Measuring the Value of Cleanup at Federal Facility National Priorities List Sites

by

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Abstract

The United Stated Environmental Protection Agency's Federal Facilities Restoration and Reuse Office seeks to ensure cleanup progress and protective cleanup solutions at the most contaminated active and legacy federal facility hazardous waste sites. Using data from 72 federal facility National Priorities List (NPL) sites combined with a panel of census tract-level information from Brown University's Longitudinal Tract Data Base, this study measures the impacts of NPL cleanup on house values and rents. Results suggest large, positive and statistically significant impacts when a federal facility site is deleted from the NPL, with particularly large impacts at the lower-end of the within-tract house value and rent distributions. Under certain specifications, achieving pre-deletion NPL milestones also yields positive impacts.

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Executive Summary

The United Stated Environmental Protection Agency's Federal Facilities Restoration and Reuse Office (FFRRO) seeks to ensure cleanup progress and protective cleanup solutions at the most contaminated active and legacy federal facility hazardous waste sites. The Superfund Federal Facilities program oversees and provides technical assistance for the protective and efficient cleanup and reuse of sites that are placed on the National Priorities List (NPL). In principle, the costs of Superfund cleanup activities are well-defined and can be easily measured. The benefits of those activities are, however, much more difficult to quantify. As is the case with many environmental goods and services, there is no explicit market for the cleanup of hazardous waste to generate price signals. Economists have therefore turned to measuring the benefits of Superfund cleanup by examining the effect of proximity to hazardous waste sites at various states of remediation on housing values and rents. We employ traditional hedonic property value modeling techniques to measure the benefits of cleanup activities at federal facility NPL sites. Specifically, our analysis considers the housing value and rent impacts of achieving four different milestones of the Superfund remediation process – final assessment, NPL listing, construction completion and deletion.

We use an empirical approach that makes use of variation in data over time at the level of the census tract. Specifically, we rely on change in site status over time to reveal the housing market impacts while still allowing us to control for any local attributes at the census tract level that are fixed over time. In addition, we pay particular attention to *within-tract* heterogeneity, emphasizing the *localized* effects of Superfund cleanups that may not be detectable using, for example, census tract median housing values or rents. Using public data, we discern separate effects at the upper and lower deciles of the housing value and rent distributions *within* each tract. This is important, because census tracts can be large, and neighborhoods may not be randomly distributed within them. If low-value or low-rent neighborhoods within tracts tend to be situated closer to facility boundaries, cleanup activities may result in appreciation primarily for cheaper homes, meaning that the impacts of cleanup may be imperceptible in the tract median value.

In consultation with FFRRO and based on the availability of detailed site boundary data, we selected 72 Department of Defense NPL sites for analysis from an initial list of 174. Combined with a panel of census tract-level information from Brown University's Longitudinal Tract Data Base, we measure the impacts of achieving four NPL milestones on house values and rents using a series of five specifications that begin with a baseline specification (including controls for census tract fixed effects, indicators for Base Realignment and Closure (BRAC) activity, and a regional consumer price index deflator) and add increasing numbers of controls for housing stock and resident attributes. A final specification replaces these controls with a vector of fixed effects that differ by region and year.

Keeping in mind that we are only able to observe three sites that reach the deletion milestone, results suggest large, positive and statistically significant impacts when a federal facility site is deleted from the NPL. Impacts are particularly large at the lower-end of the within-tract house

value and rent distributions. In particular, our baseline specification yields a deletion coefficient of 0.363 at the 10th percentile indicating that taking a site through the entire NPL process will raise house values in the 10th percentile of the within-tract distribution by 36.3% relative to pre-final-assessment levels. For rents, positive and statistically significant impacts increase in magnitude as one moves through the different stages of the NPL process. Focusing again on the 10th percentile of the within-tract rent distribution, we see a 16.7% increase at the final assessment stage relative to pre-final-assessment. Listing raises rents by 21.2% relative to pre-final-assessment and by 4.5% relative to final assessment. Rents continue to improve with construction completion (28.0%) and deletion (53.7%) relative to pre-final-assessment.

Results are similar for both dependent variables when adding controls for time-varying characteristics of the census tract housing stock and resident attributes. Consistent with a localized-impact interpretation, we see stronger evidence of larger impacts at lower deciles of the within-tract distributions of values and rents. Adding controls for time-varying socioeconomic status characteristics of census tract residents continues to yield positive and significant effects of deletion on house values, but only at the first decile of the within-tract distribution. Replacing time-varying covariates with region x year fixed effects also yields large positive effects of deletion on housing values at the lowest decile. Gross rents exhibit similarly large positive effects of deletion at the lowest two deciles.

In summary, our results suggest that the housing market impacts of NPL remediation of federal facility sites are large and positive. Conservative specifications suggest that these impacts are concentrated in the lower deciles of the within-tract house value distribution. These estimates imply that home buyers value these cleanup activities, and that homeowners and the local property tax base stand to benefit from them. Ultimately, whether these cleanup activities satisfy a benefit-cost criterion depends upon a careful accounting of the cost side of the ledger.

1. Introduction

1. Institutional Detail: Federal Facility National Priorities List Sites

Federal facility National Priorities List (NPL) sites generally encompass thousands of acres. Some of these sites are part of the Unites States' World War II and Cold War legacy. Many are still active bases. The United States Environmental Protection Agency (EPA) Federal Facilities Restoration and Reuse Office (FFRRO) seeks to ensure cleanup progress and protective cleanup solutions at the most contaminated active and legacy federal facility hazardous waste sites. These include 174 NPL sites, which include military bases, Manhattan Project sites and World War II waste disposal locations in addition to other types of waste sites.[1] The sites frequently contain some of the most dangerous and unique environmental contaminants, including munitions, radiological waste, and emerging contaminants such as per- and polyfluoroalkyl substances (PFAS).[2]

The Superfund Federal Facilities program oversees and provides technical assistance for the protective and efficient cleanup and reuse of federal facility NPL sites, as mandated by law. Program responsibilities include: (1) inventorying and assessing potentially contaminated sites; (2) implementing protective remedies; (3) facilitating early transfer of property; and (4) ensuring ongoing protectiveness of completed cleanups. Effective and efficient cleanup and reuse can play a pivotal role in a community's economic development. Property transfer and reuse might occur at Department of Defense (DOD) installations that were slated for closure or realignment via the Base Realignment and Closure (BRAC) process or at sites where local communities have expressed interest in acquiring land for redevelopment purposes. Land can also be transferred as smaller parcels taken from larger properties, as the federal owner often retains portions of the property for ongoing use or because remedial action objectives have not yet been achieved. Regardless of how property slated for transfer is identified, EPA's core mission of protecting human health and the environment remains a key focal point when decisions are made related to transfer.

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[1] Average acreages are 13,870 and 5,615 at Department of Energy and Department of Defense sites, respectively.

[2] https://www.epa.gov/pfas/basic-information-about-and-polyfluoroalkyl-substances-pfass

The Federal Facilities Superfund Program has played an integral role in the cleanup process at federal properties, contributing to positive outcomes that include the fostering of partnerships among federal, state and local governments; the development of cleanup and reuse plans in conjunction with local communities; the transformation of military installations into centers for business, industry and education; and the creation of jobs through cleanup and reuse.

2. The Superfund Program

Following the public outcry over events at Love Canal, New York, and the Valley of Drums, Kentucky, the United States Congress established the Superfund program under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980. That program was amended in 1986 under the Superfund Amendments and Reauthorization Act, which introduced new property transfer requirements and other provisions relevant to remediation of federal facilities. Since 1980, EPA has identified more than 47,000 hazardous waste sites potentially requiring cleanup actions. Many of the most seriously contaminated sites have been placed on the Superfund NPL. As of August 3, 2017, EPA had 1,343 sites listed on the NPL.[3] Along with listing, there are a number of activities and milestones that define the Superfund cleanup process.

(1) Discovery, Preliminary Assessment, Site Investigation and Final Assessment

When a potential site is discovered on federal property (i.e., when EPA becomes aware of it from the general public or from another federal, state, or local agency), it is listed on the Federal Agency Hazardous Waste Compliance Docket. A preliminary assessment is conducted by EPA or the appropriate federal agency or department to determine, based on limited data, whether that site poses a sufficiently serious threat to human health and the environment to require further investigation. If the preliminary assessment results in a recommendation for further investigation, a site inspection is performed, where investigators collect environmental and waste samples to determine what hazardous

[3] Another 49 sites have been proposed for listing on the NPL, and 393 sites have been deleted from that list (https://www.epa.gov/superfund/npl-site-totals-status-and-milestone).

substances are present, whether these substances are being released into the environment, and if so, whether there is a pathway to receptors. Information collected during the preliminary assessment and site inspection is used to calculate a Hazard Ranking System (HRS) score. Based on the results of this investigation, a final site assessment is performed.

(2) Proposal and Listing on the NPL

Based on the final site assessment, EPA proposes a site to the NPL in the Federal Register. EPA then accepts public comments on the site for 60 days and responds to public comments. EPA may list the site on the NPL if it meets at least one of three criteria: (1) its HRS score is of sufficient magnitude; (2) a state environmental authority designates the site to be a top priority; or (3) the United States Public Health Service recommends removing all people in close proximity to the site.

(3) Interagency Agreement (IAG) Completion

Completion of any interagency agreements (IAGs) is included among the milestones listed in the documentation describing federal facilities that have been placed on the NPL. The Interagency Agreement (IAG), also known as a Federal Facility Agreement (FFA), is a legally enforceable document. Signing an IAG is an important step within the cleanup process, and most FFAs are signed at the investigation stage. At a minimum, FFAs must include the selection of a remedial action, a schedule for the completion of that remedial action, and arrangements for long term operations and maintenance at the facility per CERCLA §120(e)(4).[4] After the signing of the IAG, the lead agency performs the response actions pursuant to CERCLA and under EPA (and typically state) oversight.

(4) Cleanup Process

After a site is placed on the NPL, the cleanup process commences in a series of steps. The remedial investigation collects data to further characterize site conditions and assesses risks to human health and the environment. The feasibility study screening process evaluates the potential performance and cost of alternative treatment technologies and develops and

[4] https://www.epa.gov/sites/production/files/2015-12/documents/superfundiag.pdf

evaluates alternative remedial actions. After issuing and taking public comment on the Proposed Plan, EPA publishes the Record of Decision (ROD), a public document that explains cleanup alternatives, and makes this document available to the public through the EPA online ROD system. During the remedy selection phase, cleanup goals are set based upon planned future land use. The technical specifications for cleanup remedies and technologies are developed in the remedial design phase. The cleanup operations are implemented in the remedial action phase.

(5) Construction Complete

Sites qualify for "construction completed" status when any necessary physical construction to support the remedy is complete, whether or not final cleanup levels or other requirements have been achieved.[5] Probst and Sherman (2004) observe: "this measure of success indicates when the engineering work has been completed, but not when cleanup goals have been achieved." This should not be interpreted to mean that sites that have achieved construction completion have not achieved cleanup goals, but simply that it is not a direct indicator of such in every case.

(6) Deletion from the NPL

Deletion of a site from the NPL requires that the necessary actions for remediation have been completed, apart from long-term monitoring, and the site no longer poses a threat to human health. Prior to deletion, EPA posts plans to delete the site in a local newspaper and solicits public comment. Once deletion is deemed appropriate, EPA will enter notification of deletion in the Federal Register. Prior to deletion, a site may also undergo a partial deletion for the portion of the site that meets the deletion criteria, while the rest remains on the NPL. For the purposes of this analysis, we treated sites as deleted only when they were fully designated as such. Only three sites achieved full deletion in our sample, limiting our ability to draw strong conclusions about the effects of this milestone on property values.

We analyze the impacts of achieving four major NPL milestones on house values and rents: (1) final assessment, (2) NPL listing/IAG completion, (3) construction completion, and (4)

[5] https://www.epa.gov/superfund/superfund-remedial-action-project-completion-and-construction-completions

deletion from the NPL. When these milestones are met, EPA publicizes information about the site to members of the public by entering information into the Federal Register and soliciting public comment, or by making announcements that will be covered in the media. We combine the NPL listing and IAG completion into a single milestone (denoted only as "NPL Listing") as they frequently take place in quick succession. The cleanup process is not treated as a milestone itself, but is rather considered as the activity taking place between listing and deletion.

Although it is infrequently achieved by sites in our sample, we focus primarily on deletion in order to measure the benefits from Superfund site cleanup. Deletion is the signal that cleanup is complete and no further response is required to protect human health or the environment. We do, however, control for and consider the impacts of other milestones. Valuing construction completion, in particular, acknowledges an important reality for many Superfund sites – namely, that some sites may not be fully cleaned-up for many years following the completion of construction work associated with remediation activities. This may be particularly true when, for example, contaminated groundwater is present. In these cases, construction complete is an important milestone from a policy-making perspective.

2. Benefits Measurement

In principle, the costs of Superfund cleanup activities are well-defined and can be easily measured. The benefits of those activities are, however, much more difficult to quantify. As is the case with many environmental goods and services, there is no explicit market for the cleanup of hazardous waste to generate price signals. Economists have therefore turned to measuring the benefits of Superfund cleanup by examining the effect of proximity to hazardous waste sites on housing values and rents.[6,7] Controlling for housing and neighborhood attributes, the covariation of housing values and rents with exposure to federal facilities at various stages of cleanup can be used to measure the values associated with those cleanup activities. In theory, Superfund cleanup can cause appreciation in house values by reducing public perception of health or environmental hazards (Hamilton and Viscusi, 1999) and by spurring additional development projects. However, it might also signal to the market that a site was more contaminated than originally believed, causing house values and rents to fall. When considering remediation activities that are conducted as part of larger scale realignment activities on a military base, it is possible that broader economic conditions (e.g., reductions in local employment in nearby supporting businesses) could affect property values and rents as well.

2.1. Property Value Models

We employ traditional hedonic property value modeling techniques to measure the benefits of remediation activities at federal facility NPL sites. Hedonic estimates describe the slope of indifference curves (i.e., level sets of utility functions) drawn in $(x, \$)$ – space, where x is some amenity. Individuals sort along a hedonic price function, $P(x)$, to reach the best possible indifference curve, as is seen in the following figure. If x is a good, then utility

[6] See EPA (2011), which classifies different benefit and cost categories associated with land cleanup and the methods that can be used to estimate them.

[7] Our study is narrow to the extent that it is limited to benefits discernible from the hedonic property value models. There may be other benefits that are outside the scope of our study (e.g., certain types of ecosystem benefits), and to that extent, our analysis is conservative. These additional benefits are discussed in a 2006 review by the Scientific Advisory Body (EPA, 2006).

increases as one moves in a southeasterly direction. The slope of the hedonic price function reveals the slope of the indifference curve, which can be interpreted as a measure of marginal willingness to pay (i.e., willingness to give up other consumption in the form of a more expensive house in exchange for another unit of x while holding utility fixed).

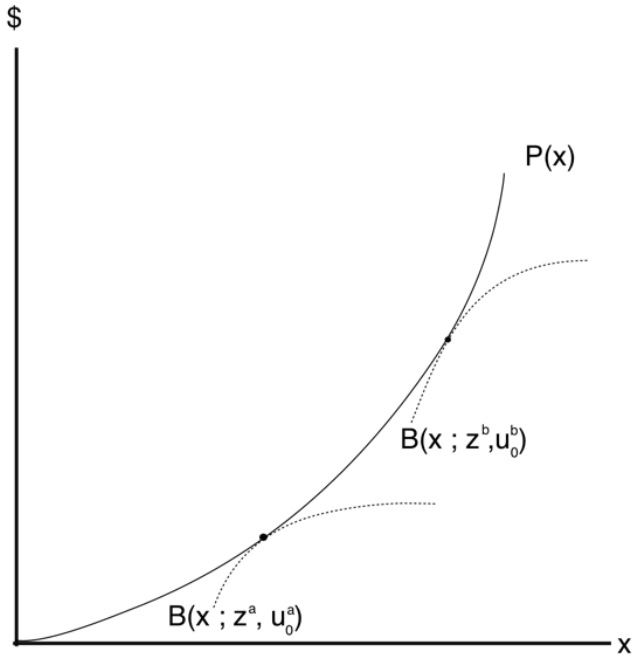

Figure 1

Individuals likely exhibit differences (heterogeneity) in their preferences for amenities (x) and "other consumption" (reflected in the money remaining after they pay for housing services). In Figure 1, this is reflected in the different indifference curves illustrated for two different types of individuals: a, who has a weak preference for x and chooses a low-cost housing bundle with little of the amenity, and b, who has stronger preferences for x and chooses a bundle with a higher price and more of the amenity.

Hedonic analysis typically relies on an assumption that all individuals' preferences are identical, yielding a common estimate of value for the entire population. This assumption has important implications for the interpretation of research findings, particularly if different socioeconomic groups have significantly different willingness to pay for local amenities and public goods. Accurately measuring differences in willingness to pay across groups is

important, for instance, in explaining the patterns related to disproportionate exposure to environmental nuisances. However, properly addressing the role of preference heterogeneity imposes strong methodological and data requirements.[8]

2.2 Capitalization Effects versus Welfare Estimates

For the sake of simplicity, the hedonic price functions described below in Figure 2 are drawn under a linearity assumption. We use these figures to discuss an additional assumption, highlighted by Kuminoff and Pope (2014), that underlies the use of *panel data* in hedonic models. Many hedonic models (including ours) rely on variation in amenities (i.e., site milestones) and prices over time in order to control for other spatial attributes using fixed effects. Fixed effects can be used in a hedonic analysis to control for any local attribute that does not vary over the time frame of our analysis – e.g., proximity to a river, railroad line, or highway.[9]

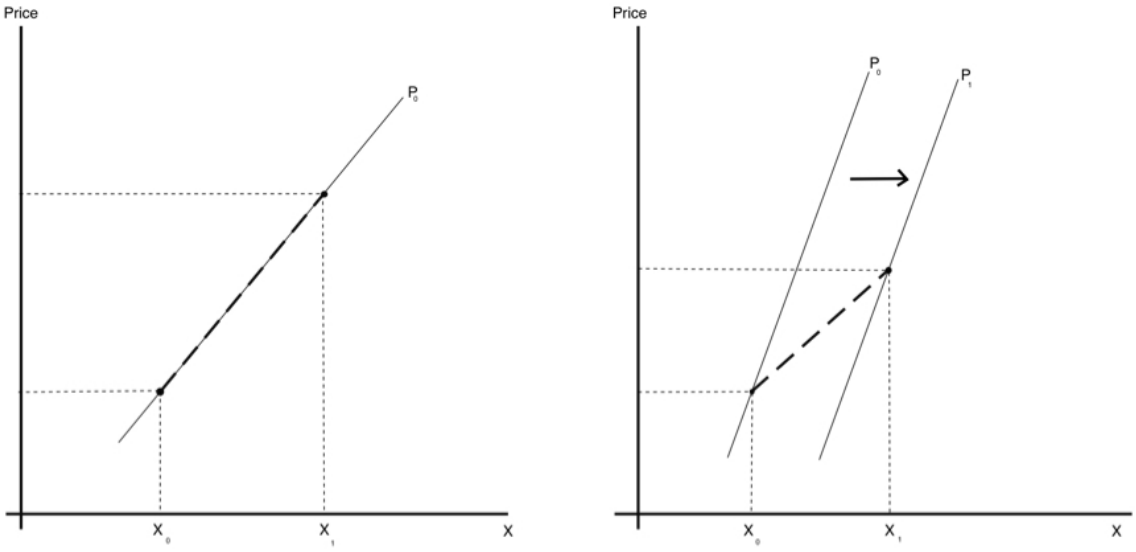

Figure 2

[8] See Bishop and Timmins (2017) for a discussion.

[9] In particular, we rely on change in site status over time for identification, allowing us to control non-parametrically for any local attributes at the census tract level that are fixed over time. However, applying a causal interpretation to the results requires an assumption that there were not also time varying unobservables that coincided with the different remediation activities applied at the site. We address this to the extent possible by using data on observable, time-varying tract-level attributes.

Kuminoff and Pope (2014) emphasize that use of panel data rests on an important assumption that the hedonic price function itself does not move over time. In particular, each of the panels of Figure 2 denote two points in the space of $(x, \$)$. Suppose that the two points represent values observed in the housing market at two points in time. Under the assumption that the hedonic price function remains stationary over time, those two points trace out the slope of that function (denoted with a heavy dashed line in the left panel), which reveals the slope of the indifference curves (and, hence, willingness to pay for x) of individuals in the marketplace. If, on the other hand, the hedonic price function shifts to the right over time as in the right panel of Figure 2, the heavy dashed line connecting the two observed points no longer reveals the slope of either hedonic price function. In the terminology of Kuminoff and Pope (2014), the estimated price function would now reveal a simple "capitalization effect" rather than an estimate of willingness to pay. The capitalization effect describes how the change in x is capitalized in house prices, but lacks a formal welfare interpretation based on utility theory. It can be useful, however, for measuring direct impacts on homeowners' wealth, local governments' property tax bases, and renters' monthly expenses.

We make this point because NPL cleanup projects take many years to complete, and it is possible that the characteristics of those living in affected communities might change dramatically during the cleanup process. The preferences of new residents may be different from those of previous residents, and with those differences could come a shift in the equilibrium hedonic price function.[10] In our analysis, we present alternative specifications that include the changing attributes of census tract residents (e.g., socioeconomic characteristics like race and income) in an effort to control for this sort of variation. However, these changes in neighborhood attributes are themselves driven in part by the changes in neighborhood amenities that we seek to value. As such, this exercise involves balancing between introducing useful controls and variables that might be endogenous. For the sake of completeness, we present a wide array of specifications containing various sets of control variables.

[10] See Ekeland, Heckman and Nesheim (2004) for a discussion of how the equilibrium hedonic price function is formed by the interaction of home buyers and suppliers in the marketplace.

3. Econometric Specifications

3.1. Baseline Regression

Our analysis considers the housing value and rent impacts of achieving four different milestones of the Superfund remediation process – final assessment, NPL listing,[11] construction completion and deletion. The deletion stage signals the end of most cleanup activities, apart from long-term monitoring. As a starting point, consider the following simple regression specification, which relates the median house price in census tract *i* located in a buffer around site *j* at time *t* ($y_{i(j),t}$) to tract attributes ($X_{i(j),t}$), a tract fixed effect ($\delta_{i(j)}$), a time-varying unobservable ($\varepsilon_{i(j),t}$), and a list of variables denoting the status of site *j* at time *t*, including "final assessment" ($F_{j,t}$), "NPL listing" ($L_{j,t}$), "construction completion" ($C_{j,t}$), and "deletion" ($D_{j,t}$). The intercept term (α) captures the baseline site status, which is assumed here to be "prior to final assessment". Years are denoted by *t* = 1980, 1990, 2000 and 2010.

$$y_{i(j),t} = \alpha + X'_{i(j),t}\beta + \gamma_1 F_{j,t} + \gamma_2 L_{j,t} + \gamma_3 C_{j,t} + \gamma_4 D_{j,t} + u_{i(j),t} \quad (1)$$

In principle, estimation of this simple specification would reveal the value of different remediation milestones as reflected in capitalized housing values. Sites are not, however, randomly distributed throughout space, which raises a concern that the combined error term in this regression ($u_{i(j),t} = \delta_{i(j)} + \varepsilon_{i(j),t}$) might be correlated with other right-hand-side variables. We therefore exploit the panel nature of our data to estimate an econometric specification that includes tract fixed effects ($\delta_{i(j)}$).

$$y_{i(j),t} = \alpha + X'_{i(j),t}\beta + \gamma_1 F_{j,t} + \gamma_2 L_{j,t} + \gamma_3 C_{j,t} + \gamma_4 D_{j,t} + \delta_{i(j)} + \varepsilon_{i(j),t} \quad (2)$$

Estimation of tract fixed effects essentially differences away any time-invariant unobservable attributes of tract *i* that might have been correlated with other right-hand-side variables. We therefore only require that the *change* in the time-varying unobservable ($\Delta\varepsilon_{i(j),t,t+1}$) be

[11] Note that the NPL Listing variable has been defined to include both the NPL Listing and IAG Completion milestones.

uncorrelated with those regressors, rather than requiring it of each individual time varying unobservable. This is a less restrictive assumption than that imposed in the simple specification described in equation (1). The model does, however, assume that the marginal effect of each variable remains constant over time (i.e., the coefficients do not have time subscripts). Moreover, the dependent variable is always deflated by a regional price index to account for national housing market trends.

We use an empirical approach that exploits variation in data over time at the level of the census tract, but pay particular attention to *within-tract* heterogeneity. This is done in order to identify *localized* effects of Superfund cleanup that may not be detectable using census tract median housing values or rents. In particular, using public data, we discern separate effects at the upper and lower deciles of the housing value and rent distributions *within* each tract. This is important, because census tracts can be large, and neighborhoods may not be randomly distributed within them. If low-value or low-rent neighborhoods within tracts tend to be situated closer to facility boundaries, cleanup activities may result in appreciation primarily for cheaper homes, meaning that the impacts of cleanup may be imperceptible in the tract median value.

With this in mind, the model is estimated separately for each decile of the within-tract house value or rent distribution. In equation (3), θ is used to denote deciles of the distribution of housing values or rents ($y^{\theta}_{i(j),t}$). We estimate a different set of parameter values for each decile. One typically focuses on the median, but it will be seen below that in certain specifications, the impacts of cleanup are strongest in the lower deciles, which would make sense if we think those houses or rental units might be the most heavily impacted by the nearby military base. This would be the case, for example, if census tracts are large and the lower-valued houses within the tract were the ones closer to the base.

$$y^{\theta}_{i(j),t} = \alpha + X'_{i(j),t}\beta^{\theta} + \gamma_1^{\theta} F_{j,t} + \gamma_2^{\theta} L_{j,t} + \gamma_3^{\theta} C_{j,t} + \gamma_4^{\theta} D_{j,t} + \delta^{\theta}_{i(j)} + \varepsilon^{\theta}_{i(j),t} \qquad (3)$$

A primary determinant of the signs and magnitudes of estimated effects of cleanup activity is the set of controls ($X_{i(j),t}$) included in the regression; these variables account for

potential confounders, and for the possibility of a shifting hedonic price function as described in the previous section. Control variables are discussed in more detail below. In addition, all specifications include indicators for whether the relevant site was managed as part of the BRAC program. We define two BRAC indicators. BRAC1-4 is a dummy variable that takes the value "1" if the site was part of BRAC1 (1988), BRAC2 (1991), BRAC3 (1993) or BRAC4 (1995). These four rounds of BRAC are distinguished by their greater degree of EPA involvement in the cleanup process. BRAC5 is a dummy variable that takes the value of "1" if the site was part of BRAC5 (2005).[12] In each case, the relevant BRAC dummy variable is turned on in the first decade following the initiation of that BRAC round (i.e., 1990 for BRAC1 and 2000 for BRAC's 2-4). All standard errors are calculated to be robust to general forms of heteroscedasticity.

3.2. Baseline and Alternative Specifications

In this subsection, we summarize the different hedonic regression specifications that we estimate later in the report.

(1) Baseline Specification

Our baseline specification is described in equation (3) above but includes only census tract fixed effects as controls. Consumer Price Index (CPI) deflators that differ by both region and year are applied to both house values and rents to control for macroeconomic impacts.[13]

(2) Specification (1) + Housing Stock Attributes

- % Vacant Units
- % Owner Occupied Units
- % Multi-Family Units

[12] We experimented with allowing the milestone effects to vary with BRAC status. There are very few sites (only 3), however, that achieve deletion status in our final data set, and results become highly unstable and dependent upon the particular specification when we interact these effects with BRAC status.

[13] CPI-All Urban Consumers by region, base period 1982-84=100. BLS series Id's CUUR0100SA0, CUUR0200SA0, CUUR0300SA0, CUUR0400SA0.

- % Structures More Than 30 Years Old

It is common practice to control for attributes of the housing stock in a hedonic regression. To the extent that the housing stock changes over time and is inadequately represented by census tract fixed effects, these controls, which are added in the second specification, will be important.

(3) Specification (2) + Resident and Economic Attributes

- % Black Non-Hispanic
- % Hispanic
- % Unemployment
- % Households in Neighborhood 10 Years or Less

This specification introduces a first set of variables describing time-varying resident and local economic attributes. These variables may serve as controls for shifts in the hedonic price function over time, but could also introduce potential sources of endogeneity.

(4) Specification (3) + Socioeconomic Status Variables

- Median Household Income (deflated by regional CPI)
- % High School Degree or Less
- % Four Year College Degree or More
- % Professional Employees
- % Manufacturing Employees
- % Female Headed Households with Children

This specification introduces additional variables describing time-varying socioeconomic status attributes of residents. These variables may provide important controls for factors that may shift the hedonic price function over time, but are also likely to introduce important sources of endogeneity bias into the hedonic regressions.

(5) Region x Year Fixed Effects

This final specification replaces time-varying tract attributes with a vector of region x year fixed effects. The regions include: Northeast, South, Midwest and West. Including year x region fixed effects is a rigorous approach, but (along with tract fixed effects) limits the source of variation to only that within the region over time.[14]

3.3. Other Specification Features

For each specification, there are results for two different dependent variables – owner stated house value and gross rent. There are several other dimensions upon which our econometric specifications might have varied. For the sake of brevity, we do not present estimates for all of these variants in this report, but note the alternatives here.

- In addition to gross rents, we also collected data on contract rents. The difference between gross rent and contract rent is summarized by the Social Explorer website. "Contract rent is the monthly rent agreed to or contracted for, regardless of any furnishings, utilities, fees, meals, or services that may be included."[15] "Gross rent is the contract rent plus the estimated average monthly cost of utilities (electricity, gas, and water) and fuels (oil, coal, kerosene, wood, etc.) if these are paid for by the renter (or paid for the renter by someone else)."[16] Results are generally similar if we use the gross or contract definition of rents; we report only the former.
- All reported estimates are based on census tracts that coded into 2 kilometer (km) buffers surrounding site boundaries using 0% areal containment. 0% areal containment indicates that tracts are included in the buffer if any positive percentage (i.e., greater than 0%) of their land area falls within that buffer. Any percentage between 0-100% can be used to define areal containment, but the higher the percentage, the fewer tracts are included. Specifications based on a 50% areal containment definition produced results that were generally similar.

[14] Specifically, we use the four regions defined by the census: Northeast, Midwest, South, and West (https://www.census.gov/geo/reference/webatlas/regions.html).

[15] https://www.socialexplorer.com/data/C1990/metadata/?ds=STF1&table=H032

[16] https://www.socialexplorer.com/data/C1990/metadata/?ds=STF3&table=H043

- We focus on a 2km buffer surrounding each site's boundary as this is the distance at which we expect the disamenities and health impacts of pollution, which is the focus of Superfund cleanup efforts, to be the greatest. We also generated estimates based on a 5km buffer. For the most part, results were similar, but differed in some important respects (e.g., we did find some evidence of negative effects of achieving deletion on house values in specifications (4) and (5)). We suspect that these differences arise because the estimates based on a 5km buffer capture the broader impacts of base closure and re-purposing on the local economy that enter when we consider housing units further from the site boundary.
- There are some instances where two sites are close enough to one another that their 2km buffers overlap. We currently treat overlapping buffers as unions; e.g., if one tract falls into two sites' buffers and the sites are at different milestones, more than one indicator will be set equal to 1 for that tract. If both sites are at the same milestone, we set the indicator for that milestone equal to 1 for that tract. An alternative approach would be to treat overlapping sites as sums (i.e., in the latter case, give that tract a milestone value of 2).
- We adopt an identification strategy for this study that relies on census tract fixed effects to control for local unobservables. This requires assembling a panel of census tracts – a process that relies upon data sources that synthesize comparable tract definitions over time.[17] An alternative would have been to rely on site fixed effects to control for characteristics of the broader community that remained fixed over time, and to then rely on tract-level observables taken from decennial censuses and the 2010 American Community Survey. We did not pursue this option primarily because the set of tract-level variables with definitions that remained constant over the period 1980 – 2010 was

[17] With every new census, the U.S. Census Bureau redefines tract boundaries in an effort to balance populations and maintain neighborhood continuity. Over time, this primarily results in tracts being split into multiple tracts as they grow in population. Publicly available data sets, described in Section 4, have been created that use a number of data sources to re-combine these tracts (and split others when necessary) to create a spatial definition that remains constant from 1980 to 2010.

limited, and we were concerned that this would result in the potential for severe omitted variables bias.

4. Data

In this section, we describe the different data sets that were used to estimate the specifications described in Section 3, and the procedures that were used to create them from raw data sources.

4.1 Data Sources and Basic Data Creation

(1) Information About Site Status

FFRRO provided a list of 174 federal facility NPL sites and related milestone data. In consultation with FFRRO, we selected only those sites for analysis that were DOD federal facility sites with available installation boundary files. DOE sites were excluded given their size and complexity. Four sites were then removed from the analysis for being either non-NPL or long-time proposed NPL.[18] Based upon these criteria, 72 federal facility NPL sites were included in the initial data set.[19]

(2) Shapefiles for Military Bases and Census Tracts

The next step involved using shapefiles to geocode the fence line boundaries of each military installation. Two data sets were used for this purpose:

- TIGER 2012 (https://catalog.data.gov/dataset/tiger-line-shapefile-2012-series-information-file-for-the-nation-military-installation-nationalc303a)
- MIR (https://catalog.data.gov/dataset/military-installations-ranges-and-training-areas)

We opted to first use TIGER 2012 to geocode as many installations as possible (i.e., 63). The remaining 9 installations' boundaries were geocoded using MIR. We then created 2 km buffers using the appropriate set of shapefiles.

[18] These sites were Whiteman Air Force Base, USN Naval Surface Warfare Center: White Oak, USN Orlando Training Center, and Chanute Air Force Base.

[19] Using the federal facility site data provided by FFRRO, our data allowed us to assign each installation to one of the following federal agencies – DOD, United States (US) Army, US Navy, or US Air Force. In the end, however, we did not use this information since all specifications included census tract fixed effects. Sites do not commonly change federal ownership, and since tracts are uniquely paired with sites, tract fixed effects capture site ownership.

Census tract shape files were downloaded from http://gisdata.lib.ncsu.edu/CENSUS/LTDB/ (see below for details), and imported into ArcGIS. Since the tracts from 1980-2000 are reconfigured into 2010 boundaries (see below), we used only the 2010 census tract shape file for calculations.

The next step involved creation of a measure of the percentage of each census tract area that falls inside a buffer drawn around each federal facility.[20] For these calculations, we used the TIGER 2012 and MIR 2km buffers along with Brown University's Longitudinal Tract Data Base 2010 census tracts to calculate percentages. This resulted in a table describing the percentage of each tract that falls in each 2km buffer as measured by the relevant set of shapefiles. Using 0% areal containment, any tract with positive area falling inside the 2km buffer was included in the analysis. Knowing the percentage of each tract falling inside the 2km buffer is useful in that it can facilitate the analysis of other areal containment rules.

(3) Information on House Values, Rents, and Demographic Information

Because we rely on tract-level fixed effects to control for most spatial determinants of house values and rents, we employed a data set that has been engineered to have common census tract boundaries over time – the Longitudinal Tract Data Base (LTDB).[21] In this data set, census tract data from 1980 to 2010 are re-configured to have common 2010 boundaries. LTDB also provides information about a variety of tract attributes, including median house value, median contract rent, and demographic information in an ArcGIS format that can be exported directly to Excel.

(4) Creation of Within-Tract Distributions of Housing Value and Rents

In order to create measures of the moments of the distributions of housing values and rents within each census tract (i.e., besides the median), we generated a series of empirical distribution functions for each tract using data from the 2008-2012 American Community

[20] The median tract in our sample had approximately one-half of a percent of its land area located inside the boundary of the military base itself. Fewer than ten percent of all tracts had more than 75% of their land inside the base boundaries.

[21] https://s4.ad.brown.edu/Projects/Diversity/Researcher/LTBDDload/DataList.aspx

Survey and the 1980, 1990 and 2000 decennial censuses.[22] Those data describe the number of houses in each set of house value or rent "bins". From those bin data, we wrote Fortran code that inverts a linear approximation to the within-tract distribution (i.e., using line segments to impute the points between discrete points observed in the data) to recover the values of rent and house values associated with nine different deciles of the within-tract distribution. We then used the crosswalk provided by LTDB to re-configure the resulting deciles to be consistent with 2010 census tract geography.[23]

(5) Creation of Dummy Variables for Site Milestones

We used the federal facility NPL site data provided by FFRRO to create dummy variables for the site status for each decadal marker (1980, 1990, 2000 and 2010):

- Final Assessment
- NPL Listing
- Construction Completion
- Deletion

The indicator for a particular status was set equal to 1 if that was the most advanced status reached prior to the year in question. For example, Eielson Air Force Base reached the final assessment milestone on 7/14/1989, but the indicator for that milestone was not turned on for 1990 because the site went on to reach the NPL listing milestone on 11/21/89. Only one milestone indicator is turned on for each site in each decadal marker year, indicating the most recent action – in this case, that would be NPL listing in 1990. Similarly, Eielson Air Force Base reached the construction complete milestone on 9/30/98, so that milestone indicator received a value of 1 in 2000 and NPL listing was set back to zero for the 2000 decadal marker. The site was not deleted prior to the end of our sample period, so the construction complete indicator

[22] Decennial census data are taken from Social Explorer (https://www.socialexplorer.com).

[23] LTDB provided the crosswalk files (1980-2010, 1990-2010, 2000-2010) and Stata codes to forward the data. Every row in the crosswalk files lists the 2010 tract id, the tract id in that source year (1980, 1990, or 2000), and the share of the source tract's population attributes that should be allocated to the 2010 tract. More detailed information can be found here: https://s4.ad.brown.edu/projects/diversity/Researcher/ltdb3.htm. More information on Stata codes can be found here: https://s4.ad.brown.edu/projects/diversity/Researcher/ltdb4.htm. All the cross-walk files and Stata code can be downloaded here: https://s4.ad.brown.edu/projects/diversity/Researcher/LTBDDload/DataList.aspx.

for 2010 was also set equal to 1.

(6) Creation of BRAC Status Dummy Variables

Six BRAC statuses (1-5, N/A) were made available in data provided by FFRRO. These refer to the following BRAC processes and their corresponding years: BRAC1 (1988), BRAC2 (1991), BRAC3 (1993), BRAC4 (1995) and BRAC5 (2005). Similar to the milestone indicators, the indicator for BRAC1_1990 was set equal to "1" for a site if it had been part of BRAC1, initiated in 1988. That status would remain with the site for BRAC1_2000 and BRAC1_2010. BRAC_2-BRAC_4 dummy variables are always set to zero in 1980 and 1990; if a site was part of one of those BRAC rounds, then that indicator would be turned on in 2000 and remain turned on in 2010. The BRAC5 indicator can only take a value of one in 2010, if a site was part of that BRAC round.

To simplify our treatment of BRAC, we created a dummy variable – BRAC1-4_YEAR, which equals 1 if BRAC1_YEAR, BRAC2_YEAR, BRAC_YEAR or BRAC4_YEAR equals 1. These four BRAC processes were similar in that they all involved EPA explicitly in the cleanup process.

4.2 Data Summary

Tables 1-6 summarize the data. Table 1 reports the number of sites observed at each milestone at each point in time (recall that our milestone indicator definition uses the most recent milestone to be achieved at the census year in question). Note that in 1980, the NPL had not yet begun, so all milestone counts were categorized as zero. Over time, most sites in the sample achieved the final assessment and NPL listing milestones. A smaller number of sites in the sample also met the construction complete and deleted milestones. In any given year, the total count looking down a column need not add up to 72, as some sites did not enter the NPL process until later in the sample period. Moreover, there were 7 sites with no final assessment date provided.

Table 1 provides a glimpse of the difficulties we encountered in trying to measure the benefits of reaching the various NPL milestones. Only four of the 72 sites achieved the deleted milestone, and one of these had to be dropped from the sample due to insufficient census tract

data in LTDB. All sites achieved the NPL listed milestone. It is unclear whether market expectations of a future cleanup would translate into capitalized benefits in house prices or increases in rents at this point in the cleanup process.

Table 2 provides information similar to that in Table 1, but uses information about census tracts. In particular, it reports the percentage of all tracts in the 2km buffer sample exposed to each milestone and each BRAC status in each year. Importantly, only 4% of tract observations in 2010 were exposed to a deleted site, and no other tracts were exposed to deleted sites in other years. Consistent with Table 1, the majority of the tracts were exposed to sites that had met the NPL listed milestone.

Tables 3 – 6 summarize other attributes of the tract sample. Table 3 reports means and standard deviations of time-varying sociodemographic, socioeconomic status, and housing stock attributes. Table 4 reports deciles of the within-tract house value distribution. Tables 5 and 6 report deciles of the within-tract contract and gross rent distributions, respectively. Consistent with their definitions, gross rents are larger than contract rents.

5. Results Summary and Discussion

Estimation results are reported in a series of tables that appear at the end of this report numbered 7.1 to 8.5. The first set of tables (Tables 7.1 – 7.5) describe house value impacts. These are followed by tables that describe gross rent impacts (Tables 8.1 – 8.5). Within each section of results, we report five specifications that correspond to the specifications described in Section 3. The first specification includes cleanup milestones, BRAC indicators, tract fixed effects, and price deflators that vary by region and year. The second specification adds time-varying information about tract housing stock. The third specification introduces some demographic and economic information (i.e., race, unemployment and neighborhood turnover). The fourth specification adds additional socioeconomic status variables. Specification (5) uses year x region fixed effects in place of time-varying covariates. In each specification, the main coefficients of interest describe the percentage increase in the dependent variable associated with a change from the baseline (i.e., pre-final assessment) to the milestone in question (e.g., deletion).[24]

For every dependent variable, specification (1) yields impacts of deletion that are large, positive, and statistically significant at all deciles of the within-tract distributions of house value and gross rent. Statistical significance at levels of 0.1, 0.05, and 0.01 is denoted by "*", "**", or "***", respectively, accompanying each estimate. In a statistical analysis, there is a chance that an estimated effect (e.g., a positive effect of deletion on house values) could be obtained simply due to sampling error. The *p-value* measures the probability of obtaining such a result given that the null hypothesis (i.e., no effect) were, in fact, true. Our measure of statistical significance indicates whether the p-value is less than a particular significance level; for example, "***" indicates that the likelihood of seeing such a result arise from sampling error is less than 0.01.

[24] Formally, given the log dependent variable, a positive $\gamma^{\theta}_{Deletion}$ indicates that house values at the θ^{th} percentile appreciate by $100\left[exp\left(\gamma^{\theta}_{Deletion} - \frac{1}{2}V\left(\gamma^{\theta}_{Deletion}\right)\right) - 1\right]$ percent as a result of a one unit (i.e., 0 to 1) increase in exposure of the tract to a deleted site, where V(.) represents the variance of the parameter estimate. (Kennedy, 1981) For the sake of simplicity, we ignore this distinction, which has little practical impact, when discussing our results.

For house values, a deletion coefficient of 0.363 at the 10th percentile indicates that taking a site through the entire NPL process will raise house values in the 10th percentile of the within-tract distribution by 36.3% relative to pre-final-assessment levels. For rents, positive and statistically significant impacts increase gradually in magnitude as one moves through the different stages of the NPL process. Focusing again on the 10th percentile of the within-tract rent distribution, we see a 16.7% increase at the final assessment stage relative to pre-final-assessment. Listing raises rents by 21.2% relative to pre-final-assessment. Comparing listing to final assessment therefore implies a 4.5% improvement from that change in milestones. Rents continue to improve with construction completion (28.0%) and deletion (53.7%).

Results are similar for all dependent variables in specification (2), which adds controls for time-varying characteristics of the census tract housing stock. In specification (2), we also begin to see evidence of larger positive impacts of deletion at the lower deciles of the within-tract housing value and rent distributions. For instance, the improvement in house values at the 10th percentile is 39.3% while it is only 30.3% at the 90th percentile. We might expect such a result if houses at lower deciles of the within-tract value distribution were located closer to the base, and would thus benefit more directly from the cleanup.

Specification (3) begins to introduce some tract-level time-varying sociodemographic variables, with the intention of controlling for changing preferences that might cause a shift in the hedonic price function over time. Results are still similar to the baseline specification, with large positive effects from deletion. Consistent with a localized-impact interpretation, we see stronger evidence of larger impacts at lower deciles of the within-tract distributions of values and rents.

Specification (4) introduces six additional controls for time-varying socioeconomic status characteristics of the census tracts. Looking at house values, we still see positive and significant effects of deletion, but only at the first decile of the within-tract distribution (i.e., benefits are targeted at the lower value homes within each tract). At other percentiles, the effect of deletion is zero (i.e., houses return to their pre-final-assessment values). This result is conservative, as endogenous neighborhood amenities (e.g., *% College Degree* and *Median*

Household Income) are likely capturing much of the effect of the cleanup.[25] Still, it is useful to show that positive impacts of cleanup are still evident for some house values, even with a long list of controls. For rents, specification (4) produces results that are more in line with previous specifications. With these additional controls, however, positive effects come primarily at the deletion stage. Those effects are statistically significant and large (although smaller than in previous specifications).

Finally, turning to specification (5), results for housing values are similar to specification (4), with large positive effects of deletion at the lowest decile. Gross rents exhibit similarly large positive effects of deletion at the lowest two deciles.

Summarizing the results with respect to cleanup milestones, we find effects of deletion that are generally large, positive and significant. Impacts tend to be larger for units at the lower end of the within-tract distributions of house values and rents. As we introduce more controls, the only significant effects of deletion tend to arise in the first or second deciles of these distributions, suggesting that the effects of cleanup are localized to the area in the immediate vicinity of the facility.

[25] In particular, changes in these variables themselves are likely *a result of* the cleanup, but the regression does not attribute their impacts on values to the cleanup.

6. Conclusions

Given that strict hedonic theory allows for controls for housing characteristics (but not characteristics of the residents who sort into those housing units, which are likely endogenous), we conclude that our strongest estimates likely come from specification (2). To the extent that the hedonic price function shifts over time, these estimates may describe a "capitalization effect" (as opposed to a willingness-to-pay), but even that is useful for measuring the direct impact of cleanup on local housing markets. These estimates are large, positive, and reveal statistically significant increases in housing values and rents associated with deletion of a federal facilities site from the NPL. Other specifications that include additional controls for factors that may cause the hedonic price function to shift over time still show evidence of improvements in house values and rents, although these effects are found primarily at the lower end of the within-tract distributions of house values and rents. Positive values are also evident from a facility achieving other milestones – in particular, the construction complete designation, although the benefits are smaller than those found for deletion. This result is important given the long time-horizon associated with many cleanups.

Our results also indicate that the benefits of cleanup are localized. In particular, the positive impacts of deletion are larger at the lower deciles of the within-tract distributions of house values and rents. That outcome is, moreover, robust to inclusion of many controls for potential confounders (i.e., our specifications 3-5).

These results (both the large positive impacts of deletion and the larger impacts at lower deciles) are similar to those found by Gamper-Rabindran and Timmins (2013), which analyzed Superfund cleanups at primarily non-federal facility sites. That study, however, found significant negative effects of NPL proposal, indicating that local housing markets were likely unaware of the contamination prior to EPA involvement. That does not appear to be the case for the final assessment stage in our analysis – considering federal facilities, that milestone generally has positive impacts, suggesting that housing markets were already aware of the contamination and considered EPA involvement to be a benefit. Given the difference in sizes between federal and non-federal facilities, these differences in results are not surprising.

Finally, we conclude by emphasizing that our study is conservative in that it considers only benefits that are capitalized into housing values. There are likely other types of benefits that fall outside the scope of this analysis (e.g., certain types of ecosystem benefits), and to that extent, our estimates likely provide a lower-bound on total benefits of NPL activity at federal facilities.

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Table 1: Counts of Sites by NPL Milestone in Each Year

Milestone	1980	1990	2000	2010
Final Assessment	0	17	0	0
NPL Listing	0	22	63	53
Construction Completion	0	0	5	15
Deletion	0	0	1	4
				Total: 72

There are 4 sites that reach deleted status by 2010, but one site was dropped because of missing census tract information in LTDB. The deleted sites that are included in the analysis are Luke AFB, Schofield Barracks, and Ft Devens (Sudbury Training Annex). Naval Air Station Whidbey Island (Seaplane Base) was excluded.

Table 2: Average Milestones and BRAC Exposure, Census Tracts

Variable	1980	1990	2000	2010	All Years
Final Assessment	0.0	0.164	0.0	0.0	0.042
	(0.0)	(0.371)	(0.0)	(0.0)	(0.200)
NPL Listing	0.0	0.300	0.897	0.785	0.495
	(0.0)	(0.458)	(0.304)	(0.411)	(0.500)
Construction Complete	0.0	0.0	0.073	0.189	0.064
	(0.0)	(0.0)	(0.260)	(0.392)	(0.246)
Deletion	0.0	0.0	0.0	0.0402	0.010
	(0.0)	(0.0)	(0.0)	(0.197)	(0.098)
BRAC1-4	0.0	0.031	0.102	0.103	0.059
	(0.0)	(0.175)	(0.302)	(0.305)	(0.235)
BRAC5	0.0	0.0	0.0	0.079	0.019
	(0.0)	(0.0)	(0.0)	(0.270)	(0.137)

Columns report means and standard deviations of milestone and BRAC exposure across all tracts within year using 2km buffer sample.

Table 3: Average Time Varying Tract Attributes

Variable	1980	1990	2000	2010	All Years
% Black Non-Hispanic	0.131 (0.218)	0.151 (0.226)	0.181 (0.246)	0.183 (0.245)	0.162 (0.235)
% Hispanic	0.063 (0.086)	0.075 (0.101)	0.098 (0.126)	0.140 (0.157)	0.094 (0.124)
% HS Degree or Less	0.630 (0.161)	0.495 (0.161)	0.441 (0.167)	0.408 (0.159)	0.494 (0.183)
% College Degree or More	0.166 (0.112)	0.201 (0.135)	0.234 (0.154)	0.270 (0.169)	0.217 (0.149)
% Unemployment	0.075 (0.044)	0.067 (0.048)	0.071 (0.060)	0.083 (0.050)	0.074 (0.051)
% Professional Employees	0.220 (0.105)	0.260 (0.114)	0.327 (0.131)	0.349 (0.146)	0.289 (0.135)
% Manufacturing Employees	0.152 (0.098)	0.124 (0.073)	0.091 (0.058)	0.081 (0.055)	0.112 (0.078)
Median Household Income (Deflated)	20819.6 (20019.1)	27194.7 (10193.8)	27915.7 (10882.8)	29042.1 (11890.7)	26242.7 (14156.5)
% Owner Occupied Units	0.568 (0.269)	0.577 (0.253)	0.600 (0.259)	0.613 (0.229)	0.589 (0.253)
% Vacant Units	0.075 (0.066)	0.087 (0.095)	0.086 (0.093)	0.098 (0.091)	0.086 (0.088)
% Multi-Family Units	0.269 (0.228)	0.265 (0.226)	0.260 (0.227)	0.256 (0.232)	0.262 (0.228)
% Structures > 30 Years Old	0.213 (0.224)	0.322 (0.255)	0.435 (0.275)	0.568 (0.271)	0.383 (0.288)
% HHs in Neighborhood <10 Years	0.749 (0.174)	0.714 (0.158)	0.698 (0.155)	0.613 (0.162)	0.694 (0.170)
% Female Headed HH w/Children	0.095 (0.087)	0.107 (0.097)	0.139 (0.106)	0.141 (0.113)	0.120 (0.103)

Columns report means and standard deviations of time varying tract attributes within each year using 2km buffer sample.
HS = High School
HH = Household

Table 4: House Value Deciles (Deflated)

Decile	1980	1990	2000	2010	All Years
10	46858.59	59589.99	48432.88	66342.34	55232.98
	(26631.25)	(37256.64)	(34223.52)	(47907.49)	(38041.73)
20	56881.94	71438.03	60179.60	86739.95	68678.29
	(29596.90)	(43347.47)	(37636.11)	(55980.14)	(44150.66)
30	64698.61	80642.47	69624.53	69624.53	102354.45
	(32591.83)	(48598.66)	(41024.14)	(41024.14)	(63515.94)
40	71846.54	89588.30	78040.29	115823.54	88618.82
	(35446.19)	(54193.60)	(44213.94)	(70362.72)	(55087.06)
50	79459.40	98843.82	86761.12	129711.18	98455.38
	(38479.48)	(59744.14)	(48530.92)	(76846.26)	(60561.51)
60	87708.05	108404.65	95884.79	144586.66	108869.88
	(41757.97)	(65404.16)	(53702.99)	(84998.19)	(66856.25)
70	98919.88	119450.12	107697.34	161506.42	121578.13
	(52549.74)	(72041.86)	(63257.39)	(93615.65)	(75579.96)
80	114905.19	133968.64	122608.44	183925.90	138479.58
	(77163.94)	(80133.59)	(73230.33)	(103182.28)	(88114.58)
90	152408.21	159160.54	148193.00	222512.73	170082.75
	(144205.60)	(93375.57)	(91074.64)	(117503.72)	(117179.79)

Columns report means and standard deviations of within tract housing value deciles within each year using 2km buffer sample.

Table 5: Contract Rent Deciles (Deflated)

Decile	1980	1990	2000	2010	All Years
10	166.43 (79.03)	216.91 (114.659)	224.61 (118.61)	291.14 (183.19)	224.63 (136.61)
20	205.63 (83.31)	270.46 (121.155)	278.53 (126.39)	358.37 (191.31)	278.08 (146.35)
30	234.95 (87.49)	308.85 (127.212)	315.82 (132.20)	408.42 (194.49)	316.82 (153.31)
40	261.15 (92.43)	340.87 (134.054)	346.67 (136.88)	449.34 (201.66)	349.30 (160.83)
50	286.26 (98.83)	371.81 (141.28)	375.03 (144.22)	489.73 (208.64)	380.48 (169.29)
60	312.37 (104.83)	404.27 (149.023)	408.10 (155.22)	531.53 (215.16)	413.82 (178.53)
70	341.60 (112.09)	441.19 (158.494)	442.30 (164.64)	578.03 (223.65)	450.51 (188.87)
80	377.31 (120.07)	485.13 (169.56)	488.91 (180.67)	633.28 (233.26)	495.87 (201.80)
90	431.46 (127.10)	550.40 (183.417)	563.41 (208.01)	716.08 (242.43)	565.02 (219.24)

Columns report means and standard deviations of within tract contract rent deciles within each year using 2km buffer sample.

Table 6: Gross Rent Deciles (Deflated)

Decile	1980	1990	2000	2010	All Years
10	213.59	261.22	260.69	341.85	269.22
	(83.82)	(122.04)	(121.65)	(185.54)	(140.93)
20	254.17	314.06	317.189	414.79	324.90
	(88.66)	(124.75)	(129.33)	(188.73)	(149.01)
30	287.47	358.41	357.64	469.01	367.96
	(93.46)	(130.50)	(134.68)	(191.44)	(155.90)
40	316.85	394.72	393.12	514.11	404.51
	(99.42)	(138.07)	(142.13)	(196.99)	(164.04)
50	346.44	429.19	427.37	558.26	440.12
	(107.34)	(144.49)	(149.33)	(203.34)	(172.34)
60	378.03	465.65	463.57	605.31	477.93
	(116.42)	(152.47)	(157.57)	(208.01)	(181.10)
70	414.47	508.92	504.43	657.21	521.02
	(128.82)	(159.42)	(167.10)	(213.01)	(190.62)
80	463.07	560.40	560.15	718.09	575.19
	(145.90)	(168.15)	(181.76)	(216.19)	(201.55)
90	539.71	636.78	648.12	807.33	657.74
	(169.01)	(176.86)	(204.72)	(214.75)	(214.74)

Columns report means and standard deviations of within tract gross rent deciles within each year using 2km buffer sample.

Table 7.1: Impacts on Housing Value, Baseline Specification

	Percentile								
VARIABLES	10	20	30	40	50	60	70	80	90
BRAC 1-4	0.073	0.125***	0.109***	0.110***	0.106***	0.109***	0.114***	0.137***	0.125***
	(0.067)	(0.047)	(0.035)	(0.030)	(0.029)	(0.029)	(0.030)	(0.032)	(0.042)
BRAC 5	-0.005	0.066	0.089**	0.110***	0.139***	0.163***	0.200***	0.222***	0.278***
	(0.059)	(0.045)	(0.039)	(0.035)	(0.033)	(0.031)	(0.024)	(0.024)	(0.026)
Final Assessment	0.161***	0.151***	0.146***	0.138***	0.123***	0.118***	0.095***	0.080***	0.071**
	(0.056)	(0.046)	(0.035)	(0.030)	(0.030)	(0.028)	(0.030)	(0.030)	(0.033)
NPL Listing	-0.009	0.071***	0.115***	0.137***	0.151***	0.158***	0.160***	0.160***	0.155***
	(0.024)	(0.018)	(0.015)	(0.013)	(0.012)	(0.012)	(0.012)	(0.012)	(0.014)
Construction Completion	-0.014	0.122***	0.192***	0.235***	0.255***	0.254***	0.259***	0.264***	0.271***
	(0.051)	(0.038)	(0.029)	(0.026)	(0.024)	(0.024)	(0.024)	(0.025)	(0.027)
Deletion	0.363***	0.361***	0.351***	0.343***	0.342***	0.338***	0.349***	0.360***	0.361***
	(0.077)	(0.063)	(0.055)	(0.051)	(0.048)	(0.046)	(0.045)	(0.045)	(0.040)
Constant	10.658***	10.877***	11.014***	11.123***	11.227***	11.327***	11.434***	11.559***	11.749***
	(0.013)	(0.010)	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)
Observations	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870
Number of tractid	742	742	742	742	742	742	742	742	742
R-squared	0.011	0.030	0.064	0.096	0.120	0.135	0.143	0.149	0.128
Adj. R-squared	0.00882	0.0277	0.0619	0.0943	0.119	0.133	0.141	0.147	0.126

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 7.2: Impacts on Housing Value, Baseline Specification + Housing Stock Attributes

	Percentile								
VARIABLES	10	20	30	40	50	60	70	80	90
BRAC 1-4	0.070	0.117***	0.100***	0.100***	0.096***	0.098***	0.103***	0.125***	0.113***
	(0.063)	(0.045)	(0.034)	(0.028)	(0.027)	(0.028)	(0.029)	(0.031)	(0.041)
BRAC 5	-0.003	0.049	0.065*	0.083**	0.105***	0.128***	0.166***	0.184***	0.234***
	(0.061)	(0.045)	(0.039)	(0.035)	(0.033)	(0.031)	(0.025)	(0.025)	(0.027)
Final Assessment	0.157***	0.139***	0.133***	0.122***	0.103***	0.098***	0.075**	0.059*	0.046
	(0.058)	(0.047)	(0.036)	(0.030)	(0.030)	(0.029)	(0.030)	(0.030)	(0.034)
NPL Listing	-0.001	0.048**	0.081***	0.098***	0.103***	0.111***	0.113***	0.108***	0.098***
	(0.025)	(0.020)	(0.018)	(0.016)	(0.015)	(0.014)	(0.015)	(0.015)	(0.017)
Construction Completion	0.003	0.096**	0.151***	0.186***	0.193***	0.193***	0.196***	0.194***	0.191***
	(0.053)	(0.041)	(0.033)	(0.029)	(0.028)	(0.027)	(0.028)	(0.028)	(0.031)
Deletion	0.393***	0.351***	0.325***	0.311***	0.301***	0.295***	0.301***	0.303***	0.303***
	(0.075)	(0.060)	(0.052)	(0.048)	(0.046)	(0.044)	(0.044)	(0.043)	(0.040)
% Vacant Units	0.657**	0.471**	0.328*	0.342*	0.387**	0.409***	0.342**	0.338**	0.431**
	(0.279)	(0.219)	(0.193)	(0.182)	(0.181)	(0.146)	(0.150)	(0.157)	(0.169)
% Owner Occupied Units	0.259***	0.230***	0.218***	0.205***	0.182***	0.198***	0.204***	0.225***	0.160**
	(0.087)	(0.068)	(0.059)	(0.055)	(0.054)	(0.054)	(0.055)	(0.057)	(0.077)
% Multi-Family Units	-0.574***	-0.459***	-0.408***	-0.358***	-0.312***	-0.234**	-0.154	-0.058	-0.055
	(0.140)	(0.120)	(0.112)	(0.104)	(0.098)	(0.101)	(0.106)	(0.105)	(0.122)
% Structures > 30 Years Old	-0.113*	0.046	0.107***	0.135***	0.173***	0.168***	0.176***	0.201***	0.228***
	(0.059)	(0.046)	(0.041)	(0.038)	(0.036)	(0.034)	(0.035)	(0.036)	(0.039)
Constant	10.637***	10.818***	10.945***	11.040***	11.132***	11.201***	11.287***	11.369***	11.581***
	(0.072)	(0.060)	(0.054)	(0.051)	(0.050)	(0.050)	(0.051)	(0.049)	(0.063)
Observations	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870
Number of tractid	742	742	742	742	742	742	742	742	742
R-squared	0.033	0.052	0.089	0.123	0.149	0.161	0.165	0.171	0.149
Adj. R-squared	0.0300	0.0486	0.0860	0.120	0.146	0.158	0.163	0.168	0.146

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 7.3: Impacts on Housing Value, Baseline Specification + Housing Stock Attributes + Resident and Economic Attributes

	Percentile								
VARIABLES	10	20	30	40	50	60	70	80	90
BRAC 1-4	0.157**	0.163***	0.119***	0.107***	0.089***	0.083***	0.081***	0.095***	0.070
	(0.063)	(0.045)	(0.035)	(0.029)	(0.029)	(0.030)	(0.031)	(0.034)	(0.043)
BRAC 5	0.086	0.090**	0.076*	0.080**	0.088***	0.102***	0.132***	0.140***	0.179***
	(0.062)	(0.043)	(0.039)	(0.035)	(0.033)	(0.032)	(0.027)	(0.027)	(0.030)
Final Assessment	0.146**	0.135***	0.132***	0.122***	0.106***	0.102***	0.079***	0.064**	0.054
	(0.058)	(0.047)	(0.035)	(0.030)	(0.031)	(0.029)	(0.031)	(0.031)	(0.035)
NPL Listing	0.058**	0.081***	0.097***	0.106***	0.105***	0.108***	0.107***	0.096***	0.080***
	(0.025)	(0.020)	(0.018)	(0.017)	(0.015)	(0.015)	(0.015)	(0.015)	(0.017)
Construction Completion	0.094*	0.148***	0.178***	0.201***	0.196***	0.187***	0.184***	0.174***	0.159***
	(0.053)	(0.041)	(0.034)	(0.031)	(0.029)	(0.028)	(0.028)	(0.029)	(0.032)
Deletion	0.459***	0.387***	0.339***	0.315***	0.298***	0.288***	0.291***	0.287***	0.281***
	(0.079)	(0.061)	(0.051)	(0.048)	(0.047)	(0.045)	(0.046)	(0.046)	(0.045)
% Vacant Units	0.598**	0.419**	0.298*	0.326**	0.380**	0.399***	0.327**	0.336**	0.407**
	(0.266)	(0.196)	(0.170)	(0.160)	(0.162)	(0.136)	(0.136)	(0.142)	(0.160)
% Owner Occupied Units	0.078	0.109	0.146**	0.149**	0.138**	0.171***	0.180***	0.204***	0.144*
	(0.095)	(0.075)	(0.066)	(0.062)	(0.062)	(0.060)	(0.060)	(0.062)	(0.085)
% Multi-Family Units	-0.668***	-0.523***	-0.432***	-0.367***	-0.306***	-0.220**	-0.147	-0.043	-0.076
	(0.141)	(0.123)	(0.115)	(0.107)	(0.099)	(0.103)	(0.107)	(0.105)	(0.124)
% Structures > 30 Years Old	0.080	0.164***	0.191***	0.189***	0.200***	0.175***	0.176***	0.187***	0.199***
	(0.064)	(0.049)	(0.043)	(0.039)	(0.039)	(0.036)	(0.037)	(0.038)	(0.041)

Table 7.3: Impacts on Housing Value, Baseline Specification + Housing Stock Attributes + Resident and Economic Attributes (*Continued)*

% Unemployment	0.022	0.075	0.003	-0.028	-0.078	-0.121	-0.080	-0.125	-0.053
	(0.330)	(0.263)	(0.222)	(0.213)	(0.214)	(0.214)	(0.205)	(0.207)	(0.240)
% Black Non-Hispanic	-1.002***	-0.714***	-0.608***	-0.513***	-0.448***	-0.389***	-0.364***	-0.350***	-0.241*
	(0.198)	(0.168)	(0.143)	(0.134)	(0.129)	(0.126)	(0.126)	(0.126)	(0.128)
% Hispanic	-1.418***	-0.773***	-0.370**	-0.199	0.012	0.160	0.258**	0.390***	0.674***
	(0.244)	(0.178)	(0.149)	(0.135)	(0.115)	(0.113)	(0.113)	(0.116)	(0.133)
% HHs in Neighborhood < 10 Yrs	0.175	0.059	-0.017	-0.085	-0.132**	-0.160***	-0.160**	-0.203***	-0.100
	(0.113)	(0.087)	(0.075)	(0.068)	(0.066)	(0.062)	(0.064)	(0.070)	(0.093)
Constant	10.831***	10.984***	11.099***	11.214***	11.317***	11.384***	11.459***	11.563***	11.673***
	(0.129)	(0.100)	(0.087)	(0.081)	(0.080)	(0.073)	(0.073)	(0.076)	(0.100)
Observations	2,845	2,845	2,845	2,845	2,845	2,845	2,845	2,845	2,845
Number of tractid	740	740	740	740	740	740	740	740	740
R-squared	0.081	0.080	0.110	0.140	0.164	0.174	0.178	0.188	0.162
Adj. R-squared	0.0766	0.0754	0.105	0.136	0.160	0.170	0.174	0.184	0.158

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 7.4: Impacts on Housing Value, Baseline Specification + Housing Stock Attributes + Resident and Economic Attributes + SES Variables

	Percentile								
VARIABLES	10	20	30	40	50	60	70	80	90
BRAC 1-4	-0.023	-0.028	-0.069**	-0.075***	-0.088***	-0.094***	-0.091***	-0.076**	-0.099**
	(0.061)	(0.042)	(0.032)	(0.027)	(0.027)	(0.028)	(0.029)	(0.032)	(0.039)
BRAC 5	0.023	0.022	0.007	0.010	0.018	0.028	0.055**	0.058**	0.095***
	(0.064)	(0.043)	(0.038)	(0.033)	(0.032)	(0.030)	(0.025)	(0.027)	(0.029)
Final Assessment	0.008	-0.001	-0.004	-0.008	-0.022	-0.016	-0.027	-0.037	-0.039
	(0.058)	(0.047)	(0.036)	(0.031)	(0.032)	(0.031)	(0.031)	(0.031)	(0.035)
NPL Listing	-0.140***	-0.127***	-0.115***	-0.100***	-0.094***	-0.085***	-0.074***	-0.079***	-0.088***
	(0.032)	(0.027)	(0.023)	(0.021)	(0.019)	(0.017)	(0.018)	(0.018)	(0.019)
Construction Completion	-0.113*	-0.072	-0.051	-0.022	-0.019	-0.021	-0.011	-0.017	-0.027
	(0.059)	(0.046)	(0.038)	(0.034)	(0.032)	(0.030)	(0.031)	(0.032)	(0.035)
Deletion	0.159*	0.071	0.025	0.010	-0.002	-0.006	0.011	0.009	0.008
	(0.084)	(0.072)	(0.068)	(0.066)	(0.065)	(0.064)	(0.066)	(0.065)	(0.062)
% Vacant Units	0.403	0.230	0.114	0.149	0.205	0.231**	0.170	0.180	0.251*
	(0.271)	(0.198)	(0.162)	(0.148)	(0.144)	(0.112)	(0.115)	(0.124)	(0.143)
% Owner Occupied Units	-0.290***	-0.261***	-0.209***	-0.189***	-0.190***	-0.145**	-0.121**	-0.079	-0.108
	(0.102)	(0.077)	(0.066)	(0.061)	(0.061)	(0.057)	(0.057)	(0.058)	(0.084)
% Multi-Family Units	-0.521***	-0.387***	-0.305***	-0.248**	-0.192**	-0.121	-0.062	0.021	-0.034
	(0.137)	(0.117)	(0.106)	(0.097)	(0.088)	(0.093)	(0.099)	(0.098)	(0.116)
% Structures > 30 Years Old	0.188***	0.256***	0.274***	0.265***	0.269***	0.241***	0.240***	0.239***	0.240***
	(0.063)	(0.048)	(0.041)	(0.037)	(0.037)	(0.035)	(0.035)	(0.036)	(0.039)

Table 7.4: Impacts on Housing Value, Baseline Specification + Housing Stock Attributes + Resident and Economic Attributes + SES Variables (*Continued)*

% Unemployment	0.760**	0.752***	0.664***	0.596***	0.532**	0.437**	0.423**	0.335*	0.344
	(0.330)	(0.260)	(0.215)	(0.205)	(0.206)	(0.206)	(0.196)	(0.199)	(0.238)
% Black Non-Hispanic	-0.783***	-0.478***	-0.380***	-0.284***	-0.226**	-0.149*	-0.105	-0.090	0.002
	(0.166)	(0.127)	(0.100)	(0.092)	(0.089)	(0.085)	(0.087)	(0.089)	(0.094)
% Hispanic	-1.316***	-0.674***	-0.263*	-0.091	0.112	0.269***	0.376***	0.509***	0.790***
	(0.238)	(0.173)	(0.142)	(0.125)	(0.105)	(0.101)	(0.102)	(0.104)	(0.123)
% HHs in Neighborhood < 10 Yrs	0.315***	0.141	0.045	-0.032	-0.083	-0.120*	-0.125*	-0.182**	-0.075
	(0.119)	(0.095)	(0.083)	(0.076)	(0.074)	(0.068)	(0.072)	(0.079)	(0.101)
% HS Degree or Less	-0.216	-0.137	-0.189	-0.173	-0.162	-0.088	-0.014	0.019	0.073
	(0.204)	(0.166)	(0.138)	(0.125)	(0.110)	(0.101)	(0.104)	(0.109)	(0.125)
% College Degree or More	1.250***	1.292***	1.214***	1.194***	1.226***	1.311***	1.395***	1.534***	1.513***
	(0.297)	(0.219)	(0.186)	(0.180)	(0.184)	(0.181)	(0.185)	(0.180)	(0.202)
% Professional Employees	-0.324	-0.123	-0.008	0.018	-0.089	-0.008	0.039	-0.031	0.024
	(0.262)	(0.221)	(0.194)	(0.183)	(0.178)	(0.184)	(0.188)	(0.166)	(0.183)
% Manufacturing Employees	-0.281	-0.410**	-0.401**	-0.462***	-0.531***	-0.525***	-0.477***	-0.577***	-0.798***
	(0.285)	(0.208)	(0.165)	(0.150)	(0.138)	(0.135)	(0.138)	(0.142)	(0.166)
% Female Headed HH w/Children	0.135	0.127	0.096	0.044	0.060	0.020	-0.029	-0.017	-0.023
	(0.184)	(0.125)	(0.110)	(0.104)	(0.106)	(0.106)	(0.108)	(0.116)	(0.138)
Median HH Income (Deflated)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	10.201***	10.374***	10.574***	10.737***	10.869***	10.916***	10.966***	11.115***	11.282***
	(0.252)	(0.207)	(0.173)	(0.153)	(0.142)	(0.123)	(0.121)	(0.124)	(0.147)
Observations	2,842	2,842	2,842	2,842	2,842	2,842	2,842	2,842	2,842
Number of tractid	740	740	740	740	740	740	740	740	740
R-squared	0.180	0.232	0.299	0.340	0.369	0.377	0.365	0.365	0.296
Adj. R-squared	0.174	0.226	0.294	0.335	0.364	0.373	0.361	0.360	0.292

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 7.5: Impacts on Housing Value, Region x Year Fixed Effects

	Percentile								
VARIABLES	10	20	30	40	50	60	70	80	90
BRAC 1-4	0.047	0.076	0.052	0.052*	0.045	0.047*	0.055*	0.077**	0.062
	(0.069)	(0.050)	(0.036)	(0.029)	(0.028)	(0.028)	(0.030)	(0.032)	(0.040)
BRAC 5	-0.144**	-0.122**	-0.112***	-0.090**	-0.074**	-0.063*	-0.025	-0.004	0.062**
	(0.063)	(0.048)	(0.041)	(0.037)	(0.035)	(0.033)	(0.027)	(0.027)	(0.029)
Final Assessment	-0.059	-0.053	-0.052	-0.056*	-0.067**	-0.064**	-0.074**	-0.075**	-0.055*
	(0.063)	(0.050)	(0.037)	(0.030)	(0.030)	(0.028)	(0.029)	(0.029)	(0.033)
NPL Listing	0.087**	0.038	0.010	0.012	0.002	0.003	0.012	0.011	0.010
	(0.034)	(0.026)	(0.022)	(0.020)	(0.019)	(0.018)	(0.018)	(0.018)	(0.020)
Construction Completion	0.022	-0.005	-0.029	-0.011	-0.026	-0.045	-0.032	-0.031	-0.015
	(0.069)	(0.054)	(0.042)	(0.037)	(0.034)	(0.032)	(0.032)	(0.033)	(0.037)
Deletion	0.276***	0.110	0.022	-0.003	-0.041	-0.065	-0.047	-0.037	-0.018
	(0.092)	(0.072)	(0.063)	(0.058)	(0.055)	(0.052)	(0.052)	(0.050)	(0.046)

Table 7.5: Impacts on Housing Value, Region x Year Fixed Effects (*Continued)*

1980 (Northeast)	-0.417***	-0.580***	-0.640***	-0.653***	-0.685***	-0.687***	-0.671***	-0.672***	-0.679***
	(0.074)	(0.052)	(0.044)	(0.040)	(0.037)	(0.037)	(0.038)	(0.037)	(0.039)
1980 (South)	-0.145**	-0.350***	-0.454***	-0.482***	-0.513***	-0.517***	-0.506***	-0.514***	-0.563***
	(0.062)	(0.049)	(0.040)	(0.035)	(0.031)	(0.030)	(0.030)	(0.030)	(0.031)
1980 (Midwest)	0.107	0.050	-0.003	0.004	-0.009	-0.027	-0.011	-0.028	-0.036
	(0.118)	(0.081)	(0.059)	(0.053)	(0.047)	(0.044)	(0.044)	(0.049)	(0.064)
1980 (West)	0.012	-0.171***	-0.272***	-0.299***	-0.343***	-0.368***	-0.353***	-0.346***	-0.285***
	(0.062)	(0.045)	(0.037)	(0.033)	(0.030)	(0.029)	(0.029)	(0.029)	(0.034)
1990 (Northeast)	0.186**	-0.003	-0.076*	-0.100***	-0.137***	-0.159***	-0.160***	-0.168***	-0.172***
	(0.075)	(0.052)	(0.041)	(0.036)	(0.033)	(0.032)	(0.032)	(0.032)	(0.032)
1990 (South)	0.074	-0.171***	-0.290***	-0.333***	-0.382***	-0.401***	-0.410***	-0.427***	-0.463***
	(0.053)	(0.040)	(0.032)	(0.028)	(0.025)	(0.024)	(0.024)	(0.023)	(0.025)
1990 (Midwest)	0.118	0.026	-0.023	-0.030	-0.054	-0.090***	-0.099***	-0.139***	-0.141***
	(0.105)	(0.068)	(0.048)	(0.040)	(0.036)	(0.032)	(0.033)	(0.039)	(0.054)
1990 (West)	0.108**	-0.067*	-0.162***	-0.185***	-0.221***	-0.246***	-0.249***	-0.265***	-0.279***
	(0.051)	(0.037)	(0.030)	(0.028)	(0.025)	(0.023)	(0.023)	(0.022)	(0.023)
2000 (Northeast)	-0.239***	-0.321***	-0.345***	-0.352***	-0.368***	-0.373***	-0.365***	-0.346***	-0.312***
	(0.035)	(0.023)	(0.020)	(0.018)	(0.018)	(0.017)	(0.018)	(0.019)	(0.022)
2000 (South)	-0.290***	-0.389***	-0.438***	-0.462***	-0.490***	-0.496***	-0.495***	-0.505***	-0.537***
	(0.035)	(0.030)	(0.026)	(0.024)	(0.022)	(0.019)	(0.019)	(0.019)	(0.021)
2000 (Midwest)	0.078	0.047	0.055	0.078**	0.076***	0.064***	0.052**	0.013	-0.020
	(0.056)	(0.055)	(0.042)	(0.034)	(0.028)	(0.023)	(0.023)	(0.023)	(0.027)
2000 (West)	-0.290***	-0.333***	-0.337***	-0.326***	-0.338***	-0.357***	-0.356***	-0.362***	-0.362***
	(0.039)	(0.028)	(0.024)	(0.022)	(0.020)	(0.018)	(0.018)	(0.018)	(0.018)
Constant	10.687***	11.097***	11.333***	11.468***	11.611***	11.727***	11.827***	11.958***	12.149***
	(0.043)	(0.032)	(0.026)	(0.023)	(0.021)	(0.020)	(0.021)	(0.020)	(0.022)
Observations	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870	2,870
Number of tractid	742	742	742	742	742	742	742	742	742
R-squared	0.125	0.209	0.307	0.378	0.444	0.481	0.478	0.482	0.436
Adj. R-squared	0.120	0.204	0.303	0.374	0.440	0.477	0.475	0.478	0.432

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 8.1: Impacts on Gross Rents, Baseline Specification

	Percentile								
VARIABLES	10	20	30	40	50	60	70	80	90
BRAC 1-4	0.103*	0.113**	0.077**	0.089***	0.084***	0.078***	0.082***	0.084***	0.095***
	(0.054)	(0.044)	(0.037)	(0.032)	(0.030)	(0.029)	(0.029)	(0.029)	(0.026)
BRAC 5	-0.008	0.017	0.040	0.061***	0.070***	0.074***	0.079***	0.076***	0.069***
	(0.053)	(0.037)	(0.028)	(0.023)	(0.023)	(0.025)	(0.025)	(0.025)	(0.025)
Final Assessment	0.167***	0.196***	0.197***	0.201***	0.211***	0.212***	0.208***	0.200***	0.172***
	(0.023)	(0.020)	(0.018)	(0.017)	(0.017)	(0.016)	(0.017)	(0.016)	(0.015)
NPL Listing	0.212***	0.230***	0.232***	0.229***	0.226***	0.225***	0.219***	0.213***	0.203***
	(0.016)	(0.013)	(0.012)	(0.011)	(0.010)	(0.010)	(0.009)	(0.009)	(0.008)
Construction Completion	0.280***	0.311***	0.324***	0.326***	0.321***	0.319***	0.320***	0.314***	0.302***
	(0.028)	(0.024)	(0.022)	(0.020)	(0.020)	(0.020)	(0.019)	(0.019)	(0.019)
Deletion	0.537***	0.533***	0.498***	0.448***	0.434***	0.465***	0.449***	0.447***	0.419***
	(0.106)	(0.090)	(0.079)	(0.076)	(0.066)	(0.058)	(0.055)	(0.048)	(0.051)
Constant	5.319***	5.528***	5.669***	5.772***	5.863***	5.950***	6.043***	6.149***	6.296***
	(0.009)	(0.008)	(0.007)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)
Observations	2,959	2,959	2,959	2,959	2,959	2,959	2,959	2,959	2,959
Number of tractid	748	748	748	748	748	748	748	748	748
R-squared	0.141	0.221	0.254	0.281	0.292	0.304	0.307	0.314	0.312
Adj. R-squared	0.140	0.220	0.252	0.279	0.291	0.302	0.306	0.313	0.311

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 8.2: Impacts on Gross Rents, Baseline Specification + Housing Stock Attributes

	Percentile								
VARIABLES	10	20	30	40	50	60	70	80	90
BRAC 1-4	0.098*	0.109***	0.074**	0.086***	0.080***	0.074***	0.077***	0.079***	0.090***
	(0.053)	(0.042)	(0.034)	(0.029)	(0.026)	(0.025)	(0.026)	(0.025)	(0.023)
BRAC 5	-0.008	0.012	0.033	0.049**	0.056**	0.058**	0.058**	0.056**	0.051**
	(0.055)	(0.039)	(0.028)	(0.023)	(0.022)	(0.024)	(0.024)	(0.024)	(0.025)
Final Assessment	0.163***	0.188***	0.187***	0.189***	0.197***	0.198***	0.192***	0.185***	0.158***
	(0.025)	(0.021)	(0.020)	(0.019)	(0.018)	(0.017)	(0.017)	(0.016)	(0.014)
NPL Listing	0.213***	0.225***	0.224***	0.214***	0.206***	0.202***	0.188***	0.183***	0.176***
	(0.021)	(0.018)	(0.016)	(0.015)	(0.015)	(0.014)	(0.012)	(0.012)	(0.009)
Construction Completion	0.287***	0.309***	0.317***	0.310***	0.299***	0.295***	0.286***	0.282***	0.274***
	(0.034)	(0.028)	(0.026)	(0.024)	(0.024)	(0.023)	(0.022)	(0.021)	(0.020)
Deletion	0.531***	0.523***	0.487***	0.430***	0.411***	0.440***	0.416***	0.413***	0.389***
	(0.106)	(0.090)	(0.079)	(0.076)	(0.065)	(0.056)	(0.054)	(0.047)	(0.050)
% Vacant Units	0.611***	0.664***	0.688***	0.670***	0.661***	0.655***	0.639***	0.598***	0.547***
	(0.131)	(0.110)	(0.093)	(0.089)	(0.086)	(0.085)	(0.087)	(0.089)	(0.090)
% Owner Occupied Units	0.375***	0.318***	0.250***	0.262***	0.274***	0.273***	0.295***	0.310***	0.272***
	(0.108)	(0.089)	(0.076)	(0.072)	(0.070)	(0.068)	(0.069)	(0.066)	(0.052)
% Multi-Family Units	-0.046	-0.127	-0.236**	-0.281***	-0.313***	-0.343***	-0.353***	-0.341***	-0.337***
	(0.125)	(0.108)	(0.096)	(0.090)	(0.086)	(0.081)	(0.074)	(0.070)	(0.055)
% Structures > 30 Years Old	-0.091*	-0.061	-0.047	-0.016	0.007	0.016	0.049	0.049*	0.042*
	(0.051)	(0.041)	(0.038)	(0.036)	(0.035)	(0.034)	(0.031)	(0.029)	(0.024)
Constant	5.098***	5.349***	5.552***	5.654***	5.742***	5.836***	5.913***	6.011***	6.183***
	(0.087)	(0.073)	(0.063)	(0.060)	(0.059)	(0.057)	(0.056)	(0.054)	(0.039)
Observations	2,959	2,959	2,959	2,959	2,959	2,959	2,959	2,959	2,959
Number of tractid	748	748	748	748	748	748	748	748	748
R-squared	0.167	0.255	0.292	0.326	0.345	0.361	0.371	0.380	0.373
Adj. R-squared	0.165	0.252	0.290	0.324	0.342	0.358	0.369	0.378	0.371

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 8.3: Impacts on Gross Rents, Baseline Specification + Housing Stock Attributes + Resident and Economic Attributes

	Percentile								
VARIABLES	10	20	30	40	50	60	70	80	90
BRAC 1-4	0.067	0.074*	0.035	0.048*	0.042*	0.037	0.041	0.043*	0.058**
	(0.052)	(0.042)	(0.033)	(0.029)	(0.026)	(0.025)	(0.026)	(0.026)	(0.024)
BRAC 5	-0.026	-0.014	-0.000	0.011	0.016	0.017	0.017	0.016	0.011
	(0.054)	(0.039)	(0.028)	(0.022)	(0.022)	(0.025)	(0.025)	(0.025)	(0.026)
Final Assessment	0.170***	0.195***	0.195***	0.197***	0.205***	0.206***	0.201***	0.194***	0.165***
	(0.024)	(0.021)	(0.020)	(0.019)	(0.019)	(0.018)	(0.017)	(0.016)	(0.015)
NPL Listing	0.204***	0.212***	0.210***	0.201***	0.191***	0.188***	0.176***	0.171***	0.159***
	(0.021)	(0.019)	(0.017)	(0.016)	(0.015)	(0.014)	(0.012)	(0.011)	(0.009)
Construction Completion	0.274***	0.288***	0.292***	0.284***	0.270***	0.266***	0.260***	0.256***	0.243***
	(0.033)	(0.029)	(0.026)	(0.024)	(0.024)	(0.023)	(0.022)	(0.021)	(0.020)
Deletion	0.502***	0.488***	0.446***	0.396***	0.377***	0.414***	0.392***	0.395***	0.369***
	(0.114)	(0.096)	(0.083)	(0.080)	(0.068)	(0.059)	(0.056)	(0.049)	(0.052)
% Vacant Units	0.492***	0.594***	0.652***	0.651***	0.655***	0.670***	0.665***	0.643***	0.637***
	(0.152)	(0.131)	(0.109)	(0.105)	(0.101)	(0.100)	(0.100)	(0.103)	(0.108)
% Owner Occupied Units	0.340***	0.343***	0.262***	0.270***	0.296***	0.298***	0.312***	0.330***	0.304***
	(0.108)	(0.099)	(0.085)	(0.081)	(0.080)	(0.079)	(0.077)	(0.074)	(0.061)
% Multi-Family Units	-0.069	-0.122	-0.238**	-0.295***	-0.324***	-0.354***	-0.374***	-0.367***	-0.344***
	(0.124)	(0.112)	(0.098)	(0.093)	(0.089)	(0.085)	(0.073)	(0.069)	(0.059)
% Structures > 30 Years Old	-0.113**	-0.091**	-0.084**	-0.054*	-0.029	-0.021	0.015	0.019	0.021
	(0.050)	(0.040)	(0.035)	(0.032)	(0.031)	(0.030)	(0.027)	(0.026)	(0.024)

Table 8.3: Impacts on Gross Rents, Baseline Specification + Housing Stock Attributes + Resident and Economic Attributes (*Continued)*

% Unemployment	-0.685***	-0.499***	-0.513***	-0.472***	-0.449***	-0.419***	-0.367**	-0.375***	-0.361***
	(0.236)	(0.188)	(0.175)	(0.177)	(0.165)	(0.149)	(0.147)	(0.132)	(0.137)
% Black Non-Hispanic	-0.080	-0.012	-0.067	-0.128	-0.119	-0.148	-0.188**	-0.159**	-0.099
	(0.135)	(0.111)	(0.110)	(0.103)	(0.099)	(0.093)	(0.085)	(0.076)	(0.067)
% Hispanic	0.500***	0.541***	0.609***	0.622***	0.632***	0.630***	0.611***	0.610***	0.583***
	(0.138)	(0.113)	(0.101)	(0.094)	(0.090)	(0.090)	(0.090)	(0.088)	(0.087)
% HHs in Neighborhood < 10 Yrs	-0.002	-0.019	-0.043	-0.069	-0.069	-0.083	-0.077	-0.059	-0.055
	(0.097)	(0.084)	(0.077)	(0.070)	(0.066)	(0.063)	(0.056)	(0.053)	(0.046)
Constant	5.163***	5.358***	5.593***	5.723***	5.798***	5.901***	5.982***	6.060***	6.206***
	(0.123)	(0.115)	(0.107)	(0.101)	(0.098)	(0.096)	(0.086)	(0.081)	(0.065)
Observations	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916
Number of tractid	746	746	746	746	746	746	746	746	746
R-squared	0.166	0.257	0.301	0.342	0.363	0.383	0.398	0.409	0.394
Adj. R-squared	0.162	0.254	0.298	0.339	0.360	0.380	0.395	0.406	0.391

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 8.4: Impacts on Gross Rents, Baseline Specification + Housing Stock Attributes + Resident and Economic Attributes + SES Variables

	Percentile								
VARIABLES	10	20	30	40	50	60	70	80	90
BRAC 1-4	-0.002	-0.023	-0.069**	-0.059**	-0.059**	-0.062**	-0.052**	-0.046*	-0.024
	(0.050)	(0.042)	(0.031)	(0.027)	(0.025)	(0.025)	(0.026)	(0.025)	(0.023)
BRAC 5	-0.044	-0.031	-0.022	-0.008	-0.002	0.001	0.001	-0.003	-0.008
	(0.056)	(0.042)	(0.030)	(0.024)	(0.022)	(0.025)	(0.026)	(0.025)	(0.025)
Final Assessment	0.028	0.044**	0.042**	0.047**	0.060***	0.066***	0.063***	0.063***	0.045***
	(0.027)	(0.022)	(0.020)	(0.019)	(0.019)	(0.018)	(0.017)	(0.016)	(0.016)
NPL Listing	0.022	0.007	-0.001	-0.009	-0.012	-0.010	-0.014	-0.012	-0.011
	(0.022)	(0.019)	(0.015)	(0.013)	(0.012)	(0.012)	(0.012)	(0.011)	(0.010)
Construction Completion	0.069*	0.050	0.048*	0.043*	0.037*	0.039*	0.040*	0.045**	0.045**
	(0.037)	(0.032)	(0.026)	(0.023)	(0.022)	(0.021)	(0.021)	(0.020)	(0.019)
Deletion	0.303***	0.258***	0.207**	0.155*	0.145**	0.187***	0.172***	0.183***	0.170***
	(0.117)	(0.098)	(0.085)	(0.080)	(0.068)	(0.058)	(0.055)	(0.045)	(0.048)
% Vacant Units	0.375***	0.439***	0.492***	0.490***	0.495***	0.515***	0.517***	0.502***	0.505***
	(0.135)	(0.115)	(0.087)	(0.081)	(0.077)	(0.079)	(0.079)	(0.085)	(0.092)
% Owner Occupied Units	0.152	0.140	0.053	0.058	0.094	0.101	0.129**	0.163***	0.162***
	(0.107)	(0.094)	(0.075)	(0.069)	(0.068)	(0.067)	(0.063)	(0.061)	(0.050)
% Multi-Family Units	0.077	0.048	-0.071	-0.131	-0.167**	-0.202***	-0.232***	-0.246***	-0.251***
	(0.113)	(0.100)	(0.086)	(0.081)	(0.078)	(0.074)	(0.062)	(0.057)	(0.049)
% Structures > 30 Years Old	-0.099**	-0.066*	-0.059*	-0.027	-0.002	0.005	0.035	0.030	0.023
	(0.049)	(0.038)	(0.033)	(0.030)	(0.029)	(0.028)	(0.025)	(0.024)	(0.023)

Table 8.4: Impacts on Gross Rents, Baseline Specification + Housing Stock Attributes + Resident and Economic Attributes + SES Variables (*Continued)*

% Unemployment	0.026	0.154	0.150	0.183	0.193	0.208	0.243**	0.197*	0.152
	(0.196)	(0.169)	(0.156)	(0.159)	(0.149)	(0.135)	(0.121)	(0.120)	(0.125)
% Black Non-Hispanic	0.008	0.039	-0.007	-0.077	-0.074	-0.106	-0.159**	-0.132**	-0.086
	(0.125)	(0.093)	(0.087)	(0.080)	(0.075)	(0.070)	(0.067)	(0.064)	(0.061)
% Hispanic	0.624***	0.649***	0.722***	0.721***	0.726***	0.719***	0.693***	0.692***	0.652***
	(0.133)	(0.103)	(0.089)	(0.080)	(0.075)	(0.074)	(0.075)	(0.073)	(0.075)
% HHs in Neighborhood < 10 Yrs	-0.028	-0.050	-0.073	-0.087	-0.073	-0.088	-0.084	-0.075	-0.072
	(0.099)	(0.081)	(0.071)	(0.065)	(0.063)	(0.060)	(0.053)	(0.050)	(0.044)
% HS Degree or Less	-0.985***	-0.972***	-0.948***	-0.889***	-0.869***	-0.832***	-0.841***	-0.805***	-0.742***
	(0.125)	(0.101)	(0.094)	(0.084)	(0.079)	(0.076)	(0.069)	(0.067)	(0.061)
% College Degree or More	0.029	-0.053	-0.007	-0.067	-0.091	-0.111	-0.107	-0.029	0.016
	(0.219)	(0.172)	(0.149)	(0.132)	(0.125)	(0.118)	(0.110)	(0.104)	(0.096)
% Professional Employees	0.071	0.204	0.243*	0.299**	0.304**	0.329***	0.247**	0.223**	0.200**
	(0.182)	(0.147)	(0.129)	(0.123)	(0.120)	(0.113)	(0.104)	(0.094)	(0.090)
% Manufacturing Employees	0.433**	0.230	0.141	0.052	0.046	0.032	-0.021	-0.050	-0.136
	(0.194)	(0.149)	(0.120)	(0.113)	(0.110)	(0.108)	(0.109)	(0.107)	(0.106)
% Female Headed HH w/Children	-0.125	-0.022	-0.035	0.001	0.003	0.010	0.029	0.054	0.100*
	(0.110)	(0.078)	(0.070)	(0.070)	(0.072)	(0.066)	(0.061)	(0.060)	(0.059)
Median HH Income (Deflated)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	5.427***	5.601***	5.825***	5.909***	5.977***	6.066***	6.196***	6.295***	6.463***
	(0.157)	(0.127)	(0.110)	(0.095)	(0.091)	(0.087)	(0.083)	(0.082)	(0.078)
Observations	2,912	2,912	2,912	2,912	2,912	2,912	2,912	2,912	2,912
Number of tractid	746	746	746	746	746	746	746	746	746
R-squared	0.262	0.398	0.472	0.527	0.546	0.561	0.570	0.572	0.538
Adj. R-squared	0.257	0.393	0.468	0.523	0.543	0.558	0.567	0.569	0.535

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 8.5: Impacts on Gross Rents, Region x Year Fixed Effects

	Percentile								
VARIABLES	10	20	30	40	50	60	70	80	90
BRAC 1-4	0.086	0.091**	0.043	0.048	0.040	0.034	0.038	0.041	0.055**
	(0.053)	(0.041)	(0.034)	(0.030)	(0.028)	(0.027)	(0.027)	(0.026)	(0.024)
BRAC 5	-0.125**	-0.106***	-0.082***	-0.065***	-0.061**	-0.061**	-0.054**	-0.044*	-0.030
	(0.060)	(0.040)	(0.030)	(0.025)	(0.024)	(0.026)	(0.026)	(0.026)	(0.026)
Final Assessment	0.038	0.034	0.015	0.024	0.038**	0.042**	0.034**	0.037**	0.024
	(0.031)	(0.025)	(0.022)	(0.019)	(0.019)	(0.018)	(0.017)	(0.017)	(0.016)
NPL Listing	0.055**	0.023	0.007	0.003	-0.004	-0.003	-0.009	-0.009	-0.009
	(0.027)	(0.022)	(0.017)	(0.015)	(0.013)	(0.013)	(0.012)	(0.012)	(0.012)
Construction Completion	0.019	-0.008	-0.012	-0.009	-0.018	-0.016	-0.014	-0.014	-0.015
	(0.045)	(0.037)	(0.030)	(0.026)	(0.024)	(0.023)	(0.023)	(0.022)	(0.023)
Deletion	0.220**	0.160*	0.112	0.062	0.040	0.072	0.061	0.076	0.080
	(0.111)	(0.094)	(0.080)	(0.076)	(0.065)	(0.058)	(0.055)	(0.048)	(0.050)

Table 8.5: Impacts on Gross Rents, Region x Year Fixed Effects (*Continued)*

1980 (Northeast)	-0.154**	-0.220***	-0.295***	-0.323***	-0.345***	-0.365***	-0.373***	-0.344***	-0.311***
	(0.065)	(0.053)	(0.044)	(0.037)	(0.034)	(0.032)	(0.032)	(0.032)	(0.033)
1980 (South)	-0.333***	-0.412***	-0.458***	-0.460***	-0.467***	-0.469***	-0.472***	-0.463***	-0.451***
	(0.042)	(0.030)	(0.025)	(0.023)	(0.022)	(0.021)	(0.020)	(0.020)	(0.021)
1980 (Midwest)	-0.147*	-0.192***	-0.225***	-0.227***	-0.230***	-0.227***	-0.250***	-0.280***	-0.310***
	(0.087)	(0.059)	(0.051)	(0.045)	(0.045)	(0.046)	(0.044)	(0.045)	(0.046)
1980 (West)	-0.429***	-0.501***	-0.507***	-0.500***	-0.501***	-0.488***	-0.480***	-0.456***	-0.413***
	(0.041)	(0.033)	(0.028)	(0.025)	(0.023)	(0.022)	(0.022)	(0.021)	(0.020)
1990 (Northeast)	-0.043	-0.025	-0.030	-0.053	-0.072**	-0.080***	-0.082***	-0.082***	-0.070***
	(0.057)	(0.046)	(0.038)	(0.033)	(0.029)	(0.027)	(0.027)	(0.026)	(0.025)
1990 (South)	-0.246***	-0.286***	-0.302***	-0.296***	-0.304***	-0.308***	-0.308***	-0.304***	-0.297***
	(0.034)	(0.024)	(0.020)	(0.019)	(0.018)	(0.017)	(0.016)	(0.016)	(0.017)
1990 (Midwest)	-0.066	-0.107**	-0.100***	-0.101***	-0.096***	-0.077**	-0.074**	-0.083**	-0.126***
	(0.077)	(0.047)	(0.037)	(0.031)	(0.031)	(0.032)	(0.034)	(0.040)	(0.041)
1990 (West)	-0.226***	-0.278***	-0.279***	-0.280***	-0.288***	-0.289***	-0.277***	-0.268***	-0.252***
	(0.037)	(0.029)	(0.024)	(0.022)	(0.020)	(0.019)	(0.016)	(0.015)	(0.015)
2000 (Northeast)	-0.127**	-0.160***	-0.153***	-0.150***	-0.155***	-0.176***	-0.178***	-0.157***	-0.126***
	(0.049)	(0.040)	(0.036)	(0.030)	(0.024)	(0.023)	(0.024)	(0.026)	(0.028)
2000 (South)	-0.294***	-0.300***	-0.317***	-0.315***	-0.310***	-0.307***	-0.308***	-0.296***	-0.279***
	(0.028)	(0.019)	(0.017)	(0.017)	(0.016)	(0.016)	(0.015)	(0.014)	(0.013)
2000 (Midwest)	-0.041	-0.075***	-0.088***	-0.088***	-0.086***	-0.073***	-0.080***	-0.077**	-0.088**
	(0.061)	(0.028)	(0.026)	(0.021)	(0.023)	(0.023)	(0.024)	(0.030)	(0.040)
2000 (West)	-0.242***	-0.253***	-0.256***	-0.255***	-0.261***	-0.261***	-0.257***	-0.244***	-0.216***
	(0.026)	(0.019)	(0.016)	(0.013)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Constant	5.626***	5.897***	6.060***	6.164***	6.261***	6.347***	6.438***	6.531***	6.656***
	(0.031)	(0.025)	(0.019)	(0.016)	(0.015)	(0.014)	(0.014)	(0.014)	(0.014)
Observations	2,959	2,959	2,959	2,959	2,959	2,959	2,959	2,959	2,959
Number of tractid	748	748	748	748	748	748	748	748	748
R-squared	0.240	0.381	0.452	0.499	0.523	0.539	0.554	0.552	0.532
Adj. R-squared	0.236	0.377	0.449	0.496	0.520	0.536	0.551	0.549	0.529

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1