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Application of fuzzy multi-criteria decision making methods for financial performance evaluation of Turkish manufacturing industries

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ABSTRACT

For manufacturing industries, financial performance evaluation is very important in a highly competitive environment. Therefore, an accurate and appropriate performance evaluation is critical. As financial performance indicators reflect the competitiveness of a company, they must be carefully identified in the evaluation process. Generally, traditional accounting-based financial performance (AFP) measures are used for performance evaluation. However, these measures are not sufficient for performance evaluation solely in the modern industry time. So, value-based financial performance (VFP) measures have recently been introduced to express the company value. In this paper, we propose a new financial performance evaluation approach to rank the companies of each sector in the Turkish manufacturing industry. For this purpose, a hierarchical financial performance evaluation model is structured based on the AFP and VFP main-criteria and their sub-criteria. We use fuzzy analytic hierarchy process (FAHP) to determine the weights of the criteria. The companies are ranked according to their own manufacturing sector by using TOPSIS and VIKOR comparatively. The results show that the obtained ranks of the companies by these methods are almost same with respect to their own sectors.

1. Introduction

In today's competitive world economy, evaluating the financial performance of a company has a great importance not only for managers, creditors and current/potential investors but also for the companies taking place in the same sector. Performance evaluation of companies is generally carried out within the context of financial analyses. As the concept of financial performance is considered under different meanings such as return, productivity, output and economic growth, using the financial ratios in the performance evaluation process can be suitable for both companies and related sectors. Financial ratios derived from the data in income statement and balance sheets are considered as crucial measurement tools in determining performance and financial assets of companies. For many years, a great number of studies in the literature have shown the benefits of the financial ratios (Chen & Shimerda, 1981). They allow the user to summarize and analyse related data to provide meaningful information for making decisions (Singh & Schmidgall, 2002). And, the significance of the financial ratios also demonstrates the strong and weak sides of companies in terms of liquidity, growth, and profitability.

In the performance evaluation, the most common used financial ratios are traditional financial indicators that are usually related to profitability. Traditional financial measures known to be as accounting-based financial performance (AFP) measures have basically been used to evaluate the company's financial situation and performance. These measures provide useful quantitative financial information to both investors and analysts so that they can evaluate the operation of a company and analyze its position within a sector over time (Gallizo & Salvador, 2003). In the literature, there are about approximately twenty five traditional financial performance measures reported for the manufacturing industry. However, these measures are gathered into one group within itself because they provide similar information. In other words, AFP measures can be classified as liquidity ratios, financial leverage ratios, profitability ratios, activity ratios, and growth ratios with respect to the information they provide.

Because of the competition conditions, increase in liberalization and internationalization of financial markets, diversification of the activities in these markets and increase in the mobility of capital, the importance of the efficient usage of resources in the companies has become vital and activities aimed at appreciating the company values has also gained importance. The changes in companies' aims require improving the tools used for the financial performance measurement. In connection with the attempts intended for increasing company value, the development of new performance

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measures based upon this value is inevitable. Traditional AFP measures have long been criticized for their inadequacy in guiding strategic decisions. In the 1990s, new measures and analysis instruments appeared to measure a company's performance. Modern value-based financial performance (VFP) measures have attracted an increasing attention to traditional AFP measures as alternatives for using in value creation for the manufacturing companies (Sandoval, 2001).

The shareholders are directly interested in value creation as this is the payment they expect in return of the capital invested and risks taken. The strategic objective to increase company's performance and new value creation also satisfies the immediate interest of the managers and the employees. For a national economy, value creation means the efficient usage of the national economic potential and the increase of gross domestic product that contributes to the increase of social welfare (Camelia & Vasile, 2009). Thus, the theoretical and practical background for the development of modern finance systems was created. Later, a value creation-based management system was developed. Consequently, measures that give importance on value creation by management for the owners have emerged. In this way, this evolution period is described as three phases: profit maximization is the old-age term, wealth maximization is matured term, and value maximization is today's wisdom term (Shil, 2009). By this way, the performance evaluation of companies is based on the analysis that measures company value. There are numerous consulting companies marketing their own measures of value-based measures, such as Stern Stewart's EVA and MVA, Holt Value Associates' Cash Flow Return on Investment (CFROI), Boston Consulting Group's total business return (TBR) and Cash Value Added (CVA), McKinsey's economic profit and LEK/Alcar's shareholder value added (SVA).

According to the International Monetary Fund (IMF) data, Turkey has been among the nations that are growing up rapidly with regard to the economy in recent years. The main reason of the economic growth and also the development in Turkish economy is the industrialization. The significant part of the industrialization belongs to manufacturing industry that has a popular role in incorporating these developments to production process.

The aim of this study is to propose a new evaluation approach by using both AFP and VFP measures together to rank the companies in a considered sector in the Turkish manufacturing industry. Turkey's manufacturing industry is mainly grouped in seven sectors and each sector has several companies. These companies are evaluated by using the 2007 data obtained from Istanbul Stock Exchange (ISE). A hierarchical structure depending on the main criteria of AFP and VFP is firstly constructed by an expert group from ISE. Each main-criterion is divided into four sub-criteria with respect to the frequently used financial indicators by this expert group. In the evaluation procedure, FAHP is used to determine the weights of the criteria and two multi-criteria decision making methods TOPSIS and VIKOR are used as comparatively to rank the companies in the same manufacturing sector.

The remainder of this paper is organized as follows. In Section 2, a literature review of financial performance measures and MCDM techniques focused on performance measures are given. In Section 3, AFP and VFP financial ratios that are used in the performance evaluation of the companies are briefly explained. In the next section, we mention the importance of the MCDM techniques. This section is separated into two subsections. The first subsection includes the explanation of the FAHP method used to determine the weights of the criteria. The second subsection is on the ranking methods TOPSIS and VIKOR. In Section 5, an application for financial performance evaluation of the companies in the seven sectors of the Turkish manufacturing industry is given. At the last section, results of the application are presented and suggestions for further research are given.

2. Literature review

In the financial performance literature, many studies are generally focused on determining the relationships among the financial measures and also the effects of these measures on the performance of companies. These studies are often related to conduct a regression model to show how much financial measures explain the performance of companies. While some of these studies use either VFP or AFP measures, others use both measures together. Many studies related to the financial performance evaluation in various sectors are summarized in the following.

The first empirical study regarding the association between EVA and MVA was proposed by Stewart (1991). In this study, a sample of 1000 industrial companies was selected for the years 1987–1988 and these VFP measures were analyzed to examine if any association of them affects the company value. Uyemura, Kantor, and Pettit (1996) used a sample of the 100 largest US banks for a ten-year period to calculate MVA and tested its correlation with EVA, and three AFP measures that are ROA, ROE and EPS. Lehn and Makhija (1996) proposed a study including companies operated in the manufacturing industry to find out how well EVA and MVA related to share price performance. Chen and Dodd (1997) suggested a regression model to compare EVA with the other traditional AFP measures such as EPS, ROE and ROA. John, Balakrishnan, and Fiet (2000) hypothesized that there was a non-linear relationship between corporate strategy, short-run financial variables, and wealth creation measured as market value added (MVA), and used neural networking to model this relationship. Yook and McCabe (2001) investigated the effectiveness of MVA as an investment tool by examining its relationships to other commonly used VFP measures and rates of return on common stock. Worthington and West (2001) studied a synoptic survey of EVA's conceptual underpinnings and the comparatively few empirical analyses of value-added performance measures in Australian companies. Johnson and Soenen (2003) used monthly data of 478 companies to investigate the possible indicators of financially successful companies, using three measures of financial performance i.e., the Sharpe index, Jensen's alpha and EVA. Warr (2005) investigated inflation's effect on EVA and found that inflation had significant distorting effects on EVA as traditionally computed. Dutta and Reichelstein (2005) developed a multi-period principal-agent model in which a manager must be given incentives to undertake investments and to exert personally costly effort. Kyriazis and Anastassis (2007) investigated the relative explanatory power of the EVA. Hejazi and Oskouei (2007) suggested that both of CVA and P/E ratios had an explanatory power to each other. Erasmus (2008) analyzed that the incremental information content tests indicated that their components added significantly to the information content of earnings, but that the level of significance was relatively low. Wang and Lee (2008) proposed a clustering method in which the financial ratios of different companies with similar variations were partitioned into the same cluster. Lähtinen and Toppinen (2008) examined the effects of cost and value-added components on the firm-level financial performance large and medium sized companies evaluated by using regression analysis.

Performance evaluation is regarded as a MCDM problem, which selects an option from a set of alternatives characterized in terms of their attributes. The aim of the MCDM is to obtain the optimum choice that has the highest degree of satisfaction for all of the relevant attributes (Yang, Chen, & Hung, 2007). Several studies on performance evaluation are focused on ranking the units according to their performance measures included in their comparison environments. Feng and Wang (2000) constructed a performance evaluation process for airlines with some financial ratios. They used the grey relation analysis to select the representative indicators and used the TOPSIS method for outranking Taiwan's five major