Estimating Life Cycle Carbon Emissions from Intermediate Goods and Its Driving Force

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The development of the world economy has expanded through trade. As global supply chains expand and become more complex, the share of CO2 emissions induced by final consumer goods, especially in developed countries, that are emitted abroad is increasing. In the emission responsibility for international trade on climate change control, consumption-based accounting has been proposed as complementary to direct emissions from industrial production (production-based accounting), an approach to the problem of emission transfer between emitting and consuming countries. However, the progress of international specialization and the consequent expansion of trade in intermediate goods led to the difficulty in evaluating the emission responsibility of intermediate goods producers in international trade using existing emission accounts. With this background, this study applies the hypothetical extraction method (HEM) after Szyrmerâ€™s total flow concept to trace the embodied emissions of intermediate goods production in international trade. We also develop the new structural decomposition framework corresponding to the above HEM indicators and identify the drivers of change in embodied emissions considering downstream structure and upstream.

Based on the multi-region input-output (MRIO) database from 2000 to 2018, for the case study of Japan, we found that carbon emissions from exports of intermediate goods increased, with a particularly large increase in emissions outside of the country. Although upstream supply chains in industries such as computer and motor vehicle manufacturing have been relocated overseas, growth in intermediate demand from abroad contributed significantly to domestic value-added creation. In addition, the growth in emissions associated with exports of intermediate goods such as chemicals and metal products was larger than the growth in domestic value-added. The results of structural decomposition indicate that chemical products have a large potential for emission reductions through the improvement of domestic emission factors and basic metal products contributed to emission reductions while domestic value-added growth slowed down due to the offshore transfer of supply chains. There is a trade-off between domestic value-added growth through exports and emission reductions in the basic metal industries.
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