ERC-Grant "Health, Labor, and Environmental Regulation in Post-Industrial Europe" (HEAL)

Ulrich Wagner
University of Mannheim

Ulrich Wagner *is a Professor of economics at the University of Mannheim. His research on empirical environmental economics has appeared in leading economics journals and won him the Erik Kempe Award in 2015. Ulrich is a co-editor of the Journal of the Association of Environmental and Resource Economists and editorial board member of the Journal of Environmental Economics and Management. He obtained his PhD in economics from Yale University and subsequently worked as a postdoctoral research fellow at the Earth Institute at Columbia University. Before moving back to his native Germany, he was an Associate Professor at Universidad Carlos III in Madrid.*

Environmental regulation dates back at least as far as the thirteenth century when the King of England banned the burning of sea-coal in London in order to mitigate air pollution (Brimblecombe, 1987). Today, improving air quality is not only a priority in rapidly industrializing economies such as China and India where air pollution has been shown to shorten lives and increase morbidity, but it also continues to be a top priority for policy makers in post-industrial societies. In line with the view that the demand for environmental quality increases with economic growth (Grossman and Kruger, 1995), we observe that the richest urban agglomerations in Europe adopt very costly measures to further reduce air pollution.

As environmental economists, we teach our students that regulating air pollution and other environmental externalities is subject to trade-offs. Improving environmental quality is not a free lunch. Someone will have to pay for it. We then introduce them to the concept of socially optimal pollution, characterized by the equality of marginal social benefits of pollution and marginal social costs, as a utilitarian approach to resolving this trade-off. I am sure that many of you share my experience that this concept is often met with a healthy dose of skepticism. Some students disapprove of the notion to put a price on environmental quality, others object to the simple aggregation of environmental damages across individuals. Sometimes there are more extreme positions, such as refusal to compromise on either environmental quality or economic growth. But there is also a group of students who grow up to become policy makers and ultimately find themselves in a position where they have to allocate scarce resources between improving environmental quality and other socially desirable objectives. As researchers in environmental economics, we have a responsibility to provide them with the most precise tools for cost-benefit analysis, in particular when it comes to estimating the damages of air pollution, for which market prices are not available.

Measuring the damages of air pollution is challenging for a number of reasons. A major obstacle to the estimation of causal impacts is that air pollution exposure is not random across individuals. In their review paper, Graff Zivin and Neidell (2013) list numerous reasons for why spurious correlations between air pollution and health outcomes could arise over time or in the cross section. Sometimes it is precisely the – rational – attempt to avoid exposure to air pollution which biases the estimation of the true dose-response function with observational data[1]. Mismeasurement of pollution exposure is another important issue. Some air pollutants travel over long distances, so that the impacts are not confined to the place of emission.
My ERC-project HEAL, submitted under the 2019 Consolidator Grant call to the SH1 panel, quantifies air pollution damages using an empirical framework that addresses these challenges in a series of empirical applications. HEAL will support evidence-based environmental policy making in Europe and elsewhere through the development of new empirical tools that bring together causal inference and spatially detailed impact analysis. Although the main focus is on air pollution, the results have straightforward and politically significant implications for climate change

mitigation. This is because both global climate change and regional air pollution originate to a large extent from the combustion of fossil fuels, an activity that, in Europe as well as in other post-industrial societies, can be curbed only at steeply increasing marginal costs.

A large amount of the time and resources budgeted in HEAL is dedicated to analyzing the efficiency and distributional implications of changes in local air quality that arise as an unintended consequence of the European Union Emissions Trading Scheme (EU ETS) for carbon dioxide (CO_2). The EU ETS is the cornerstone of EU climate policy and has served as a blueprint for similar schemes in other countries[2]. There are plenty of things that we have learned about carbon trading through rigorous ex-post analysis of the EU ETS (the interested reader is referred to the symposium in REEP vol. 10(1), 2016). However, an important knowledge gap concerns the extent to which carbon trading has reallocated air pollution across Europe.

To understand why this matters, consider the map of Europe displayed in Figure 1. The map shows the spatial distributions of people and ETS regulated facilities that also emit air pollution. Since CO_2 is harmless to human health, it makes economic sense to allow market forces to allocate CO_2 emissions in ways that minimize the total abatement cost. However, the facilities displayed in Figure 1 emit CO_2 jointly with air pollutants that do have health impacts. For example, assume that firm A in Spain sells a permit to firm B in Germany. This trade is neutral in terms of CO_2 emissions, but it might not be neutral in terms of nitrogen dioxide (NO_2), an air pollutant. If, for the sake of the argument, we assume that firm B is more pollution intensive than firm A, overall pollution increases. In addition, the permit trade shifts pollution to a more densely populated area in Germany where it harms more people. While this is a hypothetical example, the vast potential for implicit pollution trades suggests that CO_2 trading could have large impacts on air quality and public health. Measuring such health damages (or benefits) is far from trivial as they are jointly determined by the heterogeneity in abatement costs and pollution intensities across thousands of polluting facilities, by complex patterns of atmospheric pollution transport, and by differences in population density.

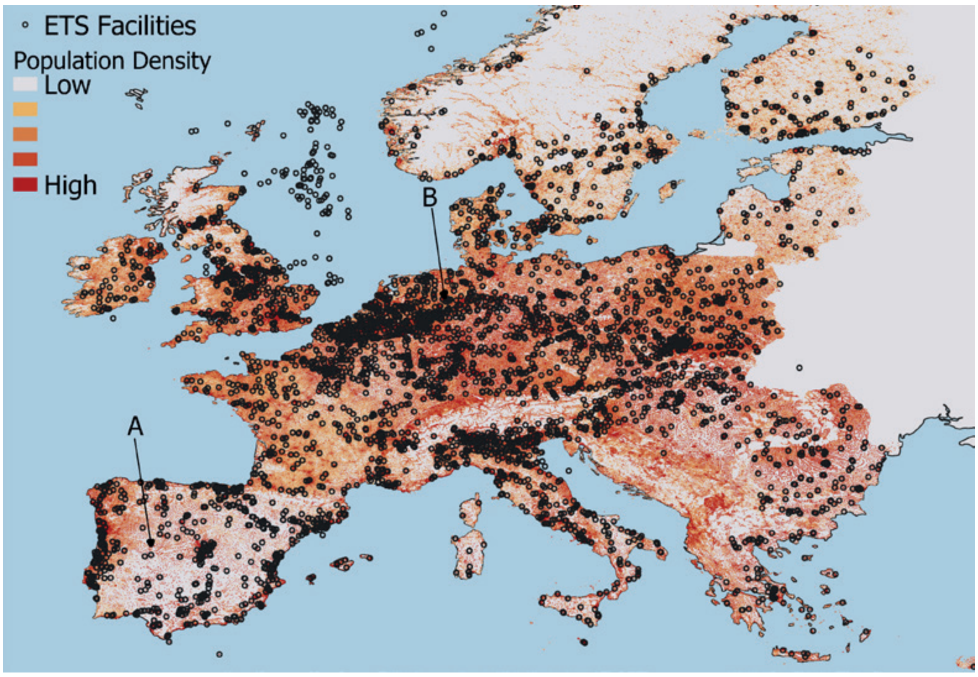

Figure 1. Polluters and Pollutees in the European Carbon Market

The various work packages of HEAL contribute the buildings blocks for a spatially explicit ex-post analysis of this issue. In painstaking data work joint with Laure de Preux (Imperial College London), I have linked EU ETS installations of polluting facilities to the European Pollution Release and Transfer Register (EPRTR). Our dataset comprises 5,745 geo-referenced installations in 29 countries (cf. Figure 1), representing 92% of all CO_2 emissions in the EU ETS. These installations release up to 50 different pollutants to air, water, and land. In ongoing work with our Mannheim colleague Dana Kassem, we use this dataset to econometrically estimate the facility-level impacts of CO_2 trading on air pollution emissions. The microeconometric model allows us to predict pollution emissions by each facility in a counterfactual scenario without CO_2 trading.

To estimate health impacts in the counterfactual, we need to translate emissions into human exposure to pollution. This is a complex process governed by weather, topography and chemistry. A state-of-the-art chemical transport model will be calibrated to carry out this step. Finally, the treatment effect on public health will be calculated on a spatial grid for Europe by multiplying the counterfactual pollution exposure with monetized per-capita dose-response functions from the literature. The estimates obtained in this way allow us to analyze the efficiency and distributional consequences of implicit pollution trades under the EU ETS.

The possibility of efficiency losses due to heterogenous marginal damages across space is well-known in the context of trading schemes for emissions of local and regional air pollutants (Baumol and Oates, 1988). Recent empirical research on this matter has focused on emissions trading programs for sulfur dioxide and nitrogen oxide in the U.S., and examines the economic gains from adjusting permit prices to account for heterogeneous marginal damages (Muller and Mendelsohn, 2009; Fowlie and Muller, 2019). However, there is no ex-post evidence thus far on efficiency losses in the EU ETS where CO_2 trades may give rise to multiple implicit pollutant trades without being accounted for in the permit price.

The analysis of distributional consequences is motivated by the fact that, efficiency aside, any reallocation of air pollution due to the EU ETS creates winners and losers. In the U.S., emissions trading programs have been subject to great public scrutiny regarding distributional impacts against the backdrop of environmental justice (Fowlie et al, 2012; Grainger and Rungmas, 2018). Due to its large scale and unique importance for carbon trading schemes elsewhere in the world, the EU ETS presents an excellent opportunity for studying the distributional effects of carbon trading. Beyond environmental justice, the distribution of the public health impacts of carbon trading matters because it can have repercussions on public support for climate policy and for centralized policy making in the EU more broadly.

Using the example of the EU ETS, I have described the interdisciplinary approach taken in HEAL which emphasizes both causal inference and spatial detail in the empirical analysis of air pollution damages. As part of the 5-year grant, I will employ this approach to obtain credible estimates of the pollution-health gradient while also incorporating subclinical and long-term health impacts. The methodological advances of this research agenda will directly benefit cost-benefit analysis in a broad range of policy domains where air pollution externalities matter, including energy, climate and transportation.

References

Baumol, W. and Oates, W. (1988). *The theory of environmental policy*. Cambridge University Press, Cambridge.

Brimblecombe, Peter. (1987). *The Big Smoke: A History of Air Pollution in London since Medieval Times*. Methuen, London and New York.

Fowlie, M., Holland, S., and Mansur, E. (2012). "What Do Emissions Markets Deliver and to Whom? Evidence from Southern California's NO_x Trading Program." *American Economic Review*, 102(2):965–93.

Fowlie, M. and Muller, N. (2019). "Market-based emissions regulation when damages vary across sources:What are the gains from differentiation?" *Journal of the Association of Environmental and Resource Economists,* 6(3): 593-632.

Graff Zivin, J., and Neidell, M. (2013). "Environment, health, and human capital." *Journal of Economic Literature,* 51(3): 689–730.

Grainger, C. and Ruangmas, T. (2018). "Who Wins from Emissions Trading? Evidence from California." *Environmental and Resource Economics*, 71: 703-727.

Grossman, G. and Krueger, A. (1995). "Economic Growth and the Environment." *Quarterly Journal of Economics*." 110(2): 353-377.

Martin, R., M. Muûls, and U.J. Wagner (2016). "The Impact of the EU Emissions Trading Scheme on Regulated Firms: What is the Evidence after Ten Years?" *Review of Environmental Economics and Policy*, 10(1): 129-148.

Muller, N. Z., and Mendelsohn, R. (2009). "Efficient Pollution Regulation: Getting the Prices Right." *American Economic Review*, 99(5):1714–1739.

End Notes

[1] Experimental approaches to this topic remain limited to very low exposures for obvious ethical reasons.

[2] Canada, Japan, Kazakhstan, South Korea, Switzerland, and the U.S. have also implemented (pilot) ETS for CO_2. China is in the process of rolling out its pilot ETS to a nationwide scheme. Several countries plan to adopt ETS.