The Interplay Between Economic Development and Air Quality in Poland (2004–2022)

A Panel Data Econometric Analysis of the Environmental Kuznets Curve (EKC)

Objective: To quantify how GDP growth, motorization, and urbanization affect air pollutant concentrations (PM2.5, NO2, SO2) across 16 Polish voivodeships

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Transforming Raw Data into Analytical Insights

Data Scope: A comprehensive panel dataset covering 19 years (2004–2022) for all Polish regions.

Data Sources: Integrated environmental monitoring data with socio-economic indicators (Statistics Poland - GUS).

Key Variables:

- Economic: GDP per capita, GDP squared (for EKC testing).
- Socio-Demographic: Population density, Urbanization rate.
- Industrial/Logistics: Motorization rate (Cars per 1000 people).

Tools Used: R

Advanced Econometric Modeling

Approach: Utilized Linear Panel Data Models to account for regional heterogeneity.

Specific Model: Fixed Effects (FE) using the plm package in R.

Why FE? To control for time-invariant characteristics unique to each voivodeship (e.g., geographic location, historical industrial base)

Statistical Tests: Correlation analysis (Pearson), Descriptive statistics, and Model verification in Gretl.

Data-Driven Conclusions

- Statistically significant positive correlation between car density and NO2 levels. Actionable Insight: Urban transport policy is the primary lever for improving air quality in metropolitan areas.

- Evidence of a "decoupling" effect where SO2 levels decrease as GDP grows, suggesting technological advancement and shift to cleaner energy.

Correlation Matrices: Clear visualization of the link between urbanization and PM2.5.

Interactive Heatmaps: Identified regional hotspots (Silesia vs. Podlaskie)

The exact results and visualizations obtained will not be published.
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