The Impact of Toxic Waste Sites on Housing Values[1]

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This paper analyzes the impact of the Environmental Protection Agency (EPA) announcements and policy actions on housing markets. When the EPA announces that a toxic waste site is on the Superfund list, the findings of this paper show that a new market for "safe" housing is created. A premium to be located farther from a waste site appears only after a site has been added to the Superfund list. Empirical analysis of the housing market calculates the marginal prices in this new market, and importantly, show that the marginal price to avoid a toxic waste site disappears after a site has been cleaned. © 1991 Academic Press, Inc.

1. INTRODUCTION

Dangerous toxic waste dumps still exist across the United States, the remnants of past practices of freely dumping toxic wastes. To deal with the environmental hazard[2] that these often abandoned dumps cause, Superfund legislation was passed in 1980 creating the impetus for a major environmental cleanup effort. The Environmental Protection Agency (EPA) began its cooperative arrangement with state agencies to identify and classify fixed location hazardous waste sites across the United States in 1981. As of June 1986, the EPA had inventoried over 24,000 uncontrolled hazardous waste sites. Only the most toxic 703 "final" sites on the National Priorities List (NPL) are eligible for Superfund dollars. National attention and publicity has been focused on these 703 NPL sites. An-

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[2]Contaminants in these toxic waste sites often pose hazards that can lead to increased risks of cancer and adverse effects on reproduction.

nouncements by the EPA that a toxic waste site has been added to the NPL have an important impact on the public's perceptions of the dangers associated with existing sites.

This paper investigates the effect of publicity surrounding toxic waste sites on local housing markets. The paper explores whether the EPA generates new information of value to consumers by the addition of sites to its NPL. The EPA announcements could potentially have several impacts on consumer expectations about future environmental quality. Negligible impact on consumer behavior would occur if consumers already knew of the potential health hazards associated with toxic waste sites. A positive effect on consumer behavior would occur if consumers expected an environmental improvement in the near future. A negative impact is likely if consumers were for the first time alerted to the health hazards and expected no cleanup effort in the near future. This research provides a framework to test the hypotheses by examining Houston's housing market over the 10-year period 1976–1985.

The major finding in this paper is that the EPA announcements created a new market for "safe" housing. A significant discount in the price of homes located close to toxic waste dumps is found only after the sites have been identified and publicized by the EPA. Despite the efficacy of the market, the market appears to be imperfect. Consumers of housing are not able to differentiate between degrees of toxicity of the sites. Nonetheless, preliminary evidence implies that the negative price effect is reversible; once a toxic site has been cleaned the deleterious effect on housing prices seems to vanish.

The new market also creates important distributional effects on current and future homeowners. Existing homeowners located close to a toxic site experience a sudden decline in home values when the EPA adds the site to its NPL. Future homeowners, who buy after the announcement, may later reap an unexpected reward when the site is cleaned.

2. NPL SITES IN HOUSTON

Housing sales in Houston's Harris County 1976–1985 are used to examine the EPA announcement effects. Harris County contains 10 sites on the NPL (Table 1) and is one of the most toxic urban counties in the United States. The waste sites vary considerably in their actual and perceived toxicity and in their treatment by the EPA. Four of the sites rank in the worst 5% in the nation. Significant to the research presented here, all of the Harris County sites were operated in the 1960s and 1970s, and four into the 1980s. Many sites are close to large residential developments. Consumers thus may have known about dumping at these sites even before the EPA announcements.

Table 2 details the variation in toxicity of the 10 Harris County sites on the NPL as of June 1986. In general a site is placed on the NPL and assigned a rank according to its score based on the Hazardous Ranking System (HRS).[3] The HRS score is an indicator of the degree of health and environmental risk associated with a particular site. The Crystal, Geneva, Sikes, and French sites rank among the worst 5% of the sites in the nation as signified by NPL numbers ranging from 22 to 37. Two, Harris–Farley (number 538) and Sol–Lynn (Group 8), are near the bottom of the NPL ordering.

Despite the variation in the environmental risk between the sites, all are hazardous. EPA and state investigations (EPA [20–23], Texas Water Commission [17]) report the circumstances and extent of contamination at each Harris County site. Most of the toxic sites were used as waste disposal dumps by manufacturing plants located on the site. For example, wood treatment facilities were located on both Cavalcade sites, a metal reworking plant was located at Sol–Lynn, and an herbicide plant was operated at Crystal. Only three of the sites were solely operated as waste disposal pits: Harris–Farley, Highlands, and French. The common practice at all sites was to dispose of toxic substances directly into landfills or in metal drums. The French and Highlands sites also stored pollutants in waste ponds and reservoirs. As a consequence of the unsafe storage practices, all sites show significant contamination of ground water, surface water, soil, and in some cases air. Perhaps most important from a public policy point of view is the nearness of the sites to sources of public water supply. Drinking water wells are within 2500 feet of each site.

There are two dimensions by which EPA treatment varies among the sites. One is the eligibility for funds and the second is the cleanup that sites have already received. Two categories of sites are distinguished on the NPL, those designated as being "final" and those designated as being in "proposed" status. Eight of the Harris County sites are final and two

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[3]The NPL has existed since 1983 (with preliminary lists issued in 1981 and 1982) and is updated annually. Sites are initially proposed and go through a public comment period before being promulgated to final status. During the time period of this study (1976–1985) the relevant rules for site designation come under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). CERCLA established a $1.6 billion trust fund to pay costs for corrective actions (long term "remedial action") not assumed by responsible parties. Sites can be designated on the NPL if any of several criteria are satisfied: 1) state government designation as a "top priority" site 2) the site scores a minimum of 28.50 in the HRS or 3) The Department of Health and Human Services has issued a health advisory that recommends removing people from the site, EPA agrees and EPA views its remedial authority under Superfund to be more cost-effective than its removal authority. The toxic waste sites in Harris County have HRS ranging from a low of 33.94 (Harris–Farley) to a high of 69.83 (French). The highest score on the NPL as of June 1986 was 75.60 (Limpari Landfill, New Jersey). For further information see EPA [20, 23].

TABLE 1
Hazardous Waste Sites[a] in Major U.S. Cities, June 1986

| City (and main county) | Number of sites on National Priorities List in main county | | | |
| | Final | | Proposed | Total |
	All sites	Sites rank 1–350 on NPL		
Baltimore (Baltimore)	1	(0)	0	1
Boston (Suffolk)	0	—	0	0
Chicago (Cook)	0	—	4	4
Columbus (Franklin)	4	(0)	0	4
Dallas (Dallas)	1	(0)	0	1
Detroit (Wayne)	0	—	0	0
HOUSTON (HARRIS)	8	(4)	2	10
Indianapolis (Marian)	1	(0)	1	2
Jacksonville (Duval)	3	(1)	0	3
Los Angeles (Los Angeles)	8	(5)	1	9
Memphis (Shelley)	1	(1)	0	1
Milwaukee (Milwaukee)	1	(0)	0	1
Newark (Essex)	4	(2)	0	4
New York City (New York)	0	—	0	0
Philadelphia (Philadelphia)	1	(0)	0	1
Phoenix (Maricopa)	3	(3)	2	5
San Antonio (Bexar)	0	—	0	0
San Francisco (San Francisco)	0	—	0	0
San Diego (Dan Diego)	0	—	0	0
San Jose (Santa Clara)	6	(0)	12	18
Washington, D.C.	0	—	0	0

Note. Computed from [20, pp. 50–93].
[a]As of June 1986 703 final sites were ranked (1 = worst) on the NPL list, 185 sites were in proposed status for a total of 888 NPL sites.

are proposed, as of June 1986. Only final sites are eligible for Superfund dollars to finance further investigation and cleanup. Proposed sites are not eligible for federal cleanup dollars and are undergoing a period of public comment and continuing investigation of HRS scores. The announcement date of being on the NPL (either final or proposed status) therefore marks the beginning of a concerted effort by federal and state governments to disseminate information concerning the sites.[4]

[4]Information about toxic waste sites on the NPL is disseminated to the public through government sponsored press releases and a series of public information meetings. Detailed government reports on the NPL sites are also available at public and university libraries or directly from the EPA or (in Texas) from the Texas Water Commission. The federal and state agencies also employ community relations officers to oversee information availability.

TABLE 2

Characteristics of Toxic Waste in Houston (Harris County)

| Site | National Priorities List | | | Comments[c] |
	Status[a] June 1986	Rank[b] June 1986	Date announced	
Brio	P	Group 4	10-84	56-acre site; pollutants include copper, vinyl chloride, fluorene, styrene, ethyl benzene; water well 2500 ft.
Crystal	F	34	7-82	5-acre site; arsenic contamination; emergency capping of site with clay late 1982; water well 300 ft.
French	F	22	10-81	22-acre site; pollutants include heavy metals, phenols, PCBs, oil, grease, acids, solvents; located within 100-year flood plain of San Jacinto River, emergency capping; water well 1500 ft.
Geneva	F	37	9-83	13-acre site; pollutants include PCB, vinyl chloride, asbestos insulation; emergency capping of site with clay late 1982; water well 900 ft.
Harris–Farley	F	538	7-82	2-acre site; pollutants include styrene tars and its degradation products; Dow Chemical began clean-up in 1984; water well on site.
Highlands	F	424	7-82	6-acre site on peninsula in San Jacinto River; pollutants include heavy metals and organic compounds; subsidence and prone to flooding; water well 2000 ft.
North Cavalcade	F	440	10-84	23-acre site; main pollutant creosote; water well 200 feet.
Sikes	F	30	10-81	25-acre site; chemiwastes from petrochemical plants including metals, VOCs; portions lie within 10-year flood plain of San Jacinto River; water well 1750 ft.
South Cavalcade	F	391	10-84	46-acre site; pollutants include polynucleor aromatic compounds associated with creosote, benzopyrene, chrysene, fluoranthene, anthracene; water well 1500 ft.
Sol–Lynn	P	Group 8	10-84	1-acre site; pollutants include trichloroethylene (TCE) and polychlorinated biphenyls (PCBs); water well on site.

Note. References [17, 22].

[a]P = proposed, F = final.

[b]As of June 1986, 703 final sites were ranked from 1 to 703 (1 = worst), 185 proposed sites were ranked in Groups 1–15 (group 1 = worst). 888 total NPL sites existed.

[c]Contamination of soil, water, groundwater, and (sometimes) air (except Harris–Farley), where only soil contamination has occurred. TCE—trichloroethylene, PCBs—polychlorinated biphenyls, VOC—volatile organic compounds.

Second, only three of the toxic sites received any on-site treatment during the period of the study. Both Crystal and Geneva received emergency temporary treatment by the EPA in 1982 whereby the sites were capped by a thin layer of clay. No actual cleanup was attempted. However, for the Harris–Farley site a cooperative cleanup arrangement was established with a private firm. In early 1984 Dow Chemical began cleaning the site.

The variety in the levels of toxicity and treatments of the toxic sites therefore provides a significant source of variation and allows a full study of whether a new market for safe housing was created by the EPA announcements. Importantly, the framework provided here allows the timing issue to be examined in detail and the impact of the EPA announcements to be ascertained.

3. HOUSING MARKET VALUES AND INFORMATION

The role of the EPA announcements in the dissemination of information about health hazards is examined in a hedonic framework. The hedonic framework (Rosen [13], Freeman [5], Follain and Jimenez [4]) allows the estimation of the effects of various characteristics on housing prices. An important aspect of the analysis is the evaluation of the marginal price of distance from toxic sites and its examination of how marginal prices change as the EPA varies its activities.

The potential health hazard of a given toxic site is presumably reflected in its ranking on the NPL list. Yet the expectations and interpretations of the rankings by consumers translate the potential hazards into potentially depressed housing values. If information is absent or consumers ignore EPA warnings, housing prices should be unaffected by proximity to toxic waste sites. However, if EPA warnings and subsequent publicity affect consumers, housing prices should reflect a location premium that increases with distance at a decreasing rate only after the warnings are issued. This is true only if the EPA has provided new information not previously available or publicized. The spatial extent of the disamenity may or may not reflect the spatial extent of the real health hazard depending on consumers' perceptions. Consumers' anxiety may imply that the attenuation of the disamenity occurs several miles from a site. Mild concern may translate into a maximum distance effect of only a few hundred feet.

Housing prices are hypothesized to be a function of the proximity to toxic waste sites, housing characteristics, neighborhood and location characteristics, and time of sale. The hedonic equation can be expressed in semi-log form as

$$\ln(\text{PRI}) = a + b\text{TOXIC} + c\text{TOXICSQ} + d\text{HOUSE}$$
$$+ e\text{NEIGHBOR} + f\text{TIME} + u, \tag{1}$$

where

   ln(PRI) is the natural log of house price

   TOXIC is the distance in miles to the nearest toxic waste site

   HOUSE is a vector of housing characteristics (see Table 3 for the variable list)

   NEIGHBOR is a vector of neighborhood and location characteristics (see Table 3 for the variable list)

   TIME is a vector of quarterly time period dummies

   u is an additive error term.

The variables of importance to this study are the proximity to a toxic waste site, TOXIC and its square TOXICSQ. If the market views closeness to a toxic site as a disamenity, the disamenity should be capitalized into the house price (Freeman [5]). The quadratic formulation allows a nonlinear price–distance relation and the computation of a range for the perceived effect of TOXIC on house values. Under the disamenity interpretation, a positive coefficient on TOXIC and a negative coefficient on TOXICSQ are expected to reflect a location premium that decreases with distance at a decreasing rate.

   Yet the aforementioned pattern may not hold depending on the perceptions and expectations of consumers. By examining over time the sign and magnitude of the TOXIC coefficients (and the marginal price of TOXIC) different hypotheses about the role of information can be distinguished. To control for perceptions of the noxious attributes of the toxic waste sites three time periods are examined, two before the EPA announcements and one after the EPA announcements. In 1976 most sites were operating with little or no publicity about their potential health hazard. The NPL did not yet exist, and if any regulation prevailed it came solely through the Texas Department of Water Resources. Environmental awareness about the dangers of fixed location toxic sites in Houston in 1976 was almost non-existent. By 1980 the story started to change. The Superfund legislation had been passed and the awareness of the EPA's ensuing role in environmental cleanup was being widely publicized. Thus in 1980 general environmental awareness was awakening in Houston and elsewhere. It is not clear however whether there was any significant site-specific environmental awareness in that year. By 1985 all 10 sites had been announced as being on the NPL and the potential health hazards had been widely publicized. Two sites had received emergency treatment and one site was at the early stage of cleanup. Thus in 1985 there was the potential for consumers to expect a cleanup of some of the sites in the near future.

   The pattern of the coefficients on TOXIC and TOXICSQ during the three time periods discloses the role of EPA information. If consumers were aware of the potential health hazards of the toxic sites even before the EPA announcements and expected no cleanup in the near future, then

TABLE 3
Mean Characteristics of Housing Data Sets 1976, 1980, 1985
(Standard Deviation)

Variable	1976	1980	1985 Include H–F[a]	1985 Exclude H–F[a]
Distance				
TOXIC (distance to site in miles)	3.55	3.54	3.67	3.62
	(1.39)	(1.44)	(1.27)	(1.26)
CBD (distance to CBD in miles)	10.1	12.9	11.6	10.5
	(4.8)	(4.3)	(4.8)	(4.2)
Housing characteristics				
HOUSING PRICE (in $00s)	395.7	753.0	1016.9	1061.5
	(260.9)	(474.1)	(792.8)	(848.8)
SQUARE FEET of living space in (00s)	15.7	17.3	18.4	18.6
	(6.0)	(5.8)	(7.7)	(8.1)
PRICE PER SQUARE FOOT (in $)	24.0	40.3	53.4	54.8
	(7.8)	(13.2)	(24.5)	(26.2)
LOTSIZE (in 00s)	82.1	76.0	78.6	79.5
	(46.7)	(35.8)	(48.5)	(51.6)
PARKING (no. cars)	1.63	1.85	1.70	1.72
	(0.66)	(0.49)	(0.65)	(0.63)
BEDROOMS	3.03	3.11	3.11	3.09
	(0.67)	(0.65)	(0.72)	(0.74)
FIREPLACES	0.35	0.59	0.60	0.60
	(0.49)	(0.50)	(0.53)	(0.54)
BATHS	1.72	1.84	1.85	1.84
	(0.62)	(0.48)	(0.55)	(0.57)
CONDITION (1 = worst 6 = best)	3.86	3.80	3.47	3.43
	(0.75)	(0.67)	(0.87)	(0.82)
AGE (in years)	15.4	10.2	17.66	19.11
	(11.9)	(11.7)	(16.3)	(16.5)
CENTRAL AIR (= 1 if yes)	0.59	0.91	0.82	0.82
RANGE (= 1 if yes)	0.65	0.90	0.81	0.79
DISHWASHER (= 1 if yes)	0.57	0.81	0.77	0.75
Seasonal dummies (= 1 if yes)				
Previous year				
2nd quarter	—	—	0.10	0.09
3rd quarter	0.005	0.023	0.15	0.15
4th quarter	0.04	0.16	0.19	0.18
Seasonal dummies (= 1 if yes)				
Current year				
2nd quarter	0.38	0.19	0.19	0.20
3rd quarter	0.26	0.39	0.09	0.09
4th quarter	0.06	—	0.13	0.13
Neighborhood Characteristics				
OWNER (% owner occupied)	62.2	60.1	62.4	62.9
	(20.4)	(19.4)	(19.1)	(19.7)
EDUC (% completed high school)	61.7	80.6	80.6	80.0
	(22.1)	(13.7)	(14.5)	(15.1)

TABLE 3—*Continued*

Variable	1976	1980	1985 Include H–F[a]	Exclude H–F[a]
INCOME (average family income	129.9	297.8	305.0	309.1
in $00's)	(46.1)	(108.3)	(120.6)	(130.6)
POOR (% below to 1.24 times	9.3	6.2	6.4	6.7
poverty level)	(9.2)	(5.7)	(5.9)	(6.3)
BLUE (% blue collar)	47.9	50.1	47.8	47.2
	(16.6)	(15.0)	(15.3)	(15.5)
BLACK (%)	11.2	7.6	8.8	10.0
	(24.9)	(18.2)	(21.4)	(23.2)
HISP (%)	10.0	11.4	10.7	11.2
	(10.3)	(11.1)	(11.0)	(11.8)
YOUNG (% under 19)	38.3	30.1	28.4	27.8
	(12.8)	(7.1)	(7.5)	(7.7)
Sample Size	1969	1083	1811	1511

[a]Harris–Farley toxic site.

the proximity variables should have equal coefficients over time (adjusting for inflation). However, if EPA actions create new information for the market to digest, then only 1985 will show any price effects. If consumers had previously internalized the dangers and believed the EPA announcements implied a cleanup effort in the near future, then the proximity variables should be insignificant only in 1985 after the EPA announcements.

4. DATA DESCRIPTION

Data on individual housing sales in Houston for 1976, 1980, and 1985 provide the basis for the analysis (Table 3). The sales data come from the Society of Real Estate Appraisers (SREA [16]) which compiles comparable sales figures on single family dwellings for property appraisers. The time periods are selected to examine the stages of environmental awareness in Houston concerning the toxic waste sites. Two time periods before the EPA announcements are compared to a period after the announcements. In 1976 Superfund had not yet been created, while 1980 is the period concurrent with the creation of Superfund. By 1985 all ten sites had been announced as being on the Superfund NPL.

The housing data are augmented by Census data on neighborhood characteristics for the Census tract in which the house is located. Both

1970 and 1980 Census data are used, 1970 for the 1976 sales and 1980 for the 1980 and 1985 sales.[5]

Two location variables are constructed from maps of the Houston metropolitan area. The first, TOXIC (the distance to a toxic waste site), is constructed by measuring the straight-line distance between the house and the nearest toxic waste site. The house's location is given by the centroid of its Keymap letter taken from a location grid map. The location of the toxic waste site was determined on the appropriate Keymap by staff at the Texas Water Commission.[6] The second location variable, CBD (the distance to the central business district), is not measured by a straight line, but is based on the most efficient commuting route from each Census tract centroid to the centroid of the CBD's Census tract.

Two issues are important in the definition and subsequent use of the proximity variable. One is how to measure proximity and the second is how to use the proximity measure to spatially classify (if at all) the three data sets, 1976, 1980, and 1985. Observations in the housing data sets cover the entire 1735 square mile Harris County and the 10 toxic sites are widely scattered over the county. In a prior stage of the research, distance from each house to each of the 10 toxic sites was computed. Preliminary analysis indicated that due to the great spatial separation of sites, the appropriate measure of proximity to toxic waste was simply the straight line distance to the nearest site (rather than distance to each of the ten sites). Hence TOXIC is defined as the distance to the nearest toxic site. Two caveats should be pointed out concerning the separation of toxic sites from each other. First the North and South Cavalcade sites are located side by side, and are counted as one site. Secondly Brio and Harris–Farley are about 8 miles apart resulting in some potential market area overlap.

The model in (1) is estimated using various samples differentiated by distance to the nearest toxic site. Because few observations (less than 20) are within 10 miles of French, Sikes, and Highland, the final data sets are based on home sales within a 7-mile radius[7] of one of the remaining sites: Brio, Crystal, Geneva, Harris–Farley, Cavalcade (North and South) and

Sol–Lynn. For all three time periods the distance to a toxic site ranges from 0.2 to 7 miles with about half the homes located within 3 miles of a toxic site.

5. EMPIRICAL RESULTS

This section presents evidence that the EPA announcements created a new market for safe housing. First the basic hedonic results are presented and are shown to be robust to alternative estimating techniques. Nonetheless I find the new market to be unable to distinguish the severity of the sites. Next the accompanying wealth effects are evaluated. Finally I relate my findings to the literature on disamenities.

5.1. Hedonic Results

Table 4 reports model estimates of the hedonic house value equation for each of three time periods 1976, 1980, and 1985. These regressions are based on a sample of homes within a 7-mile radius of the nearest toxic waste site and are pooled across the site.[8] Two regressions are reported for 1985, one including observations near the partially cleaned Harris–Farley site and one excluding those observations. Based on the results of a Chow test, subsequent discussion of the 1985 results will focus on results from the 1985 data set that excludes homes near the Harris–Farley site.[9]

The most striking aspect of the results is the time pattern on the TOXIC coefficients. The empirical findings demonstrate that EPA actions are central to the creation of a new market for safe housing. The Houston housing market values proximity to a toxic waste site as a disamenity only in 1985, the time period following the EPA announcements. There appears to be no anticipation effect; consumers did not internalize the dangers until confronted with federal government documentation and ensuing publicity.

In 1976, several years before the creation of Superfund, there was no premium on locations far from a toxic site. Coefficients on both TOXIC and TOXICSQ are insignificant in 1976. Even though all but the Caval-

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[8]Individual regressions were also estimated for the immediate market area surrounding each site. Due to the smaller sample sizes around the individual sites, the proximity variable did not have the smooth continuous distribution as in the pooled regression. Results were more precise in the pooled regression as can be observed in the smaller standard errors for the pooled regressions shown in Table 6.

[9]Harris–Farley underwent extensive cleanup during 1984–1986 and it is possible that the cleanup and accompanying publicity impacted consumer expectations. A Chow test supports the conclusion that the Harris–Farley subsample is significantly different. The calculated $F = 3.42$ while the Table $F(23,1765) = 1.52$ at the 5 percent level. The maintained hypothesis of the equality of coefficients can be rejected. Table A-1 in the Appendix reports regression results for homes near the Harris–Farley site.

TABLE 4
Regression Results for Pooled Toxic Sites
1976, 1980, 1985

| | | | 1985 | |
| | | | Include | Exclude |
Variable	1976	1980	H–F	H–F
Distance				
TOXIC	0.012	−0.036[a]	0.055[a]	0.054[a]
	(0.79)	(2.3)	(2.1)	(1.9)
TOXICSQ	0.0015	0.0072[a]	−0.005[b]	−0.004[b]
	(0.74)	(3.4)	(1.5)	(1.4)
CBD	−0.034[a]	−0.55[a]	−0.15[a]	−0.14[a]
	(6.5)	(7.5)	(20.1)	(13.3)
CBDSQ	0.0006[a]	0.0011[a]	0.004[a]	0.003[a]
	(3.0)	(4.6)	(15.0)	(6.4)
Housing characteristics				
SQUARE FEET	0.062[a]	0.036[a]	0.078[a]	0.076[a]
	(16.8)	(8.6)	(25.8)	(22.7)
SQUARE FEETSQ	−0.0005[a]	0.0001[a]	−0.0007[a]	−0.0007[a]
	(5.9)	(1.8)	(21.3)	(19.1)
LOTSIZE	0.0004[a]	0.0011[a]	0.001[a]	0.001[a]
	(4.5)	(6.4)	(8.2)	(8.0)
PARKING	0.06[a]	0.03[a]	−0.008	0.01
	(8.1)	(2.3)	(0.8)	(0.9)
BEDROOMS	−0.02[a]	−0.01	−0.03[a]	−0.02[b]
	(2.5)	(0.6)	(2.2)	(1.4)
FIREPLACES	0.10[a]	0.09[a]	0.03[a]	0.04[a]
	(8.1)	(6.2)	(2.3)	(2.9)
BATHS	0.04[a]	−0.002	0.12[a]	0.11[a]
	(2.8)	(0.1)	(7.5)	(6.3)
CONDITION	0.04[a]	0.03[a]	0.03[a]	0.04[a]
	(7.2)	(4.6)	(4.3)	(4.4)
AGE	−0.002[a]	−0.004[a]	−0.002[a]	−0.001[b]
	(3.6)	(5.0)	(3.0)	(1.4)
CENTRAL AIR	0.08[a]	0.08[a]	0.06[a]	0.06[a]
	(6.6)	(3.8)	(3.7)	(3.5)
RANGE	0.05[a]	−0.06[a]	0.04[a]	0.03[b]
	(3.9)	(2.6)	(1.8)	(1.4)
DISHWASHER	0.07[a]	0.08[a]	0.0003	0.002
	(4.9)	(3.7)	(0.02)	(0.1)
Seasonal dummies				
Previous year				
2nd quarter	—	—	0.13[c]	0.12[c]
			(5.5)	(4.3)
3rd quarter	−0.03	0.02	0.06[c]	0.02
	(0.5)	(0.6)	(2.7)	(1.0)
4th quarter	0.008	0.02	0.04[c]	0.04
	(0.34)	(1.2)	(2.3)	(1.6)

TABLE 4—*Continued*

Variable	1976	1980	1985 Include H–F	1985 Exclude H–F
Current year				
2nd quarter	0.07^c	0.07^c	−0.006	−0.02
	(6.0)	(4.7)	(0.3)	(0.7)
3rd quarter	0.08^c	0.06^c	0.02	−0.002
	(6.5)	(4.7)	(0.9)	(0.1)
4th quarter	0.12	—	−0.03	−0.04
	(5.8)		(1.3)	(1.5)
Neighborhood characteristics				
OWNER	0.00007	−0.0022	$−0.0008^b$	$−0.0008^b$
	(0.2)	(4.6)	(1.5)	(1.6)
EDUC	0.001^a	0.002^b	0.005^a	0.005^a
	(1.7)	(1.9)	(4.4)	(4.5)
INCOME	0.008^a	0.0003^a	0.0004^a	0.0003^a
	(4.4)	(4.5)	(4.6)	(2.8)
POOR	$−0.003^a$	−0.007	−0.002	−0.001
	(2.3)	(3.2)	(0.8)	(0.5)
BLUE	$−0.006^a$	$−0.008^a$	$−0.002^a$	$−0.005^a$
	(8.8)	(7.9)	(2.3)	(4.2)
BLACK	$−0.002^a$	$−0.002^a$	$−0.004^a$	$−0.004^a$
	(5.5)	(5.0)	(8.6)	(7.9)
HISP	−0.0006	$−0.004^a$	$−0.008^a$	$−0.007^a$
	(0.9)	(3.8)	(7.0)	(5.9)
YOUNG	$−0.003^a$	$−0.002^a$	−0.002	$−0.002^a$
	(8.9)	(1.5)	(1.0)	(1.0)
INTERCEPT	5.0^c	6.75^c	6.0^c	5.9^c
	(47.6)	(41.7)	(43.8)	(39.4)
R^2	0.89	0.88	0.83	0.83
Sample Size	1969	1083	1811	1511

Note. Absolute *t*-statistics are in parentheses. Dependent variable is natural log of housing price. Square feet, price and lot sizes are all actual units divided by 100. Omitted time is 1st quarter of current year. H–F represents Harris–Farley toxic site.

[a]Significant at 5% level, one-tailed test.

[b]Significant at 10% level, one-tailed test.

[c]Significant at 5% level, two-tailed test.

cade sites were being openly operated during that time period consumers either did not care or did not know of the potential health hazards associated with proximity to the toxic dumps.

By 1980 a different pattern occurs on the TOXIC variables. The negative coefficient on TOXIC and positive coefficient on TOXICSQ (both significant) unexpectedly imply an attraction to toxic waste sites up to 2.7 miles. The anomalous finding is surprising, although a recent study

by Michaels and Smith [11] also finds anomalous results for some of their subsamples.[10] Nonetheless two explanations may offer insights into the paradoxical 1980 finding. One is that the finding is a result of the estimated functional form. The second is that other unmeasured economic trends may be driving the result.

If the model is estimated in log–log form a small but positive coefficient occurs on ln TOX. The coefficient is statistically indistinguishable from the 1976 coefficient but significantly smaller than that estimated for 1985.[11]

Closer examination of economic trends occurring in Houston between 1976 and 1980 may provide a partial explanation for the small band of attraction in 1980. If an employment subcenter grew between a toxic site and housing developments during 1976–1980, distance to the site could be proxying for distance to local employment. Other possible explanations can be eliminated. Examination of Houston maps shows no parks or schools to be close to any of the sites. However, a few sites are close to office buildings built between 1978 and 1980.[12] Attempts were made to control for the decentralized employment structure of Houston. Several alternative measures of accessability to employment were used, such as entering distance from each house to the four most important employment subcenters (CBD, Greenway Plaza, Galleria, Medical Center) or the minimum distance. Results did not change from those presented here.

In 1985, the year after the most recent NPL announcements, the coefficients on proximity to a toxic site imply a sharp reversal in the markets' valuation of the sites. Nearness to a toxic site is now perceived as a disamenity. The positive coefficient on TOXIC is significant at the 5% level and the negative coefficient on TOXICSQ at the 10% level. Housing prices increase at a decreasing rate up to 6.2 miles as shown in Fig. 1. Being designated as a site on the NPL, whether it be final or proposed status, provides new information which depresses home values near toxic

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[10]The Michaels and Smith paper uses home sales in suburban Boston 1977–1981 to discuss the impact of market segmentation on valuing hazardous waste sites as disamenities. The direction of the effect of TOXIC on housing prices is computed as $d \ln \text{PRI}/d\text{TOXIC} = (a + b\text{TIME1} + c\text{TIME2})$ where TIME1 and TIME2 are dummy variables taking the value 1 if the sale occurs in the first 6 months after the "discovery" date (Harrison and Stock [7]) or zero if the sale occurs after the first 6 months. If time periods are evaluated as dummies, only the full sample always exhibits a positive effect of TOXIC while every subsample has at least one of the two time periods associated with a surprising negative effect of TOXIC implying a paradoxical attraction to toxic sites.

[11]The log–log form is unable to capture the initial turn-down of the price-distance relation that is found in the semi-log form with quadratic distance. Further discussion of the double log form is deferred to page 15.

[12]Ideally a local employment variable showing the number of firms or jobs within each keymap letter could be used to control for local employment effects. Unfortunately such data are not easily attainable for researchers.
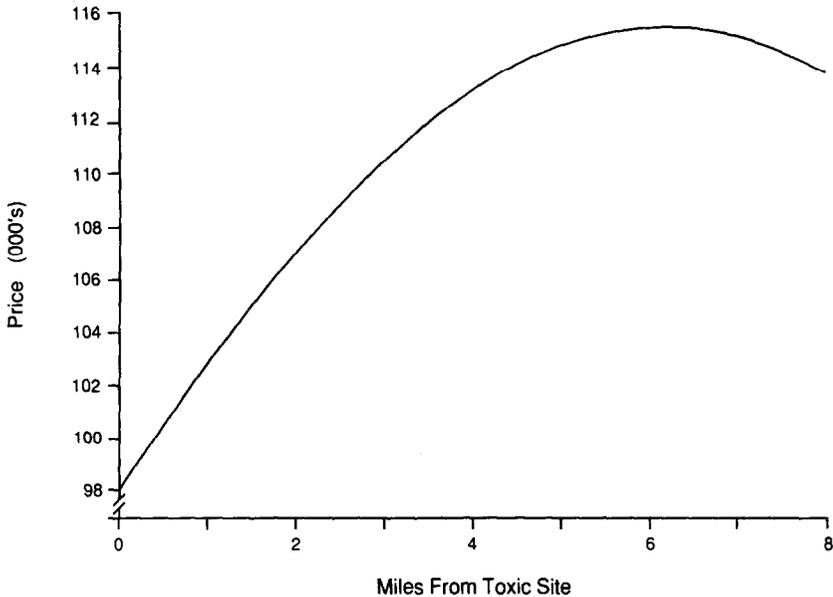
FIG. 1.   Predicted house price and distance from a toxic waste site, 1985.

sites.[13] The EPA announcements created a new market for safety, that of increased distance from a toxic waste site.

The time pattern of the marginal prices of TOXIC also support the conclusion that the EPA announcements were seminal in creating the new market.[14] The marginal price of TOXIC, evaluated at the means, and its standard error in 1976 and 1980 are $880 (500) and $1180 (430). The values are statistically indistinguishable between 1976 and 1980. Yet after the EPA announcements in 1985 the marginal price of TOXIC more than doubled to $2364 (550), significantly greater than either the 1976 or 1980 results. For comparison the average actual home price increased by only 40% between 1980 and 1985. The EPA announcements and ensuing publicity provided valuable information to consumers as shown by marginal prices of TOXIC rising at more than double the rate of home prices 1980–1985.

[13]Local employment effects are still likely to work opposite to any disamenity effects of the toxic sites in 1985. The point is that in 1985 the disamenity effects outweigh any proximity effects to local employment. The change in the estimated disamenity effect can be approximated by the change in the marginal price of TOXIC between 1980 and 1985.

[14]Based on the semi-log form, the marginal price of increased distance from a toxic site evaluated at the means is computed as $(b + 2c\text{TOXIC})\text{PRI}$ where PRI and TOXIC are evaluated at the means, b is the coefficient on TOXIC and c is the coefficient on TOXICSQ.

TABLE 5
Repeat Sales Analysis

Equation	Toxic (t-stat.)	Sig. level	R^2
No time dummy	0.0285		
	(1.37)	0.178	0.04
Year dummies	0.0307		
	(1.41)	0.165	0.05
$\frac{1}{2}$-year dummies	0.0285		
	(1.32)	0.196	0.10

5.2 Robustness

In order to test the robustness of my conclusions concerning the major impact of the EPA announcements on the market for safe housing, I examine three additional topics: (1) repeat sales, (2) experiments with non-spatially restricted data sets, and (3) alternative functional forms for the regression. All three tests provide significant additional evidence supporting the conclusion that EPA announcements created a new market for safe housing.

The technique of repeat sales analysis described by Palmquist [12] requires restrictive assumptions, the main one being that the hedonic function for other housing characteristics has not shifted over time.[15] Given this caveat, the repeat sales technique permits a test of whether a change in an environmental variable has effected the relative prices of the homes in multitime periods as a function only of the time periods and nuisance variables. The estimation is based on the 45 observations that were repeat sales between 1980 and 1985. Based on Palmquist's equation (6) the equation estimated here is:

$$\ln(\text{PRI85}/\text{PRI80}) = f(\text{initial sale date, final sale date, TOXIC})$$
$$+ \text{ error.} \qquad (2)$$

Equation (2) estimates the change in valuation of the disamenity since the repeat sales pairs are equally distant from a toxic site in each year. The coefficient of interest is the coefficient on TOXIC. If the coefficient on TOXIC is positive there is evidence that homes farther from toxic sites are worth more in 1985 relative to 1980. If the coefficient on TOXIC is negative, 1985 homes are worth less for a marginal increase in distance from a toxic site.

The results of the regressions are reported in Table 5 and show that there is a considerable (though imprecisely estimated) positive effect of

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[15]I thank Myrick Freeman for the suggestion to apply the repeat sales technique.

TABLE 6
Spatial Extent of Negative Impacts of Toxic Sites and
Marginal Prices of Selected Housing Characteristics 1985[a]
(Linearized Standard Errors[b])

Data set (number of observations)	Maximum extent of negative impact	Marginal price of housing characteristic		
		Distance to toxic waste site	Distance to CBD	Square foot of living space
Pooled Sites				
Excluding Harris–Farley	6.19 miles	$ 2364	$ − 7584	$ 52
(N = 1511)	(3.67)	(552)	(385)	(2.2)
Including Harris–Farley	5.34	1742	− 5630	52
(N = 1811)	(3.15)	(465)	(273)	(1.9)
Individual Sites				
Brio (N = 166)	2.61	1006	4016	36
	(2.28)	(1809)	(1994)	(3.4)
Crystal (N = 588)	2.94	1738	− 1835	57
	(1.98)	(1460)	(1091)	(3.0)
Geneva (N = 120)	1.86	3182	− 142	8
	(1.85)	(1325)	(995)	(3.8)
Harris–Farley (N = 300)	—	− 3831	2288	48
		(1262)	(838)	(3.4)
Sol–Lynn (N = 410)	3.92	3310	− 16,726	61
	(1.12)	(2520)	(1761)	(5.4)
South Cavalcade (N = 227)	4.76	− 2517	− 2332	47
	(2.30)	(2763)	(2546)	(6.0)

[a]Marginal prices are computed from the semilog form as $(b + 2cx)Y$, where b is the coefficient on the linear term, c is the coefficient on the squared term, x is the mean of the independent variable, and Y is mean house price.

[b]Based on [8].

TOXIC. I experimented with different time delineations—none, year, or half year, and in all cases TOXIC have a positive coefficient. In all cases the t values are significant at the 17–20% level. Therefore, the repeat sales technique offers further support for the finding that EPA announcements changed consumer perceptions of the risk of proximity to toxic waste sites.

Interpretation of the coefficients from the repeat sales technique reinforces the basic hedonic findings. A 3% premium, or about $2448 in 1985 dollars, exists for a home at a given distance from a toxic waste site in 1985 relative to 1980 based on the repeat sales results. Similarly the marginal price of distance (evaluated at the means) for the 1985 hedonic regression is $2364 as reported in Table 6. Thus repeat sales valuation is within one standard error of the hedonic valuation.

Further support of the announcement effect is provided by control group experiments. Observations in the control group experiments are not spatially restricted to be within 7 miles of a toxic site but are located from 0.2 miles to 31 miles from a site. Because observations in the control regressions are not spatially restricted, larger data sets form the basis for the analysis—1976 (3525 obs), 1980 (2389 obs), and 1985 (4781 obs). Two experiments are run, each using a different metric for proximity to a toxic waste site. The first experiment uses a continuous variable measuring distance to the nearest toxic site. In the second experiment a zone dummy variable is used to measure proximity. For instance, a zone dummy equals one if a home lies within a certain radius of a toxic site, and zero otherwise.

The time pattern on the estimated coefficients of the proximity variables reinforces the results presented above. Estimation of (1) in the first experiment results in coefficients following the pattern reported in Table 4. The coefficients on TOXIC and TOXICSQ and associated t-statistics are as follows: (1) 1976: 0.0010 (0.64), 0.0009 (0.60); (2) 1980: 0.0017 (0.60), -0.0004 (-2.55); (3) 1985: 0.0055 (2.32), -0.002 (-2.35).

In the second experiment various definitions of the zone dummy were employed. Coefficients on the zone variable were insignificant in 1976 and 1980. However, in 1985 the zone coefficient is negative and significant implying that house values are depressed in zones close to a toxic site. Results defining ZONE ($= 1$) up to 3.65 miles are as follows. For 1976 the coefficient on ZONE and its t-statistic in parenthesis are 0.00032 (0.05), for 1980 0.00054 (0.07), and for 1985 -0.0255 (-2.88). The results also provide strong reinforcement for the conclusion that the disamenity of toxic sites was recognized by the market only after the EPA announcements.

Third, testing alternative functional forms establishes the robustness of the pattern of marginal price changes: 1976 and 1980 are statistically indistinguishable, while 1985 is statistically much greater. The EPA announcements significantly impacted consumer perceptions of danger, and further depressed home prices near toxic waste sites. As an example of results from an alternative functional form consider the log–log form.[16] In the log–log form the dependent variable is the natural log of house price and all continuous variables are entered as natural logs, dummy variables remain 0–1. Estimation shows ln TOX to be significantly positive in every

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[16] I tried several alternative functional forms for the estimating equations but do not report them in the paper. The semi-log form fits the data better (also found by Linneman [9]) than a linear specification or double log specification. As to the specification of TOXIC, a functional form that allows non-linearities and the computation of maximum range better fits the data and theoretical expectations. Hence I use a quadratic form involving TOXIC and TOXICSQ.

year (seemingly unlike the semi-log results). Yet the coefficients in 1985 are significantly greater than the coefficients in 1976 or 1980. Moreover the same pattern established in the semi-log form emerges with respect to the marginal price of moving 1 mile farther from a site. In 1976 and 1980 the marginal price of TOXIC evaluated at the mean is $670 and $680, respectively. After the announcements the marginal price more than triples to $2674, a statistically significant increase over 1976 and 1980 marginal prices. For comparison the average actual home price increased about 40% 1980–1985. Thus the pattern of consumer responses is similar under alternative empirical specifications.

5.3. The Workings of the New Market

The EPA announcements created a new market in 1985, that of per-ceived safety from toxic waste sites. The spatial extent of the market area can be computed from the estimated coefficients. The derivative of ln(PRI) with respect to TOXIC is set equal to zero and solved for miles. Table 6 shows that in 1985 the negative effects on housing price disappear after about 6.2 miles from a toxic site. The results are supported by site-specific regressions based on (1), although the sizes of the negative impact zones are found to vary by site. Approximate standard errors of the maximum distance zone show the pooled results to be superior to individual site results.[17]

The market for safe housing seems unable to distinguish the severity of the sites. Subsample regression results show that marginal prices differ by site but not necessarily in NPL rank order. Correlations between the marginal prices (or marginal price divided by average house price) and HRS score are positive but insignificant. For example, a house located 1 mile farther from the Crystal site is worth $1738 more, while a house 1 mile farther from Sol–Lynn is worth $3310 more evaluated at the means. Yet Crystal is the worst site in the data set with a NPL rank of 34 while Sol–Lynn is in Group 8 (out of 15 groups on proposed status).[18]

Despite the market's inability to distinguish the severity of the sites it appears to be accurate in its all-or-nothing assessment of whether a site is likely to remain toxic. The Harris–Farley site is the only site to undergo a concerted cleanup effort during the time period of the study (Appendix Table A1). As of August 1986 Harris–Farley had been "almost cleaned

[17]Based on Klein [8, p. 258].

[18]It is possible that the lower marginal price on the Crystal site is due to the temporary and emergency capping done at the site. The procedure simply pours dirt over the site. Perhaps residents misperceived the importance of this procedure, although in fact little real relief is provided. The Geneva site also received emergency capping but exhibits a high marginal price on TOXIC. These results should be interpreted with caution due to the small sample sizes for regressions around individual sites.

up" by Dow Chemical according to EPA and Texas Water Commission reports.[19] The 1985 coefficients on distance to the Harris–Farley site, although insignificant, imply a negative marginal price on distance as well as a negative maximum distance effect. The negative price and negative distance effect could imply that the site was no longer a perceived problem and that the market believed the cleanup effort was effective. While the conclusion is speculative and should be verified as other sites are cleaned it is consistent with the workings of a market.[20]

5.4. Wealth Effects

The EPA announcements not only created a new market for safe housing but caused important distributional consequences. Homeowners living within 6 miles of a toxic site experience a sudden a sudden drop in the value of their homes after the EPA announcements. Yet homeowners located beyond 6 miles experience no loss in home value. The spatial consequences can be computed from the estimated coefficients on the two toxic variables and can be summarized by the marginal price of distance from a toxic site. Table 6 reports the marginal price of increasing the distance from a toxic site by 1 mile for the average home located at the average distance from a toxic waste site. The coefficients on the two toxic variables imply that in 1985 the asset value of the average house would increase by about $2360 if the same house were located 1 mile farther from a site. On a flow basis, this corresponds to about $310 per mile per year at a 10% interest rate and 15-year time horizon.

An important outcome of the quadratic specification is the prediction that the marginal price of TOXIC attenuates non-linearly with distance. In 1985 the asset value of the average home would be $4940 more if located 1 mile farther from a toxic site than if located at the site, $4259 more at 1 mile, $3476 more at 2 miles, $2606 more at 3 miles, $1670 more at 4 miles, $690 more at 5 miles, and $100 more at 6 miles. The wealth effects of the EPA announcements are not spatially neutral.

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[19]The notion of "cleaned up" is a relative term. What is meant here is that traces of toxic chemicals at the Harris–Farley site now occur within acceptable standards set by the EPA. In 1987 the process was initiated to remove the site from the NPL.

[20]The conclusion is supported by the results of the Chow test as reported in footnote 9: the Harris–Farley subsample is not poolable with the sample as a whole. The only other site with a negative marginal price on TOXIC is Cavalcade. However, the negative marginal price cannot be distinguished from zero as indicated by its approximate standard error given in Table 5. In 1983 Houston citizens voted to support the building of the Hardy Toll Road, a highway serving the Northern suburbs of Houston. The terminus of the planned Toll Way occurs within blocks of the Cavalcade site. The accessability effects may therefore outweigh the disamenity effects of the Cavalcade site in the 1985 data set.

While these wealth effects are purely distributional in nature, as opposed to affecting allocation, they nonetheless may have serious consequences for homeowners.[21] Only after EPA announcements that sites are on the NPL are nearby housing prices depressed. Homeowners who are surprised to find that their homes are close to toxic waste sites suffer large negative windfall losses. While these negative effects may be reversed as cleanup occurs, a permanent loss in wealth results for a homeowner who sells after the announcement and before the cleanup. The story is more positive for a future home buyer who buys a home near a toxic site after the announcement but before cleanup is expected. A permanent windfall gain in home value accrues to that household. The distributional consequences are not yet likely to have been taken into consideration in the formulation of the EPA's policy actions.

5.5 Related Literature

My work corroborates and refines related work on disamenities in housing markets and consumer surveys of risk. Many amenity studies based on market transactions find distance effects smaller than those reported here. In fact, in many hedonic studies, distance effects are often insignificant (see Follain and Jimenez [4]). However the study of hazardous waste sites by Michaels and Smith [11] finds that distance has a significant positive effect on home values in suburban Boston.[22] Other studies limit distance effects in specification, as do Brookshire et al. [2] when they look at earthquake zones' (0.25-mile strip along faults) influence on house prices. Consumer surveys find evidence of significant concern over undesirable land uses. In 1984 Smith and Desvousges [14, 15] surveyed Boston residents on their perceptions of dangers from different types of fixed location undesirable land uses including toxic waste sites and nuclear reactors. They find the distance effect goes to zero at 10 miles from a toxic waste site and 22 miles from a nuclear reactor site. The 1985 results reported here tend to confirm those found by Smith and Desvousges' survey.

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[21] There are also potential efficiency effects due to a more efficient allocation of risk across households after the announcements. The extent of the welfare gain depends on the taste and mobility of the households. For example households that move away from the site after the announcements could realize a welfare gain equal to the difference between their willingness to pay for a non-toxic house and the actual price differential for a non-toxic house (assuming zero moving costs and that the hedonic does not shift).

[22] See footnote 10 for a qualification. Michaels and Smith do not try to capture EPA announcement effects on home values. All home sales occur before the relevant EPA announcement data and only 4 of their 11 sites are on the NPL in 1984. They instead look at the "discovery" date, the date the state of Massachusetts determined a waste site or industrial site to contain hazardous material.

Michaels and Smith [11] find flow values similar to the results presented here. Although they do not compute the marginal price of distance, they present a close approximation in [11, Table 8] where they report that the marginal willingness to pay to be on average 1.08 miles farther from a hazardous waste site is $124 per year in 1977 dollars assuming a 10% discount rate. Using their deflator, the total shelter component of the CPI, to inflate to 1985 prices the marginal willingness to pay is $252, or about $58 less than that estimated here. Thus the two studies produce remarkably similar results even though different time periods and locations were analyzed.[23]

Lower marginal asset prices are found by Smith and Desvouges' survey in Boston where marginal asset prices of distance from a toxic site range from $250 to $1300 (vs $2360 found here). The difference may be due to the fact that different markets and time periods are analyzed, but is also predicted by an article by Brookshire et al. [1]. They show theoretically that rent differentials based on estimating hedonic house value equations must be larger than the willingness to pay obtained from consumer surveys. The results presented here are consistent with Brookshire's finding.

6. CONCLUSION

EPA's revelations of toxic waste sites as being on its Superfund list created a new market for perceived safety from hazardous waste dumps. This finding results from the special Houston data set that was created to specifically allow tests about consumer knowledge and expectations concerning perceived dangers of toxic sites. No disamenities are discerned around toxic sites in 1976, despite the fact that six of the seven sites in the analysis were operating. Neither is a disamenity found for homes within 2.7 miles of a site in 1980 despite the facts that Superfund was created in the same year and five of the seven sites were operating. The significant disamenity for all distances (up to 6.2 miles) found in 1985, however, shows that consumers did respond to EPA announcements that placed particular sites on the NPL.

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[23]It is instructive to compare the two studies' results based on the full samples in time periods after discovery or announcements. Michaels and Smith's Table 6 implies that a marginal increase in distance to a toxic waste site would increase the value of a house sold in the second time period by about 2.2 percent ($a + c$TIME2). If I specify TOXIC to enter linearly in the semi-log form for 1985 (excluding Harris–Farley), I estimate a 2.1 percent higher price. Again our results are remarkably similar.

However, an advantage to my quadratic specification (TOXIC and TOXICSQ) is that nonlinear effects can easily be captured. Because Michaels and Smith use a linear specification of TOXIC, the implied marginal price of TOXIC remains the same at all distances from a site. In contrast my quadratic specification allows the TOXIC's effect to attenuate with distance.

   In 1985 the new market created by the EPA showed that the price of a home would likely be higher if it were located further from a site, by as much as \$3310 per mile evaluated at the means. Even though EPA reports noted "lack of concern" at public hearings on the sites, the Houston housing market capitalized the information of the disamenity into housing prices. The sudden wealth loss that existing homeowners experience after a site is announced implies a redistributive effect due to the EPA announcement. The redistributive effect is not spatially neutral; only nearby homeowners experience lower property values.

   This work provides important evidence that the announcement effect of the EPA is the primary cause of the depression in housing values observed. The new market for safe housing seems to have the ability to classify whether or not a site will continue to be toxic but seems unable to accurately distinguish between degrees of toxicity. Evidence exists that the information available to the public is incomplete (or not completely internalized), in that marginal prices do not significantly correlate with the degree of toxicity of the site. However, the decline in house values appears to be only a temporary phenomenon that can be reversed once cleanup commences. In the one site that was cleaned up during 1984–1986, no depressive effect after the EPA announcement is observed. These results provide crucial new evidence that consumers act on the information that is available to them, and that government and private efforts to clean-up toxic wastes can enhance housing values.

APPENDIX

TABLE A1
Regression Results for Harris–Farley Toxic Site
1976, 1980, 1985

Variable	1976	1980	1985
Distance			
TOXIC	0.039	0.065[b]	− 0.014
	(1.1)	(1.5)	(0.2)
TOXICSQ	− 0.004	− 0.008[b]	− 0.004
	(1.0)	(1.6)	(0.4)
CBD	− 0.054[b]	0.131[a]	0.118
	(1.4)	(2.1)	(1.1)
CBDSQ	0.0018[b]	− 0.0040[a]	− 0.0026
	(1.4)	(2.2)	(0.8)
Housing characteristics			
SQUARE FEET	0.050[a]	0.048[a]	0.055[a]
	(5.8)	(7.1)	(4.1)
SQUARE FEETSQ	− 0.0002	0.0001	0.0001
	(0.7)	(0.5)	(0.5)
LOTSIZE	0.0009[a]	0.0005[b]	− 0.0001
	(3.8)	(1.4)	(0.1)

TABLE A1—*Continued*

Variable	1976	1980	1985
PARKING	0.02[a]	0.05[a]	−0.01
	(1.7)	(2.4)	(0.5)
BEDROOMS	−0.03[a]	−0.00	−0.05[a]
	(1.8)	(0.2)	(2.2)
FIREPLACES	0.06[a]	0.05[a]	−0.03[b]
	(2.4)	(2.0)	(1.3)
BATHS	0.04[b]	−0.00	0.01
	(1.6)	(0.1)	(0.2)
CONDITION	0.02[a]	0.04[a]	0.01
	(1.8)	(3.5)	(0.9)
AGE	−0.007[a]	−0.006[a]	−0.003[a]
	(3.8)	(4.1)	(3.1)
CENTRAL AIR	0.07[a]	0.02	0.02
	(3.3)	(0.6)	(0.8)
RANGE	0.05[a]	−0.06[b]	0.09[a]
	(1.9)	(1.5)	(1.9)
DISHWASHER	0.07[a]	0.02	−0.03
	(3.5)	(0.7)	(0.6)
Seasonal dummies			
Previous year			
2nd quarter	—	—	0.09[c]
			(2.2)
3rd quarter	—	−0.01	0.07[c]
		(0.2)	(1.9)
4th quarter	−0.04	−0.02	0.01
	(0.9)	(0.9)	(0.2)
Current year			
2nd Quarter	0.03[c]	0.07[c]	−0.05
	(2.0)	(3.0)	(1.2)
3rd Quarter	0.04[c]	0.00	0.07
	(2.4)	(0.1)	(1.4)
4th Quarter	0.11[c]	—	−0.02
	(2.6)		(0.6)
Neighborhood characteristics			
OWNER	0.004	0.0017	−0.001
	(0.6)	(0.9)	(0.4)
EDUC	0.005	−0.002	−0.003
	(1.0)	(0.4)	(0.3)
INCOME	−0.016	−0.000	0.001
	(0.7)	(0.6)	(1.0)
POOR	0.020[a]	0.014[b]	−0.003
	(2.3)	(1.5)	(0.1)
BLUE	−0.0004	−0.0042[a]	−0.001
	(0.1)	(1.7)	(0.2)
BLACK	−0.021[a]	−0.004	−0.009
	(2.1)	(0.8)	(1.3)
HISPANIC	−0.002	−0.007[a]	0.008
	(0.5)	(1.7)	(1.2)

TABLE A1—*Continued*

Variable	1976	1980	1985
YOUNG	−0.001	−0.011^a	−0.017^a
	(0.2)	(3.1)	(2.4)
INTERCEPT	4.94^c	4.93^c	5.09^c
	(18.0)	(8.7)	(4.0)
R^2	0.94	0.92	0.84
SAMPLE SIZE	253	251	300

Note. Absolute *t*-statistics are in parenthesis. Dependent variable is natural log of housing price. Square feet, price, and lot size are in units of 100. Omitted time period is first quarter of current year.

^{a}Significant at 5% level, one-tailed test.
^{b}Significant at 10% level, one-tailed test.
^{c}Significant at 5% level, two-tailed test.

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