Carbon Emissions in the US: Factor Decomposition and Cross-State Inequality Dynamics

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In recent years, a number of international initiatives and abatement methods have been postulated to condense emissions from anthropogenic sources, e.g., 1997 Kyoto Protocol or the 2015 Paris Agreement. As constraints of carbon emission reductions are linked to economic growth and development, emission (in)equalities are of key concern to, *inter alia*, climate negotiations, the design of mitigation policies, R&D investments and production reallocation decisions. The notions of emissions inequality and polarisation are aimed to inform different emission abatement proposals on the contribution of each state to the climate change debate. Economists have also noted the potential for income inequality to affect pollution indirectly through either the distribution of political power or changes in consumption. An inequality index, which summarizes this distribution and used in this paper is the Theil index; the fact that it can be decomposed into different factors, makes it an appealing candidate for this purpose.

This paper examines the determinants of inequality in the distribution of CO_2 emissions across US states comprising a balanced panel of 48 regions with time span from 1980 to 2017. We implement a factorial decomposition of CO_2 per capita based on extended Kaya factors; that is, carbon intensity of fossil fuel consumption, energy mix, energy intensity of GDP, economic growth in terms of labor productivity and employment rate. Findings reveal that inequality in emissions increased between 1980 and 2017. Post-2005 period Theil indices are above the average across years, implying that responsibilities for CO_2 have not diffused in the last decade. Overall, we identify energy intensity as the main source of inequality. Therefore, policy measures focusing on either reducing the cost or increasing the efficiency of converting energy to GDP prove effective in controlling emissions, as convergence of energy intensity leads to a corresponding reduction in total CO_2 per capita inequality. Indicative strategies might include incentives to high intensity states for the development/use of advanced technologies in energy conversion, technology transfers, allocating the production of certain manufactured products to low energy intensity regions/states (rather than producing them in-state) or even infrastructure investments to facilitate use of fuel efficient vehicles, mass transportation and carpools.

Based on the within and between group inequality components we also explore the effect of geographical, geological, climatic and human development partitions of US states' groups. Results reveal that the attributes of a cluster of states over that of others differentiate. The structure of US states is not homogeneous; disparities in income, emissions, energy mix and intensity, production/consumption structure and energy efficiency, or even conflicting political views with respect to environmental strategies, vary greatly. These differences and their driving forces have implications for the willingness to share the burden of emission mitigation within the US. For example, as most of domestic oil, gas and coal production originates from just a few states, regional heterogeneities can lead to different perceptions about the fair distribution of the burden of emissions and different agendas which can act as an obstacle to share objectives about targets and/or agreements.

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Finally, the empirical results present a comprehensive picture of US emission inequality and polarization to policymakers, and this way, we aim to advance knowledge regarding interrelationships among states broadly while also helping to inform regulators and decisions of environmental policies. Explaining the unequal distribution of emissions is vital to establish differentiated targets and work towards successful mitigation proposals.