Measuring Effectiveness: A DEA Approach Under Predetermined Targets

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ABSTRACT

This paper presents a Data Envelopment Analysis approach that evaluates the relative effectiveness of decision making units (DMUs) in the presence of predetermined targets which are to be achieved simultaneously. As such targets are a core element of common performance management systems, the approach is a desirable complement of these systems. The proposed method classifies the DMUs into subsets according to their ability to meet the targets and provides a complete ranking within each subset on the basis of a measure of relative effectiveness. For that purpose, we introduce a new concept called super-effectiveness. The approach is illustrated by means of an example referring to a European pharmacy chain.

Keywords: Data Envelopment Analysis, Effectiveness, Ranking, Super-Effectiveness Score, Targets

INTRODUCTION

Suitable performance measures are essential for high-quality managerial decisions, necessary to complement human intuition with respect to performance evaluation. This topic is exemplified here from the perspective of a European pharmacy chain. The increased competitive pressure and new legislative regulations force this pharmacy chain to attach increased importance to the control of its pharmacy stores with regard to pre-defined strategies. This requires a comprehensive performance management system. The measuring instruments of such a system should be able to evaluate the actual performance level of each store by providing measures like efficiency and effectiveness scores which are appropriate to support managerial decision making (Neely, Gregory, & Platts, 1995).

However, a great part of the literature as well as the majority of the companies focus on performance management as optimization of efficiency, thereby disregarding the aspect of effectiveness (Mouzas, 2006). This neglects the fact that it is of vital importance for long-term business success to monitor the fundamental goals of a company (Ebnerasoul, Yavarian, & Azodi, 2009). The question to what extent such goals are achieved is addressed by the concept of effectiveness. In contrast to efficiency which has been recognized as a component of performance measurement for a long time, effectiveness has only recently begun to receive considerable attention.

A practical example is the pharmacy chain mentioned above. As method for measuring the
relative efficiency of its stores, Data Envelopment Analysis (DEA) was integrated into the management process. It is now intended to measure also the relative effectiveness of the stores on the basis of a DEA-based approach. Thereby, effectiveness refers exclusively to the fundamental goals pursued by the central management and to the respective targets to be attained by the stores. The central management

- Determines these targets as benchmarks for its stores;
- Welcomes the achievement of goals beyond the benchmarks, i.e. a maximization of the goals is encouraged;
- Strives for a management-oriented approach to evaluate the stores’ DEA effectiveness as a complementary measure to their DEA efficiency, i.e. managers’ workload should not be increased and the results should be easy to interpret.

The existing DEA models for measuring effectiveness are not appropriate to meet all of these requirements. We therefore introduce a new approach which is not only suited for the described case but also for effectiveness measurement in general.

The paper is organized as follows. In the next section, a review of the existing contributions regarding the measurement of effectiveness by means of DEA is provided. Then, the new approach is described which classifies the DMUs into subsets according to their achievement of predetermined targets and provides a ranking within each subset. A numerical example based on data from the European pharmacy chain illustrates the method. Finally, a conclusion discusses the results.

MEASURING (RELATIVE) EFFECTIVENESS: A BRIEF REVIEW

Although effectiveness and efficiency are among the most frequently used terms of economic theory and constitute one of the major themes of management control, their differentiation is often vague (Mensah, Lam, & Werner, 2008). Usually, effectiveness is referred to as “doing the right things”, efficiency as “doing things right” (Golany, Learner, Phillips, & Rousseau, 1990; Chang, Hwang, & Cheng, 1995; Sheth & Sisodia, 2002; Asmild, Paradi, Reese, & Tam, 2007; Amiri, Zandieh, Vahdani, Soltani, & Roshanaei, 2010; Lu & Hung, 2011). This leaves room for several, to some extent even contradictory interpretations and affects the DEA approach addressed here. While DEA efficiency is well-defined (Cooper, Seiford, & Tone, 2007), there is no consistently used definition of DEA effectiveness and no consensus on how DEA effectiveness should be measured (Lee, 2006; Asmild et al., 2007; Amiri et al., 2010).

A literature review on the key phrase “effectiveness evaluation by means of DEA” has revealed that effectiveness is often associated with efficiency and is therefore usually evaluated with traditional DEA models (Rouse, Putterill, & Ryan, 1997; Karkazis & Thanassoulis, 1998; Rousseau & Rousseau, 1998; Karlaftis, 2004; Vennesland, 2004; Keh, Chu, & Xu, 2006; Lee, 2006; Asmild et al., 2007; García-Sánchez, 2007a and 2007b; Mensah et al., 2008; Yu & Lee, 2009; Lu & Hung, 2011; Cotte Poveda, 2012). On the other hand, there are several concepts for new models of effectiveness measurement. The wide range of these models is due to the fact that effectiveness has numerous definitions depending on the context of the corresponding studies (Golany, 1988; Golany et al., 1990; Golany, Phillips, & Rousseau, 1993; Golany & Tamir, 1995; Lan & Lin, 2003; Paradi & Schaffnit, 2004; Chiou & Chen, 2006; Yu, 2008; Yu & Lin, 2008; Yu & Fan, 2009; Chiou, Lan, & Yen, 2010; Hsieh & Lin, 2010; Ting & Huang, 2011).

In our study, effectiveness exclusively refers to the fulfillment of the fundamental goals pursued by an organization, representing one of the dimensions of purpose-rational behavior (see the next section). The approaches that implicitly address this idea can be classified into two types: those integrating DEA and Goal Programming and those eliminating inputs from DEA evaluation. We review these two types of
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