

Decomposition analysis when there are common factorial effects: how to reduce its size?

Topic: Thematic IO analysis: Environment

Author: Paul de Boer

In many decompositions of an aggregate change in a variable into several factors there are one or more factors common to all research units (sectors, countries etc.) In our toy model, borrowed from Chung and Rhee (2001) (C&R), of the sectoral decomposition of carbon dioxide emissions the factor “size of the economy”TM, measured by GDP, is common to all sectors. It is straightforward to show that in the multiplicative four-factor decomposition GDP can be factorized out so that the decomposition is reduced to a three-factor one. In this paper we consider the additive decomposition of the C&R model and - using a novel trick - answer the research question: “Is it possible to reduce the additive four-factor decomposition to a three-factor one?”TM It is a multi-step procedure using at each step the Bennet decomposition which, by collecting duplicates, reduces the computation of the average of $n!$ elementary decompositions to a weighted average of $2^{(n-1)}$ combinations. In the empirical part we apply it to the two datasets provided by C&R: (i) seven sectors in which changes-in-sign are present and (ii) four sectors without negatives.

This multi-step procedure allows for a considerable reduction in computational burden. As example we show that in the framework of the six- factor model with two common factorial effects used in Lan et al. (2016) an additive decomposition can be performed using the weighted average of $2^3 = 8$ combinations instead of computing the average of $6! = 720$ elementary decompositions.

References:

Chung, H.S. and H.C. Rhee (2001), A residual-free decomposition of the sources of carbon dioxide emissions: a case for the Korean industries, *Energy* 26, 15-30.

Lan, J., A. Malik, M. Lenzen, D. McBain and K. Kanemoto (2016), A structural decomposition analysis of global energy footprints, *Applied Energy* 163, 436–451.