The Effectiveness of Environmental Policies in Reducing Population Exposure to Fine Particulate Matter

Master Thesis by Paul Steinmaßl

Abstract for the Momentum Kongress 2025

Fine particulate matter is a major cause of premature mortality, responsible for an estimated 374,000 deaths annually in the European Union. Current EU Air Quality standards impose a maximum population exposure to PM2.5 of 10 µg/m3. According to the European Environment Agency, a reduction to 10 µg/m3 could reduce adverse health effects by 27%. This thesis aims at analyzing the effectiveness of policies and measures in achieving emission reductions for fine particulate matter, that is particles with a diameter of 2.5 micrometers or less.

A "within-between" Random Effects model is applied on OECD data from the Green Growth Database and on the Climate Actions and Policies Framework. It allows for the differentiation of instrument types and target sectors, as well as to disentangle time-invariant and time-variant effects. The empirical analysis covers a 10-year period from 2010 to 2019 and includes 22 EU countries. PM levels decreased (on average by 21.77%) and the number of policies increased (on average by 43.65%) over time in all observed countries, but both variables were subject to substantial cross-country differences in magnitude and structural composition. The mean particulate matter concentration was 13.439 µg/m3 (15.65 µg/m3 in 2010 and 12.22 µg/m3 in 2019). On average, each country applied around 23 policies at the beginning and 33 policies at the end of the observed period.

Policy variables were significant in all regressions. The largest PM2.5 reductions occurred for Non-Market-based policies (0.840 µg/m3 per policy) and the Industry sector (0.999 µg/m3 per policy). Compared to the mean PM2.5 level, it relates to a respective decrease of 6.5% and 7.43% of the average concentration. The overall reduction per policy was 0.335 µg/m3, or 2.5% of the mean.