Disentangling property value impacts of environmental contamination from locally undesirable land uses: Implications for measuring post-cleanup stigma

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ABSTRACT

This research seeks to identify the impact of environmental contamination on residential housing prices separate from land use externalities associated with the contaminated sites. This is possible in an empirical model that considers the influence of uncontaminated commercial properties on home values concurrently with contaminated property influences. Our approach addresses an important source of omitted variable bias that has not been fully recognized in the literature, and it allows identification of stigma effects in a way not possible in past studies. We estimate difference-in-differences models that pool observations across a metro area and across time, as well as repeat sales models that rely on multiple transactions per home. Results indicate that environmental contamination more than doubles the negative influence commercial properties have on neighboring residential home values. Furthermore, we find little evidence of stigma effects once a contaminated site is remediated. The negative spillover effects associated with remediated contaminated sites are largely indistinguishable from the spillover effects from commercial properties with no known contamination.

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1. Introduction

Recent estimates suggest there are as many as 350,000 environmentally contaminated properties in the U.S. whose cleanup costs could reach $250 billion (US Environmental Protection Agency, 2004). Even though the majority of environmentally contaminated sites are privately owned commercial and industrial properties, remediation costs are often borne by the public sector, thus necessitating careful benefit/cost analyses of state- and federally-funded remediation programs. A striking example is seen in the more than 1000 hazardous waste sites that are listed on the National Priorities List (NPL) of the most severely contaminated sites. Recent estimates are that remediation activities by the U.S. Environmental Protection Agency at only 75 of these NPL sites will alone cost $6 billion through 2015 (US Government Accounting Office, 2010).

An important source of benefits from remediating environmentally contaminated sites is the value cleanup may confer to property owners living in nearby neighborhoods that are stigmatized by their proximity to hazardous wastes. A large literature exists that employs hedonic pricing models to identify price gradients for proximity of residential homes to contaminated sites (for reviews, see Boyle and Kiel, 2001, US EPA, 2009, Braden et al., 2011, and Sigman and Stafford, 2011). Generally, the hedonic property value literature finds economically significant price discounts for homes located closer to a contaminated site (e.g. Gamper-Rabindran and Timmins, 2013), although individual studies have reported neutral and in some cases even positive impacts (e.g. Kiel and Williams, 2007).

To directly assess the benefits of hazardous waste site remediation, a number of studies have employed cross-sectional residential sales data pooled across important milestones in the site's history, such as before and after cleanup, to determine whether or not property values rebound post-cleanup (e.g., Kohlhase, 1991; Kiel, 1995; Dale et al., 1999; Kiel and Williams, 2007). Panel models of mean or median home values in a census tract have also been employed (Noonan et al., 2007; Greenstone and Gallagher, 2008; Gamper-Rabindran and Timmins, 2013). The empirical evidence on whether or not residential properties rebound post-remediation varies, with some empirical results suggesting price appreciation

(Kohlhase, 1991; Dale, et al., 1999), and others reporting significant ongoing negative external impacts post-cleanup (McCluskey and Rausser, 2003; Kiel and Williams, 2007). In cases where residual negative price impacts of formerly contaminated sites are found, they have been interpreted as ongoing 'stigma', resulting from the site's contamination history (e.g., McCluskey and Rausser, 2003; Messer et al., 2006).

A near universal feature of this past literature, however, is the absence of explicit consideration of *uncontaminated* commercial property influences on home values concurrently with *contaminated* property influences. This is true despite the fact that commercial properties agglomerate, meaning the distance to a contaminated site is likely to be correlated with the distance to uncontaminated sites (Ihlandfeldt and Taylor, 2004). Two important considerations arise from this omission. First, omitted variable bias may result when the negative external effects of concurrent commercial development such as traffic, noise, congestion and potential crime are not accounted for in the modeling (Li and Brown, 1980; Mahan et al., 2000).[1] If the net external effect of proximity to commercial properties is negative and the distance to contaminated and uncontaminated commercial sites is positively correlated, estimates of the external cost of contamination may be upwardly biased in past studies.[2]

Standard econometric methods can be used to alleviate potential omitted variable bias that arises from ignoring the spatial relationships among uncontaminated and contaminated commercial properties, such as spatial fixed effects, difference-in-differences models, or repeat sales models. However, a critical problem remains for benefits estimation: the appropriate comparison group is missing for measuring post-remediation price effects. Regardless of the size and direction of post-remediation price gradients emanating from a former hazardous waste site, without a comparable estimate of the distance gradient for uncontaminated commercial properties, it is not possible to use the price change around contaminated sites as the measure of realized benefits from cleanup activities. In other words, absent an appropriate comparison group, residential stigma effects cannot be identified separately from other potential land use externalities associated with commercial properties, once they are remediated.[3]

This research departs from the past literature by focusing on land use externalities more generally, to isolate the impacts of environmental contamination on housing values. We explicitly recognize that hazardous waste sites are commercial or industrial properties (hereafter simply referred to as 'commercial properties') that may be undesirable neighbors, irrespective of their environmental status. We employ a database containing the universe of contaminated and uncontaminated commercial properties in a large urban housing market and explicitly model the concurrent influence of these properties on housing transactions prices. Key to our estimation approach is the explicit consideration of uncontaminated commercial properties, which provide a benchmark against which we can compare any residual price impacts of remediated hazardous waste sites, and thus determine the degree to which stigma exists.

Our empirical models employ residential home sales prices between 1990 and 2007 from the five urban core counties of the Twin Cities of Minneapolis and Saint Paul, Minnesota. Homes are linked spatially to 103 hazardous waste sites, 64% of which were remediated during our study period. At least one of these sites was delisted each year during the study period, with the exception of 1990 and 1992. Homes are also linked spatially to 8000 commercial properties that are not known to have any environmental contamination.

The main identification strategy relies on a difference-in-differences model within a cross-sectional framework pooling transactions across the metro area and over an 18 year period (Parmeter and Pope, 2011), combined with numerous spatial and time fixed effects, to capture the external effects of commercial properties, while minimizing the potential for omitted variables bias (Davis, 2011). We also estimate a repeat sales, house fixed-effect specification (Mastromonaco, 2015). To further reduce the potential for confounding neighborhood unobservables that vary over space, all estimation samples include only residential homes that lie within three miles of a hazardous waste site. In our main modeling approaches, we examine the impact of proximity to hazardous waste sites on housing transactions prices before and after cleanup *in comparison to* the impact of proximity to uncontaminated commercial properties, across the same time periods. In this way, we are able to identify the impact of environmental contamination separately from other land use externalities.

Results from cross-sectional models indicate that proximity to clean commercial properties reduces neighboring home values by 2.5%, while proximity to a contaminated site reduces values by approximately 8%. For the latter, we find that remediation increases property values as much as 5% – a result that is also confirmed by the repeat sales analysis. Importantly, we find little evidence of stigma effects once a hazardous waste site is remediated: the price discount for proximity to a remediated contaminated site is largely indistinguishable from the price discount for proximity to a clean commercial site. This is true when considering an average price change over the entire delisting period, and also when we allow price effects to differ across the number of years post-remediation. Thus findings of stigma in earlier research may be the result of proximity to non-hazardous, but still commercial land uses, rather than residual impacts of the past environmental contamination.

2. Data

Our empirical analysis focuses on the Minneapolis-Saint Paul metropolitan statistical area (MSA), which is also referred to as the Twin Cities region. The area is representative of northern cities that had industrial economies in the last century that left a legacy of environmentally contaminated properties throughout the urban core. The MSA is comprised of 13 counties and has a population of 3.3 million people. Our data cover five counties lying in the urban core of the MSA. They cover approximately 2000 square miles, with a 2010 population of 2.48 million people residing in more than one million housing units. The latter represents 77% of the housing units in the MSA (all MSA figures are drawn from the 2010 census).

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[1] The literature examining the impact of commercial development on home values generally finds a discount for homes near commercial properties, though this is not robust across all studies since proximity to commercial development can also provide access to employment and retail opportunities (Li and Brown, 1980; Grether and Mieszkowski, 1980; Crafts, 1998; Mahan, et al., 2000; Matthews and Turnbull, 2007).

[2] This is the conclusion reached by Deaton and Hoehn (2004), the only study we are aware of that explicitly considers contaminated and uncontaminated commercial property impacts on home values concurrently. The authors find that price gradients around two NPL sites are significantly upwardly biased when proximity to an (uncontaminated) industrial zone is omitted from the model.

[3] For example, McCluskey and Rausser (2003) estimate price gradients for distance from an industrial site over several time periods including: (i) before the site's "discovery" as contaminated; (ii) while the site was listed as a hazardous waste site; and (iii) post-cleanup of the site. The authors find a positive price gradient associated with distance to the site in all three periods, with the gradients in periods (i) and (iii) being very nearly identical and the gradient in period (ii) being significantly larger. The authors hypothesize that the positive gradient during period (i) results from market perceptions of contamination prior to discovery by the US EPA, and that the positive gradient during period (iii) is due to stigmatization from the contamination history (pg. 283). However, another possible explanation is that the gradients in periods (i) and (iii) simply reflect the undesirable externalities of a large industrial operation, and are not related to contamination. It is not possible to test which interpretation is correct without estimates of price gradients for comparable uncontaminated industrial properties.