The Effects of Air Pollution on Health and Health Spending: Evidence from Forest Fires

Seema Jayachandran, UC Berkeley and UCLA & Sarah Reber, UCLA

This paper uses a natural experiment approach to estimate the causal effect of air pollution (specifically particulate matter) on mortality, morbidity and Medicare spending in the United States. In particular, we examine the effects of air pollution from large-scale forest and brush fires, which has a similar particulate matter composition to industrial pollution. Establishing causality through epidemiological studies has proved difficult because particulate matter may be correlated with unobserved factors. The fact that pollution from fires is concentrated in time and space allows one to overcome these difficulties and also to precisely estimate the timing of the adverse effects of air pollution.

We focus on health outcomes for a particularly vulnerable group, the elderly. The data sources for the outcome variables are death certificates (Vital Statistics data) and Medicare claims data. These data are combined using geographic identifiers with information about the location and intensity of forest and brush fires and also air quality measurements taken by monitors maintained by the Environmental Protection Agency. The study period is 1990 to 2003.

The paper answers several key questions. First, what is the causal effect of particulate matter (PM) on mortality and do pollution-related deaths represent the loss of days, weeks, or years of life (that is, is there “harvesting”)? Second, what is the causal effect of PM on morbidities including acute myocardial infarction and respiratory problems? The medical literature suggests that pollution might induce these two

morbidities, and diagnosis information in the Medicare claims data will allow us to identify adverse health events. Third, what are the health care costs associated with pollution-induced health problems? Fourth, are certain populations more susceptible to pollution (race, gender, and age)?

We estimate the effects of air pollution on these outcomes using instrumental variables (IV) methods, where the endogenous variable is ground-level air pollution (and in some cases lagged air pollution) and the instrument is the presence of a nearby fire. (In some specifications, we take into account wind patterns to get a stronger prediction of poor air quality.) We include county and month fixed effects to control for fixed characteristics of counties and to account for seasonality of mortality and morbidity. In some specifications, we also include county-by-month fixed effects, allowing each county to have a different seasonal pattern in the outcome variable. Intuitively, this approach estimates the effects of air pollution by comparing death rates (and other outcomes of interest) in a county and month with no nearby fire to death rates in the same county and calendar month when air quality was worse due to a nearby fire. One concern with this approach is that fires may occur during particularly dry, hot periods and that heat may have an independent effect on health. To address this concern, we control for temperature and precipitation. We also utilize the individual-level control variables such as age, gender, and race to adjust for potential demographic changes in a county over time (the county fixed effects already control for fixed characteristics of a county).

The effects of air pollution have long been of interest to policymakers and researchers. Both Federal and state policy have regulated air pollution since the 1970s (e.g, Clean Air Act, California's Air Pollution Control Act and subsequent legislation). In order

to continue to evaluate existing policies and to determine future standards reliable research on the health and other effects of pollution is needed. Also, design of effective public health warning policies requires a better understanding of who is most at risk from air pollution. In addition, pollution from fires is important per se for policy decisions about controlled burning, resources to spend on fighting forest fires, and temporary evacuations of affected populations.