

Equity and the Environment: An Application of the  
Berliant-Strauss Vertical and Horizontal Equity Framework to  
Measuring the Distributional Effects of Air Quality Regulation

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Abstract

This paper builds on a series of theoretical and empirical index number papers by Berliant and Strauss (1983, 1985, 1993, 1996) which decompose the distribution of income and taxation into vertical and horizontal components, and a series of recent environmental engineering papers by Heo et al. (2016a, 2016b, 2017) which estimate the social costs of air pollutant emissions and their source contributions in the US.

By viewing the net spatial effects of pollution on human mortality as an implicit tax on communities and their ability to pay, as proxied for by percapita personal income, both the horizontal equity and vertical equity effects of air regulations can be summarized and compared across US counties. A major regulation of US Environmental Protection Agency (USEPA) on emissions from fossil fuel-fueled power plants of emissions was analyzed as a case study to illustrate our method to characterize the distributional effects of reduced exposure to fine particulate matter (PM<sub>2.5</sub>) from such regulations on 3109 US counties' mortality rates. We find progressivity in the relationship between mortality rates and percapita income from 48% to 61% of vertical comparisons, and high levels of regressive comparisons, from 38% to 51% of vertical comparisons.

Surprisingly, proportionality in the relationship between mortality rates and percapita incomes is quite infrequent. On the other hand, horizontal inequity in mortality rates was evident in better than 87% of comparisons where percapita income of communities were quite similar. When our index measures keep track of before and after policy changes to reduce PM<sub>2.5</sub>, we find that the policy changes tend to make the relationship between mortality rates and percapita income more regressive, while horizontal inequity remains extremely high, and these types of comparisons are sensitive to whether or not we weight the changes by disparities in percapita incomes and mortality rates. That similar percapita income communities experience quite variable rates of mortality may be a surprising result to those who follow environmental policy debate, and warrants further investigation.

Keywords: Fine Particulate Matter, PM<sub>2.5</sub>, Public Health Effects, Distributional Effect, Vertical Equity, Horizontal Equity

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