

How to model technologies accounting for undesirable outputs? A numerical comparison of non-parametric approaches

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Abstract

In this paper we compare the existing non-parametric approaches that account for undesirable outputs in technology modelling. The approaches are grouped based on Lauwers (2009)'s seminal three-group classification, and extended to a fourth group of recent models grounded on the estimation of several sub-technologies depending on the type of the outputs. With this fourth group of models, we provide a new complete picture of pollution-technologies modelling in the non-parametric framework of DEA. We provide a numerical comparison of the most recent models: the frontier eco-efficiency model; the approach based on materials balance principle and the estimation of iso-environmental lines; and the by-production model with two sub-technologies extended with dependence constraints between the sub-technologies. The results reveal that, under constant emission factors and one undesirable output, the three models considered yield the same efficiency score for each decision-making unit. However, when we assume different emission factors across decision-making units, the extended by-production model yields intermediate results between the different models. We have also proposed a modification of the model based on materials balance principles to account for non-constant emission factors across decision-making units.

Key words: eco-efficiency; materials balance principles; by-production; non-parametric technology modelling; emission factor

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