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A Systematic Review and Bibliometric Analysis of the Scientific Literature on DEA models under the Common Set of Weights

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Over the past few decades, there has been a growing need to address the limitations of the Data Envelopment Analysis methodology, particularly the issue of freely selecting weights. As a result, common weight models have emerged and expanded. This article aims to provide a comprehensive overview of CSW methods, analyzing papers and bibliometric information through a systematic literature review. In this study, a total of 116 articles on CSW published between 1991 and 2022 were carefully selected and reviewed. These contributions were categorized based on specific features related to the computational technique or the main purpose of the procedure. The findings revealed that uncertain models had the highest share among the articles in the field of CSW. Furthermore, the Journal of Expert Systems with Applications emerged as the leading journal in terms of the number of publications on CSW models in DEA. The analysis of the bibliometric information of the articles was carried out using advanced software tools, including R-Studio and VOS Viewer... This review offers valuable insights and discussion, which can guide future research endeavors in this field. By addressing the limitations of DEA and exploring various CSW methods, this study contributes to the advancement of knowledge and understanding in this area.

Keywords: *Common set of weights, Data envelopment analysis, Systematic review.*

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1. Introduction

Data Envelopment Analysis (DEA) is a mathematical programming-based decision-making tool whose primary models include CCR (Charnes et al., [16]) and BCC (Banker et al., [10]) models that simultaneously consider the inputs and outputs of independent decision-making units (DMU) (Moradi et al., [78] ; Bastehzadeh & Mehrabian, [12]). Throughout the years, researchers have established multiple models within the framework of DEA, each with its own limitations and utility (Moradi et al., [79]). While these models possess distinct capabilities and fundamental features, they also confront difficulties and criticisms. The conventional DEA model allows maximum flexibility in selecting input and output weights for DMUs, enabling each unit to allocate more weight to outputs than inputs to maximize its efficiency (Moradi et al., [77]). However, this flexibility presents difficulties in comparing and ranking units, because the same units may receive different weights in efficiency assessments (Ghasemi, Mozaffari, Malkhalifeh, et al., [39]). This can lead to a situation where most units are considered efficient and cannot be effectively compared (Moradi et al., [80]). Thus, the flexibility of weight choice is both a strength and a weakness of this methodology. On the one hand, DEA allows for the determination of optimal vector weights based solely on observations of inputs and outputs without subjective judgments. On the other hand, the flexibility in weight

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assignments results in different efficiency scores for units due to variations in weightings, which is considered a weakness. This issue highlights the importance of calculating weights for input and output indices in DEA. Many researchers believe that it makes no sense to consider different weights for identical DMUs (Moradi et al., [77]). To address this concern, various models have been proposed and developed to calculate the Common Set of Weights (CSWs) for input and output variables. These models aim to increase discriminating power and provide a reliable basis for comparing DMUs. This study focuses on a systematic and comprehensive review of existing literature on CSW-DEA approaches, categorizing them into three main categories: models based on multi-objective programming, approaches based on statistical tools, and game theory. In the first category, the main objective is to find a CSW that maximizes the ratio of the weighted outputs to the weighted inputs for all DMUs. In order to improve clarity and convenience, the models are segmented into ten categories according to shared features, like calculation methodology. The second and third categories utilize statistical approaches and game theory, respectively, to calculate weights. In this study, we surveyed the DEA-CSW literature to achieve the following goals: retrieve and review the literature from 1991 to 2022 to answer bibliographic questions and identify aspects not previously studied. Although studies involving the application of existing models to datasets have been valuable, this study deliberately excludes research that only contributes to this topic by applying existing models. The remainder of this paper is organized as follows. Section 1 provides a brief introduction to this study and its objectives. Sections 2 and 3 describe the methodology for reviewing the literature and conducting the research. Section 4 deals with the bibliographic data and analysis, and Section 5 concludes the paper.

2. CSW in DEA models

Classical DEA models are classified into two categories: CCR and BBC (Modhej & Dahimavi, [76]). These models were further formulated using three different approaches: fractional, multiplier, and envelopment (Emrouznejad et al., [31]). The multiplier and envelopment DEA models are considered dual to each other. Depending on the type of return to scale, each model can be presented in either input or output-oriented forms. The fractional formulation of classical models, including CCR, allows for the weights to be determined freely, enabling the optimization of input and output coefficients and maximizing the relative efficiency value of DMUs (Fugger, [35]). The mathematical structure of the CCR model is given by Equation 1.

$$
\begin{aligned}
& \text{Max } Z_0 = \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}} \\
& \text{st}: \quad \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}} \le 1 \quad (j = 1, 2, ..., n) \\
& \qquad u_r, v_i \ge 0
\end{aligned}
\tag{1}
$$

This model can be transformed into a linear program in the multiplier form, which can be represented in two ways: input-oriented (Eq. 2), and output-oriented (Eq. 3).

$$\begin{aligned} &\text{Max } Z_0 = \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}} \\ &\text{st}: \quad \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}} \le 1 \quad (j = 1, 2, ..., n) \\ &\qquad u_r, v_i \ge 0 \end{aligned} \tag{2}$$

$$\begin{aligned} &\text{Max } Z_0 = \sum_{r=1}^{s} u_r y_{r0} \\ &\text{st}: \quad \sum_{i=1}^{m} v_i x_{i0} = 1 \\ &\qquad \sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \le 0 \quad (j = 1, 2, ..., n) \\ &\qquad u_r, v_i \ge 0 \end{aligned} \tag{3}$$

As previously mentioned, the dual to the multiplier form is called the "envelopment" (Emrouznejad et al., [31])and can be presented in two different forms: input-oriented (Eq. 4), and output-oriented (Eq. 5).

$$\begin{aligned} &\text{Max } Z_0 = \theta \\ &\text{st}: \\ &\qquad \sum_{j=1}^{n} \lambda_j x_{ij} \le x_{i0} \quad (i = 1, 2, ..., m) \\ &\qquad \sum_{j=1}^{n} \lambda_j y_{rj} \ge \theta y_{r0} \quad (r = 1, 2, ..., s) \\ &\qquad \lambda_j \ge 0 \end{aligned} \tag{4}$$

$$\begin{aligned} &\text{Min } Z_0 = \theta \\ &\text{st}: \\ &\qquad \sum_{j=1}^{n} \lambda_j y_{rj} \ge y_{r0} \quad (r = 1, 2, ..., s) \\ &\qquad \sum_{j=1}^{n} \lambda_j x_{ij} \le \theta x_{i0} \quad (i = 1, 2, ..., m) \\ &\qquad \lambda_j \ge 0 \end{aligned} \tag{5}$$

The BCC model, similar to the CCR model, is presented in envelopment and multiplier forms. However, unlike the CCR model, the BCC model allows variable returns to scale. In the BCC model, a free variable (W_0) is introduced to both the objective function and all constraints. Models (6) and (7) represent the input and output-oriented envelopment models of the BCC, respectively.

$$\begin{aligned} &\text{Max } Z_0 = \theta \\ &\text{st}: \quad \sum_{j=1}^{n} \lambda_j x_{ij} \le x_{i0} \quad (i = 1, 2, ..., m) \\ &\qquad \sum_{j=1}^{n} \lambda_j y_{rj} \ge \theta y_{r0} \quad (r = 1, 2, ..., s) \\ &\qquad \sum_{j=1}^{n} \lambda_j = 1 \quad (j = 1, 2, ..., n) \\ &\qquad \lambda_j \ge 0 \ , \quad \theta \text{ is free} \end{aligned} \tag{6}$$

$$
\begin{aligned}
&\operatorname{Min} Z_0 = \theta \\
&\text{st}: \quad \sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{r0} \quad (r = 1,2,\dots,s) \\
&\qquad \sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{i0} \quad (i = 1,2,\dots,m) \\
&\qquad \sum_{j=1}^{n} \lambda_j = 1 \quad (j = 1,2,\dots,n) \\
&\qquad \lambda_j \geq 0 \ , \quad \theta \text{ is free}
\end{aligned} \tag{7}
$$

Although the classic models have advantages, they also have drawbacks and shortcomings. For instance, if n units exist, the linear programming model must be written and solved n times (Toloo & Hančlová, [114]). As a result, the set of weights of the inputs and outputs will typically be different for the same DMUs. However, it has been deemed unacceptable by some researchers to consider different weights for the same DMUs (Moradi et al., [77]). Another issue with classical DEA models is the maximum flexibility in selecting the input and output weights for the DMUs (Salahi et al., [100]). This leads to most units being classified as efficient, making it impossible to make meaningful comparisons between them. Therefore, a key challenge in classical DEA is the calculation of weights for input and output indices. Over the years, researchers have proposed and developed methods to overcome these shortcomings by calculating a common set of weights for input and output variables. The main idea behind this approach is to establish a common framework for evaluating units while still maintaining an objective determination of weights in DEA models (Ruiz & Sirvent, [97]). As a result, comparisons of DMUs or selection of the best DMU occur in a fairer context. As mentioned earlier, in classical models, units are evaluated in their most favorable state, and a weighting vector is determined for each unit based on its optimal state. However, the idea of determining a CSW is to establish a weighting profile that simultaneously enhances the efficiency of all the units. This may initially result in a multi-objective planning approach. To illustrate this concept, Kao and Hung converted classical models into multi-objective programming to increase the ratio of virtual output to virtual input for n decision-making units. For more details, refer to Kao and Hung (Kao & Hung, 2005).

$$
\begin{aligned}
&\left(\max \frac{\sum_{r=1}^{s} u_r y_{r1}}{\sum_{i=1}^{m} v_i x_{i1}}, \dots, \max \frac{\sum_{r=1}^{s} u_r y_{rn}}{\sum_{i=1}^{m} v_i x_{in}} \right) \\
&\text{s.t.} \quad \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1 \quad j = 1,2,\dots,n \\
&\qquad u_r, v_i \geq 0 \qquad r = 1,2,\dots,s \ \ m = \quad ,\dots,2,
\end{aligned} \tag{8}
$$

In order to provide a better understanding of the different types of models in the CSW category, it is crucial to consider the main methodology used in articles that adopt a multi-objective approach. To achieve this, we organized the CSW procedures into subgroups based on the multi-objective concept. Firstly, we examine a collection of contributions that have played a significant role in developing the formulation of the multi-objective concept. This provides a solid foundation for understanding the subsequent procedures. Next, we consider the primary computational approach employed and the main objective of each procedure as secondary criteria for subgroup classification. This allows for a more detailed analysis and comparison of the different approaches used in CSW models. Finally, we present a comprehensive review of the contributions made in the CSW field, covering a wide range of models and methodologies.

3. Methodology

This study explores DEA-CSW models, focusing on the research process depicted in Figure 1. To address the research question, the process was divided into eight steps.

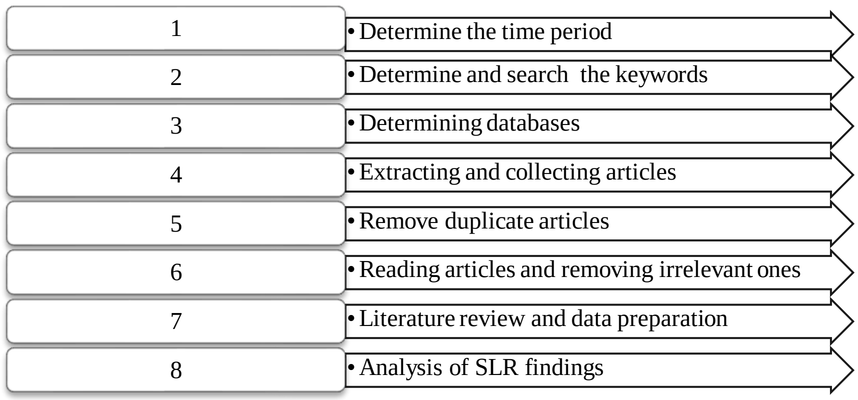

Figure 1. Steps of a systematic review

Step 1: We conducted a comprehensive search in two databases, Web of Science and Scopus, using the keywords "Data Envelopment Analysis" and "common AND set AND weights" in the title, abstract, and keywords fields, between 1991 to 2022. This search yielded a total of 1372 articles. A summary of the search process is provided in Table 1.

Step 2: We applied specific criteria to filter the raw research data, including publication date (1991 - 2022), publication type (journal), and English language.

Step 3: After a thorough review, we identified and removed 270 duplicate articles out of the 369 initially reviewed, resulting in the elimination of 135 duplicates from our study.

Step 4: We carefully examined the remaining articles and excluded any that were deemed irrelevant. Additionally, we deliberately omitted articles that merely proposed the application of an existing model to a specific dataset. Detailed results for each database can be found in Tables 1 to 3. Overall, this research process ensures a comprehensive and rigorous approach to addressing the research question at hand.

Table 1. A summary of the search in Scopus dataset

keyword	field	Type of Document	Language	Quantity
"Data Envelopment Analysis" AND common AND set AND weights	All	All	All	1187
"Data Envelopment Analysis" AND common AND set AND weights	All	All	English	1176
"Data Envelopment Analysis" AND common AND set AND weights	All	Article	English	1011
"Data Envelopment Analysis" AND common AND set AND weights	Title, Abstract, Keyword	All	All	203

"Data Envelopment Analysis" AND common AND set AND weights	Title, Abstract, Keyword	All	English	200
"Data Envelopment Analysis" AND common AND set AND weights	Title, Abstract, Keyword	Article	English	181

Table 2. A summary of the search in WOS dataset

keyword	field	Type of Document	Language	Quantity
"Data Envelopment Analysis" AND common AND set AND weights	All	All	All	191
"Data Envelopment Analysis" AND common AND set AND weights	All	All	English	191
"Data Envelopment Analysis" AND common AND set AND weights	All	Article	English	188
"Data Envelopment Analysis" AND common AND set AND weights	Title, Abstract, Keyword	All	All	191
"Data Envelopment Analysis" AND common AND set AND weights	Title, Abstract, Keyword	All	English	191
"Data Envelopment Analysis" AND common AND set AND weights	Title, Abstract, Keyword	Article	English	188

Table 3. Database article by number

Database	2nd stage	3rd stage	4th stage
Scopus	181	94	42
Web of Science	188	140	76
Total	369	234	116

From this point onwards, the study was divided into two main sections: a systematic literature review and research profiling. This systematic literature review focuses on organizing the existing CSW literature published between 1991 and 2022. By analyzing various publications, the aim of this study is to provide a comprehensive research map that addresses the following key questions:

- What kind of models have researchers utilized to extract CSW?
- What kind of structures have researchers employed to extract CSW?
- Has the current model considered the concept of non-Archimedean epsilon? If so, has a solution been proposed to calculate it?
- Does the current model consider the weight of each stage?
- Which periods of time saw the most publications in the field of CSW?
- What were the prevailing subject trends in the articles surveyed in this particular domain?
- In this particular area, which researchers are at the forefront?
- In terms of article count, which publications have emerged as the most prolific in this area of study?
- In this field, which references are cited most frequently?
- What is the scientific production of researchers in the database under investigation based on Lotka and Bradford's law?
- In this field, what are the frequently used keywords?
- What does the density map of scientific production look like for researchers?

In total, 116 articles have been classified based on the types of models, structures, non-Archimedean epsilon considerations, and calculation methods used.

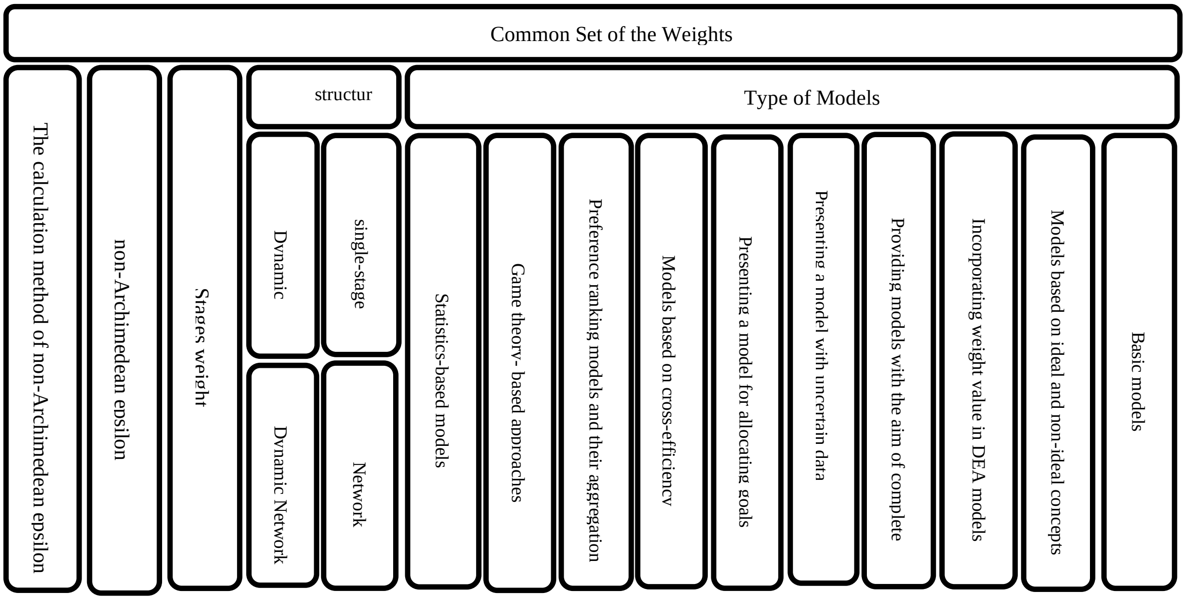

Fig 2. Map of systematic literature review

The literature on CSW-themed topics is continuously evolving and transforming. To conduct a thorough and systematic review, this study employed the SLR approach to gain insights into the future and address any gaps in knowledge in this area. Based on this approach, the models of this study were categorized into ten distinct categories, as in Contreras's study [6]. After analyzing the classification of models, the result present of the SLR in an organized manner, as depicted in Figure 2. This categorization allowed us to gain valuable insights into the current state of research in the field of CSW models.

3.1. Basic models

One particular category, known as the Basic models, focuses on the development of computational methods for determining the CSW. These methods are based on classical fractional models. The authors of the papers in this category have made significant efforts to create computationally efficient procedures for addressing the challenges of multi-objective programming. Interestingly, the models within this category have served as the foundation for numerous other articles. Additionally, different computational approaches, such as the separation process, linear approximations, and iterative algorithms, have been explored and included in this category. To provide an overview of the studies in this category, please refer to Table 4.

Table 4. Basic models

Researcher	structure	Stages weight	Non-Archimedean epsilon	The calculation method of non-Archimedean epsilon	Description
(Belton & Vickers, [13])	single-stage	-	✓	×	Presenting an approach based on visual interactive decision support system based on a MCHP value function and integrating multi-criteria analysis

(G. R. Jahanshahloo et al., [51])	single-stage	-	×	×	Presenting a multi-objective fractional programming problem by maximization of the minimum value of efficiency
(Chen, [17])	single-stage	-	✓	×	Presenting a multi-objective fractional programming problem considering the difference between of inputs and outputs as the objective function
(C.-I. Chiang et al., [18])	single-stage	-	✓	×	Presenting a separation method considering a fractional multi-objective programming model
(Sanei et al., [102])	single-stage	-	✓	✓	Presenting an improved MCDA-DEA model for constructing composite indices and developing the (Hatefi & Torabi, [46]) model.
(Davoodi & Rezai, [27])	single-stage	-	✓	×	presenting a model of linearization of the fractional programming and propose a procedure to increase the power of discrimination between multiple optimal solutions
(Foroughi & Aouni, [33])	single-stage	-	✓	×	Development the (Karsak & Ahiska, [59]) model's in order to determine the maximum feasible value of existing parameters
(Toloo, [110])	single-stage	-	✓	✓	Revises and development of mixed-integer programming model of (Karsak & Ahiska, [59])
(Toloo, [112])	single-stage	-	×	×	Development of the model (Karsak & Ahiska, [59]) by presenting a model based on mixed integer programming with non-Archimedean epsilon elimination.
(Gan & Lee, [36])	single-stage	-	✓	×	Development of the integer linear programming model (Toloo, [110]) so that the maximum deviation of the units from the efficient frontier is minimized by its implementation.

3.2. Models based on ideal and non-ideal concepts

The CSW value is determined by minimizing its deviation from the ideal value in this category. In certain instances, the anti-ideal point is taken into account. Table 5 provides a summary of the studies conducted in this category.

Table 5. Models based on ideal and non-ideal concepts

Researcher	Structure	Stages weight	non-Archimedean epsilon	The calculation method of non-Archimedean epsilon	Description
(Kao & Hung, [58])	single-stage	-	×	×	presenting a compromise solution where the calculated efficiency value is considered as the ideal point.
(G. R. Jahanshahloo et al., [53])	single-stage	-	✓	×	First, by using the proposed model, minimizes the disagreement with the ideal values, and then the special line, which is considered linear as a reference, is defined.
(Zohrehbandian et al., [128])	single-stage	-	×	×	Introducing a multi-criteria model, which is derived from a new linear DEA model, to improve the (Kao & Hung, 2005) model.

(Kiani Mavi et al., [62])	Network		✓	×	The CSW model is being developed for the case where the DMUs inputs are beyond control, using the ideal point approach.
(Sun et al., [108])	single-stage	-	✓	×	By introducing feasible virtual units, two models for ideal and anti-ideal values were presented.
(Barzegarinegad et al., [11])	single-stage	-	✓	×	Presenting a nonlinear model based on goal programming with the idea of determining ideal and anti-ideal points
(Qi & Guo, [90])	single-stage	-	✓	✓	Present a model of the combination of CSW and Shannon's entropy and a modified weight-constrained model to calculate non-Archimedean epsilon.
(Wu, Chu, Zhu, et al., [123])	single-stage	-	✓	×	Presenting a maximum model wherein the concept of DMU satisfaction level with respect to a weighting profile is measured as the distance between the proposed efficiency ratio and the efficiency ratio determined with the CSW. The non-Archimedean epsilon value without providing a specific solution is equal to ε=0. 0001 is considered
(Carrillo & Jorge, [15])	single-stage	-	✓	×	Presenting the minimization model based on the differences in weighted inputs and outputs from its ideal values
(Yang et al., [126])	single-stage	-	✓	×	Presenting a model of composite indicators in such a way that the proposed model for weight allocation uses an objective method to determine the weights associated with each indicator.
(Gharakhani et al., [37])	Dynamic Network	Equivalent to the arithmetic mean of the stages	×	×	Presenting a model that allows the examination of efficiency links in different periods
(Kiani Mavi et al., [61])	Dynamic	-	×	×	Presenting a new approach to CSW under the conditions of double boundaries in a way where it is possible to deal with undesirable outputs.
(Lozano et al., [72])	single-stage	-	×	×	Presenting the DEA goal-allocating approach using adaptive programming, in which an efficient goal is determined that is as close to the ideal point as possible.
(Salahi et al., [101])	single-stage	-	✓	✓	Revised and development of the (Zhou et al., [127])model and used the (Amin & Toloo, [2]) model to calculate non-Archimedean epsilon.
(Mavi & Mavi, [74])	Dynamic	-	✓	×	Presenting a technique based on goal programming to find a set of weights under dynamic conditions
(Hammami et al., [42])	single-stage	-	✓	×	Providing a method for defining the set of common Euclidean weights in DEA that allows for the objective ranking of units
(Omrani et al., [85])	single-stage	-	×	×	Presenting the goal programming model that minimizes the deviation from the ideal solutions and derives a set of weights that are used to calculate the final efficiency values

3.3. Incorporating weight value in DEA models:

Models within this category encompass weighting schemes in DEA models. These models utilize pre-weighting schemes and the incorporation of additional constraints to determine CSW. They are developed based on the subjective preferences of decision-makers and aim to minimize disagreement regarding component weights in order to determine CSW values. Table 6 provides an overview of the studies conducted within this category.

Table 6. Incorporating weight value in DEA models

Researcher	structure	Stages weight	non-Archimedean epsilon	The calculation method of non-Archimedean epsilon	Description
(Roll et al., [95])	single-stage	–	×	×	The provision of three models for the incorporation of weights in DEA, encompasses the maximization of the number of efficient units, a preferred order of factors, and the determination of the central values between bounds.
(Franklin Liu & Peng, [34])	single-stage	–	✓	×	A model that takes into account and formulates subjective preferences, using virtual weight restrictions, while establishing common weighing units.
(Payan et al., [78])	single-stage	–	✓	×	Revision and development of the model (Franklin Liu & Peng, 2009) in order to ensure the ranking of decision-making units and increase the differentiation of multiple optimal weights
(G. R. Jahanshahloo, Zohrehbandian, Alinezhad, et al., [54])	single-stage	–	✓	×	Providing an alternative approach that takes into account the decision maker's preferences.
(Saati et al., [98])	single-stage	–	✓	✓	This paper proposed a two-stage algorithm was proposed to determine CSW in DEA. First determined an ideal DMU, next used the central value between the weight bounds to determine the model and the non-Archimedean epsilon is the central value between the limits of the weights.
(Makui & Momeni, [73])	single-stage	–	✓	×	The DEA optimal weighting vectors are considered as an input of the UTA-STAR technique in this paper. The combination of multi-criteria technique UTA-STAR and CSW models is presented.
(Ramón et al., [92])	single-stage	–	×	×	Presenting a method to determine CSW based on optimal vectors of weights.
(Jain et al., [56])	Network	-	✓	×	Presenting an approach based on genetic algorithm to estimate the weight constraints in DEA
(Pourhabib Yekta et al., [88])	single-stage	–	×	×	Proposing an alternative weight restriction approach to generate a common set of weights for all DMUs. The weight restriction approach not only generates positive weights but also prevents weight dissimilarity.
(Razipour-GhalehJough et al., [93])	single-stage	-	×	×	In this paper presents a model for determining the closest possible target in the presence of weight restrictions.

3.4. Models based on cross-efficiency:

In this category, researchers employ cross-efficiency to extract CSW values. The cross-efficiency method calculates the efficiency score of each DMU based on the optimal weights of each DMU, with the primary objective of eliminating unrealistic weighting schemes without considering weight constraints. A summary of the studies in this category can be found in Table 7.

Table 7. Models based on cross-efficiency

Researcher	structure	Stages weight	non-Archimedean epsilon	The calculation method of non-Archimedean epsilon	Description

(Anderson et al., [6])	single-stage	–	×	×	It was proved that, in the case of a single input and multiple outputs, a mutual evaluation implicitly requires a common set of weights.
(Appa & Williams, [7])	single-stage	–	×	×	Presenting an alternative framework for solving DEA models in which the outputs are first improved through the Fourier-Motzkin algorithm and then the efficiency values are calculated with cross-efficiency.
(Y. M. Wang & Chin, [119])	single-stage	–	×	×	To determine a CSW, the authors propose a cross-weight efficiency as an alternative to aggressive and benevolent evaluation
(Noorizadeh et al., [83])	single-stage	–	×	×	Presenting a model of cross-efficiency that is able to consider non-optional inputs
(Wu, Chu, Sun, et al., [122])	single-stage	-	×	×	Presenting the cross-efficiency evaluation approach based on Pareto improvement, which investigates whether a set of values obtained from cross-efficiency can be Pareto-optimal solutions.
(Shi et al., [104])	single-stage	–	×	×	Presenting the approach to assessing cross-efficiency evaluation based on a balanced evaluation approach using interval weights
(Chu, Wu, & Chu, [21])	single-stage	–	×	×	Presenting an approach to address the non-Pareto optimization problem in cross-efficiency evaluation
(Davtalab-Olyaie & Asgharian, [28])	single-stage	–	×	×	Introducing a notion of Pareto-optimality for cross-efficiency scores which aligned with the commonly used concept of dominance

3.5. Preference ranking models and their aggregation solutions:

This category explores a solution to the challenge of combining individual preferences. Decision-makers in these categories express their preferences as ordinal rankings, aiming to establish a collective order. Table 8 provides a summary of the studies conducted in this field.

Table 8. Preference ranking models and their aggregation solutions

Researcher	structure	Stages weight	non-Archimedean epsilon	The calculation method of non-Archimedean epsilon	Description
(Cook & Kress, [25])	-	-	×	×	Obtaining the common vector of weights to aggregate votes in such a way that the vector is determined by minimizing the distance between the sorted weights.
(Y. M. Wang et al., [120])	-	–	×	×	Presenting three models for evaluating CSW, two of which are linear programming and one nonlinear programming, all three of which end in a complete ranking of units.
(Contreras, [23])	-	–	✓	×	Developing a method for determining a CSW based on the difference in the ordinal positions generated by the efficiency value.
(Foroughi & Aouni, [33])	-	–	✓	×	Reviewing and developing the CSW-based model for a ranked voting system and improving a two-objective model to increase the differentiation between variables
(G. Jahanshahloo et al., [50])	-	–	✓	×	Reviewing and Developing Liu & Hsuan Peng, (2008) model and presenting a rule to obtain a complete ranking of units.
(Hadi-Vencheh, [40])	–		✓	✓	Presenting two models for evaluating CSW, both based on linear programming that culminates in complete unit ranking.
(Ebrahimnejad & Bagherzadeh, [30])	-	-	✓	×	Proposing a new approach to express the preference of voters for a set of candidates. The proposed method divides voters into several

					categories, each with its own significance level. Non-Archimedean epsilon is considered in this model without providing a specific solution equal to 0.0001.
(Izadikhah & Farzipoor Saen, [49])	-	-	✓	✓	Presenting a model for calculating the preference score of units to evaluate the sustainability of the supply chain and calculating the non-Archimedean epsilon using a new mixed integer nonlinear model inspired by the Toloo, [111]

3.6. Providing models with the aim of complete ranking

In this category, the efficient units are ranked, meaning that the evaluation is not conducted on all DMUs. Instead, only a subset of units with the same rank is considered to calculate the optimal weight. Table 9 provides a summary of the papers that contribute to this approach.

Table 9. Providing models with the aim of complete ranking

Researcher	structure	Stages weight	non-Archimedean epsilon	The calculation method of non-Archimedean epsilon	Description
(Troutt, [116])	single-stage	–	×	×	Developing a maximum efficiency ratio model for the generation of a CSW, with the aim of prioritizing the efficient subset of DMUs that rank the entire set of DMUs.
(Despotis, [29])	single-stage	–	×	×	Providing a model that increases the power of differentiation between efficient units and the CSW is estimated by minimizing the distance from the ideal point.
(Amin & Toloo, [3])	single-stage	–	✓	✓	Presenting a mixed integer linear programming model to evaluate the most efficient units and determining the non-Archimedean epsilon by developing the model provided by (Cook et al., [26])
(Liu & Hsuan Peng, [70])	single-stage	–	✓	×	Proposing a model to determine CSW value by minimizing the set of deviations from the efficient unit.
(Amirteimoori et al., [5])	single-stage	–	✓	×	Proposing a complete ranking method for fully ranking all DMUs that makes use of a common set of weights for all DMUs.
(Ramezani-Tarkhorani et al., [91])	single-stage	–	✓	×	Reviewing, and developing the model Liu & Peng, 2008 in order to enhance the ability of discrimination
(Toloo, [113])	single-stage	–	✓	✓	Presenting an integrated mixed integer linear programming model for determining the most efficient unit and determining the non-Archimedean epsilon using the model provided by (Toloo, 2013)
(Kritikos, [63])	single-stage	–	×	×	Presenting a linear programming model based on the topsis approach for ranking decision-making units
(Toloo et al., [115])	single-stage	–	✓	✓	The mixed-integer non-linear programming model is proposed to identify the most efficient DMU by utilizing a CSW. Additionally, the model is formulated to provide a suitable value for the non-Archimedean epsilon.

3.7. Presenting a model with uncertain data

In this category, the efficient units are ranked based on their performance. In other words, the evaluation is not performed on all DMUs, and only a subset of units with the same rank is considered to calculate the optimal weight. In Table 9, the main papers contributing to this approach are summarized.

Table 10. Presenting a model with uncertain data

Researcher	structure	Stages weight	non-Archimedean epsilon	The calculation method of non-Archimedean epsilon	Description
(C. I. Chiang & Tzeng, [19])	single-stage	–	✓	×	Presenting a multi-objective programming model in which the efficiency of each unit is an objective function to be maximized and the CSW are calculated using the fuzzy MOP approach.
(Saati & Memariani, [99])	single-stage	–	✓	✓	Developing a model to determine CSW in fuzzy DEA and determining the non-Archimedean epsilon by calculating the upper bounds and compressing intervals to determine CSW
(Lee & Yeh, [64])	single-stage	–	×	×	Formulating a multiple criteria decision-making problem as a fuzzy multiple objective DEA model where inputs correspond to cost criteria and outputs correspond to benefit criteria
(Omrani, [84])	single-stage	–	✓	×	A robust optimization approach for a CSW in DEA in the presence of uncertain inputs and outputs is determined, which minimizes the distance to an ideal point.
(G. R. Jahanshahloo, Zohrehbandian, Lotfi, et al., [55])	single-stage	–	×	×	Determining the priority of units in interval environments using the AHP, that based on the assumption that input and output data are imprecise due to decimal truncation or rough estimation by the decision maker.
(Sun et al., [107])	single-stage	–	✓	×	Presenting three interval DEA models from three different perspectives in order to obtain a common set of weights for the lower and upper bounds
(Rezaie et al., [94])	single-stage	–	✓	×	Calculating the CSW by simultaneously considering the best and worst relative efficiencies, which are integrated to rank the units completely
(Payan, [86])	single-stage	–	×	×	Developing a CSW model for fuzzy data, where a fuzzy efficiency score is obtained for each unit, resulting in a fuzzy ranking of alternatives.
(Azar et al., [8])	single-stage	-	✓	×	Presenting a model for calculating CSW in a fuzzy context using fuzzy DEA
(Aghayi et al., [1])	single-stage	-	✓	×	Presenting a robust DEA model with a CSWs under different degrees of uncertainty
(Salahi et al., [101])	single-stage	–	✓	✓	Reassessing Omrani's [84] model by using Kao and Hung's [58] model to find a CSW under interval uncertainties of inputs and outputs and determining the non-Archimedean epsilon using the model provided by (MirHassani & Alirezaee, [75])
(Puri et al., [89])	Dynamic	–	✓	×	Presenting a model that determines the interval efficiency and leads to the ranking of units, which provides the possibility of including undesirable outputs and common inputs.
(Shirdel et al., [105])	single-stage	–	✓	×	Presenting a method to evaluate units with imprecise data in order to rank units
(Hajiagha et al., [41])	Dynamic	–	×	×	Presenting a multi-objective fractional model with the aim of maximizing the mean and minimizing the variance of efficiency values and proposing the fuzzy approach to solve the fractional model.
(Wen et al., [121])	single-stage		✓	✓	Developing a mixed integer linear programming model for evaluating six sigma projects with interval or imprecise data and determining the non-Archimedean epsilon using the model provided by (Toloo, 2014)
(Shabani et al., [103])	single-stage	–	×	×	Developing a CSW-based model which considers not only precise data but also imprecise data.

(Hatami-Marbini & Saati, [44])	Network		✓	✓	Presenting a two-stage model which considers fuzzy data to evaluate the efficiency and identify the source of inefficiency. The non-Archimedean epsilon is determined by considering the upper and lower bounds.
(Ebrahimnejad & Bagherzadeh, [30])	single-stage	-	✓	✓	Presenting a deterministic linear model according to the theory of probability and possibility to deal with fuzzy stochastic DEA models. The non-Archimedean epsilon is determined by considering the upper and lower bounds.
(Amiri et al., [4])	single-stage	-	✓	✓	Presenting an algorithm based on bootstrap simulation to calculate CSW. The non-Archimedean epsilon is determined by considering the upper and lower bounds (the lower bound is zero, and the upper bound is the inverse of the maximum ratio of inputs and outputs).
(Bagheri et al., [9])	single-stage	-	✓	×	Developing a new fuzzy CSW-based approach for solving fully fuzzy MOTPs. The value of non-Archimedean epsilon is considered equal to $\acute{\varepsilon}=-10^{6}$ without providing a specific solution.
(Kazemi et al., [60])	single-stage	-	✓	×	Presenting a fuzzy equivalence approach for clustering DMUs in terms of environmental and operational conditions in order to incorporate the uncertainty of decision-maker judgment in efficiency analysis.
(Tabatabaei et al., [109])	Network	-	✓	×	Presenting a common weights approach for a relational network DEA model in a fuzzy environment to measure the efficiencies of the system and the component processes, which first finds upper bounds on input and output weights for a given cut level and then determines a CSW for all DMUs.

3.8. Presenting a model for allocating goals:

In this category, the models focus on calculating additional resources or profit, as well as setting targets for inefficient DMUs. When a centralized agent is responsible for allocating these resources, it is justifiable to use a common basis to determine how much should be assigned to each unit. Table 11 provides a summary of the main contributions in this area.

Table 11. Presenting a model for allocating goals

Researcher	structure	Stages weight	non-Archimedean epsilon	The calculation method of non-Archimedean epsilon	Description
(Bi et al., [14])	Network	–	✓	×	Development of CSW DEA-based model to allocate resources and target setting based on DEA for the organization consisting of production units, each of which has several parallel production lines
(Liu & Tsai, [71])	single-stage		✓	×	Presenting two models [CSBM-CSW] and [CSBM-G] to solve resource reallocation problems by maximizing efficiency value
(Hosseinzadeh Lotfi et al., [48])	single-stage	–	✓	×	Developing a linear model based on a common dual weights approach to allocating additional resources to inputs or target settings based on output levels
(Si et al., [106])	single-stage	–	×	×	Proposing a model for fixed cost allocation based on DEA, which shows that the cost allocations making all DMUs efficient with a CSW can resulted from the extended proportional sharing method

(Hatami-Marbini, Tavana, et al., [45])	single-stage	–	✓	×	Providing a CSW model based on goal programming for the cases that focus on reducing input and output values of DMUs
(G. R. Jahanshahloo et al., [52])	single-stage	–	×	×	Developing a model for fixed cost allocation based on a common set of weights, which satisfies the efficiency invariance principle
(Li et al., [65])	single-stage	–	✓	×	Developing a model for resource allocation and target setting that aims to minimize the deviation between the feasible plan and the possible plan base on CSW.
(Li et al., [68])	Network	–	×	×	The cooperative game theory and the cross-efficiency approach are combined, to generate a unique and equitable allocation scheme base on a super-additive characteristic function defined for coalitions of DMUs. For each DMU, The Shapley value is then derived and the associated CSW is optimized to establish the final allocation strategy.
(Chu & Jiang, [20])	single-stage	–	×	×	Presenting an approach for fixed cost allocation among a group of DMUs based on CSW and DEA evaluation framework
(Li, Zhu, & Chen, [67])	Network	–	×	×	Developing A CSW model for allocating fixed costs for situations in which the DMUs have a two-stage network structure
(Li, Zhu, & Liang, [69])	single-stage	-	×	×	Developing A CSW model for allocating fixed costs for situations in which each DMU proposes the reception of the maximal cost.
(Jiang et al., [57])	single-stage	–	✓	×	A common-weight evaluation mechanism and a possibility set are used to show that all the DMUs can be environmentally friendly after resource allocation.
(Chu, Wu, Chu, et al., [22])	Network	–	×	×	Proposing approaches for fixed cost allocation among DMUs with two-stage structures under the DEA framework which proved all the two-stage systems can be efficient when evaluated by a set of common weights after fixed cost allocation.
(Feng et al., [32])	single-stage	-	✓	×	Providing a cost allocation scheme based on the DMU input-output scale, which is calculated by utilizing the common weight determined from the developed CSW method. The objective of this scheme is to maximize the overall efficiency of the organization, wherein the inputs and outputs are the summations of all the DMU inputs and outputs.
(Li et al., [66])	single-stage	–	×	×	Proposing a new approach for allocating the fixed cost across DMUs based on efficiency ranking, which can determine the best efficiency ranking for each individual DMU simultaneously under a set of common weights.
(Ghasemi, Mozaffari, Hosseinzadeh Lotfi, et al., [38])	single-stage	-	✓	×	Providing a new model by determining a CSW in which the minimum resources and targets allocated to each DMU were commensurate with the efficiency of that DMU and the share of that DMU in the input resources and the output productions.
(Nojoumi et al., [82])	single-stage	–	×	×	To create new DMUs, this study uses the centralized resource allocation approach. the new DMUs are located on a strong supporting hyperplane. This hyperplane is derived by solving the dual model and generating CSWs.

3.9. Game theory-based approaches

This approach entails a strategic negotiation process aimed at attaining a CSW. However, one of the primary obstacles associated with this method is its intricate nature. Game theory provides a framework for analyzing strategic interactions between DMUs and allows for the determination of weights that consider the competitive behavior of DMUs. Some of the game theory-based models used in this category include the Non-Cooperative Game Model (NGM), the Cooperative Game Model (CGM), and the Bargaining Game Model (BGM). Table 12 summarizes the main contribution in this area.

Table 12. Game theory-based approaches

Researcher	structure	Stages weight	non-Archimedean epsilon	The calculation method of non-Archimedean epsilon	Description
(Rousseau & Semple, [96])	-	–	×	×	They showed that the CCR model is a two-player zero-sum game in which the first player has pure strategies corresponding to different sets of input and output weights, and the second player's strategy is the regulator.
(Nakabayashi & Tone, [81])	single-stage	–	×	×	They investigated consensus among organizations in the field of DEA using cooperative game theory and proposed a solution.
(Wu, Liang, & Yang, [124])	single-stage	–	×	×	In the cross-efficiency model, units are considered as players in a cooperative game, where the characteristic function values of the coalitions are defined to calculate the Shapley value.
(Wu, Liang, Yang, et al., [125])	single-stage	–	×	×	Presenting Nash Bargaining Game Theory to improve mutual efficiency evaluation method, which concludes with the computation of a CSW to rank the complete set of alternatives
(M. Wang & Li, [117])	single-stage	–	×	×	Improving the previous Nash bargaining game DEA models presented by (J. Wu, Liang, Yang, et al., 2009) and solving its problems of the non-uniqueness of Nash bargaining efficiency
(Hinojosa et al., [47])	single-stage	–	×	×	Presenting a new method for ranking efficient units in DEA based on the well-known concept of cooperative game theory, namely Shapley value
(Contreras et al. , [24])	single-stage	–	×	×	Presenting a new bargaining game theory approach in which two players are considered: one whose utility function matches its virtual input and another whose utility is negative virtual input.
(Q. Wang et al., [118])	single-stage	-	✓	✓	Developing a new DEA method using normalized CSW and the thought of the bargaining game, which was established solves the problem with the non-uniqueness of weights. The non-Archimedean epsilon is determined by considering the upper and lower bounds.

4. Bibliometric analysis

Upon reviewing the related article, it was found that the largest share (18%) of studies focused on "uncertain models". This subgroup of contributions incorporated new computational techniques, such as fuzzy or interval comparison, which may explain their high number. After that, "Presenting a model for allocating goals" claimed second place with 15%, while "Models based on ideal and non-ideal concepts" secured third place with 14%. "Basic models", "Incorporating weight value in DEA models" and "Providing models with the aim of complete ranking" each accounted for 8% in fourth place. "Preference ranking models and their aggregation solutions" and "Game theory- based approaches" each with 7%, "Models based on cross-efficiency" both received 7%, "Models based on cross-efficiency" received 6%, and "Statistics-based models" received 4%. Meanwhile, 78% of the studies were devoted to single-stage structures, 7% to network structures, 3% to dynamic structures, and less than 1% to dynamic network structures. Although 58% of the presented models emphasized the existence of non-Archimedean epsilon, only 15% of them offered a solution to calculate it. Such way that some researchers used the methods that were proposed in the past to calculate this issue (Amin & Toloo, [2]; MirHassani & Alirezaee, [75]; Toloo, [110]), while others determined the interval scale (Hatami-Marbini, Beigi, et al., [43]) or an exact value without specifying a particular solution (Ebrahimnejad & Bagherzadeh, [30]). Interestingly, none of the studies directly investigated the weights of the stages in the field under investigation. Therefore, according to the mentioned materials, the four basic questions, i.e. “What kind of models have researchers utilized to extract CSW?”, “What kind of structures have researchers employed to extract CSW?”, “Has the current model considered the concept of non-Archimedean epsilon? If so, has a solution been proposed to calculate it?”, “Does the current model consider the weight of each stage?” was answered. To further analyze the data, it was uploaded to Microsoft Excel software, and two additional software tools were employed for research profiling. RStudio software was used to connect to Biblioshiny, while a VOS viewer was employed to draw the density map of the collaborative network of researchers.

1. Which periods of time saw the most publications in the field of CSW? Figure 3
2. What were the prevailing subject trends in the articles surveyed in this particular domain? Figure 4
3. In this particular area, which researchers are at the forefront? Figure 5
4. In terms of article count, which publications have emerged as the most prolific in this area of study? Figure 6
5. In this field, which references are cited most frequently? Table 14
6. What is the scientific production of researchers in the database under investigation based on Lotka and Bradford's law? Figures 6 and 7
7. In this field, what are the frequently used keywords? Figure 8
8. What does the density map of scientific production look like for researchers? Figure 9

From 1991 until 2022, there has been a consistent publication of at least one paper each year, except for the years 1993 to 1995, 1998 to 2000, and 2003. This demonstrates a sustained interest in the field since 1991. In particular, there has been a significant increase in the number of contributions between 2010 and 2020. Figure 3 visually represents the annual scientific productions in the field of CSW. This data serves as evidence of the continuous growth and significance of research in this field over the years.

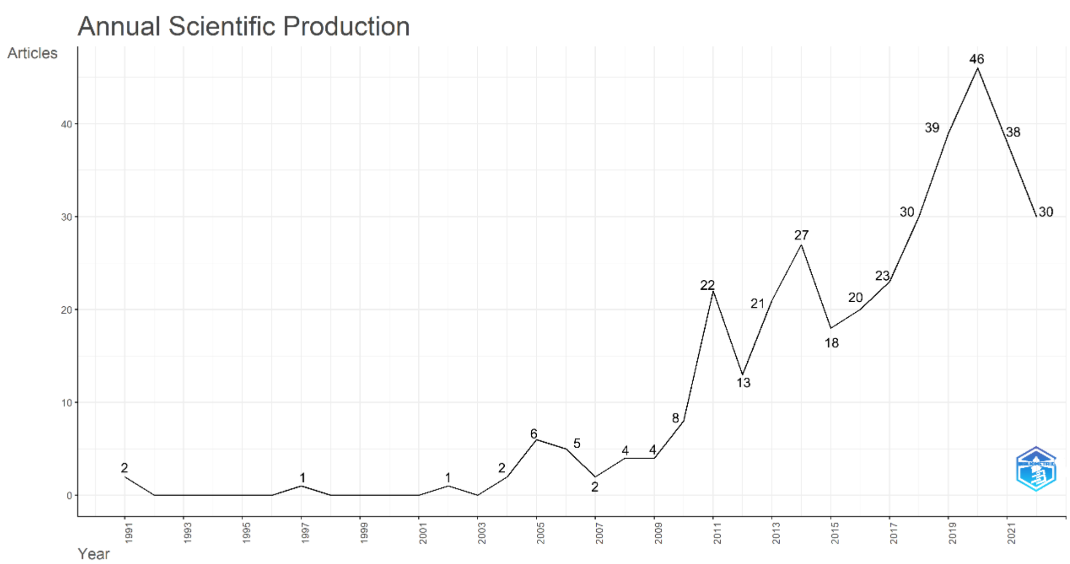

Figure 3. Annual scientific production per year

According to Pareto analysis, 20% of the articles published between 1991 and 2012 accounted for 70 articles. This number increased to 237 articles in the period from 2014 to 2020. In 2021 and 2022, this amount reached 38 and 30 cases, respectively. By evaluating such a trend alongside the trend topic diagram (fig 4), the authors are expected to address specific issues in the field of CSW, which include: teco-innovations, resource allocation, fixed cost allocation, and so forth. Mentioning these topics will be beneficial for researchers in future research.

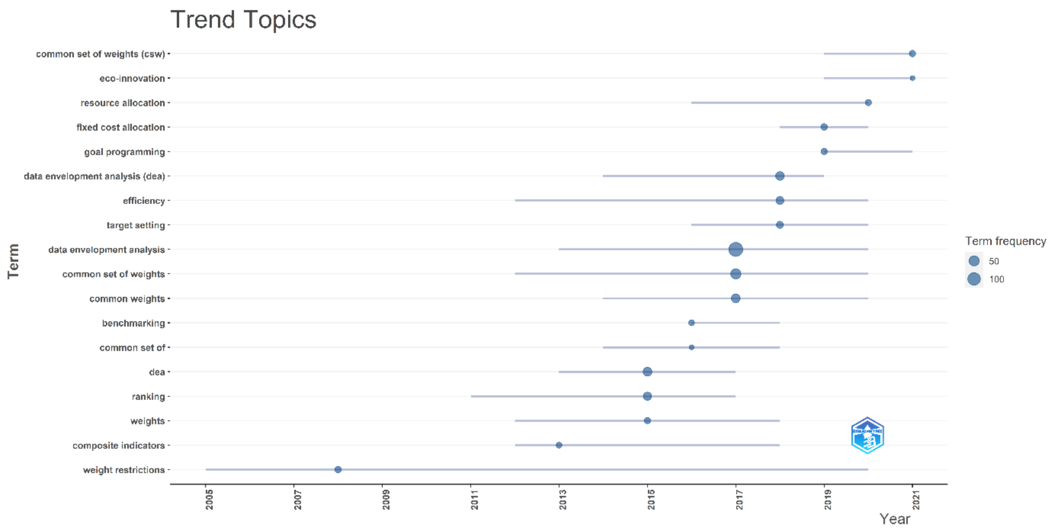

Figure 4. Trend topics

Over 200 diverse co-authors have made valuable contributions to the field of CSW. However, it is noteworthy that only eight of these co-authors have published more than five articles. The high number of authors can likely be attributed to the use of ad-hoc models in specialized contexts or case studies. Figure 5 presents an analysis of the top 10 authors in the DEA-CSW field from 1991 to 2022, highlighting their significant scientific production.

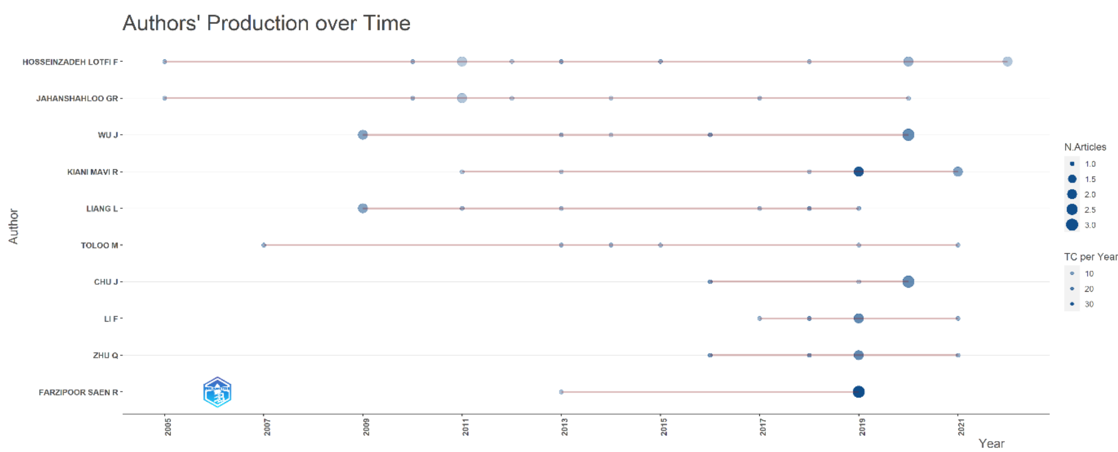

Figure 5. Top 10 authors who published on CSW between 1991 and 2022

According to Figure 5, Hossein Zadeh Lotfi has emerged as the leading contributor in this field, publishing a total of 12 articles between 2009 and 2022. The reviewed articles have generally appeared in 55 journals. It is worth noting that the majority of these journals are refereed and pertain to operational research, including computer and management science, as well as applied mathematics. Additionally, there are journals in applied fields such as engineering and environmental science. For a comprehensive overview of the distribution of contributions, please refer to Figure 6.

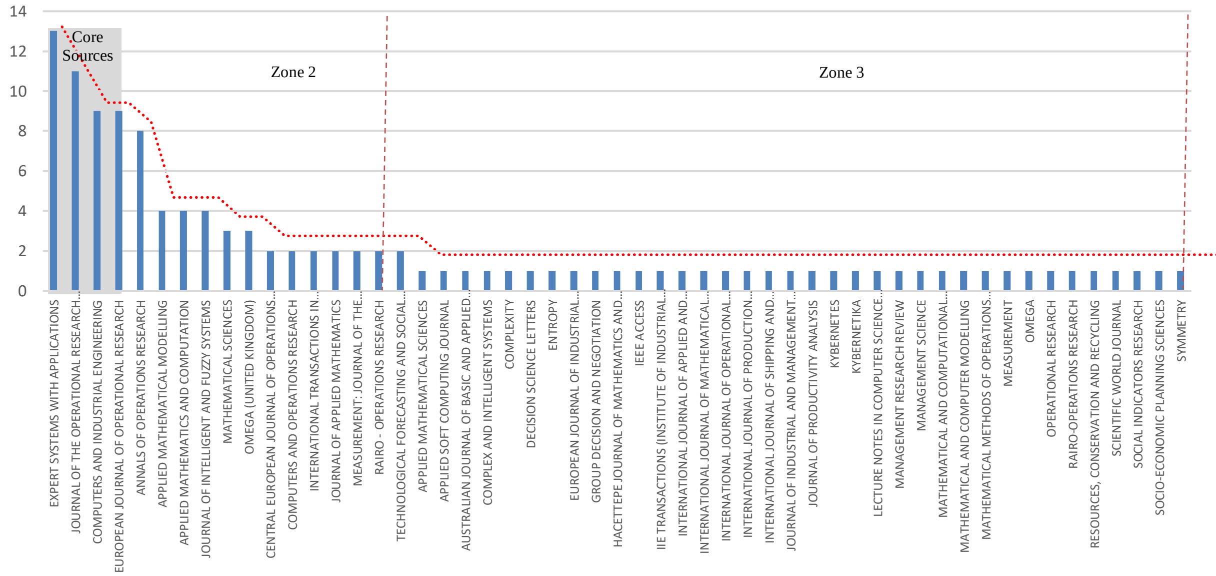

Figure 6. Contribution of Journals and Bradford's Law

Figure 6 illustrates that the journal "EXPERT SYSTEMS WITH APPLICATIONS" has published the highest number of articles (13) on the topic of concern. According to Bradford's Law, 40% of the articles included in the literature review are published in the top four journals, which are considered the core journals, and have the highest citation rates. Table 14 provides a list of the top ten journals with the highest number of citations in the field of CSW.

Table 14. Top ten most cited journals.

Journal	Citations
EUROPEAN JOURNAL OF OPERATIONAL RESEARCH	275
JOURNAL OF THE OPERATIONAL RESEARCH SOCIETY	101
EXPERT SYSTEMS WITH APPLICATIONS	75
COMPUTERS & INDUSTRIAL ENGINEERING	72
OMEGA	70
APPLIED MATHEMATICS AND COMPUTATION	67
MATHEMATICAL SCIENCES	57
APPLIED MATHEMATICAL MODELLING	53
ANNALS OF OPERATIONS RESEARCH	46
COMPUTERS AND OPERATIONS RESEARCH	45

In Figure 7, the Lotka plot visualizes the number of researchers and their articles, providing insight into the degree of collaboration among the authors examined. The degree of collaboration, represented by a number between 0 and 1, indicates the level of cooperation within the group. A value above 0.2 suggests a more favorable degree of collaboration, while a value closer to zero indicates weaker cooperation between the authors. This graphical representation sheds light on the dynamics of author collaboration in a comprehensive and informative manner.

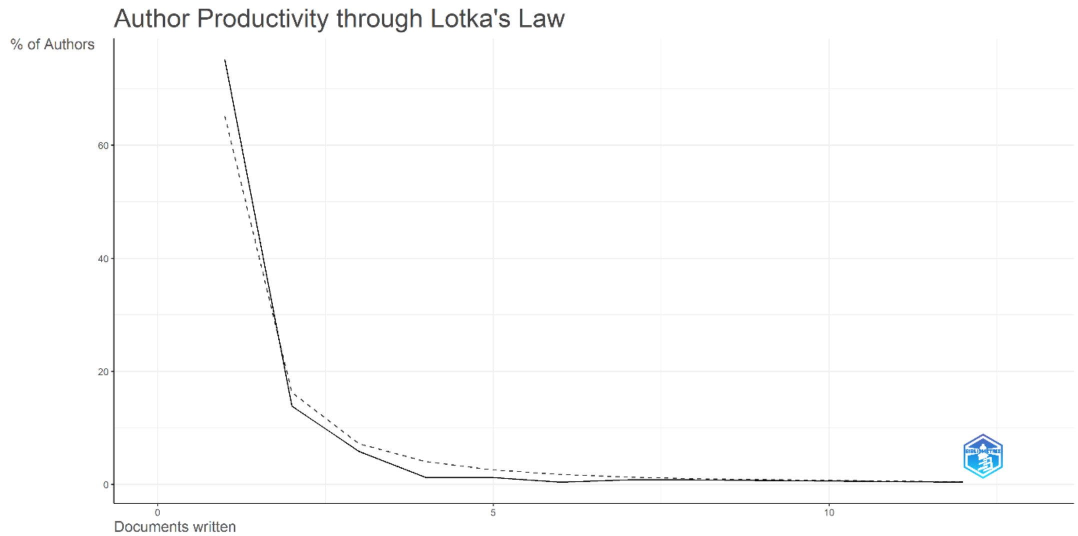

Figure 7. Lotka plot

According to Figure 7, there are 179 authors who have only published a single article. Lotka's law suggests that around 60 percent of all authors fall into this category. However, in this study, the participation rate is higher, at 75 percent. Additionally, the study reveals that there are 33 authors who have published two articles, whereas according to Lotka's law, this number should be 44. Similarly, there are 14 authors who have published three articles, whereas Lotka's law predicts this number to be 19. By comparing the actual number of authors for each document with Lotka's formula, it becomes apparent that Lotka's law does not hold true in this particular field. Nevertheless, it is worth noting that in some cases, the obtained numbers only slightly differ from Lotka's predicted numbers, while in others, they remain equal. As a result of the analysis, the most often-used keywords in CSW literature have been identified and shown in Figure 8. Although the placement of words in the figure is random, the dominant keywords are positioned in the middle.

Figure 8. often -used keywords

According to the analysis of CSW-related literature from 1991 to 2022, it has been found that the most frequently used keywords were "Common Set of Weights" and "Data Envelopment Analysis". The VOS viewer is used to create a figure illustrating the co-authorship network of CSW researchers.

This network map reveals that researchers with more scientific connections have located closer to each other, while those with fewer connections are farther apart. The presence of a researcher at the center of the density map signifies their importance in the collaborative network of researchers. Additionally, the color spectrum, ranging from red to blue, indicates the varying density weight of nodes within the network. Furthermore, cluster analysis of the CSW researcher's co-authorship network revealed that the given network consists of 93 distinct clusters. Among the cluster consisting of the co-authorship network in CSW, Hossein Zadeh Lotfi and Jahanshahloo were the most important. The density map of researchers in terms of scientific productions of CSW is given in Figure 9.

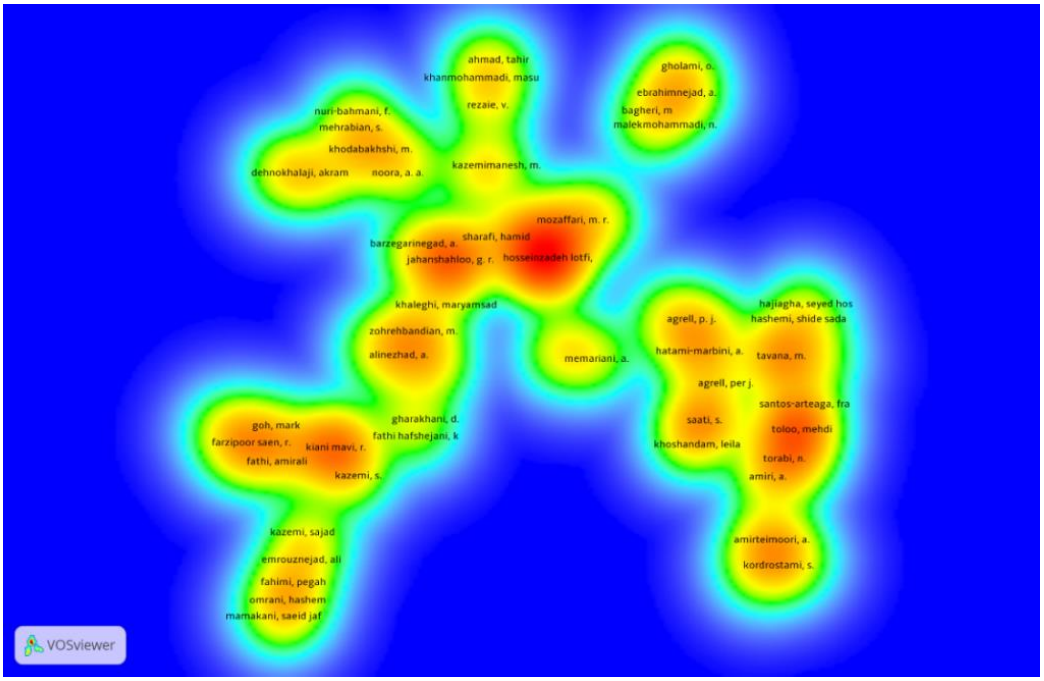

Figure 9. The density map of researchers

5. Finding and Managerial Implications

The current paper was created by focusing on one of the specific areas of the DEA models under the CSW. The search was made in “Scopus” and “Web of Science” source-neutral abstract and citation databases for articles published in the 1991 to 2022 time-span using “Data Envelopment Analysis" and “common AND set AND weights” as title, abstract, and keyword. Parallel to the objectives outlined in this research, 116 articles on CSW were carefully selected. All selected articles were closely examined and analyzed by taking note of items such as computational methodology and main goals, authors, approaches, and so forth. Based on the analysis, this study developed a conceptual framework of CSW, which can outline potential paths for future research in the form of a guide. The results indicated that more than 200 authors have contributed to the field of CSW, and their publications appear in 55 journals. The growing interest in the field of CSW has been on the rise over the years. This can be partly attributed to the development of new computational techniques over time, such as fuzzy or interval comparisons and the development of specific models for evaluating particular situations. The significant titles and topics covered by the leading authors of this period were outlined by topic trends. Most of the studies have used key terms such as "common set of weights" and "data envelopment analysis". Meanwhile, Hossein Zadeh Lotfi and Jahanshahloo were among the most influential authors in this field. 2020 period was associated with significant growth of CSW. By defining the core of the journals, a basis for arranging and selecting scientific journals in CSW was established based on Bradford's law. Nevertheless, Lotka's law can’t be used as a general principle at all times, according to Lotka's results, and more investigations are needed to ensure that it remains correct. RStudio tools, and the VOS viewer software were used to cluster articles, calculate citation rates, and create a co-authorship network density map. These findings may aid researchers in their pursuit of CSW-related sources and references. More than 60% of the studies emphasized the existence and importance of the non-Archimedean epsilon value; in only 15% of the cases, they provided a specific solution to determine this issue, and some of them used non-Archimedean epsilon models provided by other researchers, regardless of the type of model and data. Archimedean epsilon models, provided by other researchers, regardless of the type of model and data. However, non-Archimedean epsilon plays a crucial role in common weight models, and it must be determined correctly for the corresponding model to be practical. Finally, this study provides insights for decision-makers and managers in various industries, particularly those interested in optimizing efficiency and performance. The following are the key points to consider:

-By conducting a systematic review and bibliometric analysis, insights were provided to managers about the potential benefits of using DEA models under CSW for performance measurement purposes. This information can guide managers in developing more accurate and comprehensive performance evaluation systems for their organizations.

-By conducting an overview of various CSW models, this study provides a platform for managers to understand the performance of these models and make an informed decision about which one is most suitable for their specific needs.

-By conducting a systematic review and bibliometric analysis, insight was provided for the managers so that they could understand the current state of research and learn about the latest developments in this field.

-Using bibliometric analysis of the literature, researchers and key journals that have made significant contributions to the field of CSW models were highlighted. Managers can leverage this information to build partnerships and collaborative networks with experts, potentially leading to the exchange of ideas, knowledge sharing, and joint research projects Such collaborations can further enhance managerial decision-making and foster continuous improvement.

- Through a systematic review, insights into the evolving models of CSW were provided, and areas for future research and innovation were identified. Managers can capitalize on these opportunities by encouraging internal R&D teams to explore novel applications of CSW models. This can lead to the development of innovative approaches to performance measurement, efficiency analysis, and resource allocation.

In summary, this study on CSW models offers several managerial implications. By adopting DEA models under CSWs, managers can make informed decisions, identify best practices, promote innovation, foster collaboration, and improve their organization's overall efficiency and performance.

6. Conclusion

Conclusions from the literature on CSW were challenging, both because it is widespread and because of the barriers and constraints that are present for its implementation. Although a literature review can provide a comprehensive overview of the major background, consequences of CSW, and future research opportunities for those interested in the field, there are still many areas for research. Some research opportunities are defined as follows: Researchers need to investigate computational approaches and new models for developing CSW models in various contexts. These contexts include multi-stage production processes, aggregation procedures for individual preferences, the construction of composite indicators while considering the principle of uncertainty, and providing models that assign different weights to different stages of the processes. Future research should also focus on identifying potential challenges that may arise when selecting weights for different stages of a process in a CSW model. For example, what happens when there are conflicting preferences among stakeholders? How do we ensure that the process remains transparent and fair?. Therefore, these cases are examples of gaps in this field that have received less attention, and they represent significant research challenges. On the other hand, although non-Archimedean epsilon plays a decisive role in common weight models and its lack of precise selection renders the relevant model useless, only a small percentage of studies have focused on it. Researchers interested in this field of study should pay attention to these issues and try to cover the research gap of CSW. In addition, presenting a trend chart of topics can be useful for identifying up-to-date subjects for future academic research.

Limitation of the literature review

This literature review had some limitations, they can be divided into three categories:

1- the two databases «Web of Science» and «Scopus» were solely used for the literature review. our efforts focused on articles published in English academic journals and avoided articles published in other languages and other publications (such as conference papers).

2- it is possible that some articles in publications that were related to the research subject, but used different keywords were omitted from the study due to the search method, which was through the keywords «Data Envelopment Analysis» and «Common set of weights».

Finally, the present study, considering the limitations mentioned, has provided significant findings for academic research.

Declaration of competing interest

We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us. This study also does not violate other relevant ethical issues.

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References

[1] Aghayi, N., Tavana, M., & Ali Raayatpanah, M. (2016). Robust efficiency measurement with common set of weights under varying degrees of conservatism and data uncertainty. *European Journal of Industrial Engineering*, *10*(3), 385–405. https://doi.org/10.1504/EJIE.2016.076386

[2] Amin, G. R., & Toloo, M. (2004). A polynomial-time algorithm for finding ε in DEA models. *Computers & Operations Research*, *31*(5), 803–805. https://doi.org/https://doi.org/10.1016/S0305-0548(03)00072-8

[3] Amin, G. R., & Toloo, M. (2007). Finding the most efficient DMUs in DEA: An improved integrated model. Computers and Industrial Engineering, 52(1), 71–77. https://doi.org/10.1016/j.cie.2006.10.003

[4] Amiri, A., Saati, S., & Amirteimoori, A. (2020). Determining a common set of weights in data envelopment analysis by bootstrap. Mathematical Sciences, 14(4), 335–344. https://doi.org/10.1007/s40096-020-00344-7

[5] Amirteimoori, A., Kordrostami, S., Masoumzadeh, A., & Maghbouli, M. (2014). Increasing the discrimination power of data envelopment analysis. International Journal of Operational Research, 19(2), 198–210. https://doi.org/10.1504/IJOR.2014.058950

[6] Anderson, T. R., Hollingsworth, K., & Inman, L. (2002). The fixed weighting nature of a cross-evaluation model. Journal of Productivity Analysis, 17, 249–255.

[7] Appa, G., & Williams, H. P. (2006). A new framework for the solution of DEA models. European Journal of Operational Research, 172(2), 604–615. https://doi.org/10.1016/j.ejor.2004.09.051

[8] Azar, A., Zarei Mahmoudabadi, M., & Emrouznejad, A. (2016). A new fuzzy additive model for determining the common set of weights in Data Envelopment Analysis. Journal of Intelligent and Fuzzy Systems, 30(1), 61–69. https://doi.org/10.3233/IFS-151710

[9] Bagheri, M., Ebrahimnejad, A., Razavyan, S., Hosseinzadeh Lotfi, F., & Malekmohammadi, N. (2020). Solving the fully fuzzy multi-objective transportation problem based on the common set of weights in DEA. Journal of Intelligent and Fuzzy Systems, 39(3), 3099–3124. https://doi.org/10.3233/JIFS-191560

[10] Banker, R. D., Charnes, A., & Cooper, W. W. (1984). Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis. Management Science, 30(9), 1078–1092. https://doi.org/10.1287/mnsc.30.9.1078

[11] Barzegarinegad, A., Jahanshahloo, G., & Rostamy-Malkhalifeh, M. (2014). A full ranking for decision making units using ideal and anti-ideal points in DEA. Scientific World Journal, 2014, 8. https://doi.org/10.1155/2014/282939

[12] Bastehzadeh, D., & Mehrabian, S. (2022). integrated Slacks-based Measure of Efficiency and Super-efficiency improving in additive Data Envelopment Analysis. Iranian Journal of Operations Research, 13(2), 44–61.

[13] Belton, V., & Vickers, S. P. (1993). Demystifying DEA—A visual interactive approach based on multiple criteria analysis. Journal of the Operational Research Society, 44(9), 883–896.

[14] Bi, G., Ding, J., Luo, Y., & Liang, L. (2011). Resource allocation and target setting for parallel production system based on DEA. Applied Mathematical Modelling, 35(9), 4270–4280. https://doi.org/10.1016/j.apm.2011.02.048

[15] Carrillo, M., & Jorge, J. M. (2016). A multiobjective DEA approach to ranking alternatives. Expert Systems with Applications, 50, 130–139. https://doi.org/10.1016/j.eswa.2015.12.022

[16] Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. European Journal of Operational Research, 2(6), 429–444. https://doi.org/10.1016/0377-2217(78)90138-8

[17] Chen, C.-M. (2009). A network-DEA model with new efficiency measures to incorporate the dynamic effect in production networks. European Journal of Operational Research, 194(3), 687–699. https://doi.org/10.1016/j.ejor.2007.12.025

[18] Chiang, C.-I., Hwang, M.-J., & Liu, Y. H. (2011). Determining a common set of weights in a DEA problem using a separation vector. Mathematical and Computer Modelling, 54(9–10), 2464–2470.

[19] Chiang, C. I., & Tzeng, G. H. (2000). A multiple objective programming approach to data envelopment analysis. In New frontiers of decision making for the information technology era (pp. 270–285). World Scientific.

[20] Chu, J., & Jiang, H. (2019). Fixed Cost Allocation Based on the Utility?: A DEA Common-Weight Approach. IEEE Access, 7, 72613–72621. https://doi.org/10.1109/ACCESS.2019.2919645

[21] Chu, J., Wu, J., & Chu, C. (2020). A multi-objective model for Pareto optimality in data envelopment analysis cross-efficiency evaluation. European Journal of Operational Research. https://doi.org/10.1016/j.ejor.2019.12.020

[22] Chu, J., Wu, J., Chu, C., & Zhang, T. (2020). DEA-based fixed cost allocation in two-stage systems: Leader-follower and satisfaction degree bargaining game approaches. Omega (United Kingdom), 94(xxxx). https://doi.org/10.1016/j.omega.2019.03.012

[23] Contreras, I. (2011). A DEA-inspired procedure for the aggregation of preferences. Expert Systems with Applications, 38(1), 564–570. https://doi.org/10.1016/j.eswa.2010.07.002

[24] Contreras, I., Lozano, S., & Hinojosa, M. A. (2021). A bargaining approach to determine common weights in DEA. Operational Research, 21(3), 2181–2201. https://doi.org/10.1007/s12351-019-00498-w

[25] Cook, W. D., & Kress, M. (1991). A data envelopment model for aggregating preference rankings. Management Science, 36(11), 1302–1310.

[26] Cook, W. D., Kress, M., & Seiford, L. M. (1996). Data envelopment analysis in the presence of both quantitative and qualitative factors. Journal of the Operational Research Society, 47(7), 945–953.

[27] Davoodi, A., & Rezai, H. Z. (2012). Common set of weights in data envelopment analysis: a linear programming problem. Central European Journal of Operations Research, 20(2), 355–365. https://doi.org/10.1007/s10100-011-0195-6

[28] Davtalab-Olyaie, M., & Asgharian, M. (2021). On Pareto-optimality in the cross-efficiency evaluation. European Journal of Operational Research, 288(1), 247–257. https://doi.org/10.1016/j.ejor.2020.05.040

[29] Despotis, D. K. (2002). Improving the discriminating power of DEA: Focus on globally efficient units. Journal of the Operational Research Society, 53(3), 314–323. https://doi.org/10.1057/palgrave/jors/2601253

[30] Ebrahimnejad, A., & Bagherzadeh, M. R. (2016). Data envelopment analysis approach for discriminating efficient candidates in voting systems by considering the priority of voters. Hacettepe Journal of Mathematics and Statistics, 45(1), 165–180. https://doi.org/10.15672/HJMS.2015489355

[31] Emrouznejad, A., Petridis, K., & Charles, V. (2023). Introduction to Data Envelopment Analysis. In Data Envelopment Analysis with GAMS: A Handbook on Productivity Analysis and Performance Measurement (pp. 11–39). Springer.

[32] Feng, Q., Wu, Z., & Zhou, G. (2021). Fixed cost allocation considering the input-output scale based on DEA approach. Computers and Industrial Engineering, 159(24), 107476. https://doi.org/10.1016/j.cie.2021.107476

[33] Foroughi, A. A., & Aouni, B. (2012). New approaches for determining a common set of weights for a voting system. International Transactions in Operational Research, 19(4), 521–530. https://doi.org/10.1111/j.1475-3995.2011.00832.x

[34] Franklin Liu, F. H., & Peng, H. H. (2009). A systematic procedure to obtain a preferable and robust ranking of units. Computers and Operations Research, 36(4), 1012–1025. https://doi.org/10.1016/j.cor.2007.12.003

[35] Fugger, G. (2023). Absolute and relative weight restrictions in DEA-a comparison. International Journal of Operational Research, 47(2), 245–271.

[36] Gan, G. Y., & Lee, H. S. (2019). An alternative MILP-DEA model to choose efficient unit without explicit inputs. Annals of Operations Research, 278(1–2), 379–391. https://doi.org/10.1007/s10479-017-2472-9

[37] Gharakhani, D., Toloie Eshlaghy, A., Fathi Hafshejani, K., Kiani Mavi, R., & Hosseinzadeh Lotfi, F. (2018). Common weights in dynamic network DEA with goal programming approach for performance assessment of insurance companies in Iran. Management Research Review, 41(8), 920–938. https://doi.org/10.1108/MRR-03-2017-0067

[38] Ghasemi, M., Mozaffari, M. R., Hosseinzadeh Lotfi, F., Rostamy Malkhalifeh, M., & Behzadi, M. H. (2022). New Approach in Fixed Resource Allocation and Target Setting Using Data Envelopment Analysis with Common Set of Weights. Complexity, 2022, 1–11. https://doi.org/10.1155/2022/2149093

[39] Ghasemi, M., Mozaffari, M. R., Malkhalifeh, M. R., Behzadi, M. H., Rostamy Malkhalifeh, M., & Behzadi, M. H. (2022). Stochastic Efficiency Based on a Common Set of Weights in Data Envelopment Analysis. International Journal of Industrial Mathematics, 14(2), 139–152.

[40] Hadi-Vencheh, A. (2014). Two effective total ranking models for preference voting and aggregation. Mathematical Sciences, 8(1). https://doi.org/10.1007/s40096-014-0115-8

[41] Hajiagha, S. H. R., Mahdiraji, H. A., Tavana, M., & Hashemi, S. S. (2018). A novel common set of weights method for multi-period efficiency measurement using mean-variance criteria. Measurement, 129(May), 569–581. https://doi.org/10.1016/j.measurement.2018.07.061

[42] Hammami, H., Ngo, T., Tripe, D., & Vo, D. T. (2022). Ranking with a Euclidean common set of weights in data envelopment analysis: with application to the Eurozone banking sector. Annals of Operations Research, 311(2), 675–694. https://doi.org/10.1007/s10479-020-03759-6

[43] Hatami-Marbini, A., Beigi, Z. G., Fukuyama, H., & Gholami, K. (2015). Modeling centralized resources allocation and target setting in imprecise data envelopment analysis. International Journal of Information Technology and Decision Making, 14(6), 1189–1213. https://doi.org/10.1142/S0219622015500248

[44] Hatami-Marbini, A., & Saati, S. (2018). Efficiency evaluation in two-stage data envelopment analysis under a fuzzy environment: A common-weights approach. Applied Soft Computing Journal, 72, 156–165. https://doi.org/10.1016/j.asoc.2018.07.057

[45] Hatami-Marbini, A., Tavana, M., Agrell, P. J., Hosseinzadeh Lotfi, F., & Ghelej Beigi, Z. (2015). A common-weights DEA model for centralized resource reduction and target setting. Computers and Industrial Engineering, 79, 195–203. https://doi.org/10.1016/j.cie.2014.10.024

[46] Hatefi, S. M., & Torabi, S. A. (2010). A common weight MCDA-DEA approach to construct composite indicators. Ecological Economics, 70(1), 114–120. https://doi.org/10.1016/j.ecolecon.2010.08.014

[47] Hinojosa, M. A., Lozano, S., Borrero, D. V., & Mármol, A. M. (2017). Ranking efficient DMUs using cooperative game theory. Expert Systems with Applications, 80, 273–283. https://doi.org/10.1016/j.eswa.2017.03.004

[48] Hosseinzadeh Lotfi, F., Hatami-Marbini, A., Agrell, P. J., Aghayi, N., & Gholami, K. (2013). Allocating fixed resources and setting targets using a common-weights DEA approach. Computers and Industrial Engineering, 64(2), 631–640. https://doi.org/10.1016/j.cie.2012.12.006

[49] Izadikhah, M., & Farzipoor Saen, R. (2019). Solving voting system by data envelopment analysis for assessing sustainability of suppliers. Group Decision and Negotiation, 28(3), 641–669. https://doi.org/10.1007/s10726-019-09616-7

[50] Jahanshahloo, G., Hosseinzadeh Lotfi, F., Khanmohammadi, M., & Kazemimanesh, M. (2012). A Method for Discriminating Efficient Candidates with Ranked Voting Data by Common Weights. In Mathematical and Computational Applications (Vol. 17, Issue 1, pp. 1–8). https://doi.org/10.3390/mca17010001

[51] Jahanshahloo, G. R., Memariani, A., Lotfi, F. H., & Rezai, H. Z. (2005). A note on some of DEA models and finding efficiency and complete ranking using common set of weights. Applied Mathematics and Computation, 166(2), 265–281. https://doi.org/10.1016/j.amc.2004.04.088

[52] Jahanshahloo, G. R., Sadeghi, J., & Khodabakhshi, M. (2017). Proposing a method for fixed cost allocation using DEA based on the efficiency invariance and common set of weights principles. Mathematical Methods of Operations Research, 85(2), 223–240. https://doi.org/10.1007/s00186-016-0563-z

[53] Jahanshahloo, G. R., Zohrehbandian, M., Abbasian-Naghneh, S., Hadavandi, E., & Ghanbari, A. (2010). Using dea for evaluating the attribute weights and solving one MADM problem. Australian Journal of Basic and Applied Sciences, 4(10), 5271–5276.

[54] Jahanshahloo, G. R., Zohrehbandian, M., Alinezhad, A., Naghneh, S. A., Abbasian, H., & Mavi, R. K. (2011). Finding common weights based on the DM's preference information. Journal of the Operational Research Society, 62(10), 1796–1800.

[55] Jahanshahloo, G. R., Zohrehbandian, M., Lotfi, F. H., & Khaleghi, M. (2011). Using AHP for priority determination in IDEA. Applied Mathematical Sciences, 5(61–64), 3001–3010.

[56] Jain, V., Kumar, A., Kumar, S., & Chandra, C. (2015). Weight restrictions in Data Envelopment Analysis: A comprehensive Genetic Algorithm based approach for incorporating value judgments. Expert Systems with Applications, 42(3), 1503–1512. https://doi.org/10.1016/j.eswa.2014.09.034

[57] Jiang, H., Wu, J., Chu, J., & Liu, H. (2020). Better resource utilization: A new DEA bi-objective resource reallocation approach considering environmental efficiency improvement. Computers and Industrial Engineering, 144(March), 106504. https://doi.org/10.1016/j.cie.2020.106504

[58] Kao, C., & Hung, H.-T. (2005). Data envelopment analysis with common weights: the compromise solution approach. Journal of the Operational Research Society, 56(10), 1196–1203. https://doi.org/10.1057/palgrave.jors.2601924

[59] Karsak, E. E., & Ahiska, S. S. (2005). Practical common weight multi-criteria decision-making approach with an improved discriminating power for technology selection. International Journal of Production Research, 43(8), 1537–1554. https://doi.org/10.1080/13528160412331326478

[60] Kazemi, S., Mavi, R. K., Emrouznejad, A., & Mavi, N. K. (2021). Fuzzy clustering of homogeneous decision making units with common weights in data envelopment analysis. Journal of Intelligent and Fuzzy Systems, 40(1), 813–832. https://doi.org/10.3233/JIFS-200962

[61] Kiani Mavi, R., Fathi, A., Farzipoor Saen, R., & Kiani Mavi, N. (2019). Eco-innovation in transportation industry: A double frontier common weights analysis with ideal point method for Malmquist productivity index. Resources, Conservation and Recycling, 147(April), 39–48. https://doi.org/10.1016/j.resconrec.2019.04.017

[62] Kiani Mavi, R., Kazemi, S., & M. Jahangiri, J. (2013). Developing common set of weights with considering nondiscretionary inputs and using ideal point method. Journal of Applied Mathematics, 2013, 9. https://doi.org/10.1155/2013/906743

[63] Kritikos, M. N. (2017). A full ranking methodology in data envelopment analysis based on a set of dummy decision making units. Expert Systems with Applications, 77, 211–225. https://doi.org/10.1016/j.eswa.2017.01.042

[64] Lee, H.-S., & Yeh, C.-H. (2006). A multiple criteria decision making model based on fuzzy multiple objective DEA. International Conference on Knowledge-Based and Intelligent Information and Engineering Systems, 917–921.

[65] Li, F., Song, J., Dolgui, A., & Liang, L. (2017). Using common weights and efficiency invariance principles for resource allocation and target setting. International Journal of Production Research, 55(17), 4982–4997. https://doi.org/10.1080/00207543.2017.1287450

[66] Li, F., Yan, Z., Zhu, Q., Yin, M., & Kou, G. (2021). Allocating a fixed cost across decision making units with explicitly considering efficiency rankings. Journal of the Operational Research Society, 72(6), 1432–1446. https://doi.org/10.1080/01605682.2020.1718561

[67] Li, F., Zhu, Q., & Chen, Z. (2019). Allocating a fixed cost across the decision making units with two-stage network structures. Omega (United Kingdom), 83, 139–154. https://doi.org/10.1016/j.omega.2018.02.009
[68] Li, F., Zhu, Q., & Liang, L. (2018). Allocating a fixed cost based on a DEA-game cross efficiency approach. Expert Systems with Applications, 96, 196–207. https://doi.org/10.1016/j.eswa.2017.12.002
[69] Li, F., Zhu, Q., & Liang, L. (2019). A new data envelopment analysis based approach for fixed cost allocation. Annals of Operations Research, 274(1–2), 347–372. https://doi.org/10.1007/s10479-018-2819-x
[70] Liu, F. H. F., & Hsuan Peng, H. (2008). Ranking of units on the DEA frontier with common weights. Computers and Operations Research, 35(5), 1624–1637. https://doi.org/10.1016/j.cor.2006.09.006
[71] Liu, F. H. F., & Tsai, L. C. (2012). Reallocating multiple inputs and outputs of units to improve overall performance. Applied Mathematics and Computation, 219(1), 237–247. https://doi.org/10.1016/j.amc.2012.06.012
[72] Lozano, S., Soltani, N., & Dehnokhalaji, A. (2020). A compromise programming approach for target setting in DEA. Annals of Operations Research, 288(1), 363–390. https://doi.org/10.1007/s10479-019-03486-7
[73] Makui, A., & Momeni, M. (2012). Using CSW weight's in UTASTAR method. Decision Science Letters, 1(1), 39–46. https://doi.org/10.5267/j.dsl.2012.06.001
[74] Mavi, R. K., & Mavi, N. K. (2021). National eco-innovation analysis with big data: A common-weights model for dynamic DEA. Technological Forecasting and Social Change, 162(October 2019), 120369. https://doi.org/10.1016/j.techfore.2020.120369
[75] MirHassani, S. A., & Alirezaee, M. R. (2005). An efficient approach for computing non-Archimedean e in DEA based on integrated models. Applied Mathematics and Computation, 166(2), 449–456.
[76] Modhej, D., & Dahimavi, A. (2022). Evaluation Efficiency of Large-Scale Data Set: Cerebellar Model Articulation Controller Neural Network. Iranian Journal of Operations Research, 13(1), 13–30.
[77] Moradi, H., Rabbani, M., babaei meybodi, H., & Honari, M. . (2022). Development of a Range-Adjusted Measure-Based Common Set of Weights for Dynamic Network Data Envelopment Analysis using a Multi-Objective Fractional Programming Approach. Journal of Industrial Engineering and Management Studies, 9(2), 13–32.
[78] Moradi, H., Rabbani, M., Babaei Meybodi, H., & Honari, M. . (2023). Novel approaches for determining exogenous weights in dynamic network DEA. Iranian Journal of Management Studies, x, accepted and under publish.
[79] Moradi, H., Rabbani, M., Babaei Meybodi, H., & Honari, M. . T. (2021a). Development of a Hybrid Model for Sustainable Supply Chain Evaluation with Dynamic Network Data Envelopment Analysis Approach. Iranian Journal of Operations Research, 12(2), 1–13.
[80] Moradi, H., Rabbani, M., Babaei Meybodi, H., & Honari, M. T. (2021b). Sustainable Supplier Selection?: A New Integrated Approach of Fuzzy Interpretive Structural Modeling and Dynamic Network Data Envelopment Analysis. 12(2), 14–36.
[81] Nakabayashi, K., & Tone, K. (2006). Egoist's dilemma: a DEA game. Omega, 34(2), 135–148.
[82] Nojoumi, K., Saati, S., & Khoshandam, L. (2022). Centralized resource allocation to create New Most Productive Scale Size (MPSS) DMUs. RAIRO - Operations Research, 56(4), 2929–2944. https://doi.org/10.1051/ro/2022116
[83] Noorizadeh, A., Mahdiloo, M., & Farzipoor Saen, R. (2013). Using DEA cross-efficiency evaluation for suppliers ranking in the presence of non-discretionary inputs. International Journal of Shipping and Transport Logistics, 5(1), 95–111.

[84] Omrani, H. (2013). Common weights data envelopment analysis with uncertain data: A robust optimization approach. Computers & Industrial Engineering, 66(4), 1163–1170.

[85] Omrani, H., Fahimi, P., & Emrouznejad, A. (2022). A common weight credibility data envelopment analysis model for evaluating decision making units with an application in airline performance. RAIRO - Operations Research, 56(2), 911–930. https://doi.org/10.1051/ro/2022031

[86] Payan, A. (2015). Common set of weights approach in fuzzy DEA with an application. Journal of Intelligent and Fuzzy Systems, 29(1), 187–194. https://doi.org/10.3233/IFS-151586

[87] Payan, A., Hosseinzadeh Lotfi, F., Noora, A. A., & Khodabakhshi, M. (2011). A modified common set of weights method to complete ranking DMUs. International Journal of Mathematical Models and Methods in Applied Sciences, 5(7), 1143–1153.

[88] Pourhabib Yekta, A., Kordrostami, S., Amirteimoori, A., & Kazemi Matin, R. (2018). Data envelopment analysis with common weights: the weight restriction approach. Mathematical Sciences, 12(3), 197–203. https://doi.org/10.1007/s40096-018-0259-z

[89] Puri, J., Yadav, S. P., & Garg, H. (2017). A new multi-component DEA approach using common set of weights methodology and imprecise data: an application to public sector banks in India with undesirable and shared resources. Annals of Operations Research, 259(1–2), 351–388. https://doi.org/10.1007/s10479-017-2540-1

[90] Qi, X. G., & Guo, B. (2014). Determining common weights in Data Envelopment Analysis with Shannon's entropy. Entropy, 16(12), 6394–6414. https://doi.org/10.3390/e16126394

[91] Ramezani-Tarkhorani, S., Khodabakhshi, M., Mehrabian, S., & Nuri-Bahmani, F. (2014). Ranking decision-making units using common weights in DEA. Applied Mathematical Modelling, 38(15–16), 3890–3896. https://doi.org/10.1016/j.apm.2013.08.029

[92] Ramón, N., Ruiz, J. L., & Sirvent, I. (2012). Common sets of weights as summaries of DEA profiles of weights: With an application to the ranking of professional tennis players. Expert Systems with Applications, 39(5), 4882–4889. https://doi.org/10.1016/j.eswa.2011.10.004

[93] Razipour-GhalehJough, S., Hosseinzadeh Lotfi, F., Jahanshahloo, G., Rostamy-malkhalifeh, M., & Sharafi, H. (2020). Finding closest target for bank branches in the presence of weight restrictions using data envelopment analysis. In Annals of Operations Research (Vol. 288, Issue 2). Springer US. https://doi.org/10.1007/s10479-019-03166-6

[94] Rezaie, V., Ahmad, T., Awang, S.-R., Khanmohammadi, M., & Maan, N. (2014). Ranking DMUs by calculating the interval efficiency with a common set of weights in DEA. Journal of Applied Mathematics, 2014.

[95] Roll, Y., Cook, W. D., & Golany, B. (1991). Controlling factor weights in data envelopment analysis. IIE Transactions (Institute of Industrial Engineers), 23(1), 2–9. https://doi.org/10.1080/07408179108963835

[96] Rousseau, J. J., & Semple, J. H. (1995). Two-person ratio efficiency games. Management Science, 41(3), 435–441.

[97] Ruiz, J. L., & Sirvent, I. (2016). Common benchmarking and ranking of units with DEA. Omega (United Kingdom), 65, 1–9. https://doi.org/10.1016/j.omega.2015.11.007

[98] Saati, S., Hatami-Marbini, A., Agrell, P. J., & Tavana, M. (2012). A common set of weight approach using an ideal decision making unit in data envelopment analysis. Journal of Industrial and Management Optimization, 8(3), 623–637. https://doi.org/10.3934/jimo.2012.8.623

[99] Saati, S., & Memariani, A. (2005). Reducing weight flexibility in fuzzy DEA. Applied Mathematics and Computation, 161(2), 611–622. https://doi.org/https://doi.org/10.1016/j.amc.2003.12.052

[100] Salahi, M., Toloo, M., & Torabi, N. (2020). A new robust optimization approach to common weights formulation in DEA A new robust optimization approach to common weights

formulation. Journal of the Operational Research Society, 72(6), 1390–1402. https://doi.org/10.1080/01605682.2020.1718016
[101] Salahi, M., Torabi, N., & Amiri, A. (2016). An optimistic robust optimization approach to common set of weights in DEA. Measurement: Journal of the International Measurement Confederation, 93(June), 67–73. https://doi.org/10.1016/j.measurement.2016.06.049
[102] Sanei, M., Khoshtinat, F. Z., & Khodadadi, M. (2011). An improved common weight MCDA-DEA approach to construct composite indicators. Australian Journal of Basic and Applied Sciences, 5(12), 1471–1475.
[103] Shabani, A., Visani, F., Barbieri, P., Dullaert, W., & Vigo, D. (2019). Reliable estimation of suppliers' total cost of ownership: An imprecise data envelopment analysis model with common weights. Omega (United Kingdom), 87, 57–70. https://doi.org/10.1016/j.omega.2018.08.002
[104] Shi, H., Wang, Y., & Zhang, X. (2019). A cross-efficiency evaluation method based on evaluation criteria balanced on interval weights. Symmetry, 11(12). https://doi.org/10.3390/SYM11121503
[105] Shirdel, G. H., Ramezani-Tarkhorani, S., & Jafari, Z. (2017). A Method for Evaluating the Performance of Decision Making Units with Imprecise Data Using Common Set of Weights. International Journal of Applied and Computational Mathematics, 3(2), 411–423. https://doi.org/10.1007/s40819-016-0152-0
[106] Si, X., Liang, L., Jia, G., Yang, L., Wu, H., & Li, Y. (2013). Proportional sharing and DEA in allocating the fixed cost. Applied Mathematics and Computation, 219(12), 6580–6590. https://doi.org/10.1016/j.amc.2012.12.085
[107] Sun, J., Miao, Y., Wu, J., Cui, L., & Zhong, R. (2014). Improved interval dea models with common weight. Kybernetika, 50(5), 774–785. https://doi.org/10.14736/kyb-2014-5-0774
[108] Sun, J., Wu, J., & Guo, D. (2013). Performance ranking of units considering ideal and anti-ideal DMU with common weights. Applied Mathematical Modelling, 37(9), 6301–6310.
[109] Tabatabaei, S., Mozaffari, M. R., Rostamy-Malkhalifeh, M., & Hosseinzadeh Lotfi, F. (2022). Fuzzy efficiency evaluation in relational network data envelopment analysis: application in gas refineries. Complex & Intelligent Systems, 1–29.
[110] Toloo, M. (2013). The most efficient unit without explicit inputs: An extended MILP-DEA model. Measurement, 46(9), 3628–3634. https://doi.org/10.1016/J.MEASUREMENT.2013.06.030
[111] Toloo, M. (2014a). An epsilon-free approach for finding the most efficient unit in DEA. Applied Mathematical Modelling, 38(13), 3182–3192. https://doi.org/10.1016/j.apm.2013.11.028
[112] Toloo, M. (2014b). The role of non-Archimedean epsilon in finding the most efficient unit: With an application of professional tennis players. Applied Mathematical Modelling, 38(21–22), 5334–5346. https://doi.org/10.1016/j.apm.2014.04.010
[113] Toloo, M. (2015). Alternative minimax model for finding the most efficient unit in data envelopment analysis. Computers and Industrial Engineering, 81, 186–194. https://doi.org/10.1016/j.cie.2014.12.032
[114] Toloo, M., & Hanclová, J. (2020). Multi-valued measures in DEA in the presence of undesirable outputs. Omega, 94, 102041.
[115] Toloo, M., Tavana, M., & Santos-Arteaga, F. J. (2019). An integrated data envelopment analysis and mixed integer non-linear programming model for linearizing the common set of weights. Central European Journal of Operations Research, 27(4), 887–904. https://doi.org/10.1007/s10100-017-0510-y
[116] Troutt, M. D. (1997). Derivation of the maximin efficiency ratio model from the maximum decisional efficiency principle. Annals of Operations Research, 73, 323–338.

[117] Wang, M., & Li, Y. (2014). Supplier evaluation based on Nash bargaining game model. Expert Systems with Applications, 41(9), 4181–4185.

[118] Wang, Q., Wei, K., Zhang, Y., & Wang, X. (2021). Data envelopment analysis method based on a common set of normalized weights using bargaining game thought. Computers and Industrial Engineering, 154(December 2020), 107047. https://doi.org/10.1016/j.cie.2020.107047

[119] Wang, Y. M., & Chin, K. S. (2010). A neutral DEA model for cross-efficiency evaluation and its extension. Expert Systems with Applications, 37(5), 3666–3675. https://doi.org/10.1016/j.eswa.2009.10.024

[120] Wang, Y. M., Chin, K. S., & Yang, J. B. (2007). Three new models for preference voting and aggregation. Journal of the Operational Research Society, 58(10), 1389–1393. https://doi.org/10.1057/palgrave.jors.2602295

[121] Wen, Y., An, Q., Xu, X., & Chen, Y. (2018). Selection of Six Sigma project with interval data: common weight DEA model. Kybernetes, 47(7), 1307–1324. https://doi.org/10.1108/K-07-2017-0250

[122] Wu, J., Chu, J., Sun, J., & Zhu, Q. (2016). DEA cross-efficiency evaluation based on Pareto improvement. European Journal of Operational Research, 248(2), 571–579. https://doi.org/10.1016/j.ejor.2015.07.042

[123] Wu, J., Chu, J., Zhu, Q., Li, Y., & Liang, L. (2016). Determining common weights in data envelopment analysis based on the satisfaction degree ga. Journal of the Operational Research Society, 67(12), 1446–1458. https://doi.org/10.1057/jors.2016.35

[124] Wu, J., Liang, L., & Yang, F. (2009). Determination of the weights for the ultimate cross efficiency using Shapley value in cooperative game. Expert Systems with Applications, 36(1), 872–876.

[125] Wu, J., Liang, L., Yang, F., & Yan, H. (2009). Bargaining game model in the evaluation of decision making units. Expert Systems with Applications, 36(3), 4357–4362.

[126] Yang, F. C., Kao, R. H., Chen, Y. T., Ho, Y. F., Cho, C. C., & Huang, S. W. (2018). A Common Weight Approach to Construct Composite Indicators: The Evaluation of Fourteen Emerging Markets. Social Indicators Research, 137(2), 463–479. https://doi.org/10.1007/s11205-017-1603-7

[127] Zhou, Z., Amowine, N., & Huang, D. (2018). Quantitative efficiency assessment based on the dynamic slack-based network data envelopment analysis for commercial banks in Ghana. South African Journal of Economic and Management Sciences, 21(1), 1–11.

[128] Zohrehbandian, M., Makui, A., & Alinezhad, A. (2010). A compromise solution approach for finding common weights in DEA: An improvement to Kao and Hung's approach. Journal of the Operational Research Society, 61(4), 604–610. https://doi.org/10.1057/jors.2009.4