WHAT ARE THE EFFECTS OF CONTAMINATION RISKS ON COMMERCIAL AND INDUSTRIAL PROPERTIES? EVIDENCE FROM BALTIMORE, MARYLAND.

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Abstract: Using the hedonic pricing approach, we investigate how the information released on public registries of contaminated and potentially contaminated sites affects nearby commercial and industrial properties in Baltimore, Maryland. We find that industrial properties are virtually unaffected by proximity to a site with a history of contamination, while commercial properties do suffer an external cost due to the proximity to a contaminated site. This external cost is not cleared once the site has been cleaned up, or has been pronounced to be harmless.
We also find that the impacts of urban economic development policies, such as Empowerment Zones and Enterprise Zones, have had positive effects on industrial property values, but less so on commercial properties. In sum, brownfield properties in Baltimore are not particularly attractive investments for developers, and there is little potential for self-sustaining cleanup based on appropriate fiscal incentives, such as Tax Increment Financing. It is doubtful that "one size fits all" measures to encourage the cleanup of contaminated sites can be successful in this context.

JEL Classification: **Q51, Q53, R33.**
Key Words: Contaminated sites registries, Distance to Contaminated Sites, Hedonic Pricing Model, Brownfields.

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We wish to thank Shawn Bucholtz for his help with the construction of the dataset. The National Center for Smart Growth Research and Education at the University of Maryland provided financial support for this research.

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1. Introduction

A large body of literature documents the adverse effects of proximity to contaminated sites and environmental disamenities on the values of neighboring homes (Boyle and Kiel, 2001). By contrast, the economics literature on the effects of contamination on commercial and industrial properties is sparse, despite the broad implications of the contaminated site legislation in the US.

In the US, the Superfund law (1980) has been interpreted by the courts to impose strict liability for the cost of cleanup on the parties responsible for sites that pose risks to human health and ecological systems (Fogelman, 1992). Responsible parties are sought among the current owners and operators of contaminated properties. Many observers believe that, because of this provision, real estate developers and investors shun previously used properties, a problem compounded by the fact that lenders may deny investors loans for these properties.

Despite widespread efforts at the state level to encourage voluntary cleanups by offering liability and regulatory relief, and numerous state and federal brownfield initiatives,[2] acquiring and redeveloping contaminated land continue to be problematic. There is still much concern that properties may become unattractive to developers because of existing or suspected contamination on the premises, or because of existing or suspected contamination on neighboring properties.

The recent Small Business Liability Relief and Brownfield Revitalization Act (2002), for example, spells out requirements that property owners must satisfy to avail themselves of the "third party causation" and the "innocent purchaser" defense, which

[2] Brownfields are "abandoned, idled or underused industrial and commercial properties where real or perceived contamination complicates expansion or redevelopment" (Simons, 1998).

protects the owner from contamination that migrates to his or her property from someone else's property. Although the intent of this statute was to protect small businesses from the heavy burdens of the Superfund program and to expedite the cleanup and reuse of brownfields, some observers have expressed concern that its complexity may in the end spur more litigation and create new impediments to the redevelopment of brownfield properties (see, for example, Morford and Lifsey, 2002).

Some observers have also pointed out that many underused and potentially contaminated properties are located in economically blighted areas of cities (see, for example, Shutkin, 2000). Local and regional governments have often relied on fiscal policies and subsidies to stimulate growth in these areas.

In this paper we use the hedonic pricing model to investigate the effects of proximity to contaminated sites—or to sites that are merely suspected of contamination—and the effects of policies to stimulate growth in neglected areas on the value of commercial and industrial properties in Baltimore, Maryland.

Economic theory holds that the value of land is the discounted stream of net profits from that land. Contamination may enter in the determination of the land value through several channels: For example, it may reduce the sale price, reduce the purchase price, impose environmental remediation costs, and/or influence the productivity of economic activities on site.

We expect to see some or all of these effects influence the price of a contaminated property, but does the presence of contamination on this property influence the price of nearby commercial and industrial properties? It may if contaminants migrate to surrounding properties and foul nearby soil, water and air—or the market fears that this may happen (Ihlanfeldt and Taylor, 2004).

Public registries of contaminated sites can provide information on the hazardous effects of living near a contaminated property, but how valuable is this information for commercial and industrial activities?[3] Are the values of commercial and industrial parcels affected by the presence of contamination on nearby properties, to the point that owners might apply formal or informal pressures on the owners of neighboring properties to urge them to take precautions against releases of pollutants into the environment?

In principle, policies such as direct financial incentives or tax credits should boost investment in industrial and commercial areas where re-development can prove difficult, and in turn influence the value of these properties. But how much are the effects of these policies reflected on property prices, and can they offset the adverse effects of contamination or location close to contaminated sites?

This paper contributes to the debate on brownfields by investigating the above questions. We are particularly interested in understanding the effect of contamination *risk* on the value of adjacent properties. Our proxy for contamination risk is the placement of a parcel on an official registry of sites with known or suspected contamination, such as the CERCLA Information System and/or the State of Maryland's mini-superfund program database. We also wish to measure the impact on the prices of adjacent properties of a subsequent "no further action" recognition that there is no contamination on the premises.

[3] Decker et al. (2005) looked at the effects of the information provided by the Toxic Release Inventory (TRI) on housing prices in Omaha, Nebraska, and concluded that announcements about TRI pollutant emissions *are* significant determinants of residential housing values. In a different context, other authors have found that the release of information about the existence of pollution and a party's polluter status does have an effect on prices. For example, Konar and Cohen (1997) found that large TRI emitters realized significant company stock price declines on the day that those companies' TRI information was made public, and that those companies subsequently reduced TRI emissions to levels below their competitors. Khanna et al. (1998) found that repeated and persistent information on a firm's poor environmental performance, as measured by TRI releases, leads to statistically significant negative stock price returns.

Focusing on commercial and industrial properties in Baltimore, we first check whether the proximity to a site recorded on the two official registries of (potentially) contaminated sites affects the value of nearby commercial and industrial properties. Second, we check if property values rebound when a formerly contaminated site is cleaned up or a site that was *thought* to be contaminated is found to be clean. Third, we look at how two economic development policies, the State of Maryland Enterprise Zone (ENZ) Program and the federal Empowerment Zones (EMP) have affected commercial and industrial property values in Baltimore.

The answers to these questions should be valuable to policymakers seeking community support and/or funding mechanisms to finance the cleanup of contaminated properties. Both should depend crucially on the appreciation in value ensuing remediation and redevelopment, so it is important to find out if such appreciation truly occurs, and if it is aided by additional urban development policies.

We find that proximity of sites listed on—or de-listed from—registries of contaminated sites impose a negative externality on commercial properties, while industrial property values are virtually unaffected by such proximity.

We also find evidence that urban development policies that offer tax credits for locating a business in specified areas in Baltimore have been reasonably effective in increasing the value of industrial properties, but less so in raising commercial real estate values. To the extent that property values capture attractiveness, we conclude that caution is needed when relying on subsidies or other fiscal measures in Baltimore to boost the development of neglected commercial areas. All policies and incentives will not be equally effective at all land-uses, a conclusion that sounds a common theme with Schoenbaum (2002).

The remainder of the paper is organized as follows. Section 2 reviews the literature on the effects of source sites and non-source sites contamination and of policies to stimulate the growth of neglected areas in inner cities. Section 3 presents the model and the data used for the analysis. Section 4 presents the results of the investigation of commercial and industrial properties in Baltimore city. We offer concluding remarks in section 5.

2. Previous Literature

A. The Effect of Source Site Contamination

In theory, contamination may affect several of the components of the profit of using land for commercial or industrial uses, which in turn influences the value of the property. In practice, how important are these effects for commercial and industrial properties, which often inherit contamination from previous owners?

It is not entirely clear whether the presence of contamination on or near a property slated for commercial or residential use affects its price.[4] One reason why it is difficult to study this issue is that, as Jackson (2001a) notes, only recently have these properties begun to sell with any frequency. Alberini et al. (2004) survey US real estate developers themselves and find that they do not automatically assume that contaminated properties are priced less than comparable, but pristine, parcels.[5]

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[4] By contrast, when attention is restricted to housing prices, several studies have documented the negative effect of the proximity to contaminated sites on the sale prices of homes (Kohlhase, 1991; Reichert et al., 1991; Nelson et al., 1992; Smolen, Moore and Conway, 1992; Kiel and McClain, 1995; Kiel, 1995; Carroll et al., 1996; Dale et al., 1999; Simons, 1999). Boyle and Kiel (2001) survey studies that have used the hedonic pricing method to estimate the prices that households are willing to pay for environmental goods. Of these, 14 look at the distance to toxic or potentially toxic sites.

[5] When asked to express their agreement or disagreement with the statement “Contaminated properties have prices that are depressed relative to market potential,” less than 1 percent of the respondents said that this “never” happens, 6.40% selected an intermediate response category between “never” and “sometimes,” 39.73% said “sometimes,” 39.36% selected an intermediate category between “sometimes” and “always,” and 16.84% opted for the “always” answer.

Simons and Sementelli (1997) compare sale prices of commercial properties with leaking underground storage tanks (LUSTs), properties with non-leaking tanks registered with the State of Ohio (RUSTs) and other commercial properties (baseline) in Cleveland for the years 1989-1992. Both LUST sites and RUST sites transact at significantly lower rates than the baseline commercial properties, but the prices of RUST and LUST sites are not significantly different. Sementelli and Simons (1997) further find that removing a LUST from the registry of contaminated properties after remediation accompanied by a ‘‘no further action’’ letter from the State of Ohio does not improve transaction rates: Only 0.2% of the LUST sites sold after receiving the “no further action” letter. This is much lower than the 10% transaction rate for non-tank commercial properties over the same period and the 4% rate for the LUST sites that did not receive a “no further action” letter.

McGrath (2000) examines the role of contamination *risk* on urban industrial redevelopment in the City of Chicago. Following Noonan and Vidich (1992), he represents contamination risk as the a priori probability of a parcel’s contamination based on historical land use at the site, and finds that contamination impacts the probability that a previously used site is redeveloped both directly, and indirectly, via the differential in price before and after redevelopment.[6]

In one analysis, Jackson (2001b) finds that the prices of previously contaminated industrial properties in California are not adversely impacted relative to comparable but uncontaminated properties. In another, which covers 140 industrial property sales in Southern California in the period 1995-1999, Jackson (2002) finds that industrial contaminated properties sell at prices approximately 30% less than

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[6] McGrath’s theoretical model assumes that land is redeveloped when its value in the redeveloped state is higher relative to its value in the current use. The empirical work models the probability that a commercial or industrial property is redeveloped as a function of the difference in the estimated value of a parcel in its redeveloped state and its current use.

unimpaired levels. After the cleanup had occurred, prices recover to be indistinguishable from comparable uncontaminated properties.

Howland (2000) studies the impact of contamination on demand for and supply of industrial land in Baltimore City. Based on a survey that covers 69 percent of the industrial area, she concludes that documented land contamination is not deterring buyers from purchasing land in the Canton/Southeast area of Baltimore City. Land purchases and redevelopment are occurring on larger parcels, where sellers are willing to lower their price to compensate for the risks and costs associated with owning a site with a history of contamination.

She reports that in the period between September 1995 and September 1996, brownfield sites sold for 55 percent of the price per acre of clean sites, and among brownfield sites, those that were truly contaminated were sold at prices that were, on average, 75% lower than the asking price. Although there is some evidence that business and land owners are reluctant to put parcels on the market, the problem does not appear widespread. Surprisingly, the City of Baltimore appears to be more reluctant to redevelop contaminated parcels than does the private sector.

In another area in Baltimore City—the district known as Carroll Camden in southwest Baltimore—Howland (2004) finds that in the period 1990-2000 parcels with known contamination sold at a 67% discount and parcels with historical reasons to suspect contamination sold at an average 65% discount compared to clean properties in the same areas. Based on interviews with real estate agents, Howland suggests that more important barriers to the revitalization of brownfields in Baltimore City are incompatible land uses, obsolescent road patterns, inadequate water, sewer and telecommunications infrastructure, and obsolete buildings. In our minds, this raises the question whether prices and redevelopment activities are sensitive to other policy variables that imply in-kind subsidies to developers or tax credits.

Schoenbaum (2002) focuses on non-residential parcels in Fairfield, a two square mile industrial area in Baltimore City. Comparison of brownfields to non-brownfield properties to identify variations in assessed land value, vacancy, property turnover, and redevelopment over 1963-1999 suggests no evidence of an association between these measures of value or market performance and brownfield status. [7]

B. The Effect of Non-source Site Contamination

Simons, Bowen and Sementelli (1999) compare transaction rates of commercial properties near LUST sites with other commercial properties in Cleveland. They find that for properties adjacent to LUST sites the transaction rate is 2.7% per year versus 4.0% per year for all other properties, the difference being statistically significant. Next, they compare the incidence of seller financing, which is indeed higher for properties adjacent to LUST sites than for other properties. Finally, they look at sites with sales before and after the discovery of contamination. Based on an analysis of six such sales, Simons, Bowen and Sementelli (1999) conclude that the average decline in value due to the contamination was from 28% to 42%.

Ihlanfeldt and Taylor (2004) study the effects of proximity to hazardous waste sites on commercial and industrial properties. Using sales data for the period 1981-1998 in Atlanta, Georgia, they estimate separate property price gradients both before and after the hazardous waste sites were listed on the Georgia Environmental Protection Division's Hazardous Site Inventory (HSI) or on the CERCLIS database.[8] They find that the announcement of contamination status generates significant

[7] Schoenbaum considers brownfields only those parcels where the possibility of contamination is deemed a reasonable assumption based on the historical and current land use.
[8] See Section 3.B for details on CERCLIS.

negative externality effects on the values of nearby properties. In contrast, prior to the discovery of contamination, proximity to sites that were eventually listed has no influence on the price of surrounding properties. In all cases, the post-announcement gradient is steeper than the pre-announcement gradient.

Ihlanfeldt and Taylor use the price gradients to examine tax-increment financing (TIF)[9] as an option for funding the cleanup of contaminated sites. The total value losses caused by many of the sites are sufficiently large relative to the cost of remediation to justify tax-increment financing as a cleanup option. In their study, Ihlanfeldt and Taylor do not control for other economic development policies.

C. The Effect of Economic Development Incentives

It is widely argued that contaminated properties are located in economically disadvantaged areas (Simons, 1998) and that incentives are needed to encourage their reuse. Wassmer and Anderson (2001) study the use of local economic development incentives within the Detroit metropolitan area,[10] finding that only certain forms of local incentives, at certain times, exert the expected positive influence on the value of commercial and manufacturing property. For example, establishing a TIF authority or a downtown development authority district in the average city in the Detroit area increased the commercial value of properties during the study period. These findings

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[9] Tax increment financing (TIF) is a subsidy originally intended to help redevelop areas that are deemed "blighted" or "distressed." Since the area in the district where TIF is going to be implemented is going to be redeveloped, that means property values will probably go up, and therefore property tax revenues will go up, based on higher assessments. When that increase happens, the property tax revenue from the TIF district is split into two streams. The first stream is pegged to the original property values before the redevelopment; that amount of tax continues to go to the city, county, school district and other taxing bodies as before. The second stream consists of the increase in taxes resulting from the new development and higher property values – the "tax increment." That stream is paid into a special fund used to subsidize some portion of the redevelopment in the TIF district. TIF subsidies may pay for new infrastructure, planning expenses, job training, career education, demolition or rehabilitation of buildings, and cleanup at contaminated areas (LeRoy et al., 2002).

[10] These include industrial development bonds, manufacturing and commercial property tax abatements, tax increment financing, and downtown development authorities.

are tied to issues related to the redistribution of economic activity from the core to the periphery in US metropolitan areas.

On their part, real estate developers claim that they *are* responsive to a broad range of inducements. In surveys in Europe (Alberini et al., 2005) and in the US (Wernstedt et al., 2006) choice experiments reveal that developers can be attracted to contaminated sites by offering them subsidies, liability relief, and less stringent regulation. Prior experience with projects at contaminated sites matters, in the sense that these incentives do not appeal to the same extent to all developers.

3. Study Design, Data and Model

A. Locale of the Study

We focus on industrial and commercial properties in Baltimore, Maryland, a city with an industrial past that has struggled to regain its economic foothold and has many contaminated properties.[11] This should allow us to identify properties with contamination ranging from light to severe. In addition, we wish to compare the results of our research with Howland (2000, 2004) and Schoenbaum (2002), who also studied areas within Baltimore, and with Ihlanfeldt and Taylor (2004), who focused on the Atlanta area, which has experienced much recent growth.

We restrict attention to the arms-length sales[12] of commercial and industrial properties in Baltimore City (US Census County 24510) documented in the Maryland Department of Planning's MDPropertyView from 1990 to 2000, and use these data to

[11] The population of Baltimore has steadily declined since World War II, when many people began leaving the city to move to the suburbs. It has continued to decline over the last decades, decreasing from 786,775 in 1980 to 651,154 in 2000. In 2003, the median household income in Baltimore was $30,078 and the percent of the residents below poverty line was 22.9%. For comparison, the median household income in the entire state of Maryland was $52,868 and the share of the population below poverty line 8.5%. Over the decade from 1990 to 2000, Baltimore *lost* 54,526 jobs, while the State of Maryland created 349,819 new jobs (http://www.fedstats.gov).

[12] We restricted our attention to private sales, and excluded other types of transactions, such as leases, gifts, auctions, foreclosures, straw deeds, tax sales, and confirmatory deeds.

answer three key research questions. First, are property values influenced by the proximity to sites that are potentially contaminated? We consider as potentially contaminated those properties listed on official registries where site investigation and/or the cleanup process are still on-going. Second, once these sites are no longer considered contaminated, do the values of neighboring properties rebound? Third, are commercial and industrial property prices affected by incentives and other development policies?

B. Contamination Risk and Economic Development Policies

To capture the effect of contamination risk, we focus on sites listed on federal or state registries of contaminated or suspect properties because "listing" a site is a public signal of the possible presence of contamination on the premises. The registries we are interested in are US Environmental Protection Agency's CERCLA Information System (CERCLIS),[13] and the State of Maryland List.

Some observers argue that listing a site in a contaminated site registry creates a "stigma" effect that remains present until the site has been removed from the list (Simons, 1999). Other observers have argued that the stigma effect persists even after a site is removed from the registry (Dybvig, 1992).

The stigma effect associated with listing a site in a registry of contaminated sites was apparently one important reason why the US Environmental Protection Agency (EPA) deleted about 25,000 sites from CERCLIS after it established that no

[13] A site is listed in CERCLIS when the US Environmental Protection Agency (EPA) receives information suggesting that a hazardous substance has been or may be released into the environment at that location. CERCLIS also contains sites that have been assessed or addressed by the Superfund Emergency Response program for emergency or time-critical cleanups. Being included in CERCLIS does not mean that the site has been marked for cleanup by the Superfund program, nor does it mean that a hazardous substance has indeed been released there. What it *does* mean is that EPA needs to assess the site, determine whether it poses a risk to human health, and whether remediation is needed. Only sites that are assigned a hazard ranking score of 28.5 or higher are proposed for inclusion in the National Priorities List (NPL). This list currently contains roughly 1,400 sites that are deemed the most egregious for the seriousness and extent of the contamination problem.

further remedial action was needed (US GAO, 1995). Although these sites were not seriously contaminated in the first place, had already been cleaned up under state programs, or were being cleaned up, the EPA felt that developers were reluctant to get involved with them because they remained on EPA's database.

The sites where contamination was suspected but eventually ruled out, or truly existed but was subsequently cleaned up, are those labeled NFRAP (No Further Action Planned) from the CERCLIS Archives.[14] Baltimore City has a total of 29 sites currently in CERCLIS, 16 in the State of Maryland mini-Superfund program registry of contaminated sites during the period 1990-2000, and 88 sites in the CERCLIS Archives.

In 1982 the State of Maryland Enterprise Zone (ENZ) Program was established as an economic development tool to stimulate job creation and business investment through the use of real property tax and employment tax credits in specific areas of the State. Enterprise Zones are designated areas in Baltimore City for which special tax incentives are available to industrial and commercial businesses that hire additional full time workers. To further stimulate economic growth, Baltimore City received a Federal Empowerment Zone (EMP) designation on December 21, 1994, to foster economic opportunities and promote community revitalization through job training, employment tax credits and loan programs to assist residents and businesses. The Baltimore EMP extends over 6.8 square miles, covering three separate areas of

[14] A site is deleted from the CERCLIS database for one of two possible reasons. Either an investigation has shown that the site is not truly contaminated, or the property was contaminated but has been subsequently cleaned up. When a site is removed from the CERCLIS database, it is recorded on the CERCLIS Archive. In 1995, the US EPA removed about 35,000 sites from CERCLIS, placing them in a separate archive, NFRAP, having determined that these sites were no longer considered a potential threat to human health.

east, west, and south Baltimore, and containing over 70,000 people and 2,000 businesses.[15]

C. The Model

We use the sale data to estimate the regression model:

$$\text{(1)} \quad lprice_i = \gamma_0 + \mathbf{x}_i\gamma_1 + LCER\_dist_i\gamma_2 + LNFR\_dist_i\gamma_3 + NUM\_500_i\gamma_4 + + EMP_i\gamma_5 + ENZ_i\gamma_6 + \upsilon_i,$$

where $lprice_i$ is the log transformation of sale price (in 2000 dollars),[16] $\mathbf{x}_i$ is a vector of variables thought to influence property prices, and $LCER\_dist_i$ is the log distance to the nearest suspected site at the time of the sale, if the nearest site is on the CERCLIS database or on the State of Maryland mini-Superfund program registry of contaminated sites, and 0 otherwise. $LNFR\_dist_i$ is the log distance to the nearest site previously thought to be contaminated at the time of the sale, if the nearest site is on the CERCLIS Archive, and 0 otherwise. NUM_500_i, EMP_i and ENZ_i are additional controls, which we explain in more detail in sections 3.D and 3.E below.

[15] There are two additional government program that concern directly contaminated sites and brownfields. The first is the Maryland Voluntary Cleanup program, which was established in 1997 and provides a certificate of completion and release from liability once remediation has taken place and has been approved by the Maryland Department of the Environment (MDE). The VCP law also exempts lenders from liability at a property that has undergone voluntary cleanup. The second program is the Brownfield Program, which is managed by the Department of Business and Economic Development. This program provides economic incentives, such as loans grants, and property tax credits to clean up and redevelop certain properties that are contaminated with oil or other hazardous substances, are located in economically disadvantaged areas, and are located in specified jurisdictions. In this paper, we are unable to examine the effects of these programs: Only one site on CERCLIS and 5 sites on the CERCLIS Archives participated in the VCP after 1997, and only four of the sales we examine occur at a property that underwent voluntary cleanup.

[16] Ideally, we would have liked to deflate prices using a suitable price index for commercial and industrial properties. Unfortunately, we are unable to find such an index, so—assuming that the prices of commercial and industrial properties co-vary with home prices—we adjusted sale prices to the year 2000 using the House Price Indexes (HPI) for Maryland provided by the Office of Federal Housing Enterprise Oversight, available at http://www.ofheo.gov/. The HPI is a broad measure of the movement of single-family house prices. To further account for variations in the commercial and industrial property markets not accounted for by the HPI, we added dummy variables for the year of the sale.

D. Hypotheses about Contamination Risk

Using GIS software, for each property, at the time of the sale, we measure the distance to the closest site on (i) the union of CERCLIS and the State of Maryland's mini-Superfund program registry of contaminated sites, or (ii) the CERCLIS Archives. Let *d* denote the distance from the property being studied to the closest site. We create the variable LCER_dist=ln(d) if the closest site is on (i), and 0 if the closest site is on (ii). The variable LNFR_dist is equal to ln(d) if the closest site is on the CERCLIS Archives, and zero if it is on CERCLIS. (We exclude from the usable sample the 24 sales of parcels listed on any one of the three registries. Note that if a site was listed on a registry only *after* the present sale, we ignore it for the purpose of this calculation.)

In equation (1), the coefficient γ_2 captures the effect of proximity to a site listed on (i). If γ_2 is positive, it suggests that an increase of the distance from a (potentially) contaminated site increases property values. If it is equal to zero, proximity to a (potentially) contaminated site does not impact the value of surrounding properties.[17]

The coefficient γ_3 captures the effect of proximity to a de-listed site. We have no prior expectations on the sign of γ_3: Prices may remain depressed even after cleanup or investigation have shown that the site is not a threat to public health and the environment—the so-called "stigma" effect (γ_3>0). Dale et al. (1999) found that housing property values do rebound after cleanup, so that γ_3 may well be negative.

For a property, we can calculate the price change when the closest listed site is de-listed. This is given by the difference of the coefficients of listing and de-listing multiplied by distance of the site from the listed site:

[17] Because our sale data span the period from 1990 to 2000, we are unable to empirically examine any structural changes due to the passage of the Small Business Liability and Brownfield Revitalization Act, which was passed in 2002.

(2) $\Delta lprice_i = (\gamma_2 - \gamma_3) LCER\_dist_i$.

If the distance to a contaminated site reduces the value of surrounding properties, but deleting a site from a registry of contaminated sites eliminates this effect, then $\gamma_2 - \gamma_3 = 0$. If de-listing a site has no effect whatsoever on the value of nearby properties, then $\gamma_3 = 0$. This would be interpreted to mean that signaling that an area is not a threat to human health and the environment (through de-listing) does not help increase the value of surrounding properties. Finally, de-listing a site may raise the values of property values, without completely offsetting the initial loss of value that occurred with its listing: In this case, $\gamma_2 - \gamma_3 \geq 0$. It is also conceivable that $\gamma_2 - \gamma_3 < 0$, i.e., the rebounding effect is more pronounced that the original depreciation.

Another variable measuring the extent of contamination in the neighborhood is NUM_500_i, the number of contaminated or suspect sites within 500 meters from the property whose sale price is being studied. The coefficient γ_4 gives information on a "density effect." It tells us how the value of a property is influenced by the presence of an additional site that is contaminated or suspect, or was contaminated and has been cleaned up.

E. Other Regressors

When running hedonic pricing regressions on property values, some authors (Wieand, 1973; Bastian et al, 2002; Lynch and Lovell, 2002; Howland, 2002) use price per acre (or its log) as the dependent variable. We cannot do so because we have many missing observations for the square footage of a site. To circumvent this problem our dependent variable is log price of the parcel. We must, of course, control for the size of the parcel, and we do so by creating a missing value dummy, recoding acreage to zero when it is missing, and entering both the recoded acreage variable and the indicator of a missing value in the right-hand side of the price equation.

We further control for capital intensity, measured as the square footage of the buildings divided by the size of the site, the age of the main building, distance to the city center, distance to the Chesapeake Bay, and socio-economic characteristics of the census tract where the properties are located. Table 1 summarizes the variables used in the study.

Finally, two variables, EMP_i and ENZ_i, capture the effect of urban economic development policies. EMP_i is a dummy variable that takes on the value of 1 if property i is within an Empowerment Zone and was sold after 1994, and 0 otherwise; ENZ_i is a dummy variable that takes on a value of 1 if property i is within an Enterprise Zone, and 0 otherwise.

We have no a priori expectation on the signs of γ_5 and γ_6. In principle, one might expect these coefficients to be positive, in the sense that providing these incentives to developers and businesses should make properties more attractive. On the other hand, these designations may capture undesirable neighborhood characteristics that tend to depress property values, in which case these coefficients might be negative (or zero).

F. Estimation strategy

Estimating equation (1) is complicated by the fact that commercial and industrial properties are sold infrequently, and that unobservable characteristics of the parcel may influence both the frequency of its transaction and its price. Since a transaction is observed only when the reservation price of the seller is lower or equal to the transaction price, a sample consisting only of sold properties is affected by a sample selection problem (Gatzlaff and Haurin, 1998), which we address by adopting a two-step Heckman-type approach.

Formally, we observe the sale of a property i at time t only if the profit from the sale is greater than the discounted sum of profits from keeping the property. Therefore, the net profits y* from selling a property can be described by the equation

(3) $$y_{it}^{*} = z_{it}\delta + \eta_{it},$$

where z_{it} is a vector of site characteristics and location attributes, and η_{it} is the error term, which we assume to be i.i.d. standard normal. We observe a transaction price only when net profits $y_{it}^{*} \geq 0$, i.e., when a sale occurs. If the error terms in equation (1) and (3) are correlated ($E(\eta_{it}\varepsilon_{it}) = \sigma_{\eta\varepsilon} \neq 0$), the OLS estimates of the coefficients in equation (1) are biased.

To avoid this problem, we introduce an indicator y_{it} that takes on a value of 1 if a sale occurs, and 0 otherwise. The expectation of price, conditionally on observing a sale, is:

(4) $$E(lprice_{it}|y_{it} = 1) = E(lprice_{it}|y_{it}^{*} \geq 0) = \beta_0 + \mathbf{W}_{it}\boldsymbol{\gamma} + \sigma_{\eta\varepsilon}\frac{\phi(\mathbf{z}_{it}\delta)}{\Phi(\mathbf{z}_{it}\delta)},$$

where **W** is a vector that subsumes all of the right-hand side variables of equation (1), $\boldsymbol{\gamma}$ is the vector of their respective coefficients, $\phi(\bullet)$ is the standard normal pdf and $\Phi(\bullet)$ is the standard normal cdf.

On appending an error term, equation (4) becomes a regression equation that can be estimated using a two-step procedure. In the first step, we estimate a probit equation where the dependent variable is the sale dummy y_{it}:

(5) $$E(y_{it} = 1) = \Pr(y_{it}^{*} \geq 0) = \Phi(\mathbf{z}_{it}\delta).$$

In the second step, we use the probit coefficients to form an estimate of the inverse Mills' ratio in equation (4):

$$(6) \qquad \hat{\lambda}_{it} = \frac{\phi(\mathbf{z}_{it}\hat{\delta})}{\Phi(\mathbf{z}_{it}\hat{\delta})},$$

and include (6) in the right-hand side of the price equation. OLS estimation of this amended price equation gives unbiased estimates. Because the regression equation corresponding to (4) has heteroskedastic error terms, we use heteroskedasticity-robust standard errors to compute t statistics for the coefficients. For identification purposes, we also make sure that **z** in probit equation (5) contains some regressors—such as the distance to a primary highway, to the railway, to a transportation terminal, the percentage of vacant units in the zipcode—that are not included among the **W**s (Wooldridge, 2002, page 564). The vector **z** also includes as the size of the site, capital intensity, and, for industrial parcels, the type of activity carried out at the site.

4. Results

A. Site Characteristics

We run separate regression equations for industrial and commercial properties. Data from the state of Maryland indicate that as of 2000 there were 9,162 commercial and industrial properties in Baltimore, and that 3,039 of these were sold in the period 1990-2000.

Table 2 shows the descriptive statistics for the variables used in the analysis of the properties that were *sold* in the period considered. Commercial properties sold at an average price of $1,358,131, have an average area of 2,035 square feet, and are about 1.4km and 3.3km distant from the Chesapeake Bay and the City Centre, respectively. Retail shops account for about 43% of commercial properties, followed by auto dealerships and other auto services (25%), offices (19%), restaurants (12%) and hotels with less than 1% of commercial sites. Most commercial activities are located in the centre of the city, in periphery and in the area of Canton (see figure 1).

Unfortunately, our dataset contains many missing observations for the square footage of the site's areas and buildings, and for the age of the buildings. The table shows that for the 594 sites for which we have information on the age of the buildings, the average age of the main building on site is about 76 years. The average capital intensity is 0.0186. On average, commercial sites are located at a distance of 1.8km from a site listed on the CERCLIS database or on the State of Maryland mini-Superfund program registry of contaminated sites, and 0.7km from a site on the CERCLIS Archive. There is usually about one listed site within a 500-meters radius from a commercial property. Finally, about 14% of commercial properties sold within an EMP zone and 37% within an ENZ zone.

Industrial properties sold at an average price of $877,163, have an area of 18,557 square feet, are about 1.2km and 3.5km distant from the Chesapeake Bay and the City Centre respectively. Most of the industrial properties (71%) are for storage and warehouses, the remaining being other industrial activities, such as truck terminals, manufacturing, tank farms, and cement plants. Most of the industrial properties sold are located in the south-east (Canton), the south-west (Camden) and the periphery of the city. The main building at the site is about 58 years old and its capital intensity is 0.0091. On average, the industrial sites sold are located at a distance of 0.8km from a site listed on the CERCLIS database or on the State of Maryland mini-Superfund program registry of contaminated sites, and 0.5km from a site on the CERCLIS Archive. On average, there are about 1.4 listed sites within a

500-meters radius from the industrial properties, and about 17% and 45% of the industrial properties sold are in EMP- and ENZ-designated areas, respectively.

For both commercial and industrial properties most sales happened during the second half of the 1990s. We do T-tests to compare the characteristics of sites that were and were not sold during the study period. Briefly, for commercial properties we find that sold properties are located closer to the Chesapeake Bay, are smaller than unsold properties and are mostly located in the city centre. For industrial properties, we do not find significant differences among the characteristics of properties that were sold and those that were not sold during the period we considered.

B. Commercial properties – determinants of price

Table 3 presents the results of the hedonic pricing models for commercial properties in Baltimore city. All of these models implement the sample-selection correction detailed in section 3.[18] Model I is our base model. Models II and III account for the possible effects of the parcel's location in specific areas in Baltimore City.

Model I shows that log price is positively associated with its size and with the degree of development on the property (i.e., capital intensity), even though the coefficients are insignificant, and negatively associated with the age of the main buildings on-site.[19] Properties slated for hotels sell, ceteris paribus, at higher prices

[18] The first-step probit equation includes the following explanatory variables: the area of the site, a companion area-missing dummy, capital intensity, minimum distance to a primary highway, distance to nearest transportation terminal, and other census tract characteristics, such as the percentage of college graduates, the percentage of vacant units, and the percentage of White-Caucasians. Briefly, the result for this model shows that larger properties, properties located close to a transportation terminal and properties located in areas with higher percentage of white and with higher percentage of graduate people were more likely to sell.

[19] We also find that the price of properties for which we have information on their size or on the age of the main buildings is not different from the price of properties where we lack such information.

than properties slated for offices (the reference dummy), followed by auto services, restaurants and retails.

The coefficient of the distance to the Chesapeake Bay has the expected negative sign, and is significant, while the distance to the central business district is not significant. Among the socio-economic characteristics of the census tract, the employment rate and mean household income are positively associated with property prices, while the poverty rate does not affect property prices.

We find mixed results for the EMP and ENZ designations. The coefficient on ENZ designation is negative and significant, suggesting that even though businesses that locate in these areas are eligible for tax credits, these areas are still considered less valuable for commercial activities. When we look at the EMP designation, properties that sold after 1994 in an EMP zone experienced price increases, suggesting that the effects of EMP designation have positively affected property values in the commercial businesses.

Model I of table 3 shows that the distance to a listed site (LCER_dist) and to a de-listed site (LNFR_dist) are positively related to prices, with the coefficient for listed sites being larger than the coefficient for de-listed sites. The elasticity of price with respect to distance from a listed site is 0.0974, and from a de-listed site is 0.0616. F-tests reject the null hypothesis that the coefficients on LCER_dist and LNFR_dist are equal to each other (F-test=6.2), and also the null that both coefficients are identically equal to zero (F-test=7.24), suggesting that proximity to a listed site *does* affect property values for commercial properties and that de-listing *does not* help in eliminating the contamination stigma.

Turning to NUM_500, we find that the coefficient of this variable is significant, and its negative sign suggests that an additional (potentially) contaminated property located within 500 meters from a site decreases the value of that site by 15.33%. For the average site, this means a decrease in its value of roughly $208,000.

C. Commercial properties – controlling for geographical areas

Previous research on commercial and industrial properties in Baltimore city has focused on specific areas of the city. To compare our results with the finding of Howland (2000, 2004) and Schoenbaum (2002), and to allow for geographically diverse effects, we add in Model II of table 3 dummy variables for four areas of Baltimore—Canton, Camden, Centre, and Fairfield—with the Periphery of Baltimore being the reference dummy. The results, shown in column II, show that property prices are indeed affected by location: All else the same, commercial sites in the centre of the city are more expensive than in the periphery and in Camden, with sites in Canton and Fairfield being the least valuable areas in the city. The coefficients of the other variables in the model do not change considerably compared to model I, except for the coefficient of the distance to the central business district (lcbddist), which is now positive and significant. The effect of the distance from a listed or a de-listed site is still positive and significant. An F-test of the null hypothesis of equality of the two coefficients for LCER_dist and LNFR_dist cannot be rejected (F-test=0.18), confirming once again that de-listing does not clear the contamination stigma.

Model III of table 3 further adds interaction terms between the distances to listed and de-listed sites and the area dummies.[20] The results suggest that there may be heterogeneous effects of proximity to listed sites: In the periphery of Baltimore and

[20] The reference dummies are the interaction terms with the periphery of Baltimore. The reader should also note that there were no sites on the CERCLIS database, nor on the State of Maryland mini-Superfund program registry of contaminated sites within the Centre of Baltimore at the time of the observed sales, so we cannot construct and include the regressor LCER_dist*centre.

in Canton, proximity to a listed site causes a negative externality on the value of commercial sites, and de-listing does not clear this effect.[21] In Fairfield, proximity to a listed site has a negative impact on the value of commercial properties, but distance from a de-listed site has no impact on the value of properties.[22] In Camden, both the coefficients for the distances from listed and de-listed sites have *negative* and significant signs.[23] However, concluding that in Camden property values increase with proximity to listed and de-listed sites might be misleading, as Camden is an area rich in commercial and industrial activities and it is likely that the coefficients of the distances to listed and de-listed sites capture other effects more related to the heavily specialized characteristics of the area. In the Centre of the city, we suspect that the positive coefficient of LNFR_dist*Centre is likely to capture stigma effects, or simply other disamenities associated with proximity to the sites on the CERCLIS Archives.

D. Industrial Properties

Table 4 presents the results of the hedonic pricing models for industrial properties. Again, all models implement the sample-selection correction detailed in section 3.[24]

Model I shows that the logarithm of the price of a site is positively and significantly associated with its size, while the coefficient of capital intensity and of

[21] In the Periphery of Baltimore, the F-test of the null hypothesis of equality of the two coefficients for LCER_dist and LNFR_dist cannot be rejected (F-test=0.6); in Canton an F-test of equality of coefficients (LCER_dist + LCER_dist*Canton = LNFR_dist + LNFR_dist*Canton) cannot be rejected (F-test=0.08).

[22] A T-test of the null hypothesis that the sum of the coefficients (lnfrdist + lnfrdist*fairfield) is equal to zero cannot be rejected (F-test=0.85).

[23] An F-test of equality of coefficients (lcerdist + lcerdist*Camden = lnfrdist + lnfrdist*Camden) cannot be rejected (F-test=0.00).

[24] The first-stage probit uses the following regressors: capital intensity, minimum distance to a primary highway, distance to nearest railroad line or spur, distance to nearest transportation terminal, type of activity carried out, the percentage of vacant units and the percentage of White-Caucasians in the census tract. The result for this model shows that properties with high degree of development and properties, such as truck terminals, manufacturing, tank farms, or cement plants were more likely to sell.

the age of the main buildings are positive but insignificant. Properties for which we do not know the size sold for higher prices. Storage sites and warehouses sold at lower prices compared to other industrial activities included in the reference dummy category. The socio-economic variables of the census tract are not significantly associated with prices, except for mean household income, which is positive and significant.

As with commercial properties, the coefficient of the distance to the Chesapeake Bay has the expected negative sign, and is significant. The distance to the central business district is positive and significant, suggesting that industrial properties benefit more from proximity to the shoreline, where most activities are carried out, than to the city centre that may be associated with traffic congestion and difficult access and therefore increase the costs of an industrial activity. This time, the EMP and ENZ designations appear to have been effective in increasing property values, the effects being 38% and 25%, respectively.

Distances to listed and de-listed sites are not significant determinants of prices, all else the same. Industrial property prices do not appear to suffer any externality by the proximity to listed or de-listed sites.[25] Interestingly, we find a positive and significant sign for the coefficient of the number of sites with a history of contamination in a 500 meters radius, indicating that, ceteris paribus, the price of an industrial property increases by 8% with an additional site included in one of the three registries. It is likely that NUM_500 acts as a proxy for a highly industrialized area, a valuable asset in terms of potential synergies for the location of industrial activities.

Models II and III of table 4 add the area dummies and the interaction terms between the area dummies and the two measures of the distance to the listed and the

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[25] An F-test of equality of the coefficients for LCER_dist and LNFR_dist cannot reject the null hypothesis that they are identically equal to zero (F-test=1.08).

de-listed sites, but these do not improve fit. These results confirm that the distance to listed or de-listed sites has little impact on the price of industrial properties.[26]

5. Discussions and Conclusions

It is sometimes speculated that the value of a parcel slated for commercial or industrial uses is influenced by the proximity to a contaminated site, much like residential property values are often found to be negatively affected by proximity to Superfund sites or other environmental disamenities. Ihlanfeldt and Taylor (2004) have found evidence of such an effect in Atlanta, a city with much recent growth but relatively few contaminated sites, so one natural question is whether the same effect is detected in Baltimore, a city that has experienced loss of population and of its manufacturing base in recent decades and has many sites that are contaminated or suspect.

Our hedonic pricing models find that proximity to a site listed on a registry of (potentially) contaminated properties or to one that was de-listed from such a registry causes a negative externality on the value of commercial properties. Based on model I of Table 3, we can calculate that for the average commercial site, holding all other characteristics of the property constant at its sample means, increasing distance from a listed (de-listed) site from 500 meters to 1km causes a 6.98% (4.36%) increase in price, that is an increase equal to \$94,857 (\$59,245). So, unlike in Ihlanfeldt and Taylor (2004), de-listing sites—a public announcement that these sites are no longer considered contaminated—does not improve much the value of surrounding commercial properties.

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[26] A F-test that all the coefficients of the area dummies of Model II are jointly equal to zero cannot reject the null (F-statistic =0.44). An F-test that all the coefficients of the area dummies and all the interaction terms of Model III are jointly equal to zero also fails to reject the null (F-statistic=1.30).

For industrial properties we find no relationship between the distance from a listed or a de-listed site and the value of surrounding industrial properties. As Howland suggests, more important barriers to the revitalization of brownfields in Baltimore City than distance to potentially contaminated sites are "outdated parcel sizes, inadequate roads for modern truck access, outdated and aging infrastructure, incompatible land uses, and unrealistic assumptions about the land's possibilities." (Howland, 2004, p. 208).

Our results confirm the findings of previous studies in Baltimore by Howland (2000, 2004): The proximity to a contaminated or suspected to be contaminated property has little, if any, effect on the value of an industrial parcel in Baltimore City. Our results are also broadly consistent with the findings in Schoenbaum (2002): Policies aimed at enhancing economic growth have had little impact on commercial property values in Baltimore city, but they seem to have worked better for industrial activities.

One possible reason why our results are so different from those in Ihlandfeldt and Taylor (2004) is that the effects of listing on—and de-listing from—a registry of (potentially) contaminated sites depends on the characteristics of the real estate market. Clearly, Atlanta and Baltimore are different cities, both in terms of contamination and of economic activities and growth. We wholeheartedly agree with Ihlanfeldt and Taylor that their "results are specific to Atlanta, and care should therefore be taken in applying them to other areas" (Ihlanfeldt and Taylor, 2004, p. 133). Taken together with those in Ihlandfeldt and Taylor, our results support Jackson's claim (2001a, p. 110) that "urban areas and areas that have stronger market demand may be impacted to a greater degree than rural areas and areas with weaker demand."

Our study bears on the issue of how valuable the information released on the public registries of contaminated properties is. For example, Boyd, Harrington, and Macauley (1996) argue that it is not the environmental liabilities themselves that predominantly distort real estate markets, but rather information asymmetries between buyers and sellers regarding the extent of contamination. However, the evidence from Baltimore suggests that raising awareness about possible contamination, or ruling out that a property might be contaminated, does not necessarily penalize neighboring industrial properties in terms of price. Perhaps prices of industrial property already incorporate a "discount" for the possible presence of contamination and the vicinity to suspect sites that is not dispelled when a site is listed (or de-listed) on registries that can be easily consulted by the public.

Taken together with the results in Howland (2000, 2004) and Schoenbaum (2002), our work has a number of interesting and potentially important implications. The first is that at certain locales there would seem to be little to gain for a developer specializing in industrial/commercial projects from acquiring contaminated properties or properties near brownfields: In Baltimore, these properties are not necessarily cheaper than other non-contaminated but otherwise similar properties. Second, there may be little incentive for a developer to clean up a contaminated property when this property and neighboring properties do not appear to experience increases in values.

Third, based on our results, we surmise that any informal pressure by neighbors on a property or business owner to take care and avoid contamination on the premises is unlikely to be effective: Owners of nearby properties slated for industrial use would not be able to claim that they suffer losses in value due to the presence of nearby contamination, and neither they nor owners of commercial properties would not experience appreciation in the event that a contaminated site is remediated. Finally, another implication of our hedonic models is that there is little potential in Baltimore for public financing schemes for cleanup based on appreciation of property values (e.g., TIF), because property values and revenues would not increase as a result of the cleanup.

In sum, we find that the information contained in publicly accessible registries of contaminated sites has not had much of an effect on industrial properties in Baltimore, and has not been able to clear the stigma on commercial properties due to the previous presence or suspicion of the presence of contamination. Economic development initiatives intended to attract business have worked well only for industrial properties, but less for commercial properties, suggesting that "one size fits all" prescriptions for encouraging environmental remediation and redevelopment through increases in values are unlikely to work at all locales, and that policies may have to be devised based on local conditions.

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Table 1. Description of the variables used in the analysis

Variable name	Description
lprice	Natural logarithm of sale price at CPI values
lareasf	Natural logarithm of square feet of the area + 1
missland	Dummy variable equal to 1 if there is no information on the land area of the site, 0 otherwise
lcapit	Natural logarithm ((area of main building in square feet/land area in square feet) + 1)
age	Age of the main building at the site at the time of the sale
agemiss	Dummy variable equal to 1 if there is no information on the age of the main building, 0 otherwise
poverty	Percentage of residents below the poverty line in the zipcode
hhinc	Mean household income in the zipcode (in 1,000 US$)
employed	Percentage of employed in the zipcode
lcbddist	Natural logarithm of the distance to the Central Business District
lbaydist	Natural logarithm of the distance to the Chesapeake Bay
lcerdist	Natural logarithm of the distance to the nearest site at the time of the sale, if the nearest site is on the CERCLIS database or on the State of Maryland mini-Superfund program registry of contaminated sites, and 0 otherwise
lnfrdist	Natural logarithm of the distance to the nearest site at the time of the sale, if the nearest site is on the CERCLIS Archive, and 0 otherwise
NUM_500	Number of sites with a history of contamination (listed, de-listed, not listed at the time of the sale of site j) within a 500 meter radius distance from site j
EMP	Dummy variable equal to 1 if a site has been sold after 1994 and is located within an Empowerment Zone, 0 otherwise
ENZ	Dummy variable equal to 1 if a site is located within an Enterprise Zone, 0 otherwise
centre	Dummy =1 if property is located in the Center of Baltimore; 0 otherwise
camden	Dummy =1 if property is located in Camden area; 0 otherwise
canton	Dummy =1 if property is located in Canton area; 0 otherwise
fairfield	Dummy =1 if property is located in Fairfield area; 0 otherwise
periphery	Dummy =1 if property is located in the Periphery of Baltimore; 0 otherwise (reference dummy, excluded in the regressions)
hotels	Dummy =1 if commercial activity is a hotel; 0 otherwise
autos	Dummy =1 if commercial activity is Auto Dealerships, Service Stations, Car Washes, Auto Service; 0 otherwise
restaurants	Dummy =1 if commercial activity is a restaurant; 0 otherwise
retails	Dummy =1 if commercial activity is a retail shop; 0 otherwise
offices	Dummy =1 if commercial activity is an office; 0 otherwise (reference dummy, excluded in the regressions)
storage	Dummy =1 if industrial activity is a storage activity; 0 otherwise
othindu	Dummy =1 if industrial activity is truck terminals, manufacturing, tank farms, or cement plants; 0 otherwise (reference dummy, excluded in the regressions)

Table 2. Descriptive statistics of commercial and industrial properties sold in Baltimore city in the period 1990-2000.

	Commercial			**Industrial**		
variable	mean	st dev	Obs	mean	st dev	Obs
price	1,358,131	3,921,895.98	2430	877,163.3	2,965,120.4	609
lareasf	7.6182	1.6356	885	9.8286	1.7790	338
missland	0.6358	0.4813	2430	0.4450	0.4974	609
lcapit	0.0091	0.0574	2430	0.0186	0.1036	609
age	72.6902	23.4729	594	58.1779	25.6221	281
agemiss	0.7527	0.4315	2430	0.5271	0.4997	609
employed	0.9168	0.0536	2430	0.8938	0.0664	609
poverty	0.2425	0.1344	2430	0.2473	0.1520	609
mhhin	30.2728	9.8345	2430	28.0670	8.8472	609
lbaydist	7.2540	1.2956	2430	7.0958	1.2304	609
lcbddist	8.1056	0.6531	2430	8.1771	0.6619	609
LCER_dist	0.7489	2.2701	2430	1.2314	2.6596	609
LNFR_dist	5.7346	2.2906	2430	4.9619	2.7831	609
NUM_500	0.9152	1.8296	2430	1.4056	2.1677	609
emp	0.1444	0.3516	2430	0.1741	0.3795	609
enz	0.3753	0.4843	2430	0.4499	0.4979	609
hotels	0.0058	0.0757	2430			609
autos	0.2547	0.4358	2430			609
restaura	0.1193	0.3243	2430			609
retails	0.4296	0.4951	2430			609
offices	0.1905	0.3928	2430			609
storage				0.7094	0.4544	609
othindu				0.2906	0.4544	609
centre	0.3432	0.4749	2430	0.1182	0.3231	609
camden	0.1416	0.3487	2430	0.2578	0.4378	609
canton	0.2029	0.4022	2430	0.3103	0.4630	609
fairfield	0.0288	0.1673	2430	0.0591	0.2360	609
periphery	0.2835	0.4508	2430	0.2545	0.4359	609

Table 3. Hedonic models for commercial properties, dependent variable is natural logarithm of price, heteroskedasticity-robust t-statistics. All models include year-specific dummies.

	Model I		**Model II**		**Model III**	
	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio
intercept	11.7962	7.93	10.5757	6.35	10.8359	6.19
lareasf	0.1271	1.16	0.0989	0.89	0.0965	0.87
missland	0.4663	0.48	0.1447	0.15	0.1340	0.14
lcapit	0.7305	1.22	0.9249	1.55	0.8509	1.42
age	-0.0128	-4.61	-0.0114	-4.09	-0.0127	-4.43
agemiss	0.3878	1.63	0.3412	1.38	0.2323	0.92
employed	4.2000	4.14	3.0743	2.99	2.9881	2.91
poverty	0.0821	0.19	-0.5897	-1.30	-0.6248	-1.38
mhhin*1000	0.0186	4.56	0.0138	3.37	0.0164	3.83
lbaydist	-0.5060	-12.10	-0.5781	-9.62	-0.6047	-9.78
lcbddist	-0.0037	-0.05	0.3105	2.46	0.3269	2.44
LCER_dist	0.0974	3.33	0.0770	2.67	0.0673	2.12
LNFR_dist	0.0616	2.25	0.0705	2.65	0.0536	1.67
NUM_500	-0.1533	-6.80	-0.1272	-5.37	-0.1168	-4.77
emp	0.6953	5.13	0.6043	4.40	0.5086	3.78
enz	-0.2224	-3.19	-0.2127	-2.94	-0.2275	-2.96
hotels	1.6235	3.09	1.6370	3.21	1.6309	3.17
autos	-0.0243	-0.24	-0.0079	-0.08	0.0144	0.14
restaurants	-0.4268	-4.22	-0.3952	-3.81	-0.3324	-3.17
retails	-0.5492	-6.98	-0.5107	-6.56	-0.4707	-6.06
centre			0.2659	2.31	-1.4016	-2.25
camden			0.0076	0.04	1.3431	2.20
canton			-0.4339	-4.45	-0.9962	-2.04
fairfield			-0.9665	-4.62	0.6294	0.56
LNFR_dist*centre					0.2721	2.89
LCER_dist*fairfield					0.4112	2.10
LNFR_dist*fairfield					-0.2462	-1.56
LCER_dist*camden					-0.2301	-2.60
LNFR_dist*camden					-0.2146	-2.30
LCER_dist*canton					0.0806	1.06
LNFR_dist*canton					0.0817	1.17
inverse mills ratio	-1.1765	-1.33	-0.4398	-0.48	-0.3904	-0.43
Obs.	2430		2430		2430	
Adj. r-squared	0.44		0.45		0.46	
F-value	64.38		59.72		51.34	
F test:lcerdist=lnfrdist	6.2		0.18		0.6	
F test:lcerdist=lnfrdist=0	7.24		4.51		2.48	

Table 4. Hedonic models for industrial properties, dependent variable is natural logarithm of price, heteroskedasticity-robust t-statistics. All models include year-specific dummies.

	Model I		**Model II**		**Model III**	
	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio
intercept	1.3911	0.48	0.3263	0.11	0.4737	0.15
lareasf	0.5333	11.15	0.5323	11.13	0.5454	11.65
missland	5.3019	9.66	5.3154	9.68	5.4996	10.31
lcapit	0.2910	0.37	0.2410	0.30	0.1863	0.24
age	0.0036	1.39	0.0035	1.36	0.0035	1.36
agemiss	0.3597	1.73	0.3241	1.56	0.3357	1.61
employed	1.9193	1.37	1.8057	1.22	1.8241	1.23
poverty	-0.6497	-1.03	-0.6736	-1.07	-0.7670	-1.18
mhhin*1000	0.0163	2.07	0.0179	2.15	0.0165	1.95
baydist	-0.2687	-4.79	-0.2291	-3.07	-0.2658	-3.36
cbddist	0.3456	2.88	0.3980	2.48	0.3846	2.30
LCER_dist	0.0215	0.55	0.0165	0.41	0.0236	0.44
LNFR_dist	-0.0097	-0.27	-0.0090	-0.25	0.0316	0.60
NUM_500	0.0840	3.21	0.0860	3.12	0.0880	3.06
emp	0.3857	2.24	0.3803	2.16	0.4296	2.46
enz	0.2502	2.07	0.2377	2.03	0.1610	1.34
storage	-0.5274	-3.62	-0.5399	-3.67	-0.5014	-3.42
centro			0.2593	1.12	0.3577	0.33
camden			0.2189	1.10	-0.3785	-0.50
canton			0.1721	0.99	0.9681	2.04
farfield			0.1617	0.60	-0.7978	-1.20
LNFR_dist*centre					-0.0313	-0.18
LCER_dist*fairfield					0.1314	1.20
LNFR_dist*fairfield					0.1503	1.45
LCER_dist*camden					0.1146	1.04
LNFR_dist*camden					0.0985	0.89
LCER_dist*canton					-0.0349	-0.39
LNFR_dist*canton					-0.1545	-1.91
inverse mills ratio	2.3433	1.97	2.6100	2.16	2.5137	2.02
Obs.	609		609		609	
Adj. r-squared	0.33		0.33		0.33	
F-value	12.27		10.71		9.15	
F test:lcerdist=lnfrdist	2.14		1.2		0.05	
F test:lcerdist=lnfrdist=0	1.08		0.61		0.16	

Figure 1. Baltimore City

CEN = Center of Baltimore
CAN = Canton/Southeast
CAM = Camden
FAIR = Fairfield
REST = Periphery of Baltimore

Figure 2. Contaminated and potentially contaminated sites in Baltimore City

Figure 3 Baltimore City, Enterprise Zones

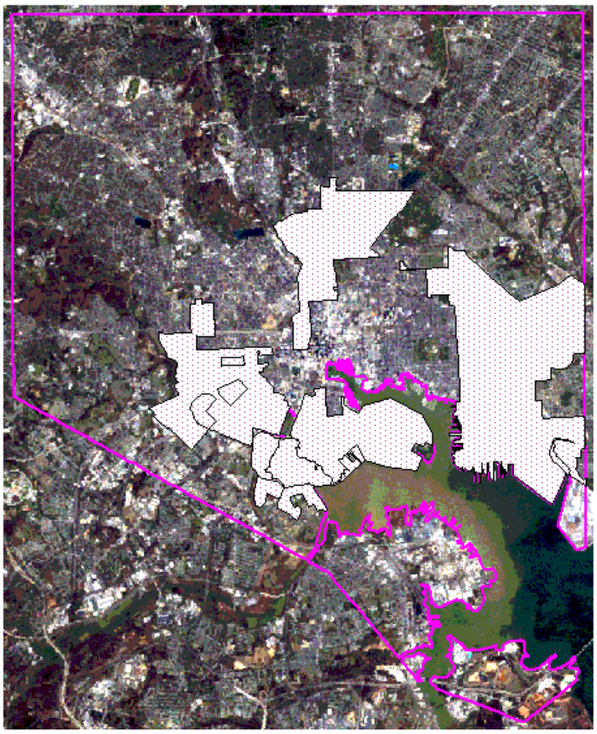

Figure 4. Baltimore City, Empowerment Zones