Soundscape Policy: Noise Pollution as an Issue in Oregon Municipalities

by

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Abstract

Noise is an environmental issue uniquely harmful to public welfare but essential to a well-functioning modern economy. Given the prevalence of noise especially in urban soundscapes, noise pollution has been recognized as a negative externality and an environmental stressor and thus has become an issue in public policy. Yet, as there is no leadership or uniformity of regulatory standards for noise pollution on a national level in the United States, much of the regulatory burden has fallen to municipalities which have fewer resources but a relatively wide latitude to craft their own noise policies. This study samples Oregon municipalities to assess the demographic, economic, and political characteristics of municipalities which influence municipal response to noise pollution. Logistic regression modeling shows that the likelihood of Oregon cities’ having a high response to noise pollution is most strongly determined by per capita city government expenditures, with population density and labor composition also proving to be influential. Finally, a case study on the City of Portland reveals the experience of a city with a detailed and balanced regulatory scheme including a noise ordinance, a process to collect citizen noise complaints, and variance process to permit otherwise unlawful (but economically beneficial) noise. Yet, Portland’s relatively ambitious noise control policy provides notable exemption for several loud construction tools including pile drivers, and after a years-long public debate over a proposal to remove the pile driving exemption, it was upheld after the city made only modest changes to its construction noise policy.
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I. **Introduction:**

Human beings have a complex relationship with sound. We call unwanted and unpleasant sounds *noise*, a word derived from the Latin *nausea* (Bronzaft 2017). Though sound is ubiquitous, the ear has long been neglected by modern societies in favor of the eye (McLuhan 1962; Postman 1985). This is unfortunate, given that analysis of the acoustic environment may reveal insights to the socio-historical conditions, even the ethos, of the societies which produce that environment (Schafer 1994; Fong 2016). Additionally, noise pollution is a common target of laws and regulations, although laws towards noise pollution have been fairly slow to develop historically (Gillespie 2009; McLaren 1983). It is useful to note the reflection of economic priorities inherent in the decision of whether to regulate noise pollution and officially deem it a nuisance, especially when noise generation is related to the productive exploitation of land and resources (Shapiro 1992; McLaren 1983; Hawkins 2012).

This paper seeks to contribute to the *soundscape* literature, a theoretical framework developed by Murray Schafer which attempts to describe and classify the social effects of sounds, by treating noise pollution as an issue in public policy which has considerable economic consequences (Schafer 1994; Coase 1960; Quah and Chun 1992). Despite being a low salience issue, social and legal norms towards noise pollution reflect a balancing of competing societal interests when one considers that *there are both benefits of noise generation and external costs created which impose a negative toll on its consumer*. Noise regulation alters these benefits and costs, but it can also move society away from the optimal level of noise production (Coase 1960). Efficient and fair regulation of the soundscape is thus very difficult to achieve, especially given the intangible nature of sound itself and what Coase calls “the reciprocal nature of the problem:” the economic problem of causing undue harm towards the producers of noise by avoiding harm to the victim(s) of noise pollution (Schafer 1994; Coase 1960: 838).

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The purpose of this study is to assess the state of noise pollution as a public policy issue in light of the economic priorities relevant to it. It will use both quantitative and qualitative data collected on cities in Oregon in order to pursue answers to the following questions: How common is it for cities to have noise ordinances? Which factors influence the likelihood of a city having a higher policy response to noise pollution? What does a municipal program set up to regulate the soundscape (and reduce noise pollution) look like in practice, given the economic problems involved in regulating noise pollution?

II. Literature Review
   i. The Economics of the Soundscape: Noise as a “Good” and as a “Bad”

   The soundscape was originally developed as a positivist, typological framework for understanding the relationship between humans and their sonic environment which combines technical tools of acoustic science with the concerns of the humanities and the social sciences (Schafer 1994; Truax and Barrett 2011). In its simplest form, the soundscape consists of “earwitness accounts” of “events heard, not objects seen” (Schafer 1994: 8). He identifies common sounds as keynote sounds (ubiquitous background sounds, unconsciously listened to, which comprise the fundamental tones of society), signal sounds (foreground sounds, listened to consciously, which often convey some sort of warning, such as a police siren), and soundmarks (a unique community sound which possesses special qualities, such as a church bell) (Schafer 1994: 9-10, 271-275). By thinking of sound this way, we can begin to glean the insight necessary to evaluate the costs and benefits of individual sounds, and also to note the subjective accommodation of noise (Fong 2016). For instance, Schafer identifies the internal combustion engine (specifically the automobile) as being the keynote sound of modern life, yet one could argue that that the widespread use of the automobile has been a net positive for society, despite the ubiquity of annoying traffic noise.

   Schafer’s work on the soundscape is rich with historical description of sound and the social meaning of humanity’s auditory experience (Fong 2016). As human societies made the centuries
long transition from the pasture to the town, and then from the town to the city, so did the soundscape undergo near total transformation. Schafer (1994: 43) convincingly describes this shift as one which began in a rural, hi-fi soundscape, where ambient noise is generally very low and there is a favorable signal-to-noise ratio, which allows discrete sounds to be easily heard and identified. Western society has shifted to a largely urbanized lo-fi soundscape with an unfavorable signal-to-noise ratio, where a congestion of sounds leads to the inability of the listener to identify discrete sounds and a loss of acoustic perspective. This shift was driven by what Schafer identifies as two important socio-historical soundscape developments: The Industrial and Electronic Revolutions.2

These developments, of course, had immense economic impacts. The Industrial Revolution between 1770 and 1870 saw rapid technological innovations and welfare gains to the masses (Lucas 2002; McLaren 1983). Prior to its onset, the loudest sounds in human history were probably made by the blacksmith (Schafer 1994: 58; Russolo 1913). Yet, due to the relentless innovation and diffusion of machines and factory production, the Industrial Revolution wrought a complete transformation in the sounds of work and productivity, and of civilization more broadly. It became possible for factories to be in operation at all hours of the day and night, and modern cities quickly became hubs of economic and population growth (Schafer 1994: 58, 63, 71-77).

Though this soundscape shift was critically noted by some contemporary observers (including Dickens and Tocqueville), noise was not considered a serious problem in industrial hygiene or nuisance law until the Industrial Revolution was well underway (Schafer 1994; McLaren 1983).3 Historically, the needs of industry have almost totally dominated the social concerns of noise. In short, Schafer notes that “noise equals power,” and as capitalism is strongly attached to the pursuit

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2 What Schafer calls the “Electric Revolution” is a part of what is more commonly called “the Second Industrial Revolution”

3 Consider that the scientific ability to quantify the pressure generated by sound (decibels) was not developed until the 1920s
of wealth and material goods, “industry must grow, therefore its sounds must grow with it” (Schafer 1994: 77; Quah and Chun 1992). Left to their own devices, profit maximizing producers of noise may be ignorant of its external costs which harm the welfare of those nearby, or else they may be so powerful that they disregard protests against noise pollution and continue production as usual. A purely self-interested pursuit of noise generation likely will not lead to the socially optimal soundscape, assuming these external costs are non-trivial (Hardin 1968; Schafer 1994).

The Electronic Revolution was largely a continuation of these trends, and by the 1850s many of the most important electrical discoveries had been made (Schafer 1994). The real transformative impact which these discoveries had on the soundscape was that sounds could now be recorded and packaged, and therefore split the sound from its original context, which Schafer (1994: 88) calls schizophonia. While a full accounting of the social effects of the Electronic Revolution is beyond the scope of this paper, the economic consequences of electric innovations like the telephone, phonograph, radio, and television should be fairly obvious. These soundscape innovations have reduced global barriers to communication as well as transaction costs and have had profound effects on world culture (McLuhan 1962).

The soundscape today is the sum total of these technological developments. We can easily see that the production of noise is often economically beneficial, even if the noise itself is not particularly desirable (Gillespie 2009). Noise can be associated with many positive qualities in the individual at work: an industrious laborer who thrives in a hub of activity would be prized by nearly any employer. So, too, does noise generation have obvious benefits to economic efficiency to the firm, assuming its overall goal is profit maximization. Many industries which rely on one or more of our soundscape innovations would place such a high value on access to and use of the soundscape relative to the public’s valuation of it that regulation of these industries’ noise would likely generate
inefficiencies. Given these benefits of noise, we may simply prefer to let firms produce noise unabated, no matter the external cost (Theeuwes and Harrison 2008).

To some, it may be tempting to simply write off peace and quiet as the opportunity cost to modernity and economic progress (Dumyahn and Pijanowski 2011). However, to ignore the downside of noise generation would be to also ignore the inequities generated by noise pollution. Technological innovations which are also shifts in the soundscape create externalized social costs because of the way they transform the ability of individuals, firms and governments alike to access, use, and abuse the soundscape as a common resource and thus generate a nuisance (Dumyahn and Pijanowski 2011). These external costs can reduce both individual happiness and social welfare as a whole, yet they seem only rarely to be included in decisions about how much noise to produce (Quah and Chun 1992; Weinhold 2013; Shapiro 1992). But, since it is important here to establish the disutility of noise, this paper will review evidence of the social costs of noise pollution in three areas: housing markets, public health, and education.

Economists have often used difference-in-difference estimators to measure the costs of noise by comparing property values in noisy areas (particularly those affected by transportation noise) to those in quieter areas. Nelson (2004) conducted a meta-analysis of difference-in-difference studies of housing markets near 23 airports in the US and Canada and found there to be a significant noise discount: properties at 75-dBA were worth about 10-12% less than a similar property where sound levels were 55-dBA. This means a $200,000 house would sell for between $20,000 and $24,000 less if it were in the noisier area, a hedonic value of $1000-$1200 per decibel. Railroad noise is also problematic: residential areas in Memphis, TN with train noise above 65-dBA see a 14-18% drop in property values (although no negative effects accrue to commercial properties) (Walker 2016). Other

4 Interestingly, Canadian markets showed a stronger noise discount than American ones (i.e., they placed a higher value on quieter homes than Americans)
quasi-experimental studies point to evidence from newly changed soundscapes to measure changes in housing markets. After the governments of Malaysia and Singapore agreed to terminate the operations of an 80-year-old railway line in 2011, residential properties in the previously noise-affected areas saw a 13.7% increase in total value, with a 3.5% relative increase over properties in non-affected areas (Diao et al., 2016). A similar noise discount for rental apartments was found in Zurich. After a policy change altered the distribution of aircraft noise around the city in 2003, it took two years for a new market equilibrium to be reached as apartment rents in newly affected areas declined by an average of 1.7% per decibel increase (Almer et al., 2017). The market reveals that people place a high value on living in quieter areas and that soundscape shifts are correlated with changes in property value. Although the soundscape is only one factor in the deciding where to live, these findings are perhaps unsurprising.

Beyond mere annoyance, chronic noise exposure is a problematic public health issue that is associated with increased risk of cardiovascular disease, irreversible hearing loss, diabetes, and sleep disturbance, among other health issues (Hammer et al., 2018; Muzet 2007; Ising et al., 1990; Gillespie 2009). In 2013, it has been estimated that 104 million Americans had a 24-hour continuous exposure average which exceeded 70dBA (Hammer, et al. 2014). A sound level of 45dBA is enough to disturb sleep, and since humans’ auditory system is interestingly still activated during sleep, people can still experience a reaction to external stimuli like noise (Mozet 2007). The Federal Aviation Administration uses a 65dBA threshold as being “incompatible with residential use,” but one should note that this allows noise which is four times more powerful than the 45dBA required to disturb sleep (Walker 2016). The economic cost of noise’s correlation with cardiovascular disease is substantial, with a hypothetical 5dBA decrease being associated with $3.9 billion in annual healthcare savings and productivity gains in the US (Swinburn et al., 2016). Noise induced hearing loss is a leading occupational disease and the US, and the administrative costs of treating
occupational noise-induced hearing loss can also be considerable: one study using data from the Baltimore area in 2005 estimated it cost the US government $13,472 to treat afflicted sailors in the US Navy over the course of their lifetimes (Tufts, et al. 2010). This, of course, does not include the full economic costs of loss of hearing to the individual, whose future job prospects will likely suffer.

Finally, environmental noise exposure also negatively impacts thinking and learning (Woolner and Hall 2011). A classic early soundscape study was conducted in the 1970s which measured the effects which noisy trains had on educational outcomes in a New York City public school (Bronzaft and McCarthy 1975; Bronzaft 1981). The reading scores of second fourth, and sixth grade students, who attended class next to an elevated train track and suffered through train noise every four and a half minutes, were collected for three years. Teachers were often forced to shout, and actually stopped teaching for about 11% of class time. By the end of the study, these students’ reading scores had fallen a full eleven months behind other students at the school whose classrooms were unaffected by the train noise. Though subsequent studies on the impact of noise on elementary education tend to confirm the negative impacts of noise on education, there is a relative lack of scholarly work on the area on a national level in the US (Collins et al., 2019; Stewart and Bronzaft 2011).

We should be cautious with these findings, especially so when it comes to soundscape research in the United States. Because there is only a very weak research and monitoring system in place, we cannot honestly claim to know the true impact of noise pollution in the US (Truax and Barrett 2011; Hammer et al., 2014). For instance, the estimation of the noise affected populace in the US is extrapolated from the last official government estimate of noise pollution which was made back in 1981 (Hammer et al. 2014). It is also exceedingly difficult to evaluate precisely the external social costs of noise pollution given the subjective and shapeless nature of sound itself and the basic lack of data on the market forces which govern it. Sleep deprivation is estimated to cost $18 billion in
a year in the US, in terms of lost productivity, but it is almost impossible to know how much of it is due to noise (Keizer 2010). Even if one assumes that the lower rents charged for noise affected properties counts as partial compensation to residents for their exposure to noise, the full internalization of the social cost of noise pollution rarely occurs (Coase 1960; Brechet and Picard 2010; Weinhold 2013; Quah and Chun 1992). Yet, despite our lack of clarity on the magnitude of the negative effects, there is a strong case that noise pollution is a negative externality which can cause people to become sicker and less productive, an obvious problem given the economic importance of noise production (Hammer et al., 2018; Bronzaft 2017). Further equity concerns arise when one considers the unequal societal distribution of noise exposure, which may disproportionately affect the poor and racial minorities (Collins et al., 2019; Casey et al. 2017; Keizer 2010). What, then, is government in the US doing about the problem?

ii. Noise Control Policy in the United States

As far back as the Roman era one can point to official efforts to control noise as nighttime noise from chariots was identified as a nuisance (Keizer 2010; Gillespie 2009). Schafer (1994) points to examples of noise control legislation in the early modern period in England and Switzerland: street criers and musicians, as well as night watchmen, were common targets. Noise pollution gained attention as an environmental and regulatory policy issue in the United States during the 1960’s and 70’s, as did numerous other environmental problems (Kraft 2018; Salzman and Thompson 2019). This led to new laws like the Noise Control Act of 1972, which proclaimed “inadequately controlled noise presents a growing danger to the health and welfare of the Nation's population, particularly in urban areas,” and declared it “the policy of the United States to promote an environment for all Americans free from noise that jeopardizes their health or welfare” (Gillespie 2009: 189). The law authorized the EPA to develop a regulatory process to set noise emission standards and target specific goods like automobiles and construction equipment. New executive programs like the Office
of Noise Abatement and Control (ONAC), which was designed to educate the public about the problem and provide assistance to the states and cities in their efforts to create more locally based noise control programs, also showed the growing importance of noise on the national environmental policy agenda (Gillespie 2009; Bronzaft 1981).

Yet, as quickly as noise policy rose in importance, it faded away perhaps even more quickly. ONAC had its funding cut by the Reagan administration in 1981 and was abruptly eliminated, and the EPA has completely discontinued noise monitoring and abatement efforts since this time (Shapiro 1992, Bronzaft 2017; Gillespie 2009). The rationale offered by the Reagan administration for quashing the noise regulatory process was that the nature of problem, given its localized costs and benefits, means that it is an issue most efficiently regulated at the state and local level (Shapiro 1992). A more practical explanation is that the emission setting process became so ambitious as to generate widespread opposition both in industry and in politics (given the dominance of deregulatory conservative politics during that period), as the resistance of ONAC and EPA efforts to promulgate a rule related to garbage truck noise in 1979 showed. Shapiro (1992) claims that the rule, which was supposed to require garbage truck drivers to run their engines with less power while they compacted garbage, meant that garbage compacting would be quieter but take longer and cost more, and that this episode was largely responsible for the subsequent defeat of noise policy at the federal level. Though the Noise Control Act retains legal force, Congress acquiesced to the removal of noise from the regulatory agenda and, due to the weak political constituency which supports stricter noise regulation, it has never regained importance at the federal level despite numerous attempts to reintroduce noise legislation in Congress (Shapiro 1992; Hammer at al. 2018; Gillespie 2009).

Another important noise law of the era was the Quiet Communities Act of 1978 which strengthened the EPA’s regulatory authority on noise and expanded grants to aid state and local abatement programs. This too fell victim of Reagan-era environmental deregulation (Hammer et al., 2018)
Federal noise policy today effectively offers no leadership or information to aid noise abatement initiatives at any level of government and might be aptly called a policy failure (Shapiro 1992). Responsibility for noise control is dispersed throughout several different agencies, as the Department of Labor sets occupational noise standards, the Federal Aviation Administration sets aircraft noise standards, and so on (Gillespie 2009; Hammer et al. 2018). This means that when it sets acceptable noise standards, an agency is held accountable by an uninterested Congress, the skeletal remains of EPA and executive noise policy, and itself (Shapiro 1992). But the collapse of the issue at the federal level has also had a ripple effect as this has crippled state and local governments’ ability to tackle the issue. Since 1981, state and local noise abatement programs have declined in number due to lack of resources, and the programs which do exist lack the information benefits which federal regulation provides (Shapiro 1992; Bronzaft 2017; Hammer et al. 2018). The State of Oregon is one useful example of this trend: it also passed state noise control legislation, and the Department of Environmental Quality operated a Noise Control Program which was terminated in 1991 due to budgetary restrictions (Berger and Obteshka 1993). Though the state has not rescinded its legal standards when it comes to noise, it no longer investigates or attempts to mitigate noise pollution.

Regulatory responsibility has mostly fallen to the municipal level by default, although cities have even less resources to devote to noise control efforts than do the states. Since there apparently exists no other higher governing body in the United States willing to enforce a common standard, the leadership vacuum created the federal government has led to a lack of consistency municipal noise policies where standards can be quite different from one community to the next (Hammer et al., 2018; Shapiro 1992). Cities are mostly free to choose when it comes to their policy towards the soundscape, and many will not want to risk their economic prospects by increasing regulation of

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6 For more on the State of Oregon and noise pollution see: [https://www.oregon.gov/deq/Residential/Pages/noise.aspx](https://www.oregon.gov/deq/Residential/Pages/noise.aspx)
businesses for the sake of a more pleasant, yet strictly regulated sonic environment. Cities may see no need to seriously prioritize the issue of noise pollution, and policy will reflect that.

Consider the municipal noise ordinance of Waco, Texas: daytime noise restrictions are 85dBA, with nighttime restrictions at 80dBA. These seem almost comically high when one imagines the type of behavior which would be legal under this standard: cutting the grass with a gas powered lawn mower at 2:00 am would likely be acceptable. Additionally, there are actually more exceptions to this limit than actual noise sources controlled or banned. This could be interpreted as a positive thing especially if we assume that cities will have a variety of preferences when it comes to their soundscape, as cities can then use policy to attempt to create the type of soundscape they demand. But it may also lead to a type of prisoner’s dilemma if cities competitively lower noise standards in an effort to attract business and enable further abuse of the soundscape (Shapiro 1992; Dumyahn and Pijanowski 2011).

Setting aside land use policies like zoning (which are probably the most common policy tools cities have used to mitigate noise pollution), there are three types of regulatory schemes cities may use if they are seriously interested in combatting the problem of noise pollution (Shapiro 1992; Hammer et al 2018; Dumyahn and Pijanowski 2011). First, a market-based scheme which assigns property rights over the soundscape may allow for the compensation of the external cost borne by the consumer of noise (Coase 1960). Brechet and Picard (2010) imagine what a market for noise licenses might look like for the right to produce aircraft noise when we assign the rights over the airspace to local residents most affected by noise in order to let market forces determine the optimal allocation of flights. Most efforts to control noise in the US, however, have been of the command and control variety where officials determine the legally acceptable levels and types of noise and punish violators

(Dumyahn and Pijanowski 2011; Gillespie 2009; Shapiro 1992). Yet, public command and control schemes towards noise usually lack the information which efficient policymaking requires, as central planners cannot perfectly tell the impacts of new policies on industry nor can they easily identify the affected population, let alone establish the exact disutility of noise suffered by them (Brechet and Picard 2010; Dumyahn and Pijanowski 2011). Finally, some argue that more collaborative regulatory institutions, where users of the soundscape could in theory develop rules together, can be more effective over the long run (Ostrom 1990; Dumyahn and Pijanowski 2011).

Finally, cities themselves have little to no regulatory power over maybe the biggest policy issue related to the soundscape: transportation noise (Brechet and Picard 2010; Bronzaft 2017; Sobotta et al., 2007). Consider City of Burbank vs. Lockheed Air Terminal (1973), where the Supreme Court struck down a municipal ordinance passed by the City of Burbank, California which placed an injunction on overnight jet traffic. The court rightly saw that “the imposition of curfew ordinances on a nationwide basis would cause a serious loss of efficiency in the use of the navigable airspace.” It is a common feature of municipal noise ordinances to acknowledge that they cannot regulate sources of transportation noise including air, rail, and automobile traffic. One can easily see the logic of leaving control of airspace and other modes of transportation to the federal government, as the court did. But, if there is a city which seriously wants to tackle noise pollution, the fact that it is legally prevented from regulating the loudest and most common sources of noise does not bode well for its chances of developing effective policy and a satisfactory soundscape.

iii. Policy Tools at the Municipal Level

Although it can be rewarding to think of the soundscape in an abstract sense, as Schafer does with his rich allusions to music, art, religion, and aesthetics, this approach could hardly be expected

8 [https://www.law.cornell.edu/supremecourt/text/411/624](https://www.law.cornell.edu/supremecourt/text/411/624)
lead to efficient regulation of the soundscape in a world where a high value is placed on noise production and its costs are mostly ignored. Yet, policymakers and acoustic experts could certainly benefit from the creativity of Schafer’s approach, as well as from the work other soundscape researchers, to evaluate noises individually and determine which are necessary in an economic sense, because after all, “industry cannot go on without the production of some noise” (Hawkins 2012: 111; Truax and Barrett 2011). Policy tools can be created and employed at the municipal level, despite its jurisdictional and resource deficits, to target some of the more unpleasant aspects of noise, especially when it focuses on regulating its temporal and spatial contexts, as well as particularly offensive sources of noise (Schafer 1994). Some of these be the lowest hanging fruit, as specific sources of noise pollution can be effectively controlled at relatively low cost. To return to the example from New York City public schools, Bronzaft (1981) showed how the identification of railroad noise lead to the introduction of sound-muffling rubber pads on the track adjacent to the school: after this, student outcomes in the previously affected areas began to improve.

It seems dubious that any politician at the national level would see meaningful political gains from pursuing a noise control policy agenda. Yet, despite being a low salience issue nationally with minimal media coverage, it is a very real problem for many communities (Hammer et al 2018). If cities are both able to collect public complaints over noise in an organized fashion and design noise control policy which has protections against causing undue harm to the producers of economically beneficial noise, they may be able to minimize the external cost of noise without eliminating the gains from noise production. As a complaint driven issue, it is important that cities give clear paths of communication for citizens to give voice to local noise issues so that policymakers can have more complete information about the nature of the problem in their community (Hammer et al. 2018). This type of arrangement might minimize welfare loss to citizens as well as the potential for economic damage from overly ambitious noise laws which Coase (1960) warns of.
III. **Method**

The decline in state and local noise control programs was noted by the early 1990s (Shapiro 1992; Berger and Obteshka 1993). By gathering data on the issue in Oregon nearly forty years after noise pollution faded from the national political agenda, this study tests to see which cities’ noise control programs have survived these years and which cities have a less robust system in place. This study uses mixed methodology to assess the state of municipal noise policy in Oregon. This will provide a more general view of the issue based on various municipal characteristics and also allows for a closer look at how a particular city manages noise issues based upon a case study of the City of Portland.

In the quantitative section, a logistic regression model was used to assess the probability of Oregon cities having a noise control program in place. These results were compared to a linear probability estimator in order to better gauge the marginal effects of independent variables. Data on noise control policy was collected from official municipal websites of incorporated cities listed in the Oregon Municipal Recorder Association in order to create the binary dependent variable tested for in the logit model. Documents sourced from city websites pertaining to municipal ordinances, city council meetings, strategic plans, community livability reports/brochures, law enforcement and other city reports publicly available were analyzed to classify which cities have the following: a municipal noise ordinance, an executive process to receive citizen complaints, and a variance process for producers of noise. Cities which had these three characteristics were coded as a “1” for having a high policy response to noise control with all others as a “0”. Those with uninformative or nonexistent websites were dropped from the sample.

Municipal codes are typically linked through city websites to third party repositories which allow text queries to be made. Coding for noise ordinances was based upon a search protocol

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9 See the Oregon Association of Municipal Recorders: [https://www.oamr.org/](https://www.oamr.org/)
fashioned from the soundscape literature to identify relevant sections of the city codes. Noise control ordinances as either a standalone law or as part of a nuisance ordinance were coded for positively when they mention noise specifically. This is an important note because some nuisance codes will not explicitly mention noise, and additionally this study does not positively code zoning or building ordinances as noise control efforts, although these are quite common features of municipal law. Executive processes to collect complaints were also collected using a search protocol, and cities which display evidence of specific contact information to collect noise issues specifically were positively coded. Finally, noise variance processes were also coded for using the same sample of municipal webpages and ordinances, and exceptions to noise policy for emergencies were not counted as variance processes.

Independent variables tested for in this model describe these municipalities based on various administrative, demographic, political, and economic variables. Data on municipal spending comes from the League of Oregon Cities’ (LOC) Certified Annual Financial Report for FY 2018. Data on municipal airport spending also comes from LOC data and was used to make a dummy variable of cities which have airports. A population density variable was derived from population estimates from the LOC data with city land area estimates from the 2010 US Census. Political partisanship data at the municipal level are unavailable so county level voter registration data was used from the Oregon Secretary of State’s office. Finally, data on age, racial composition, household income, and labor market composition comes from the American Community Survey’s five-year estimates for each city for the year 2018.

A case study was done on the City of Portland, Oregon’s policy response to noise pollution. The city’s noise ordinance can be found in Title 18 of the Portland City Code, a relatively comprehensive law which details the city’s noise policy. This ordinance also gives authority to two

10 More details on the coding procedure can be found in Appendix B.
public bodies relevant to this discussion: The Noise Control Program, which enforces and develops community noise rules as well collects public noise complaints, and the Noise Review Board, a regularly occurring public noise variance forum. Documents collected from the City of Portland’s website (including its municipal archives) with respect to these two programs were sampled, including minutes, reports, briefings from Noise Task Force meetings held in 2015, and other organizational papers. These documents describe the programs’ inner workings and analysis of them can help describe the extent of the city’s response to noise pollution including their weighing of potential economic damage inflicted by noise control policy.

IV. Results

i. Quantitative Modeling

Out of 241 incorporated municipalities in Oregon, this study samples the 174 with functioning websites and publicly available documents potentially pertinent to noise control policy. Of these, 164 cities have noise ordinances and only 10 do not. Yet, only 45 out of 174 cities sampled were coded as having a high policy response to noise control. The statistics in Table 1 describe this sample and reflect some of the bias involved in selecting cities based on available web data. Cities not included in this sample are typically less densely populated, have lower household incomes and per capita government spending levels, and are located in more conservative areas than the cities which comprise the sample. These cities’ inclusion in this model would make for a robust sample, but nevertheless the cities included in this sample show enough variety to allow us to make reasonable inferences about Oregon communities’ noise control policy.

11 A complete list of these documents can be found in Appendix A.
To estimate which factors increase the likelihood of a city having a high policy response to noise pollution, the following logistic regression model was used:

\[ P(Y = 1 | X_1, X_2, \ldots X_{11}) = F(B_0 + B_1pd_i + B_2hhinc_i + B_3cgexp_i + B_4repub_i + B_5plptm_i + B_6plc_i + B_7plmanu_i + B_8pltwu_i + B_9airport_i + B_{10}age_i + B_{11}nonwhite_i) \]

where \( Y=1 \) is when a city has the three noise policy elements (a noise ordinance, a process to collect citizen complaints, and a noise variance procedure) identified above. The main variables of interest are \( pd \) (population density), \( cgexp \) (city government fund expenditures per capita), \( hhinc \) (median household income), and \( repub \) (the percentage of county level voters who are republican). City labor
market composition variables which may also be useful to understand municipal soundscapes are
plptm (percentage of labor in production, transportation, and moving), plc (the percentage of labor in
construction), plmanu (the percentage of labor in manufacturing), and pltwu (the percentage of labor
in transportation, warehousing, and utilities). Finally, airport is the dummy variable for whether a
city has an airport, age is that city’s median age, and nonwhite is the percentage of the city’s
population identified as nonwhite. The linear model based on this specification is transformed into a
logistic regression model, and as the log odds coefficients from the logistic regression model are only
useful for interpretation in a general sense, the results will be interpreted in the text in terms of their
marginal effect (i.e., the marginal dy/dx impact) on the likelihood of high response probability, with
a standard deviation increase used to compare magnitude. 12

Table 2 shows the results of the logistic regression modeling with comparison to the results
of a linear probability estimator. The first model uses a logistic estimator to assess the impact of
population density on the probability of Oregon cities having all three noise policy components
mentioned above (or, a city having “a high response” to the issue). One would expect that given the
association between noise and urban environments that the more densely populated a city is the more
likely noise pollution is to become a public nuisance and thus the more likely that a city
government’s would become active in using policy measures on the issue. The results from the first
model show that population density has a statistically significant and positive relationship with the
likelihood of a city having a high response to noise pollution, with a marginal effect of 0.76
percentage points and a standard deviation increase in population density yielding a 10.49 percentage
point likelihood increase.

12 A full accounting of the marginal impacts discussed in the text is available in Appendix C.
Table 2: Regression Results

<table>
<thead>
<tr>
<th></th>
<th>(1) Logit</th>
<th>(2) Logit2</th>
<th>(3) Logit3</th>
<th>(4) Logit4</th>
<th>(5) Logit5</th>
<th>Marginal dy/dx</th>
<th>Linear Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Density (hundreds)</td>
<td>0.0431***</td>
<td>0.0426***</td>
<td>0.0359**</td>
<td>0.0347**</td>
<td>0.0273</td>
<td>0.00415</td>
<td>0.00412</td>
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<tr>
<td>Mean H.H. Income (thousands $)</td>
<td>0.0122</td>
<td>0.0210</td>
<td>0.0220*</td>
<td>0.0202</td>
<td>0.00307</td>
<td>0.00413*</td>
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<tr>
<td>City Govt. Exp. P.C. (hundreds $)</td>
<td>0.139***</td>
<td>0.150***</td>
<td>0.137***</td>
<td>0.138***</td>
<td>0.02096***</td>
<td>0.0200***</td>
<td></td>
</tr>
<tr>
<td>Perc. Republican Voters</td>
<td>-0.0492</td>
<td>-0.0534</td>
<td>-0.0426</td>
<td>-0.0647</td>
<td>-0.00518</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P.L. Production, Transp., Moving</td>
<td>0.103*</td>
<td>0.0961*</td>
<td>0.0812</td>
<td>0.01235</td>
<td>0.0126</td>
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<td></td>
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<tr>
<td>P.L. Construction</td>
<td>-0.0633</td>
<td>-0.0830</td>
<td>-0.0734</td>
<td>-0.01116</td>
<td>-0.00754</td>
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<tr>
<td>P.L. Manufacturing</td>
<td>-0.0285</td>
<td>-0.0199</td>
<td>-0.0240</td>
<td>-0.00364</td>
<td>-0.00614</td>
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<tr>
<td>P.L. Transp., Ware., Utilities</td>
<td>-0.0787</td>
<td>-0.0595</td>
<td>-0.0364</td>
<td>-0.00554</td>
<td>-0.00325</td>
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<td>Airport</td>
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<td>Median Age</td>
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<td></td>
<td>0.00519</td>
<td>0.00078</td>
<td>0.00175</td>
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<tr>
<td>Perc. Population Nonwhite</td>
<td>0.0497</td>
<td>0.00755</td>
<td>0.00970</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Observations</td>
<td>174</td>
<td>164</td>
<td>163</td>
<td>163</td>
<td>162</td>
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<td></td>
</tr>
<tr>
<td>Chi2</td>
<td>11.5040</td>
<td>29.1425</td>
<td>36.0407</td>
<td>38.2685</td>
<td>40.2555</td>
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<tr>
<td>AIC</td>
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<td>171.5826</td>
<td>174.0407</td>
<td>173.8129</td>
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<tr>
<td>BIC</td>
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<td>201.8844</td>
<td>204.7504</td>
<td>212.2285</td>
<td></td>
<td></td>
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<tr>
<td>R2</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>0.2291</td>
<td></td>
</tr>
</tbody>
</table>

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(P.L.= “percentage of labor”)  (Exp.= “expenses”)
(H.H.= “household”)  (P.C.= “per capita”)
The second logistic model introduces mean household income (measured in thousands) and city government expenditures per capita (measured in hundreds). It is expected that both will have a positive effect of the likelihood of a city having a high policy response to noise pollution. Population density remains significantly positively correlated with the likelihood of a high response, with a marginal effect of 0.69 percentage points and a one standard deviation increase in population density yielding an increase of 9.5 percentage points. A marginal increase in mean household income raises the likelihood of a high policy response by 0.20 percentage points, with a one standard deviation increase in mean household income yielding an increase of 3.75 percentage points, although this variable is without statistical significance. Per capita city government expenditures show a strongly significant positive effect on high response likelihood, with a marginal effect of 2.27 percentage points and a one standard deviation increase in per capita city government expenditures yielding an increase in likelihood of 13.62 percentage points. This hints at a basic truth about municipal noise policy in Oregon that was anticipated by observers of noise policy decades ago (Shapiro 1992; Berger and Obteshka 1993), that the decline of federal leadership and technical assistance on the issue could mean that city governments would decline at least partly due to lack of financial resources. The strong correlation between municipal expenditures and the likelihood of a high policy response suggests cities which have more plentiful financial resources can afford to spend at least part of them in pursuit of solutions to noise issues, and smaller less fiscally capable cities will not have the means to prioritize noise policy.

The third logit model introduces county level political partisanship as well as the labor composition variables for (1) production, transportation, and material moving, (2) construction, (3) manufacturing, and (4) transportation, warehousing, and utilities. Population density and city government expenditures per capita retain statistical significance with a decline in magnitude. The

13 Full accounting of the marginal dy/dx impacts from each logit model are included in the Appendix.
percentage of Republican voters in a county shows a negative coefficient as predicted by theory (as by the history of actual conservative opposition to noise control at the federal level) but the effect is statistically insignificant. The occupational class which shows a statistical correlation with the dependent variable is production, transportation, and moving, with marginal impact on high response likelihood of 1.6 percentage points and a standard deviation increase raising this likelihood by 10.31 percentage points. All other occupational classes show an insignificant negative effect on the likelihood of a high policy response to noise pollution.

The fourth model includes a dummy variable for cities which have an airport, which does not have statistical significance but has a large positive effect on high policy response likelihood at 12.8 percentage points. It also shows that population density, city government expenditures per capita, the percentage of labor in production, transportation, and material moving, and now median household income have statistical significance, each with a positive effect on the likelihood of a city having a high response to noise pollution. Though this model might lack strong demographic controls, it shows stronger evidence that urbanization and government size have a lot to do with a city experiencing and paying official attention to noise pollution. Additionally, an occupational class involved in transportation noise, an area of economic life prolific in noise production, shows at least some correlation to a high response to the issue.

The fifth logistic model introduces demographic controls for median age and the percentage of a city’s population which is non-white which have been omitted thus far and is perhaps the most useful model in preventing omitted variable bias. While neither of these variables show statistical significance, the positive sign on percentage of non-white population is anticipated by the literature (Collins et al. 2018; Casey et al 2017). These controls reduce the marginal effects of each of the other

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14 No multicollinearity issues were detected in any of the models tested in this study. See Appendix D for pairwise correlation and variance inflation factor data.
variables beyond statistical significance except city government expenditures, which still shows a strong correlation with a city having a greater likelihood of a high policy response to noise pollution. This should instill greater confidence that municipal response to noise pollution is largely a function of the level of municipal financial resources.

Finally, the marginal impacts on probability of the fifth logistic model were compared against the same inputs in a linear probability model. A $100 increase in per capita city government expenditures correlates with an increase in the likelihood of a high policy response to noise pollution of 2.09 percentage points, and a standard deviation increase of about $600 in per capita city government expenditures shows a 12.57 percentage point increase. Other variables which showed statistical significance in previous models include the percentage of labor in production, transportation, and moving, where a one percentage point increase shows a 1.23 percentage point increase in the likelihood of a high response (and a one standard deviation increase raises this likelihood by 7.8 percentage points); population density, with a 100 person increase in density raising high response likelihood by 0.45 percentage points (and a one standard deviation increasing this likelihood of 6.14 percentage points); and mean household income, where an increase of $1000 of income yields an increase of 0.3 percentage points (with a one standard deviation increase raising likelihood by 5.75 percentage points). Finally, a city having an airport has a large marginal impact (11.6 percentage points) on the likelihood of a high response, although this relationship is statistically insignificant. Though the logistic model is preferred due to nonsensical predictions in the linear model, the marginal effects computed in the logistic model appear to be roughly equivalent to the coefficients in the linear probability model.

15 Marginal dy/dx impacts are multiplied here by 100 for probability to be read between 0 and 100.
16 Predicted probabilities in the linear regression model ranged from -.169 to 1.19, with 11 observations showing a probability less than 0 or greater than 1.
ii. **Case Study: The City of Portland**

a. **Title 18: Portland’s Noise Ordinance**

In order to properly contextualize a city’s noise ordinance, one should note the wide variety of municipal policy responses to noise pollution, as discussed above. Some cities show ambition in tackling the issue, and others show indifference. This is no different in Oregon, and certain cities are especially illustrative of this point. Culver has a nuisance code which outlaws common nuisances (like improper garbage dumping) but notes specifically that the city does not consider noise to be a nuisance.\(^\text{17}\) Chiloquin used to have a noise ordinance, later repealed it, and then an attempt to reintroduce a noise ordinance failed in its city council.\(^\text{18}\) Even among cities which do have a noise ordinance, an array of approaches and seriousness still exists. Falls City once had a lengthy noise ordinance which was revised in 2019 due to its “complex and lengthy nature” and the ordinance being “rendered unenforceable by lack of resources and changes in the regulatory environment.”\(^\text{19}\) The revisions cut sections of the law related to proper sound measuring techniques, thresholds with objective acceptable decibel levels to be enforced, and regulations towards specific sources of sound, but left in place numerous identifiable sources which remain exempt from regulation. Finally, Klamath Falls has perhaps the most ambiguous and unusually abrupt noise ordinance of any city in this sample which was coded for having a noise ordinance at a mere 24 words. The entire law reads: “No person shall create, assist in creating, permit, continue, or permit the continuance of any unreasonably loud, disturbing, or unnecessary noise in the City.”\(^\text{20}\) The brevity of this law likely renders it inconsequential.

\(^\text{17}\) Culver Municipal Code, Chapter 8.16
[https://www.codepublishing.com/OR/Culver/#/Culver08/Culver0816.html#8.16](https://www.codepublishing.com/OR/Culver/#/Culver08/Culver0816.html#8.16)
\(^\text{18}\) Chiloquin Code of Ordinances, Ordinance List and Disposition Table.
[https://library.municode.com/or/chiloquin/codes/code_of_ordinances?nodeId=ORLIDITA](https://library.municode.com/or/chiloquin/codes/code_of_ordinances?nodeId=ORLIDITA)
\(^\text{19}\) Falls City Ordinance No. 556-2019: [https://12b21bdc-acbd-f231-56d0-4449d83daafa.filesusr.com/ugde20cecb_a4a73a910b3b4b6ab07aa4a8c7e755c.pdf](https://12b21bdc-acbd-f231-56d0-4449d83daafa.filesusr.com/ugde20cecb_a4a73a910b3b4b6ab07aa4a8c7e755c.pdf)
\(^\text{20}\) Klamath Falls City Code: Chapter 5.318, “Unreasonable Noise.”
It is beyond doubt that Portland has the most comprehensive and ambitious policy response to noise pollution of any city in Oregon. Its noise ordinance is longer than 8600 words and describes city policy related to several dimensions of the issue. Given that Portland is Oregon’s largest city, its size and scale of government makes it an outlier for the state. Yet, analysis of the way the city responds to noise pollution might then be more generalizable to other major cities in the outside world, given how common it is for metropolitan areas to experience a noise polluted soundscape (Fong 2016; Adams et al. 2006; Lynch 2019). Portland may then be a useful and illustrative case for other major cities, and just as Portland officials appear to be cognizant of the noise policies in other major American cities like Seattle and New York, others can learn from its experience.21

Portland’s city archives show it has a long history of municipal involvement with noise issues. Its earliest attempt to regulate noise was made with an 1854 city ordinance which appears to associate noise with riotous behavior in an attempt to punish public indecency.22 Additionally, there are other examples specific sources of noise identified by citizen complaint, including an 1880 petition which sought city action to control the “immoral noise and disquietude” coming from a Chinese Theatre in the city, and another against Salvation Army marching bands apparently continuously playing loud music in city streets.23 There are numerous other examples in the archives about industrial and automobile noise which reflect the evolution of the modern urban soundscape as described by Schafer (1972). The city’s first relatively comprehensive noise ordinance, passed by the city council in 1960, notes the need for “immediate preservation of the public health, peace, and

“Nuisances-Petition Against Chinese Theatre.”09/01/1880 https://efiles.portlandoregon.gov/Record/12411718/
This document is useful to understand how the problem of noise generation (and its regulation) is often wrapped with political and social power (as Schafer (1972) and others (Lynch 2019; Hawkins 2012; Keizer 2010) have noted) given the anti-Chinese sentiment common in the US during that time.
safety of the City of Portland,” and even declares an emergency which necessitates such swift
action.24

The city noise ordinance in effect today, Title 18, was created in 1976 and is the result of
decades of amendment of city noise policy.25 It begins with a policy statement which contains
language reminiscent of the federal Noise Control Act and declares it the “intent of the City Council
to minimize the exposure of citizens to the potential negative physiological and psychological effects
of excessive noise and protect, promote and preserve the public health, safety and welfare.” It also
signals the city’s intention “to control the level of noise in a manner that promotes the use, value, and
enjoyment of property, (and) conduct of business.”26 This statement thus displays an official
awareness of the problems related to the themes of the literature cited above: that noise production
can have negative impacts on public health and livability yet can also have great economic
importance to the local business community, and that over ambitious noise regulations may harm
industry.

The law itself seems to incorporate themes and terminology from the soundscape literature. It
defines terms like ambient noise (“the all-encompassing noise associated with a given environment,
being usually a composite of sounds from many sources, near and far”) and impulse sounds (“a
single pressure peak or a single burst (multiple pressure peaks) for a duration of not more than one
second....”) that fit with Schafer’s (1973) understanding of the soundscape and of distinct sound
events.27 It also displays a scientific understanding of sound and the processes from acoustic
engineering which are consistent with the needs for accurate and quantifiable data in soundscape
regulation, beyond a simple qualitative approach to identifying and regulating noise (Schafer 1973;
Truax and Barret 2011). The law identifies both temporal and spatial contexts of sound. Permissible daytime sound levels in the city are significantly lower than the 65dBA threshold used by the FAA noted above, with residential areas at 55dBA between 7am and 10pm, and 50dBA otherwise.28 The code also demonstrates a sophisticated understanding of urban land use, with different standards for different zones, and includes an audibility standard which introduces the distance from the source of the noise as measured from the property line of the consumer of that noise as a standard of measurement.29

b. Portland’s Noise Control Institutions

Title 18 gives life to the city’s bureaucratic response to noise pollution, the Noise Control Program and the Noise Review Board.30 These institutions represent the city’s blending of the command-and-control and collaborative approaches to noise control (Dumyahn and Pijanowski 2011). The Noise Control Program is administratively housed in the City’s Office for Civic and Community Life and its purpose is to collect citizen noise complaints through a simple online form, issue noise variances, develop administrative rules, and enforce the city’s noise regulations by issuing citations. The Noise Control Program does not have authority to amend the city’s noise code but is an integral part of collecting important regulatory information and issuing it to the other city agencies and the city council, which has the final say over changes to the law.31 The program also plays an important role in education and community outreach about noise issues in Portland.

Within the Noise Control Program, the city employs an appointed official designated as the Noise Control Officer, which is highly unusual within the context of Oregon noise control laws given that no analogous position appears to exist in any other city in the state. Importantly, the Officer is a crucial source of advice for the rest of the city government, as this position is responsible for

28 Ibid, Ch. 18.10.010. “Land Use Zones.”
29 City of Portland Noise Task Force meeting, 9/10/2015
30 Portland City Code, Ch. 18.17.010; Ch. 18.18.010. “Authority for Enforcement.”
developing measurement protocols in the city and also leads noise research efforts in the city. Perhaps most telling as a sign of Portland’s unusually high policy response to noise pollution, though, is the fact that the position is responsible for enforcing Title 18 and citing offenders of the law, and ultimately has “full police power and authority” to do so.\textsuperscript{32} The Officer investigates citizen complaints and issues citations for noise violations in the city, the penalties for which can be quite steep. A maximum fine of $5000 can be issued for each citation, with each separate incident and each day of non-compliance with the law being potentially considered a separate citation, although these would be given to the most egregious repeat offenders.\textsuperscript{33} Citation data from FY 2014-15 show that Portland does regularly enforce these penalties: during this period 42 citations were issued with nearly $30,000 in fines, with the highest fine at $6000 at a noisy construction site.\textsuperscript{34} These totals came after the city collected 691 citizen complaints during the same period.\textsuperscript{35}

Though the Noise Control Officer has authority to issue variances to noise producers with relatively small impact, the formal variance process for lengthier and more impactful noise generation is conducted the Noise Review Board, a separate body from the Noise Control Program. The Board consists of five voting members: one acoustic professional, one from the construction industry, and three citizens at large.\textsuperscript{36} These positions are unpaid, as board members serve for a term of three years. All decisions made by the Board (including whether to issue variances) result from a simple majority vote, with the potential for an appeal to be made. Crucially, the Noise Control Officer is a nonvoting member of the Board but one whose experience, expertise, and collaboration with other stakeholders (including the City Council) is integral to the variance process. Variances are issued according to a fee schedule, as the cost is determined by the type and length of the project.

\textsuperscript{32} Portland City Code, Ch. 18.06.010, “Noise Control Officer.”
\textsuperscript{33} Ibid, Ch. 18.18.030, “Civil Penalties and Fees.”
\textsuperscript{34} City of Portland Noise Citation Form, https://www.portlandoregon.gov/civic/article/545382
\textsuperscript{35} Citations for FY 2014. https://www.portlandoregon.gov/civic/article/545381
\textsuperscript{36} Noise Complaints Opened, August 2014-August 2015, https://www.portlandoregon.gov/civic/article/545374
\textsuperscript{36} Portland City Code, Ch. 18.06.020, “Responsibility and Authority.”
City records show that during FY 2014-15, about 600 variances were issued in the city. In FY 2017-18, these variance fees account for about $275,000, or about half of funding for the city’s overall noise control efforts. The city has moved since then to increase reliance on variance fees for funding as part of its goal to implement a 100% cost recovery model.

Title 18 mandates that review of variance applications take into consideration six essential criterion. These include the physical characteristics and temporal dimensions of the sound, the location and population density of the affected area, whether the public’s welfare or safety is impacted, whether the sound source predates the receiver, the applicant’s previous history of compliance, and “whether compliance with the standard(s) or provision(s) from which the variance is sought would produce hardship without equal or greater benefit to the public.” Typically, the Board reviews applications during monthly public meetings related to large sound events like construction, public events like stock car races and concerts, and infrastructure projects including city public works projects which often need to work beyond the temporal regulations. It might be most apt to think of variances as an exchange between the noise producers, the city, and the public. In exchange for a strong set of regulatory conditions which the Board imposes (which usually include a higher noise threshold, specific dates/times of allowable noise, the limiting of certain noise sources at the project/event, and the assigning of responsibility to the noise producer to conduct public outreach and to collect and report citizen complaints to the Board), the noise producer is able to continue their business in ways that would otherwise be legally unacceptable. The Board reserves the right to review the variances, and to alter or revoke the variance if it deems that the noise producer has violated the terms of the agreement.

c. **Sources of Noise: Title 18’s Pile Driving Exemption**

Numerous specific sources of noise are identified and regulated by the law, including motor vehicles, racing events, home equipment and power tools, watercrafts, parking lot sweepers, animals, music, and sound producing and reproducing equipment (presumably a catch-all for stereo/amplifier devices). Interestingly, there is a separate section for leaf blowers, which sets temporal restrictions and a list of acceptable leaf blowers under 65 dBA.\(^40\) However, more interesting than a full accounting of these regulations is one source of noise identified in the law which is particularly emblematic of the economic dilemma inherent in municipal soundscape regulation: construction.

Title 18 sets an 85 dBA standard for construction equipment from 50 feet away, but crucially notes that “this standard shall not apply to trucks,...pile drivers, pavement breakers, scrapers, concrete saws, and rock drills.”\(^41\) Thus, the law permits a liberal daytime use of some of the most prolific noise producing construction equipment between the hours of 7 am and 6 pm on all days except Sundays and official holidays.\(^42\) This equipment, however, is of vital economic importance to transportation and housing and are used to build the literal foundations of urban life.

The city documents in this sample show abundant evidence that this construction equipment noise exemption is no accident but rather a carefully considered policy which resulted from several years of government, industry, and public discussion. Most of this process surrounded a proposal to strengthen city regulation of pile drivers, large construction rigs which hammer preformed foundational columns deeper into the ground than do other construction techniques.\(^43\) The proposal included amending the noise ordinance to remove the construction exemption for pile driving and having the Noise Review Board approve pile driving projects as they arise as part of its preexisting

\(^{40}\) Portland City Code, Ch. 18.10.035  
\(^{41}\) Ibid, Ch. 18.10.060. Use of the exempt construction equipment is, however, not exempt from temporal (i.e., overnight and weekend) restrictions  
\(^{42}\) The allowable pile driving time was reduced by this process, as mentioned below.  
\(^{43}\) City of Portland’s Noise Control Office: Pile Driving FAQ.  
[https://www.portlandoregon.gov/civic/article/709633]
variance procedure. The problem became so public that the city created a Noise Task Force which held six meetings between September and November to study and collect input on the issue, although public discussion on the issue continued after its conclusion. By 2018 the Noise Control Program released an official study documenting the nature of the problem, its importance to industry, and the city’s official deliberations after conducting 11 total public meetings with pile driving noise on the agenda and spending an estimated 400 total staff hours on the issue since the city began to receive public complaints on pile driving in 2014. During a period of high construction activity in Portland between 2014 and 2017, there were 17 total construction projects in the city using pile drivers. Three of these projects were in the city’s Pearl District, with one project alone accounting for 27 complaints after driving pile for an average of 3.5 hours daily for 22 days. Though the total number of pile driving projects may not seem high upon first glance, the noise forced upon Portland residents unfortunate enough to live near these projects is substantial: the city has measured pile drivers as high as 109 dBA from fifty feet, comparable to a sawmill or perhaps a rock concert (Schafer 1973).

The official response to the pile driving problem and the composition of Portland’s Noise Task Force reveals the balanced and inclusive approach the city takes in developing noise policy on the pile driving issue. A roster of the Task Force shows nine members: four from the public, four from the construction/development industry, and one from the city’s Noise Review Board. In addition to the command-and-control enforcement authority afforded to the Noise Control Officer noted above, the noise policymaking process is thus defined by a consensus-seeking, collaborative approach, as these meetings and others had numerous stakeholders present. City officials seem far more

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45 See: Pile Driving FAQ. The project which accrued the most complaints is referred to as the “Block 17” project. See: Noise Review Board Meeting. 3/9/16. [https://www.portlandoregon.gov/civic/article/573021](https://www.portlandoregon.gov/civic/article/573021)
46 City of Portland Noise Review Board Meeting. 4/01/2015. [https://www.portlandoregon.gov/civic/article/526661](https://www.portlandoregon.gov/civic/article/526661)
interested in collecting input during this public process than they do in imposing a unilateral solution to pile driving noise, a commendably diplomatic approach given the uncertainty involved in regulating noise (Brechet and Picard 2010; Dumyahn and Pijanowski 2011). They were also aware of their being caught in between competing interests, as one official noted that the board has been criticized for both moving too swiftly and too slowly.49

Over the course of the public meetings related to pile driving noise, noise control officials likely felt pressure to act as they took in public testimony from resident negatively impacted by pile driving noise. The input from these citizens sheds light on their sense of powerlessness and frustration. Some noted the proximity of their residences to pile driving projects (some as close as 50 feet away) rendered their apartments unlivable and made sleep nearly impossible.50 Interestingly, one speaker repeatedly introduced the idea that a monetary valuation could be placed on impacted residents’ time due to their no longer being able to enjoy their property, and that similar to the Coase’s understanding of negative externalities (1960), they might be compensated for the loss of enjoyment of their property if it is true that “time is money” as it is commonly held for industry.51 One citizen noted that a construction site near her home often began work early and finished late, outside of the city’s temporal restrictions.52 Finally, some questioned the wisdom of including construction industry representatives on the Noise Review Board and the city’s overall regulatory process in the first place, as they felt that the city gives the industry “special treatment” and shows “favoritism” to them.53

Even if these are largely subjective inputs, the city of Portland’s process to collect public complaints

can inform regulators about where noise pollution is occurring in the city more precisely and about the negative consequences which residents appear to be experiencing from noise.

This public process also gave industry representatives the chance to publicly comment on the proposed changes to pile driving. It is not surprising that industry seems opposed to steeper regulation from a philosophical standpoint, as one union representative noted that noise laws are “restrictive enough” as it is, but these were not the only objections brought forth. They also informed regulators about the necessity of pile driving from an engineering and geotechnical standpoint. While the conditions in many cities do not necessitate pile driving, Portland lies next to the Willamette River and has softer and more contaminated soil composition in many building sites, thus requiring a foundation to be set deeper than 100 feet below the earth’s surface for safety purposes. It was also made clear to the city that the state’s building code preempts local ordinances from altering the legal standards of engineering in projects like these. Industry representatives noted further that no viable alternatives to pile driving exist, and noise mitigation efforts at pile driving projects have proven to be unsafe and impractical. Finally, the changes in development costs the proposal would create were brought up repeatedly. Forcing the use of pile driving alternatives would make projects take longer, “cost us more,” “hamper development,” and further restrict the supply of housing in the city while making newly constructed buildings less safe. One developer said that, while it is difficult to generalize the change in cost given the wide variety of projects, one project which used a separate construction method cost about 10-15% more than it would have using a pile driver.

The end result of this process was not the removal of the pile driving exemption. Rather, after Noise Control Program stated in its 2018 Pile Driving Report that it explicitly “does not recommend

54 Noise Review Board Meeting, 4/01/2015, p. 11
55 See: Pile Driving FAQ
56 Noise Review Board Meeting, 4/01/2015, p. 4
57 City of Portland Noise Task Force meeting, 10/8/2015, p. 6
removing any exemption on pile driving in (the city’s) Title 18 Noise Code,” and the Program’s reticence towards the proposed changes was likely the decisive factor in the modest changes which did result. Title 18 was amended to reflect the city’s choice to place greater temporal restrictions on when pile driving can occur. Pile driving can now be done in Portland between 8 am and 6 pm only on weekdays (with the exception of holidays), which curtailed the previously allowable time period for pile driving by 16 hours weekly. This outcome suggests that the construction industry was better represented, better organized, and armed with more complete and objective information about the pile driving exemption than were the citizens whose testimony about the perceived impacts of pile driving noise was often more subjective, more accusatory, and less informed about the imperatives of the development community and noise policy’s effect on it. One citizen introduced a document outlining the city of Aspen, Colorado’s (pop. ~ 6000) construction noise policy, an unreasonable comparison given these cities’ relative size difference and likely disparity in development goals.

This outcome also suggests that city noise officials were swayed by the industry concerns brought forth during this process, including the economic impacts inherent on the development community to the code change proposal. Noise control officials noted that since the passage of Title 18 the City Council recognized “that construction was essential to the economic health of the City, and that it is necessarily loud,” and that the challenge with pile driving noise is “balancing the needs of the neighborhood with the needs of the development community.” To force developers to apply for variances for pile driving projects would prolong development projects “which contradicts the

58 2018 Pile Driving Report, p. 6; Portland City Code, Ch. 18.10.060.F1
59 Although, the testimony of some citizens involved displays an unusually deep awareness of the pile driving issue.
City of Portland’s commitment to prioritizing and streamlining the permitting process.” City officials thus used economic reasoning in the decision to confirm pile driving exemption, and displayed an official awareness of the central economic problem of regulating the soundscape outlined in this study. In choosing how best to protect the public against the worst abuses of the soundscape while also protecting economically essential noise, the city made minor concessions to negatively impacted residents but ultimately still considered pile driving an economically necessary noise (Hawkins 2012).

V. Discussion and Conclusion

The findings here indicate that soundscape policy might be most strongly determined by the rate of per capita city government spending and population density, findings that are perhaps unsurprising. Without the federal government stepping in to aid state and local programs, these programs are likely to decline due to lack of resources (Shapiro 1992). Less densely populated areas may not experience noise pollution or may not experience it enough to warrant public involvement on the issue. Labor composition of a city may have some additional importance, with noisy industries inducing more public attention to noise issues, although this is less clear. What is beyond doubt is that noise producing industries are economically affected by whether a city chooses to regulate noise, and the concerns about added costs and bureaucratic red tape mean that noisy industries may resist strong attempts by the public and municipal officials to control particularly noisy projects (like the pile driving example shows).

That the City of Portland has a legal process to issue noise variances, that Title 18 mandates this process take into account the potential for undue economic hardship to noise producers, and that the city has actually used this noise policy process to continue to allow noise with particular economic importance is evidence that the city consciously crafted a policy with both public welfare and the

62 2018 Pile Driving Report, p. 6
economic interests of industry in mind. In its resistance to override the imperatives of structural engineers and the construction industry as a whole, the Noise Control Program seems to acknowledge the limitations of noise control policy and also heed Coase’s (1960) fear that overly ambitious noise policy is economically harmful when it disrupts the productive use of property on the part of the noise producer without equal or greater economic gains elsewhere. When one considers the shrinking of the city’s housing supply which might have occurred beyond the first stage of using policy to ban pile driving as a construction technique in Portland, as developers in theory take up projects elsewhere in search of more profits and less red tape, the logic behind this is clear. This supports the basic thesis of this study: that as cities in the United States are left more or less free to design their own soundscape policies, these policies reflect cities’ relative weighing of the negative externality generated by noise pollution with its economic benefits.

A balanced approach to noise control is for a city to create public institutions and processes designed to both collect information about complaints and potential welfare loss due to noise and to determine which noise is necessary economically or for some other public imperative, like the numerous months-long overnight sewer repair projects routinely approved by the Noise Review Board. Portland is obviously an outlier in Oregon given its sheer size, but other smaller municipalities which suffer from noise pollution can learn from the experience of its noise control institutions. Noise control policy need not be overambitious, as the collection of both citizen and industry inputs in a formal process may be less elaborate, expensive, and time consuming than opponents to government regulation may imagine. Although Portland is a large city, it only devotes a relatively tiny fraction of its fiscal resources to noise control. One might imagine a cost-effective response to the issue in smaller, less fiscally capable municipalities where creative solutions are found to problems of public outreach and code enforcement without having to devote considerably more resources. Yet if cities are too responsive to either the complaints of citizens or to the needs industry (or lack the institutional capacity to do one or both), then it seems likely that loss of welfare
and economic surplus would occur where simple policy mechanisms might have helped solve the problem (or prevented it in the first place).

These efforts can be made in spite of the fact that cities will likely never have full control over their soundscape policy, given the federal preemption inherent to transportation noise policy as discussed above (Shapiro 1992). Rather than being vehicles towards the creation of a city’s ideal soundscape, the biggest benefit to these types of programs may be that regulators gain crucial information (both from the public and from noise producing industry) in order to simply avoid passing misguided and economically harmful noise control policies (Brechet and Picard 2010; Quah and Chun 1992; Coase 1960). Making public participation an imperative of these programs also gives their decisions greater legitimacy and, even if this makes for a lengthier and messier process, testimony can help reveal the unique and subjective experiences which people have with noise and shed light on why particular sources of noise are so excruciating to live with.

This study has certain limitations which should be acknowledged. The sampling frame involved allows us to make reasonable inferences about Oregon cities, but a larger sample of cities across the US could further clarify which variables are most impactful on increasing municipal response to noise pollution. Since this study is mostly concerned with assessing noise policy contemporary to the time of writing, it has less to say about the conditions and developments over time which lead to the creation (and sometimes the removal) of noise ordinances although Shapiro (1992) and Gillespie (2009) show the utility of doing so. Although this study has shown that there is variability in the types of approaches which exist among cities which do in fact regulate noise, it does not attempt to measure that variation. It is clear that Portland and Klamath Falls take different approaches to the problem, and one could imagine a study which tried to weigh various factors and scale the seriousness and sophistication of a city’s response to the problem. Though the sample of documents is highly representative of the actual functions of Portland’s noise policy organizations, qualitative methodology designed to elicit firsthand responses from members of these organizations
would have been insightful. A study of this type was not pursued due to the time limitations of these organizations’ small staffs. Additionally, though the City of Portland case study has been useful and is illustrative of the basic economic nature of noise regulation, another study which places Portland’s noise control policies in better context with respect to other large American cities would be beneficial. Portland is perhaps an outlier with the amount of public attention and official resources given to noise control, but the degree of similarity between its approach to the issue relative to that of other major cities is unclear. Finally, one could imagine a study which attempts to quantify the economic impact of marginal increases in the strength of noise policy against industry, such as the 16 hour per week reduction on allowable pile driving time in Portland, in order to show more definitively how industry might suffer from them.

Contemporary observers may notice quieter urban soundscapes today because of the coronavirus pandemic. This newly found quietude is likely correlated with the extreme decline in economic activity and especially of transportation, as millions of Americans shelter themselves from the virus in their homes and travel more scarcely. This is perhaps an oversimplification of the connection between noise and the economy, but it nonetheless illustrates some of the tradeoffs involved in noise production. Surely, it is likely that most would not choose to sacrifice economic health for more peace and quiet, but perhaps this unfortunate event will cause citizens to notice and observe their soundscapes more acutely. Then, they might also reflect on why it is our world has become so noisy and what noise does to human health and welfare. A contemporary awareness of the problem of noise pollution may increase demand for more pleasing soundscapes and might cause citizens to become more critical about which noises are economically necessary, and which might be reduced or eliminated without economic harm.
Works Cited
Casey, J. A., Morello-Frosch, R., Mennitt, D. J., Fristrup, K., Ogburn, E. L., & James, P. (2017). Race/Ethnicity, Socioeconomic Status, Residential Segregation, and Spatial Variation in Noise Exposure in the Contiguous United States. *Environmental Health Perspectives*, 125(7), 077017. [https://doi.org/10.1289/EHP898](https://doi.org/10.1289/EHP898)
Hammer, Monica, Tracy Swinburn, & Richard Neitzel. (2014). Environmental Noise Pollution in the United States: Developing an Effective Public Health Response. *Environmental Health Perspectives (Online)*, 122(2), 115–119. [https://doi.org/10.1289/ehp.1307272](https://doi.org/10.1289/ehp.1307272)


Appendix A: Documents from the City of Portland’s Noise Control Institutions

a. Noise Review Board Meetings

   ----- Attachments: https://www.portlandoregon.gov/civic/article/511675


   ----- Attachments: https://www.portlandoregon.gov/civic/article/519998

1/14/2015. https://www.portlandoregon.gov/civic/article/520002


b. Noise Task Force

“Noise Task Force Fall 2015 Roster.”

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https://www.portlandoregon.gov/civic/article/546840


----- “Noise Complaints Opened, August 28, 2014 - August 28, 2015”

https://www.portlandoregon.gov/civic/article/545374

----- “Noise Variance Process Flowchart, September 2015.”

https://www.portlandoregon.gov/civic/article/545376


https://www.portlandoregon.gov/civic/article/545375


----- “Citations issued Fiscal Year 2014.”

https://www.portlandoregon.gov/civic/article/545381


c. Other Documents

Portland City Code Title 18.

----- https://www.portlandoregon.gov/citycode/28182

Noise Control Program Website.

----- https://www.portlandoregon.gov/civic/63242

2018 Pile Driving Report.

----- https://www.portlandoregon.gov/civic/article/709631

Pile Driving FAQs.

----- https://www.portlandoregon.gov/civic/article/709633

Citizen Documents Related to Pile Driving.

----- https://www.portlandoregon.gov/civic/article/526174

Report on Proposed Title 18 Changes

----- https://www.portlandoregon.gov/civic/article/525402

City of Portland Auditor’s Office. “Nuisances - Petition to Abate Noise from Salvation Army.” 12/31/1887.

----- https://efiles.portlandoregon.gov/Record/13144673/

City of Portland Auditor’s Office. “Nuisances-Petition Against Chinese Theatre.”09/01/1880.”

----- https://efiles.portlandoregon.gov/Record/12411718/
Appendix B: Municipal Coding Procedure

In order to code for the presence of noise policies in Oregon municipalities, a simple search protocol was used. The Oregon Municipal Recorder’s Association provides an up to date list of the official websites of Oregon municipalities, and the sites listed there were used in this study. Where applicable, these sites’ search engines were used to compile documents relevant to noise issues, and a Ctrl-F search was used on the documents themselves to reveal greater detail about their policy. This set of documents mostly includes municipal codes, but also includes other documents pertinent to municipal governing like livability codes, city council reports, and strategic planning documents. The following terms were largely derived from the literature consulted here and were used in theses searches:

“noise OR noise control OR noise pollution OR noise abatement OR noise mitigation OR noise complaint OR noise variance OR noise policy OR construction noise OR industrial noise OR livability code OR report a problem OR report an issue OR complaint OR report a complaint OR nuisance OR code enforcement OR code compliance OR code violation OR beautification OR beautiful OR noise compliance OR noise violation OR file a complaint OR.”

When the result of these showed reasonable evidence that a standalone noise ordinance exists, not including zoning laws, it was coded as:

- 1 = Noise ordinance exists
- 0 = no ordinance

Typically, whether a city has a noise ordinance is self-evident based on this search protocol, and it was also easy relatively find whether a city has a noise variance process as this will typically be found in the city code which was similarly coded:

- 1 = Noise variance process exists
- 0 = no variance process
It is important to note that exceptions to the law for emergencies or “public necessities” are not considered variances here, although they are in effect sources of noise allowed for outside the law. Only more routine processes in which it is possible under the law to have other makers of noise approach the city government and potentially be granted a permit to make noise outside the law were positively coded for.

To code for whether a city has a clear process to collect citizen complaints was less straightforward, although the same search protocol was used, and the results were coded similarly as:

- 1 = Clear noise complaint collection
- 0 = No clear evidence of noise complaint collection

A city’s website had to show clear proof of a law or city code enforcement contact about who to call to report a noise issue specifically. Many cities list contact information to report a problem in other areas such as leaf burning or wildlife issues, but if these sites did not provide a specific contact point for noise related complaints then they were marked a 0.

Finally, cities classified as “high responders” to noise pollution issues were coded:

- 1 = Noise ordinance, variance process, and complaint collection exists
- 0 = No noise ordinance, variance process, and/or complaint collection
**Appendix C: Marginal dy/dx Impacts of Logit Modeling**

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Observations: 174 164 163 163 162

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
(P.L.= “percentage of labor”) (Exp.= “expenses”) (H.H.= “household”) (P.C.= “per capita”)
## Appendix D: Pairwise Correlation and Variance Inflation Factor Data

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