

International Differences in Emissions Efficiency and the Drivers of Emissions Embodied in Trade

Topic: Input-Output Analysis: Trade and Global Value Chains policies (9)

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The environmental consequences of international trade have been widely debated for more than three decades, particularly regarding whether trade reallocates pollution-intensive production across countries. A central question in this debate concerns the relative importance of composition effects (differences in the sectoral structure of production) and technique effects (differences in production technologies and environmental efficiency) in explaining the emissions embodied in trade.

This paper proposes a framework that treats pollution as a factor input and allows for international differences in emissions efficiency, analogous to differences in labour or capital efficiency. Specifically, we assume the presence of country-specific Hicks-neutral technical differences that are common across sectors. These differences are identified econometrically, allowing factorâ€‘inputâ€‘output coefficients to be decomposed into three components: (i) a country-specific efficiency component, (ii) an industry-specific component, and (iii) an error component capturing measurement noise and variation arising from product heterogeneity within industries. This decomposition makes it possible to measure emissions in efficiency units and to separate the emissions embodied in trade into technique and composition effects.

The empirical analysis uses data from the World Inputâ€‘Output Database (WIOD), 2016 Release, covering 43 countries plus a composite Rest of the World and 56 industries. These data are combined with industry- and country-level carbon dioxide emissions data compiled by the Joint Research Centre of the European Commission, which are fully consistent with the WIOD accounts.

The results reveal substantial international differences in emissions efficiency, although these are smaller than cross-country differences in labour efficiency. On average, less than half of the emissions embodied in countriesâ€™TM net exports can be attributed to differences in output composition. Moreover, when emissions are measured in efficiency units, the negative correlation between net exports of emissions and GDP per capita disappears. In several cases, factor intensity reversals emerge: countries that appear to be net importers of emissions in natural units become net exporters when emissions are measured in efficiency units. This occurs in some high-income economies (e.g., Norway and Denmark), whose low emissions intensity reflects high emissions efficiency rather than a cleaner production structure. Conversely, several emerging economies (e.g., China and Russia) remain net exporters of emissions under both measures, reflecting both low emissions efficiency and emissions-intensive production structures.

These findings suggest that pollution-intensive industries may locate both in countries with low emissions efficiency and presumably weak environmental regulation, and in countries with high emissions efficiency. This has important policy implications: environmental policies that induce improvements in emissions efficiency may not necessarily trigger relocation of pollution-intensive industries to â€‘pollution havens.â€‘

The paper contributes to the literature by introducing an efficiency-based decomposition of emissions in inputâ€‘output analysis, providing a new way to distinguish technology-driven from composition-driven determinants of emissions embodied in trade.