Intensive and extensive margins of the peak load: Measuring adaptation with mixed frequency panel data

Objective

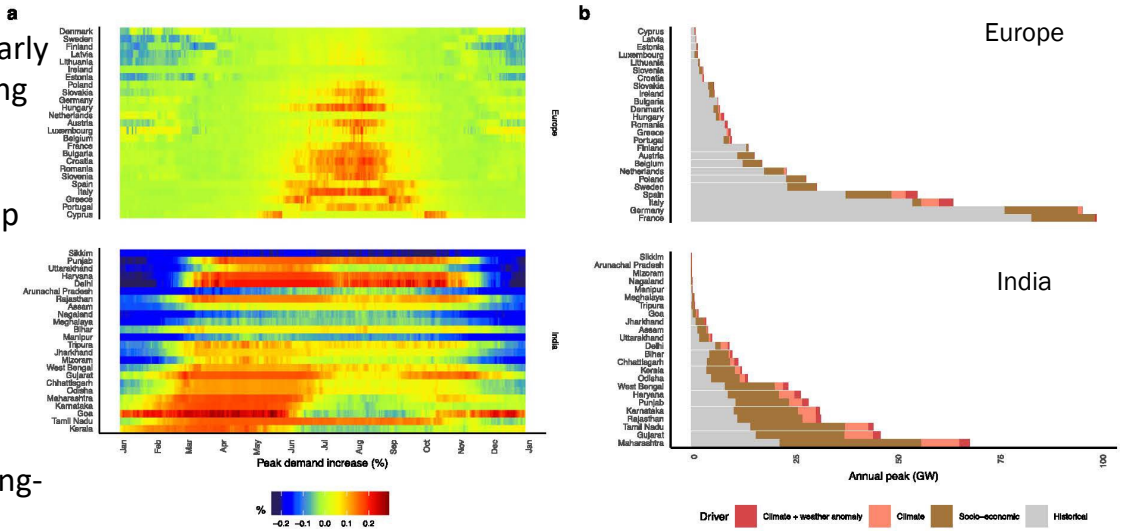
Understanding the impact of daily maximum temperatures on peak electricity demand, particularly as air conditioning usage rises, is critical for ensuring system reliability. We propose a methodology to separate the intensive- and extensive-margin adaptation components inherent in the relationship between electricity demand and temperature in Europe and India.

Approach

Rather of assessing air conditioner ownership directly, this method uses the slow changes in climate in each location to estimate the average long-term effects, similar to extensive margin adjustments. It also maintains the swift variations in load-weather correlations to record instantaneous reactions to abrupt weather shifts, much as intensive margin adjustments.

Impact

Long-term impacts differ from short-term dynamics, with income influencing adjustments. Peak load is expected to increase by 20-30% by 2050 in Southern Europe and some Indian states, emphasizing the importance of economic structure in climate adaptation.



Panel a: Peak load shock induced by climate change shifts, by day of the year circa 2050 under RCP 5-8.5. The values correspond to the mean across 25 GCMs.

Panel b: Annual peak load in 2050, decomposed between four additive components: i) historical annual peak load (highest level observed in the time series), ii) additional increase due to the income per capita growth, under the RCP 5-8.5., iii) additional increase due to climate change and iv) due to a positive weather anomaly, under the RCP 5-8.5.

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