The Evaluation of Common Stocks Using an Intuitive Decision Support System

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Abstract

This paper explores the use of an intuitive decision support system to facilitate the investment analysis of common stocks. The results suggest that the pairwise comparison procedure is capable of accommodating multiple investment criteria and multiple asset alternatives. However, appropriate investment criteria should be determined in light of a particular investment environment. The present evaluation model can capture investor behavior and perceptions in a changing scenario in the form of judgments of investment criteria and stock alternatives. Therefore, it represents a useful addition to asset selection and portfolio management.

1. Introduction

Stock evaluation and selection is a complex individual decision process, influenced by multiple environmental variables and the multiple facets of the decision-maker's behavior. Usually, investors tend to be risk-averse in preferences and to consider many alternative assets in maximizing expected utility [12]. Instead of pursuing the microanalysis of investment decision making, much of the traditional literature has been devoted to the study of aggregate market phenomena [5] [7]. It is only since the 1970s that behavioral attributes of individual investors have begun to attract attention. Baker and Haslem discover that individuals emphasize dividends, expected returns, and the firm's financial stability [1]. Individual investors could rationally consider the tradeoffs between risk and expected return in relation to a particular investment in the portfolio [2]. Human variables have been found to exercise significant influence on expectations of capital gain and investment return [6]. Demographic variables affect stock evaluation and portfolio selection [4]. In addition to risk aversion, individual investor behavior might be influenced by lifestyle characteristics, control orientation and occupation [3]. A behavioral approach has been used to explore the behavioral aspects of financial decision-making [11]. Environmental factors such as firm's market image and the quality of accounting information have also been examined [7].

Criteria appropriate for the selection of common stocks vary widely, depending in the first place on the type of stocks in question and the investment environment at the time. Conflicting criteria often arise, as between the highest possible return and the lowest possible risk with respect to an investment. Individual preferences and intuition also enter, in judgment over the importance of any criterion and the particular degree of conflict between criteria. As a result, a useful framework for stock selection would be required to fulfill the *desiderata* of incorporating multiple criteria, the introduction of investor idiosyncrasies, and the input of intuitive judgments and assessments of criteria arising from experience. An equilibrium can then be pursued in the context of such a framework, between the individual investor's expectations, attitudes, and the environment associated with a set of investments.

The Analytic Hierarchy Process (AHP) developed by Saaty has been widely exploited to analyze unstructured decision problems involving qualitative measures, because the AHP not only allows multiple criteria, but also easily accommodates several conflicting and complementary possibilities and judgments associated with complex decisions [8] [9] [10].

The present paper applies the AHP to model and simulate investor behavior in the evaluation and selection of common stocks. It is shown how behavioral finance attributes, multiple quantitative and qualitative criteria and diverse alternatives can be introduced simultaneously to analyze this investment decision [11]. It begins with the model framework, followed by the use of pairwise comparisons to simulate an exemplified stock selection process.

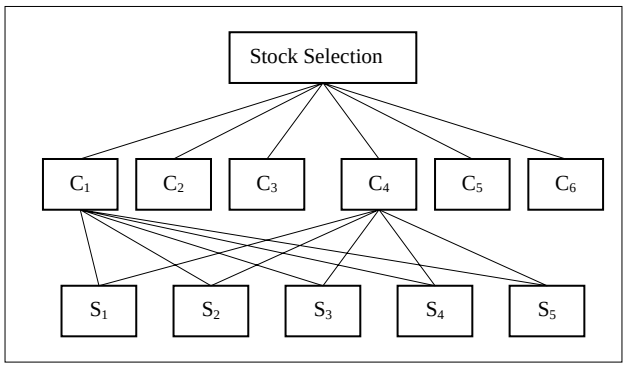
2. Model

The AHP-based evaluation model applied to simulate individual behavior in the selection of common stocks. As displayed in Figure 1, the framework includes three levels: objective of stock selection, criteria (C_1, C_2, … C_6) and stock alternatives (S_1, S_2, … S_5). Actually, stock evaluation is a dynamic decision process in a particular investment environment. It also depends on how the investor perceives the potential of each stock and how these magnitudes and attributes are expected to change. The criteria used should be determined to a large degree by individual's experience and assessment of environmental influences.

However, it is difficult to present a set of evaluation criteria that can usefully be applied in every situation. In our exemplified framework, therefore, the behavioral factors [7] are used to develop six investment criteria for stock selection (i.e. C_1, C_2, C_3, … C_6). They are perceived market image of a firm (IMA), current economic

indicators (IND), acceptable level of expected earnings (EAR), performance of a firm (PER), level of investment risk (RIS), and quality of accounting information (RIS).

Figure 1 The Evaluation Model



3. Evaluation Process

The AHP-based framework is used to simulate an investor's evaluation of five common stocks listed in main board of the Hong Kong Stock Exchanges. These stock alternatives (Stock 1 to Stock 5) are chosen for the present exercise, which are then structured into the position of the stock alternatives. The evaluation process is facilitated by an intuitive decision support system: The Expert Choice. It involves pairwise comparisons of criteria, pairwise comparisons of stock alternatives, and integration of comparisons.

Firstly, pairwise comparisons of criteria, based on a 1-9 score, begin from comparing the relative importance of one criterion versus another in the same level, with respect to the task objective at the top level. If a criterion carries subordinate considerations, the relative importance of each subordinate criterion versus another with respect to their parent criterion is also ranked.

Table 1 Comparisons of Criteria

	IND	EAR	PER	RIS	ACC	Relative Weight
IMA	3	1/3	1/3	1/4	1/3	0.086
IND		1/2	1/4	1/2	1/2	0.068
EAR			1	2	2	0.238
PER				3	3	0.305
RIS					2	0.174
ACC						0.128
					IR:	0.080

Pairwise comparisons of the criteria with respect to the objective are exemplified in Table 1. The six criteria are compared in pairs, while their relative importance judged using a score from 1 to 9. Because of the reciprocal relationship of each pairwise comparison, 15 judgments are required to complete the comparison matrix in this case. A normalized eigenvector of the comparison matrix is generated when judgments are completed.

As shown in Table 1, the normalized eigenvector indicates that the relative weights of the different criteria are: perceived image (0.086), economic indicators (0.068), expected earnings (0.238), performance (0.305), risk level (0.174), and accounting information (0.128).

Secondly, the above-mentioned stock alternatives are represented anonymously as (S_1, S_2, S_3, S_4 and S_5) in order to avoid the possibility of supplying idiosyncratic ideas and conclusions to any real world investor. Pairwise comparisons are performed to determine the relative importance of one alternative versus another with respect to each of the six criteria displayed in the middle level of the framework. As a result, six matrices are obtained (Table 2).

Pairwise comparisons of the different stocks begin with judging the preference of one stock over another with respect to the criterion of "IMA" in Table 2, i.e., Consistency with the perceived image of a firm. For example, because Stock 2 is considered to be very significantly more preferable to Stock 4 in this direction, a score of 7 is entered in the cell of (S_2/S_4) of the matrix. In addition, Stock 3 is judged to be moderately more preferable than Stock 5, so a score of 3 is placed in the cell of (S_3/S_5). This procedure is continued until the upper right half of the matrix is completed. The Expert Choice is able to immediately generate a set of relative weights, indicating the degree of preference of the five different stock alternatives with respect to the "IMA", by calculating the eigenvector of the comparison matrix. Similarly, pairwise comparison between the stock alternatives with respect to each of the other five criteria are carried out (Table 2).

The relative weights of alternatives in Table 1 and the relative weights of criteria in Table 2 are combined to produce normalized composite indices that represent the overall relative weights of the stocks. These magnitudes are obtained by multiplying the relative weights of the stocks against the criteria by relative weights of the corresponding criterion and summing.

The composite relative weights yield the overall priorities of the different stocks as evaluated against the objective of the framework. Because they are derived from the individual's perceptions and judgments of the full range of criteria and alternatives, a stock with a higher synthesized score would emerge as more desirable relative to lower scoring stocks. A stock would be deemed desirable if it demonstrates a potential to be compatible with the above criteria.

In the present case, the composite weights for Stock Alternatives 1, 2, 3, 4 and 5 are computed to be 0.302, 0.399, 0.118, 0.083, and 0.099, respectively. Therefore, the priorities are Stock 2, 1, 3, 5, and 4. The results are reliable, because the overall inconsistency ratio (IR) of 0.08 indicates that limited inconsistencies are present.

The composite weights can also reflect the priority ranking of the stock alternatives being considered. Relatively speaking, the stock with the highest weight represents that it would fit most appropriately with the criteria in comparison with the other alternatives, while a stock with the second highest weight would be associated with the second best alternative.

Table 2 Comparisons of Stock Alternatives

	S_1	S_2	S_3	S_4	S_5	Relative Weights
IMA						
S_1		1/4	3	3	3	0.225
S_2			3	7	5	0.489
S_3				3	3	0.149
S_4					1/3	0.051
S_5						0.086
					IR:	0.08
IND						
S_1		2	4	3	5	0.412
S_2			3	2	4	0.259
S_3				1/4	1/2	0.065
S_4					3	0.183
S_5						0.081
					IR:	0.050
EAR						
S_1		1/2	2	4	3	0.263
S_2			3	5	4	0.413
S_3				2	1/3	0.101
S_4					1/4	0.056
S_5						0.167
					IR:	0.070
PER						
S_1		1/2	3	5	3	0.272
S_2			5	6	4	0.446
S_3				3	3	0.141
S_4					1/3	0.048
S_5						0.092
					IR:	0.060
RIS						
S_1		2	5	3	5	0.418
S_2			3	5	7	0.322
S_3				2	3	0.122
S_4					2	0.087
S_5						0.051
					IR:	0.050
ACC						
S_1		1/2	2	3	4	0.269
S_2			3	4	3	0.393
S_3				1/3	2	0.105
S_4					3	0.163
S_5						0.070
					IR:	0.080

4. Discussion

The stock evaluation which is facilitated by the Expert Choice involves five steps. Firstly, multiple criteria are determined by an assessment of the investment environment. Secondly, the criteria and stock alternatives under consideration are structured into an AHP framework. Thirdly, the criteria are compared in pairs with respect to the investment objective, while the alternatives are compared in pairs with respect to each of the pre-determined investment criteria. Moreover, if the requirement of consistency is satisfied each time [10], a set of composite weights can be obtained to synthesize the relative importance of the different stocks with respect to each criterion. Lastly, since the composite relative weights result from the individual investor's preferences and judgments with respect to the full range of criteria and alternatives of the framework, it is possible to determine a stocks selection on the basis of the relative priorities represented by these magnitudes. In particular, a given wealth can be allocated among the different stocks, proportionally in terms of their overall relative weights.

The perceptive evaluation framework provides a flexible and analytically sophisticated approach to stock selection and equity portfolio management. The environmental and constraint variables in such a decision environment are quantitative and qualitative as well as interdependent, so that the individual would generally be confronted with conflicting and complementary relationships in many dimensions among the criteria selected for evaluation.

Under the AHP, it is possible to compromise multiple criteria, in a structured and consistent fashion. In addition, the multitudinous facets of individual behavior and preferences can be accommodated. The pairwise comparisons can capture the individual investor's experience and perception with regard to different criteria and stocks, thus allowing the selection process to cope with a particular investment environment.

The AHP eigenvalue method produces relative weights for both investment criteria and stock alternatives. The significance of different criteria is represented by an eigenvector, which results from the pairwise comparison of all criteria against the framework objective. A ranking of alternatives follows from pairwise comparisons of alternatives against each criteria in turn. Since all these evaluations are tested against pre-assigned inconsistency ratios, consistency is ensured. The rankings of criteria and alternatives are finally combined to yield composite or overall weights for the different stocks, with respect to the decision objective. An optimal portfolio can be determined within the framework, in the sense that a given wealth is allocated among the different stocks proportionally in terms of their overall relative weights. The resource constraint and investment opportunities would, of course, have to be introduced to solve the portfolio selection problem in full.

An investor would be able to interact dynamically with the investment environment within the AHP framework, by conducting judgmental (re-)assessments of environmental variables based on experience. Since the overall priority ranking of stocks produced by the analysis is based on individual evaluation of investment criteria and stock alternatives at a point of time, an operationally useful framework is made available to facilitate real-time investment decision-making and portfolio management. The present model together with the use of the decision support system can be extended to stock selection under different institutional arrangements by modifying the evaluation model to incorporate particular investment criteria and asset alternatives.

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