Environmental Regulation-Evidence from India

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Research Objectives

Using Ambient Air Monitoring Data from India State Pollution Control Boards, we analyze the effects of a selective firecracker ban issued by the National Green Tribunal in India near the Diwali festival of 2020. We aim to study how effective the bans were in lowering pollution from fire cracker bursting and explore how political incentives could account for heterogeneity of enforcement across areas.

Following concerns over aggravation of COVID-19 symptoms from air pollution, the National Green Tribunal imposed a total ban of all firecrackers in the National Capital Region (NCR) and issued notices for a complete ban in States where air quality is not satisfactory. In the official report, The NGT compiled a list of 122 non-attainment cities and their respective states as a target for enforcement of a complete firecracker ban. In states where pollution levels are satisfactory, the NGT urged these states to only allow environmentally friendly Green Crackers and the timings for bursting would be restricted to 2 hours during festivals.
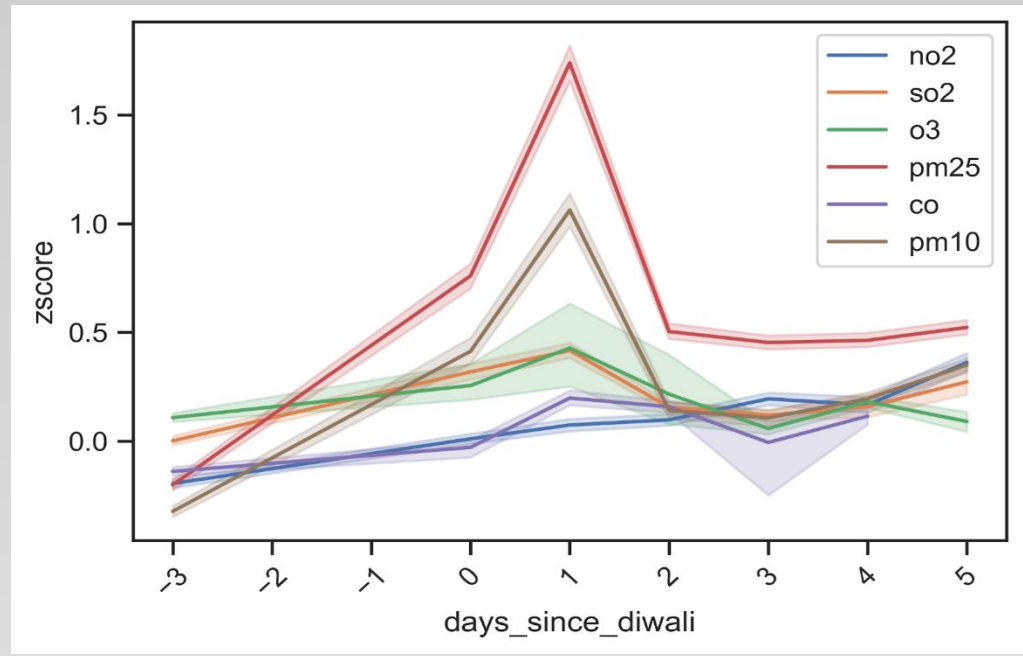

Figure 1 shows various pollutants and their normalized levels on days since Diwali. There is a great degree of heterogeneity across different pollutants but PM2.5, PM 10, SO2, and O3 peak 1 day following Diwali. This gives clear evidence of the effect of Diwali on some pollutants in the air and reason to impose a firecracker ban

RA Contribution

Part of my task as an RA included constructing a dataset containing the status of the firecracker ban in India's 742 districts and 36 States/UTs. I looked through State Gazettes on State Pollution Control Websites to find out whether a state imposed a complete ban on use and sale of fireworks following Diwali. Using indicator variables, I also took note of whether the ban was selective in areas containing non-attainment cities or state-wide and whether or not a state imposed a green cracker policy. As for data on enforcement of the Ban, the official reports from State Pollution Boards don't give any detail about the degree of enforcement during the Diwali Season.

After Completing this Dataset, I merged it with district shape file data and visualized the spatial distribution of the ban in ArcMap. I then took this new dataset and merged it with Ambient Air Monitoring Data from ground-level pollution monitors. I used time series line plots to compare the trends in pollution levels in places with a complete ban on firecrackers compared to places without a complete ban on firecrackers.

Spatial Distribution of Firecracker Ban

Figure 2: India Districts with Complete Ban on Use and Sale of Fireworks
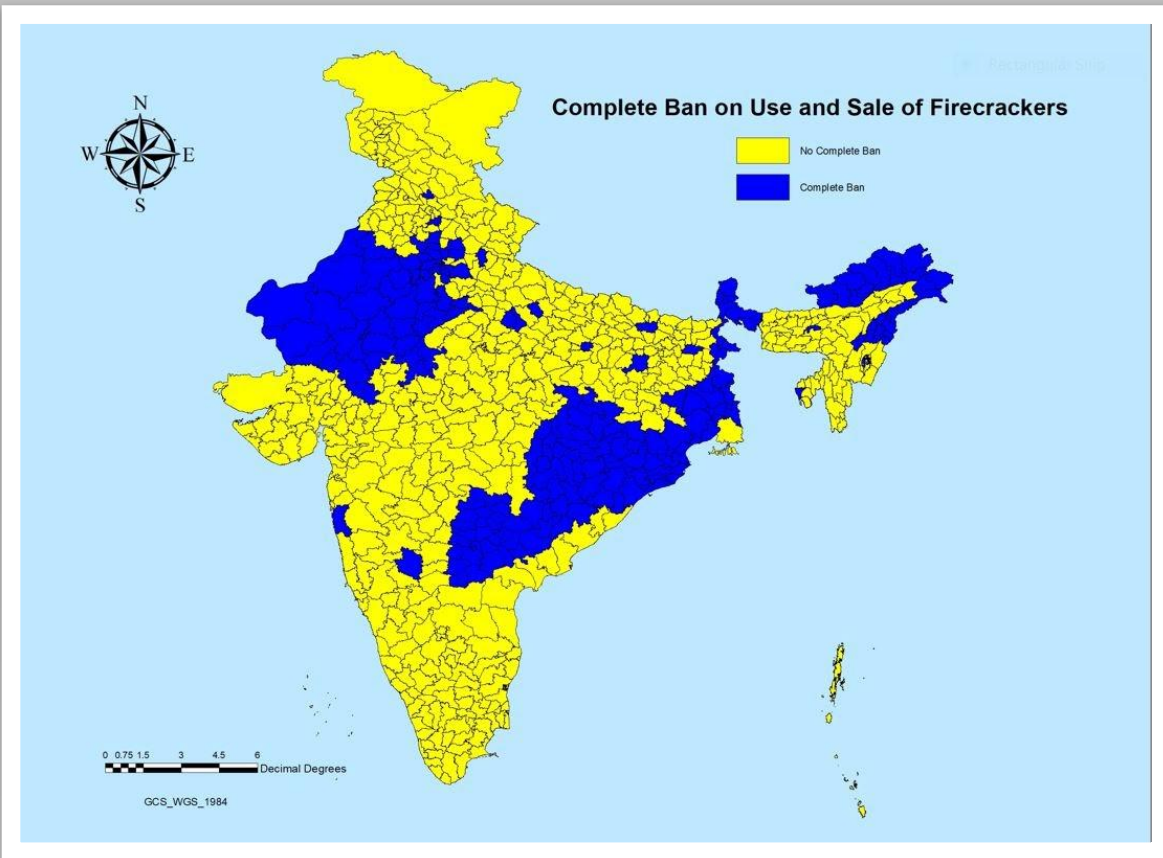

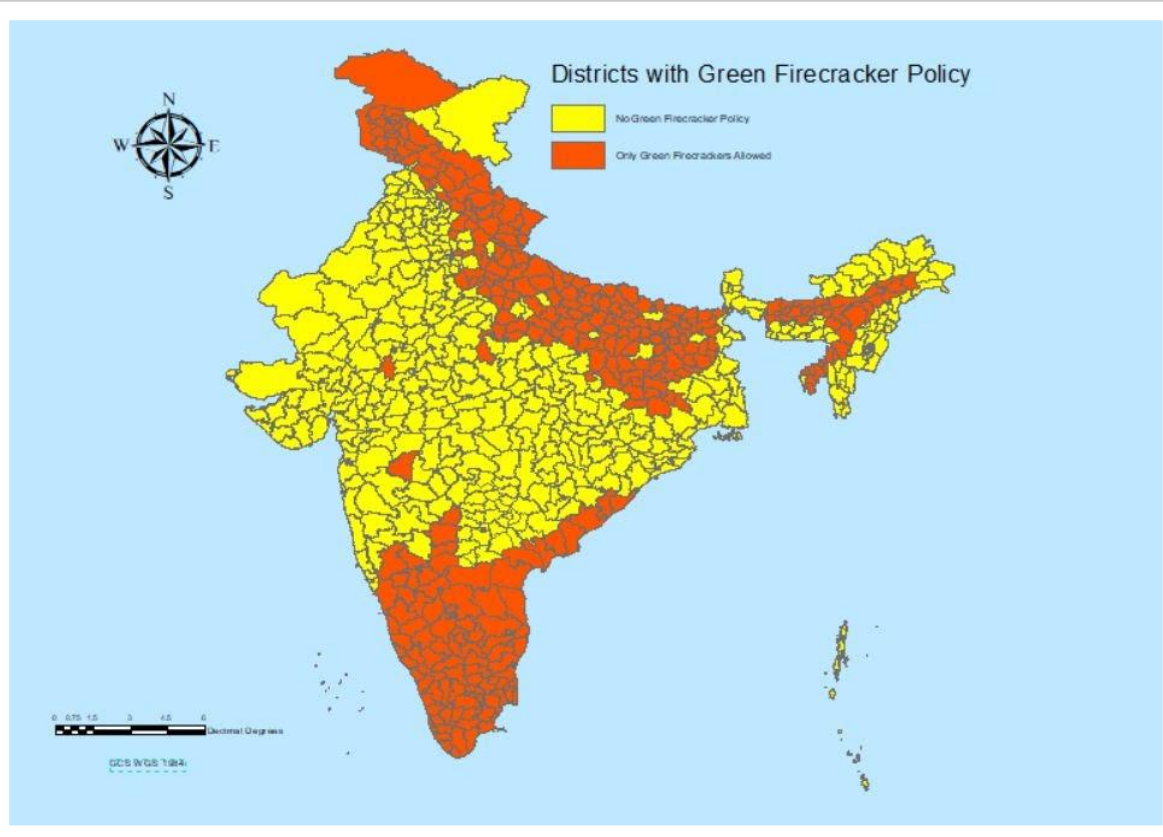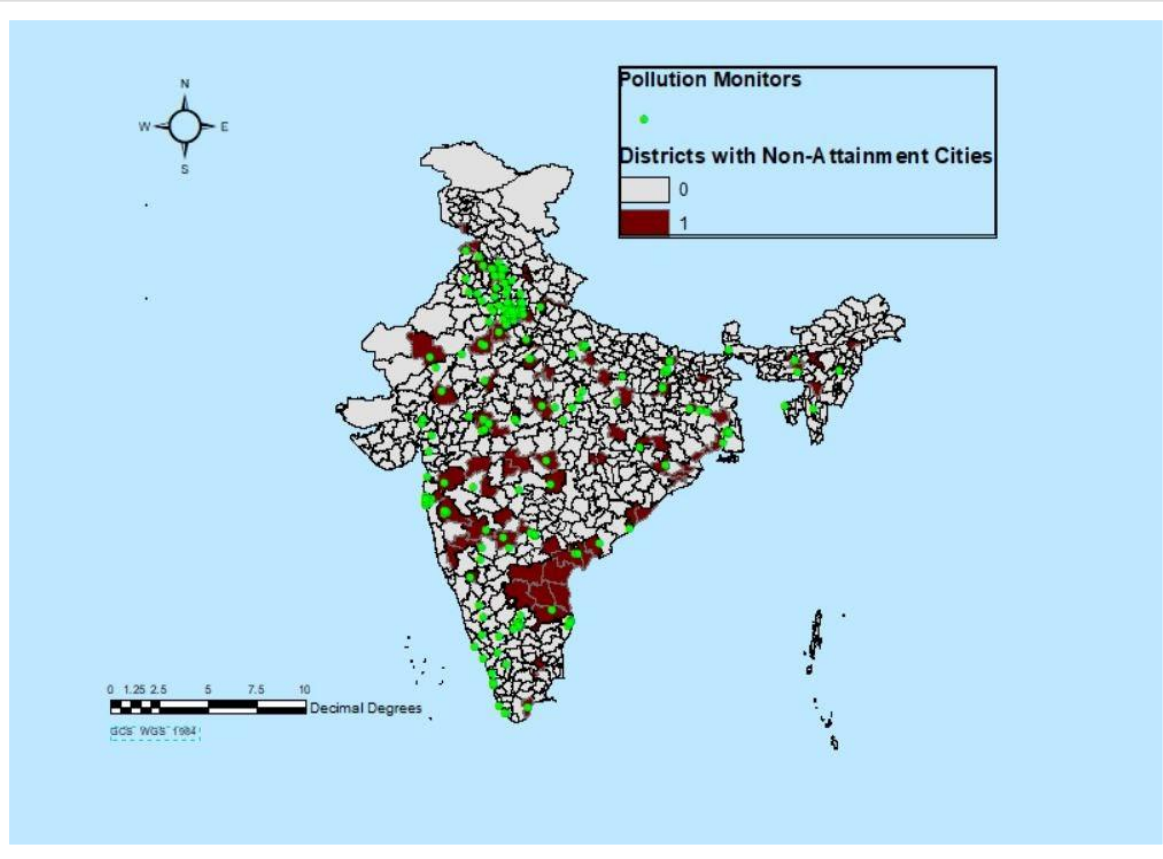**Figure 3: India Districts with Green Firecracker Policy**

Figure 4: Spatial Distribution of Pollution Monitors and Districts with Non-Attainment Cities

Time Series Analysis of Firecracker Ban

Figure 5: PM 2.5 Levels in Districts with a Complete Ban vs. Districts without a Complete Ban
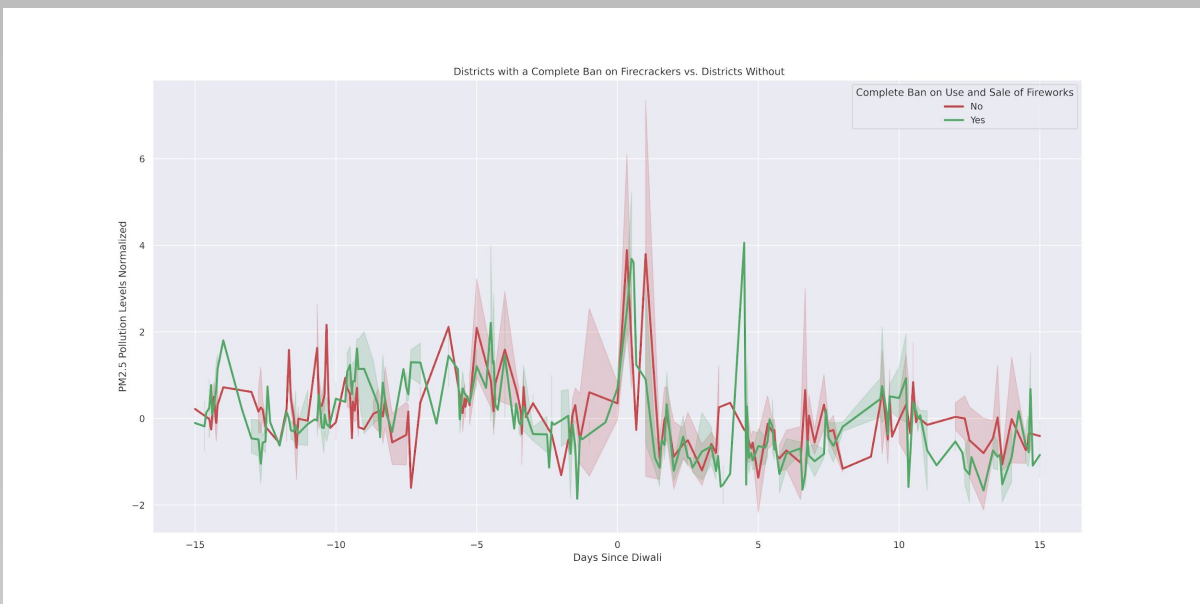

Figure 6: NO2 Levels in Districts with a Complete Ban vs. Districts without a Complete Ban
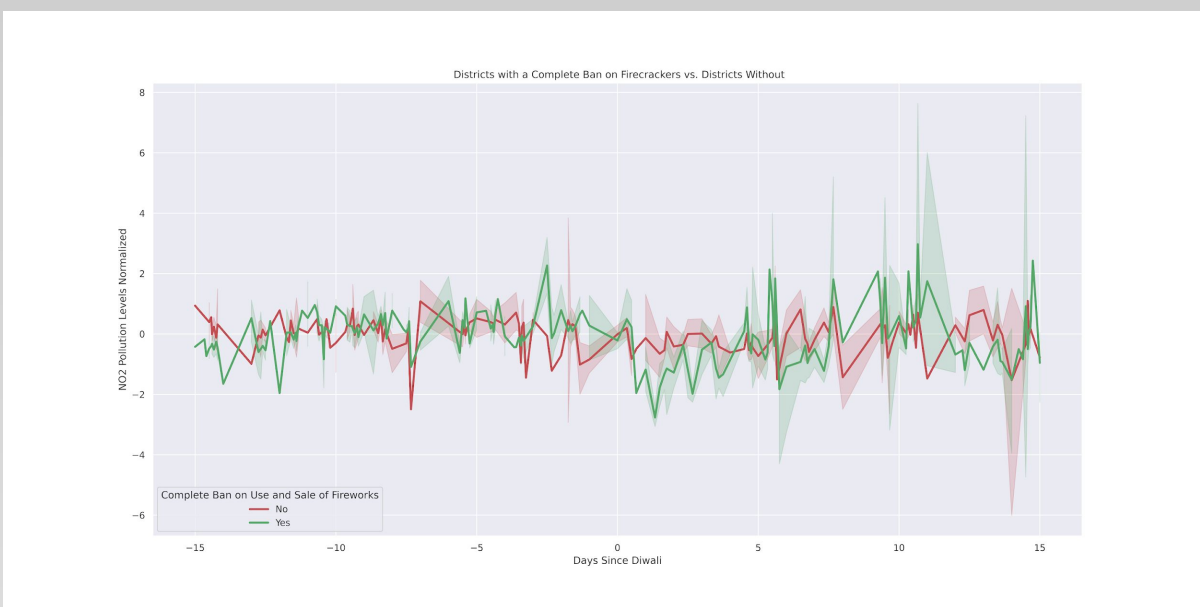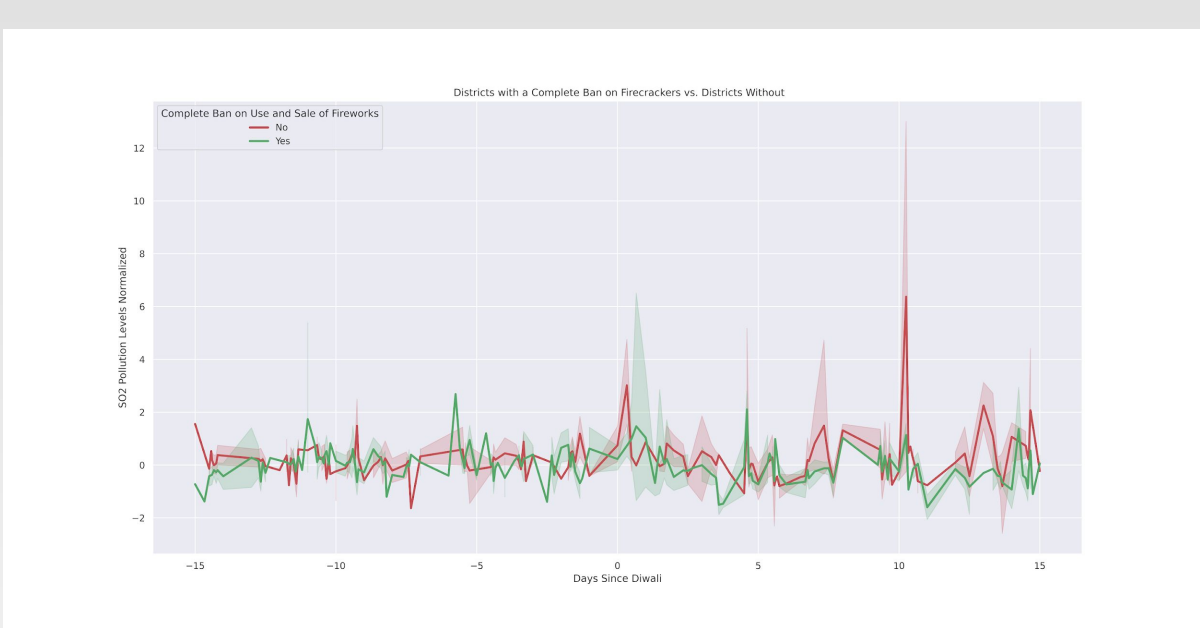

Figure 7: SO2 Levels in Districts with a Complete Ban vs. Districts without a Complete Ban

**Time Series Pollution Data only account for 158 monitors distributed across 87 districts

Figure 8: PM10 Levels in Districts with a Complete Ban vs. Districts without a Complete Ban

Results and Analysis

Figure 2 and Figure 3 show that the Complete Firecracker Ban and Green Cracker Policies are concentrated in different areas of the Country. The Blue areas show that Complete Bans on Sale and Use of Firecrackers were concentrated in the North-West Regions bordering the National Capital and in the North East states of Odisha and Chhattisgarh. Green Cracker Policies were mostly issued in States bordering the Himalayas and in the Southern Areas including Tamil Nadu, Kerala, and Karnataka. Figure 4 shows that Pollution Monitors do not cover all districts that contain non-attainment cities (cities with pollution levels above CPCB thresholds). This limits a potential analysis comparing heterogeneous firecracker policies across non-attainment districts and attainment districts. With most monitors concentrated in dense metropolitan areas, there is only pollution data available on a select few districts .

In Figures 5 -8, we look at time series trends of different pollutant levels 15 days since Diwali in districts with complete bans compared to districts without Complete Bans. The time series graphs suggest little evidence of the firecracker ban effect on lowering air pollution levels. From Figure 5, There isn't any noticeable difference in trends of PM 2.5 pollutant levels except for a spike in pollution roughly 4 days after Diwali across districts with no Complete Ban. In both groups of districts, PM2.5 levels spike 0-1 days after Diwali . For Figure 6-8, the time series trends are similar excepts for spikes in SO2 and PM 10 occurring 10 and 5 days after Diwali across districts with no complete ban in place.

Next Steps

The time-series analysis shows some interesting trends that give mixed evidence of the effect of the Firecracker Ban on air pollution. To infer causality, we would use regression discontinuity analysis, comparing district just above and just below the ban prescription criteria imposed by the NGT.

The following steps would involve exploring heterogeneity in enforcement of the ban by proportion of population that is Hindu, to shed light on electoral incentives behind differential enforcement. Additionally to that end, the project will also look at differential enforcement by partisan alignment - comparing enforcement across constituencies where local politicians have great influence over regulatory institutions - those who have more influence, particularly in Hindu majority areas, could prefer to enforce the ban less so as not to risk upsetting people wanting to celebrate, therefore improving their chances of re-election.