

# Urban air pollution and sick leaves: Evidence from social security data

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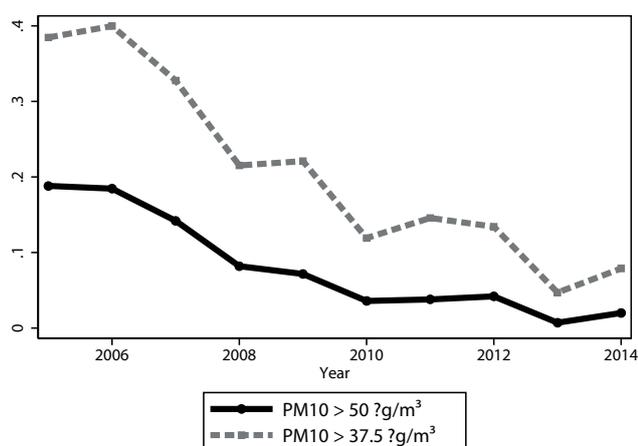
Air pollution poses a major threat to public health by shortening lives (Deryugina et al., 2019) and increasing acute morbidity (Schlenker and Walker, 2016). Air pollution causes additional damage by reducing productivity on the job (Graff Zivin and Neidell, 2012) and by hindering human capital accumulation (Currie et al., 2009; Ebenstein et al., 2016). Recent research has provided credible evidence that air pollution damages the economy also via reductions in labor supply in the context of emerging economies (Hanna and Oliva, 2015; Aragón et al., 2017), but little is known so far about this relationship in post-industrial societies where pollution levels are low and productivity is high.

Our paper provides the first causal estimates of how many work days are lost due to air pollution concentrations typically

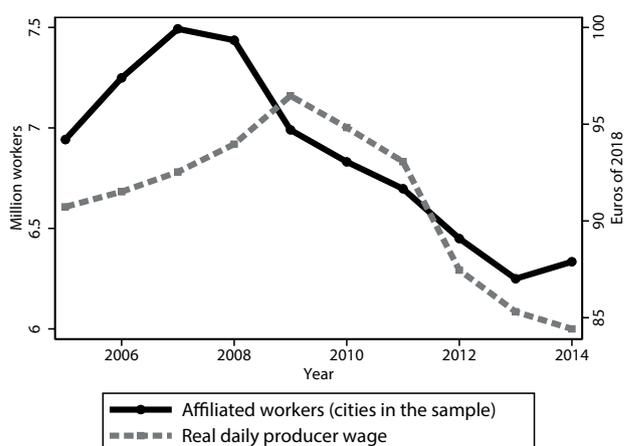
observed in post-industrial economies. Our empirical analysis is based on a novel administrative dataset from the period 2005-2014 that links rich information on personal and occupational characteristics of Spanish workers to the frequency, length, and diagnosis, of sick leaves taken. We estimate the impact of air pollution on workers' propensity to call in sick, based on weekly variation in ambient concentrations of particulate matter (PM<sub>10</sub>) across 99 cities in Spain. Our baseline model is a linear regression of the share of sick-leave days on the share of high-pollution days and weather variables. To control for non-random assignment of pollution across workers, we include city-by-year, year-by-quarter, and worker fixed-effects. Possible remaining endogeneity is addressed in an instrumental-variables (IV) regression that exploits exogenous variation in PM<sub>10</sub> driven by dust storms in Northern Africa. Under certain meteorological conditions, storms in the Sahara Desert stir up dust into high altitudes. These dust clouds can travel very long distances and reach European territory several times a year. The arrival of Sahara dust occurs throughout all of Spain, and it is most frequently observed on the Canary Islands, due to their geographical proximity to the Sahara, where the phenomenon is popularly known as "Calima". Because

Figure 1  
TRENDS IN POLLUTION, EMPLOYMENT AND WAGES 2005-2014

1 SHARE OF HIGH-POLLUTION DAYS (a)



2 EMPLOYMENT AND PRODUCER WAGES (b)



NOTES: Figure 1.1 displays the share of worker days with PM<sub>10</sub> concentration exceeding EU 24-hour limit of 50 mg/m<sup>3</sup> (solid line) and the share of worker days with concentration in excess of 75% of the limit value (dashed line). The figure is based on our sample of 99 Spanish cities with at least 40,000 inhabitants. PM<sub>10</sub> concentrations are weighted by the number of social security affiliates in each city and year. Figure 1.2 displays the number of workers affiliated with the General Social Security Regime on our sample of 99 Spanish cities with at least 40,000 inhabitants (solid line) and the daily producer wage, expressed in constant 2018 Euros (dashed line).

Calima events substantially increase non-anthropogenic PM<sub>10</sub> concentrations, the cities affected by this phenomenon are allowed to discount the measured 24-hour-mean concentration for this effect. Official PM<sub>10</sub> discounts constitute a valid instrument for pollution because they shift local PM<sub>10</sub> concentrations in ways that are plausibly orthogonal to local conditions that drive sick leaves, after conditioning on weather.

Our IV estimates imply that a 10%-reduction in high-pollution events reduces the weekly absence rate by 0.0213 percentage points, i.e. by 0.8% of the mean absence rate (2.79%). The estimation results allow us to compute a lower bound on the benefits of improving urban air quality in Spain. We proceed in two steps. First, we calculate the reduction in sick days caused by a specific improvement in air quality. To translate this into a monetary benefit, we then multiply this number by the average daily producer wage. Under the assumption that workers are paid their marginal product, this approximates the value of incremental production enabled by the reduction in sick days. While improving air quality yields sizable additional benefits by reducing mortality, human suffering, and medical treatment costs, we focus on foregone production because this component of the social costs of air pollution is directly linked to our outcome variable and has not yet been quantified in previous research.

In particular, we evaluate the cumulative benefits of the actual air quality improvements that have taken place in urban Spain over the period. The left-hand side graph of Figure 1 shows that worker exposure to PM<sub>10</sub> concentrations exceeding the EU 24-hour limit of 50 µg/m<sup>3</sup> decreased from 18.8% in 2005 to just under 2% in 2014. This improvement in ambient air quality saved at least €503 million in foregone production by reducing worker absence by more than 5.55 million days. It is important to note that this calculation is affected by major economic fluctuations that occurred during the sample period, depicted in the right-hand side graph of Figure 1. We account for this by using annual values of employment and wages.

We uncover two important sources of treatment heterogeneity. One relates to preexisting medical conditions that we infer from a worker's sick leave record. We estimate that the health

response of vulnerable workers (defined as those belonging to the top-five percentile of the distribution of sick leaves taken during the pre-estimation period) is more than three times stronger than the response of healthy workers. Furthermore, our analysis reveals that job security matters, in that workers with a high predicted risk of losing their job respond less strongly to a pollution shock than others. This finding suggests that exacerbated presenteeism could adversely affect future health outcomes and lower productivity in this tier of the labor market. These interactions of behavior and labor market institutions have a large impact on estimates of the external costs of air pollution that arise from changes in labor supply. If we adjust the above-mentioned benefits of air quality improvements to account for presenteeism, the impact estimates imply a corresponding increase in production worth €706 million. Irrespective of which number one prefers, this exercise shows that the productivity-related benefits of air quality improvements that occurred in Spain between 2005 and 2014 were both economically and statistically significant.

## REFERENCES

- Aragón, F., Miranda, J. J., and Oliva, P. (2017). Particulate matter and labor supply: The role of caregiving and non-linearities. *Journal of Environmental Economics and Management*, 86, 295–309.
- Currie, J., Hanushek, E. A., Kahn, E. M., Neidell, M., and Rivkin, S. G. (2009). Does pollution increase school absences? *Review of Economics and Statistics*, 91 (4), 682–694.
- Deryugina, T., Heutel, G., Miller, N. H., Molitor, D., and Reif, J. (2019). The mortality and medical costs of air pollution: Evidence from changes in wind direction. *American Economic Review*, 109 (12), 4178–4219.
- Ebenstein, A., Lavy, V., and Roth, S. (2016). The long-run economic consequences of high-stakes examinations: Evidence from transitory variation in pollution. *American Economic Journal: Applied Economics*, 8 (4), 36–65.
- Graff Zivin, J. and Neidell, M. (2012). The impact of pollution on worker productivity. *American Economic Review*, 102 (7), 3652–3673.
- Hanna, R. and Oliva, P. (2015). The effect of pollution on labor supply: Evidence from a natural experiment in Mexico City. *Journal of Public Economics*, 122, 68–79.
- Schlenker, W. and Walker, W. R. (2016). Airports, air pollution, and contemporaneous health. *Review of Economic Studies*, 83 (2), 768–809.