

Choking Behind the Wheel: The Effect of Air Pollution on Vehicle Accidents

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Air pollution has long been linked to health outcomes and productivity losses, as well as a number of avoidance behaviors, even at relatively low levels of air pollution (Beatty and Shimshack, 2011, 2014; Chay et al., 2003; Chay and Greenstone, 2003; Currie et al., 2009; Currie and Walker, 2011; Graff Zivin and Neidell, 2009; Hanna and Oliva, 2015; Knittel et al., 2015; Sanders, 2012; Schlenker and Walker, 2015).

Several recent studies investigate the link between air pollution and cognitive ability as measured by (a) processing behavior related to outcomes on the stock market by Wall Street traders in New York (Heyes et al., 2016), (b) activities by criminals downwind versus upwind from highways in Chicago (Herrnstadt and Muehlegger, 2015) and student test scores (Lavy et al. (2014).

In this working paper, we also investigate this “new link” between air pollution and cognitive ability, but for an activity that is much more common: “every day” driving. In the United States, over thirty five thousand traffic fatalities occur annually, which amounts to roughly 300 billion in loss of life annually. A total of six million crashes were recorded in 2016 in the USA and among those 1.6 million people were injured or disabled from traffic accidents. This negative externality from driving has long been recognized in the economics literature (Anderson and Auffhammer, 2014; Jacobsen, 2013).

Although there are literally hundreds of academic studies on the determinants of accidents (road security infrastructure, vehicle security measures, alcohol consumption, drug use and sleepiness all have been determined as the leading determinants of crashes), we are not aware of any study that links air quality to driving behavior in the US. Because driving, however, requires concentration, we hypothesize that environmental factors such as air pollution could contribute significantly to our driving behavior and crash outcomes. To investigate this, for this project we collect the most comprehensive dataset on geocoded vehicle crashes in California from 2001 to 2015, which contain details of the time of day of the crash, number of vehicles, motorcycles and

pedestrians involved, type of road and other information from over 7 million police reports. Secondly, we collect the universe of all air quality measurement stations throughout California in terms of PM_{2.5}, PM₁₀, CO, Ozone, NO_x and SO₂. Thirdly, we also acquire comprehensive weather data including temperature, precipitation, wind speed, visibility, snowfall, dew points.

Because traffic accidents are a function of the number of vehicles circulating on roads, we construct an “estimate” of the hourly accident “rate”. Our numerator is the number of accidents in a geography by hour and the denominator is the number of vehicles recorded circulating on certain major roads. To construct various alternative denominators, we collect the universe of all CalTrans hourly traffic volume records.

Traffic itself creates air pollution. Hence regressing accident rate on air pollution produces biased results. To address this endogeneity problem, we develop several research designs that aim to isolate the causal effect of air quality on hourly accident rate. We construct the following instrumental variables approaches.

First, in southern California, we collected the universe of wildfire data. In total we obtained data on 123,687 wildfires for the years 1980 to 2015. Our first stage relates wildfires to air pollution. The second stage relates instrumented air pollution to accidents.

Second, we collected the universe of all ship arrival and departure information by vessels in the two main harbors of Los Angeles (Los Angeles Harbor and Long Beach Harbor). This instrumental variable approach has been used by (Moretti and Neidell, 2011), in their paper how air pollution in Los Angeles effects hospital admissions.

Third, we collect the wind pattern information throughout major urban areas of San Francisco and Los Angeles. Changes in wind can serve as an instrumental variable to identify the causal effect of air pollution on traffic accidents.

Fourth, temperature inversions episodes in the Los Angeles basin are used as an instrumental variable.

Fifth, in the spirit of Schlenker and Walker (2011), we use air traffic congestion as an instrumental variable.

References

Anderson ML, Auffhammer M. Pounds that kill: the external costs of vehicle weight. *Review of Economic Studies* 2014;81; 535-571.

Beatty TKM, Shimshack JP. School buses, diesel emissions, and respiratory health. *Journal of Health Economics* 2011;30; 987-999.

Beatty TKM, Shimshack JP. Air pollution and children's respiratory health: A cohort analysis. *Journal of Environmental Economics and Management* 2014;67; 39-57.

Chay K, Dobkin C, Greenstone M. The Clean Air Act of 1970 and adult mortality. *Journal of Risk and Uncertainty* 2003;27; 279-300.

Chay KY, Greenstone M. 2003. Air quality, infant mortality, and the Clean Air Act of 1970. NBER Working Paper No. 10053; 2003.

Currie J, Neidell M, Schmieder JF. Air pollution and infant health: Lessons from New Jersey. *Journal of Health Economics* 2009;28; 688-703.

Currie J, Walker R. Traffic Congestion and Infant Health: Evidence from E-ZPass. *American Economic Journal: Applied Economics* 2011;3; 65-90.

Graff Zivin J, Neidell M. Days of haze: Environmental information disclosure and intertemporal avoidance behavior. *Journal of Environmental Economics and Management* 2009;58; 119-128.

Hanna R, Oliva P. The effect of pollution on labor supply: Evidence from a natural experiment in Mexico City. *Journal of Public Economics* 2015;122; 68-79.

Herrnstadt E, Muehlegger E. Air Pollution and Criminal Activity: Evidence from Chicago Microdata. National Bureau of Economic Research Working Paper Series 2015;No. 21787.

Heyes A, Neidell M, Saberian S. The Effect of Air Pollution on Investor Behavior: Evidence from the S&P 500. National Bureau of Economic Research Working Paper Series 2016;No. 22753.

Lavy, Victor, Avraham Ebenstein, and Sefi Roth. The impact of short term exposure to ambient air pollution on cognitive performance and human capital formation. No. w20648. National Bureau of Economic Research, 2014.

Jacobsen MR. Fuel Economy and Safety: The Influences of Vehicle Class and Driver Behavior. *American Economic Journal: Applied Economics* 2013;5; 1-26.

Knittel CR, Miller DL, Sanders NJ. Caution, Drivers! Children Present: Traffic, Pollution, and Infant Health. *Review of Economics and Statistics* 2015;98; 350-366.

Moretti E, Neidell M. Pollution, health, and avoidance behavior evidence from the ports of Los Angeles. *Journal of Human Resources* 2011;46; 154-175.

Sanders NJ. What Doesn't Kill You Makes You Weaker: Prenatal Pollution Exposure and Educational Outcomes. *Journal of Human Resources* 2012;47; 826-850.

Schlenker W, Walker WR. 2011. Airports, air pollution, and contemporaneous health. National Bureau of Economic Research; 2011.

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