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Review

Human development and data envelopment analysis: A structured literature review ☆, ☆☆

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ABSTRACT

Given the importance the concept of productive efficiency has on analyzing the human development process, which is complex and multidimensional, this study conducts a literature review on the research works that have used the data envelopment analysis (DEA) to measure and analyze the development process. Therefore, we researched the databases of Scopus and Web of Science, and considered the following analysis dimensions: bibliometrics, scope, DEA models and extensions used, interfaces with other techniques, units analyzed and depth of analysis. In addition to a brief summary, the main gaps in each analysis dimension were assessed, which may serve to guide future researches.

Contents

1. Introduction

The particularities of the development processes, both economic and human, have been increasingly studied, albeit these processes, especially the latter, are still not fully understood. It should be emphasized that human development includes

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expanding well-being for all people and increasing the possibilities of individual choice [91], and it can be defined as the process of expanding people's capacity to perform freely chosen core value activities [82]. In broad terms, the human development approach appeared as a means to reallocate human beings at the center of actions related to politics, economy and society, in such a way that the central concern is no longer how much is being produced, but rather how this affects people's quality of life [41].

Bearing in mind how new the idea of human development is, and how difficult it is to measure and analyze it, given its multidimensional nature, the data envelopment analysis (DEA) can greatly contribute to this process, by making it possible to better study and understand it. DEA is an operational research method developed by Charnes et al. [16], which through the empirical construction of a frontier, allows calculating the efficiency of a set of units, designated as decision making units (DMUs). The main attributes of DEA are its versatility and its capacity to be adapted to many different situations.

According to Liu et al. [57], the number of accumulated papers about DEA applications has exceeded the number of purely methodological ones since 1999. The survey of DEA applications conducted by these authors, however, was focused only on industrial applications and the gap in the systematization of the studies that used DEA to evaluate human development continues to exist. This gap will be filled with this work.

In line with this view, the objective of this research paper is to identify and systematize information regarding studies that have used DEA to evaluate the human development process, while pointing out possible directions for future research. To this end, a literature survey using a structured literature research was conducted because, according to Jabbour [49], it enables to:

1. Integrate the results of the articles assessed and relate them to the emerging issues on the topic researched.
2. Analyze in depth the most important studies that incorporate state-of-the-art research on a theme.
3. Identify possible gaps and challenges for future research.

Taking this into account, the outline of this paper is as follows: the major DEA models and extensions are described in Section 2; the research method is presented in Section 3; the results are discussed in Section 4; finally, in Section 5 some conclusions are presented about this work.

2. Data envelopment analysis

DEA is a mathematical procedure based on linear programming, which can determine the set of weights that maximizes the efficiency of a DMU, allowing it to incorporate multiple inputs and outputs into a single value, without the need to convert them into a common unit of measure [22]. Under this basic principle, a big number of models and extensions were developed; part of these was used in the research about human development and they will be addressed in the next two subsections. More details about these and others models and extensions of DEA can be found in Cook and Seiford [20]; a survey about the most cited journals and researches in DEA literature can be found in Liu et al. [56].

2.1. Models

DEA can be expressed as a series of models, whereas the type of returns to scale is what characterizes the two main ones: (a) CRS (constant returns to scale), or CCR which is an acronym for Charnes, Cooper, and Rhodes [16]; and (b) VRS (variable returns to scale) or BCC which is an acronym for Banker, Charnes, and Cooper [4]. Simply put, while the CCR model assumes that outputs always grow proportionally to inputs, in the BCC model this proportionality is not required, as a DMU may display returns to scale: (a) *increasing*: where outputs grow proportionally more than inputs; (b) *constant*: where there is proportionality; or (c) *decreasing*: where outputs grow proportionately less than inputs.

The CCR and BCC models are classified as radial models. This occurs because the efficiency index of a DMU will represent either the equiproportional reduction of all inputs or the equiproportional increase of all outputs needed to make this DMU more efficient. Radial models therefore require first selecting an orientation, which can be 'input orientation' or 'output orientation'. Other types of radial models are the DRS (decrease returns to scale), working with decreasing and constant returns to scale; and IRS (increase returns to scale), working with increasing and constant returns to scale.

Besides these, there are the non-radial models, whose efficiency is based on the slack concept, which represents how much each input and each output, respectively, should be reduced or increased until the DMU reaches the frontier. These models, unlike the radial ones, do not rely on equiproportional increases or reductions of inputs or outputs, and can simultaneously work in both directions. The additive model of Charnes et al. [18] was the first model to be developed, which can work with both constant returns as well as with variable returns to scale. An advancement of this model was the Slack Based Measure (SBM), proposed by Tone [89], which has the advantage of generating an index between zero and one as a result. Another commonly used non-radial model is the Russell Measure (*RM*), which was developed by Pastor et al. [74].

Finally, the multiplicative models, which were innovatively presented in Charnes et al. [17] must be mentioned. Unlike the aforementioned models, these models do not originate from a linear combination of inputs and outputs, but rather from a geometric combination between variables.

2.2. Extensions

For each of the models presented in the previous subsection, some extensions were developed with several objectives, some of which are (a) breaking the tie between efficient DMUs; (b) incorporating experts' opinions; (c) approaches to deal with panel data; (d) approaches to determining common weights etc. Table 1 shows a brief summary of all DEA extensions that have been used in studies on human development, grouped according to the role they play.

3. Method

The structured literature review followed the method proposed by Lage Junior and Godinho Filho [52], which was later disseminated by Jabbour [49]. This method is summarized in the following steps:

- *Step* 1: Assessing the articles published in major databases, using a set of pre-established keywords.
- *Step* 2: Screening the articles found by reading their abstracts.
- *Step* 3: Developing a classification and an analysis system that can represent all dimensions of the object researched.