Environment Risk Perceptions of Commercial and Industrial Real Estate Lenders

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Abstract   This study analyzes the risk perceptions of commercial and industrial mortgage lenders related to environmental contamination. Two research questions are addressed. The first is whether perceived risks vary with a property's remediation/cleanup status. The second is whether market conditions have an intervening effect on environmental risk. An analysis of national lender survey data found significant differences in perceived risk before, during and after cleanup, with most lenders unwilling to make a loan before cleanup and a majority willing to lend at typical rates and terms after cleanup. The study also found that strong market demand significantly reduces environmental risk while weak demand increases these risks.

Introduction

Environmental contamination can potentially impact real estate by increasing the risks of providing mortgage loans secured by such properties. As explained by Jackson (1998), increases in these risks reduce the value of the contaminated property. In many cases, it is the perceptions of risk by lenders and other key market participants that underlie the effects on value. Accordingly, research focused on understanding how lenders perceive contamination related risks, which is essential to understanding how and under what conditions environmental contamination affects commercial and industrial real estate.

This research is directed at commercial and industrial properties. Much of the existing published research on the effects of contamination and other environmental disamenities on real estate has focused on residential properties. Income-producing commercial and industrial properties have different markets and different market participants than residential properties. The transactions are generally larger and the level of due diligence is typically higher than for residential properties. In addition, commercial and industrial properties are more likely to be the sources of contamination. Residential properties affected by contamination are not the source in many cases but may be impacted by their proximity to a contamination source.

Finally, this survey research specifies that the contamination to be considered is groundwater contamination. Contamination conveyed through groundwater is typically more difficult to measure and delineate than soil contamination. The specific constituents of groundwater contamination could be, and commonly are, petroleum hydrocarbons or chlorinated solvents. In the survey data analyzed in the following pages, the specific constituent was not identified. Thus, the results would apply to source site groundwater contamination generally.

Literature

There is a dearth of published scientific research concerning the perceptions of mortgage lenders as to the risks associated with environmental contamination. Undoubtedly, there are numerous unpublished surveys that focus on individual properties. However, these types of surveys have limited external validity, or a limited ability to generalize beyond the property under study. Some of the surveys reported in the professional literature share this characteristic. Their samples were not drawn to be representative of a broad population group, but rather are directed at a narrower group of respondents. Indeed, some of the survey research discussed below was not constructed to have significant external validity. However, these surveys provide valuable insight into the perceptions of lenders.

Healy and Healy (1992) offer the seminal article on lender perceptions of environmental issues and risks. They interviewed individual lenders from the twenty-five largest banks in the United States, the fifteen largest banks in California not among the previous group and the five largest foreign banks in the U.S. The Healys' survey dealt with different types of contamination, environmental due diligence requirements and the credit underwriting adjustments lenders would make to compensate for their perceptions of increased risks due to contamination. On the first issue, the lender respondents indicated that groundwater contamination (41%) was of greater concern than unencapsulated asbestos (14%), encapsulated asbestos (2%), toxic inventories (12%) and underground tanks (12%). In these questions, the Healys mix conveyances (groundwater) with sources (tanks) and do not specify individual contaminants (petroleum hydrocarbons, chlorinated solvents). As for the due diligence required by lenders in 1990, when the survey was taken, most of the domestic banks (72%) required a Phase I environmental assessment on all real estate loans.

In another series of questions, the Healys found that lenders were least likely to lend on properties with unencapsulated asbestos (36% would lend) and contiguous contamination (38%), but most likely to lend on properties with previous contamination (84%). There were about fifty-five respondents for these questions. As noted, other questions addressed adjustments to specific underwriting standards for contaminated properties. The most frequently selected adjustment (66%) was to require additional indemnifications, followed by personal guarantees (60%). For loan calculation criteria, 46% would lower the loan-to-value ratio, while only 21% would raise the interest rate. The Healy survey was limited in size and scope, but

provides an initial and important view of lender responses to environmental contamination issues.

In 1996, six years after the Healys' survey, Worzala and Kinnard (1997) conducted a survey on lender and investor reactions toward alternative sources and types of contamination. A total of sixty-nine responses was received out of 244 deliverable surveys mailed to a preselected, but not random, sample of lenders for a response rate of 28%. The survey revealed that lenders were least likely to lend on properties with groundwater contamination, followed by soil contamination and building contamination. Worzala and Kinnard also ask about properties ''known'' to be contaminated in certain ways and properties ''alleged'' to be contaminated. Their results did not show a clear pattern of avoidance of alleged versus known contamination. Perhaps other unknown variables, such as cleanup costs or remediation requirements, play a greater role if the contamination is known. Lastly, Worzala and Kinnard investigate lender perceptions concerning properties near (within 300 feet) sources of contamination, hazards and disamenities. For a contaminated groundwater plume, 1.8% of the lenders would lend, 7% would probably lend, 57.9% would maybe lend, 24.6% would probably not lend and 8.8% would not lend.

Subsequently, Bond, Kinnard, Worzala and Kapplin (1998) compare the results of the Worzala and Kinnard survey with lenders and investors in New Zealand. In Bond's New Zealand survey, twenty-one responses were received out of 136 lenders to whom surveys were mailed for a response rate of 15%. Some additional items are also reported. One of these is the frequency with which respondents had lent on contaminated property. In the 1996 U.S. sample, 85% had done so in the past. In the N.Z. sample, 45% had lent on contaminated properties, indicating mortgage funds for contaminated properties are more available in the U.S. than in N.Z.

Another survey approach was taken by Wilson and Alarcon (1997), who pre-screened a small sample of lenders and then provided them with detailed case studies of several hypothetical properties. Screening criteria include lending experience, specific experience with the property types being described and previous experience with contaminated property loans. Wilson and Alarcon then provide detailed information for the lenders to assess the risks of making a loan on a specific contaminated property. In general, more information should lead to less uncertainty and risk, everything else being equal. The results of the Wilson and Alarcon survey indicate that for the source properties described in their case studies, all five lenders would be willing to lend, and for non-source properties, seven out of eight would lend on the properties as described. This approach is also discussed by Bell (1999), who adds that such surveys should be designed so that no preconceived bias is projected in the questions being asked, and further that respondents be ''pre-qualified'' as to their knowledge and experience with the issue and property type under study.

Finally, although not directly dealing with environmental issues, another alternative survey methodology is used by Rabianski and Black (1999), who assess

the importance of various real estate concepts to practitioners and academics outside the U.S. and Canada. In the Rabianski and Black survey, a two-step Delphi process was used to, first, identify the most important topics and concepts and, second, to rank the relative importance of these concepts. In the first step, an open-ended questionnaire was used to identify topics and concepts of importance to the respondents. A total of sixty responses was received from 376 individuals to whom the questionnaires were mailed, for a 16% response rate. Fifty responses were received on the second, closed-ended, survey that asked respondents to rank the importance of the concepts and topics generated as a result of the first survey. Their low response rate may be indicative of difficulty or reluctance to answer open-ended questions. The survey questionnaire discussed below primarily contained closed-ended questions, but also provided opportunities for the respondent to indicate other responses that were not included in the listed response options. Where provided, the listed response options were developed on the basis of the review of other surveys on this topic, pre-testing of the questions, and on the underlying hypotheses and questions that structured the research.

Research Design and Data Collection

Research Questions

Two research questions derived from the literature and other sources are addressed. The first involves changes in the effect of contamination on risk perceptions over the remediation cycle. As a contaminated property is remediated, the level of perceived risk is likely to change. Three periods over the remediation cycle are identified for this purpose: (1) before remediation or cleanup, and without an approved cleanup plan; (2) during cleanup, with cleanup proceeding under a plan that has been approved by applicable regulatory authorities; and (3) after cleanup to applicable regulatory standards. Thus, the research question is whether lender perceptions of risk due to the environmental condition of a commercial or industrial property change over these three periods. The question assumes that any change over the remediation cycle would involve a reduction in additional lending and investment risk.

The second research question to be addressed involves the potential intervening effects of market conditions on lender risk perceptions before, during and after cleanup. The research hypothesis is that market conditions affect these perceptions, and that strong market conditions mitigate investment while lending risks while weak conditions exacerbate these risks. The null hypothesis is that market conditions have no effect. This question has not been directly addressed in any of the published survey research. However, strong market demand would logically support higher selling prices and increase property income. These effects would likely reduce default risk and increase debt coverage for the mortgage lender.

The research question, then, involves the extension of these effects as intervening factors mitigating or exacerbating contamination related risks perceived by lenders over the remediation cycle.

Data Collection

A national lender survey was undertaken to address these research questions. Questionnaires distributed to the potential respondents contained sets of question items designed to provided sufficient data to statistically test the research questions. The reliability of the results of the survey research is dependent on the scope and quality of the data collection process. Toward this end, a broad population of lenders was targeted and randomly sampled. The sampling process as well as the target population and sampling frames were structured to produce results representative of the appropriate populations of mortgage lenders that would encounter lending decisions on contaminated commercial and industrial properties.

Sample Selection

The target population for the lender survey is commercial and industrial mortgage lenders. This target population is part of the general population of lenders that are involved in all types of loans and banking activities. The unit of analysis is the individual lender, rather than the lending institution, under the assumption that the risk perceptions of the individual lender are the key to lending decisions on contaminated commercial and industrial properties. This is also consistent with other surveys on this topic such as those of Healy and Healy (1992) and Bond, Kinnard, Worzala and Kapplin (1998). In order to develop a sample of the target population of commercial and industrial mortgage lenders on a national basis, a sampling frame must be selected. Babbie (1990) discusses the sampling frame as "the actual list of sampling units from which the sample, or some stage of the sample, is selected." The sampling frame should be selected to be representative of the target population.

The Official Registrar for the American Bankers Association (ABA) Routing Number Administration Board is Thomson Financial Publishing (Thomson). Through this routing system, Thomson maintains an updated list of ABA members and, additionally, classifies these lenders by function, such as loan administration, legal, etc. The sampling frame for the lender survey was developed using two of these functional lender classifications: "mortgage loans" and "real estate." These functions were the most likely to identify members of the target population from among those in the ABA database maintained by Thomson. Accordingly, a search of the database by "mortgage loan and real estate function at bank head offices" produced a national sampling frame of 3,253 records. These records included mailing addresses, lender names, title, institution and phone numbers in a computerized data file suitable for input into a database management system.

The next step in the data collection process was to select individual lenders from the sampling frame. A simple random sampling procedure was used for this purpose. In this procedure, the lenders in the sampling frame were sorted by last names. After sorting, every seventh lender was selected in descending order. This single-stage sampling procedure produced a simple random sample of 465 names and related information. This type of sample is also referred to as a probability sample, with each element given an equal probability of selection (Kerlinger, 1992). The size of the sample and the sampling interval were based on resource considerations, as well as a rough approximation of the minimum size for estimating means of 50%, plus or minus 6%, at a 95% confidence level, as specified in Blalock (1979). The sample size approximation assumed a 50% response rate.

As noted, the survey questionnaire was developed to address the research hypotheses listed in the preceding chapter. A remaining sampling issue in the design of the survey dealt with the selection of respondents involved with lending on commercial and industrial properties. The sampling frame, discussed above, specified lender functional classifications of mortgage loans or real estate, presumably including lenders specializing in all property types, including residential. To target only commercial and industrial lenders, the cover letter accompanying the survey as well as the cover of the questionnaire included instructions that if the respondent to whom the questionnaire was mailed was ''not responsible for evaluating loans on commercial and industrial properties, please give the questionnaire to the individual who would normally evaluate these loans.''

Finally, a preliminary version of the questionnaire was pretested with several lenders from the Bryan/College Station, Texas area in early September 1999. After completing the questionnaires, the lenders were interviewed as to the clarity of the questions and the time required to complete all of the items. The questionnaire was slightly reformatted as a result. The questionnaire, cover letter and survey protocol were reviewed and approved by the Texas A&M University Institutional Review Board. The approved protocol included requirements for the strict maintenance of the confidentiality of the identities of the survey respondents.

Implementation and Response. The procedure for implementing the lender survey involved two mailings as well as follow-up reminder cards. Prior to the first mailing, addresses were verified through a bulk mailing service. Twelve undeliverable addresses were identified. For the remaining 453 lenders, questionnaires and cover letters were mailed on September 27, 1999. Reminder cards were mailed on October 9, 1999. A second wave of questionnaires was mailed to the 340 lenders who had not yet responded on November 2, 1999. A second set of reminder cards was sent on November 20, 1999.

The first wave of the lender survey, mailed to 453 potential respondents, eventually produced usable responses from 145 lenders, for a response rate of 32.0%. The second wave of questionnaires, mailed to 340 lenders, produced 93 usable responses, for a response rate of 27.4%. Accordingly, with a net sample size of

453 lenders with deliverable addresses and 238 total usable responses, the overall lender survey response rate was 52.5%. Excluding the undeliverable questionnaires from the response rate calculation is consistent with procedures outlined by Babbie (1990). The response rate goal for the survey was 50%, which is considered adequate for a scientific, probability-based sample survey.

Survey Data Analysis

Background of Survey Respondents

Background information on the lender respondents is summarized in Exhibit 1. As can be seen, most of the respondents were senior lenders with substantial experience. More than 90% of the respondents are bank presidents or vice presidents involved with commercial real estate lending. The respondents have an average of 18.7 years of lending experience. In addition, the banks represented by each of the 238 lenders had made an average of 59.2 loans in the preceding year on commercial and industrial properties. Thus, these are experienced and senior lenders that actively make loans on commercial and industrial properties, and would be representative of the target population for this study.

Exhibit 1 | Lender Survey Respondents Background Information

	n	%
President	15	6.4
Senior / Executive Vice President	88	37.8
Vice President	94	40.3
Associate / Assistant Vice President	13	5.6
Loan Officer	14	6.0
Other	9	3.9
Totals	233	100.0
Years of lending experience	18.7	
Number of loans on industrial or commercial properties in last 12 months by lending institution of respondent	59.2	
Involved with loan application for commercial or industrial property with environmental problems	176	73.9
Extended the loan	92	52.3

Note: Five missing responses on job title out of 238 total lender respondents.

The survey also asked about specific experience with contaminated property loans. Approximately 74% of this nationally representative sample of lenders indicated that they had been involved with a loan on a contaminated commercial or industrial property. Further, these lenders had provided a loan 52.3% of the time.

Effects of Remediation Status on Risk Perceptions

In the lender survey questionnaire, several preconditions were presented to potential respondents before any specific questions on risk perceptions. These preconditions were that: the borrower was creditworthy; the reference property was an income generating commercial or industrial property; and the contamination referred to was groundwater contamination. Specifying a type of groundwater contamination such as petroleum hydrocarbons or chlorinated solvents was considered but not used because of concerns about the length and complexity of the mail questionnaire. In addition to the other preconditions, the respondent was asked to assume that the groundwater contamination originated at the reference property, which would be considered the source site.

Exhibit 2 presents detailed results of the survey questions on the risk perceptions of lenders with respect to contaminated commercial and industrial real estate, generally and over the remediation cycle. As can be seen, there are three risk levels: normal lending risks (loan made at typical rates, terms, etc.); higher than normal lending risk (loan made but with adjustments to rates, terms, etc.); and very high lending risk (loan would not be made due to environmental risk).

The survey results indicate that before cleanup, and without an approved remediation plan, 93.2% of the lenders would not provide a mortgage loan due to excessive environmental risk. During cleanup, with the cleanup proceeding under an approved plan, this decreases to 39.4%, and over half, or 54.2%, would make a loan, but would make adjustments to the mortgage terms and conditions. Another 6.4% would make a loan without any adjustments. Thus, once the remediation plan has been approved by the appropriate regulatory authority and cleanup has begun, more than 60% of the lenders would provide a mortgage loan on a contaminated source site commercial or industrial property. From another perspective, such a property could be considered unmortgageable or unfinanceable prior to remediation, but mortgageable with some adjustments to loan terms and conditions once remediation has begun. Lastly, by the time the remediation has been completed, nearly all of the lenders, or 95.8%, would provide a loan, with most, or 65.3%, providing a loan with no adjustments to typical rates, terms and conditions. The Healy and Healy (1992) survey of lenders in 1990 found that 84% would lend on previously contaminated property, in comparison to 95.8% in this 1999 survey.

The research question analyzed in Exhibit 2 is whether remediation status affects lender risk perceptions. The corresponding null hypothesis is that remediation status does not affect the perceived level of lending risk. Using the non-parametric

Exhibit 2 | Effects of Remediation Status on Lender Risk Perceptions

	Before Cleanup and Without an Approved Remediation Plan	During Cleanup, with Cleanup Proceeding under an Approved Plan	After Cleanup to Applicable Regulatory Standards
Normal level of lending risk (mortgage loan provided at typical amount, rate, amortization, term, conditions)	1.3% (±1.4%)	6.4% (±3.1%)	65.3% (±6.1%)
Higher than normal lending risk (mortgage loan provided at typical amount, rate, amortization, term, conditions)	5.5% (±2.9%)	54.2% (±6.4%)	30.5% (±5.9%)
Very high lending risk (mortgage loan would not be provided due to excessive environmental risk)	93.2% (±3.2%)	39.4% (±6.2%)	4.2% (±2.6%)
Total Percent	100	100	100

Note: 95% confidence interval shown below each parameter estimate. Kruskal-Wallis Test using Wilcoxon scores: Chi-Square = 430.39 (*p*-value = .001). Number of responses = 236.

Analysis of Variance: Among Mean Square (Cleanup Status): 140.485
　　　　　　　　　　　　　　Within Mean Square (Error): 0.258
　　　　　　　　　　　　　　F-value: 544.516
　　　　　　　　　　　　　　p-value: .001

Kendall's tau$_b$ correlation coefficient = −0.73 (*p*-value = .001)

Kruskal-Wallis test, with Wilcoxon rank sum scores, the null hypothesis can be rejected at the .001 level based on the chi-square test statistic of 430.39, with a *p*-value of .001. In addition, an analysis of variance, with the three risk levels given values of 1, 2 and 3 results in a *F*-value of 544.52, which is also significant at the 0.001 level, and provides further statistical support for the research hypothesis that cleanup status affects lender risk perceptions. Thus, while not testing direction, these two statistics indicate that remediation status has a statistically significant effect on lender risk perceptions for a contaminated commercial or industrial property.

The direction of the relationship depicted in Exhibit 2 is tested through the Kendall's tau$_b$ correlation coefficient. This statistic is estimated at -0.73, which is also significant at the .001 level and indicates the extent of a linear relationship along the main diagonal, from lower left to upper right, of the table in Exhibit 2. The negative sign of the correlation coefficient indicates that a scale of before, during and after cleanup is negatively correlated with a scale of normal, higher and very high lending risk. In other words, the correlation coefficient can be interpreted as confirming the statistical significance of the assumption made earlier

that the very high perceived lending risk indicated before remediation decreases to higher than normal lending risk during remediation and then to normal lending risk after cleanup is completed.

Adjustments to Lending Criteria

In the preceding analysis, the middle level of lender risk was defined as ''a mortgage loan provided with adjustments to amount, rate, term or conditions.'' This level of risk was selected by over half of the lenders as appropriate for contaminated commercial and industrial properties during cleanup. Exhibit 3 presents eight potential adjustments in rank order to more specifically identify what specific adjustments would be made by lenders to compensate for the increased risks. As can be seen, the adjustment most frequently selected, by a large margin, was to decrease the loan-to-value ratio, followed by requiring remediation costs to be placed in escrow, additional collateral and indemnifications. Lenders could select more than one adjustment, and may indeed require some combination of adjustments to compensate for the additional perceived lending risks.

The adjustments listed above can be compared to those discussed by Healy and Healy (1992) in their 1990 lender survey. For loan criteria, they found that 46% would lower loan-to-value ratio and 21% would increase the interest rate. This compares to 65% reducing the loan-to-value ratio and 40% increasing the interest

Exhibit 3 | Adjustments for Increased Lending Risks Due to Environmental Contamination

	%	n
Decrease the loan-to-value ratio (or loan amount)	65.1	155
Require estimated remediation costs to be placed in escrow until cleanup is complete	52.7	125
Require additional collateral	49.6	118
Require indemnifications from a financially responsible third party against all future costs of remediation	46.8	111
Increase interest rate	40.3	96
Reduce loan maturity / term	21.4	51
Reduce loan amortization period	18.1	43
Would either deny loan or make it without adjustments	14.7	35

Note: Percentages do not sum to 100% since more than one adjustment was selected in many cases. Responses from 238 lenders. One missing response each for increase escrow and require indemnifications, so percentages for these alternatives are based on 236 cases.

rate in this 1999 survey, as well as a higher percentage willing to lend on contaminated property in 1999.

Effect of Adjustments to Lending Criteria on Property Value

Many of the lending adjustments in Exhibit 3 have the effect of lowering the overall value of the contaminated property. As can be seen, the most frequently selected lending adjustment to compensate for increased environmental risk, indicated by 65.1% of the respondents, is a reduction in the loan-to-value ratio. The effect of lowering the loan-to-value ratio for income producing property is usually tantamount to lowering its value. This can be seen though the application of mortgage-equity analysis. Mortgage-equity analysis has been traditionally accomplished through the general mortgage-equity, or Ellwood, formula. However, this approach has the disadvantage of accommodating only a limited number of income and value change patterns. Jackson (1998) presents a modified format that addresses these limitations. Jackson's format incorporates elements of the Ellwood formula in a discounted cash flow (DCF) analysis.

The effect of the loan-to-value and other lending adjustments can be discussed with reference to the following mortgage-equity formulae in a DCF framework, using standard appraisal nomenclature, and as illustrated by Brueggeman and Fisher (1997):

$$V_O = V_M + V_E, \tag{1}$$

$$V_E = \sum (BTCF_i)/(1 + Y_E)^i + (BTER_n)/(1 + Y_E)^n, \tag{2}$$

$$V_M = \sum (DS_i)/(1 + Y_M)^i + (MB_n)/(1 + Y_M)^n, \tag{3}$$

where:

V_O = Overall property value;
V_M = Value of the mortgage interest;
V_E = Value of the equity interest;
$BTCF_i$ = Before tax cash flow per annual period i of the investment period n;
Y_E = Equity yield rate;
$BTER_n$ = Before tax equity reversion at the end of the holding period n;
DS_i = Mortgage debt service per annual period i;
Y_M = Mortgage yield rate; and
MB_n = Mortgage balance at the end of the holding period n.

As illustrated in Equation (1), a reduced mortgage component (V_M) will, by definition, reduce the overall property value (V_O). Moreover, assuming that the property's overall cash flow is not reduced as a result of the contamination, and

assuming that Y_E is greater than Y_M, then the value of the property (V_O) would decrease as a result of a lowered loan-to-value ratio, since a greater proportion of the property's cash flow would be discounted to present value at the relatively higher Y_E. In addition, the mortgage cash flow (DS_i and MB_n) could be discounted at an adjusted Y_M, increased by a risk premium corresponding to the additional uncertainty associated with the property's environmental condition, as perceived by the mortgage lender. This adjustment was selected by 21.4% of the lender survey respondents, as shown in Exhibit 3. Lastly, the application of these adjustments and their impact on property value will vary by the levels of risk perceived by mortgage lenders before, during and after cleanup, as depicted in Exhibit 2. Indeed, changes in property value over the remediation cycle provide an incentive for investing in contaminated properties (Jackson, 1997).

Effects of Market Conditions on Lender Risk Perceptions

As noted, the second major research question involves the potential intervening effects of general market conditions on the perceptions of risk due to environmental contamination. Accordingly, an appropriate test of this question would involve an analysis of the significance of any changes in perceived contamination related risks due to stronger or weaker market conditions. Further, since the preceding analyses have demonstrated the effect of the remediation status of the property on risk perceptions, this variable should be accounted for in the market conditions analysis.

In measuring the intervening effect of market conditions, a series of survey questions asked respondents if *strong/weak market demand for similar properties in the general market area would reduce/not effect/increase the risks of providing a mortgage loan*. The questions specified were asked in the before, during and after cleanup conditions. Thus, there were six questions: strong and weak market in the before, during and after conditions. Unlike the previous sets of questions, which focused on whether a loan would be provided, the questions on market conditions more simply asked if strong or weak market demand for similar properties would increase, not affect or reduce lending risk. All of the aforementioned pre-conditions were maintained (income-producing commercial or industrial property, groundwater contamination, source site and creditworthy borrower).

Exhibit 4 presents an analysis of the survey results on the effects of strong market conditions on lender risk perceptions. To test the research hypothesis that market conditions affect lender risk perceptions, and the null hypothesis that they have no effect, a scale was constructed, with a score of zero for no effect, a score of minus one for risk reduction and a score of one if the respondent believed the market condition increased lending risks. A *t*-Statistic and corresponding *p*-value were then calculated for the mean scale score for each market condition.

As can be seen in Exhibit 4, the mean scale score for strong market conditions before cleanup is not statistically different from zero, and the null hypothesis

Exhibit 4 | Effects of Strong Market Demand on Lender Risk Perceptions

	Before Cleanup	During Cleanup	After Cleanup
Reduce risks of providing a mortgage loan, scale = −1	10.9% (n = 26)	24.4% (n = 58)	61.9% (n = 146)
Not affect risks of providing a mortgage loan, Scale = 0	77.3% (n = 184)	64.3% (n = 153)	33.9% (n = 80)
Increase the risks of providing a mortgage loan, scale = 1	11.8% (n = 28)	11.3% (n = 27)	4.2% (n = 10)
Total percent	100	100	100
Total responses	(n = 238)	(n = 238)	(n = 236)
Mean scale score	−0.01	−0.13	−0.58
t-Statistic for effect of market conditions (H$_0$: mean scale score = 0)	−0.27	−3.44	−15.40
p-value	.786	.001	.001

Note: Strong market demand for similar properties in the general market area.

cannot be rejected. In other words, strong market conditions have no effect on lender risk perceptions relative to a contaminated property before cleanup. However, the mean scale score for the effect of strong market demand on lender risk perceptions is −0.13, indicating that under these market conditions lender risk is reduced. The corresponding t-Statistic is −3.44, which is significant at the .001 level. After cleanup, strong market conditions have the greatest effect in reducing lending risks, as indicated by the mean scale score of −0.58, which is also significant at the .001 level. Thus, although strong demand had no effect on risk perceptions in the before cleanup condition with a mean score of −0.01, these conditions have a statistically significant intervening effect on lender risk perceptions during and after cleanup, with the greatest risk mitigating effect after cleanup of previous contamination to applicable regulatory standards. Accordingly, remaining lender reluctance to loan on previously contaminated property could be additionally reduced or mitigated by strong general market conditions.

Exhibit 5 presents the same analysis, but for the contaminated commercial or industrial property during cleanup. In the before condition, the mean scale score of 0.61 and the t-Statistic of 18.33 (p-value of .001) indicate that weak market conditions significantly exacerbate lender risk, and that the null hypothesis can be rejected for this scenario. Further, weak market conditions have a statistically significant effect on lender risk perceptions in the during and after conditions, and given the positive signs and magnitude of the mean scores there is strong statistical evidence to conclude that weak market conditions significantly increase lender risk perceptions before, during and after cleanup.

Exhibit 5 | Effects of Weak Market Demand on Lender Risk Perceptions

	Before Cleanup	During Cleanup	After Cleanup
Reduce the risks of providing a mortgage loan, scale $= -1$	1.3% (n = 3)	3.4% (n = 8)	7.6% (n = 18)
Not affect the risks of providing a mortgage loan, scale $= 0$	36.3% (n = 86)	35.7% (n = 85)	39.5% (n = 94)
Increase the risks of providing a mortgage loan, scale $= 1$	62.4% (n = 148)	60.9% (n = 145)	52.9% (n = 126)
Total percent	100%	100%	100%
Total responses	(n = 237)	(n = 238)	(n = 238)
Mean Scale Score	0.61	0.58	0.45
t-Statistic for effect of market conditions (H_o: mean scale score $= 0$)	18.33	15.88	11.06
p-value	.001	.001	.001

Note: Weak market demand for similar properties in the general market area.

Lastly, Exhibit 6 summarizes the analysis of the intervening effects of market conditions on lender risk perceptions. The table presents the mean scale scores and t-statistics for each of the six scenarios. The summary shows the relative increase in the risk mitigating effects of strong market conditions over the remediation cycle, with increases in absolute values from an insignificant -0.01 in the before condition to -0.58, with a t-Statistic of -15.40, in the after

Exhibit 6 | Summary of Intervening Effects of Market Conditions on Lender Risk Perceptions

	Strong Market Demand	Weak Market Demand
Before cleanup	−0.01 (−0.27)	0.61 (18.33)
During cleanup	−0.13 (−3.44)	0.58 (15.88)
After cleanup	−0.58 (−15.40)	0.45 (11.06)

Note: Mean scale scores vary from -1.00 (strongest risk reduction) to 1.00 (strongest risk increase). t-Statistics are in parentheses.

condition. On the other hand, weak market conditions have a strong and statistically significant adverse effect on lender risk across the remediation cycle. There does appear to be some decrease in the risk exacerbating effect, though, as the mean scale score decreases from 0.61 in the before condition, to 0.45 in the after condition. The statistical summary also shows that except for the after condition, weak market conditions have a greater effect in absolute terms on lender risk than strong market conditions.

In conclusion, market conditions, as reflected by strong and weak market demand, in nearly all tests had a significant effect on lender risk perceptions with respect to contaminated commercial and industrial real estate. Of the six statistical tests of strong and weak conditions, before, during and after cleanup, the null hypothesis of no effect was rejected at the .001 level five times. The only scenario under which lender perceptions were unaffected was before cleanup with strong market demand. In addition to concluding that there is a significant effect, the analysis provides strong statistical evidence indicating that strong market demand reduces, or mitigates, lender risk and weak market demand increases, or exacerbates, lender risk. This was indicated by the direction of the relationships in all six scenarios, with five of the six significant at the .001 level.

Conclusion

Effects of Remediation Status on Risk Perceptions

In the analysis of the effects of remediation status on lender risk perceptions presented in Exhibit 2, the survey responses indicated that 93.2% of the lenders would not provide a mortgage loan on a contaminated commercial or industrial property before cleanup and without an approved remediation plan. The lenders were asked to assume that the hypothetical borrower was creditworthy. In the period during cleanup the majority, or 54.3%, of the lenders would make a loan but would make adjustments to the terms and conditions of the loan. The most frequently cited adjustment was to decrease the loan-to-value ratio. Through income capitalization formula presented herein, this adjustment would typically reduce the value of the property. For the period after cleanup, 65.3% of the lenders would make a loan without adjustment. The statistical significance of these changes was tested in various methods, and each was determined to be significant at the .001 level. Thus, the null hypothesis was rejected in favor of the research hypothesis that remediation status affects these perceptions.

Effects of Market Conditions on Risk Perceptions

The effects of market conditions on risk perceptions were addressed through a series of scenarios in the survey questionnaires in which the lender and investor respondents indicated whether strong and weak market demand in the general

market area would increase, decrease or not affect investment and lending risks for contaminated commercial and industrial properties before, during and after cleanup. In general, strong market conditions were found to reduce these risks while weak market conditions were found to increase risks.

More specifically, the lender survey revealed that of the six combinations of the two market conditions and the three types of environmental remediation status, the risk dampening effect of strong market conditions was found to be statistically significant in five combinations. The only scenario in which strong market conditions did not significantly reduce lending risks was for contaminated properties before remediation. In this situation, the effect of strong market demand was not significantly different from zero and the null hypothesis could not be rejected in favor of the research hypothesis. In the other five scenarios, the null hypothesis was rejected at the 0.001 level of significance. Alternatively, the statistical analysis indicated that strong conditions significantly decreased the risk of lending on contaminated property during and after cleanup and weak market conditions increased these risks before, during and after cleanup.

Implications of this Research

This research has focused on the risk perceptions related to environmental contamination before, during and after cleanup, and the intervening effects of general market conditions. Risk can reduce property value and loan collateral through increases in required rates of return. These effects are related to, but not the same as, reductions in market value from direct costs for remediation that are deducted from property cash flows. Uncertainties about these future expenditures create risk for the investor and the lender. As cleanup is completed and regulatory compliance is achieved these uncertainties are diminished and the risk perceptions of mortgage lenders approach levels consistent with the property's non-environmental risk profile.

The importance of this research is that it quantifies, through formal survey research using a statistically representative national sample of commercial and industrial mortgage lenders, the precise changes in lender risk perceptions for source site, income-producing contaminated and previously contaminated real estate over the remediation cycle. Other surveys reviewed herein were not based on probability sampling and were not intended to achieve comparable levels of inference. The results of the research reported herein can serve as important benchmarks for the valuation and analysis of environmentally impacted commercial and industrial real estate. The changes in lender risk perceptions and the probabilities of obtaining a mortgage loan under varying environmental conditions directly affects market value and loan collateral. Indeed, the benchmark risk measurements presented in Exhibit 2 can be interpreted as a probability function for obtaining or not obtaining financing for the property types and environmental conditions that are the subject of this study. These probabilities could establish a benchmark range of value effects through the mortgage-equity framework previously presented.

In addition, the findings of this research also have several implications for mortgage lending practices and policies with respect to contaminated and previously contaminated properties, as related to the significant change in risk over the remediation cycle. As mortgage lenders increasingly consider loans for environmentally impacted properties, underwriting can be more precisely tailored to the appropriate risk levels, and duration of these levels. Adjusting the loan-to-value ratio may not adequately compensate for the increased risk due to contamination for properties financed before and during cleanup, but may over compensate for the property's risk after remediation. Indeed, in situations where the mortgage yield exceeds equity yield, loan-to-value reductions may have the opposite effect. In these situations, a risk premium added to the mortgage yield rate could provide a more appropriate adjustment. Further, while most loans are structured with constant interest rates over their term, variable risk pricing based on changes in the property's risk profile may provide appropriate adjustments. Mortgage interest rate risk premiums could be adjusted as the property moves through the remediation cycle, and may provide the lender with a more precise and efficient approach to adjusting for the increased but changing risks associated with environmental contamination.

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