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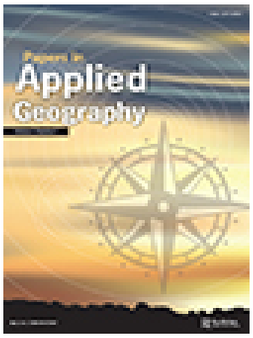

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Craft Breweries and Neighborhood Crime: Are they related?

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Abstract: In their search for inexpensive real estate, many craft breweries have located in economically distressed neighborhoods. In many cases, breweries have contributed to the revitalization of neighborhoods. However, as a business that serves alcohol, some jurisdictions are concerned with potential negative externalities associated with craft breweries. One concern is a possible increase in crime. Using Portland as a case study, our purpose in this paper is to quantitatively assess changes in crime levels after the opening of a craft brewery. Using detailed data on calls for service to the Portland Police Bureau and brewery locations with their opening dates, we estimate the relationship between brewery openings and crime between 2012 and 2018. We control for brewery specific attributes, city-wide trends, and changes in neighborhood characteristics that may also affect crime levels. Our findings suggest that there is no significant change in crime around craft brewery locations post opening. However, the findings do provide guidance as to under which conditions brewery locations may be associated with relatively less or more crime. While breweries located in residential, industrial, or employment zones tend to be associated with less crime, breweries located in clusters in commercial zones tend to experience more crime.

Keywords: alcohol outlets, externalities, crime, neighborhood change.

1. INTRODUCTION

As of 2018 there were over 7,000 craft breweries in the United States. Their popularity has attracted the attention of local economic and community development agents, who have seen potential economic benefits of a successful craft brewery. In their search for inexpensive and spacious real estate, many craft breweries have located in buildings in economically distressed neighborhoods. In many cases, craft breweries have contributed to the revitalization of these neighborhoods. However, as a business that serves alcohol, some people are concerned with potential negative externalities associated with craft breweries. One concern is a possible increase in crime. Hypothetically, craft breweries could contribute to decreased crime in and around the areas where they open through upgrading of the visual aesthetics of a neighborhood (broken windows theory), increased foot traffic and an increased presence of people which

could provide a feeling of increased safety (routine activities theory). However, with more people moving around the area, sometimes intoxicated, it could also have an adverse effect on crime, particularly in formerly industrial districts where many craft breweries tend to locate which previously had little or no foot traffic (Nilsson and Reid 2019).

Using Portland, OR as our case study, our purpose in this paper is to quantitatively assess whether neighborhood crime rates significantly change after the opening of a craft brewery using data on calls for service to the Portland Police Bureau between 2012 and 2018. In our analysis, we control for changes in neighborhood characteristics (which may occur simultaneously) that may also have an effect on crime. The results suggest that, on average, there is no significant change in crime in the immediate area around a craft brewery location post opening of the craft brewery, not after controlling for socioeconomic and demographic characteristics of the surrounding neighborhood, brewery specific characteristics, as well as year and neighborhood unobservables. We do find that breweries located in commercial areas experience higher volumes of crime (as measured by calls for service) as opposed breweries located in employment, industrial, or residential zones.

While a case study, the results from this paper provide guidance to local land-use planners and officials making decisions regarding whether or not to allow craft breweries to open within their jurisdictions. Not only do we show that craft breweries do not appear to be significantly associated with crime, our results also provide guidance in terms of the neighborhood characteristics which may create environments less susceptible to crime, particular land-use characteristics (e.g., which type of zones may generate relatively less crime).

The remainder of this article is divided into four sections. The article begins with a review of the relevant literature to describe the potential relationship between craft breweries, neighborhood change and its potential effect on crime incidence as well as a description of the study area. In the next section, we describe the data and analytical strategy used in the analysis, followed by a presentation and discussion of

the results. The final section concludes with a discussion on the implications and limitations of our analysis.

2. BACKGROUND

As craft beer increased in popularity, a growing number of communities came to view craft breweries as a community asset, whose growth and expansion should be nurtured (Houston 2017, Bula 2019). Craft breweries are attractive for a number of reasons. For example, in the search for inexpensive real estate, they are willing to locate in what Weiler (2000, 168) calls an "economically peripheral location". As a result, craft brewery entrepreneurs often invest in economically distressed parts of a city such as a struggling downtown or an old industrial neighborhood (Reid 2018). The real estate options available in these parts of a city mean that craft brewery entrepreneurs frequently engage in adaptive reuse, with the result that craft breweries are found occupying a wide variety of old buildings such as former churches, fire stations, warehouses, etc. (Reid et al. 2019). In some cities, craft breweries have acted as pioneer investors and have been the catalyst for subsequent neighborhood revitalization. Two examples of this are the Ohio City neighborhood in Cleveland, OH and the Lower Downtown ("LoDo") neighborhood of Denver, CO where the opening of the Great Lakes Brewing Company and Wynkoop Brewing Company respectively (both in 1988), were critical to the subsequent revitalization of these neighborhoods (Weiler 2000, Alexander 2013). In other cities, craft breweries have followed other investors into a neighborhood (e.g. the Pearl District in Portland, OR), where they have also been important contributors to neighborhood revitalization (Walker and Miller 2019). Through their impact on neighborhood revitalization, craft breweries can have significant economic impacts in terms of increased property values. A study by Nilsson and Reid (2019) examined the impact of craft breweries on both residential and commercial properties in Charlotte, NC. They found that single-family homes within a half a mile of a brewery experienced a 9.3% increase in their value following the opening of the brewery, while condominiums experienced a 3.2% increase in value. They found no significant effect on commercial property values. As for the neighborhoods craft breweries tend to locate in, Apardian and Reid (2020)

found that brewpubs in San Diego tend to be located in neighborhoods with higher Walk Scores. Barajas et al. (2017) found that craft breweries are more likely to locate in neighborhoods with larger shares of 25–34-year olds. While people of different ages have stated a preference for walkable neighborhoods, they seem particularly desirable to the Millennial demographic (American Planning Association 2014, National Association of Realtors 2017). The findings of Nilsson and Reid (2019), Apardian and Reid (2020), and Barajas et al. (2017) suggest that craft breweries may be a neighborhood amenity and that having one within walking distance is desirable. Millennials, in particular, may covet having one in their neighborhood as they represent a key market demographic for craft beer (Nilsson and Reid 2019, Watson 2014).

While many municipalities welcome craft breweries, there are residents who worry about the negative externalities associated with alcohol consumption (Sharp 2019). In other words, not all residents will necessarily welcome a craft brewery into their neighborhood. Increased noise, anti-social behavior, and crime are concerns for some people. While there have been no published[1] studies that have examined the impact of craft breweries on neighborhood crime levels, there does exist a considerable body of literature on the impact of alcohol outlets on crime rates.

Two basic types of alcohol outlets exist. First, there are on-premise establishments. These include bars, restaurants, etc. where alcohol is consumed on-site. Second, there are off-premise establishments. These include liquor stores, grocery stores, etc., from which alcohol is purchased but consumed at another location. Our concern in this study is on-premise establishments, specifically craft breweries.

The incidence of crime is unevenly distributed across both space and time. The existence of crime hot spots – places where above average incidences of crime occur – is well documented (e.g., Sherman et al. 1989, Twinam 2017, Weisburd and Wire 2018). The same hot spot phenomenon exists with regard to bar-related crime. Data collected across numerous cities show that crime tends to be concentrated in and

[1] A study by Wartell (2016), presented at the 2016 Environmental Criminology and Crime Analysis Symposium but never published, found lower numbers of police calls for service at breweries than non-brewery alcohol establishments.

around a relatively small proportion of bars within a city. For example, in Cincinnati, OH, 20% of the bars accounted for 75% of all physical violence incidents over a two-year period (Madensen and Eck 2008), while in Milwaukee, WI, 15% of taverns accounted for over half of all tavern-focused crime (Sherman et al. 1992). Twinam (2017, 118) concluded that "a substantial amount of crime in Chicago is concentrated around a narrow subset of bars and focused in a particular window of time" (i.e. between 2am and 6am). A review of the literature suggests that the level of crime associated with a particular bar depends on a multitude of factors. These include outlet density, neighborhood characteristics, internal characteristics of and management practices at specific establishments, type of business (e.g., bar or restaurant) and patron characteristics (Roncek and Maier 1991, Gruenwald 2007, Madensen and Eck 2008, Lipton et al. 2013, Quick et al. 2017).

The impact of alcohol outlet density on neighborhood crime has been the focus of a number of studies. Livingston et al. (2007) suggest that the clustering of bars encourages "disruptive strolling" between them, therefore increasing the likelihood of violent acts. The geographic clustering of bars increases both the number of potential offenders and victims (White et al, 2015). In Minneapolis, MN, Toomey et al. (2012) found a positive relationship between the density of on-site alcohol establishments and violent crime. Livingston (2011) reported similar findings for Melbourne, Australia. For Norfolk, VA, White el al. (2015, 868) concluded that "alcohol availability would appear to be one of the stronger structural characteristics affecting crime at the neighborhood level". Controlling for prior levels of crime, socioeconomic disadvantage, population size, and spatial lag, White et al (2015) found a statistically significant relationship between the number of alcohol outlets and the number of street crimes. In the case of Philadelphia, PA, Grubesic et al.'s (2013) results were less conclusive, finding only weak evidence of a relationship between the incidence of aggravated assault and on-premise outlet density. In their study of on-premise alcohol outlets and crime in Buffalo, NY, Conrow et al. (2015) explored how violent crime near bars clustered in both space and time. Their analysis showed significant clustering of violent crime at a distance of between 320 feet and 1,020 feet of an alcohol outlet, and between 165 and 180 days of an

alcohol license being issued. The impact of on-premise, alcohol outlet density on crime can be moderated by other factors, however. For example, Pridemore and Grubesic (2012) found that higher levels of social organization within a neighborhood moderated the impact of bar density on violence in Cincinnati, OH. Zhang et al. (2015) examined the impact of declining density of on-premise alcohol outlets on crime in the Buckhead neighborhood of Atlanta, GA between 2003 and 2007. They found that the declining density of such outlets was accompanied by a decrease in violent crime. Campbell et al. (2009, 565-566) conducted a meta-analysis of 47 different studies that examined the relationship between alcohol outlet density and crime. They concluded that, "using a variety of different study methods, study populations, and alcohol measures, most of the studies included in this review reported that greater outlet density is associated with increased alcohol consumption and related harms, including medical harms, injuries, crime, and violence."

Bars and liquor stores have also been shown to be related to neighborhood decline. From his analysis of crime across thirteen US cities, Hipp (2010) suggested that crime associated with bars and liquor stores can be responsible for sending neighborhoods into a spiral of decline. Speer et al. (1998) noted that high crime rates scare away desirable business, thereby creating a vacuum which is often filled by alcohol outlets. In other words, an increase in crime can trigger a change in a neighborhood's business mix, with general retail stores closing and alcohol outlets such as bars and liquor stores moving in (Hipp 2010). A word of caution, however. While evidence exists regarding the correlation between alcohol density and crimes/harms, Gmel et al. (2016) noted a lack of evidence of directional causality between the two. As a result, when reviewing studies in which crime is analyzed by alcohol outlet type, the results are too diverse and contradictory to be able to make causal conclusions.

In Cincinnati, OH, Madensen and Eck (2008, 111) found that violent and non-violent bars were located in close proximity to each other in the same neighborhood, leading them to conclude that they "find little support for the hypothesis that high crime bars are simply the product of high crime neighborhoods". Bars, they argue, "function as relatively autonomous microenvironments that are at least partially

insulated from external neighborhood-level effects" (Madensen and Eck 2008, 117). The microenvironment of a bar, they contend are the products of decisions made by bar management. These decisions, and the microenvironment that is created, influence the type of patrons that frequent a particular bar. Graham et al. (2006, 1569) suggest that "the physical and social environment of certain bar-room settings may . . . contribute to risk of aggression and injury". In other words, certain characteristics of a bar may create an environment which makes crime more or less likely to occur. Green and Plant (2007) identify four broad bar characteristics that help explain inter-establishment variations in crime levels - internal physical characteristics and atmosphere, organizational factors, patron characteristics, and external characteristics (which includes outlet density). While the list of precise characteristics identified by Green and Plant (2007) are too numerous to detail here, they include permissive decorum, overcrowding, an expectation on the part of patrons that aggressive behavior will be tolerated, ineffective bouncers, and insufficient staff numbers. Quigley et al. (2003), however, found that the characteristics of the bar were more important than the personalities of patrons in determining the level of crime that occurred at a particular bar.

In understanding why some on-premise drinking establishments may experience more crime than others, the work of Gruenewald (2007) is particularly insightful. Gruenwald (2007) invokes social ecological theory to explain inter-establishment crime levels. Underpinning Gruenwald's (2007) ideas are the interconnected niche and assortative drinking theories (essentially different sides of the same coin) that we believe have particular relevance for our current study. According to these theories, bars segment themselves in such a way that different bars are attractive to a different clientele (niche theory), in response to the reality that different individuals are attracted to different kinds of drinking establishments (assortative drinking theory). In this fashion, NFL fans are attracted to sports bars during football season, local music enthusiasts are attracted to bars with a reputation for showcasing local artists, while craft beer drinkers frequent craft breweries and bars whose tap handles include a large and diverse variety of craft beer. According to Gruenewald (2007, 875), "commercial interests will progressively segment the market

creating unique niches for drinking. Consumers will assort themselves across these niches, forming drinking subgroups". In other words, when an individual is deciding which drinking establishment to patronize, homophily appears to be one factor. The following observation from a resident of Minneapolis-St. Paul supports this idea:

> Here in the Twin Cities you can find dive bars full of old working class guys, college type bars with males/females, cocktail lounge-type places where you'll find middle aged white collar types, upscale hipster bars, bars catering to LBGT, VFW bars, etc. (City-data.com, 2009).

From niche and assortative drinking theories, it follows that some bars may attract drinkers who are more predisposed to consume more alcohol and consequently are more likely to engage in criminal activities (Toomey et al. 2012). This is consistent with Sherman's (1995, 45) patron hypothesis which suggests, "high-crime bars are where high-crime people congregate". As noted by Madensen and Eck (2008, 121), "the characteristics of those who frequent an establishment will influence the likelihood of violence at the location", while Quigley et al. (2003, 770) suggest that "violent and heavy-drinking people are attracted to bars with physical and social conditions that promote aggressive behavior." The type of patrons that frequent a particular bar is determined by a number of factors, including the type and price of alcohol, as well as the nature of the activities and events offered by an establishment. After they enter an establishment, the behavior of patrons is heavily influenced by the internal characteristics of the bar's management philosophy and practices. Bars that charge higher alcohol prices, for example, tend to experience less violence (Madensen and Eck 2008; Quigley et al. 2003). In their study of Norfolk, VA, White et al. (2015) identified areas of the city which had less crime than might have been expected, based upon the number of on-site alcohol outlets located in these areas. Areas with lots of on-site alcohol outlets, but low crime, catered to a wealthier clientele; one of them had a cluster of restaurants specializing in international cuisine (Bolivian, Japanese etc.) whose clients were more interested in food than drink. Additionally, most of the restaurants closed shortly after the dinner service was complete, thus

not staying open late. These findings are consistent with other research which shows that bars that charge higher alcohol prices tend to experience less violence (Madensen and Eck 2008; Quigley et al. 2003).

In the case of craft breweries, we suggest that the nature of the establishments and characteristics of the clientele should result in relatively low incidences of crime in and around them. Baginski and Bell (2011) characterize craft beer as a "high order prestige good" that is "often viewed as highbrow". Murray and O'Neill (2012, 900) refer to the craft beer drinkers as "sophisticated" and "discerning", while Tremblay and Tremblay (2011, 155) refer to the "prestige factor" of drinking craft beer. Drinking to get drunk is not an objective of craft beer drinkers (Kraftchick et al. 2014). For craft beer drinkers, flavor and style are more important than the strength of the beer (C+R Research, 2018). The average weekly craft beer drinker is male, between the ages of 21 and 44, and has an annual income between $75,000 and $99,000 (Kendall 2019). Nothing that we know about craft beer drinkers suggests that they are likely to engage in criminal behavior when visiting a craft brewery. Furthermore, a visit to the website of any craft brewery will show that it is extremely rare for a craft brewery to be open after midnight. Research has clearly demonstrated that remaining open beyond midnight (particularly after 2am) seems to increase the incidence of crime.

3. DATA AND METHODOLOGY

To measure crime volumes, we use data on calls for service from the Portland Police Bureau. The call data come from the City of Portland's Open Data Portal and cover the time period 2012 to 2018. The data were downloaded and then filtered by crime group to retain all crime, disorder and traffic calls (with the latter only having drunk driving as the call type, so does not include officer-initiated traffic stops). In addition to call type/category, the data include address, latitude/longitude coordinates, date, time and priority. We narrow our focus to calls made within 50 feet of a brewery location. This distance was chosen due to the impreciseness of police call data for problems at and around specific addresses (Hart

and Zandbergen 2013). This distance will include calls that may be related to the brewery, such as in the parking lot or street out front, but not include calls that may be generated by a location further down the block from a neighboring bar or other establishment. We perform the analysis on all call types as well as a selected call types most likely related to alcohol establishments such as assault, disturbance, drunk driving, disorder, parking problems, theft, robbery, vandalism, etc.

Locations of craft breweries in Portland was provided by PubQuest, a mapping service website that allows users to locate craft brewery locations across the United States and Canada. Brewery locations are classified in three ways – brewery on-site with a taproom but no restaurant, brewery on-site but location also includes a restaurant, and owned by a brewery but no brewing on-site. This dataset was enhanced by adding opening years for breweries, collected via craft brewery websites and news articles, as well as sorting out breweries that might have closed. Only breweries within Portland city limits that opened after 2012 and prior to 2018 were included in the analysis in order to have police service call data available before and after opening. This resulted in a panel dataset consisting of 36 breweries and 252 brewery-year observations.

Both the opening of craft breweries as well as crime rates are likely related to neighborhood socioeconomic characteristics, hence we include lagged values of neighborhood characteristics in our models. Neighborhood characteristics are lagged in order to avoid potential endogeneity between changes in neighborhood characteristics (e.g., revitalization) and crime rates (Autor et al. 2017). As a proxy for neighborhood we use the census tract, which is common practice in studying neighborhood change (Walker and Miller 2019, Wei and Knox 2014, Delmelle 2016). While census tracts are fairly large compared to how some may conceptualize neighborhood, it is the smallest geographic level at which relatively more robust estimates of socioeconomic characteristics can be found annually for the study period in question. This data comes from the United States Census Bureau's American Community Survey (ACS) 5-year estimates which includes rolling averages (not year-to-year point estimates) of

population estimates, socioeconomic and demographic characteristics of census tracts between 2011 and 2017.

To quantify the relationship between craft brewery openings and crime, we estimate the following model using ordinary least squares (OLS):

$$Service\ calls_{i,t} = \alpha + \beta_1 Post_{i,t} + \beta_2 X_{i,t-1} + \beta_3 G_{i,t} + \beta_3 Z_{i,t} + \varepsilon \qquad (1)$$

where *i* denotes the brewery location, *t* the year, and the dependent variable is police service calls within 50 feet of a brewery location in time *t*. $Post_{i,t}$ is a dummy variable equal to one for the year the brewery opened and afterwards and zero for all years before the brewery opened. Hence, β_1 is our coefficient of interest, as it provides an estimate of the difference in service calls (our dependent variable) in the time period after the brewery opened compared to before it opened. $X_{i,t-1}$ is a vector of characteristics of the neighborhood (tract) within which the brewery is located. Neighborhood characteristics are lagged one year (hence denoted *t-1*) in order to avoid possible endogeneity. Neighborhood characteristics included are those that have been often associated with neighborhood revitalization (and gentrification) which may have either a positive or negative effect on crime. These include share of college-educated, median household income, and percentage white population (Ding et al. 2016, Ellen and O'Regan 2011, McKinnish et al. 2010), as well as the share of the population in the Millennial cohort (here proxied by share of population in ages 25-44 years old) as they have been recognized as a driving factor of urban resurgence in the past two decades (Ehlenz et al. 2019, Lee et al. 2019). We also include population counts as more people in the area may lead to increased instances of police calls (ceteris paribus) as well as the percentage of households with children present to control for whether it is more of a single family neighborhood, and one may also hypothesize that families with children are more likely to report disturbances such as loud noise late at night, etc. $G_{i,t}$ is a vector of brewery specific controls such as the brewery's distance to the city center in order to control for higher crime rates in inner city areas, whether the brewery serves liquor or not, number of other breweries within one mile of brewery *i* in year *t*.

Finally, $Z_{i,t}$ is a vector of other controls including citywide crime rates in year *t*, neighborhood and year fixed effects.

3.1 THE PORTLAND, OR CONTEXT

Portland is the largest city in the state of Oregon and was the 25th largest city in the United States in 2018 (Njus 2019). The old working-class, timber and port town used to be the low-rent option for those looking to leave Southern California (Weber 2014). However, since the 1990s, the city has experienced growth in its technology sector and has emerged as a second-tier high-technology region specializing in manufacturing of test equipment, semiconductors, and computers giving it the nickname "Silicon Forest" (Mayer 2011). With its shifting economic base came an influx of young, creative professionals, and the city and many of its neighborhoods has experienced socioeconomic ascent with home values growing faster than median household income (Miller 2014, Weber 2014, also see Table 1). While the city continues to grow, growth is slowing down. In 2016, the city ranked as the 19th fastest growing city out of the 100 largest US cities. However, in 2018, it had fallen to number 56 on that list (Njus 2019).

Table 1. Descriptive statistics for Portland city

Variable	2012	2017	Change
Population	585,888	653,115	7.6%
White	77.5%	77.4%	-0.1
Black or African American	6.5%	5.7%	-0.8
Owner-occupied housing units	53.8%	53.4%	-0.4
Median home value	$288,300	$352,700	22.3%
Bachelor's degree or higher	43.1%	48.2%	5.1
Median household income	$51,238	$61,532	20.1%
Persons in poverty	17.2%	16.2%	-1.0

Portland is also one of the largest craft brewing cities in the United States (Watson 2018). Figure 1 shows all craft breweries within Portland's city limits with the ones included in this study being those opened between 2013 and 2017. Portland's craft brewery scene is relatively concentrated around its downtown. A large cluster of breweries is located in the inner eastside of the city across the river from downtown but there are also some smaller clusters, including the well-known Pearl District just north of downtown Portland. The earliest breweries opened in the 1980s in the Pearl district and in Southwest Portland. However, as the city's craft brewing industry grew, many opened up slightly further away from the central business district (CBD) in northern and southern Portland and across the river that runs through the city to the east. As noted by Walker and Miller (2019), by 2015 craft breweries were spreading east of the river with few located east of 82nd Ave. which divides the city's wealthier and whiter West side from its poorer and less white East side. However, with increasing house prices on the city's west side, east-side neighborhoods have become more attractive to the city's young, professional class due to its older and culturally-rich aesthetics (Jackson 2012). On the other hand, while the city's Pearl District has had a reputation as a wealthy enclave, it hosts several affordable apartment complexes (Hottman 2013) and a lower median household income compared to its more western neighbors (Figure 1).

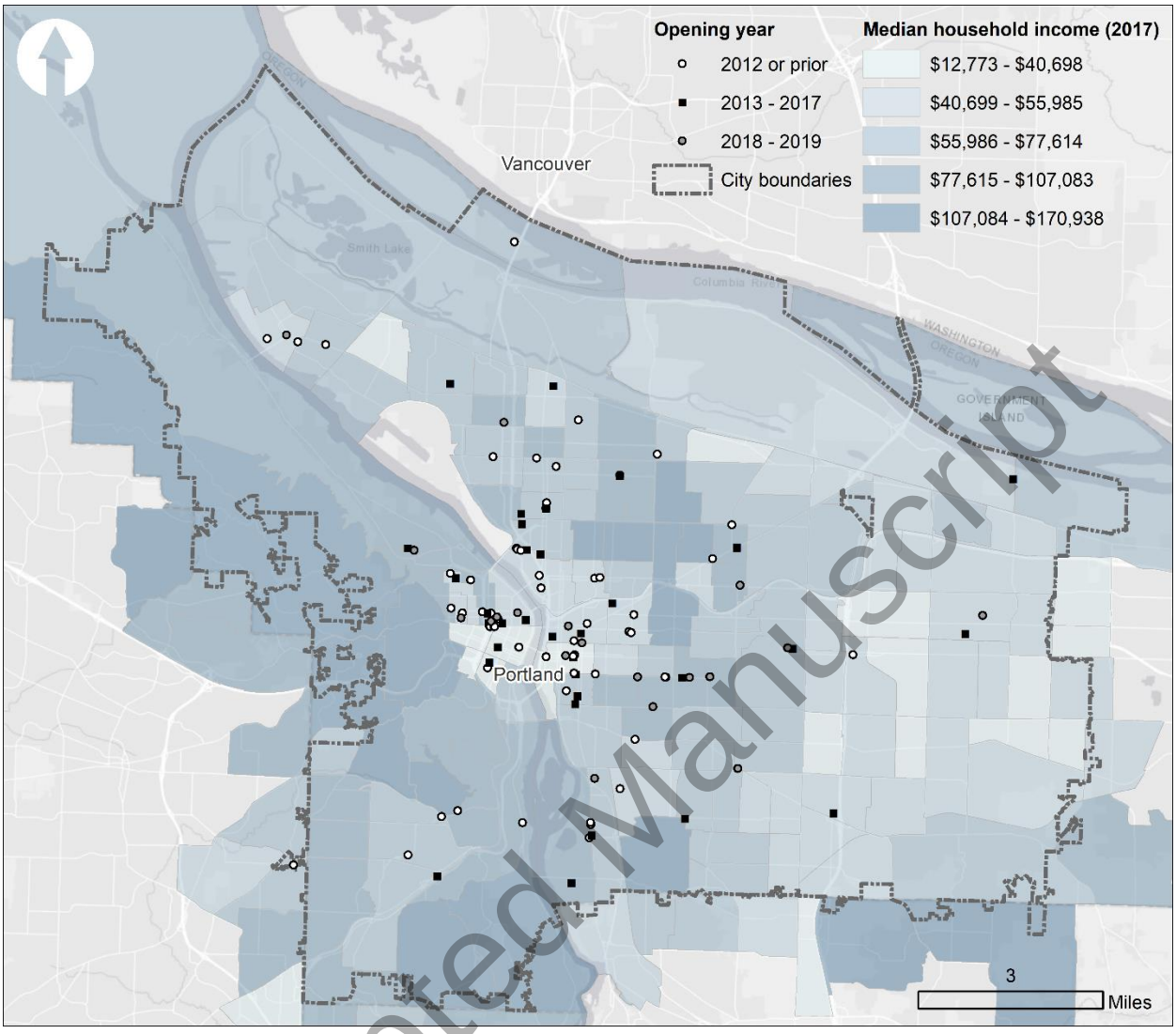

Figure 1. Portland craft breweries

As for crime in Portland, there has been an overall increase in calls for service to the Portland Police Bureau, from around 0.25 service calls per person to close to 0.3 calls per person between 2012 to 2018. As seen in Figure 2, the overall increase in calls can mainly be attributed to an increase in service calls related to disorder as the calls for service related to crime has stayed relatively flat throughout the time period.

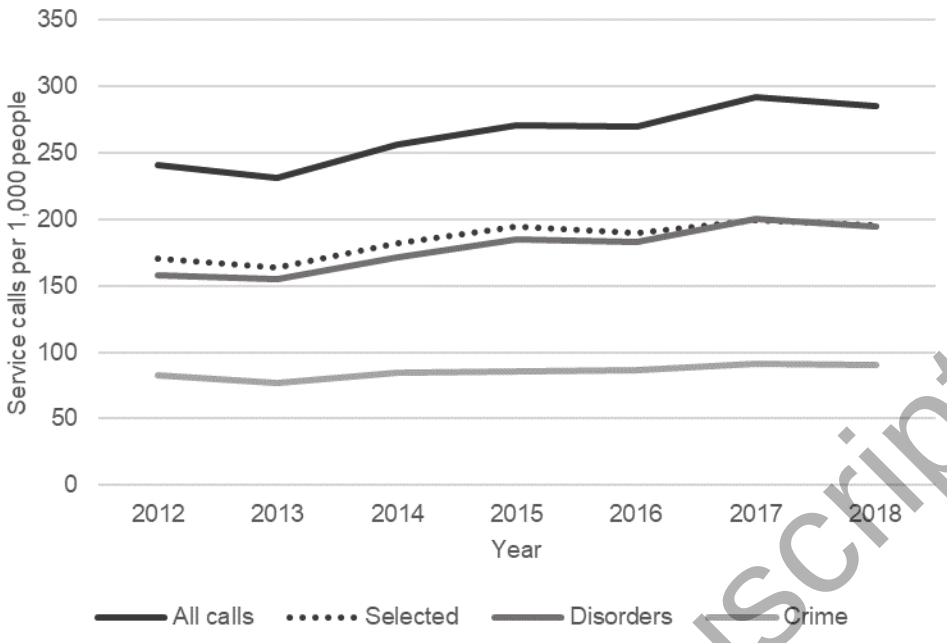

Figure 2. Service calls per capita for Portland 2012-2018

Figure 3 shows the distribution of calls for service in 2018 divided by the estimated census tract population in 2017. Higher call rates are found in and around the downtown area, including neighborhoods on the east side of the river, where many of the city's craft breweries are located. Comparing the patterns of crime in Figure 3 with the distribution of median household income in Figure 1, we find somewhat of a negative relationship where higher income areas tend to have lower crime rates and vice versa. Hence it is important that we control for neighborhood characteristics in our quantification of the relationship between craft breweries and crime.

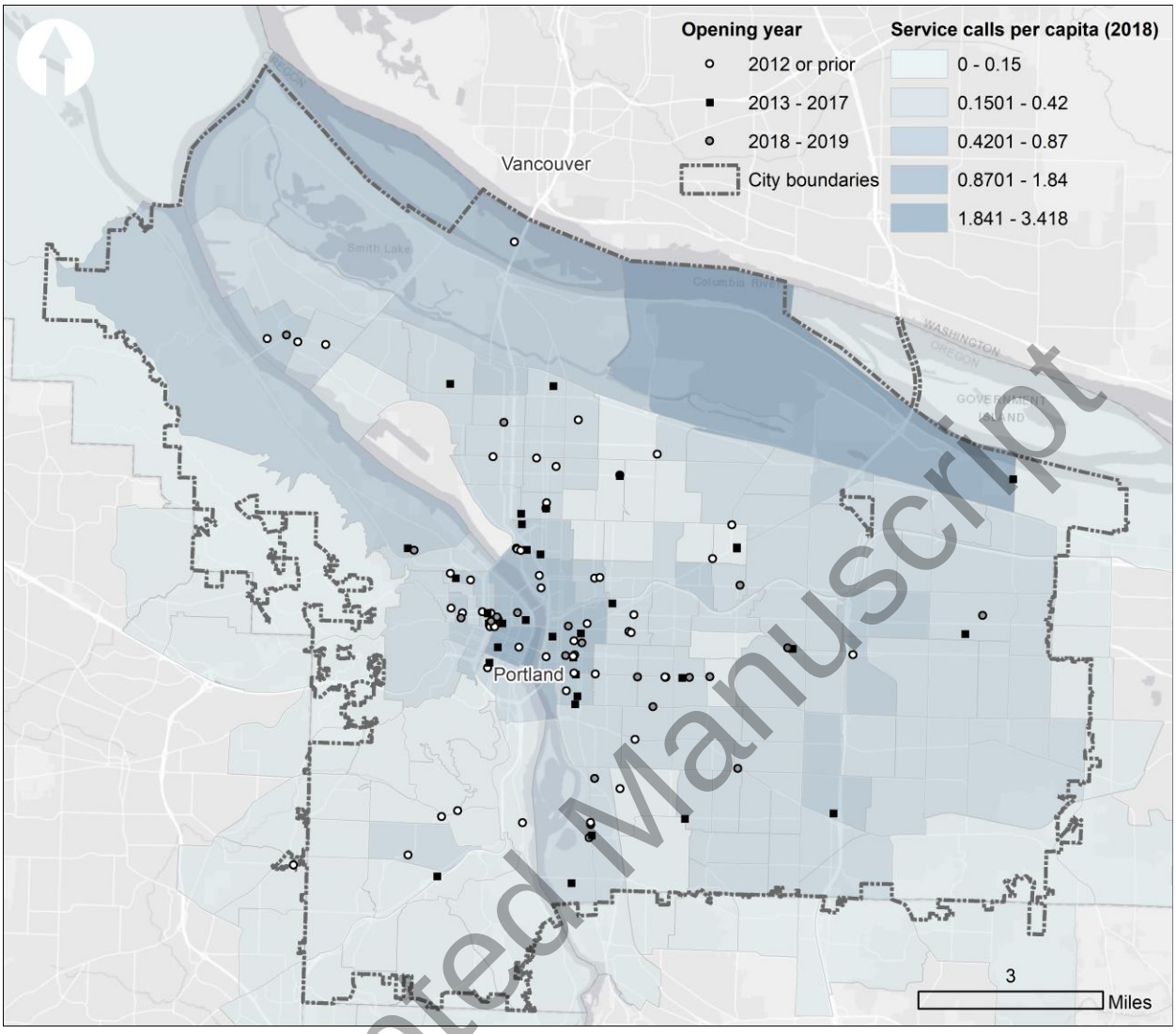

Figure 3. Spatial distribution of service calls per capita in 2018

4. RESULTS

Table 2 shows the mean and standard deviation of brewery specific attributes and characteristics of the neighborhoods that they are located in for the years 2012 and 2017. While we use data for all years available in the regression analysis, the descriptive statistics highlight some changes over the time period, which can be compared to the city of Portland characteristics presented in Table 1. Population in the brewery neighborhoods has grown at a higher rate (12.2% on average) compared to the citywide average (7.6%) between 2012 and 2017. Similarly, the median household income has increased at a slightly higher

rate and was as of 2017 just above the city median household income (see Table 1). These neighborhoods also have a relatively higher share of college-educated residents. As the rest of Portland, these neighborhoods are majority white and have remained this way throughout the study period.

Table 2. Descriptive statistics for 2012 and 2017

Mean (sd)	2012	2017
All service calls	1.86 (5.12)	2.33 (9.31)
Selected service calls	1.61 (4.60)	1.94 (8.16)
Liquor license (1 if yes)	0.47 (0.50)	0.47 (0.50)
Breweries within 1-mile	6.19 (4.76)	8.83 (7.04)
Distance to CBD (miles)	2.66 (2.00)	2.66 (2.00)
Population	3,643 (1,816)	4,086 (2,028)
Median household income ($1,000)	50.30 (20.95)	64.02 (23.83)
Bachelor's degree or higher (%)	52.34 (15.62)	56.89 (15.06)
Millennials (%)	44.21 (10.15)	44.82 (11.29)
Households with children (%)	17.04 (10.23)	16.44 (11.33)
White population (%)	81.02 (10.78)	81.05 (6.76)
Commercial zone (1 if yes)	0.28 (0.45)	0.28 (0.45)
Industrial zone (1 if yes)	0.25 (0.44)	0.25 (0.44)
Employment zone (1 if yes)	0.31 (0.46)	0.31 (0.46)
Residential zone (1 if yes)	0.14 (0.35)	0.14 (0.35)
Open space zone (1 if yes)	0.03 (0.16)	0.03 (0.16)
N	36	36

As for the breweries themselves, about half of them (47%) have liquor licenses.[2] As the industry has grown, more clustering has occurred hence we see an increase in the number of other breweries within 1-

[2] For currently operating breweries, we used data from the Oregon Liquor Control Commission to determine whether a brewery had a liquor license or not. For those that closed before the end of the study period, we used

mile of any given brewery between 2012 and 2017 (although the variation in how many nearby breweries the average brewery has in each time period is rather large as evident by the rather large standard deviation in each year). While the zoning data obtained from the City of Portland is annual and covers the entire study period, almost no brewery experienced rezoning during the study period. For the few that experienced change in zoning codes, changes were minor (e.g., from one type of industrial zone class to another industrial zone class) and hence did not change the broader zoning code group it belonged to. The majority of breweries are can be found in commercial or industrial zoning districts. About one-fourth are located in single family or multi-dwelling residential zones. Crime, or more specifically calls for service to the Portland police, both overall (all service calls) and with regards to crime and disorder more likely associated with the breweries themselves (selected calls) has increased between 2012 and 2017.

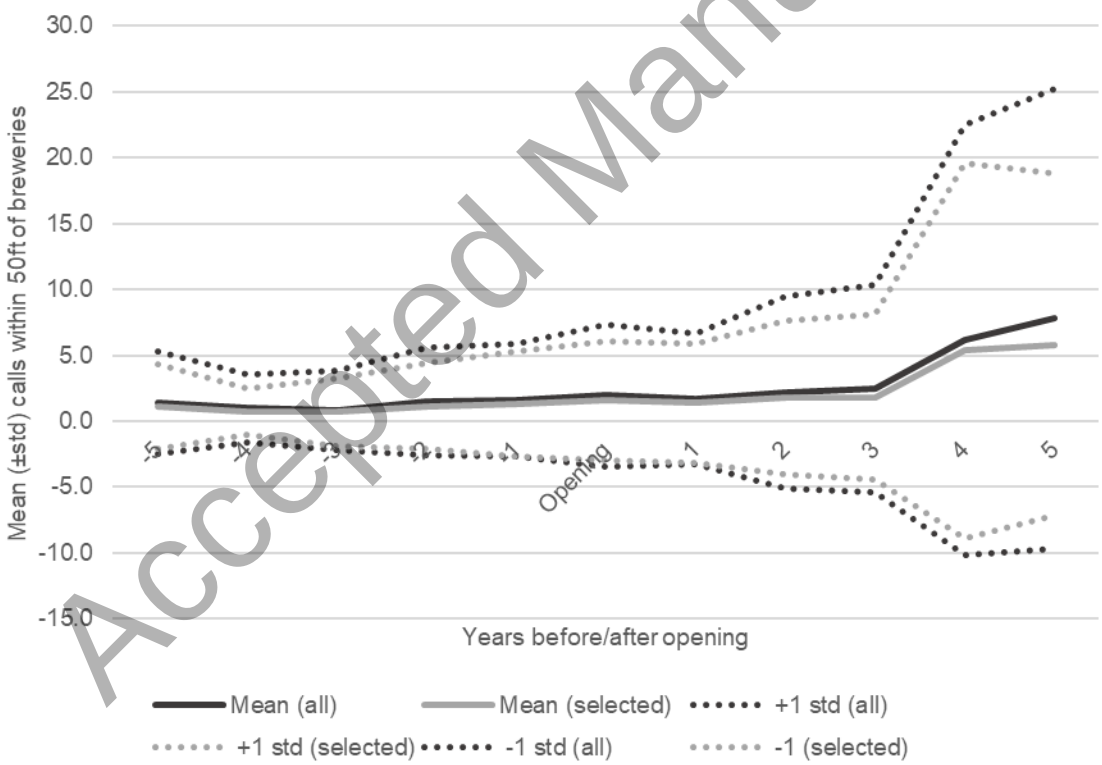

Figure 4. Mean number service calls within 50 feet of breweries (±1 standard deviation).

websites such as Yelp and news articles to determine whether hard liquor was being sold during the time of operation.

Figure 4 shows the mean number of service calls within 50 feet of breweries included in the study, in the years before and after opening. There is no noteworthy increase immediately after opening. We do however see an increase after three years of being opened. This can at least partially be explained by the rather large share of breweries opening up in 2014 and 2015 (19 out of 36) and hence year four would occur in 2017 and 2018, respectively which is when we not only see an increase in crime around breweries but also citywide as depicted in Figure 5.

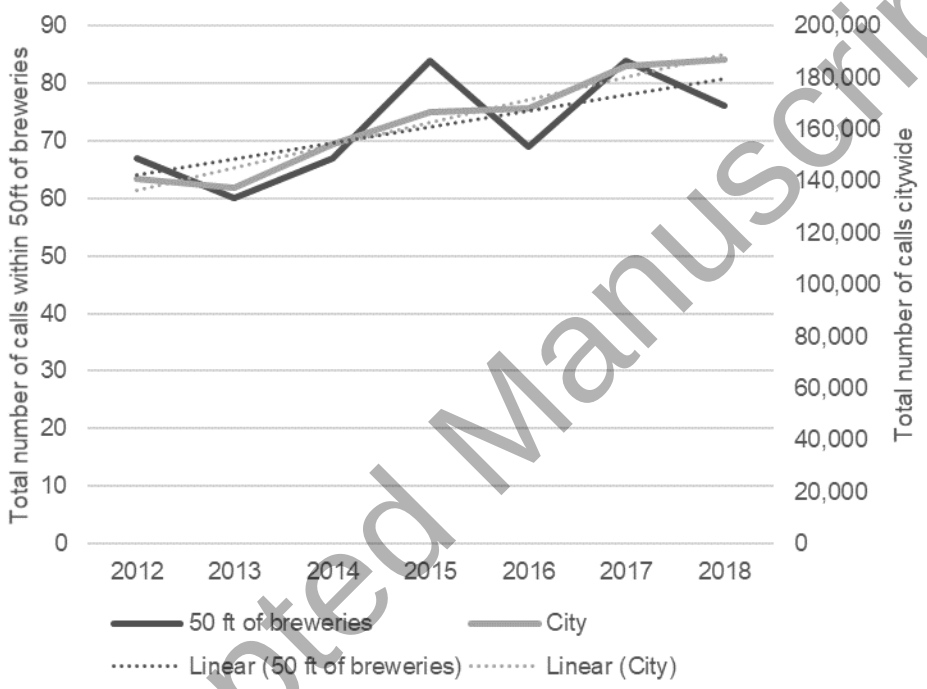

Figure 5. Total number service calls within 50 feet of breweries vs. citywide.

Figure 5 shows the total number of service calls around breweries (shown on the left y-axis) and citywide (right y-axis). Fitting a linear trendline through each show that the rate of increase in service calls has been relatively lower in the brewery locations compared to citywide. This is reflected in the regression results. Table 3 shows the results from estimating the model outlined in Equation (1) with selected service calls most likely related to the brewery within 50 feet of a brewery location as the dependent variable with (column 2) and without neighborhood fixed effects (column 1) as well without brewery specific attributes

(column 3).[3] The control variable for citywide service calls suggests in both specifications that higher call volumes at the city level is associated with relatively lower call volumes around craft breweries. However, when neighborhood fixed effects are accounted for (models estimated in column 2 and 3), the coefficient for city-wide call levels is not statistically significant. As for the variable of interest, the post brewery opening dummy is not statistically significant after controlling for neighborhood characteristics in the previous time period, the increase in citywide service calls, brewery specific characteristics, and year-neighborhood fixed effects. Hence the increase observed is Figure 4 cannot be attributed to brewery opening.

Table 3. Estimation results

	(1) Without neighborhood fixed effects	(2) With neighborhood FEs	(3) Without brewery specific attributes
Post-opening of brewery	1.1130 (0.9529)	-0.1642 (0.5958)	-0.2183 (0.5927)
Liquor license	-2.0136*** (0.6844)	0.4602 (0.8012)	
Breweries within 1-mile *t*	0.7707*** (0.1263)	0.2067 (0.1672)	
Distance to CBD	0.9877** (0.4231)	10.2447*** (2.5711)	8.9329*** (2.1677)
Population *t*	0.0012*** (0.0002)	0.0017 (0.0010)	0.0020** (0.0010)
Median household income ($1,000) *t-1*	-0.0161 (0.0260)	0.0660 (0.0424)	0.0689 (0.0424)
Bachelor's degree or higher *t-1* (%)	0.0554 (0.0477)	-0.0113 (0.0702)	-0.0057 (0.0701)
Millennials *t-1* (%)	-0.0996** (0.0490)	-0.2068** (0.0809)	-0.2114*** (0.0807)

[3] The reason for estimating the model in column 3 is because the brewery specific characteristics are undefined in the period before the brewery opens. It also appears to be some multicollinearity present between the brewery specific characteristics and population in the neighborhood within which the brewery is located. We also estimated the model in column 2 with all types of calls for service within 50 feet of a brewery location as the dependent variable. The results are qualitatively very similar to the ones presented here and available upon request from the corresponding author.

Households with children *t-1* (%)	0.0825 (0.0750)	-0.0092 (0.0893)	-0.0177 (0.0890)
White population *t-1* (%)	0.0235 (0.0470)	0.1105* (0.0632)	0.1040 (0.0629)
Industrial zone *t*	-0.1499 (1.2835)	-18.5717*** (1.4762)	-18.3282*** (1.2962)
Employment zone *t*	-2.1346** (1.0420)	-16.8228*** (1.3742)	-16.6025*** (1.2192)
Residential zone *t*	-3.0870*** (1.1320)	-16.5293*** (2.0500)	-15.7071*** (1.3535)
Open space zone *t*	-2.5882 (2.3103)	-15.0504*** (1.9263)	-15.1142*** (1.6889)
City wide call volumes *t*	-0.0001** (0.0000)	-0.0001 (0.0000)	-0.0001 (0.0000)
Year fixed effects	Yes	Yes	Yes
Neighborhood fixed effects	No	Yes	Yes
N (brewery-year)	216	216	216
Adjusted R^2	0.35	0.81	0.81

Statistically significant at the *** 1 %, ** 5% or * 10% significance level according to *t*-test.

While the models without neighborhood fixed effects show that breweries in clusters with other breweries experience higher crime rates as indicated by the positive and significant coefficient of the variable measuring the number of other breweries within a one-mile radius of brewery *i*, this does not hold true when neighborhood unobservables are accounted for. The results from model 3 which accounts for these observables differ from others that have found a positive relationship between the density of on-site alcohol establishments and crime (e.g., Campbell et al. (2009), Toomey et al. (2012) and Zhang et al. (2015)). Similarly, we would expected that the number of people living in the neighborhood where the brewery is located is positively related to crime with more calls being made by concerned residents in more residential areas. While the models without neighborhood fixed effects picks up such a tendency (column 1) as well as the one without brewery specific attributes (column 3), these are insignificant after controlling for neighborhood unobservables and brewery specific characteristics. We also control for

zoning of the area within which the brewery is located, using commercial zones as the reference group (the most common zoning code for Portland craft breweries after employment districts). Breweries located in more mixed use, residential areas, industrial, open space, or employment districts, experience relatively less calls compared to those in commercial zones.[4] These results are in line with Twinam's (2017) findings regarding the association between crime and land-use where commercial areas were associated with higher crime volumes compared to mixed-use, residential areas.

The liquor license indicator is negative and significant in the model without neighborhood fixed effects (column 1), suggesting that breweries that also serve hard liquor such as cocktails have lower call rates associated with them. While one might argue that serving stronger alcoholic drinks could lead to more intoxicated customers, these types of brewery establishments usually also serve food and are hence more like a restaurant in character than breweries that only serve beer in their taprooms. However, once we control for neighborhood unobservables (column 2), the significance vanishes, suggesting that there is something unobserved at the neighborhood level that might be driving such results. That the population variable becomes significant after removing brewery specific variables from the equation supports these suspicions. We estimated the model in the second column with an indicator for brewpub instead of liquor license. The estimated coefficient for the brewpub variable was -0.3710 but still not statistically significant, the estimated coefficients of the remaining variables remained qualitatively the same in terms of sign and magnitude. However, we decided to include the model with the liquor license to proxy for a restaurant style type brewery due to model fit and selection statistics such as R^2 and AIC which again were very close, but slightly in favor of the models presented in Table 3.

Finally, as for neighborhood characteristics, the higher share of the neighborhood population is in the Millennial cohort, an age group that has been often associated with neighborhood revitalization and potential gentrification, the less service calls made around breweries. This relationship is consistently significant across all three models. The full model specification which includes neighborhood fixed

[4] Only one craft brewery is located in an "Open Space" zoning district throughout the study period.

effects (column 3), also show weak evidence of a positive and significant relationship between the share of white residents and crime levels. The remaining variables are not statistically significant.

5. CONCLUDING REMARKS

This article examines the relationship between brewery openings and a potential negative externality associated with the opening of craft breweries, namely changes in crime prevalence around brewery locations. Hypothetically, craft breweries could either contribute to decreased or increased crime in and around the areas where they open through attracting more foot traffic and increased development. However, it is likely context specific. Formerly distressed post-industrial areas which used to experience little activity could see either a decrease in crime (broken windows theory) or an increase in crime (where more people and development are, the more crime and reporting of crime is likely to occur). In already established entertainment districts, intensified activity could lead to more reporting of crime. However, depending on what kind of establishment a craft brewery is replacing, a reduction in crime may be observed since craft beer is a product that attracts a certain type of clientele (higher income and more educated).

We find no significant evidence of either an increase or reduction in crime around brewery locations after opening of the brewery. However, we do find that land-use in the area where breweries are located plays an important role. Breweries in residential, industrial, or employment zones experience relatively lower crime volumes compared to those in commercial areas. Few of the socioeconomic and demographic characteristics of the neighborhood are significant in explaining crime volumes around the breweries. The share of the population in the Millennial cohort has a decreasing effect on crime. One reason for this might be that this cohort of residents has often been associated with inner city revitalization. Millennials have also been a driver of the craft brewery revolution that has taken place in the last couple of decades, both as brewery owners and as an important customer segment.

There are however limitations associated with this study. We investigate a relatively short time period (seven years). A longer time period and hence a larger number of observations could yield more significant results by yielding more power to detect small effects on crime. These results are also based on a case study of a city which has experienced significant growth in the past few decades and with a large craft brewery scene compared to many other cities. With that growth, the city has also seen a lot of its neighborhoods changing, particularly those where its craft brewing industry is located (such as the Pearl District and the central eastside industrial district). While we use temporal lags to control for potential endogeneity between crime volumes and changes in neighborhood characteristics as well as neighborhood fixed effects, there is a strong endogenous relationship between the two where the direction of the effect is ambiguous as discussed in recent literature (see for example Autor et al. 2017 for a recent review).

Suggestions for future research therefore include longer time periods and/or a larger sample of cities which would involve overcoming the issue of finding high quality police calls for service data which is one of the reasons we limited this study to focus on a city for which we could obtain such data. Finding suitable instruments for neighborhood change in order to avoid potential endogeneity is another fruitful avenue for future research not only as it relates to craft breweries potential effect on crime (and neighborhood change) but also to better assess the relationship between crime and neighborhood change in general.

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