Bridging Input-Output Analysis and Computable General Equilibrium modeling for Consequential LCA: Rectangular Choice-of-Technology model with price-elastic demand

Topic: 516C Special session: Exploring the Interface between IOA and CGE
Author: Arne KÄTELHÖN
Co-Authors: Matthias LAMPE, Björn BAHL, André BARDOW, Sangwon SUH

Input-Output Analysis (IOA) and Computable General Equilibrium (CGE) models are increasingly used in Consequential Life Cycle Assessment (CLCA). IOA expands the system boundaries, while CGE models integrate market feedback mechanisms in CLCA. Even though the benefits of both models are highly complementary, an integrated modeling approach allowing the joint application of IOA and CGE models in CLCA is still missing.

In this work, we propose a new modeling approach, which aims to bridge IOA, CGE, and CLCA, building upon the Rectangular-Choice-of-Technology (RCOT) model.[1] We extend the RCOT model to incorporate physical engineering-level data and price-elastic demand using mixed-integer nonlinear programming. The resulting RCOT model with price-elastic demand allows us to simultaneously determine the supply and demand in multiple markets. In a case study on rice production, we demonstrate that the proposed approach captures changes in complex production technology mixes as well as the expected environmental impacts in response to the introduction of a new climate policy at a high level of granularity.

Reference:
[1] Duchin, F.; Levine, S. H. Sectors May Use Multiple Technologies Simultaneously: The Rectangular Choice-of-Technology Model with Binding Factor Constraints. Econ. Systems Res. 2011, 23 (3), 281-302; DOI 10.1080/09535314.2011.571238.