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The Problem of Efficiency Measurement and Its Solutions

Tatyana Arshinova (*Riga Technical University*)

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I. Introduction

The interest to the problem of efficiency measurement has significantly increased in the last decade. Frontier analysis methods are considered to be among sophisticated tools for performance measurement that allows the investigation of complex multidimensional production processes. The aim of the scientific paper is to stimulate the empirical development of performance evaluation.

II. Methodology of Frontier Data Analysis

According to the methodology of methods' of frontier data analysis, the efficiency score of investigated Decision Making Units (DMUs) is calculated as a distance from the point that defines the production process of a DMU to the certain efficiency frontier. Entities that are functionating on the efficiency frontier are considered to be absolutely technically efficient; inefficiency of other DMU's is increasing together with extension of the distance to the efficiency frontier. The value of efficiency score is fluctuating from zero to one.

Methods of frontier analysis may be divided into two groups: parametric (Stochastic Frontier Approach (SFA), Distribution-Free Approach (DFA), Thick Frontier Approach (TFA)) and non-parametric (Data Envelopment Analysis (DEA), Free Disposal Hull (FDH)) methods.

III. Parametric Frontier Methods

In accordance with parametric approaches, the efficiency frontier is constructed on the basis of econometric modelling, usually in the form of Cobb-Douglas (log-linear) production function. Econometric analyses include two error components: an error term that captures inefficiency (u_i) and a random error (v_i). Parametric methods have significant advantages – they provide the possibilities to use panel data, to distinguish the random noise from inefficiency and to calculate the standard error of efficiency measurement results'. Nevertheless, the stochastic approaches of performance measurement presume the comparison of investigated DMUs' efficiency to the theoretically developed benchmark frontier, therefore the optimal combinations of inputs' and outputs' sometimes are not achieveable practically. The application of parametric methods' also requires observance of the restrictions imposed on the distributional assumptions on the inefficiencies and random error.

IV. Non-parametric Frontier Methods

In contrast to the econometric approaches, non-parametric methods are based on the hypothesis that the efficiency frontier is generated from the empirical results' of the most efficient DMU's i.e. benchmarks' that „float" on the piecewise linear frontier. The level of technical efficiency of these DMU's is 100%. However, the level of allocative efficiency that defines the optimality of output and input proportions' may have different values even among absolutely technically efficient DMU's. While mathematical, non-parametric methods require few assumptions when specifying the best-practice frontier, they generally do not account for random errors.

The main principles of Data Envelopment Analysis, using the efficiency frontier estimation approach, were firstly stated in the scientific paper of M.J. Farrell "The Measurement of Productive Efficiency" in 1957. M.J. Farrell assumed that the efficiency of an organization consists of two components: technical efficiency, which reflects the ability of a Decision Making Unit (DMU) to obtain maximal output from a given set of inputs and allocative efficiency, which reflects the ability of a DMU to use the inputs in optimal proportions. The definition of the DMU in context of DEA is flexible; it is concerning all entities that are using multiple inputs in the production process of outputs. As an original non-parametric approach of efficiency measurement, Data Envelopment Analysis (DEA) has been introduced by Charnes, Cooper and Rhodes (CCR) in 1978. They provided the formulation of linear programs to measure the productive efficiency (CCR efficiency) of a Decision Making Unit (DMU) relative to a set of referent DMUs. Banker, Charnes and Cooper (BCC) (1984) showed that the CCR efficiency measure can be regarded as the product of a technical efficiency (BCC efficiency) measure and a scale efficiency measure. Related to the latter measure is the economic notion of returns to scale. BCC also provided a modification of the CCR linear programming formulation (via the addition of a convexity constraint) to estimate technical efficiency and the returns to scale. Since DEA in its present form was first introduced in 1978, it has been widely applied to modelling of operational processes for performance evaluations. DEA's empirical orientation and the absence of the need for the numerous a priori assumptions that accompany other approaches (such as standard forms of statistical regression analysis) have resulted in its use in a number of studies involving efficient frontier estimation in the governmental and in the private sector.

Using parametric and non-parametric frontier analysis techniques, the author will develop the efficiency measurement methodology.

Figures, tables and equations will be included into the final version of the scientific paper.

V. References

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