SI: DATA ENVELOPMENT ANALYSIS: FOUR DECADES ON

Preface: International conference on data envelopment analysis—DEA40, 16–18 April 2018

Emmanuel Thanassoulis[1] · Maria C. A. Silva[2] · Victor V. Podinovski[3]

1 Introduction

2018 saw the 40th anniversary of the publication of the seminal paper on Data Envelopment Analysis (DEA) (Charnes et al. 1978). DEA has since evolved into a major, if not the method of choice, for modelling efficiency and productivity in the public and private sectors of the economy. To mark this anniversary a conference was held at Aston University in Birmingham, England. The conference attracted over 170 participants worldwide. The participants included, apart from academics researching in the field of DEA, non-academic practitioners using DEA in the course of their employment. Indeed, the conference featured a stream dedicated to non-academic practitioners from the field of Regulation, a major area of use of DEA.

This special issue consists of 12 of the 49 papers submitted for peer-review and publication after the conference. The papers contain a variety of methodological contributions as well as pioneering applications on the broad field of DEA featured at the conference. The themes of methodology and of applications are almost unique to each paper. In terms of areas of application education, regulation, courts and labour inspectorates are among those to be found in this special issue. Methodological advances include alternative methods for assessing the impact of mergers, ascertaining the risk of initial share issues, finding closest targets and the computation of directional estimates of the distance to full or partial frontier.

More specifically, the papers of the special issue make the following contributions. In the education field the paper by Schiltz, De Witte and Mazrekaj estimates managerial efficiency in the yet unexplored field of adult education. Using a unique panel dataset from Flanders, Belgium, the paper extends the commonly used conditional model by correcting for bias within conditional draws through the m out of n bootstrap procedure. This allows the authors to estimate efficiency in the presence of heterogeneity and sampling noise. In addition, they distinguish between managerial efficiency and efficiency differentials. They find that female

✉ Emmanuel Thanassoulis
  e.thanassoulis@aston.ac.uk

1 Department of Operations and Information Management, Aston Business School, Aston University, Birmingham, UK

2 Católica Porto Business School, Universidade Católica Portuguesa, Porto, Portugal

3 School of Business and Economics, Loughborough University, Leicestershire, UK

🜋 Springer

teachers and a more homogenous teacher composition, in terms of age and number of hours allocated to teachers, are likely to go with higher program efficiency.

The field of higher education is explored in the paper by Johnes and Virmani, where the determinants of vice chancellor (VC) pay in UK higher education with a particular focus on the role of performance (principal agent theory) in determining executive pay in UK higher education. The VC is the equivalent of a CEO in the UK university sector. The work is original in that it looks at a variety of measures of VC performance including a DEA measure of managerial efficiency. The authors include three possible measures of performance: a DEA measure of managerial efficiency at transforming inputs into outputs; the performance score used by The Complete University Guide to derive their university rankings; and the financial security index produced by the Higher Education Statistics Agency (HESA) of the UK. On the basis of data collected over a period from 2009–2010 to 2016–2017, the authors find support for the principal agent theory, but the only measure that is significant in the VC pay equation is the performance score from The Complete University Guide. A raft of robustness checks undertaken to establish the rigour of the findings largely confirm these results.

The paper by Stumbriene, Camanho and Jakaitiene, continues on the education field but this time at the macro-level of a country analysis. The authors describe a comparison of the performance of education systems in 29 European countries. The evaluation is based on EU common objectives for education and training in 2020. The framework is based on the lifelong learning approach, addressing outcomes from early childhood to adult vocational and higher education. It develops a new composite indicator, based on the benefit-of-the-doubt framework, for conducting benchmarking comparisons with varying degrees of weight flexibility that can range from fixed weights to fully flexible weights. This approach enables testing the stability of performance scores, as well as defining peers and targets considering different scenarios in terms of the relative importance of indicators.

Still within the public sector, but moving to labor inspectorates, Santos, Santos, Amado, Rebelo and Mendes present a novel application of DEA that expands the application areas of DEA and demonstrates how it can help respond to the challenges faced by modern societies regarding working conditions. Furthermore, by simultaneously assessing the efficiency (e.g., in terms of activity levels relative to personnel levels) and effectiveness (e.g., preventing work related accidents), insights are derived regarding possible trade-offs between these performance criteria. From a methodological perspective, this paper also has some distinctive features as it discusses the implementation of weight restrictions in standard DEA models and in *benefit of doubt* (composite indicator) type models.

Within the public sector, Agrell, Mattsson and Månsson analysed Swedish district courts noting that one motivation for merging public organisations is the ambition to increase efficiency. The paper uses three different approaches to ascertain the impact of mergers of Swedish district courts on efficiency. First, using a global frontier the authors investigate if the sector as a whole has become more efficient. Second, by using a meta frontier approach they look at within and between (merged vs. non merged groups) efficiency gains. Finally, by using a conditional *difference in difference* approach they investigate the average treatment effect on the treated (merged courts). Their results point in the direction that on average efficiency has improved as a result of the mergers.

On applications on the private sector, we have the contribution of Afsharian, who proposes an application on the KONE Corporation—one of the international leaders in the elevator and escalator industry. The empirical case is used as a means to illustrate a methodology that is also useful in regulatory frameworks where there is a decision planner supervising a set of firms. The author proposes a metafrontier-based yardstick competition mechanism for organisations whose operating units are organised into a few distinct groups. It is shown that,

although the use of DEA in the context of incentive regulation has widely been investigated, running existing approaches may not be optimal for such centrally managed multi-group organisations. The proposed approach accounts for heterogeneity among operating units and the need for central management to cope with information asymmetry and the ratchet effect.

Related to the previous paper and also applied to a private setting—Spanish airports—the paper by Ripoll-Zarraga and Lozano applies a centralised DEA model to airports under strong centralised management (AENA). The model provides an optimal solution to increase the overall traffic (total amount of passengers, cargo and aircraft movements) of Spanish airports without the requirement of increasing the total amount of inputs (labor costs and operating costs), just by efficiently reallocating them. Potential efficiency improvements of several scenarios are computed. Airports that suffer from over-capacity are identified and the size efficiency of individual airports and the overall company is studied. Also, the potential efficiency gains and the optimal number of airports in a radical system restructuring are computed and the optimal-size operating point is determined.

Within the private sector, the financial sector is one of the most well researched areas. In this special issue we have an application on financial risk management by Sorkhi and Paradi who note that equities of initial public offerings (IPO) are highly anticipated and yet feared events by the investors. The fear is caused by the high uncertainty revolving around IPOs. DEA can contribute to the quantification of the associated risk through facilitating a robust multi-dimensional non-parametric comparison between past IPOs and the IPO of interest (IPOI). This is achieved by mapping the economic fundamentals of the companies into a new space whose coordinates are DEA parameters to be utilized to develop a similarity metric. A reliable comparable past IPO can then be selected using this metric to be tailored to the specifics of the IPOI in a Bayesian framework.

With an application in the financial sector, this time Iranian commercial banks, Razipour-GhalehJough, Lotfi, Jahanshahloo, Rostamy-malkhalifeh and Sharafi present a methodological paper for finding the closest targets, in the presence of weight restrictions and tradeoffs. The use of weight restrictions in this approach can be used to model managerial preferences. The proposed model is restated as a multi-objective programming problem and is solved using the weighted sum approach.

Related to the above problem of finding closest targets, Vakili, Amirmoshiri, Shiraz and Fukuyama show some problems of the Distance Friction Model (DFM—one of models that search for a point on the strong efficient frontier that is as close as possible to the assessed DMU) and provide ways of resolving them. The authors propose a modification of the DFM by introducing some changes to input constraints and adding some new output constraints to the original bi-objective quadratic model. The paper is mainly methodological, and the empirical application to European airports is used as a means to illustrate how the adapted method works as compared to the original one.

The paper by Daraio, Simar and Wilson also fits in this set of more methodological/computational oriented papers. The authors provide new, computationally efficient methods for computing directional estimates of distance to full or partial (e.g., order-m or order-alpha) frontiers. Methods are provided for either the unconditional case or the conditional case where the frontier may vary with environmental factors, allowing introduction of heterogeneity in the production process. In the case of robust order-m or order-alpha partial frontiers (either unconditional or conditional) the new methods eliminate the need for computationally-burdensome Monte Carlo approximation methods and provide exact estimates of directional distances for the first time. A Matlab code is provided by the authors.

The methodological contribution of Kerstens, Sadeghi and Van de Woestyne explores the link between the notions of plant capacity and the input and output efficiency. The authors first

review the existing output, attainable output and input-oriented plant capacity notions. Then, they take a new methodological step and show how graph or non-oriented plant capacity concepts naturally follow from rewriting these existing plant capacity utilisation notions. It is shown that these new graph or non-oriented plant capacity concepts have a profit-like interpretation, and a link with a graph-based capacity concept based on directional distance functions is established. Furthermore, the authors provide a critical evaluation of an existing alternative graph-based capacity concept based on directional distance functions. The authors demonstrate the usefulness of their approach by application to a simulated dataset.

In conclusion, the Guest Editors would like to thank the authors of the above papers for their valuable contributions. Also, many thanks go to all the reviewers whose collective effort has in many ways improved the final accepted papers and shaped this special issue.

Reference

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research, 2,* 429–444.