''Not in My Backyard'': The Effect of Substance Abuse Treatment Centers on Property Values

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Abstract Residential treatment centers offer the most intense form of treatment for substance abuse and are often embedded in residential neighborhoods. As a result of the Patient Protection and Affordable Care Act, the number of treatment centers has been forecasted to burgeon. We examine the external effect of residential rehab centers on nearby real estate. As addiction treatment centers are planned, a common response of nearby property owners is ''not in my backyard'' (NIMBY). Using a large MLS dataset from central Virginia, we estimate the impact of substance abuse treatment centers on nearby home prices and liquidity (as measured by time on market). We find that a neighboring treatment center is associated with an 8% reduction in nearby home prices, and that this discount is magnified for treatment centers that specifically treat opiate addiction (as much as 17%).

The primary residence is perhaps the greatest single investment made by an individual and the mantra ''location, location, location'' is an ever-present concern of a prospective buyer. Before purchasing a home, a savvy buyer will frequently research the community and the school system, as well as the crime statistics. When homeowners are made aware of an application for a special use permit for the possibility of an addiction treatment center being located in their neighborhood, initial concern for personal and household safety, followed by the stark realization that home values in their neighborhood may be adversely affected, almost always lead homeowners to the universal response of ''not in my backyard'' (NIMBY). The typical opposition to a proposed substance abuse treatment facility is based on two visceral concerns: an increase in crime risk and a related decrease in property values. The primary purpose of this paper is to examine the latter claim empirically, determining whether there is significant evidence that treatment centers have a negative impact on nearby real estate.

Ex ante, it is not clear that substance abuse treatment centers will adversely impact neighboring real estate, which motivates our empirical examination of this externality. On one hand, there may be a priori reasons to suspect that treatment facilities will not have much of an impact on neighboring real estate. Locating addiction treatment centers in residential areas has become commonplace.

Treatment centers tend to be inconspicuous and may have blackout curtains and minimal signage (or no sign). The housing is often gated and locked at a certain time of the day. Generally, clients enrolled in residential treatment programs are not allowed to interact with the ''locals'' of the neighborhood or leave the premises. Under current law (discussed in the next section), despite their challenges, residential treatment centers have relatively few limitations on where they are sited.

On the other hand, like many negative externalities or NIMBY issues, there are reasons to suspect that rehab facilities may adversely impact neighboring real estate. Substance abuse is a multifaceted health issue and many patients in residential treatment have a dual diagnosis: a mental health issue and an addiction (Connery, 2011). The Substance Abuse Mental Health Services Administration (SAMHSA, 2008) surveyed 14,423 facilities in 2008 and had a response rate of 94.1%. The SAMHSA survey indicated that 39% of the clients in treatment centers had a dual diagnosis. In addition, concurrent alcohol and drug addiction accounted for approximately 45%, while clients in treatment solely for drug abuse accounted for 34%–36% and 18%–20% of the patients only abused alcohol (SAMHSA, 2008).

One consequence of locating drug and alcohol rehabilitation centers in residential areas is that patients in substance abuse treatment programs frequently leave or are administratively discharged before successful completion. At some point, experts say that, ''relapse is an almost unavoidable—and potentially useful—step in recovery'' (Shaffer, 2012). For many, intensive residential treatment is a ''last resort.'' A healthy family of an addict will decline to ''enable'' negative behavior and, instead, will insist that the alcoholic/addict experience the ''consequence'' of the decision to use again and refuse treatment. In other words, the family will often not offer any form of financial support and the addict will have to fend for himself or herself. In addition to having a substance abuse disorder and possibly a dual diagnosis, those who relapse and leave treatment prior to completion often have limited job skills and perhaps even a criminal record—factors that make employment a challenge. Thus, as a practical matter, nearby neighbors may have valid concerns that the presence of a treatment center will be accompanied by additional unemployed or even homeless addicts on the street near the area in which the treatment center is located. This perception of elevated risk in these areas may then be reflected in the market prices of nearby real estate.

The likely occurrence of relapse combined with the probability of criminal charges and/or convictions associated with substance abuse corroborates the argument that the presence of a treatment center may bring objectionable consequences into a community. The purpose of this paper is to use market data to assess whether there is substantial evidence of nearby real estate being adversely impacted by the presence of treatment centers, consistent with the potential risks that proximity to these facilities may bring. As a clear-cut NIMBY issue, this paper contributes to the broader literature of examining the market effects of specific externalities or environmental factors in real estate. Our study contributes to the literature by being the first to examine the effect of substance abuse treatment centers on the

surrounding real estate market and, more generally, adding to our understanding of external factors that impact home prices.

Substance Abuse Treatment: Salient Issues, Recent Trends, and Related Literature

It is anticipated that the impact of the July 1, 2014 changes to insurance coverage under the Affordable Care Act (ACA) will cause the number of treatment centers to burgeon and thus, a study of the effect of nearby addiction treatment centers on real estate is timely. Prior to investigating treatment centers' effects on nearby real estate, it is crucial to understand the background of substance abuse treatment and why the current issues motivate the examination of potential real estate externalities.

Although accurate statistics of drug or alcohol disorders are difficult to obtain, according to a Harvard Medical School Special Health Report, between 15% and 28% of Americans will have a substance use disorder sometime during their lifetime and this estimate does not include addiction to nicotine (Shaffer, 2012). Residential treatment has become a more common way to treat addiction and, like many areas in healthcare services, residential rehabilitation has become a growth industry.

Broadly speaking, there are three types of treatment centers: intensive outpatient program (IOP), inpatient treatment, and partial hospitalization program (PHP). Typically, IOP treatment centers offer each client nine hours of group therapy, one hour of individual therapy, and one hour of case management (managing auxiliary services) per week. IOP clients either live in a halfway house or at home with strict guidelines established by their primary therapist. Although halfway houses can vary greatly, they generally have full-time house managers and mandatory, random urinalysis. Inpatient programs require clients to live at the facility in which all treatment takes place and may either be freestanding or hospital-based. PHP, also known as the ''Florida model,'' is a hybrid version of inpatient treatment and intensive outpatient treatment: individuals go to a counseling center during the day, and after a full day of therapy sessions return to off-site housing located in a neighborhood. Behavioral health technicians work at the off-site facilities around the clock.

Mandatory addiction treatment (commitment) does not exist under the law. An addict must choose to be in a recovery program. It is interesting to note that all three of the substance abuse treatment models include the possibility of group housing in neighborhood settings.

Projected Increase in SUD Treatment Facilities: MHPAEA and the ACA

The Patient Protection and Affordable Care Act (PPACA), also known as Obama Care, made sweeping changes to Mental Health/Substance Use Disorder

(MH/SUD) insurance coverage that went into effect on July 1, 2014. To understand the ramifications for residential treatment centers, it is necessary to briefly examine the legislative history of MH/SUD insurance coverage. Prior to July 1, 2014, the high cost of MH/SUD treatment meant that it was only available to patients with (or whose families have) considerable means, or those whose health insurance provided coverage. The Mental Health Parity and Addiction Equity Act of 2008 (MHPAEA) attempted to address the unequal treatment of MH/SUD health insurance coverage and legislated equal treatment between MH /SUD benefits and medical/surgical benefits. If a plan had MH/SUD coverage, then it must be on par with the medical/surgical benefits offered under that policy. The MHPAEA did not mandate that an insurance policy must cover MH/SUD and only applied to group health plans sponsored by employers with 50 or more employees. Both individual and small employer group policies were specifically exempted from coverage (MHPAEA Fact Sheet).

The PPACA mandates that MH/SUD coverage be included in marketplace health insurance policies as an ''essential health benefit'' as of July 1, 2014 (MHPAEA Fact Sheet). The effect of inclusion of MH/SUD coverage as an essential health benefit is that the MH/SUD parity rules now apply to non-grandfathered individual and small group plans (Beronio, Po, Skopec, and Glied, 2013). With expansion of the ''parity rules'' and inclusion of MH/SUD coverage as an essential health benefit under the ACA, it is anticipated that the number of patients having access to expensive addiction treatment options will grow exponentially, as will the number of treatment centers.

Antidiscrimination Housing Laws

When a proposed treatment center is sited, concerned members of the community frequently pressure lawmakers or hire attorneys, causing treatment centers to fight protracted legal battles that attempt to prevent the opening of the center. However, numerous laws hinder such NIMBY efforts, providing legal basis for treatment centers to be located just about anywhere. There are several federal laws that prohibit discrimination in housing based on a ''disability'' and define disability as: ''Any person who has a physical or mental impairment that substantially limits one or more major life activities; has a record of such impairment; or is regarded as having such impairment'' (HUD).

Substance abuse disorders are clearly recognized disabilities and thus are covered under fair housing laws. Federal housing laws that prohibit disability-based discrimination and ensure equal housing opportunities are briefly discussed below.

Fair Housing Act. The Fair Housing Act (FHA) was designed to prohibit discrimination in housing. In 1988, the FHA was amended to include persons with handicaps to the protected classes under the FHA, 42 U.S.C. §3604(f)(3)(B). The definition of ''handicap'' under the FHA is very broad, and drug addiction and alcoholism are considered to be disabilities that are covered. The FHA also has a provision (42 U.S.C. §3604(f)(9)) that permits the exclusion of those ''whose tenancy would constitute a direct threat to the health or safety of other individuals or ... would result in substantial physical damage to the property of others.'' Thus,

the FHA does not protect an individual currently using illegal drugs or a person with a conviction of distributing or illegally manufacturing a controlled substance.

The FHA covers almost every aspect of a real estate transaction. According to the Act, it is illegal to discriminate in the sale or rental of a dwelling against a person with a disability. Thus, an alcoholic/addict cannot be denied housing based solely on his or her addiction. The Act does permit ''reasonable local, State or Federal restriction regarding the maximum number of occupants permitted to occupy a dwelling'' 42 U.S.C. §3607(b)(1). This exemption is for living space per occupant and is intended to promote health and safety, not exclude group homes from residential areas.

Although a person with a conviction for dealing or illegally manufacturing a controlled substance is not protected under the FHA, a drug distribution conviction does not automatically exclude a person from invoking the Rehabilitation Act or the Americans with Disabilities Act.

Rehabilitation Act. §504 (45 CFR Part 84) of the Rehabilitation Act of 1973 prohibits any entity from receiving federal funds from discriminating on the basis of a disability. Drug addiction and alcoholism are covered under this act as well. Communities have attempted to use zoning laws to exclude treatment centers. Under §504, if a community's zoning regulation excludes substance abuse treatment centers, that community risks losing its federal funds.

Americans with Disabilities Act. Among other things, the purpose of Title II of the Americans with Disabilities Act (ADA) is to eliminate discrimination in housing against people with disabilities. This Act has further reach than §504 of the Rehabilitation Act because the receipt of federal funds is not required for Title II of the ADA to apply.

Zoning and Case Law. Zoning regulations create perhaps the biggest barrier to entry for a substance abuse center. As a practical matter, when considering a proposed site for a treatment center, the owners prefer to avoid spending a lot of time and money fighting a protracted court battle associated with a zoning ordinance. This mindset, however, did not stop a significant case from being appealed to the United States Supreme Court by Oxford House, a self-supporting, resident-run, residential treatment program. In the landmark case of *City of Edmonds v. Oxford House, Inc.*, et al., 514 U.S. 725 (1995), the City of Edmonds attempted to use an occupancy restriction in a zoning ordinance to exclude treatment centers from residential areas. The zoning ordinance in question allowed an unlimited number of related persons to live in a home and attempted to restrict the number of unrelated persons living in a single-family dwelling to five. The City of Edmonds claimed that the §3607(b)(1) exemption to the FHA applied to the city's zoning ordinance. In a 5–4 decision, the Supreme Court held that a zoning ordinance that defined a family in such a way as to exclude treatment centers was unlawful. The ordinance was not a maximum occupancy provision but a provision describing who may compose a ''family'' and, thus, it violated the FHA. This case was a critical victory for the ''Oxford House Model'' because this community-based treatment program leases houses located in upscale neighborhoods across the U.S.

The bottom line is that there must be a ''rational basis'' for zoning regulation to be valid and localities have consistently been prohibited from discriminating against substance abuse treatment centers. Absent drastic changes to the laws outlined above, it is clear that residential centers are here to stay, and that if challenged in court, NIMBY proponents will have an uphill battle. Thus, given the growth trends in this industry, the potential risks posed to neighbors, and the laws that protect the treatment centers' rights to locate almost anywhere, what is the consequence for real estate when a treatment center is located in one's ''backyard,'' so to speak?

Related Literature in Real Estate

Researchers have long recognized that numerous externalities impact the marketing outcomes of residential real estate. These externalities may include, for example, neighboring pollution,[1] or even the condition of adjoining or nearby properties and/or the tenant's behavior living in such properties. Real property has intangible benefits or disamenities, which are determined largely by public perception and capitalized into the pricing and marketing duration of residential properties. Furthermore, negative externalities are likely to significantly impact the marketing outcomes of properties in close proximity to the properties being marketed for sale, as well as impact the desirability of the overall neighborhood. Such ''stigma'' events are likely to be correlated with an exodus of higher income residents causing a ''snowball'' effect in declining property values (McCluskey and Rausser, 2003).

There are a number of researchers who analyze the degree to which external or neighborhood factors, both positive and negative, are capitalized in residential real estate marketing outcomes. For example, Thaler (1978) finds a negative relationship between neighborhood crime rates and property values. Gibbons (2004) finds an inverse relationship between vandalism and property values in London. As one would expect, robbery and aggravated assault rates have a significant and negative impact on property values (Ihanfeldt and Mayock, 2010). Pope (2012) found that decrease in crime rates had a positive effect on property values, particularly in those cities with substantial decreases in crime rates. Using a microspatial approach, Rosiers (2002) examined the impact of the visual encumbrance of power lines on property value and finds that on average it negatively impacts value by approximately 10%, but increases to 14% in areas where setback in property lines are less.

As a result of the recent economic and housing collapse, there are several studies that have examined the impact of foreclosed properties. Foreclosed properties may present a variety of negative effects on neighboring properties, including (but not limited to) the ''eyesore effect'' where neighboring foreclosures that have long been vacant adversely impact the aesthetic appeal of the neighborhood. Such studies include Harding, Rosenblatt, and Yao (2009), Lin, Rosenblatt, and Yao (2009), Daneshvary, Clauretie, and Kader (2011), Daneshvary and Clauretie (2012), and Agarwal, Ambrose, Chomsisengphet, and Sanders (2013). Generally, these studies find negative neighborhood spillovers from foreclosed or distressed properties.

A review of the literature does not reveal any specific examples of residential drug rehabilitation centers and their impact on neighboring property values. However, there is analogous literature of undesirable neighbors impacting property values. For example, Congdon-Hohman (2013) finds a significant and negative effect on home values located within one-eighth of a mile of a methamphetamine lab. The effect dissipates both as time passes after the discovery of and distance from a meth lab. Reichert, Small, and Mohanty (1992) estimate the impact of landfills on nearby real estate, finding a negative impact when located within several blocks of an expensive housing area. They find an effect that ranges from 5.5% to 7.3%, depending on the distance from the landfill. Indeed, the authors find that the percentage impact on older, less expensive properties to be significantly less (3%–4%) relative to the more expensive properties. Similarly, Hite, Chern, Hitzusen, and Randall (2001) find significant differences in property values located within 3.25 miles of a landfill.

Other studies have shown that a variety of other external factors affect real estate market outcomes. Coulson and Leichenko (2001) find that designated properties, as well as neighboring properties, are significantly impacted by historical designations. Other examples include the impact of registered sex offenders on the marketing outcomes of neighboring properties. Three recent studies have examined the impact as to the proximity of registered sex offenders. Most recently, Wentland, Waller, and Brastow (2014) found that close proximity to sex offenders rendered large price and liquidity effects, declining but significant out to one mile. The authors also found amplified effects for homes with more bedrooms, a proxy for children, and whether the nearby offender was convicted of a violent sex offense. Linden and Rockoff (2008) found significant reductions in home prices across radii of less than 0.1 miles and 0.1 to 0.3 miles when an offender moves in. Pope (2008) found properties located within 0.1 miles of a sex offender significantly reduced home values.

Data

We use residential real estate data from a multiple listing service (MLS) located in central Virginia, including Richmond and other surrounding areas. MLS data are critical for any externality study, particularly those that analyze both time on market and price, because it contains both the list date and sell date (or withdraw date) of residential properties, while tax data and other publically available data usually only include the property's date of sale. This is critical because nearby amenities or disamenities may be capitalized into a home's price, liquidity, or some combination of the two. In this study, we examine both. While the expected sign of living near a potential disamenity is likely negative for the price estimates, the estimated impact on liquidity is theoretically ambiguous. While the disamenity may lower the arrival rate of potential buyers, lengthening the time on market, the seller may be willing to discount the home in part to counteract this effect.

The sample is composed of listings in the residential real estate market over approximately a decade, between 2001 and 2011. The initial housing data contains 207,793 observations (including both sold and unsold properties). Among others,

Levitt and Syverson (2008) point out that MLS data are entered by real estate agents and can be incorrect or incomplete. The data were carefully examined in light of common issues prevalent in the data. After culling for incomplete, missing or illogical data that suggest data entry errors or extravagant outliers, the final data set consists of approximately 194,983 homes on the market, with approximately 111,580 that eventually sold.[2] The MLS data include numerous property characteristics (square footage, bedrooms, baths, age, acreage, etc.) and, of course, each property's location.

Our MLS data are a fairly representative housing market in the U.S., which includes urban, suburban, and rural sales. Richmond is a medium-sized city located in the eastern part of central Virginia and the MLS covers much of the ''Greater Richmond'' area (or Richmond MSA). The average property in this MLS has a listing and selling price of $263,641 and $242,116, respectively. The average listed property was 25 years of age, with 2,143 square feet, 3.6 bedrooms, and 2.4 bathrooms with an average time on market of 85 days. During this time period, there were 36 substance abuse treatment centers located within the broader region encompassing the listings in our data, and nine were located within the city limits of Richmond specifically.[3] See Exhibit 1 for additional descriptive statistics.

The primary source of the treatment center externality is its proximity to a given home on the market. Intuitively, there is likely an increasing NIMBY sentiment as the proximity to the center is closer in distance. Thus, we compute the distance from a given home in the MLS and each treatment center, using address data to code the longitude and latitude from which the straight-line distance is calculated using the great-circle formula. While NIMBY does not literally refer to one's ''backyard,'' it is usually taken to mean very close proximity, but the definition of what qualifies as ''very close proximity'' may be different depending on the person and the issue. Below we examine the effect of nearby substance abuse treatment centers on nearby real estate, using different spatial proximities (e.g., 0.175 miles, 0.15 miles, and 0.125 miles) as a robustness check.[4]

Empirical Methodology

Our primary goal is to isolate the effect of a treatment center on neighborhood real estate outcomes. Numerous studies have examined other neighborhood externalities, using a variety of empirical approaches.[5] Initially, we focus on a treatment center's effect on the sale price and liquidity of a home, utilizing a cross-sectional OLS hedonic pricing model as the baseline. While hedonic pricing models are commonly used to determine the value of specific property attributes and surrounding (dis)amenities by estimating marginal effects on the sale price of the property,[6] we also explore a simultaneous equation model to account for the joint determination of both price and liquidity. The purpose of exploring multiple approaches is to demonstrate that the results are not particularly sensitive to the choice of modeling technique.

Baseline OLS Hedonic Models

Beginning with a simple cross-sectional approach, we provide a baseline estimate of the effect of a nearby substance abuse treatment center, employing a traditional

Exhibit 1 | Summary Statistics

Variable	Mean	Std. Dev.
List Price ($)	263,641	142,300
Sale Price ($)	242,116	127,608
Time on Market (in Days)	85.45	79.99
Rehab Center (Dummy Var. = 1 if the home is near a rehab center (distance specified in each table), 0 otherwise)	0.0003	0.02
Age (in Years)	24.99	26.16
Acreage	0.79	1.91
Square Feet	2,143.29	888.25
Bedrooms	3.60	0.77
Bathrooms	2.38	0.82
Foreclosure (Dummy Var. = 1 if foreclosure, 0 otherwise)	0.02	0.12
Number of levels	1.83	0.65
Pool (Dummy Var. = 1 if the home has a pool, 0 otherwise)	0.05	0.23
Basement (Dummy Var. = 1 if they have a basement, 0 otherwise)	0.17	0.38
Short Sale (Dummy Var. = 1 if short sale, 0 otherwise)	0.02	0.13
Tenant (Dummy Var. = 1 if it has a tenant at listing, 0 otherwise)	0.03	0.16
Vacant (Dummy Var. = 1 if the home is vacant, 0 otherwise)	0.36	0.48
Taxes	1,779.95	1,311.74
HOA Fees (Dummy Var. = 1 if it has HOA fees, 0 otherwise)	0.32	0.47
Listing Density	64.41	577.40
Competition	582.22	1,062.08

Note: Location and year fixed effects summary stats omitted.

hedonic model that accounts for heterogeneous characteristics of both homes and their locations. We estimate the following functional forms:

$$SP_i = \varphi_P(X_i, LOC_i, T_i, TOM_i) + \varepsilon \quad (1)$$

and

$$TOM_i = \varphi_P(X_i, LOC_i, T_i, LP_i) + \varepsilon, \quad (2)$$

where SP_i is a vector for property selling price,[7] LP_i is a vector for property listing price X_i is a vector of property specific characteristics,[8] LOC_i is a vector for location control using ZIP Codes (see below), T_i, the variable of interest, equals

1 if a treatment center is located nearby of a given home$_i$ and is 0 otherwise, TOM_i is the time on market (in days), which the literature also calls marketing duration or a measure of liquidity, and ε is an error term that is heteroskedastic-consistent and clustered by ZIP Code.[9]

Hedonic analysis of the housing market requires some control for spatial heterogeneity because location itself is a key source of differences in housing prices. The goal is to disentangle specific proximity to a treatment center from broader location differences that explain real estate prices. Following numerous studies in the real estate and urban economics literature, we chose ZIP Code fixed effects to control for unobserved heterogeneity *across* these areas so that the explanatory variables' effects are identified from variation *within* a given area (or even in a given year, as is the case for time fixed effects). In effect, our results may then be interpreted as the treatment center's effect on home prices given comparable homes within the same ZIP Code, but located further away. In this sense, we are attempting to disentangle the broader location effect from the proximity to a treatment center by essentially comparing homes within a certain ZIP Code. Further, we explore alternative location controls (census tracts, block groups, and blocks) in a similar vein, as well as altering the control group itself by confining it to narrow bands around a rehab facility. Appropriate location controls can disentangle the negative externality effect from simply a "bad neighborhood" or "bad part of town" effect.

Simultaneous Equations Approach: System Identification

Numerous studies in real estate and urban economics model price and time on market in a simultaneous system (like 2SLS or 3SLS) given likely joint determination of these factors. A seller can always lower price to increase liquidity, and vice versa. Yet, a home's sale price and time on market are determined by virtually identical factors. Econometrically, this creates an identification problem because if one wants to model this simultaneity with a system of equations, then, by definition, such a system could not be identified using identical exogenous variables. While a number of empirical studies acknowledge this simultaneity,[10] Turnbull and Dombrow (2006) and Zahirovic-Herbert and Turnbull (2008) have identified a novel way of overcoming this identification problem through their incorporation of variables that represent market conditions from other listings on the market. Below we summarize a solution to this identification issue, as we utilize an adapted form of this approach to model price and liquidity in a simultaneous system.

Following Krainer's (2001) search market model, one can model a home's expected liquidity, $E[TOM]$, (measured as a home's marketing duration or time on market) and expected house sale price, $E[SP]$, as simultaneously determined and implicitly defined as:

$$F(E[SP], E[TOM], T, X, LOC, C) = 0, \tag{3}$$

where T is an indicator of whether a home is near a rehab treatment center, X is a vector of house (and market) characteristics, LOC is location controls, and C are neighborhood market conditions. The latter variable, C, represents neighborhood market conditions that have an ambiguous external effect on local properties. On one hand, when the number of nearby homes that go on the market increases, the supply of additional homes on the market ought to negatively impact the price and liquidity of a nearby home (i.e., ''a competition effect''). On the other hand, the increased traffic generated from additional nearby homes on the market could actually positively impact a home's price and liquidity, which is termed ''a shopping externality effect.'' Empirically, the sales price and time on market can be represented as separate functions with jointly distributed stochastic errors ε_p and ε_T:

$$SP = \varphi_p(TOM, T, LOC, X, C) + \varepsilon_p \quad (4)$$

and

$$TOM = \varphi_T(SP, T, LOC, X, C) + \varepsilon_T. \quad (5)$$

The vector C (i.e., market conditions or neighborhood competition) and another vector, L (i.e., listing density), are the keys to Turnbull and Dombrow's (2006) solution to over-identifying this system of equations (since equations 3 and 4 are not yet identified). Neighborhood competition, C, is a measure that accounts for ''nearby houses for sale as long as each competing listed house overlaps with the period that this house is on the market, inversely weighted by the distance between the houses to reflect the assumption that nearby houses will have stronger effects on the sale of this house than houses that are farther away'' (Zahirovic-Herbert and Turnbull, 2008).[11] Listing density, L, is similarly defined as ''the measure of competing overlapping listings per day on the market'' (Zahirovic-Herbert and Turnbull, 2008), where: $L(i) = \Sigma_j(1 - D(i, j))^2\{\min[s(i), s(j)] - \max[l(i), l(j)]\}/s(i) - l(i) + 1$. Essentially, both measures capture neighborhood market conditions by quantifying the marketing overlap of nearby homes on the market simultaneously, however, listing density is weighted by time on market. Turnbull and Dombrow (2006) point out that a change in competition while holding selling time constant is also the partial derivative with respect to listing density (and it is easy to see that $\partial\varphi_p/\partial C \equiv \partial\varphi_p/\partial L$). Therefore, we can rewrite our system of equations to reflect:

$$SP = \varphi_p(TOM, T, LOC, X, L) + \varepsilon_p \quad (6)$$

and

$$TOM = \varphi_T(SP, T, LOC, X, C) + \varepsilon_T. \quad (7)$$

Both L and C vectors uniquely identify the simultaneous system. Further, we supplement this approach by using different location controls across equations.[12] We estimate the system of equations (5) and (6) using three-stage least squares (3SLS) in the next section to generate a coefficient estimate of the effect of a nearby treatment center on price and time on market. We model simultaneity using a 3SLS approach because it incorporates an additional step with seemingly unrelated regression (SUR) estimation to control for correlations between error terms.[13]

Alternative Specifications and Robustness

While the baseline results include location controls, an additional way to isolate the treatment effect of a rehab facility is by limiting the control group to homes closer to rehab facilities more generally (i.e., omitting observations sufficiently far from any rehab facility). Methodologically, the comparison is then between homes that are near a rehab treatment facility and homes just outside a given range. Specifically, we explore the effect of a rehab center (within 1/8 mile) on nearby real estate as compared to similar homes further out (i.e., within 1.5 miles, 1 mile, and 2/3 mile, respectively). This approach allows us to further homogenize location as a robustness check, and to provide additional evidence that the external effect is specific to the rehab facility, and not simply the part of town in which it is located.

We also examine whether facilities that only treat opiate addicts (commonly known as methadone clinics) have a larger impact on nearby real estate. Clinics that treat heroin or prescription addicts, for example, often use buprenorphine or methadone as part of the rehabilitation process. Nearby residents may perceive patients who are still intoxicated, albeit at a lower dose, as an elevated crime risk. Approximately half of the 36 treatment centers in our sample only treat opiate addiction (hereinafter referred to as methadone clinics). We examine whether nearby real estate is more affected by methadone clinics specifically.

Results

Baseline OLS Results

The baseline OLS results provide evidence that nearby treatment centers adversely impact surrounding home values, but have little if any impact on property liquidity. Estimating equations (1) and (2), Exhibit 2 shows that this adverse effect is not qualitatively sensitive to the choice of the definition of "nearby." Column 1 shows that the presence of a rehab center within 0.125 (1/8) miles is associated with

Exhibit 2 | Effect of a Nearby Rehab Center on a Home's Price and Liquidity: Baseline OLS Results

	Dependent Variable: *ln*(*Sale Price*)			Dependent Variable: *ln*(*Days on Market*)		
	(1)	(2)	(3)	(4)	(5)	(6)
Rehab Center ≤ 0.125 Mile	−0.0796**			−0.0513		
	(−1.97)			(−0.28)		
Rehab Center ≤ 0.15 Mile		−0.0623**			0.1101	
		(−2.20)			(0.76)	
Rehab Center ≤ 0.175 Mile			−0.0517**			0.1190
			(−2.49)			(1.10)
ln(Age of Home)	−0.0649***	−0.0649***	−0.0649***	0.0213***	0.0213***	0.0213***
	(−19.07)	(−19.07)	(−19.08)	(2.71)	(2.71)	(2.71)
Acreage	0.0206***	0.0206***	0.0206***	0.0203***	0.0203***	0.0203***
	(13.39)	(13.39)	(13.39)	(4.47)	(4.46)	(4.46)
Sq. Ft.	0.0003***	0.0003***	0.0003***	−0.0000	−0.0000	−0.0000
	(15.38)	(15.38)	(15.38)	(−0.50)	(−0.50)	(−0.50)
Bedrooms	−0.0075	−0.0075	−0.0075	0.0441***	0.0441***	0.0441***
	(−0.99)	(−0.99)	(−0.99)	(5.06)	(5.07)	(5.06)
Bathrooms	0.0390***	0.0390***	0.0390***	−0.0517***	−0.0517***	−0.0517***
	(6.30)	(6.30)	(6.30)	(−5.34)	(−5.34)	(−5.33)
Foreclosure	−0.1691***	−0.1691***	−0.1691***	−0.3936***	−0.3938***	−0.3939***
	(−20.60)	(−20.60)	(−20.60)	(−15.90)	(−15.91)	(−15.93)
Number of Levels	−0.0055	−0.0055	−0.0055	0.0419***	0.0418***	0.0418***
	(−1.17)	(−1.17)	(−1.17)	(4.93)	(4.93)	(4.93)
Pool	0.0334***	0.0334***	0.0334***	0.0060	0.0060	0.0060
	(3.61)	(3.61)	(3.60)	(0.18)	(0.18)	(0.18)
Basement	0.0418***	0.0418***	0.0418***	0.0045	0.0046	0.0046
	(3.15)	(3.15)	(3.15)	(0.23)	(0.23)	(0.23)

Exhibit 2 | (continued)

Effect of a Nearby Rehab Center on a Home's Price and Liquidity: Baseline OLS Results

	Dependent Variable: *ln*(*Sale Price*)			Dependent Variable: *ln*(*Days on Market*)		
	(1)	(2)	(3)	(4)	(5)	(6)
Short Sale	−0.0935***	−0.0935***	−0.0935***	0.3775***	0.3775***	0.3775***
	(−12.68)	(−12.68)	(−12.67)	(18.07)	(18.08)	(18.07)
Tenant	−0.0815***	−0.0815***	−0.0815***	0.2479***	0.2479***	0.2479***
	(−10.10)	(−10.10)	(−10.10)	(11.82)	(11.81)	(11.81)
Vacant	−0.0279***	−0.0279***	−0.0279***	0.1207***	0.1207***	0.1207***
	(−6.56)	(−6.56)	(−6.57)	(7.44)	(7.43)	(7.43)
Taxes ($)	0.0001***	0.0001***	0.0001***	−0.0000	−0.0000	−0.0000
	(6.81)	(6.81)	(6.81)	(−1.23)	(−1.23)	(−1.23)
HOA Fee	0.0715***	0.0715***	0.0715***	−0.0690***	−0.0691***	−0.0690***
	(7.11)	(7.11)	(7.11)	(−3.26)	(−3.26)	(−3.26)
ln(*Days on Market*)	0.0003	0.0003	0.0003			
	(0.21)	(0.21)	(0.21)			
ln(*List Price*)				0.6486***	0.6487***	0.6487***
				(9.34)	(9.34)	(9.34)
Constant	11.4723***	11.4723***	11.6581	−5.6213***	−5.6222***	−5.6225***
	(171.71)	(171.70)	(0.07)	(−6.69)	(−6.69)	(−6.69)
Location Controls (ZIP Code)	✓	✓	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓	✓	✓

Notes: This table presents results of hedonic OLS models showing the effect of a nearby (i.e., within 0.125 mile, 0.15 mile, and 0.175 mile) rehab facility on a property's sale price and time on market (errors clustered by ZIP Code). *T*-statistics are in parentheses. The number of observation in columns 1–3 is 117,187; the number of observation in columns 4–6 is 206,420.

*Significant at the 10% level.

**Significant at the 5% level.

***Significant at the 1% level.

approximately an 8% reduction in home values. The corresponding impact on time on market is not statistically significant at any conventional level, providing initial evidence that the externality is primarily capitalized into home prices, rather than liquidity. Indeed, columns 2 and 3 show that homes sold for approximately 6% or 5% less if they were located within 0.15 miles or 0.175 miles of a rehab center, respectively. While qualitatively similar, these coefficient estimates also provide some evidence that the externality may be diminishing in distance, as additional, further properties are included in the latter estimates. The regressions tabulated in columns 5 and 6 tell approximately the same story as column 4, in that there is little evidence that rehab centers have a statistically significant impact on a home's liquidity.

The real estate literature has not adopted a single way to control for spatial heterogeneity. In Exhibit 3 we examine a few common alternatives to controlling for location. The initial estimates in Exhibit 2 use ZIP Codes to control for spatial heterogeneity. In Exhibit 3, we use census tract fixed effects (columns 1 and 4), block group fixed effect (columns 2 and 5), and block fixed effects (columns 3 and 6). Census tracts, according to the U.S. Census, are ''small, relatively permanent statistical subdivisions of a county ... designed to be homogenous with respect to population characteristics, economic status, and living conditions.''[14] Census block groups are subsets of census tracts; and, blocks are further subsets of block groups. One can think of these as different measures of ''neighborhoods,'' broadly to more narrowly defined. The results from the price regressions in Exhibit 3 are consistent with Exhibit 2, falling within a fraction of a percentage point of one another, with an effect of approximately 7.2% to 7.9%. Columns 4–6 in Exhibit 3 also show that substance abuse treatment centers are not associated with a statistically significant impact on nearby property liquidity. Overall, it is clear that the estimates of the effect of a substance abuse treatment center on nearby real estate is not particularly sensitive to the choice of location controls, providing evidence that the external effect of substance abuse treatment centers is robust.

Simultaneous Equation Results

When price and time on market are modeled within a simultaneous 3SLS system of equations, the estimated effect of a nearby substance abuse treatment center on home price and liquidity are similar to the OLS results, finding that nearby substance abuse treatment centers are associated with an approximately 8% drop in home values (within 1/8 mile). Column 1 in Exhibit 4 displays this result. Like the initial OLS results, the 3SLS estimations also show that substance abuse treatment centers have little impact on nearby property liquidity, as the externality appears to be capitalized into price exclusively. Exhibit 4 provides additional evidence that the external impact of substance abuse treatment centers is robust to multiple modeling approaches that are common in empirical real estate studies.

Exhibit 4 also provides evidence that not all substance abuse treatment centers may be perceived by nearby residents as presenting equal risk. It is possible that methadone clinics have a greater NIMBY sentiment from the broader community. We test this proposition empirically by exclusively examining the effect of

Exhibit 3 | Effect of a Nearby Rehab Center on a Home's Price and Liquidity with Different Location Controls

	Dependent Variable: *ln*(*Sale Price*)			Dependent Variable: *ln*(*Days on Market*)		
	(1)	(2)	(3)	(4)	(5)	(6)
Rehab Center ≤ 1/8 Mile	−0.0720**	−0.0787**	−0.0744**	−0.0695	−0.0919	−0.0520
	(−2.01)	(−2.16)	(−2.25)	(−0.41)	(−0.55)	(−0.32)
ln(*Age of Home*)	−0.0683***	−0.0668***	−0.0650***	0.0066	−0.0111	−0.0110**
	(−36.51)	(−39.52)	(−48.49)	(0.87)	(−1.50)	(−2.39)
Acreage	0.0200***	0.0209***	0.0201***	0.0372***	0.0589***	0.0552***
	(17.12)	(20.28)	(24.52)	(9.82)	(12.25)	(23.18)
Sq. Ft.	0.0002***	0.0002***	0.0002***	0.0000**	0.0001***	0.0001***
	(14.20)	(13.45)	(14.30)	(1.96)	(4.91)	(7.83)
Bedrooms	0.0004	0.0038	0.0046	0.0356***	0.0148	0.0202***
	(0.08)	(0.71)	(1.12)	(3.56)	(1.34)	(2.81)
Bathrooms	0.0404***	0.0394***	0.0383***	−0.0495***	−0.0441***	−0.0463***
	(7.09)	(7.06)	(7.96)	(−5.08)	(−4.00)	(−5.91)
Foreclosure	−0.1546***	−0.1482***	−0.1401***	−0.4062***	−0.4258***	−0.4239***
	(−24.91)	(−27.52)	(−32.23)	(−19.06)	(−18.46)	(−21.16)
Number of Levels	−0.0032	−0.0012	0.0022	0.0202***	−0.0078	0.0010
	(−1.08)	(−0.46)	(0.96)	(2.65)	(−0.78)	(0.16)
Pool	0.0355***	0.0333***	0.0289***	0.0126	0.0159	0.0219
	(4.99)	(5.69)	(8.30)	(0.43)	(0.48)	(1.07)
Basement	0.0231***	0.0193***	0.0152***	0.0400***	0.1021***	0.0865***
	(3.52)	(3.89)	(4.88)	(2.77)	(6.03)	(8.86)
Short Sale	−0.0822***	−0.0818***	−0.0817***	0.3531***	0.3422***	0.3410***
	(−14.38)	(−14.82)	(−14.83)	(18.52)	(17.81)	(18.39)
Tenant	−0.0729***	−0.0721***	−0.0702***	0.2570***	0.2966***	0.2882***
	(−14.28)	(−16.27)	(−18.31)	(13.10)	(14.02)	(15.87)

Exhibit 3 | (continued)

Effect of a Nearby Rehab Center on a Home's Price and Liquidity with Different Location Controls

	Dependent Variable: *ln*(*Sale Price*)			Dependent Variable: *ln*(*Days on Market*)		
	(1)	(2)	(3)	(4)	(5)	(6)
Vacant	−0.0309***	−0.0326***	−0.0345***	0.1171***	0.1393***	0.1301***
	(−9.74)	(−12.22)	(−20.51)	(7.81)	(8.97)	(12.79)
Taxes ($)	0.0001***	0.0001***	0.0001***	−0.0001**	−0.0001***	−0.0001***
	(10.40)	(10.45)	(13.13)	(−2.17)	(−3.20)	(−6.69)
HOA Fees	0.0660***	0.0681***	0.0635***	−0.0847***	−0.1136***	−0.1100***
	(9.93)	(11.85)	(16.69)	(−4.25)	(−5.04)	(−8.49)
ln(*Time on Market*)	0.0014*	0.0016**	0.0015***			
	(1.67)	(2.40)	(2.79)			
ln(*List Price*)				0.5101***	0.2620***	0.2991***
				(11.71)	(5.67)	(11.74)
Constant	11.4958***	11.4429***	11.5281***	−4.1742***	−1.1906**	−1.6416***
	(156.44)	(260.80)	(259.87)	(−7.64)	(−2.12)	(−4.76)
Location Controls (Census Tracts)	✓			✓		
Location Controls (Blocks Groups)		✓			✓	
Location Controls (Blocks)			✓			✓
Year Fixed Effects	✓	✓	✓	✓	✓	✓

Notes: This table presents results of hedonic OLS models showing the effect of a nearby (i.e. within 0.125 mile) rehab facility on a property's sale price and time on market, while controlling for different spatial / area fixed effects. Errors are clustered by spatial area in each regression respectively. *T*-statistics are in parentheses. The number of observation in columns 1–3 is 116,663; the number of observation in columns 4–6 is 205,281.

*Significant at the 10% level.

**Significant at the 5% level.

***Significant at the 1% level.

Exhibit 4 | Effect of a Nearby Rehab and Methadone Treatment Center on a Home's Price and Liquidity

	Dependent Variable: *ln*(*Sale Price*)	Dependent Variable: *ln*(*Days on Market*)	Dependent Variable: *ln*(*Sale Price*)	Dependent Variable: *ln*(*Days on Market*)
	(1)	(2)	(3)	(4)
Rehab Center ≤ 1/8 Mile	−0.077**	−0.009		
	(−2.44)	(−0.04)		
Meth. Center ≤ 1/8 Mile			−0.174**	0.192
			(−2.35)	(0.33)
ln(*Age of Home*)	−0.063***	0.125***	−0.063***	0.125***
	(−118.93)	(10.89)	(−118.92)	(10.86)
Acreage	0.019***	0.026***	0.019***	0.027***
	(42.37)	(5.22)	(42.38)	(5.24)
Sq. Ft.	0.000***	−0.000***	0.000***	−0.000***
	(232.99)	(−7.14)	(233.00)	(−7.10)
Bedrooms	−0.023***	0.093***	−0.023***	0.093***
	(−23.53)	(11.70)	(−23.52)	(11.69)
Bathrooms	0.024***	−0.054***	0.024***	−0.053***
	(22.80)	(−5.75)	(22.80)	(−5.73)
Foreclosure	−0.153***	−0.025	−0.153***	−0.026
	(−36.57)	(−0.62)	(−36.60)	(−0.64)
Number of Levels	−0.018***	0.077***	−0.018***	0.077***
	(−18.27)	(9.51)	(−18.27)	(9.51)
Pool	0.027***	−0.038**	0.027***	−0.038**
	(11.63)	(−2.04)	(11.62)	(−2.03)
Basement	0.039***	−0.062***	0.039***	−0.061***
	(24.13)	(−4.68)	(24.13)	(−4.67)
Short Sale	−0.115***	0.529***	−0.115***	0.528***
	(−20.08)	(11.42)	(−20.07)	(11.41)
Tenant	−0.080***	0.078**	−0.080***	0.078**
	(−21.18)	(2.46)	(−21.19)	(2.45)
Vacant	−0.041***	0.240***	−0.041***	0.240***
	(−34.67)	(22.44)	(−34.66)	(22.42)
Taxes ($)	0.000***	0.000*	0.000***	0.000*
	(91.96)	(1.82)	(91.95)	(1.86)
HOA Fees	0.059***	−0.076***	0.059***	−0.076***
	(41.51)	(−5.07)	(41.50)	(−5.05)
ln(*Time on Market*)	0.050***		0.050***	
	(45.52)		(45.45)	
ln(*Sale Price*)		1.254***		1.248***
		(7.48)		(7.44)

Exhibit 4 | (continued)
Effect of a Nearby Rehab and Methadone Treatment Center on a Home's Price and Liquidity

	Dependent Variable: *ln*(*Sale Price*)	Dependent Variable: *ln*(*Days on Market*)	Dependent Variable: *ln*(*Sale Price*)	Dependent Variable: *ln*(*Days on Market*)
	(1)	(2)	(3)	(4)
Listing Density	0.000***		0.000***	
	(21.93)		(21.95)	
Competition		0.000***		0.000***
		(21.48)		(21.50)
Location Controls	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓

Notes: This table presents the results of hedonic 3SLS models showing the effect of a nearby (i.e., within 0.125 mile) rehab facility, and a rehab facility that treats methadone addiction specifically, on a property's sale price and time on market; constant omitted here for brevity. *Z*-statistics are in parentheses. The number of observations in columns 1–4 is 110,361.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

methadone clinics. Columns 3 and 4 in Exhibit 4 display the results of the same 3SLS estimations as columns 1 and 2, but confining the treatment variable to a dummy variable that equals one if the home is within 0.125 mile of a methadone clinic. The coefficient estimates in Exhibit 4 indicate that homes within 0.125 miles of a methadone clinic sell for approximately a 17% discount relative to homes that are located further away, holding other factors constant. There is little evidence, however, that these clinics affect nearby home liquidity. Overall, Exhibit 4 provides evidence that the market differentiates among risks generated by these potential externalities, and the treatment centers that may be perceived as having a higher risk to their neighbors have a much greater impact on the surrounding real estate market.

As a robustness check, in Exhibit 5 we explore the extent to which the control groups matter, finding results generally consistent with those in Exhibit 4. A critique of hedonic models for estimating any externality might be that the interpretation of the dummy variable essentially defines the control group as homes not located near (within 0.125 miles) the potential externality. Defining the control group in this way may present some unobserved spatial heterogeneity issues. To address this issue, in Exhibits 5 and 6 we estimate the same regressions as Exhibit 4, but confine the sample to homes that are located within 1.5 miles, 1 mile, and 0.6 miles of a rehab facility respectively. The results are consistent with the initial 3SLS estimates in Exhibit 4, and by extension, the initial OLS estimates in Exhibits 2 and 3. Both exhibits show that homes near substance abuse

Exhibit 5 | Effect of a Nearby Rehab Facility on a Home's Sale Price and Days on Market

	Dependent Variable: *ln*(*Sale Price*)	Dependent Variable: *ln*(*Days on Market*)	Dependent Variable: *ln*(*Sale Price*)	Dependent Variable: *ln*(*Days on Market*)	Dependent Variable: *ln*(*Sale Price*)	Dependent Variable: *ln*(*Days on Market*)
	Within 1.5 Miles of a Rehab Facility		Within 1 Mile of a Rehab Facility		Within 0.6 Miles of a Rehab Facility	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Rehab Center ≤ 1/8 Mile	−0.076**	−0.008	−0.077**	−0.083	−0.075**	−0.331
	(−2.34)	(−0.03)	(−2.42)	(−0.34)	(−2.27)	(−1.34)
ln(*Age of Home*)	−0.063***	0.133***	−0.059***	0.060	−0.063***	0.102
	(−30.75)	(3.60)	(−20.19)	(1.34)	(−12.40)	(1.60)
Acreage	0.022***	0.017	0.020***	0.045*	0.028***	0.015
	(12.14)	(0.91)	(7.61)	(1.85)	(5.83)	(0.35)
Sq. Ft.	0.000***	−0.000**	0.000***	−0.000	0.000***	−0.000
	(57.61)	(−2.31)	(42.39)	(−0.59)	(25.45)	(−1.08)
Bedrooms	−0.023***	0.123***	−0.025***	0.144***	−0.026***	0.211***
	(−5.92)	(4.30)	(−4.44)	(3.42)	(−2.96)	(3.21)
Bathrooms	0.028***	−0.018	0.018***	0.040	0.027***	−0.048
	(6.69)	(−0.51)	(2.88)	(0.81)	(2.58)	(−0.60)
Foreclosure	−0.147***	0.014	−0.171***	−0.195	−0.188***	−0.628**
	(−9.84)	(0.11)	(−7.62)	(−1.00)	(−4.93)	(−2.11)
Number of Levels	−0.025***	0.079***	−0.021***	0.046	−0.018**	0.110
	(−6.57)	(2.64)	(−3.81)	(1.05)	(−1.99)	(1.64)
Pool	0.021**	0.034	0.016	−0.103	0.027	−0.134
	(2.17)	(0.48)	(1.16)	(−0.97)	(1.12)	(−0.77)

Exhibit 5 | (continued)

Effect of a Nearby Rehab Facility on a Home's Sale Price and Days on Market

	Dependent Variable: *ln*(*Sale Price*)	Dependent Variable: *ln*(*Days on Market*)	Dependent Variable: *ln*(*Sale Price*)	Dependent Variable: *ln*(*Days on Market*)	Dependent Variable: *ln*(*Sale Price*)	Dependent Variable: *ln*(*Days on Market*)
	Within 1.5 Miles of a Rehab Facility		Within 1 Mile of a Rehab Facility		Within 0.6 Miles of a Rehab Facility	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Basement	0.040***	0.004	0.034***	0.052	0.029*	−0.105
	(6.44)	(0.08)	(3.71)	(0.71)	(1.91)	(−0.89)
Short Sale	−0.122***	0.389**	−0.106***	0.315	−0.166***	0.006
	(−6.04)	(2.56)	(−3.23)	(1.25)	(−3.06)	(0.02)
Tenant	−0.099***	0.038	−0.114***	0.018	−0.140***	0.161
	(−6.82)	(0.32)	(−5.82)	(0.11)	(−4.47)	(0.65)
Vacant	−0.044***	0.218***	−0.046***	0.254***	−0.034***	0.304***
	(−9.59)	(5.59)	(−7.05)	(4.66)	(−2.97)	(3.68)
Taxes ($)	0.000***	0.000	0.000***	0.000***	0.000***	0.000**
	(23.21)	(1.13)	(15.54)	(3.58)	(11.40)	(2.22)
HOA Fees	0.068***	−0.104**	0.078***	−0.128*	0.079***	−0.151
	(11.98)	(−1.98)	(9.59)	(−1.72)	(5.73)	(−1.36)
ln(*Time on Market*)	0.043***		0.019***		0.010	
	(10.91)		(3.80)		(1.50)	
ln(*Sale Price*)		1.023**		0.071		0.295
		(1.98)		(0.12)		(0.39)
Listing Density	0.000***		0.000***		0.000**	
	(6.30)		(4.33)		(2.35)	

Exhibit 5 | (continued)
Effect of a Nearby Rehab Facility on a Home's Sale Price and Days on Market

	Dependent Variable: *ln*(*Sale Price*)	Dependent Variable: *ln*(*Days on Market*)	Dependent Variable: *ln*(*Sale Price*)	Dependent Variable: *ln*(*Days on Market*)	Dependent Variable: *ln*(*Sale Price*)	Dependent Variable: *ln*(*Days on Market*)
	Within 1.5 Miles of a Rehab Facility		Within 1 Mile of a Rehab Facility		Within 0.6 Miles of a Rehab Facility	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Competition		0.000***		0.000***		0.000***
		(8.80)		(6.26)		(5.95)
Location Controls	✓	✓	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓	✓	✓

Notes: This table presents the 3SLS results of simultaneous estimation of the effect of a nearby rehab facility on a home's selling price and liquidity (time on market), changing the sample to vary the control groups by smaller radii from a rehab center. *Z*-statistics are in parentheses. The number of observations in columns 1–2 is 7,711; the number of observations in columns 3–4 is 3,589; the number of observations in columns 5–6 is 1,324.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

Exhibit 6 | Effect of a Nearby Rehab Facility that Treats Methadone Addiction

	Dependent Variable: *ln(Sale Price)*	Dependent Variable: *ln(Days on Market)*	Dependent Variable: *ln(Sale Price)*	Dependent Variable: *ln(Days on Market)*	Dependent Variable: *ln(Sale Price)*	Dependent Variable: *ln(Days on Market)*
	Within 1.5 Miles of a Rehab Facility		Within 1 Mile of a Rehab Facility		Within 0.6 Miles of a Rehab Facility	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Meth. Center ≤ 1/8 Mile	−0.169**	−0.020	−0.179**	−0.086	−0.168**	−0.289
	(−2.21)	(−0.04)	(−2.37)	(−0.15)	(−2.17)	(−0.52)
ln(Age of Home)	−0.063***	0.129***	−0.059***	0.061	−0.063***	0.104
	(−30.70)	(3.49)	(−20.14)	(1.35)	(−12.30)	(1.64)
Acreage	0.022***	0.018	0.020***	0.045*	0.028***	0.014
	(12.17)	(0.99)	(7.62)	(1.84)	(5.83)	(0.33)
Sq. Ft.	0.000***	−0.000**	0.000***	−0.000	0.000***	−0.000
	(57.63)	(−2.17)	(42.43)	(−0.61)	(25.54)	(−1.10)
Bedrooms	−0.023***	0.122***	−0.024***	0.145***	−0.026***	0.216***
	(−5.88)	(4.26)	(−4.42)	(3.45)	(−2.91)	(3.29)
Bathrooms	0.028***	−0.016	0.018***	0.040	0.027***	−0.047
	(6.70)	(−0.45)	(2.89)	(0.81)	(2.59)	(−0.59)
Foreclosure	−0.148***	0.004	−0.173***	−0.196	−0.193***	−0.653**
	(−9.90)	(0.03)	(−7.71)	(−1.00)	(−5.06)	(−2.19)
Number of Levels	−0.025***	0.078***	−0.021***	0.047	−0.018**	0.109
	(−6.58)	(2.60)	(−3.84)	(1.05)	(−2.04)	(1.62)
Pool	0.021**	0.035	0.016	−0.103	0.026	−0.135
	(2.16)	(0.50)	(1.15)	(−0.97)	(1.10)	(−0.78)

Exhibit 6 | (continued)
Effect of a Nearby Rehab Facility that Treats Methadone Addiction

	Dependent Variable: *ln*(*Sale Price*)	Dependent Variable: *ln*(*Days on Market*)	Dependent Variable: *ln*(*Sale Price*)	Dependent Variable: *ln*(*Days on Market*)	Dependent Variable: *ln*(*Sale Price*)	Dependent Variable: *ln*(*Days on Market*)
	Within 1.5 Miles of a Rehab Facility		Within 1 Mile of a Rehab Facility		Within 0.6 Miles of a Rehab Facility	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Basement	0.040***	0.006	0.035***	0.051	0.030*	−0.104
	(6.44)	(0.13)	(3.72)	(0.70)	(1.94)	(−0.89)
Short Sale	−0.121***	0.383**	−0.106***	0.318	−0.165***	0.029
	(−6.02)	(2.52)	(−3.21)	(1.26)	(−3.03)	(0.07)
Tenant	−0.099***	0.031	−0.114***	0.019	−0.142***	0.158
	(−6.84)	(0.26)	(−5.84)	(0.12)	(−4.52)	(0.64)
Vacant	−0.044***	0.216***	−0.047***	0.254***	−0.034***	0.303***
	(−9.58)	(5.52)	(−7.08)	(4.67)	(−3.03)	(3.66)
Taxes ($)	0.000***	0.000	0.000***	0.000***	0.000***	0.000**
	(23.18)	(1.26)	(15.44)	(3.56)	(11.24)	(2.16)
HOA Fees	0.068***	−0.100*	0.077***	−0.130*	0.078***	−0.159
	(11.94)	(−1.90)	(9.53)	(−1.75)	(5.65)	(−1.43)
ln(*Time on Market*)	0.042***		0.020***		0.012*	
	(10.81)		(3.93)		(1.67)	
ln(*Sale Price*)		0.955*		0.082		0.322
		(1.85)		(0.14)		(0.43)
Listing Density	0.000***		0.000***		0.000**	
	(6.42)		(4.40)		(2.48)	

Exhibit 6 | (continued)

Effect of a Nearby Rehab Facility that Treats Methadone Addiction

	Dependent Variable: *ln*(*Sale Price*)	Dependent Variable: *ln*(*Days on Market*)	Dependent Variable: *ln*(*Sale Price*)	Dependent Variable: *ln*(*Days on Market*)	Dependent Variable: *ln*(*Sale Price*)	Dependent Variable: *ln*(*Days on Market*)
	Within 1.5 Miles of a Rehab Facility		Within 1 Mile of a Rehab Facility		Within 0.6 Miles of a Rehab Facility	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Competition		0.000***		0.000***		0.000***
		(8.86)		(6.25)		(5.89)
Location Controls	✓	✓	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓	✓	✓

Notes: This table presents 3SLS results of simultaneous estimation of the effect of a nearby rehab facility that treats methadone addiction on a home's selling price and liquidity (time on market), changing the sample to vary the control groups by smaller radii from a rehab center. *Z*-statistics are in parentheses. The number of observations in column 1 is 7,711; the number of observations in column 2 is 3,589; the number of observations in column 3 is 1,324.

*Significant at the 10% level.

**Significant at the 5% level.

***Significant at the 1% level.

treatment centers are still negatively impacted, and by approximately the same magnitudes. Indeed, the last two columns are particularly striking. Given that this is already a ''within neighborhood'' estimation, by controlling for location, the fact that the substance abuse treatment center result is robust when the control group is reduced to 1 mile and 0.6 miles indicates that unobserved spatial heterogeneity is not likely driving the core results of this paper. More intuitively, this provides strong evidence that the substance abuse treatment center effect is not simply a ''bad part of town effect,'' in that we are comparing ''apples with apples'' across the dimension of location; and, the principle characteristic distinguishing the variation in prices in these areas is the presence of a nearby substance abuse treatment center. Based on these results, we cannot conclude that there is a robust impact on property liquidity, but there appears to be a robust negative relationship between the presence of a substance abuse treatment center and nearby home values.

Conclusion

In this study, we find evidence that residential substance abuse treatment centers adversely impact the price of neighboring homes. We find that homes within 1/8 mile of a treatment center sell for approximately 8% less than otherwise comparable homes that are located further away. Furthermore, we find that the market differentiates between potential risks that nearby treatment centers may carry, as living near a methadone clinic that treats opiate addictions such as heroin or morphine may be associated with a reduction in home values by as much as 17%. We find little evidence that nearby treatment centers affect a home's time on market.

Examining this particular externality is important to the broader literature on neighborhood externalities and environmental factors, as well as the specific literature on the issue of residential treatment centers. The PPACA has expanded MH/SUD coverage and made intensive treatment options affordable, and as a result, demand for effective substance abuse treatment is increasing. Operating a treatment center is a growing industry and it is reasonable to assume that new centers will be built nationally, many of which will be sited near or within residential communities. Indeed, there is very little that individuals and localities can do to prohibit a substance abuse treatment center from locating in a residential area because alcohol and drug addiction is considered to be a handicap and thus alcoholic/addicts in recovery are members of a protected class under the federal anti-discrimination housing laws. Hence, as residential treatment centers become more common, it is important to understand all their effects, including the effects they may have on nearby real estate and how markets price the potential risk of nearby externalities.

Endnotes

[1] For a more complete review on the impact of environmental externalities, see Boyle and Kiel (2001).

[2] Consistent with other real estate studies, we culled outliers from our data set, confining our data to more ''typical'' range of homes listed at less than $1,000,000, fewer than 10 bedrooms, fewer than 16 acres (99% of observations), property taxes paid that were less $10,000 (99% of observations), and younger than 150 years old (99% of observations). For our other dependent variable of interest, time on market, we similarly trim the 1% extremes. Generally, the findings are not sensitive to dropping these observations. Further, important to disclose how our data has been trimmed for transparency and replicability. As an additional quality check, a sample of the MLS data was compared to county tax records, which contain data on price and housing characteristics.

[3] There were approximately 153, 96, and 60 properties listed within 0.175 miles, 0.15 miles, and 0.125 miles of a rehab treatment facility respectively, over the time period of our study. Given the very recent and projected growth of rehab centers nationally, future research will be able to take advantage of additional homes (data points) being bought and sold near rehab facilities.

[4] The choice of this radius does not fundamentally alter the qualitative conclusions of this study. The definition of one's ''backyard'' is somewhat ambiguous, and may differ depending on an individual's perception. Some externality studies use 0.1 mile, 0.2 mile, or 0.3 mile as a radius to examine a given externality. While similar results are obtained looking at bands slightly larger and slightly smaller, we follow Congdon-Hohman (2013) and use 1/8 mile in most of our tabulated regression results. An easy way to think of 0.125 miles, 0.15 miles, and 0.175 miles is that these are 2.5 minute, 3 minute, and 3.5 minute walks respectively (assuming a pace of 3 miles per hour).

[5] For recent examples of amenity or disamenity studies of externality effects, see Asabere and Huffman (1991), Gibbons (2004), Linden and Rockoff (2008), Pope (2008), Rossi-Hansberg, Sarte, and Owens (2010), Campbell, Giglio, and Pathek (2011), Hoen, Wiser, Cappers, Thayer, and Sethi (2011), Daneshvary, Clauretie, and Kader (2011), Grout, Jaeger, and Plantinga (2011), Daneshvary and Clauretie (2012), Congdon-Hohman (2013), Guignet (2013), Linn (2013), Munneke, Sirmans, Slade, and Turnbull (2013), and Wentland, Waller, and Brastow (2014).

[6] Recent examples include neighborhood foreclosure effects (Harding, Rosenblatt, and Yao, 2009; Lin, Rosenblatt, and Yao, 2009; Agarwal, Ambrose, Chomsisengphet, and Sanders, 2010).

[7] Kuminoff, Parmeter, and Pope (2010) survey 69 hedonic studies and found that 80% rely on linear, semi-log, or log-log functional form. We have explored a number of non-linear functional forms and our results remain robust. Rather than repeat all of the above models with various non-linear explanatory variables, the authors will produce results of alternative specifications upon request.

[8] For example, we use the following property specific variables: square footage, age, acreage, number of bedrooms, bathrooms, number of stories, new, vacant, HOA fees, whether it has a pool, a tenant, a basement, and whether it is a short sale or foreclosure. We also include year fixed effects to control for variation over time.

[9] When we explore different location controls later, we will cluster by location (e.g., census tract, block group, or block).

[10] For example, see Yavas and Yang (1995), Knight (2002), and Turnbull and Dombrow (2006).

[11] Specifically, both our paper and Zahirovic-Herbert and Turnbull (2008) calculate C in the following way: ''The days-on-market or selling time is $s(i) - l(i) + 1$, where $l(i)$ and $s(i)$ are the listing date and sales date for house i. Denoting the listing date and

sales date for house j by $l(j)$ and $s(j)$, the overlapping time on the market for these two houses is $\min[s(i), s(j)] - \max[l(i), l(j)]$. The straight-line distance in miles between houses i and j is $D(i, j)$. The measured competition for house i is: $C(i) = \Sigma_j (1 - D(i, j))^2\{\min[s(i), s(j)] - \max[l(i), l(j)]\}$ where the summation is taken over all competing houses j, that is, houses for sale within one mile and 20% larger or smaller in living area of house i" (Zahirovic-Herbert and Turnbull, 2008).

[12] At the suggestion of a reviewer, we also identify the system by using different control variables. A simple way to do this is to use different location controls. We use ZIP Code fixed effects in the price equation, and census tract fixed effects in the time on market equation. Generally, the results are not very sensitive to which location controls are used in each equation. Further, the results are similar when we use the Turnbull and Dombrow (2006) method alone to identify the system.

[13] According to Belsley (1988), when there are strong interrelations among error terms, 3SLS is used instead of 2SLS in estimating systems of equations because it is more efficient. Specifically, one would expect unobservables that contribute to error in estimating price to be also correlated the error in liquidity.

[14] See www.census.gov for more detail, specifically: http://www.census.gov/geo/www/cob/tr_metadata.html#gad.

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