Hedonic analysis of hazardous waste sites in the presence of other urban disamenities

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Abstract

Hedonic research indicates that residential property values are reduced by increased proximity to hazardous waste sites, a measure of diminished environmental quality. Standard hedonic procedures measure proximity by the linear distance between a property and a waste site of interest. A sample of properties is then used to estimate a distance-to-site coefficient that measures the effect of the hazardous waste site on surrounding property values. These estimates can help policy makers assess the external effects of hazardous waste sites and may also be useful in both prioritizing and assessing the benefits of cleanup. In an urban situation, hazardous waste sites are often located near other industrial disamenities such as railroads, storage tanks, industrial noises, and air pollution. This spatial grouping of hazards may be due to economic forces or due to policy instruments such as zoning. As a result, distance to hazardous waste site may be correlated with distances to other industrial disamenities. Standard hedonic procedures that use a distance-to-site variable may suffer from omitted variable bias when the bundled industrial disamenities are present but ignored. Our empirical analysis examines this bias by assessing hedonic regressions with and without a measure that accounts for industrial activity.

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Keywords: Industrial disamenities; Hedonic analysis; Spatial correlates; Superfund; Omitted variable bias

1. Introduction

Contamination of land with toxic materials is a worldwide environmental problem. In the major industrial nations, the OECD has identified 475,000 potentially contaminated sites and estimates that US$ 330 billion may be required to contain contamination at these sites (OECD, 2001). Since 1980, the Superfund program has made major efforts to clean up and contain hazardous waste sites in the United States (Probst et al., 2001). Hedonic analysis provides one method of assessing the economic damage of hazardous waste sites. Hedonic analysis measures the adverse impact of a site’s hazards on property values in the areas surrounding the site (Farber, 1998; Boyle and Kiel, 2001; Jackson, 2001). This paper examines the performance of the hedonic method in an urban setting where multiple perceived hazards may be grouped together in industrial zones.

The hedonic hypothesis is that goods are valued for their utility-bearing attributes (Rosen, 1974). Statistical methods such as regression analysis are used to measure the value of a particular attribute, taking into account additional attributes associated with the particular good under study. Many hedonic studies examine the value of attributes that contribute to overall housing value. In these studies housing prices are often used as the dependent variable and explanatory variables generally include structural characteristics of the house, neighborhood, and measures of environmental quality. A measure of the distance between each home or neighborhood to the nearest hazardous waste site is used as one measure of environmental quality (Kohlhase, 1991; Kiel and McClain, 1995; Hite et al., 2001; Kiel and Zabel, 2001; Ihlanfeldt and Taylor, 2004). A hazardous waste site is generally viewed as disamenity, a negative influence on perceptions of environmental quality. Reduced proximity to hazardous waste sites becomes a
measure of environmental quality, a valued attribute of property.

In urban areas, hedonic analysis confronts a problem insofar as industrial disamenities are bundled together by economics and by policies such as zoning. It is not surprising to find high tension power lines, railroads, and storage tanks located in industrial zones in order to serve industrial demands for power and transportation. Metal and plating shops are likely to locate near manufacturers that require their services. Waste facilities locate near waste producers in order to reduce handling and transportation costs. Each of these industrial services and activities has demonstrated an impact on property values. Hazardous waste sites have a negative impact on property values (Ketkar, 1992; Kiel, 1995; Kohlhase, 1991; Thayer et al., 1992) and so do other types of sites associated with industrial activity, such as overhead power lines (Colwell, 1990), pipelines (Maani and Kask, 1991; Simons, 1999), incinerators (Kiel and McClain, 1995), storage tanks (Simons et al., 1997), and railroad tracks (Strand and Vagnes, 1990).

The bundling of hazards in industrial zones has significant implications for hedonic analysis and its interpretation. First, a single distance-to-site coefficient is likely to measure the marginal impact of a particular type of site, as well as impacts of other zonal hazards. Second, the particular site of interest is only one of a portfolio of disamenities. Failure to differentiate one disamenity from the portfolio of disamenities may explain anomalies in previous hedonic research. For example, Colwell (1990) finds the property value affect of power lines decreases over time. Other studies indicate that property prices may not rebound when a site is cleaned up (Kiel, 1995) or may dissipate when a site is closed, but not cleaned up (Guntermann, 1995).

This analysis uses hedonic methods to estimate the marginal effect of reduced proximity to Superfund hazardous waste sites in an urban area of the United States—Lansing, Michigan. Superfund sites are hazardous waste sites that have been evaluated by the US Environmental Protection Agency (EPA) as posing the most serious health and environmental threats, relative to other hazardous waste sites and are on the EPA’s National Priorities List (2000) for remedial action. These sites can have cleanup paid from the Superfund, the national hazardous waste trust fund.

Two hedonic regressions are examined; one regression omits a measure of industrial activity and the other regression includes a measure of industrial activity. The distance-to-hazard coefficient in the former regression is larger than the same coefficient in the latter equation, a finding consistent with our hypothesis. These empirical results support our primary argument that many urban spaces are best conceptualized as ‘bundles’ or ‘portfolios’ of disamenities and environmental risks. Empirical approaches that focus on one element of the portfolio—e.g., Superfund sites—may, as in our case example, exaggerate the impact that the one element has on surrounding property values. The potential implications for environmental science and management are straightforward. In situations where hazardous waste sites are spatially correlated with industrial activity there may be multiple investment strategies for mitigating the damages caused by environmental disamenities. Emphasis on one source of environmental hazards, when there are many, may not achieve the greatest benefits for surrounding residents.

2. Examining omitted variable bias

Our general hypothesis is that the hazard effect, the property value impact of hazardous waste sites, is biased upwards by the omission of a variable that accounts for the industrial effect—the property value impact of industrial disamenities. The hedonic price function is specified such that the residential sales price of a home is a function of neighborhood and environmental characteristics, structural characteristics of the home, and the year that the home was sold. Economic theory provides little guidance regarding the choice of functional form (Freeman, 1993) and hence, regressions are often examined under alternative functional specifications (Irwin, 2002). For the purposes of our discussion on omitted variable bias, the hedonic price model is specified as follows:

\[
P_i = \beta_0 + \beta_1 D_i^H + \beta_2 D_i^I + \theta Z_i + \Phi Y_i + u_i
\]  

(1)

where the price of a house, \( P_i \), is a function of: (1) proximity to hazardous waste sites, \( D_i^H \); (2) proximity to areas of high industrial activity, \( D_i^I \); (3) a set of dummy variables to account for the year in which the house was sold, \( Y_i \). The error term, \( u_i \), is assumed to have a conditional mean of zero and a constant variance. Table 1 provides the full set of variables we use to estimate the hedonic price function.

The hazard variable, \( D_i^H \), measures distance from each house, \( i \), to the nearest Superfund site. The standard hypothesis is that reduced proximity to the hazardous waste site results in reduced perceptions of exposure and subsequently results in a marginal increase in property value. Thus, \( \beta_1 \) is hypothesized to be positive. However, in situations where a hazardous waste site is spatially correlated with zones of industrial activity, residents’ perceptions of exposure to the disamenities of any one site may be confounded with the portfolio of disamenities that characterize industrial activity. In these situations the hazard variable is spatially correlated with zones of high industrial activity, a bundle of disamenities. In these situations a correctly specified model includes a measure of residential exposure to industrial activity. One measure,
each home’s straight-line distance to the perimeter of the nearest area zoned as highly industrial, \(D_{IH}\), is included and therefore, \(\beta_2\) is also hypothesized to be positive.

The inclusion of an industrial measure allows us to develop hypotheses concerning the bias that results from a failure to include a measure of industrial activity. The expected value for \(\beta_1\), \(E(\tilde{\beta}_1)\) when the industrial variable is omitted from empirical estimation is:

\[
E(\tilde{\beta}_1) = \beta_1 + \beta_2 \frac{\text{Cov}(\text{distance}_1, \text{distance}_2)}{\text{Var}((\text{distance}_1))}
\]

where \(E(\tilde{\beta}_1)\) depends on unbiased estimates of \(\beta_1\) and \(\beta_2\), the covariance between the hazard and industrial variables, and the variance of the hazard variable (Wooldridge, 1999, p. 92). We use Eq. (2) to develop directional hypotheses rather than exact measures of bias. Under the hypothesized relationships—\(\beta_1 > 0, \beta_2 > 0, \text{Cov}(\text{distance}_1, \text{distance}_2) > 0\)—the omission of the industrial variable is expected to place an upward bias on estimates of the hazard coefficient (\(E(\tilde{\beta}_1) > \beta_1\)).

3. Study area and data collection

The city of Lansing, Michigan encompasses an area of approximately 33.8 square miles with a total population of 119,128 persons (US Census Bureau, DP-1, MI, 2000). Lansing is also the state’s capital. The property value and household income levels in Lansing are lower when compared to the rest of the state. For example, the 1990 median value of housing in Lansing was $48,400 as compared to the median value of housing in the state which was $60,600 (US Census Bureau, DP-1, Lansing City, 1990; US Census Bureau, DP-1, State of Michigan, 1990). Moreover, the 1990 median household income for the city of Lansing was $26,398 while the median household income for the state of Michigan was $31,020 (US Census Bureau, DP-4, Lansing City, 1990; US Census Bureau, DP-4, State of Michigan, 1990).

We examine housing proximity to two Superfund sites, Motor Wheel and Barrels, Incorporated (Inc.). Both sites are historically and presently linked to industrial activity. The 24
The Lansing Assessor’s office provided data on residential housing sales and associated structural characteristics for the years 1992–2000. The universe of sales available to the Assessor’s office includes all housing sales registered by the counties in which the city of Lansing lies. We examined sales considered to reflect arm’s length transactions that involve independent buyers and sellers in competitive bargaining situations. For example, quick claim deeds were not considered because they often reflect transactions between buyers and sellers who are familiar (e.g., related) to each other.

Geographic information systems (GIS) were used to determine the straight-line distance between housing observations and the perimeter boundary of the nearest Superfund site (either Barrels, Inc. or Motor Wheel). The perimeters of the Superfund sites were mapped using a global positioning system. The coordinates were applied to the base map files using 1990 Tiger Base File maps and Michigan framework data. GIS was also used to measure the straight-line distance from each housing sale to the area zoned as ‘high industrial’. The assessor’s office provided a boundary map of areas zoned as high industrial. The boundary areas for high industrial remained stable over the time period we analyze.

The police department provided the data enabling the specification of a crime variable. The number of malicious
destruction of property violations—damaging someone’s property with unlawful motives—that occurred in each block group for 1996 defines the crime variable. The neighborhood characteristics of income, education, race, ethnicity, rent, and commute (defined in Table 1 in the next section) come from the 1990 US Census summary tape file # 3. We used GIS to link the location of each housing sale with the census data.

4. The econometric model

The empirical analysis uses the Lansing data to estimate a hedonic price function analogous to Eq. (1). Table 1 describes the dependent and the independent variables used to estimate the hedonic price function. Section 2 provided testable hypotheses regarding the housing price effect of the two distance variables, hazard and industrial. In addition, omitting the industrial measure was hypothesized to bias estimates of the hazard effect upwards. This section provides hypotheses for the relationship between residential housing prices and the remaining independent variables.

All else constant, an increase in housing prices is hypothesized to result from increases in the number of bathrooms, square footage, floor area, and acreage of the home. Increases in the age of the home are hypothesized to cause a decline in housing values, all else constant. The price effect associated with the style of the home (i.e. one-story versus two-story) is uncertain given the fact that the model controls for floor area. However, it may be that construction costs or preferences differ by housing style. Thus, categorical variables are included to account for different housing styles.

Quality of neighborhood measures such as crime, income, education, and percentage of renters were also included as variables in the hedonic price function. The occurrences of crime in a neighborhood may adversely affect housing values. The number of reported cases of malicious destruction of property is used as a proxy for the total occurrence of crime in the area and is included in the hedonic price function. Higher levels of neighborhood income and education are presumed to be valuable neighborhood attributes. Therefore, higher levels of income and education in a neighborhood are expected to raise housing prices. The percentage of renters in a neighborhood may also affect the price of housing in a neighborhood. Renters may have less incentive to invest in property or neighborhood maintenance than residential homeowners. Thus, higher percentages of renters in a neighborhood are hypothesized to adversely influence surrounding housing prices, all else constant.

Three additional variables that this study uses are the race, ethnicity, and a commute variable. The race and ethnicity of a neighborhood have been shown to influence housing prices, thus these variables are included in the analysis (Cutler et al., 1999; Massey and Denton, 1988). Greater proximity of households to areas of employment should reduce the costs of commuting and this savings may be capitalized into property values and potentially result in higher housing prices. The commute variable measures the percentage of those whose commute to work is less than 20 minutes in a specified neighborhood. Higher levels of the commute variable are expected to result in higher housing prices, all else constant.

Because the hedonic price function measures the locus of supply and demand, there is little information to guide an initial choice of functional form (Freeman, 1993). Our initial model presumes a log-log relationship between price of the house and proximity to the hazardous waste site and proximity to areas of high industrial activity. Thus, the marginal effect of exposure to a hazard, as measured by distance-to-site, is expected to decrease at a decreasing rate as distance between the site and the residence increases. The remaining relationships between housing price and housing attributes are specified as a log-level function, with the exception of floor area, age of the house, and income, which also appear in logarithmic form. However, we examine the sensitivity of our empirical results to alternative specifications including both quadratic and log-level functional forms.

Palmquist (1992) and Kiel and Zabel (2001) argue that the externalities associated with hazardous waste sites are likely to be ‘localized’; that is, the externality affects those in relative close proximity to the site. For this reason, and because of the difficulties inherent in correctly specifying a hedonic price function for an entire urban area, Palmquist estimates the hedonic price function over a smaller, more homogenous area than the entire urban market. Following Palmquist’s reasoning this study focuses on a smaller area. In the case of Lansing, the city is divided into a northern and southern segment by a major east-west expressway. Since the Superfund sites under examination are in the northern portion of that northern segment, we examine housing sales in the area north of the expressway. Also, we do not include housing sales from housing locations that were relatively closer to a Superfund site located north-west of Lansing, outside the city’s incorporated area. As in the case of functional form, we examine the sensitivity of our results to a number of alternative spatial specifications.

5. Empirical estimates and regression results

Table 2 lists the means and standard deviations of the dependent and explanatory variables. The data means are fairly close to Census data discussed above in Section 3. For example, the average value of a house in the data set was

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1 The United States Census Bureau takes a census of US population and housing every 10 years. File # 3 reports this information at the block level. When the data for this study were collected, the 1990 Census data were the most current data available.
approximately $49,000. The median housing value for Lansing, as provided by the 1990 census, was approximately $48,000.

Ordinary least squares is used to estimate the hedonic price function. Table 3 lists the estimated coefficient for two versions of the hedonic equation, Model 1 and Model 2. Model 1 is a hedonic price function that includes a hazard variable, but omits the industrial variable. Model 2 includes both the hazard and industrial measures. A Breusch–Pagan test rejected the null hypothesis of homoscedastic errors for both models (Wooldridge, 1999, p. 257). Consistent estimates of the standard errors were obtained for both models using White's method (Wooldridge, 1999).

The results from Model 1 are consistent with standard expectations—increased proximity to hazardous waste sites reduces the environmental quality of an area and thereby, reduces housing prices. The coefficient for the hazard effect is positive so that increased distance to a site increases housing prices. The coefficient is also statistically different from zero at the 95% confidence level. The coefficient indicates that a 10% increase in distance from a Superfund site increases house prices by 0.32%.

However, the results from Model 2 that includes an industrial variable, presents a decidedly different coefficient estimate for the hazard effect. In Model 2, the coefficient for the hazard effect, 0.012, is nearly two-thirds the size of the coefficient estimate for the hazard effect in Model 1. The industrial effect coefficient is statistically different from zero at the 95% confidence level. The industrial effect coefficient shows that a 10% increase in distance from an industrial area increases housing prices by 0.29%.

The above results are consistent with the hypothesis that omitting the industrial variable (i.e., Model 1) leads to an upwards bias on the coefficient estimates for the hazard variable, \( \hat{\beta}_1 \). Eq. (2) provides the framework for that hypothesis. The furthest right hand term, in equation two, suggests an upwards bias if both the coefficient estimates for the industrial variable \( \beta_2 \) and the covariance between the hazard and industrial variables, are positive. As discussed
above, the coefficient estimate for the industrial variable is positive. Also, the covariance between the hazard and industrial variable is positive. Therefore, the furthest right hand term in equation two is positive and $\hat{\beta}_1$ is expected to be greater than the coefficient estimate of the hazard variable, $\beta_1$, generated from the correctly specified model.

While Eq. (2) is useful for predicting the direction of omitted variable bias, it is unlikely to provide an exact calculation of the bias because it assumes zero correlation between the distance variables and all other independent variables. Hence, differences between the hazard effect in Model 1 and Model 2 cannot be exclusively attributed to the inclusion of the industrial variable. Still, it may be instructive to predict, $\hat{\beta}_1$, using equation two and compare the estimate with Model 1’s coefficient estimate for $\beta_1$. Model 2’s coefficient estimates for the hazard and industrial variables, $\beta_1$ and $\beta_2$, are provided above. The covariance between the hazard and industrial variable is approximately 0.333, and, the variance of Model 2’s hazard variable is 0.313. Putting this information into equation two predicts $\hat{\beta}_1$ to be approximately 0.04, slightly higher than Model 1’s $\beta_1$ coefficient, .032. Both coefficients, $\hat{\beta}_1$ and Model 1’s $\beta_1$, are greater in magnitude then Model 2’s $\beta_1$ coefficient, and this is consistent with the hypothesis that the hazard coefficient is biased upwards by the omission of the industrial variable.

The estimated coefficients of the other variables in the hedonic price function were generally consistent with a priori expectations. The floor area of the home and the age of the house were found to be important factors explaining variation in housing values. For example, both Model 1 and Model 2 coefficient estimates of floor area suggest that a 10% increase in floor space raises the housing price by approximately 7%. Moreover, the floor area coefficient is statistically different from zero at the 95% level. Both models also suggested that increases in the age of the house affected a decline in the house’s value. A 10% increase in the age of the house decreases housing prices by 2%. Neither acreage coefficient nor the number of bathrooms coefficient were statistically different from zero.

The estimated coefficients for income, education, and commute variables suggest that homes located in neighborhoods characterized by higher incomes, higher levels of education, and in greater proximity to areas of work are associated with relatively higher housing prices, all else constant. With the exception of the commute variable, the coefficient estimates are statistically different from zero at conventional significance levels. Increases in the percentages of minorities and renters in a neighborhood are associated with relatively lower housing prices. These estimates are also statistically different from zero. Higher levels of crime, as measured by malicious destruction of property, were also hypothesized to be associated with lower property values, all else constant. However, the coefficient for the crime variable is not statistically different from zero at conventional levels of significance.

6. Sensitivity analysis

This section examines the sensitivity of the empirical results to alternative empirical specifications. The paper’s primary result supports the hypothesis that omitting the industrial variable places an upwards bias on coefficient estimates of the hazard effect. Hence, Model 1’s estimate of the hazard coefficient is expected to be greater than Model 2’s coefficient estimate. Specifically, we address the following issues: (1) whether the primary result is sensitive to semi-log or quadratic functional forms; (2) whether the primary result changes over time; and, (3) whether the primary results are sensitive to different spatial considerations.2

Two functional forms were examined as alternatives to the double-log form of the main results. The first alternative used the logarithm of the dependent variable regressed on the unlogged levels of the distance variables. In this log-level form, the sign of the hazard coefficient was unstable. It was positive and statistically different from zero in Model 1 where industrial activity was omitted from the equation. It was negative and statistically different from zero in Model 2, the model that included an industrial variable. These findings are qualitatively identical to those of the double-log model.

The second alternative was a quadratic function. The logarithm of the dependent variable was regressed on the distance variables that appeared in both a level and squared term. The hazard effect did not appear to decline in model 2. This result is qualitatively different from the log–log and log-level specifications discussed above. However, there is a great deal of additional correlation introduced by the squared distance terms. The squared terms were highly correlated with each other and, in addition, each squared term was highly correlated with the hazard and industrial variable. These correlations make it even more difficult to interpret the coefficients of interest separately.

In order to examine the sensitivity of our results over time, the hedonic price function (as specified in Eq. (1)) was estimated for three epochs: 1992–1994, 1995–1997, and 1998–2000. The hazard coefficient was larger in Model 1 and appears to be inflated, in each epoch, by the omission of the industrial variable. Moreover, in the epochs 1992–1994 and 1998–2000 the sign and statistical significance, associated with the hazard and industrial variables, are consistent with the findings presented in the preceding section. Surprisingly, the 1995–1997 coefficient estimates of hazard and industrial were not statistically different from zero at even the 90% confidence level.

The Superfund sites in our study are located within a mile (0.92 mile) of each other. Thus, it is possible that some residents, in some locations, perceive exposure to both sites. In these situations our measure of environmental quality,

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2 Econometric results pertaining to the sensitivity analysis will be made available upon request to the authors.
distance to the nearest site, may not capture the agglomeration effect. This may not, however, pose a major
problem. In a recent hedonic study, Ihlanfeldt and Taylor (2004)) find that the “... primary spillover effect of
hazardous waste sites occurs through proximity to the
closest site and not through the density of sites (p. 129).” We
recognize that distance to nearest Superfund site is not a
perfect measure of the environmental quality influence of
hazardous waste sites. Nevertheless, given the agglomera-
tive effects already explicit in the analysis (i.e. hazardous
waste sites and zones of industrial activity) and the
precedent in previous literature, distance to the nearest site
remains a reasonable, albeit imperfect, measure.

We do, however, examine the sensitivity of our results to
a number of alternative spatial assumptions. The first
alternative reduced the area under examination to housing
sales within a mile of the hazardous waste sites. The
regression estimates support our primary finding—the
omission of the industrial variable appears to place an
upwards bias on the estimate of the hazard coefficient
estimate. In the second alternative, the housing data was
divided into two subsets. The Motor Wheel data contained
only the data for the homes nearer the Motor Wheel site. The
Barrels data contained only data for the homes closest to the
Barrels, Inc., site. Additional regressions restricted data to
examine housing sales within a mile of one of the site. In
the regression for Motor Wheel, Model 1 coefficient estimates
for hazard were higher than Model 2 coefficient estimates.
This was also true for regressions that restricted the area of
inquiry to housing sales within a mile of the site.

Limiting the data to sales that were relatively closer to
Barrels Inc., generated coefficient estimates of the hazard
variable that were consistent with expectations for bias but
were not statistically significant. However, restricting the
regression to examine housing sales within a mile of the
Barrels site generated coefficient estimates of the hazard
effect, in Model 1 and Model 2 that were statistically
significant. Moreover, in the restricted regression, omitting
the industrial measure inflates coefficient estimates of the
hazard effect as expected.

We are not able to test the sensitivity of our results using
spatial econometrics, an econometric approach that includes
measures to account for the spatial dependence between
observations (Brasington and Hite (forthcoming), Ihlanfeldt
and Taylor (2004), Leggett and Bockstael (2000)).

Brasington and Hite argue that the use of “spatial statistics”
in hedonic analysis can capture the influence of all omitted
variables that vary across space (p. 7). However, they do not
discuss how the parameter estimates of the hedonic price
function are influenced by spatial measures of dependence.
Ihlanfeldt and Taylor (2004) and Leggett and Bockstael
(2000), both of whom explicitly examine issue, fail to find
compelling qualitative differences between hedonic models
with and without measures of spatial autocorrelation.
Leggett and Bockstael, for example, conclude that “Spatial
autocorrelation appears to introduce no consistent direction
of bias in the standard errors of the estimated coefficient...and the estimated coefficients remain significant in all
specifications (p. 140).”

Whether or not measures of spatial dependence fully
address issues of omitted variable bias remains an important
area of inquiry. The primary purpose of our empirical
analysis was to examine how an omitted variable for
industrial activity confounds and potentially biases esti-
mates of the hazard effect in hedonic analysis. Our
econometric technique is similar to much of the previous
literature (cited in the introductory section) and enables us to
explicitly examine and discuss the effect of omitting a
particular spatial measure—proximity to zones of high
industrial activity.

7. Implications for benefit estimation

The omission of an industrial variable leads to practical
differences for benefit estimates. One common method for
estimating benefit is to interpret the derivative of the hedonic
price function, with respect to the pollution variable, as the
marginal benefit of reduced exposure (Small, 1975). For this
type of benefit estimate the implications of omitting the
industrial variable are evident. For example, when the
industrial effect was omitted in Model 1 (of Section 4) the
estimate of the hazard coefficient was positive and
statistically significantly at the 95% level. Hence, the
marginal benefits of reduced exposure appear to be positive.
Under this interpretation one might expect a rebound effect,
removing the hazard by cleaning-up the site is expected to
increase housing values, all else constant. However, when the
industrial variable was included in the analysis, the
hazard coefficient was not statistically different from zero at
standard confidence levels. The latter result provides no
statistically significant evidence of a marginal value for
reduced exposure to the hazardous waste sites. This leads to
a qualitatively different conclusion than before. In this case,
one may not expect housing values to rebound from
marginal improvements in hazardous waste sites when a
bundle of other hazards, represented by an industrial zone,
are present.

Welfare estimates of non-marginal benefits of reduced
exposure to hazardous waste sites (e.g., complete clean-up
of the hazardous waste sites) can also be biased by the
omission of a variable that accounts for industrial activity.
One approach for estimating non-marginal welfare gains
from clean-up involves estimating a marginal willingness-
to-pay function (Rosen, 1974). Another approach uses the
hedonic price function itself (Freeman, 1993). In
both cases, the welfare estimates are derived from the
hedonic price function’s coefficient estimate of the hazard
variable.

The econometric difficulties of estimating the marginal
willingness-to-pay function are well known (Freeman, 1993;
Bartik, 1987) and a full discussion of these issues is beyond
the scope of this study. However, for the purposes of this paper, it is sufficient to recognize that the dependent variables, used in regression estimates of the marginal willingness-to-pay function, are marginal benefits. These marginal benefits are not observed directly, rather, they are derived using the estimated hedonic price function’s hazard variable coefficient. In “special” circumstances, where the hazardous waste sites influence a small number of houses relative to the total urban area, the estimated hedonic price function is used to provide a direct measure of the welfare gains expected from hazardous waste clean-up (Kiel and Zabel, 2001). Applying either approach to this paper’s estimates of the hedonic price function leads to qualitatively similar results; Omission of the industrial variable, as in Model 1, may generate welfare estimates of hazardous waste clean-up that exceed those derived from Model 2, which includes a measure of industrial activity.

8. Summary

In the US, as in many places throughout the world, past waste disposal activities frequently took place in close proximity to industrial activity: sometimes on the same sites. As a result, contemporary hazardous waste deposits are often located in areas that remain engaged in industrial activity. Industrial activities may generate a host of perceived disamenities such as noise, traffic, congestion, and odors as well as perceived risks from electrical lines, pipelines, pressure tanks, chemicals, rail lines, and heavy equipment. In situations where hazardous waste sites and industrial activity are spatially correlated, urban residents are likely to be confronted with a portfolio of disamenities.

In this paper we demonstrate that failure to include measures of industrial activity in hedonic analyses may, in some cases, overstate the effect that urban hazardous waste sites have on surrounding property values. The omitted variable bias we examine can confound hedonic analysis of any hazardous waste site that is spatially fixed near other disamenities. Future researchers and policy makers addressing environmental quality issues in urban areas may benefit from an analytical approach that emphasizes the relationship between the hazardous waste site and surrounding industrial activity. This may generate additional hypotheses as well as new approaches for improving environmental quality in urban areas. For example, future studies might hypothesize that the relative importance of the hazardous waste site, within a portfolio of disamenities, influences the extent to which hazardous waste cleanup improves perceptions of environmental quality and corollary increases in property values. Policy makers might, for example, consider the possibility that the net-benefits of a hazardous waste clean-up may increase through additional efforts to address the disamenities associated with surrounding industrial activity.

References

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