Title: Accounting the estimation error of environmental multi-region input-output models.

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Abstract:

The compilation of a multi-region input-output (MRIO) model requires the use of linear constraints (partial information) to estimate international inter-industry transactions, usually using the "trade share" or the "identical technology" assumptions. Since the number of constraints is smaller than the number of estimated quantities, the system is under-determined, implying there is a convex high-dimensional set of possible solutions. Under these conditions, the maximum entropy principle states that all possible solutions are equally likely. For practical purposes, this implies that the marginal variance and expectation of any international inter-industry transaction are of the same order of magnitude (which is bad), but derived environmental quantities, such as carbon intensity, can have a variance which is lower than the expectation (which is good). Thus, a method to compute environmental MRIO quantities is the repeated IO calculation of those quantities, with transaction matrices that uniformly sample the solution set. The resulting probability distribution yields both an estimation (the expected value) and a measurement of the estimation error (the variance). This alternative to the "trade share" and "identical technology" assumptions is not data-specific and allows the explicit computation of the estimation error.

In this paper we study the problem of obtaining a uniform sample of the set of possible solutions. This is a non-trivial problem because the solution set, which is convex and high-dimensional, has null-measure in the embedding space and can be mildly inconsistent because of empirical data, which makes conventional methods inefficient. We propose the following algorithm: (i) a small number of feasible solutions is obtained; (ii) iteratively, the solutions repel each other and move until becoming corner solutions; (iii) the center of mass of the solution set is obtained from the corner solutions. Using conventional sampling methods, it is possible to obtain a uniform sampling of the full solution space from these points.

The proposed estimation method is tested using simulated data, and compared against conventional methods.