Evaluating Income-Specific Carbon Footprints of Household Consumption for Assessing Carbon Tax Policies: A Case Study of Germany

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Author: Gilang Hardadi
Co-Authors: Alexander Buchholz, Stefan Pauliuk

Household consumption is an important engine of the economy, but increasing household demand pressurizes the environment due to its linkage to greenhouse gas emissions (GHG) and resource depletion. Policymakers are seeking to administer policies to minimize environmental pressures without hurting the domestic economy, and one of them is the implementation of a carbon tax. This study is conducted to provide policymakers with insight for developing carbon tax policies that are rightly-targeted to protect low-income households, using Germany as a case study.

EEIO-tables have become widely used because of their ability to quantify national GHG emissions based on individual products and industries. In this study, an MRIO-model was used to calculate carbon footprint (CF) of German households specifically for 12 different income brackets. EXIOBASE2 and a Consumer Expenditure Survey (CES) in 2013 functioned as the data basis of the model. The income-specific CF information was then used to simulate scenarios of global-level carbon tax.

The breakdown of income-specific CF into the 17 different industrial sectors showed that groups with higher per capita income showed a relatively high share of CF in transportation (16.3% of the total CF, compared to 9.6% for low-income), manufactured goods (33.6%, compared to 13.6%), and retail trade (16.8%, compared to 9.8%), while CF of lower income groups was dominated by basic needs, e.g. electricity (52.9%, compared to 19.1% for high-income). The share of direct household emissions (scope 1) and value chain emissions (scope 3) increased along with increasing per capita income from 17.5% up to 33.2% for scope 1 and from 42.4% to 57.4% for scope 3, while the share of emissions caused by the use of energy (scope 2) decreased from 39.8% to 9.4% since absolute emissions from electricity were relatively unchanged among different income groups.

The average CF per capita of Germany was 11.4 ton CO_2 eq. The increase of footprint per capita due to the increase in per capita income is generally insignificant, although a noticeable increment happened within the three highest income groups; from second-highest (15.3 ton) to the highest income group (19.2 ton) and from third-highest (12.4 ton) to the second-highest, compared to CF increase from fourth-highest (11.3 ton) to the third-highest. CF per Euro increased from the lowest income groups (0.66 kg/EUR) to the mid-income groups (0.78 kg/EUR), yet increased marginally at the highest income groups (0.81 kg/EUR).

The slight increase of footprint per Euro from the mid-income to the highest income groups was a result of the higher-income groups also increasing their consumption of low-carbon sectors while low-income groups spent most of their income to consume carbon-intensive basic necessities. This shift in consumption could result in a socially-unjust carbon tax implementation, where prices of carbon-intensive products would go up under the implementation of non-targeted carbon tax. This study illustrated the possibility of carbon tax implementation that aims to reduce overall footprint while ensuring basic welfare, where carbon tax is assigned to the consumption of petroleum and petrochemical products, trade of motor vehicles, and non-public transportation.