Traffic Noise, Housing Demand and the Local Benefits of Electric Vehicles

Enrico Moretti (Berkeley and NBER)
Harrison Wheeler (Toronto)

Introduction

In this project we seek to A) estimate the effect of traffic noise on the demand for housing units exposed to noise; B) use our estimate of the effect of traffic noise to quantify the economic benefit of the adoption of electric vehicles (EVs) on each property currently exposed to traffic noise; and C) discuss the implications of our estimates for federal policies that aim at incentivizing the adoption of EVs.

Traffic noise is a pervasive problem affecting millions of Americans and an important negative local externality. Using data from the US DOT National Transporation Map (2020), we estimate that 23 million Americans live close to high levels of traffic noise. Noise has been linked to a wealth of health problems (WHO, 2017). Traffic noise is a "regressive" externality because low-income and minority households are more likely to live near high-traffic roads, as shown in Figure 1 below (based on data from the National Transporation Map merged with the ACS). Despite its potential economic costs, traffic noise has been largely ignored in economics.

The proposed project is made of three parts:

1) In the first part we seek to estimate the causal effect of traffic noise on housing prices. We plan to ask the question: are prices in neighborhoods with more noise lower compared to prices in neighborhoods with less noise? Since residents and housing units in areas with more noise are likely to have worse unobservables, a naive comparison probably overstates the effect of noise on prices. To identify the causal effect of traffic noise on housing prices we plan to use the construction of sound barriers along noisy roads and freeways. We will focus on repeated sales of the same property and compare the change in prices of properties close to the road to the change in prices of properties further from the road.
2) In the second part of the project, we plan to use our estimate of the causal effect of traffic noise on housing prices to assess how large is the negative externality caused by traffic noise in the aggregate. We also plan to use data on Census tract income and racial composition to ask who bears the cost of this negative externality. Specifically: What fraction of the aggregate cost of the noise externality is borne by low-income or minority households?
3) In the third part, we plan to investigate the implications of our findings for federal policies that aim at increasing the adoption of Electric Vehicles. Since EVs are quieter than Internal Combustion Engine (ICE) vehicles, widespread adoption of EVs has the potential to lower traffic noise, thus benefiting areas currently exposed to high levels of noise. Subsidies for EVs are typically motivated as a way to reduce CO2--a <u>global</u> externality. However, EVs also have potentially important localized benefits in the form of lower traffic noise--a <u>local</u> externality.

- We plan to use our estimates of the effect of noise on housing prices from part 1) to estimate the local benefits of EVs for Census tracts currently exposed to traffic noise under three different scenarios of EV adoption: 25%; 50% and 100% adoption.
- We will then compare the aggregate benefits in each scenario to the total amount of EV subsidies currently offered by the federal government to speed up the production and adoption of EVs, including subsidies from the Infrastructure Investment and Jobs Act (2021), the Inflation Reduction Act (2021) and several types of federal manufacturing incentives. Since our focus is on noise only, and we ignore pollution, our estimates of the local benefits of EV diffusion are likely to be a lower bound of the total benefits.
- We will also estimate the distributional impact of the policies that aim at increasing the adoption of Electric Vehicles. The benefits of noise reduction caused by EV diffusion are likely to be "progressive" in nature, because low-income individuals are overrepresented near high-traffic roads. Contrary to the widespread perception that EV subsidies tend to benefit high-income EV drivers, our preliminary findings indicate that EV adoption is likely to have large benefits for low-income households.

Existing Literature

(a) Effect of EV Diffusion on Traffic Noise. To quantify the effect of EV diffusion on traffic noise we plan to use existing estimates from the literature. One of the main studies in this literature is Lan et al (2018), who conduct a noise measurement experiment to compare the noise emissions from the traffic flow with different proportions of EVs. They collect data from 1,434 acoustic records, with observed speeds ranging from 22km/h to 67 km/h. They find that an increase in the proportion of EVs causes a decrease in the observed noise of the traffic flow decreases with. They estimate that a reduction in noise in a scenario where 100% of vehicles are EVs is between 7.1 dB(A) and 7.3 dB(A), depending on the exact mix of vehicles. This amounts to a 9.6-11.1% reduction in noise. Consistent with Lan et al (2018), Pallas (2015), Walker (2016), King (2017) and Pallas et al (2014) find significant noise reduction from EVs.

Several studies find that the magnitude of noise reduction appears to be larger at lower speeds and smaller at higher speeds where the contribution of rolling noise becomes more important, although these studies tend to be model-based. For example, Pallas et al (2016) find that the overall noise reduction is around 5 dB(A) at 20 km/h and decreases and becomes insignificant beyond 40-50 km/h. See also Iversen et al (2015) and Marbjerb (2013).

(b) Effect of Noise on Housing Prices

The existing literature on traffic noise and property values has largely focused on correlations (Huges and Sirmans 1992; Verhoef 1994; Epsey and Lopez 2000; Sebastian and Maennig 2011; Franck et al 2015; Hofstetter and Muller-Wenk 2005; Kim et al 2007; Li et al 2009; Narvud 2002; Nelson 2004; Rich and Nilesen 2004; Theebe 2004; Wilhelmsson 2000; Blanco and Flindell 2011; Cohen et al 2021) We found only two papers that provide causal evidence on the link between noise and housing demand (Lindgren, 2021 and Wang et al., 2023)

Data

- Noise barriers are structures built beside roads to reduce noise diffusion. Since 1963, Federal-aid Highway Program has helped fund state DOT noise barriers. The data on the noise barriers are from the US Department of Transportation Barriers Inventory 1988-2023. The dataset provides information on their location, the built year, the cost, and materials.

Crucially, for each barrier built, it also provides information on expected noise reduction measured in decibel (dB) reduction, based on the material used, its height and depth.

- Baseline exposure to traffic noise is from the US DOT National Transporation Map (2020). It provides model-based estimate of local traffic noise for each Census tract.
- Data on housing prices and property characteristics are from Corelogic transactions (1990-2022) and Corelogic assessor data (2006, 2022).
- Information on neighborhood demographics and median income is from the ACS (2015-2019).

Preliminary Results on the Effect of Traffic Noise on Property Values

As proof of concept, we collected and geolocated barrier data for the state of Florida and estimated their effect on property values. While the US Department of Transportation Barriers Inventory data provides the latitude and longitude of the two extreme points of a subset of the barriers, precisely geolocating all the barriers and assigning each barrier to the correct side of the road is time consuming and labor intensive. If funded, we plan to collect data for the other 49 states or at least for as many states as possible given the budget constraint.

Figure 2 shows the effect of the construction of new barriers in Florida on the price of properties that are 0 to 100 meters from the barrier (and on the relevant side of the barrier) relative to properties that are 500 to 1500 meters from the barrier (and on the same side of the barrier). In the five years before the construction of the barrier, we observe no pre-trends in conditional property values. After the construction of the barrier, we observe an increase in property values. The increase appears to be on average around 7%.

In additional preliminary results, we also find that:

- the effect appears to decay to zero with distance and becomes insignificant at distances longer than 500 meters, consistent with the expected effect from the Transportation Barriers Inventory data.
- importantly, the estimated effect appears to increase in the amount of expected noise reduction. As mentioned above, the Transportation Barriers Inventory data assigns to each barrier a predicted decibel reduction. We estimate limited effects at noise reductions below 5dB, and significant effects at noise reductions above 5 dB. The magnitude of our estimates appears to be a concave function of the expected decibel reduction.

These results are clearly too preliminary to draw strong conclusions. In addition to extending the data to all the states, we plan to

- Perform two placebo tests:
    - Estimate the effects on housing units 0-100 meters from the barrier located on the opposite side of the highway
    - Use proposed but unconstructed barriers. These data will need to be collected state by state
- Study composition changes stemming from supply effects. Are the barriers causing new construction? Can quality differences in new buildings account for the increase in prices?
- Estimate the heterogeneity in the effects as a function of neighborhood demographics

- Investigate if barriers cause changes in other local amenities
    - Are barriers attractive by blocking the view of the highway?
        - We will test if sound wall effects vary with wall height
        - We will also test if sound wall effects are smaller with tree canopy
    - Do barriers reduce local air pollution?

Policy Implications

After establishing the causal effect of traffic noise on property values, we plan to use it to assess how large is the negative externality in the aggregate and which income and racial group bears it.

We will then focus on the expected benefits of Electric Vehicle adoption on housing demand. We will use our estimate of the causal effect of noise to estimate the economic benefit of EV adoption on each property currently exposed to traffic noise. We will then compare it to Biden's administration subsidies for EVs, namely:

Infrastructure Investment and Jobs Act (2021)
- $7.5B for charging infrastructure
- $2.5B for purchase of electric school buses

Inflation Reduction Act (2021)
- $7500 tax credit for EV buyers
- $3B to electrify USPS federal fleet

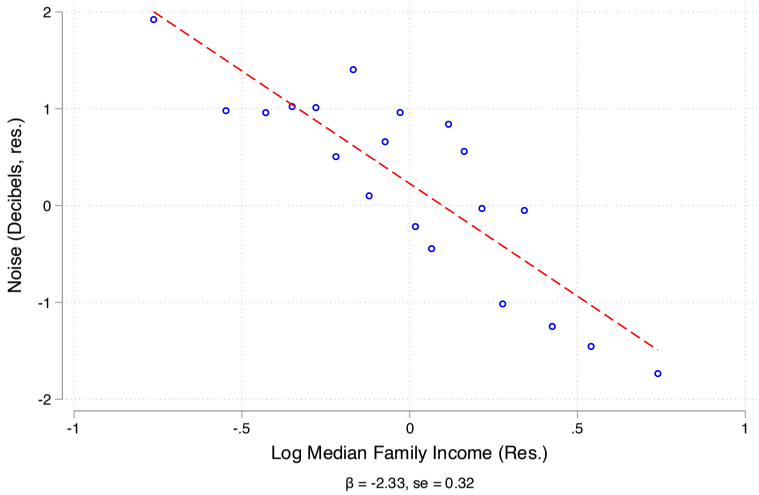
Manufacturing incentives
- IIJA: $6.1B for battery processing & recycling grants
- IRA: $10B investment tax credit for manufacturers in EV projects
- IRA: $3B incentives for battery and minerals production
- IRA: $2B to retrofit existing factories for EVs

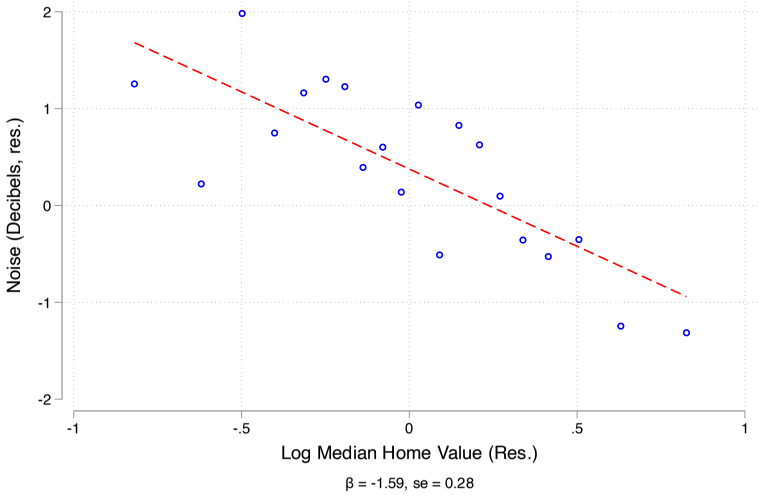
Finally, we will focus on the distributional impact of the policies that aim at increasing the adoption of Electric Vehicles. The benefits of noise reduction caused by EV diffusion are likely to be "progressive" in nature, due to the fact that low-income individuals are more likely to live near high-traffic roads.

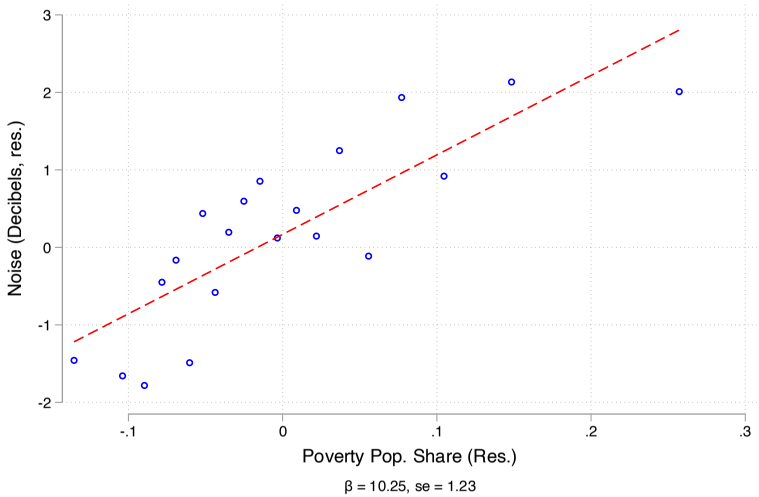
Conflict of Interest. The authors have no financial or other interests that might bear on the proposed work. They have no financial or other ties to the transportation industry.

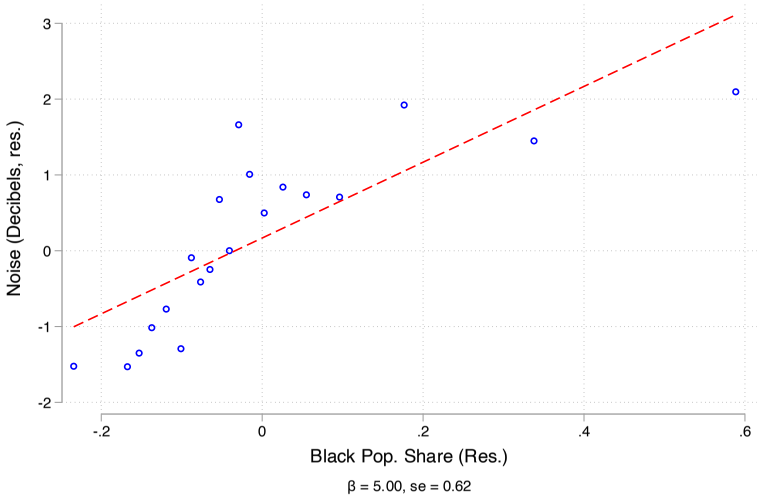
Summary statement on how the findings could help to inform research or policy issues of interest to DOT. Our data collection may improve the US Department of Transportation Barriers Inventory by geolocating each barrier and assigning it to the relevant side of the highway. Our findings could also be used to improve the Noise Maps in the DOT National Transporation Map (2020). The current maps are based on the assumption that all vehicles are Internal Combustion Engine (ICE) vehicles. As the share of EVs increases, the Noise Maps will increasingly overstate traffic noise, especially in locations with a high share of EVs. Our estimate can be used to reduce this source of measurement error.

Noise across neighborhoods









Event study chart

