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GUEST EDITORIAL

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New data envelopment analysis models for assessing sustainability Part 2: A static data envelopment analysis approach

1 | INTRODUCTION

Sustainability implies business resilience over time through robust economic, social and environmental systems. Sustainable business practices lead to the creation of economic value, healthy ecosystems and strong communities. Sustainable business practices are fostered through engagement with stakeholders, effective environmental management systems and good governance, all underpinned by effective measurement and evaluation (Shabanpour, Yousefi, & Farzipoor Saen, 2017).

Data envelopment analysis (DEA) is a technique, which helps decision makers to assess the efficiency of decision making units (DMUs) (Ahmady, Azadi, Sadeghi, & Farzipoor Saen, 2013; Charnes, Cooper, & Rhodes, 1978). Recently, new DEA models have been developed to assess sustainability issues. However, DEA research into sustainability is sparse and there is a need for greater focus on this important topic. In this special issue, ground-breaking research into new DEA models to assess sustainability of DMUs is presented. Such research will assist decision makers to manage organizations with a focus on sustainability.

The special issue also provides an opportunity for practitioners to develop and increase understanding of DEA models in sustainability evaluation. For maximum utility, authors should not only develop new DEA models but also show efficacy of real-world applications. The responses to the call for new DEA models and applications are presented in the following five accepted articles published in Part 2 of this special edition. In the next section, we summarize the main contributions of these articles.

2 | CONTENTS OF THE SPECIAL ISSUE

In the first article entitled "Study of haze emission efficiency based on new co-opetition data envelopment analysis" Wu, Chen, Zhao, Guo, and Ma (2019) address an issue of importance for environmental protection in China. The authors present a cross-efficiency model that integrates and evaluates the feature of haze moving across provincial borders. The efficiency value from application of the model shows greater variance than that gained from the traditional Charnes-Cooper-Rhodes model. The authors compare use of the DEA model in high efficiency provinces, which are mostly inland, with low efficiency provinces, which are mostly in areas of greater development such as in the relatively prosperous east China.

The second article "A hybrid data envelopment analysis and multi-attribute decision making approach to sustainability assessment" by Keshavarz and Toloo (2019) considers the three main elements of sustainability: environmental, techno-economic and social. They then discuss the challenges in measuring the many attributes of these elements before proposing a hybrid approach for analysis. The approach involves using DEA and a multi-attribute decision-making methodology to create an index for each dimension of sustainability, then an overall sustainability index as the mean of the three measured indices. The authors define new concepts of efficiency and cross-efficiency of order, finding efficiency of order by developing a novel DEA-based method of selection. The proposed selecting model significantly reduces the computational burden in comparison with successive solving using traditional DEA models. The model is applied to electricity generation in the United Kingdom to illustrate its potential application.

The third article entitled "Cross efficiency evaluation method based on the conservative point of view" by Sun, Wu, Wang, Li, and Wang (2019) argue that traditional cross-efficiency evaluation models have ignored the problem that large differences may exist among cross-efficiencies. Such differences may make DMUs unwilling to accept evaluation results. The authors propose a model that can maximize the peer-efficiency of the worst performing peer-DMU, with the effect of reducing the gaps among cross efficiencies. An algorithm is proposed to solve the nonlinear model discussed in the article. Application of the model is shown using a case based on a flexible manufacturing system.

The fourth article is entitled "Measuring environmental sustainability performance of freight transportation seaports in China: A data envelopment analysis approach based on the closest targets" is by Li, Li, Zhao, and Zhu (2019). In this article the authors propose a model to measure the environmental performance of freight transportation seaports in China. The DEA model also provides benchmarking information to improve

environmental performance effectively, while yielding the most relevant solution for inefficient seaports. The model is applied to 21 primary freight transportation seaports in China, resulting in relatively good environmental performance overall. The model also shows significant differences between the best and worst performance of coastal port groups while identifying areas for further attention.

In the fifth article "The global system-ranking efficiency model and calculating examples with consideration of the non-homogeneity of decision-making units" Wang and Sun (2019) address the issue that traditional DEA models have not considered, which is the problem of non-homogeneity of DMUs. The authors argue that if non-homogeneous DMUs are evaluated under the same production frontier the results may not be precise. A model that divides non-homogeneity into external non-homogeneity and internal homogeneity is presented. The model is applied to 114 enterprises in China's solar power industry.

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