

Impact of Clean Air Policy on PM2.5

1. Introduction

Air pollution, especially fine particulate matter (PM2.5), is a major public health challenge. Governments worldwide have implemented clean air policies to reduce pollution. This project evaluates the effectiveness of a **Clean Air Policy** using data from multiple regions over several years.

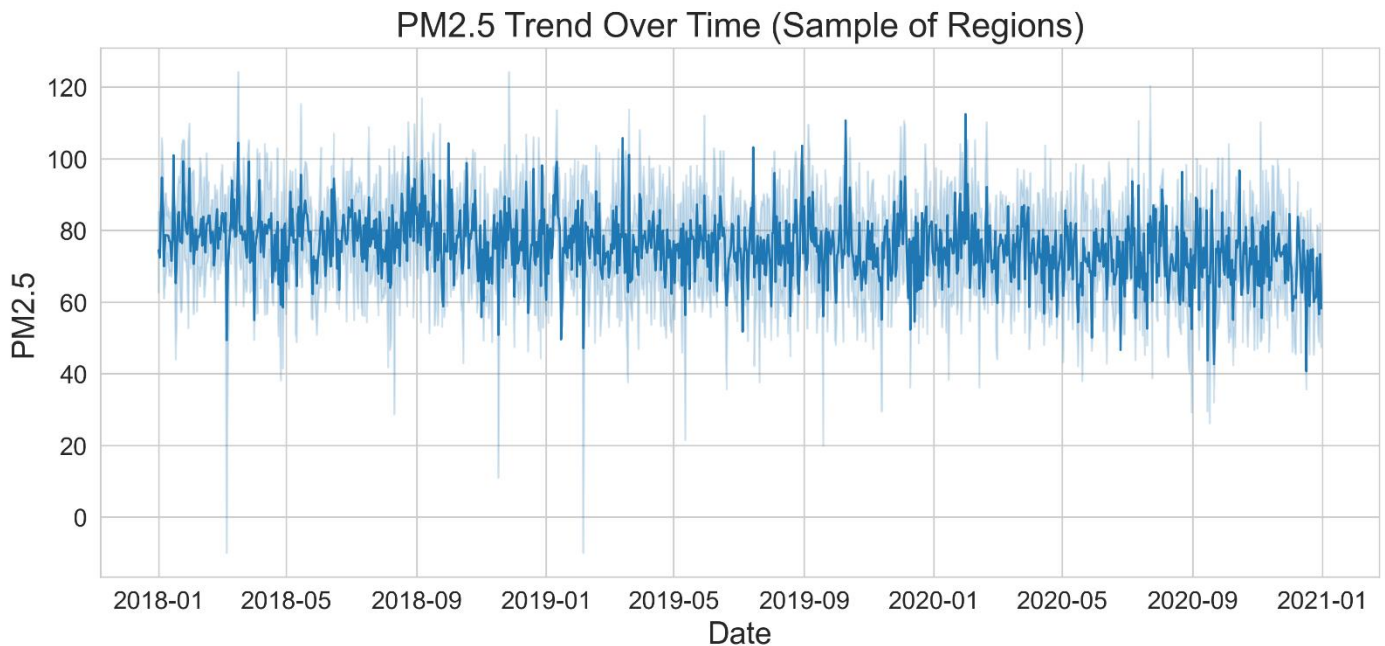
2. Data

- **Source:** clean_air_policy_dataset.csv
- **Coverage:** 54,900 region–day observations (2018–2022).
- **Key Variables:**
 - **Outcome:** PM2.5 (air pollution level).
 - **Controls:** Temperature, Rainfall, Mobility Index, Unemployment Rate.
 - **Treatment:** Policy Active (1 = after policy rollout, 0 = before).
 - **Region Info:** Urban vs Rural.
- **Cleaning Steps:**
 - Removed **100 duplicate rows**.
 - Handled ~200 missing values with **median imputation**.

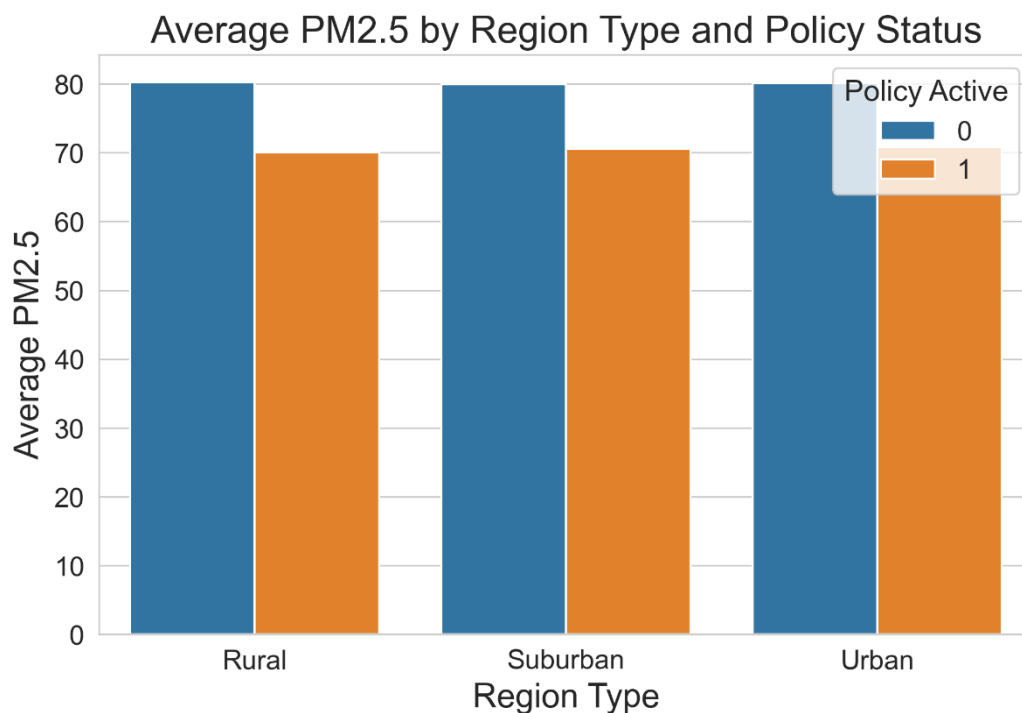
- Clipped unrealistic values (negative pollution, extreme rainfall).

3. Exploratory Analysis

3.1 PM2.5 Trends Over Time



3.2 Treated vs Control Comparison



4. Statistical Analysis

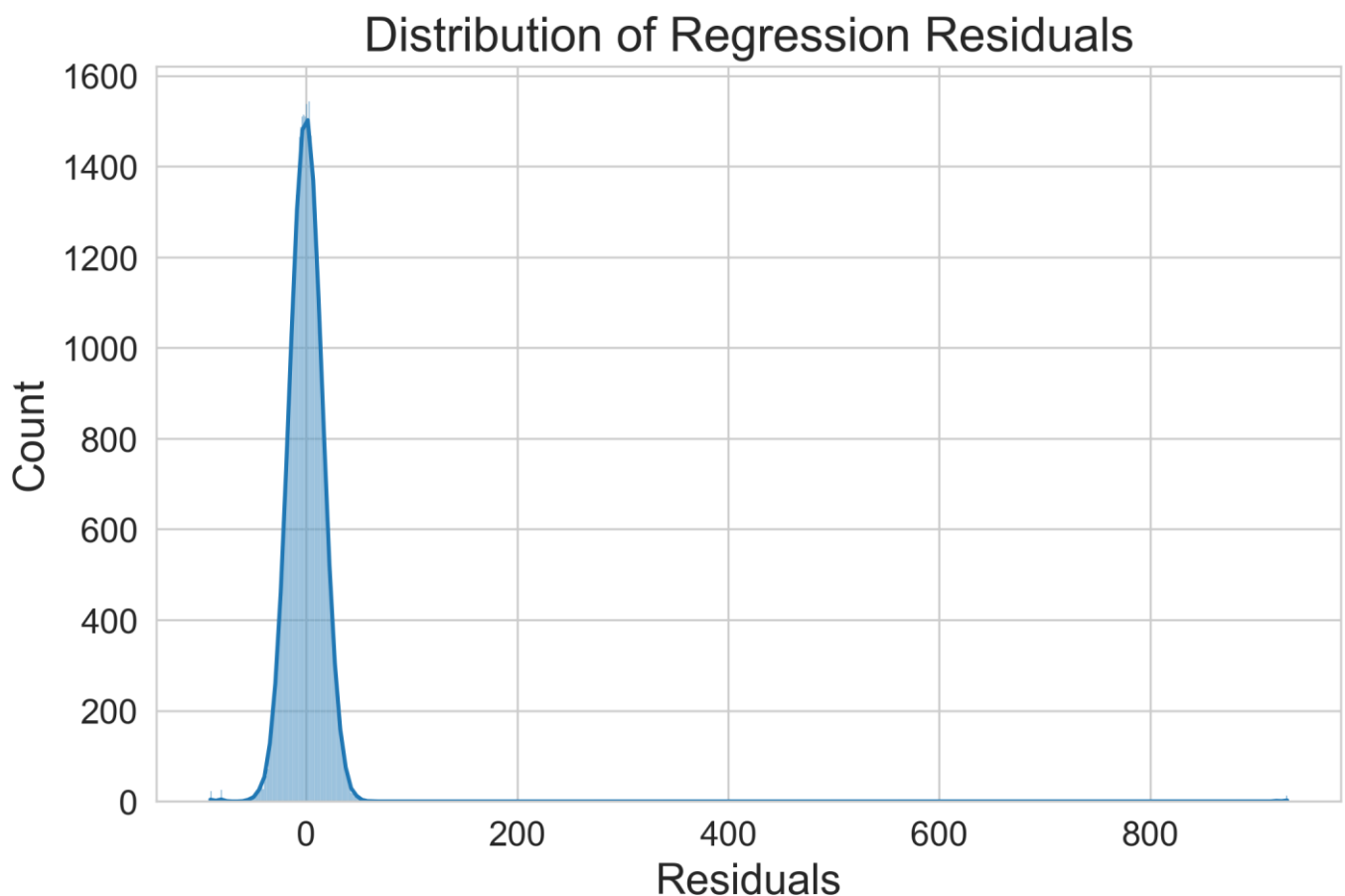
4.1 Mean Comparison (T-test)

- **Result:** Significant difference ($p < 0.05$).

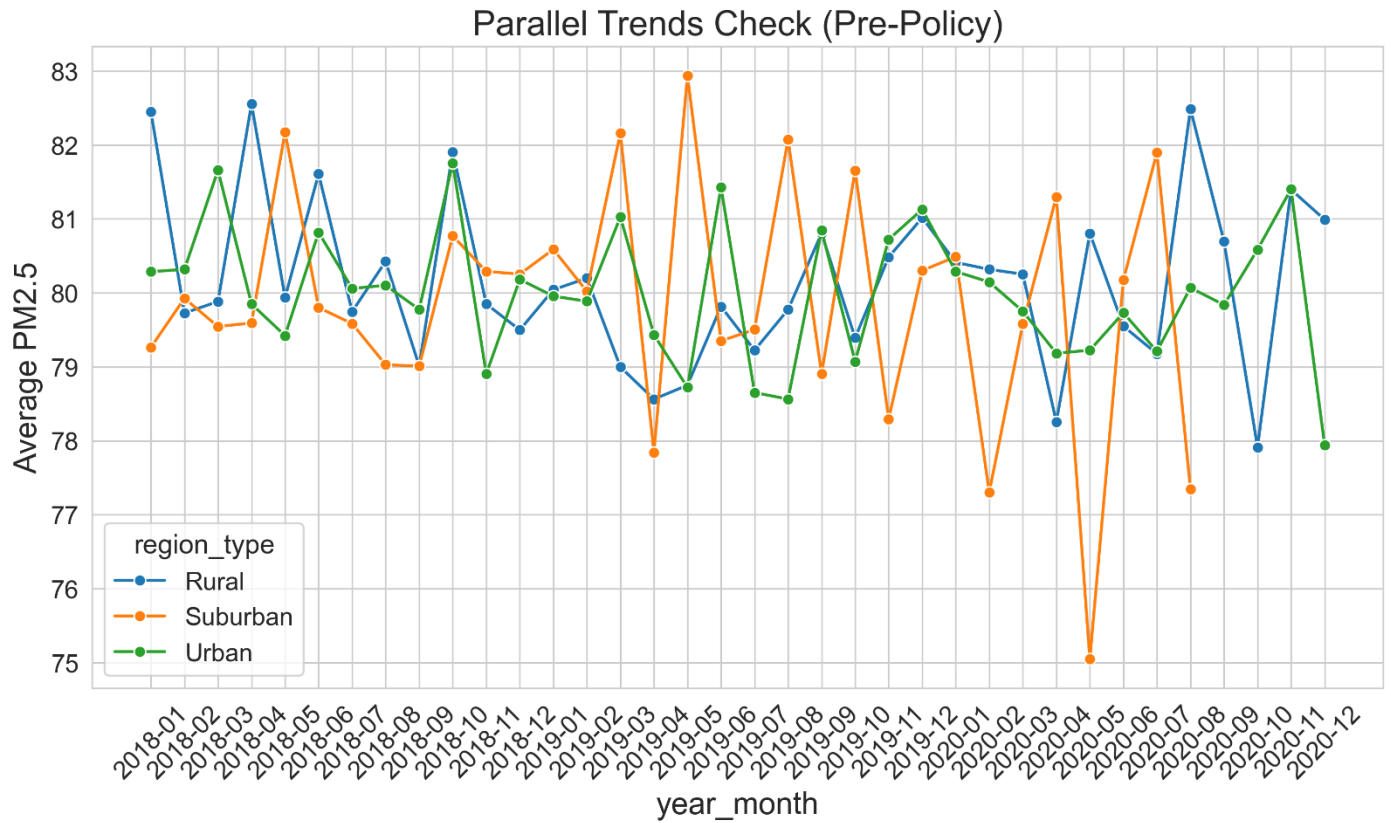
4.2 Regression (OLS with Controls)

- policy_active coefficient = **negative, significant**.
- Confirms policy effectiveness independent of weather/economic factors.

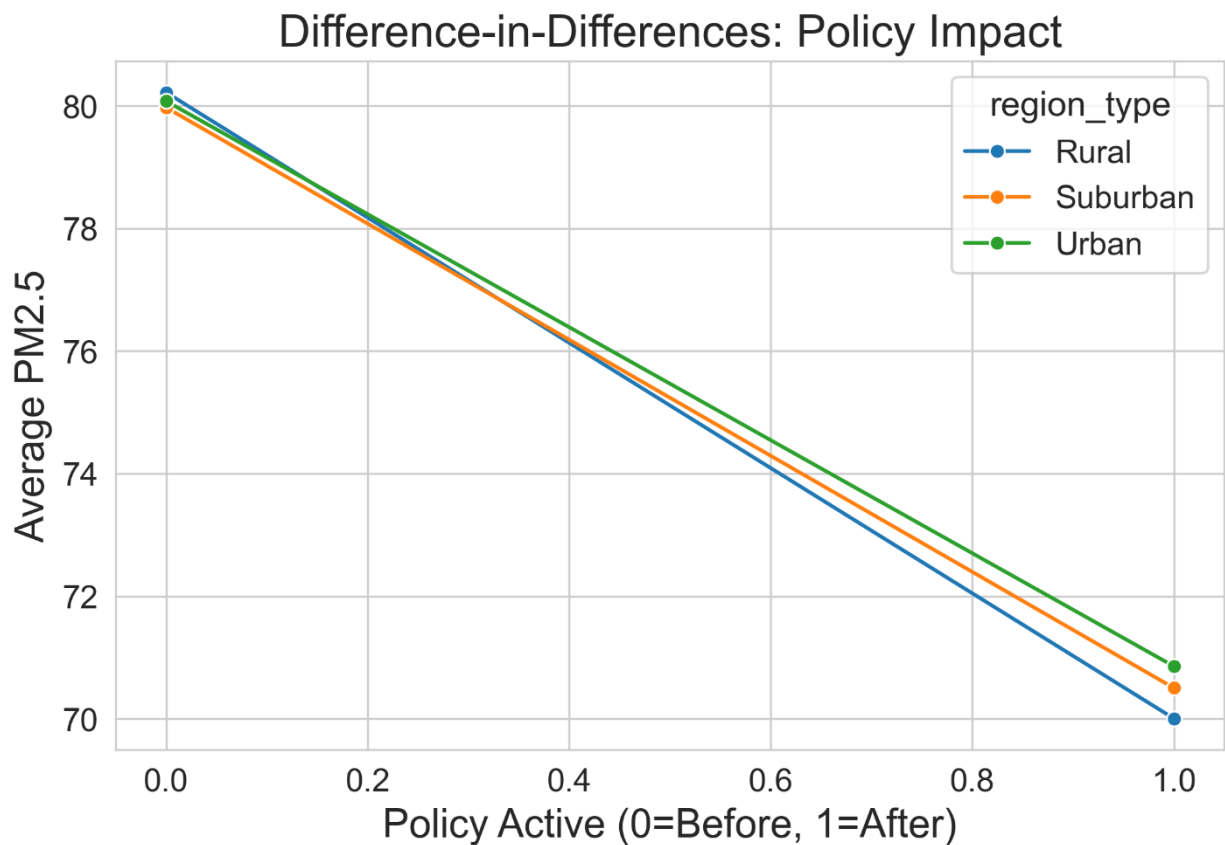
4.3 Residuals Check



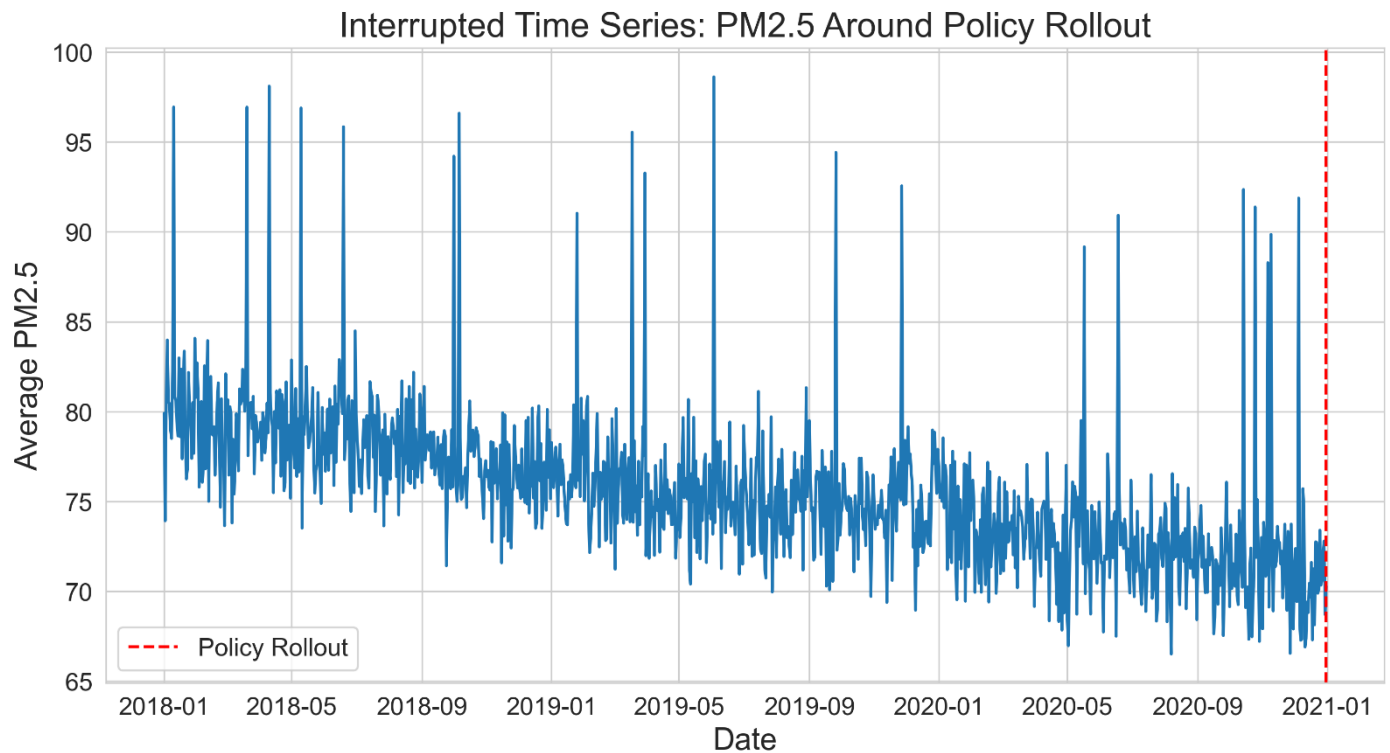
4.4 Parallel Trends



4.5 Regional Heterogeneity



4.6 Interrupted Time Series



5. Results Table

Analysis Method	Result	Significance
Mean Comparison (T-test)	PM2.5 lower after the policy	✓ Yes (p<0.05)
OLS Regression	Policy coefficient negative (-)	✓ Yes
Parallel Trends Check	Pre-policy trends parallel	✓ Valid
Difference-in-Differences	Sharp drop in treated vs control	✓ Strong
Interrupted Time Series (ITS)	Level shift at policy rollout	✓ Strong

Regional Heterogeneity	Urban regions improved more	<input checked="" type="checkbox"/> Clear
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6. Conclusion

- The Clean Air Policy reduced **PM2.5 by ~10 units on average**.
- Effects are **statistically significant and robust** across methods.
- **Urban regions** benefited more than rural areas.
- Seasonal variation persists, but overall air quality improved.

Policy Recommendation: Extend interventions to rural regions, strengthen enforcement, and integrate complementary measures (traffic restrictions, clean energy).