Stanford University • September 2011

SIEPR policy brief

Stanford Institute for Economic Policy Research

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Navigating the Roadblocks: Identifying the Health Effects of Traffic Pollution

By Nicholas J. Sanders, Ph.D.

Automobiles are a major contributor to ambient pollution levels. The Environmental Protection Agency (EPA) estimated the average passenger car produced 575 pounds of carbon monoxide, 38 pounds of oxides of nitrogen, and 77 pounds of particulate matter (small airborne solid or liquid particles) per year (EPA 2000), and a report by the Surface Transportation Policy Project (2003) found that in major metro areas between 31 percent and 60 percent of all criteria pollutants came from transportation sources. An EPA report put that number even higher, with up to 90 percent of carbon monoxide emissions coming from motor vehicles in urban areas.[1]

To reduce such pollutants, the Clean Air Act Amendments of 1990 (CAAA) contained controls for automobiles, including emissions standards for new cars, gasoline reformulation in high ozone areas, inspection and maintenance programs, and a requirement that federal monies fund only transportation projects that are consistent with the improvement of air quality goals.

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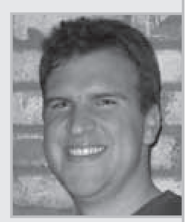
1 *Automobiles and Carbon Monoxide*, accessed 8/7/2011, http://www.epa.gov/oms/consumer/03-co.pdf

About the Author



Nick Sanders is a post-doctoral fellow at SIEPR. He received his BA in Economics and Hispanic Studies from Lewis & Clark College in 2002 and his PhD from the University of California, Davis in 2010. His research covers topics in environmental quality and its relation to health, mortality, and long-run life outcomes, as well as gender differences in the response to educational incentives.

The CAAA drastically decreased the concentration of a number of local air pollutants. Carbon monoxide decreased by 68 percent, ozone by 14 percent, and particulate matter by 31 percent. Unfortunately, the EPA estimates the compliance costs of the CAAA to be almost $20 billion annually in 2000, increasing to $53 billion by 2010 and $66 billion by 2020. A large portion of that expense is attributable to the regulation of automobiles, approximately $26 billion in 2010 and increasing to $28 billion in 2020 (EPA 2011).

The benefits of such air quality improvements are more difficult to measure. For example, how does one value clear skies, visibility, and species and habitat protection? While it is believed that major benefits come in the form of avoided health problems, it is always hard to measure the benefits of the absence of quantifiable proof. The EPA estimates potential annual health benefits — from a low of $190 billion to a high of $5.7 trillion (EPA 2011) by 2020. The substantial difference between estimates demonstrates just how much uncertainty remains in the valuation process. How can one tell if traffic pollution reduction is worth its costs, and what are the consequences if pollution is not reduced?

There have been numerous studies measuring health outcomes for those exposed to different levels of traffic pollution, but they are often confounded by the inability to control for unobservable characteristics associated with both traffic exposure and overall health. For example, economic theory describes people's housing location choice as a function of their preferences for various amenities, some of which might put then in proximity to pollution or automobile traffic. Individuals that live in high traffic areas might do so because they are unconcerned about respiratory health issues and they value other factors, like living in the heart of downtown Los Angeles, more than they value avoiding said issues. Those preferences may mean they are different from people living in low traffic areas in other ways as well, making it difficult to tease out exactly why their health outcomes could vary.

It may also be that those living close to traffic do so because they cannot afford to live in other areas — making exposure correlated with factors such as socioeconomic status, which in turn may affect availability of health insurance and access to medical care. These factors make comparing those living close to traffic with those living further from traffic an unreliable method of measuring health effects. Researchers have tried to solve this problem by looking for situations in which they can study changes to traffic pollution in a particular area while keeping other unobservable factors unchanged. Rather than compare different groups of people, the goal is to compare the same group of people faced with different pollution exposure levels.

For example, Friedman et al. (2001) noted that during the 1996 Atlanta Olympics, steps were taken to control traffic levels so visitors could more easily move between events. Roads were closed to public traffic in the downtown area, local businesses were encouraged to modify work hours, downtown delivery schedules were adjusted, and public transit buses were combined with park-and-ride systems, all with the intent of lowering traffic around the area of the events. As a result, traffic-related pollution levels dropped in the area. It is unlikely that many other things changed in conjunction with the traffic policies; for example, people probably didn't quit smoking or move to a new house because of a temporary change in the bus schedules. Therefore, any observed health changes were more likely to be attributable to the drop in traffic pollution. The researchers found the timing of such drop was correlated with a decrease in hospital visits for asthma attacks in children, suggesting a link between traffic pollution and children's respiratory health.

Currie and Walker (2011) found another good research situation involving the installation of electronic payment machines at toll plazas in the Northeast United States. A study measuring traffic at 27 toll locations found introducing the electronic systems reduced delay by 85 percent, eliminating 0.056 tons of nitrogen oxides emitted per weekday (New Jersey Turnpike Authority 2001). By comparing health outcomes in the area before and after the move to electronic tolling systems, they showed that the installation of such systems was followed by reductions in premature births and infants classified as low birth weight, two classic measures of infant health. Like the Atlanta traffic adjustments, the installation of the toll system was effectively unrelated to other factors that might impact health outcomes. They also showed that the installation didn't appear to change the type of person that lived near freeways. This suggests the health gains can be attributed to lowered traffic pollution rather than shifts in behavior or consideration of a biased population. Unfortunately, Currie and Walker were unable to observe actual traffic flows.

In Knittel, Miller, and Sanders (2011) we expand on those findings to consider the impact of traffic pollution on the infant mortality rate (the number of infants that die within the first year of life), another common measure of health. We look at changes in traffic patterns in common high-traffic regions such as the Sacramento and Los Angeles areas, portions of California with some of the worst traffic and air pollution problems in the country. Unlike Currie and Walker, we do not use a one-time policy change. Instead, we look at an all too common occurrence: traffic jams. This approach involves information on actual traffic flows in an area at any given time. In order to better investigate how common automobile traffic can affect both pollution and health, we turned to data from the Performance Measurement System (PeMS).

As you've driven on freeways in California, your car created a data point in our analysis. Metal coils buried under the road sense when cars pass by detecting shifts in the magnetic field around the coil caused by the large steel object driving overhead (similar technology is used to sense when cars are waiting at stoplights). That change in the field (or "inductance") tells the system that a car has passed over the sensor. These sensors can count how many cars travel on a particular part of the road and how fast they are moving. All these data are gathered and passed along to the PeMS data center where they are organized for use by researchers. Traffic engineers use these data to study traffic patterns, look for bottleneck points, and build a better understanding of daily and hourly traffic flow. You may have used similar data yourself to check traffic online before starting a drive by checking Google Maps™. In our study we use these same data to spot weeks where traffic is moving much more slowly than usual and/or there are an unusually large number of cars on the road — possibly as a result of road closures, traffic accidents, or the periodic holdups on the Bay Bridge, for example, when the Giants play the Dodgers.

The EPA has air monitors placed all over California, taking readings of airborne pollutants, many of which are common by-products of burning gasoline. By examining how weekly readings change at monitors around traffic jams, we can see how ambient pollution levels are influenced by traffic. The benefit of combining these systems is the ability to look at shorter-term changes, which helps better identify an effect. Rather than ask "do areas that have more traffic on average have more pollution on average," we can ask "does higher traffic in this area this week result in higher pollution in the same area this week," which helps get around long-term factors driving both pollution and traffic (e.g., urban development). Not surprisingly, more cars going more slowly on the roads means more ambient air pollution.

To determine the potential health effects of traffic pollution, we examine the infant mortality rate for zip codes in California near traffic measurements and EPA air monitors. We can observe whether any infants recorded as born in California die within the first year of birth and, if so, at which point this occurred. By matching infants to the traffic pollution levels within their zip codes, we observe how infant mortality rates change as traffic-related pollution changes. We found that reduction of traffic-related pollution resulted in decreases in infant mortality. This, combined with the findings discussed above, suggests that traffic pollution can adversely impact health at many points in the early life cycle and that by reducing traffic-related pollution we can positively affect birth outcomes, infant survival rates, and children's health.

Improvement in automobile engine efficiency and increased gas mileage could further reduce the air pollution created by automobile traffic. Current Corporate Average Fuel Economy (CAFE) regulations establish the economy-wide average fuel efficiency level at 27.5 miles per gallon (mpg) for cars and 23.5 for trucks and similar vehicles. In 2007,

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President George W. Bush set the goal, by 2020, of an average efficiency of 35 mpg for both cars and light trucks. Recent modifications by the Obama administration upped the goal to 54.5 mpg by 2025.

Automakers have a long way to go to make the required future improvements in engine efficiency, and gasoline price changes have yet to push American consumers toward more fuel-efficient options. Despite the substantial increase in gasoline prices last year, a Ward's Automotive sales report showed the average miles per gallon of vehicles sold in 2010 was 22.2, slightly lower than the 22.3 seen in 2009, and sales of gasoline-intensive light trucks, sport utility vehicles, and minivans increased.

As the efficiency deadline approaches, there will no doubt be pressure to postpone or reduce the standards or to allow greater concessions for light trucks and sport utility vehicles. But when considering such options, it is important that we look beyond the costs and inconveniences of improving fuel standards and seriously consider the evidence of the adverse health impacts from gasoline combustion and the social and health benefits that result from reduction in traffic-generated pollution.

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366 Galvez Street
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A publication of the
Stanford Institute for
Economic Policy Research

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