

Endogenising capital in MRIO models: implications for consumption-based carbon footprints

Topic: (6.2) Environmental IO modelling (4)

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Carbon footprints track the cumulated greenhouse gas emissions that occur throughout the supply chain of a product. Input output analysis is becoming increasingly popular within environmental research fields such as Industrial Ecology and has become the tool of choice for performing footprint-type impact assessments. Several global multi-regional input output (MRIO) databases have been developed in recent years, allowing practitioners to trace emissions embodied in products and thereby assigning the emissions to end consumers rather than emitters. One challenge is that these databases typically treat gross fixed capital formation as an end consumer, despite that fixed capital, e.g. infrastructure, machinery, etc., is ultimately consumed by industries to produce more goods and services destined for final consumption. Therefore, traditional consumption-based impact calculations do not account for the environmental impacts embedded in the capital goods used in the production processes. This has large implications for a country like China, whose carbon footprint has tripled in the last twenty years, largely due to a huge increase in investments needed to produce goods for export.

In this work, we apply the flow matrix method to endogenise capital transactions in the inter-industry matrices by combining the EXIOBASE3 database with detailed capital consumption matrices from other sources such as the KLEMS, WORLDKLEMS and national statistical office databases. We endogenise the consumption of fixed capital, disaggregating the product/sector level detail to the EXIOBASE classification, and compile new MRIO tables that we use to calculate consumption-based impacts that account for the capital that is used in production processes. Further, we use the EEBT approach to estimate the capital emissions embodied in actually traded goods and services. We find that for most countries, the gap between production-based and consumption-based emissions is increased further when capital goods are taken into account, and that the amplitude of this increase varies a lot across countries. We also find that endogenising capital leads to substantial changes in both volume and product mix when looking at the emissions embodied in bilateral trade.