Chapter 108
A New Framework for Industrial Benchmarking

Gürdal Ertek
Sabanci University, Turkey

Firdevs Ulus
Sabanci University, Turkey

Mete Sevinç
Sabanci University, Turkey

Özlem Köse
Sabanci University, Turkey

Güvenç Şahin
Sabanci University, Turkey

ABSTRACT

The authors present a benchmarking study on the companies in the Turkish food industry based on their financial data. The aim is to develop a comprehensive benchmarking framework using Data Envelopment Analysis (DEA) and information visualization. Besides DEA, a traditional tool for financial benchmarking based on financial ratios is also incorporated. The consistency/inconsistency between the two methodologies is investigated using information visualization tools. In addition, k-means clustering, a fundamental method from machine learning, is applied. Finally, other relevant data, apart from the financial data, is introduced to the analysis through information visualization to discover new insights into DEA results. The results show that the framework developed is a comprehensive and effective strategy for benchmarking; it can be applied in other industries as well. The study contributes to the literature with a novel methodology that integrates the various benchmarking methods from the fields of operations research, machine learning, and financial analysis.

INTRODUCTION

Benchmarking enables companies to see their positions relative to their competitors in order to explore the opportunities to improve their market position. The response to how benchmarking deals with this problem is disguised in its definition: "Benchmarking is the process of continuously measuring and comparing one's business processes against comparable processes in leading organizations to obtain

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information that will help the organization identify and implement improvements" (Andersen & Jordan, 1998). Various fields of science including computer science, management and operations research, apply alternative methods of benchmarking, such as information visualization (e.g. Self Organizing Maps, SOM), financial ratios (provided that the data is appropriate for financial benchmarking), and analytical methods (e.g. Data Envelopment Analysis, DEA).

This study proposes a framework that integrates a multitude of methods for the purpose of comprehensive benchmarking. As an analytical approach, DEA is employed due to its eligibility among all other methods for its advantage of being a nonparametric technique requiring fewer assumptions (Weill, 2004). Weill (2004) shows that DEA is consistent with standard measures of performance such as the Stochastic Frontier Approach (SFA) and the Distribution-Free Approach (DFA). In addition to its consistency, DEA can be employed to investigate the reasons for a company's inefficiency while showing how much change is needed to achieve efficiency (Galagedera & Silvapulle, 2002).

We combine and compare the DEA results with the insights obtained by other methodologies, including financial ratios, and the results of k-means clustering, as well as other relevant data. Information visualization schemes are extensively and primarily used in a second phase of the analysis in order to bring together the outcomes from all mentioned methods and make them more comprehensive. The steps of the analysis are formalized within an integrated framework. Via this framework, a researcher can combine different benchmarking approaches and data mining techniques to obtain useful insights, as well as to compare the results of the different approaches against each other.

The benchmarking data used in this study is derived from the 2010 Istanbul Chamber of Industry (ISO) List that ranks the top 500 Turkish companies of different industries, and provides financial and other relevant data regarding these companies. In this study, the food industry is selected because it is one of the most developed industries in Turkey and a significant number of companies from this industry are listed in the ISO 500 list.

The complete ISO 500 dataset (for 2000), that includes all the industries, has been subject of earlier research (Ulucan, 2002), and we have selected our inputs and outputs in coherence with this earlier study. While we have not been able to find the efficiency analysis of food industry in Turkey, there have been studies focusing on other industries, such as insurance (Çiftçi, 2004), cement (Karsak and Iscan, 2000), and automative (Bakırcı, 2006). Meanwhile, there exists literature that uses DEA for the benchmarking of food industry or its subsectors in other countries such as agriculture industry in Scotland (Barnes, 2006), food manufacturing plants in the USA (Jayanthi, 1999), productivity growth of Indian food industry (Kumar and Basu, 2008), swine industry in Hawaii (Sharma, Leung and Zaleski, 1997), meat products industry in Greece (Keramidou, Mimis and Pappa, 2011), strawberry greenhouses in Iran (Banaeian, Omid and Ahmadi, 2011), and food industrial companies in Taiwan (Wongchai, Tai and Peng, 2011). An interesting related study by Dadura and Lee (2011) uses DEA for benchmarking the innovativeness of Taiwanese food companies.

Turkish Food Industry Dataset

Sixty-three companies in the Turkish food industry from the 2010 ISO-500 list are included in the study. Each company is presented by its symbol in the Istanbul Stock Exchange (ISE); for the unlisted companies, symbols, which evoke the name of the company, are given. Based on the main food groups, the information regarding the subsector(s) that the companies are involved are appended to the original dataset. These subsectors are organized as Dairy, Flour, Beverage, Sugar, Sea Products, Meat, Poultry,