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Measuring the Efficiency of Companies in BIST Sustainability Index: An Application With Data Envelopment Analysis

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Extensive Summary

1. Introduction

Efficiency is defined as the minimum level of resource use required to perform the desired operations in a given system. (Tangen, 2005:41). The efficiency is a indicator obtained by comparing the input elements or production resources with the standards determined by specific techniques and actual use. The efficiency value can be determined by the following formula (Erpolat, 2011:29):

$$Efficiency = \frac{\text{Standard Performance}}{\text{Actual Performance}}$$

If the efficiency value calculated according to the above formula is 1, indicating that the activities are carried out efficiently. If the efficiency value is below 1, indicating that the activities are non-efficiently.

Data Envelopment Analysis (DEA), which is an activity measurement method, is a "data-driven" approach that uses multiple inputs to produce multiple outputs and is used to evaluate the performance of a set of similar entities, called Decision Making Units (DMUs) (Cooper, Seiford and Zhu, 2004).

In 1984, Banker, Cahernes and Cooper developed the BCC (Banker – Charnes – Cooper) model, which is used in case of variable return by scale and measures technical efficiency, considering the increasing and decreasing return assumptions according to the scale (Banker, vd., 1984). Input oriented BCC model is a model that determines how much the input variables must be reduced to obtain this output level most efficiently, without changing the output level. (Erpolat, 2011:82).

The formulation of the input oriented BCC model is as follows (Cooper vd., 2000:88):

$$Max \frac{uy_0 - u_0}{vx_0}$$

$Max \frac{uy_j - u_0}{vx_j} \leq 1$ *(j=1,...,n)*

$v \geq 0$,

$u \geq 0$,

u_0 *Free,*

Max: Maximization,

x_0 : Input values of the examined decision unit (0),

y_0 : Output values of the examined decision unit(0),

v: Vector of input factors

u: Vector of output factors

2. Method and Data

2.1. Method

The efficiency values of DMUs were measured using the BCC model. In this study, the activities of DMUs were determined using the Win4Deap package program. In addition, the rates of improvement that are required to be implemented in the inputs of inefficiency DMUs have also been determined.

2.2. Data

In the study, selected 28 companies that are traded in the BIST Sustainability Index in 2015 and 2016 and whose data can be accessed. The input and output variables of these units must be specified in order to measure the efficiency of the DMUs. And the selected input and output elements must be used for all DMUs. Based on the literature survey and the structure of the research, the input and output variables were determined as follows.

Table 1: Input and Output Variables Used in Research

INPUT VARIABLES	OUTPUT VARIABLES
Equity	Net profit
Total Debts	Active Profitability Ratio
Total Assets	Equity Profitability Ratio

The equity, total debts, total assets and net profit values of the DMUs were obtained from the official website of the Public Luminary Platform (www.kap.org.tr). Active profitability ratios are obtained by proportioning net profit value to total asset value. Equity profitability ratios are obtained by proportioning net profit value to equity value.

3. Findings

When the efficiency values are examined, the average efficiency value in 2015 is 0,663 and the number of efficient DMU is 10. The average efficiency value in 2016 is 0,611 and the number of efficient DMU is 7. The number of efficient DMUs in both years is 5 and the general average of the years is 0,637.

DMUs that are efficient in 2015 are BRISA, DOGUŞ, EREGLI, FORD, MIGROS, OTOKAR, PETKIM, TOFAS, TUPRAS and IS BANKASI. The DMUs that

are efficient in 2016 are ASELSAN, DOGUS, EREGLI, FORD, PETKIM, TSKB and TOFAS.

4. Conclusion

As a result, 2015 and 2016 efficiencies of enterprises that have sustained sustainability costs have been measured with DEA. 10 enterprises were efficient in 2015, while seven in 2016 were efficient. The number of efficient enterprises in both years is 5. The average efficiency values are 0,663 in 2015 and 0,611 in 2016. DMUs that are efficient in 2015 are BRISA, DOGUŞ, EREGLI, FORD, MIGROS, OTOKAR, PETKIM, TOFAS, TUPRAS and IS BANKASI. The DMUs that are efficient in 2016 are ASELSAN, DOGUS, EREGLI, FORD, PETKIM, TSKB and TOFAS. The DMUs that are efficient in the both years are DOGUS, EREGLI, FORD, PETKIM and TOFAS. Potential improvement rates have been determined for inefficient DMUs in the study. According to these rates, inefficient DMUs need to reduce their input variables by an average of 37.1% in order to be efficient. Inefficient DMUs will be efficient in the coming years if they consider the remediation recommendations.