Multi-Layer Construction Framework for Sub-region Input-Output Table

Topic: Feedback Session 5b
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Multi-region input-output (MRIO) models have become increasingly important in economic and environmental analysis. Although many studies have constructed MRIO models at various scales, the current resolution of most MRIO models fails to capture the heterogeneity between sub-regions, especially in cities. Given that city-level policymaking plays a crucial role in regional development strategies, the lack of high-resolution city-level MRIOs 1) undermines the understanding of the disparities between cities within a single region or across regions, especially for large geographical regions, and 2) fails to comprehensively capture the linkages between trade partners in cities (including at the provincial or national level) and identify the role of cities role in supply chains at multiple scales. Detailed information at the city level could be much more meaningful to local governmental decision making than general information from interregional or international MRIOs. The lack of city-level MRIO tables has negatively impacted the growing number of city-level studies.

Here, we propose a bottom-up framework for sub-regional level MRIO table compilation based on partial-survey methods. To compile large-scale MRIO tables, a conventional approach using the partial-survey method requires that all regions must be included within certain boundaries, which results in very large workloads. For example, creating the MRIO table in the EORA database involved compiling 187 countries with international trade links; in total, this included 5 Ã— 10^6 data points. For more detailed sub-regions, workloads could be even greater, making data input and processing impractical. To overcome this difficulty, we introduce a multiple-layer compilation framework to decompose the compilation processes into multiple layers; the MRIO table can then be linked at these layers to create a full sub-regional MRIO table. We employ two steps in the multiple-layer framework. In the first step, we begin MRIO table construction at the lowest layer and use the partial-survey method to compile a partial sub-region MRIO table within the larger region. The term â€œpartialâ€• here is relative to the full MRIO table from the perspective of a country. The partial sub-region level MRIO table developed in step 1 would be treated as the elementary matrix in the next step, in which it is reconciled into the higher layers. Secondly, we integrate and link the partial sub-region MRIO tables into the regional MRIO table based on the assumption of an identical trade coefficient. The regional MRIO table is treated as a reconciliation platform to link all the partial sub-region MRIO tables and create the full sub-region MRIO table. In other words, we insert the partial sub-region tables into the regional MRIO table. For example, to theoretically compile a China city-level MRIO table, our approach would first compile the city-level MRIOs within a province (such as compiling MRIO tables for the 11 cities in the province of Hebei), and then insert them into the existing province-level MRIO table with reconciliation to create a nested city-province MRIO table. The resulting nested city-province MRIO table can be used as a platform into which a new partial city-level MRIO table in the province can be inserted. To get the full China city-level MRIO table, the two procedures would be repeated for the other provinces using balancing and reconciliation until all the provinces were replaced by their city MRIO tables.

By applying this framework, we first construct Hebei 11 cities MRIO table and Jing-Jin-Ji urban agglomeration city level MRIO table through bottom-up approaches. The nested Hebei-China MRIO table is also produced in this process, which can be the further platform for other cities. This multiple-layer framework represents a feasible approach for developing sub-regional level MRIO models and offers the possibility to analyse global trade at the sub-regional level.