0.775
Orange County *(ORANGE)*	-0.0107	-0.082	0.935
San Diego County *(SANDIEGO)*	0.0116	0.086	0.931
Sale in 1994 *(S1994)*	-0.0429	-0.189	0.851
Sale in 1996 *(S1996)*	-0.0224	-0.118	0.907
Sale in 1997 *(S1997)*	-0.0392	-0.206	0.837
Sale in 1998 *(S1998)*	-0.0010	-0.005	0.996
Sale in 1999 *(S1999)*	0.0758	0.411	0.683
Sale in 2000 *(S2000)*	-0.0413	-0.176	0.861
Sale in 2001 *(S2001)*	-0.0054	-0.021	0.984
Sale in 2002 *(S2002)*	0.1080	0.596	0.554
Sale in 2003 *(S2003)*	0.2380	1.273	0.208
Sale in 2004 *(S2004)*	0.6250 **	3.229	0.002
Sale with contamination before or during remediation *(BEFORE)*	-0.1730 **	-2.799	0.007
Sale after remediation of previous contamination *(AFTER)*	0.004337	0.063	0.950
Adjusted R^2	0.962		
F-value	106.19		
p-value	0.0001		

Notes: Dependent variable is the logarithm of sales price *(LNPRICE)*. NOI transformed on the basis of nonlinear regression of $PRICE = \beta_0 + \beta_1 (NOI)^{\beta 2} + other\ variables + \varepsilon$. Nonlinear model produced an estimated of $\beta_2 =$ 0.009004708 and had an adjusted R^2 of 0.96. ** and * indicate significance at the 0.05 and 0.10 level, respectively.

Effect of contamination for properties that sold before or during remediation is significant at the 0.007 level and indicates a 15.9% reduction in sales price. Effect of contamination after remediation is not significant.

Exhibit 7
Capitalization Rate Model Parameter Estimates, Linear Specification

Variable	Parameter estimate	t-statistic	p-value
Intercept	0.09826 **	5.229	0.0001
Los Angeles East *(LAEAST)*	-0.009829	-0.855	0.396
Los Angeles North *(LANORTH)*	0.009263	0.854	0.397
Los Angeles South *(LASOUTH)*	0.005299	0.520	0.605
Orange County *(ORANGE)*	0.001319	0.114	0.910
San Diego County *(SANDIEGO)*	0.005233	0.466	0.643
Sale in 1994 *(S1994)*	0.006324	0.312	0.756
Sale in 1996 *(S1996)*	0.001690	0.100	0.921
Sale in 1997 *(S1997)*	0.006841	0.403	0.689
Sale in 1998 *(S1998)*	0.001265	0.078	0.938
Sale in 1999 *(S1999)*	-0.005797	-0.352	0.726
Sale in 2000 *(S2000)*	0.000055	0.003	0.998
Sale in 2001 *(S2001)*	0.001174	0.050	0.960
Sale in 2002 *(S2002)*	-0.01112	-0.687	0.495
Sale in 2003 *(S2003)*	-0.02119	-1.278	0.207
Sale in 2004 *(S2004)*	-0.04522 **	-2.615	0.011
Sale with contamination before or during remediation *(BEFORE)*	0.01967 **	3.568	0.001
Sale after remediation of previous contamination *(AFTER)*	0.000424	0.069	0.946
Adjusted R^2	0.537		
F-value	6.056		
p-value	0.0001		

Notes: Dependent variable is the income capitalization rate at which the property sold *(CAPRATE)*. ** and * indicate significance at the 0.05 and 0.10 level, respectively.

Effect of contamination for properties that sold before or during remediation is significant at the 0.001 level and indicates an environmental risk premium of 197 basis points.

Effect of contamination after remediation is not significant.