Reconciling Data Years in EEIO Models and Resulting Emission Factors: Alternatives and Best Practices

Topic: Advancing Multi-Regional EEIO Models: A Developerâ€™s Summit on Learnings, Evolution, and Future Directions (I)
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Research Question
Developing environmentally-extended input-output (EEIO) models requires pairing economic input-output tables (IOT) and environmental data for the same regions, sectors, and years.
IOTs are often not available for the same year(s) as the environmental data. And furthermore, for applications like the development of Emissions Factors (EFs) from these models that are used along with organizational spend data to compute organizational footprints, neither environmental data nor IOTs may be available to march the year of the spend data. Another challenge is to adjust price types represented by the final EF which is most often presented in purchaser price when the providing EEIO models are often in basic or producer price, but margins data used to convert to purchaser price are also not available for the target year. These differences in years of data presents an obvious conundrum for model developers who wish to provide final factors that are temporally relevant to users as well as a challenge to communicate the year(s) that the EFs represent. While creation of models with mixed year data is very common in EEIO models due to data scarcity, the specific adjustment procedures, their interpretation, and clear best practices in reconciling mixed year data are missing.

Objective and Novelty
The objective of this paper is to describe common adjustment procedures used to integrate data from different years into a EEIO model, provide interpretations in understandable language, demonstrate their effects with real data, and to provide some best practices for consideration to the broader IO and EEIO community.

Methods
In this paper we step through various alternatives to adjust (or not adjust) the data years to match a target year, from the creation of a direct environmental intensity matrix (B) with ratios of environmental totals by sector and economic totals by sectors, to use with the direct (A) and total requirements (L) economic matrices derived from the IOT, and to further adjustment to a year to match the desired spend data. We describe alternatives to reconciliation procedures including making assumptions that require no changes, making inflation adjustments, and use of supporting data to perform adjustments in each step using matrix algebra and detailed explanations, and then present real examples.

Data Used
To quantitatively evaluate these procedures, we use data that have been used in both the USEEIO and CEDA EEIO models to develop emission factors that have been frequently used for reporting Scope 3 GHG emissions in publicly-disclosed corporate GHG inventory reports. These data include detailed benchmark U.S. IOTs and trade and transport Margins from 2012 and 2017, detailed level annual industry gross output data and annual industry gross output price indices and from the U.S. Bureau of Economic Analysis from 2012 to 2023, Greenhouse Gas totals by sector datasets developed by the Cornerstone Sustainability Data Initiative from the official U.S. GHG inventory and other data sources for 2012-2023, and Global Warming Potentials from the International Panel for Climate Change. We also discuss these adjustments in relation to procedures used in published Emission Factors from Cornerstone and Watershed Technology, Inc.

Results and Community Engagement

We attempt to explain the meaning of the different adjustment alternatives as well as compare results of the alternative adjustments.

We synthesize the steps into a set of best practices for developing EEIO models and emission factors using mixed year data and for communicating essential information like the year(s) that the emission factors represent.

In our presentation we plan to engage the audience through realtime polls and directed questions to solicit input from their own experience in reconciling data from different years, as well as to collect their feedback on our recommended best practices, in effort to broaden the discussion beyond the author group.

We will provide all data and source code used in this analysis in an interactive notebook (Jupyter notebook) in an open code repository for any readers to run, replicate or further advance.