A multicriteria methodology for equity selection using financial analysis

Panagiotis Xidonas [a,*], George Mavrotas [b], John Psarras [a]

[a]National Technical University of Athens, School of Electrical & Computer Engineering, Management & Decision Support Systems Laboratory, 9, Heroon Polytechneiou Street, 15780 Athens, Greece
[b]National Technical University of Athens, School of Chemical Engineering Laboratory of Industrial, Energy Economics 9, Heroon Polytechneiou Str., 15780 Athens, Greece

ARTICLE INFO

ABSTRACT

In this article we present a multiple criteria methodology for supporting decisions that concern the selection of equities, on the basis of financial analysis. The ELECTRE Tri outranking classification method is employed for selecting the attractivex equities, through the evaluation of the overall corporate performance of the corresponding firms. The crucial importance issue of the industry/sectoral accounting particularities was strongly taken into account. An elaborate review of coherent research studies is also provided. Finally, the validity of the proposed methodology is tested through a large scale application on the Athens Stock Exchange.

© 2009 Elsevier Ltd. All rights reserved.

1. Introduction

Multiple criteria decision making (MCDM) approaches are well suited for the study of several financial decision-making problems. The diversified nature of the factors (evaluation criteria, objectives and goals) that affect financial decisions, the complexity of the financial, business and economic environments, the subjective nature of many financial decisions, are only some of the features of financial decisions which are in accordance with the MCDM modeling framework. Portfolio selection and management constitutes one of the most significant domains of financial decision making.

The problem of portfolio selection involves the construction of a portfolio of equities (or securities from other asset classes) that maximizes the investor's utility. The process leading to the construction of such portfolios constitute of two major phases [21]. In the first phase of the process, the decision maker (DM), a private or an institutional investor, has to evaluate and select the equities that are available as investment opportunities. The vast amount of equities traded in international stock markets make this step necessary, in order to focus the analysis on a limited number of the best investment choices. In the second phase of the process, the DM has to decide on the amount of capital that should be invested in each of the selected stocks, thus constructing a portfolio of the selected equities.

In this article the emphasis is laid on the first stage of the above mentioned process and we focus on the security analysis and evaluation phase. We develop a multicriteria methodology for equity selection exploiting the valuable tool of financial analysis (FA), which

is the most appropriate evaluation approach regarding investment decisions within a long-term horizon. FA involves the identification of the strengths and weaknesses of firms, mainly through judgemental procedures concerning the qualitative evaluation and interpretation of financial ratios, as these arise from the accounting statements. Moreover, FA can be viewed as the activity of providing inputs to the portfolio construction phase, since it entails the process of analyzing the special characteristics of securities and corresponding firms, leading to final selection recommendations. The paper proceeds as follows: In Section 2 we set the problem and we provide an elaborate review and methodological classification of the corresponding research studies. In Section 3 we present the proposed methodological framework for the equity selection problem. In Section 4 we present an illustrative application from the Athens Stock Exchange (ASE), along with the corresponding results. Finally, the concluding remarks are given in Section 5.

2. Problem setting and review

The portfolio management process is an integrated set of steps undertaken in a consistent manner to create and maintain an appropriate portfolio (combination of assets) to meet clients' stated goals [30]. The three fundamental steps that form the basis for the portfolio management process are: planning, execution and feedback. In the planning step, investment objectives and policies are formulated, capital market expectations are formed and strategic asset allocations are established. In the execution step, the manager constructs the portfolio and integrates investment strategies with capital market expectations to select the specific assets for the portfolio. Finally, in the feedback step, the manager monitors and evaluates the portfolio compared with the plan. Under the same rationale, Spronk

* Corresponding author. Tel.: +30 210 7723 583.
E-mail addresses: pxid@epu.ntua.gr (P. Xidonas), mavrotas@chemeng.ntua.gr (G. Mavrotas).

and Hallerbach [59] decompose the investment decision process in the following stages: (a) security analysis to determine the relevant characteristics (or attributes) of the investment opportunities, (b) portfolio analysis to delineate the set of non-dominated or efficient portfolios, (c) portfolio selection to choose the optimal portfolio from the efficient set and (d) preference analysis.

Since the pioneering work of Markowitz [35,36] in the theory of portfolio analysis, based on the mean–variance formulation, several portfolio selection models have been proposed. In the basis of the Markowitz mean–variance formulation, many researchers developed miscellaneous new methodologies. Elton et al. [13] provide a complete overview as far as these methodologies is concerned. Pardalos et al. [43] also provide a review and some computational results of the use of optimization models for portfolio selection.

In recent years, the development of new techniques in operations research and management science, as well as the progress in computer and information technologies gave rise to new approaches for modeling the portfolio selection problem. Several authors utilize MCDM methodologies for portfolio selection. The multidimensional nature of the problem has been emphasized by researchers in finance, as well as by MCDM researchers [19–21,24,62–66,77,83]. In the above studies, elaborate and exhausted justifications are provided for modeling portfolio management problems within the MCDM frame. Indeed, the MCDM framework provides the sound methodological basis to resolve the inherent multicriteria nature of portfolio selection problem. Additionally, it builds realistic models by taking into account, apart of the two basic criteria of return and risk, a number of important other criteria. Furthermore, MCDM have the advantage of taking into account the preferences of any particular investor.

As it has already been mentioned, the portfolio selection problem can be realized as a two-stage process [20,21]: (a) evaluation of the available securities to select the ones that best meet the investor's preferences and (b) specification of the amount of capital to be invested in each of the securities selected in the first stage. As far as the first stage of this multidimensional context is concerned, the MCDM paradigm provides a plethora of appropriate methodologies to support the evaluation of the available securities. The issue of security evaluation has been studied by MCDM researchers using discrete evaluation methods (outranking relations, multi-attribute utility theory (MAUT), preference disaggregation analysis, rough sets, etc.). Studies conducted on this topic have focused on the modeling and representation of the investor's policy, goals and objectives in a mathematical model. The model aggregates all the pertinent factors describing the performance of the securities and provides their overall evaluation. The securities with the higher overall evaluation are selected for participating the next phase of the process (portfolio construction).

Within this frame, FA can be utilized for selecting attractive equities by means of evaluating the overall corporate performance of the corresponding firms, see [12,51]. The evaluation of performance of corporate entities and organizations is an important activity for their management and shareholders as well as for investors and policy makers. Such an evaluation provides the management and shareholders with a tool to assess the strengths and weaknesses of the firm, as well as its competitive advantages over its competitors, thus providing guidance on the choice of the measures that need to be taken to overcome existing problems. Investors (institutional and individual) are interested in the assessment of corporate performance for guidance to their investment decisions, while policy makers may use such an assessment to identify the existing problems in the business environment and take measures that will ensure a sustainable economic growth and social stability. The performance of a firm or an organization is clearly multidimensional, since it is affected by a variety of factors of different nature, such as: (a) financial factors

indicating the financial position of the firm/organization, (b) strategic factors of qualitative nature that define the internal operation of the firm and its relation to the market (organization, management, market trend, etc.) and (c) economic factors that define the economic and business environment.

The aggregation of all these factors into a global evaluation index is a subjective process that depends on the DM's values and judgement policy. These findings are in full accordance with the MCDM paradigm, thus leading several operational researchers to the investigation of the capabilities that the MCDM methods provide, regarding the problems of corporate performance evaluation and equity selection. A review of some of the most important studies in the field now follows.

Srinivasan and Ruparel [87] propose the CGX multicriteria intelligent decision support system (DSS) for dealing with credit-granting problems. The credit-granting decision process which is modeled through the analytic hierarchy process (AHP) [50] multicriteria method, aims at deriving the perceived probabilities of default and payment of the loan. The evaluation criteria include both financial ratios (debt capacity ratios, profitability ratios, liquidity ratios, etc.), as well as qualitative criteria (customer background, pay record, geographical location, business potential, etc.).

Diakoulaki et al. [11] utilize the results of the analysis of a MAUT [26], applied to a large sample of Greek pharmaceutical companies, in order to indicate how suitable some common financial ratios are as indices of the firm's overall performance. The results showed that profitability constitutes the most representative measure for the differentiation and ranking of companies. Besides, a sound capital structure is a necessary but not a sufficient condition to ensure the profitable and effective operation of the firm.

Mareschal and Brans [31] present the BANKADVISER, a multicriteria industrial evaluation system, which provides evaluations of individual items such as firms, industries, companies, and industrial clients. The evaluation procedure employs the PROMETHEE [4] method and is based on financial data from each firm's financial statements. The system's aim is to allow the user for managing data about the clients, analyzing their economic profile, detecting their strong and weak features and evaluating any risk associated with them.

Siskos et al. [57] present an integrated DSS for the analysis and financing of firms by an industrial development bank in Greece. Firstly, the system evaluates the financial performance of firms (financial ratios of profitability, managerial performance and solvency) during a 5-year period and allows inferences about their development tendencies. Furthermore, multivariate statistical techniques are available to aid in the identification of the most significant financial ratios and grouping of the firms in coherent categories. Finally, the UTA [23] multicriteria method is used, which ranks the firms from the most solvent to the bankrupt and in this way support the bank to select the less risky for financing.

Zopounidis et al. [85] present the FINEVA multicriteria knowledge-based DSS for the assessment of corporate performance and viability. The FINEVA system consists of an expert system part that offers an initial financial and qualitative evaluation of firms, a principal components analysis part for the identification of the most significant financial ratios, and the multicriteria method UTASTAR [56] combining the results of the expert system and the principal components analysis, providing the final evaluation of firms.

Babic and Plazibat [1] are dealing with the ranking of enterprises according to the achieved level of business efficiency using the PROMETHEE and the AHP methods. The PROMETHEE method is used for final ranking and the AHP to determine the importance of criteria. The main purpose of this work is to present the methodology which at every moment can answer the question about financial standing of a particular enterprise.