Department of Economics

Working Paper

The Effects of Ignoring Train Whistle Bans on Residential Property Values

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Working Paper 2005-04

College of Business Administration

MARQUETTE UNIVERSITY

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Abstract

No abstract is available for this item.

Note

Work supported by the Federal Railroad Administration (FRA) under interagency agreement through U.S. Department of Energy contract W-31-109-Eng-38. The research was conducted while the author was a Special Term Appointment consultant working for Argonne National Laboratory. The opinions expressed in the paper are those of the author and do not represent the opinions of FRA or Argonne National Laboratory.

March 2005

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I. Introduction

In 1992 and 1995, the Federal Railroad Administration (FRA) issued the findings of two separate studies (FRA, Sept. 1992; FRA, April 1995) of the influence of train whistle bans on fatal accidents. The findings revealed substantially lower accident rates at train crossings where whistles are blown as compared to areas where no whistles are blown. In addition to the societal costs resulting from the loss of human life, accidents are also costly to railroads in terms of service disruptions as well as track and crossing repairs. In October of 1991, Conrail unilaterally decided to ignore the whistle bans in the cities in which it operates. Critics of this decision contended that residential property markets were detrimentally impacted by Conrail's action. There are a number of studies in the research literature that investigate the influence of noise on annoyance levels of residents. For example, Osada (1991) evaluates community reaction to aircraft noise in the vicinity of Japanese airports. Using discriminant analysis, the author finds that annoyance rates are highly related to noise levels and they also depend on personal characteristics of the respondent. In addition, Osada compares the findings on airport noise with that of other studies evaluating road traffic and train noise. Similar responses to noise are found across various sources and different time periods considered. Another study by Björkman (1991) uses a dose-response model to investigate how road-traffic noise levels and event frequency influence annoyance levels. Björkman concludes that the number of noise events increases annoyance rates up to a point, beyond which there is no additional reaction to additional events. It was also determined that annoyance depends on the level of noise, and that this effect is independent of the frequency of noise events. Sörensen and Hammer (1983) find similar results when evaluating train noise. Specifically, they find that the number of noise events and the level of noise both influence the percent of residents who report that they are very annoyed. Residents report no annoyance for less than 50 trains per 24-hour period. Above the 50-train threshold, the level of annoyance depends on noise levels. These results are similar to a study of aircraft noise by Rylander, Björkman, Åhrlin, Sörensen and Berglund (1980). Finally, a recent study by Multer and Rapoza (1997) evaluates community impacts from wayside horns (i.e., horns that are placed in a fixed location as opposed to a moving train) versus train horns. They found lower levels of reported annoyance for wayside horns, which were approximately 13 dB quieter than train horns. In addition, the wayside horn was found to have a severe impact for residents within 100 feet of the track, whereas severe impacts were found for train horns within 1000 feet of the track.

Although survey research is important in measuring attitudes towards noxious activity, stated levels of annoyance do not necessarily translate into actual economic impacts. For example, Metz (1994) shows that stated preferences on aversion to nuclear waste are inconsistent with actual behavior. That is, individuals typically report that a minimum safe distance for storage of nuclear waste is in excess of the actual distance they live from waste. An alternative approach to valuing local externalities is to examine their impact on residential property values. Under certain circumstances, these impacts can be considered implicit prices for amenities. In a recent study, Strand and Vagnes (2001) find that properties in Oslo, Norway, selling within 100 meters of rail lines are detrimentally impacted. They find that a doubling of the distance within the 100 meter buffer area increases housing values 10%. However, this study does not distinguish between proximity to rail lines, and proximity to rail crossings where whistles are blown. In a recent study by Simons and El Jaouhari (2004) evaluated activity levels on railroad tracks in Cuyahoga County in Ohio (a metropolitan county in Cleveland) in the late 1990's and found significant detrimental effects from proximity to freight tracks ranging from 2% to 4% of the average residential sales price. In a related study, Simons and El Jaouhari (2002) show that proximity to a rapid transit station in Cuyahoga County actually increases property values by 9%-14%. In the current study, we investigate the extent to which the action taken by Conrail to ignore whistle bans at grade crossings influenced residential property sales prices in the vicinity of railroad crossings in two different cities in Ohio and one city in Massachusetts.

II. Theoretical Overview of Hedonic Model

The hedonic model treats a unit of housing as a heterogeneous bundle of characteristics. These characteristics include different structural features of the housing unit (e.g., numbers of bedrooms and bathrooms, interior square footage, etc.) as well as features of the neighborhood (e.g., locational attributes such as poverty rates, racial and ethnic characteristics, average commute time, proximity to rail lines, etc.). One advantage of this modeling approach is that it allows one to examine the *ceteris paribus* influence that a particular attribute has on local housing prices. That is, holding constant the impact of structural characteristics of the home as well as other neighborhood attributes, one can examine the independent influence on the sale price of the property of a rail crossing or a decision to ignore a ban on train whistles.

The theory, which has its foundations in the works of Lancaster (1969), Rosen (1974) and others (Freeman, 1979; Palmquist , 1984; Brown and Rosen, 1982, Diamond and Smith, 1985; Epple, 1987; and Bartik ,1987) has been extensively developed in the literature, and hence it will only be briefly reviewed here. Assuming (i) perfect information about the bundle of attributes embodied in each house, (ii) zero transactions costs in market trades of bundles, and (iii) a continuous offering of attributes, the market price of a house can be represented as p($\mathbf{z}$), where $\mathbf{z}$=z_1,z_2,...,z_n is a vector of structural and neighborhood attributes. The hedonic price function p($\mathbf{z}$) represents a reduced-form equation which embodies both supply and demand influences in the housing market. The implicit price of attribute j is then given by the partial derivative of p($\mathbf{z}$) with respect to attribute j, or p_j ($\mathbf{z}$)= $\partial p/\partial z_j$.[1] That is, assuming the above conditions are satisfied, p_j($\mathbf{z}$) represents the independent influence of attribute z_j on the housing price, holding constant the influence of other attributes. The equilibrium price function, p($\mathbf{z}$), is assumed to be a nonlinear function because the cost of arbitrage activity that repackages bundles of attributes once a house is built is assumed to be prohibitive.

Many studies have applied the hedonic methodology to value neighborhood externalities and local public goods (Haurin and Brasington, 1996; McDougall, 1976). Applying this model to a train whistle policy change can shed light on the impact of noxious activity on residential property markets and the dynamic adjustment of property markets after such an event. For example, Kiel and McClain (1994) show that the implicit price, p_j associated with an incinerator project varied as the project moved from the rumor stage to actual operation of the facility. Thus, it is possible that the influence of the policy change on train whistles has an immediate short-run effect, and smaller long-run impacts. Indeed, Galster (1986) argues that even relatively significant events such as the Three Mile Island nuclear accident may have relatively minor long-term property value impacts. This is because the residents most

[1] Rosen (1974) shows that this implicit price does not represent an individual's willingness to pay for the attribute. The implicit price can be used, however, to derive the demand for an attribute in a second stage estimation process. Brown and Rosen (1982), Diamond and Smith (1985), Epple (1987), Bartik (1987), and others, however, have noted the existence of identification problems that make estimation of these demand functions difficult. Our work need only focus on the single stage model.

sensitive to the presence of a nuclear power plant had long since moved from the vicinity of the plant when the accident occurred. Those who lived in the region at the time of the accident were by definition those who were least concerned with the risks associated with the facility. The same phenomenon may be at work as we consider the influence of whistle bans. Specifically, households who are most sensitive to train noise are unlikely to live close to an established rail line. Hence, long run adjustments in the composition of local residents may serve to mitigate any property value impacts associated with the policy change. Furthermore, even though the Conrail crossings did not have whistle activity prior to October 1991, local residents may believe there to be some probability of a policy change in the future. To the extent that they consider this possibility when determining their offer price for the property, this would further diminish any measured housing price impact associated with the policy change.

III. Empirical Model

A. Description of Study Areas

We estimate a hedonic model using a sample of properties that sold in three counties; two are in Ohio, and one is in Massachusetts. The Ohio counties include Butler County in the southwestern part of the state, which contains Middletown and Trumbull County in the northeastern OH, which contains Niles. The Massachusetts data includes transactions from Middlesex County, which contains Framingham. The choice of study areas was dictated by data availability. The choice of study areas was dictated by two primary requirements. First, the data needed to span the period of the Conrail decision, and second, whistle bans needed to be in place prior to the Conrail decision. The data sets were obtained from two different sources: The Ohio data were obtained from Dataquick, and cover the period Jan. 1988
to Jan. 1997. Of the 7474 properties sold in Butler County, 4847 or 64.8% sold after the ban was ignored, whereas 61.9% of the 5416 properties in Trumbull County sold after the Conrail action. The Massachusetts data were obtained from Experían and cover the period Jan. 1986 to July 1997. Of the 11,518 observations in Middlesex County, 67.7% sold after the Conrail action. All property data are geocoded to the street address of the house, which permits matching of the property to the salient locational attributes in the vicinity of the property. The demographic characteristics of each county are described in Table I.

Table I: Demographic Characteristics of Study Areas[*]

Demographic Characteristic	Butler County Ohio	Trumbull County Ohio	Middlesex County Massachusetts
Median Family Income	$38,673	$33,313	$52,112
Median Housing Value	$72,500	$53,200	$192,200
Median Gross Rent	$415	$346	$671
Percent Owner Occupied	69.22%	73.09%	59.63%
Population (persons)	291,479	227,813	1,398,468
Population Density (persons/square mile)	154.12	91.41	419.69
Percent Black	4.50%	6.68%	2.87%
Percent Asian	0.91%	0.42%	3.70%
Percent White	94.31%	92.58%	92.05%
Percent Hispanic	0.50%	0.64%	3.39%

*County data, 1990 U.S. Census of Population and Housing

Of the three geographic regions, Middlesex County, which is a western suburb of Boston, is the most densely populated. It also has the highest median family income, as well as the highest home values and rents. In Ohio, Butler County is more affluent than Trumbull. All three regions are predominantly white, although there are some differences in minority compositions across the three areas. Minority populations in the Ohio counties are predominantly black, whereas Middlesex has higher concentrations of Asian and Hispanic residents.

B. Description of Model

To avoid misspecification biases and mitigate problems associated with unmeasured spatially correlated influences, we control for numerous housing influences in the model. These variables can be assumed to fall into one of four broad categories; *Structural, Neighborhood, Time Sold,* and *Railroad.* A semilog specification is chosen[2], and the

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[2] The issue of functional form has been investigated extensively in the hedonic literature. Although some authors (Rasmussen and Zuehlke, 1990) advocate flexible functional forms, others have voiced concerns about the accuracy of implicit prices from such forms (Cassel and Mendelsohn, 1985). Cropper, Deck and McConnell (1988) argue that the semilog model is preferred when the possibility of a misspecification exists. While we have been careful in our

model is specified by equation (1).

lnRPRICE = f(*Structure, Neighborhood, Time Sold, Railroad*) (Eq. 1)

All variable definitions, data sources, and descriptive statistics are reported in Table II. The dependent variable (lnRPRICE) is the log of real sale price of housing and is deflated by the housing component of the CPI for the month in which the property sold.

1. Categories of Independent Variables

The first category of variables, *Structure,* represents structural features of the house. The variables in this category differ slightly between the Ohio and Massachusetts specifications. These include the number of bedrooms, bathrooms (bathrooms for OH; half baths and full baths for MA) and other rooms; the number of fireplaces, the age of the structure, the size of the lot on which the structure is located, and the square footage of the structure itself and the garage (Ohio properties only). Finally, the presence of a pool (Ohio properties only) and the number of stories of the property are also controlled. The age of the house and the two areal measures are included in both linear and quadratic forms so as to account for potential nonmonotonicities of these variables on home sale

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choice of specification, such a possibility exists with spatially-defined data.

prices.[3] One would expect that structural features that increase the housing services generated by a property increase the sales price.

2. Neighborhood and Time Trend Variables

Both Dataquick and Experían data are geocoded to the property address thereby permitting a wide range of neighborhood characteristics to be precisely matched to each property. The ArcView PC-based GIS package is used to map each variable to the associated property. Each property is matched to a census block group, and the characteristics of that block group are then assigned to the property. Among the characteristics included are the percent of the houses that are occupied (*%occupied*), the percent of the occupied units that are owner occupied (*%owner occupied*), and the racial and ethnic mix of the block group (*%Asian, %Black and %Hispanic*). Also included in this set of demographic controls is the median household income of the block group (*median HH income*). Finally, the age of housing in the neighborhood (*median year built*) is included to proxy the age of the neighborhood, and the average commute time within the block group (*commute time*) is included to account for enhancements to housing prices that result from reduced travel times. Also included is *population density*, which captures both amenities (e.g., variety in cultural amenities) and disamenities (e.g., congestion, noise, crime, etc.)

[3]Older homes are expected to include more dated technology (e.g., some may not include central air conditioning) and hence may be less desirable. However, older homes may also include features such as hardwood floors, crown molding, etc. that are less likely to be found in newer homes. In addition, Palmquist (1984) has argued that building area should be included nonlinearly due to the fact that construction costs increase nonlinearly with the size of the house. Hence, we include area measures in linear and quadratic form. Overall, linear terms for the age and area variables are expected to have a positive influence on sale prices, and the quadratic terms are expected to negatively impact prices.

associated with more densely populated neighborhoods.

Neighborhoods with relatively higher rates of occupied units, owner occupancy, and median income are expected to exhibit higher sale prices since the sample is comprised of single-family homes. In addition, the urban location model predicts that lower commute times should result in higher sale prices, *ceteris paribus*. Finally, the expected impact of the racial and ethnic variables is unknown *a priori* since the race/ethnicity of the buyers, which may proxy individual preferences, are unknown.

ArcView is also used to determine how close each property is to various types of noxious activity; specifically, activity related to the proximity to interstate highways and airports. Since a primary goal of this study is to measure the influence of noise on residential property markets, we measure the airport gradient (i.e., the price-distance relationship) for distances of up to three miles from the airport and distances up to three miles for highways. These distances are believed to reflect the feasible range for noise impacts associated with these activities, and hence noise levels outside these ranges are assumed to be too low to influence property markets. Air quality in the neighborhood is proxied by distance from the nearest air quality monitor (*air quality monitor distance*). Since monitors are not uniformly dispersed throughout metropolitan areas, but rather are placed in areas that are more likely to have elevated readings, we expect properties located at greater distances from a monitor to experience higher air quality. Proximity to hazardous materials is measured by the presence of Superfund sites within a three mile radius of each property[4] and the presence of manufacturing facilities on the Toxic Release Inventory within a one mile radius. Finally, we include proximity (i.e., within three miles) to power plants to proxy emissions associated with these facilities (*power plant 3 miles).*

Next, proximity to streams, lakes and rivers (*lake/river3 mile*) is included to proxy access to aesthetic and recreational amenities as well as flooding risks. We include the *property tax rate* for the residence to measure the local property tax burden and dummy variables for the school district to account for housing price differentials related to variations in school quality. The data set also contains information about the political jurisdiction in which each dwelling lies. To account for amenities and disamenities as well as public services associated with the jurisdiction, dummy variables for the political jurisdiction are included (*city dummy*).

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[4] Note that only Bulter and Middlesex counties have sites on the National Priorities (aka Superfund) list.

Variables in the *Time Sold* category include dummy variables for the year in which the property sold. This should control for the influence of long run trends in housing prices, as well as factors related to the business cycle. The omitted year is 1987 for the Ohio data and 1986 for Massachusetts. In addition, seasonal dummy variables are included to account for whether the property was sold in the spring, summer, fall or winter, with winter being the omitted dummy variable. There are no sign expectations in any of the time-related variables since both supply and demand for housing will change during each period.

3. Railroad Variables

To account for the influence of railroad noise, we include several different measures in the *Railroad* category. To account for whistle noise, we measure the distance of the property to the closest rail crossing. Rail crossings that are maintained by Conrail are distinguished from other crossing data. Note that a crossing is classified as a Conrail crossing if Conrail maintains it, or if any Conrail trains travel through the crossing. Multer and Rapoza (1997) report that locomotive engineers begin sounding their horn approximately 1320 feet (i.e., ¼ mile) from the highway-railroad grade crossing. In addition, they report that the impact or severe impact zone for train whistles is at most, 1000 feet from the train, so we adopt an operational definition of an impact zone to be properties within 2320 feet of a rail crossing. We split the impact zone into moderate and high impact ranges by defining the area within 1000 feet as severe impact and the area 1000 to 2320 as a moderate impact zone.

In general, homes in Butler County are closer to rail crossings than in the other study areas. Specifically, 22.5% of the properties in our sample fall within 2320 feet of Conrail crossings in Butler County whereas 10% and 9.9% are within that distance of Conrail crossings for Trumbull and Middlesex counties respectively. Likewise, the properties in Butler are also closer to crossings of other rail companies on average (i.e., 12.2% are within 2320 feet for Butler county; 3.8% are within that impact zone for Trumbull county and 2.8% are within that distance for Middlesex county). Noise and vibration may also result from proximity to rail lines, even if the property is not close to a rail crossing. Thus, it is important to control for proximity to both rail lines and rail crossings. We construct a 1000 foot buffer zone (*Line Impact Area*, or *LIA*) around each rail line, and again, the line is classified by the rail company. It is assumed that noise and vibration that is unrelated to whistle noise will dissipate within 1000 feet. As with the crossing data, Butler properties tend to be closer than those in other counties to rail lines with 14.7%

within 1000 feet of Conrail lines, and 9.6% within that distance of other lines. This is in contrast to the findings for Trumbull county (5.4% for Conrail lines and 5.0% for other lines) and Middlesex county (12.1% for Conrail lines and 1.6% for other lines).

Two different specifications are examined for each of the three geographic regions. The first specification uses dummy variables to distinguish between impacts in the moderate and severe impact areas. This is given by equation (2) below.

$\ln(rprice) = \beta_0 + \beta_1 * \text{Control} + \beta_2 * LIA_j + \beta_3 * XIA_k + \beta_4 * XIA_{k:Conrail} * Ignore + \beta_5 * XIA_{k:Conrail} * Ignore * DaysSince$ (Eq. 2)

where: $\ln(rprice)$ = the log of the real sales price
Control = Vector of control variables, and $\exists_1$ a vector of coefficients on those variables;
LIA_j = Line impact area (i.e., within 1000 feet of the rail line) for j=Conrail, Other;
XIA_k = Crossing impact area for k=moderate, severe;
Ignore = A zero-one dummy variable which takes on a value of one if the property sold at least 45 days after the date which Conrail began ignoring the whistle ban.
Days Since = the number of days that have passed since 45 days after the Conrail action.

Properties which closed within 45 days of the Conrail action would not have been influenced by the action for two reasons. First, Conrail did not provide any advanced warning of its decision to discontinue observing the whistle ban. Furthermore, it typically takes 4-6 weeks to close on a property. Hence, properties selling within 45 days of the Conrail action would have had an accepted offer prior to the action to ignore the bans. While it may be possible for the buyer to withdraw the offer once Conrail began blowing their whistles, those transactions would not take place within the 45-day period subsequent to the action. The coefficient on *LIA*, (β_2) is expected to be negative if proximity to a train line represents a local disamenity. The coefficients on the crossing dummy variables (i.e., estimates of β_3) would also be expected to be negative, with the coefficient on the XIA_{severe} anticipated to be more negative than the coefficient on $XIA_{moderate}$. If the action by Conrail is detrimental to property values, then the estimate of β_4 should be negative and statistically significant. That is, ignoring the whistle ban would significantly reduce sale prices on property below the baseline level established by the estimates of β_3. Finally, the last term is designed to capture temporal differences in property value impacts, such as those identified by Kiel and McClain (1994). If negative impacts grow over time (i.e., the area is stigmatized), this coefficient could be negative, implying continued declines in property prices after the action. On the other hand, if negative impacts are only temporary, then one would expect a positive estimate of β_5.

The second specification estimates continuous distance gradients (i.e., price distance relationships) for the entire impact area rather than dividing the crossing impact area into moderate and severe ranges with separate dummy variables. It then investigates the influence of the Conrail action on the slope of the gradient. The model is given by equation (3).

$$\ln(rprice) = \beta_0 + \beta_1 * \text{Control} + \beta_2 * LIA_j + \beta_3 * LIA_j * Distance_j + \beta_4 * XIA_j + \beta_5 * XIA_j * Distance_j + \beta_6 * XIA_{Conrail} * Distance_{Conrail} * Ignore + \beta_7 * XIA_{Conrail} * Distance_{Conrail} * Ignore * Days\ Since \quad \text{(Eq. 3)}$$

where ln(*rprice*), Control, *LIA*, *Ignore and Days Since* are defined as before.

XIA_j = 2320 foot radius crossing impact area for j=Conrail, Other crossing.

$Distance_j$ = distance from property to rail crossing, or rail line j

The estimate of the coefficient on $LIA_j*Distance_j$ (i.e., β_3) represents the rate at which housing prices change with distance from the rail line. If proximity to rail lines is undesirable, then it would be expected that $\beta_2<0$ and $\beta_3>0$. That is, prices would be expected to be lower for homes selling within the impact area (i.e., $\beta_2<0$) but they would rise with greater distance from the line (i.e., $\beta_3>0$). Similarly, the coefficient estimate on XIA_j (i.e., β_4) represents the baseline impact associated with residing within the impact area. In addition, as distance from the crossing increases, property prices should rise if being close to the crossing is undesirable. Hence, the estimate of β_5 is expected to be positive. If the Conrail decision to ignore the ban increases the premium for distance from the crossing, then the estimate of β_6 would be positive, and the expected sign on β_7 depends on whether property impacts decline, or are exacerbated over time.

C. Empirical Findings

Separate regressions are estimated for each of the three geographic regions, and a White test reveals evidence of heteroskedasticity in all regressions. White's correction technique is used to generate consistent estimates of standard errors. All data descriptions and descriptive statistics are reported in Table II, and the findings on the two specifications are reported in Tables III and IV respectively. Since the coefficients and the t-scores on control variables differ very little between the specifications, they are only discussed for the first specification. In addition, the discussion will focus on coefficients that are statistically significant in a two-tailed test at the 90% level of confidence or higher. The regression models explained 67% of the variation in the log of real sale prices in Butler

County; 61% of the variation in Trumbull County; and 49.1% in Middlesex County.

1. Structural Variables

The influence of age on housing price is generally negative, with the linear coefficient negative and significant in Butler and Middlesex counties. The quadratic term is positive in Middlesex, but the age at which housing prices begin to increase is well beyond the relevant range of data. For Trumbull County the linear age term is positive but insignificant, and the quadratic term is negative and significant. Treating the linear term as a point estimate, housing prices rise for the first 2.8 years and then fall thereafter. Holding square footage constant, additional bedrooms, bathrooms and other rooms significantly increase housing values in the Ohio samples. For Butler County, an additional bedroom increases the sale price by 3.2% and an additional full bathroom increases the sale price by about 2.7%. Other rooms increase the price by 1.6%. Additional full bathrooms have a much stronger influence in Trumbull, increasing property values by nearly 11%. Bedrooms and other rooms increase values 4.2% and 3.1% respectively. In contrast, neither bedrooms nor other rooms is statistically significant for Middlesex County. An additional full or half bathroom both increase the real sale price by about 8%. The presence of a fireplace significantly increases the home sale price by approximately 12%-13% in the Ohio samples, and 6.2% in Middlesex County. This is likely serving as a proxy for other qualitative features of a home in addition to the influence of the fireplace. For example, fireplaces may be more likely to be found in homes with family rooms. Each additional story reduces the real sale price by about 6.6% in Trumbull, and about 1.9% in Butler County whereas the effect is opposite in the Massachusetts, increasing the real sale price by more than 5%. The presence of a swimming pool significantly raises the sale price of the property by about 7.3% in Trumbull and 8.5% in Butler County. Turning to the square footage measures, consistent with Palmquist (1984), the square footage of the property increases housing prices but at a decreasing rate. Other things equal, the real housing price falls after 6554 sq.ft. in Butler County, 4241 sq.ft. in Trumbull County, and 5567 sq.ft. in Middlesex County. In all areas, this is well beyond the mean building area. Evaluating this relationship at the mean building area value of each sample (i.e., 1389 sq.ft. in Butler, 1465 sq.ft. in Trumbull, and 1877 sq.ft. in Middlesex), an increment of 100 square feet increases housing value by 1.8% in Butler County, 3.9% in Trumbull County, and 1.8% in Middlesex County. Additional garage area also increases values at a decreasing rate with each 100 square foot increment in garage space leading to an increase in value of 1.5% in Butler County and 2.8% in Trumbull County (again, these are evaluated at the mean values for garage area). This higher impact of garage space in Trumbull is due to stronger marginal effects resulting from the magnitude of the coefficients in the Trumbull regression, combined with garage sizes that are on average about 34% larger in Trumbull. Finally, the size of the lot significantly increases the sale price of the housing unit by approximately 2.3% per acre in the Butler County area and 2.8% in Middlesex County. The coefficient is statistically insignificant in the Trumbull County area. In both Ohio locations, average lot size is approximately 2 acres, and it is about 1 acre in the Massachusetts county.

2. Neighborhood Characteristics

The influence of neighborhood characteristics varies across locations, and the coefficients are sometimes counterintuitive, suggesting that the variable may be capturing more than just the influence of the variable in question. For example, one would expect that other things equal, the distance from an air quality monitor should increase real housing prices, since monitors are placed in areas of relatively lower air quality. This is the case for Middlesex County, where housing prices rise about 1.4% per mile. However, the opposite is true for Trumbull County, with real housing prices falling, the greater the distance from the monitor. Note, the coefficient is not quite significant at the 90% level of confidence. Nonetheless, it is possible that there are other positive features of the community (e.g., cultural centers, employment districts, etc.) that happen to be located near the monitors, that are overwhelming the influence of the air quality monitor.

To capture the influence of airport noise, two variables are included. A dummy variable set equal to one if the property is within three miles of the airport is included separately, and it is also interacted with distance from the airport to allow for stronger impacts associated with closer proximity to the airport. It is assumed that airport impacts will be zero beyond the three-mile zone. For the Butler County regression, both coefficients suggest that on net, proximity to the airport is seen as desirable. The coefficient on the three-mile dummy variable is positive and significant implying that other things equal, housing prices are approximately 17% higher for properties within three miles of the airport, as compared to those outside that range. In addition, housing prices fall by approximately 5.2% per mile with distance from the airport. This so-called positive housing price gradient (i.e., positive price-distance relationship) suggests that employment opportunities associated with proximity to the airport overwhelm any negative impacts resulting from higher noise levels near the airport. The opposite is true for properties selling near the airport in Trumbull County. Home sales prices are nearly 30% lower in the three mile buffer area in Trumbull, and they rise by about 10% per mile further away from the airport. Although it is possible that the coefficients in Trumbull are reflecting primarily the influence of noise, they are likely capturing other influences as well. This may include traffic congestion, industrial activity, and other activities associated with proximity to airports. Proximity to highways is also measured using a buffer area around the highway to proxy noise (i.e., three mile) and a distance variable. It is assumed that highway noise is dissipated beyond three miles. While the coefficient on the dummy variable for the buffer zone is negative, and the coefficient on the distance variable is positive in all three regressions, both coefficients are only significant in the Massachusetts county. They suggest that home prices are 7% lower within the buffer zone, and they rise by about 10% per 3 mile.

Turning to the neighborhood measures drawn from 1990 census block group data, it is not surprising to find that real housing prices are higher in more affluent neighborhoods. Older neighborhoods, as determined by a smaller value for the Median Year Built variable, have significantly lower priced housing in Butler and Trumbull counties, although the latter is not statistically significant. In contrast, the coefficient is negative and significant at the 90% level of confidence in Middlesex County suggesting that older, established neighborhoods are more desirable. Surprisingly, a high percentage of occupied units significantly decreases the sale price of housing in Trumbull and Middlesex counties although it should be noted that there is very little variation in this variable, and most neighborhoods have high occupancy rates. This may be capturing the influence of desirable neighborhoods that are experiencing active construction activity in Ohio. However, we noted that newer neighborhoods appear to be less desirable in Massachusetts. Likewise, whereas an increase in the percent of occupied homes that are owner-occupied raises housing prices in Butler and Middlesex counties, it actually has the opposite effect in Trumbull. Population density, which can proxy both amenities and disamenities associated with a neighborhood, on net has a positive and significant influence on housing prices in the Trumbull regression model. The racial and ethnic mix of the neighborhood exerts a statistically important influence in all three housing markets. Specifically, increases in the Black population, are associated with decreases in housing prices in the Ohio regions; increases in Asian populations are associated with decreases prices in Trumbull and Middlesex counties; and an increase in the Hispanic population is associated with decreases in home sale prices in Trumbull. There are a number of possible reasons for these findings. Race may be serving as a proxy for other unmeasured neighborhood characteristics, or it may be capturing racial racial preferences and attitudes of the majority population.

It should be noted from Table 1 that concentrations of all minority groups are low in all three communities, with White populations at least 92% of total population in each area. Finally, consistent with the predictions of the urban location model (e.g., Bender and Hwang, 1985), higher average commuting times reduce the real home price, with the coefficient significant in the Butler county regression equation. An increase in commuting time of 10 minutes depresses housing prices about 12.7% in that city.

Proximity to a non-nuclear power generating plant exerts no significant influence on home prices in either of the Ohio counties, whereas the closest power plant is more than three miles from the closest property in Middlesex County. Proximity to a chemical manufacturing facility on the toxic release inventory decreases home prices in Butler, but it is not significant. In contrast, it is positive and significant in the other two regression models. Again, this is undoubtedly capturing other local influences such as employment opportunities at these facilities. Likewise, proximity to a Superfund site exerts a positive and significant influence in Butler County. Being within 3 mile of a lake or river significantly increases home prices in Trumbull county (i.e., by 4.1%) whereas they significantly decrease them in Middlesex (i.e., by 2%). This latter finding may be reflecting negative consequences associated with proximity to rivers, such as flooding. Unfortunately, residence in floodplains is not controlled in the regression models.

Turning to fiscal measures, a high property tax burden depresses housing prices in Niles. Specifically, a 1% increase in the tax rate leads to a 3.8% reduction in the sale price of the property. The school district exerts a relatively strong influence on real home prices in Trumbull County. For example, housing prices for equivalent housing are 98% higher, comparing the lowest and the highest valued school districts in the county. Finally, the dummy variables for the jurisdiction in the Trumbull and Middlesex counties are statistically significant.

3. Time and Seasonal Dummy Variables

Seasonal dummy variables show that housing prices in Butler County are significantly higher in the fall, than the winter (i.e., the omitted category) whereas they are significantly higher in the summer in Middlesex. In addition, real housing prices have risen over the 1988-1997 time period, with the real appreciation rate approximately 26% in Butler County, and 28% in Trumbull. The influence of the mild recession in 1990-91 is indicated by a slight decline in real housing prices (i.e., -1%) between 1990 and 1991 in Butler County and insignificant changes in 1989 and 1990 (as compared to 1988) in Trumbull County. The situation in Middlesex is somewhat stronger, with real price appreciation of 211% over the 11 year period. This is in spite of a relatively deep recession in New England during the late 1980's.

4. Railroad Related Variables: Specification 1

Proximity to Rail Lines

Turning to the findings on railroad variables in the first specification, controls for proximity to both Conrail and other rail lines consistently reveal that properties within 1000 feet of a rail line experience significantly lower home sale prices. The reductions for properties along Conrail lines are between 4.7% and 5.9%, whereas they are somewhat higher along other lines (i.e., about 5.8% in Trumbull County; 13.3% in Butler County, and 7.7% in Middlesex County).

Proximity to Crossings

Turning to the impact areas surrounding the crossings, some consistent patterns do emerge although there are some exceptions as well. Specifically, an examination of the baseline effects in the moderate impact area of Conrail crossings reveals significantly lower home sale prices in the impact area for Ohio properties. Indeed, they are 6.8% lower in the Butler moderate impact area (as compared to outside the area) and 7.7% lower in the Trumbull County moderate area. However, we find just the opposite baseline effect for Middlesex County with 6.2% higher property values within the moderate impact zone. One might suspect that some of the crossings in Middlesex County are also rail stations for public transit. However, the activity levels are too low at those crossings for that to be the case. For other lines, there are similar negative baseline effects in Ohio (-7.7% in Butler and -12.5% in Trumbull). The severe impact areas for Conrail crossings are negative and significant for Trumbull County, and as expected, the negative impact is greater in the severe impact area (i.e., -19.3% as compared to -7.7% in the moderate zone). The coefficient on the Conrail severe impact area is negative though not significant in Butler County, and positive, but again insignificant for Middlesex. Finally, the only coefficient that is significant among those in the severe impact area (other) category is for Middlesex County, which experiences 14.3% lower sales prices than those outside the impact area.

Note that activity levels at these crossings are not controlled. Although information was collected from the Federal Railroad Administration on activity levels at the crossings, these data were not consistently defined over time. Furthermore, of the three areas considered, only Middlesex County had activity levels that exceeded 50 trains per 24 hour period, which is the threshold activity level identified by Sörensen and Hammer (1983) as they measured annoyance levels among residents. When we did include controls for high activity levels in Middlesex County, the activity interaction terms were all insignificant and none of the other coefficients changed appreciably.

Effects of Conrail Action

Examining the effect of the Conrail action, there is no evidence of a permanent negative impact associated with the Conrail policy. For Trumbull and Middlesex counties, none of the interaction terms with the variable *Ignore* were statistically significant. Housing prices did decline 6.7% in the moderate zone of Butler County as a result of the action, but the decline appears to be temporary since the coefficient on the interaction term with *Days Since* the action was positive and significant. Over time, real housing prices rose about 2.3% per year in the moderate zone, which implies the detrimental impact would be eliminated in just under 3 years. A similar pattern emerges for the severe zone in Butler County, although only the coefficient on the *Days Since* interaction term is statistically significant.

5. Railroad Related Variables: Specification 2

The second specification estimates continuous price-distance gradients, which measure the rate at which housing prices change with the distance of the property from the rail line or rail crossing. The findings are similar in many respects to those found in the previous specification, but there are some important differences as well.

Proximity to Rail Lines

The coefficient estimates on the line impact dummy variables consistently reveal negative and significant property value impacts. For Conrail lines, the price reductions range from about 9.5% in Butler and Middlesex counties to 25.8% in Trumbull County. For other rail lines, real home prices are significantly reduced 14.3% in Butler County and -16.9% in Middlesex County. While these values are larger in magnitude than those found in the first specification, there is an important difference in the interpretation. For the first specification, no gradient was estimated. Hence the coefficient on the line impact area variable represented the average impact over the entire impact area. In this specification, the Line Impact Area dummy variable is included and it is also interacted with the distance of the property from the line. Thus, the interpretation of the coefficient on *LIA* is now interpreted as the impact at the closest point to the rail line, rather than the average impact over the entire impact area. The interaction between *LIA* and distance measures the marginal effect of distance from the rail line, within the Line Impact Area. Two of the six gradients are positive and significant implying that property values significantly increase with distance from the rail line. Since distance is denominated in miles, the findings imply that an additional 100 feet from the Conrail track (i.e., 0.0189 miles) increases property values 0.9% in Butler County and 2.8% in Trumbull County. None of the distance gradients for rail lines in Middlesex County were statistically significant.

Proximity to Rail Crossings

Turning to the analysis of rail crossing measures, there are some surprising results. For other rail lines, the coefficient on the Crossing Impact Area (*CIA*) in Butler County is positive and significant. That is, real home prices are 10.2% higher for properties located at the edge of the track. In addition, the housing price-distance relationship is negative implying that within the impact area, housing prices fall about 1% per additional 100 feet from the track. For Middlesex County, the coefficient on *CIA* for other rail lines does take on the expected negative sign (i.e.,-14.3%), and the gradient is positive (i.e., prices rise 0.8% per additional 100 feet from the track). However, neither coefficient is statistically significant, although t-scores exceed 1.4 on both coefficients. It should be noted that the non-Conrail Middlesex crossings are the only ones for which train activity levels exceeded 50 trains per day (i.e., there were 62 trains per day in one location).

The only group of coefficients that is statistically significant for Conrail crossings are in the Butler County model. The coefficient estimate on the *CIA* dummy variable is negative and statistically significant, implying that property prices at the edge of the track are 9.6% lower than those outside the CIA. Furthermore, the coefficient on the interaction term with distance is positive but it is not significant. This implies that property prices do not appear to vary with distance, at least in the period prior to the Conrail action. However, the coefficient estimates on the *CIA * Ignore * Distance* is negative with a t-score approaching significance at the 90% level. That is, immediately following the action, the distance gradient actually flattened slightly (i.e., declining by 0.3% per 100 feet). This implies a flattening of the gradient by a total of 6.6% for the property at the edge of the impact area (i.e., 2320 feet away from the crossing) as compared to the property adjacent to the crossing. In contrast, the coefficient on the term that interacts distance with the *Days Since* the action (i.e., *CIA*Ignore*Days Since*Distance*) is positive and significant. This implies that the gradient becomes more positive over time following the action by Conrail. Although the annual change is small (0.12% for each additional 100 feet from the crossing), the collective impact over the five years since the Conrail decision, for larger moves (e.g., a movement to the edge of the impact zone from a location directly next to the crossing) can be more substantial 16.3%. Thus, on net, the housing price gradient became positively sloped approximately 2.3 years after the Conrail action, and increased by 9.7% (i.e., +16.3%-6.6%) after five years.

IV. Conclusions and Policy Implications

The findings consistently show that proximity to rail lines has a negative and statistically important influence on residential property values. In addition, there is also evidence that proximity to rail crossings can reduce the real sale price of homes, although there is also evidence to the contrary. All of these impacts existed prior to the point at which Conrail began ignoring the train whistle bans in these three areas. However, the overall weight of evidence reveals little evidence that the decision by Conrail to begin ignoring whistle bans had any permanent and appreciable influence on the housing values in these communities. For two of the three study areas, there was no statistically significant influence of the Conrail action. Furthermore, in the only area where a negative effect was identified (i.e., Butler County in Ohio), one model suggested the effects were minor and temporary (i.e., property prices rebounded within about 3 years) whereas the other suggested an increasing aversion to the crossing over time. These different findings between the two models, combined with the insignificant results in other study areas, cast doubt on the argument that the Conrail action permanently reduced property values in the neighborhoods near the crossings.

This is not necessarily surprising. Individuals buying properties within the potential audible range of a rail crossing likely consider at least the possibility that train whistles will be blown at the crossing in the future. Thus, when Conrail began ignoring the ban, it may have only confirmed their initial suppositions. Furthermore, it is likely that the Conrail action generated dynamic changes in the composition of residents that served to mitigate the initial impact of the action. Residents most sensitive to train whistle noise would be expected to eventually move away from the impacted area, and they would be replaced with those less bothered by train whistles. This is because the residents most tolerant of train noise would have the highest willingness to pay for the property when it is on the market. This transition from more sensitive to less sensitive residents would reduce, and possibly eliminate any long-run impacts from the Conrail decision that could explain the insignificant coefficients in two of the three study areas.

This study has important implications for policymakers. In a cost-benefit analysis of the impacts of lifting of whistle bans, one component of the costs of such a policy would be the reduction in property values for properties in the vicinity of rail crossings. These costs would then be weighed against the benefits of the policy change (i.e., reduced societal costs from accidents). These findings suggest that for communities with low to moderate train activity (i.e., less than 75 trains per day), the costs in terms of property value reductions appear in most cases to either be negligible, or minor in magnitude and temporary in duration. Thus, it is likely that removal of train whistle bans results in positive net-benefits to society.

These findings, while enlightening, are just a first step in understanding how train whistles influence local property markets. More complete data is needed to achieve a thorough understanding of the factors leading to residential property price impacts of train whistles. This includes continuously defined data on train activity levels. Next steps should also investigate the relationship between distance, terrain, and the presence of other factors such as tall buildings that can serve as barriers to noise. Moreover, the analysis could be extended to study areas in other geographic regions. For example, all of the study areas in this study were in the Northeast or North Central regions. In more moderate climates, residents likely spend more time outdoors year round. This may influence their sensitivity to train whistle noise. Finally, this study has focused on property impacts from train whistles. There are other whistle impacts that could also be investigated, including the effect on residential mobility. That is, does a change in policy regarding train noise motivate some residents to move out of the audible range of trains? Although this study suggests that this dynamic process may be at work, more direct measures of mobility are needed before strong conclusions can be drawn. Finally, this study focused exclusively on residential property. Train whistle noise may also influence the value of commercial property and an empirical investigation of commercial impacts is needed to more fully understand the impacts of a policy change regarding train-whistles.

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Table II
Variable Name and Definition, Data Source and Descriptive Statistics

Dependent Variable and Variables in the *Structural* Category

Variable Name	Definition [mean (μ) standard deviation (σ)] N_{BUTLER}=6971, $N_{TRUMBULL}$=5064, $N_{MIDDLESEX}$=8986	Source
Real Price	Real sale price of the property (1990 dollars) [μ_{BUTLER}=66846.52, σ_{BUTLER}=36284.43] [$\mu_{TRUMBULL}$=57448.85, $\sigma_{TRUMBULL}$=34760.24] [$\mu_{MIDDLESEX}$ =154373.50, $\sigma_{MIDDLESEX}$=94787.99]	Dataquick or Experían nominal price divided by the national CPI for housing
Age house	Age of the house in years. [μ_{BUTLER} =43.076, σ_{BUTLER}=27.191] [$\mu_{TRUMBULL}$=39.156, $\sigma_{TRUMBULL}$=24.226] [$\mu_{MIDDLESEX}$ =37.827, $\sigma_{MIDDLESEX}$=27.892]	Dataquick Experían
Bathrooms (OH) Half baths (MA) Full baths (MA)	Sum of full and half baths, where each full bath=1 and each half bath=0.5. Bathrooms: [μ_{BUTLER} =1.500, σ_{BUTLER}=0.633] Bathrooms: [$\mu_{TRUMBULL}$=1.455, $\sigma_{TRUMBULL}$=0.577] Half baths: [$\mu_{MIDDLESEX}$ =0.532, $\sigma_{MIDDLESEX}$=0.545] Full baths: [$\mu_{MIDDLESEX}$ =1.569, $\sigma_{MIDDLESEX}$=0.653]	Dataquick Experían
Bedrooms	Number of bedrooms in house [μ_{BUTLER} =2.885, σ_{BUTLER}=0.703] [$\mu_{TRUMBULL}$=3.002, $\sigma_{TRUMBULL}$=0.630] [$\mu_{MIDDLESEX}$ =3.289, $\sigma_{MIDDLESEX}$=0.781]	Dataquick Experían
Other rooms	Total rooms minus number of bedrooms [μ_{BUTLER} =3.073, σ_{BUTLER}=0.990] [$\mu_{TRUMBULL}$=3.053, $\sigma_{TRUMBULL}$=0.881] [$\mu_{MIDDLESEX}$ =3.783, $\sigma_{MIDDLESEX}$=0.958]	Dataquick Experían
Fireplace	Number of fireplaces in the house [μ_{BUTLER} =0.458, σ_{BUTLER}=0.498] [$\mu_{TRUMBULL}$=0.306, $\sigma_{TRUMBULL}$=0.461] [$\mu_{MIDDLESEX}$ =1.103, $\sigma_{MIDDLESEX}$=0.787]	Dataquick Experían
Number of stories	Number of stories in the property [μ_{BUTLER} =1.367, σ_{BUTLER}=0.506] [$\mu_{TRUMBULL}$=1.584, $\sigma_{TRUMBULL}$=0.531] [$\mu_{MIDDLESEX}$ =1.379, $\sigma_{MIDDLESEX}$=0.654]	Dataquick Experían
Pool	1=Presence of a pool, 0=otherwise. (OH only) [μ_{BUTLER} =0.023, σ_{BUTLER}=0.150] [$\mu_{TRUMBULL}$=0.085, $\sigma_{TRUMBULL}$=0.278]	Dataquick

Variable Name	Definition [mean (μ) standard deviation (σ)] N_{BUTLER}=6971, $N_{TRUMBULL}$=5064, $N_{MIDDLESEX}$=8986	Source
Building area	Structure area in square feet.. [μ_{BUTLER} =1386.535, σ_{BUTLER}=564.664] [$\mu_{TRUMBULL}$=1464.757, $\sigma_{TRUMBULL}$=569.502] [$\mu_{MIDDLESEX}$ =1874.657, $\sigma_{MIDDLESEX}$=819.616]	Dataquick Experían
Garage area	Garage area in square feet. (OH only) [μ_{BUTLER} =262.078, σ_{BUTLER}=248.098] [$\mu_{TRUMBULL}$=353.136, $\sigma_{TRUMBULL}$=235.575]	Dataquick
Lot area	Lot area in square feet. [μ_{BUTLER} =20716.730, σ_{BUTLER}=54621.570] [$\mu_{TRUMBULL}$=20797.380, $\sigma_{TRUMBULL}$=80574.35] [$\mu_{MIDDLESEX}$ =31306.25, $\sigma_{MIDDLESEX}$=52842.21]	Dataquick Experían

Variables in the *Railroad* Category

Variable Name	Definition [mean, standard deviation] N_{BUTLER}=6971, $N_{TRUMBULL}$=5064, $N_{MIDDLESEX}$=8986	Source
Line Impact Area (LIA)	1 = Conrail line within 1000 feet of the property, 0=otherwise. [μ_{BUTLER} =0.147, σ_{BUTLER}=0.354] [$\mu_{TRUMBULL}$=0.054, $\sigma_{TRUMBULL}$=0.226] [$\mu_{MIDDLESEX}$ =0.121, $\sigma_{MIDDLESEX}$=0.326] 1 = Other rail crossing within 2320 feet of the property, 0=otherwise. [μ_{BUTLER} =0.094, σ_{BUTLER}=0.291] [$\mu_{TRUMBULL}$=0.049, $\sigma_{TRUMBULL}$=0.216] [$\mu_{MIDDLESEX}$ =0.016, $\sigma_{MIDDLESEX}$=0.128]	Computed from FRA crossing database.
Distance from Rail Line	Distance of the property from Conrail line in miles [μ_{BUTLER} =1.161, σ_{BUTLER}=1.234] [$\mu_{TRUMBULL}$=1.359, $\sigma_{TRUMBULL}$=1.096] [$\mu_{MIDDLESEX}$ =0.992, $\sigma_{MIDDLESEX}$=0.992] Distance of the property from other rail line in miles. [μ_{BUTLER} =1.291, σ_{BUTLER}=1.090] [$\mu_{TRUMBULL}$=1.304, $\sigma_{TRUMBULL}$=1.145] [$\mu_{MIDDLESEX}$ =3.160, $\sigma_{MIDDLESEX}$=1.400]	Computed from FRA database
Crossing Impact Area (CIA)	1 = Conrail crossing within 2320 feet of the property, 0=otherwise. [μ_{BUTLER} =0.229, σ_{BUTLER}=0.420] [$\mu_{TRUMBULL}$=0.101, $\sigma_{TRUMBULL}$=0.301]	Computed from FRA database

Variable Name	Definition [mean, standard deviation] N_{BUTLER}=6971, $N_{TRUMBULL}$=5064, $N_{MIDDLESEX}$=8986	Source
	[$\mu_{MIDDLESEX}$ =0.098, $\sigma_{MIDDLESEX}$=0.297] 1= Other rail crossing within 2320 feet of the property, 0=otherwise. [μ_{BUTLER} =0.123, σ_{BUTLER}=0.329] [$\mu_{TRUMBULL}$=0.038, $\sigma_{TRUMBULL}$=0.191] [$\mu_{MIDDLESEX}$ =0.028, $\sigma_{MIDDLESEX}$=0,167]	
Severe Impact Area	1 = Conrail crossing within 1000 feet of the property, 0=otherwise. [μ_{BUTLER} =0.058, σ_{BUTLER}=0.233] [$\mu_{TRUMBULL}$=0.017, $\sigma_{TRUMBULL}$=0.131] [$\mu_{MIDDLESEX}$ =0.023, $\sigma_{MIDDLESEX}$=0.150] 1= Other rail crossing within 1000 feet of the property, 0=otherwise. [μ_{BUTLER} =0.034, σ_{BUTLER}=0.181] [$\mu_{TRUMBULL}$=0.005, $\sigma_{TRUMBULL}$=0.074] [$\mu_{MIDDLESEX}$ =0.006, $\sigma_{MIDDLESEX}$=0.078]	Computed from FRA database
Moderate Impact Area	1 = Conrail crossing between 1000 and 2320 feet of the property, 0=otherwise. [μ_{BUTLER} =0.171, σ_{BUTLER}=0.376] [$\mu_{TRUMBULL}$=0.084, $\sigma_{TRUMBULL}$=0.276] [$\mu_{MIDDLESEX}$ =0.075, $\sigma_{MIDDLESEX}$=0.263] 1= Other rail crossing between 1000 and 2320 feet of the property, 0=otherwise. [μ_{BUTLER} =0.089, σ_{BUTLER}=0.285] [$\mu_{TRUMBULL}$=0.032, $\sigma_{TRUMBULL}$=0.177] [$\mu_{MIDDLESEX}$ =0.022, $\sigma_{MIDDLESEX}$=0.148]	Computed from FRA database
Distance from rail crossing	Distance of the property from the Conrail rail crossing in miles. [μ_{BUTLER} =1.369, σ_{BUTLER}=1.102] [$\mu_{TRUMBULL}$=1.586, $\sigma_{TRUMBULL}$=0.068] [$\mu_{MIDDLESEX}$ =1.337, $\sigma_{MIDDLESEX}$=0.864] Distance of the property from the other rail crossing in miles. [μ_{BUTLER} =1.595, σ_{BUTLER}=1.051] [$\mu_{TRUMBULL}$=2.233, $\sigma_{TRUMBULL}$=1.309] [$\mu_{MIDDLESEX}$ =2.330, $\sigma_{MIDDLESEX}$=1.312]	Computed from FRA database
Ignore	1=property sold more than 45 days after the decision by Conrail to ignore the whistle ban, 0=otherwise. [μ_{BUTLER} =0.653, σ_{BUTLER}=0.476]	Computed from FRA database

Variable Name	Definition [mean, standard deviation] N_{BUTLER}=6971, $N_{TRUMBULL}$=5064, $N_{MIDDLESEX}$=8986	Source
	[$\mu_{TRUMBULL}$=0.614, $\sigma_{TRUMBULL}$=0.487] [$\mu_{MIDDLESEX}$ =0.656, $\sigma_{MIDDLESEX}$=0.475]	
Days Since	The number of days since the whistle ban was ignored. [μ_{BUTLER} =700.244, σ_{BUTLER}=704.097] [$\mu_{TRUMBULL}$=549.426, $\sigma_{TRUMBULL}$=577.750] [$\mu_{MIDDLESEX}$ =699.206, $\sigma_{MIDDLESEX}$=696.599]	Computed from FRA database

Table III: Hedonic Regression Examining Effect of Conrail Action on Impact Zones
Dependent Variable: Log of Real Price

	Butler County		Trumbull County		Middlesex County	
Variable	*Coefficient*	*t-stat.*	*Coefficient*	*t-stat.*	*Coefficient*	*t-stat.*
Intercept	-0.22284	-0.151	8.66759	5.441	416.2352	2.038
			Structural Characteristics			
Age house	-0.00322	-3.664	0.00027	0.235	-0.20904	-2.029
Age house squared	-5.53E-06	-0.755	-4.90E-05	-4.131	2.07E-05	5.971
Bathrooms (OH) Full bath (MA)	0.027058	2.4845	0.108748	7.557	0.082223	7.892
Half bath (MA)					0.081115	8.819
Bedrooms	0.032142	3.555	0.042276	4.078	0.009412	1.237
Other rooms	0.016642	3.1265	0.031686	3.667	0.007968	1.399
Fire place	0.132343	13.969	0.11851	9.329	0.061938	7.95
Garage area	0.000177	8.2822	0.000387	6.956		
Garage area squared	-5.04E-08	-4.832	-1.55E-07	-2.212		
Building area	0.00035	11.034	0.000453	7.571	0.000275	8.583
Building area squared	-2.67E-08	-4.135	-5.34E-08	-3.459	-2.47E-08	-4.162
Lot area	5.46E-07	3.7904	2.34E-08	0.501	6.44E-07	2.942
Number of stories	-0.01874	-1.793	-0.06586	-4.503	0.056795	5.94
Pool	0.084993	4.9757	0.073228	4.639		
			Structural Characteristics			
Airport 3 miles	0.17256	5.0854	-0.29146	-2.42	-0.10534	-0.952
Airport 3 miles * distance	-0.05185	-4.432	0.102091	2.863	0.025275	0.543
Highway quarter mile	-0.16597	-0.576	-0.1351	-1.496	-0.07098	-2.097
Highway quarter mile * distance	0.928794	0.6857	0.540062	1.081	0.405387	2.089
% Owner occupied	0.003034	6.2207	-0.00252	-3.713	0.003532	1.798
% Occupied	-0.00218	-1.168	-0.01161	-3.902	-0.00315	-6.822
% Asian	0.003504	0.3971	-0.01499	-2.067	-0.00454	-3.089
% Black	-0.00507	-12.31	-0.00734	-7.422	-0.00092	-0.391
% Hispanic	-0.00533	-0.557	-0.04239	-3.501	0.00168	1.243
Median HH income	5.89E-06	6.1544	1.27E-05	8.71	4.10E-06	9.184
Commute time	-0.01271	-6.347	0.00365	1.282	-0.00081	-0.491
Population density	2.85E-06	0.9149	8.69E-06	2.192	-1.29E-06	-0.53
Median year built	0.005305	7.1279	0.001063	1.309	-0.20458	-1.989
Superfund within 3 miles	0.563635	2.0153			-0.01483	-1.322
Lake/River	-0.00782	-0.685	0.040776	2.04	-0.02015	-2.428
Tax rate	0.046613	1.4078	-0.03865	-3.639	0.468581	1.608
Air quality monitor distance	-0.00023	-0.022	-0.01332	-1.622	0.01402	2.35
Toxic Release Inventory	-0.02276	-1.816	0.077225	5.268	0.061305	7.238
Power plant 3 miles	-0.49905	-0.401	0.037878	0.637		
Power plant 3 miles * distance	3.36E-05	0.3221	-0.00392	-0.183		

Table III: Hedonic Regression Examining Effect of Conrail Action on Impact Zones (continued)

	Butler County		Trumbull County		Middlesex County	
Variable	*Coefficient*	*t-stat.*	*Coefficient*	*t-stat.*	*Coefficient*	*t-stat.*
			Railroad Variables			
Conrail Line and Crossing Variables						
Line Impact Area (LIA)	-0.05903	-4.584	-0.04789	-1.562	-0.0553	-3.353
Moderate Crossing Impact Area (CIA)	-0.06815	-3.228	-0.0777	-2.831	0.062119	2.23
Moderate CIA * Ignore	-0.06691	-1.997	0.03008	0.737	-0.03953	-1.039
Moderate CIA * Ignore * Days Since	6.48E-05	2.9195	-1.20E-05	-0.291	-2.26E-05	-1.129
Severe Crossing Impact Area (CIA)	-0.0517	-1.511	-0.19342	-3.185	0.068268	1.547
Severe CIA * Ignore	-0.05215	-1.004	0.048577	1.179	-0.03567	-0.536
Severe CIA * Ignore * Days Since	7.92E-05	2.5302	-3.75E-06	-0.076	-1.29E-05	-0.273
Other Railroad Line and Crossing Variables						
Line Impact Area (LIA)	-0.13315	-6.15	-0.05781	-1.957	-0.07696	-2.187
Moderate Crossing Impact Area	-0.07781	-4.022	-0.12991	-3.068	0.008679	0.347
Severe Crossing Impact Area	0.006432	0.1885	0.04774	0.502	-0.14362	-1.793
Adjusted R-squared	0.668579		0.609188		0.491219	
S.E. of regression	0.310421		0.341168		0.383304	
Mean dependent var	10.97128		10.81136		11.80856	
F-statistic	231.5029		107.6709		140.917	
Number observations	6971		5069		8986	
Log likelihood	-1705.42		-1702.34		-4102.06	
Omitted City Control dummies:	2		4		5	
Omitted Time Control dummies:	12		12		14	
Omitted School District dummies:	4		16		4	

Table IV: Hedonic Regression Examining Effect of Conrail Action on Housing Price-Distance Gradients
Dependent Variable: Log of Real Price

	Butler County		Trumbull County		Middlesex County	
Variable	*Coefficient*	*t-stat.*	*Coefficient*	*t-stat.*	*Coefficient*	*t-stat.*
Intercept	-0.25892	-0.175	8.421265	5.248	418.0675	2.044
Structural Characteristics						
Age house	-0.00329	-3.75	0.000119	0.104	-0.21	-2.035
Age house squared	-5.10E-06	-0.698	-4.74E-05	-4.014	2.11E-05	6.11
Bathrooms (OH) Full bath (MA)	0.028436	2.6147	0.107547	7.479	0.082255	7.883
Half bath (MA)					0.081156	8.827
Bedrooms	0.032442	3.5968	0.042806	4.138	0.009608	1.264
Other rooms	0.016575	3.1178	0.032659	3.772	0.008347	1.463
Fire place	0.130973	13.856	0.118197	9.289	0.062238	8.004
Garage area	0.000175	8.1336	0.000386	6.92		
Garage area squared	-5.07E-08	-4.691	-1.52E-07	-2.17		
Building area	0.000353	11.115	0.000454	7.596	0.000273	8.521
Building area squared	-2.71E-08	-4.191	-5.37E-08	-3.48	-2.46E-08	-4.142
Number of stories	-0.01971	-1.887	-0.06732	-4.609	0.05648	5.908
Lot area	5.47E-07	3.7971	2.18E-08	0.472	6.43E-07	2.946
Pool	0.087527	5.1222	0.07407	4.695		
Neighborhood Characteristics						
Airport 3 miles	0.183971	5.4458	-0.30018	-2.492	-0.10669	-0.964
Airport 3 miles * distance	-0.05758	-4.948	0.104253	2.924	0.026107	0.561
Highway quarter mile	-0.16166	-0.562	-0.14314	-1.576	-0.06981	-2.072
Highway quarter mile * distance	0.910298	0.6726	0.553272	1.105	0.400412	2.071
% Owner occupied	0.002965	6.0806	-0.00255	-3.78	0.003587	1.825
% Occupied	-0.00198	-1.069	-0.01132	-3.815	-0.00322	-6.916
% Asian	0.00474	0.5382	-0.01508	-2.089	-0.46237	-3.156
% Black	-0.00507	-12.33	-0.00732	-7.347	-0.1026	-0.435
% Hispanic	-0.00611	-0.633	-0.04361	-3.576	0.187253	1.362
Median HH income	5.87E-06	6.1369	1.24E-05	8.5	4.11E-06	9.224
Commute time	-0.01229	-6.142	0.003081	1.091	-0.00068	-0.415
Population density	3.24E-06	1.0343	7.91E-06	1.989	-1.44E-06	-0.594
Superfund within 3 miles	0.582255	2.1104			-0.01415	-1.256
Lake/River	-0.00673	-0.59	0.043649	2.197	-0.01982	-2.387
Tax rate	0.044898	1.3524	-0.03861	-3.626	46.93446	1.605
Median year built	0.005314	7.1268	0.001186	1.447	-0.20551	-1.995
Air quality monitor distance	0.000648	0.0642	-0.01182	-1.444	0.013903	2.326
Toxic Release Inventory	-0.02382	-1.899	0.078608	5.346	0.061732	7.281
Power plant 3 miles	-0.51129	-0.41	0.051022	0.857		
Power plant 3 miles * distance	3.47E-05	0.3312	-0.00986	-0.46		

Table IV: Hedonic Regression Examining Effect of Conrail Action on Price Housing Distance Gradients (cont.)

	Butler County		Trumbull County		Middlesex County	
Variable	*Coefficient*	*t-stat.*	*Coefficient*	*t-stat.*	*Coefficient*	*t-stat.*
			Railroad Variables			
Conrail Line and Crossing Variables						
Line Impact Area (LIA)	-0.09612	-3.849	-0.25841	-2.873	-0.09438	-2.455
LIA * Distance	0.467615	2.3954	1.470155	2.616	0.362548	1.133
Crossing Impact Area (CIA)	-0.0965	-3.192	-0.06024	-0.681	0.041421	1.187
CIA * Distance	0.076772	0.7611	-0.00657	-0.026	0.060223	0.488
CIA * Ignore * Distance	-0.15031	-1.555	-0.16425	-0.869	-0.10532	-0.948
CIA * Ignore * Days Since * Distance	0.000177	2.7548	5.63E-05	0.371	-7.37E-05	-1.208
Other Railroad Line and Crossing Variables						
Line Impact Area (LIA)	-0.14342	-2.905	-0.04232	-0.579	-0.16937	-2.058
LIA * Distance	0.048921	0.1415	-0.00938	-0.017	0.72038	1.003
Crossing Impact Area (CIA)	0.102603	2.0633	-0.09876	-0.830	-0.14332	-1.508
CIA * Distance	-0.57455	-3.903	-0.03339	-0.089	0.407939	1.430
Adjusted R-squared	0.669014		0.609521		0.491186	
S.E. of regression	0.310217		0.340979		0.383317	
Log likelihood	-1700.84		-1700.91		-4102.35	
Mean dependent variable	10.97128		10.8116		11.80856	
F-statistic	231.9557		107.9043		140.8987	
Omitted City Control dummies:	2		4		5	
Omitted Time Control dummies:	12		12		14	
Omitted School District dummies:	4		16		4	