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Identify and Prioritize the Factors Affecting the Stock Portfolio using Fuzzy AHP Technique (Fuzzy AHP)

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ABSTRACT

The purpose of investing in the stock market return is higher if investors choose stocks to decide logically, cannot achieve the desired performance. Important factors that can help investors choose the optimal stock, according to the criteria approved by financial experts. According to this explanation, in recent years a variety of tools and techniques to help people and effective measures aimed at investing in the capital market, provided that any restrictions have been met. This research examines the factors affecting the choice of stock portfolio priorities in Tehran Stock Exchange Using Fuzzy AHP technique is discussed. After reviewing the research literature on the subject and some experts are evaluating a stock exchange, market metrics cluster, a cluster of risk, cluster cluster profitability and growth as the most important factors that influence the optimal portfolio selection and described. After analyzing the results using the technique of FAHP most investors focus on the profitability criteria weighing 0.56, 0.35 weighing scale growth, 0.044 and 0.036 measure of risk-weighted market benchmark weights are placed. Again noted that the sub directed to the criteria which showed the highest weight and operating margin 0.416 index weights is most important from the perspective of experts and investors are responsible.

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INTRODUCTION

Optimal portfolio selection problem is an issue that has all investors, including entities with which they are confronted. Issue stock options include creating a portfolio that maximizes the utility investor. Create a portfolio of mind has been preoccupied researchers and financial analysts. Optimal stock portfolio construction process consists of two major parts: A) evaluate and select the desired stock. In this part of the decision-maker, whether natural or legal person, shares as investment opportunities are available to evaluate and choose. This section concerns the existence of a large number of shares traded and the international stock markets, in order to focus the analysis on a smaller number of investment choices is essential. B) Decide on the amount invested in each of the selected shares in the first section. In this case, the investor should invest in each of the selected shares in the first part of the decision and thus create a portfolio of shares selected. Every day an extensive effort to improve the methods for analysis of global financial markets are and efforts to improve methods for analyzing stocks, especially in markets where a high number of stocks has led to the emergence of new ways in addition to the procedures set out to find an answer to the desire to maximize profit in the financial markets. However, this method is able to adapt to the conditions in the capital markets and investors will have an influence on the selection. On the other hand, the clarification made in recent years in the stock market, leading to a large volume of data access has been specialized. Proper use of this information is not possible for ordinary people to use financial experts. There is plenty of information and other factors; the decision to select an appropriate stock portfolio has turned into something hard, as far as most people own criteria for making decisions about buying and selling stock options to the size of the queue, news and rumors heard in the market and so on have been reduced. How to handle the massive amounts of information and improves the decision-making effective use of them, discussion of controversial issues. The main purpose of this paper, the factors affecting the stock portfolio selection techniques using the FAHP to do so, beginning with a review of the literature identified criteria for

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stock selection and prioritization criteria identified by the experts and techniques Fuzzy AHP (FAHP) takes place.

Review of Literature:

In the advanced industrial countries and in other countries as investors viewed as an important component of the stock. We are also investing in the stock market boom in the country involved. Countries to privatize state-owned shares of the economy, investors and stakeholders need to have an accurate understanding of the factors considered by investors. Wameryd, did research on the psychometric properties of financial investors that a better understanding of the financial markets led investors and financial decision but he studies the behavior of the investment is paid. He believes that a strong link exists between the choice of investment and investor behavior [25] Baker & Haslem, suggests that three factors dividends, future expectations and financial balance among different perceptions of investors and this difference is due to the characteristics of investors, such as age, gender and psychological characteristics are [4]. Fisher & Statman is not reasonable to say that we found that the portfolio investors simply due to factors such as risk and return. This is like saying that the price we pay attention only to buy fruits. More expertise in this study, factors that influence the choice of the investor shares in the stock exchange and only in the field of finance and investment has been discussed [11]. Lee et al [16] in a study with the combination of multiple criteria decision making techniques to stock selection based on Gordon model perspective, effective measures identified in the stock price. In this study, the effective measures of Gordon's three key elements of the model were extracted according to a review of the literature. Effective measures based on three main criteria Gordon (dividend forecasts, growth rates and discount rates), including the industry perspective, earnings, operating cash flow, dividend payout ratio, market beta, risk-free return, the rate of earnings growth and dividend growth rates. Janani and et al [13] in his article Portfolio Selection Using Multiple Criteria Decision Making (Tehran Stock Exchange), using vector method for calculating weights and measures and then using the TOPSIS method to determine the portfolio selection began. In their paper, the 9 criteria used are:

Return on equity, earnings per share, the price-to-earnings ratio, systematic risk (beta), return on assets, current ratio and ... [13] Samaras using a multi-criteria approach in accordance with a decision support system to evaluate companies on the Athens Stock Exchange. This method is based on fundamental analysis ratios ETA Star Yu method to classify stocks from best to worst and in the strength of investor risk appetite benefits. The system is designed for both corporate and private investors, the large volume of data and use them in real-world situations establishes the data will always be up to date [20].

Hadavi race [12] to identify the factors affecting the selection of stocks in Tehran Stock Exchange (limited to cement companies) pays using MADM approach. She firms listed in Tehran Stock Exchange play a significant role in the capital markets and the economy. Investors in these firms must evaluate many factors affecting the stock. It is natural that this application requires rapid and accurate identification and assessment is required. In this study, after the 244 criteria, using a Likert scale, as basic criteria affecting the selection of stocks chosen were identified in the Tehran Stock Exchange, the three of them in foreign and domestic investment goals based on the analytic hierarchy process was transferred to the questionnaire. The end result of his research, the main factors affecting the selection of stocks in the Tehran Stock Exchange in order of profitability, technology and economic control identified. Accordingly, the most important measures were effective economic policies and regulations, financial ratios pertaining to profitability due to the contribution of research and development projects and how it [12]. Important factors in the selection of the Tehran Stock Exchange in this paper, based on the criteria identified in the literature, the main cluster consists of the following four criteria are related to each category. This conceptual model is shown in the following figure.
Cluster profitability metrics

- Return on assets (ROA): to trade assets that shows companies how to effectively and efficiently use their assets as well.
- Net profit margins, net profit company that creates revenue per unit [10].
- Earnings per share (EPS): net income minus preferred stock dividends divided by the number of ordinary shares.
- Return on equity (ROE): net income is derived from any of the rights of ordinary shareholders.
- Operating margin: Operating profit a company generates revenue per unit.

Cluster of risk factors:

- Business risk: business risk and uncertainty because of changes in the industry is the company's revenues. Business risk is divided by the standard deviation of the mean is calculated as operating profit [19].
- Financial risk, uncertainty and risk, return on equity for the firm's use of other means of financing with fixed obligations (including debt), the uncertainty in addition to the company's business risk [19].
- Systematic risk (beta): variability in the returns of the securities directly with changes in market or economic developments and the general public is concerned [18].

Market cluster criteria:

- The ratio of market to book value (MV/BV): Fama and colleagues demonstrated that this ratio can be explained by the scattering cross-sectional stock returns.
- Price-earnings ratio (P/E): This ratio indicates that investors expect over the next few years (the default condition) to recover the value of your investment today.
- The ratio of dividends (DPS / EPS): The measure of the ratio of dividends to earnings per share. Usually seek shareholders to receive dividends and other corporate management is interested more the share of profits less cash to invest retained earnings, earn more profits in the future.

Methods:

The population of this study was to describe the exchange of experts to form the population of which 25 experts were designed to respond to the questionnaire. This study is conducted to identify factors affecting the portfolio selection. Then, using fuzzy AHP (FAHP) prioritizes these aspects of paid professionals.

Dimensions identified in this study are summarized in Table 1.

Table 1: Size of Portfolio Selection and indicators identified in this dimension

Dimension	Abbreviation	Index
Market	C_1	The ratio of market value to book Price-earnings ratio Dividend ratio
Growth	C_2	Earnings growth rate Growth in net profit Rate of earnings per share Sustainable growth rate
Risk	C_3	Business risk Financial risk Systemic risk
Profitability	C_4	Return on Assets Net profit margins Earnings per share Return on equity Operating margin

Techniques Fuzzy AHP (FAHP):

The analytic hierarchy process (AHP) is a research technique for decision support logic of a qualitative factor. This technique is an outstanding tool for managing complex multi-criteria decision making problems and a flexible approach that can solve the problems of quantitative and qualitative way-offers, extended. The concept of fuzzy AHP method typical indirectly without using fuzzy sets has been considered. In fact, in this way, using verbal expressions in Table 2, the concept of fuzzy set pair comparison matrices are involved. Thus, the generalization of the above methods is proposed in which the fuzzy numbers are used to express the degree of preference. Among these may be mentioned the method proposed by Chang [7]. Also widely associated with these techniques can be found in the works of Karaman et al [14]. In this study, a fuzzy AHP method is used to analyze the development of Chang.

Table 2: The membership functions of linguistic variables determine the criteria

Preferred row to column				Preferred column to row			
Linguistic variable	Fuzzy number equivalent			Linguistic variable	Fuzzy number equivalent		
Equally important	1	1	1	Equally important	1	1	1
Equal to slightly more	2/67	2	1/33	Equal to slightly more	0/75	0/5	0/37
Relatively more important	3/67	3	2/33	Relatively more important	0/43	0/33	0/27
Moderately to very important	4/67	4	3/33	Moderately to very important	0/.30	0/25	0/21
Very important	5/67	5	4/33	Very important	0/23	0/20	0/18

Since in this study, Chang used, so went on to explain the algorithm in this way we solve problems. The analytical method development for each row of the matrix of paired comparisons, Sk value, which is a triangular fuzzy number, is calculated as follows [2,3]: If X = {x1, x2, x3, ..., xn} and objectives set U = {u1, u2, ..., un} is a set of ideals, then according to this method with respect to any objective analysis can be used to develop each of ideals (gi) did. Therefore, the analysis developed for the purpose of m as follows:

i=1, 2,3,…n where

$M_{g_i}^1$ و $M_{g_i}^2$ و ... و $M_{g_i}^n$

$$\begin{bmatrix} M_{g_1}^1 & M_{g_1}^2 & \cdots & M_{g_1}^n \\ M_{g_2}^1 & M_{g_2}^2 & \cdots & M_{g_2}^m \\ . & . & \cdots & .. \\ M_{g_n}^1 & M_{g_n}^2 & \cdots & M_{g_n}^m \end{bmatrix}$$

All $M_{g_i}^j$ the triangular fuzzy numbers are all that are (l, m, u) can be expressed. Chang developed the analysis is as follows:

The first step is to obtain an expansion phase for each target compound. Values $M_{g_i}^1, M_{g_i}^2, \ldots M_{g_i}^m$ if i th goal of the analysis is ideal for$M_{g_i}^1 = (l_{ij}, m_{ij}, u_{ij})$, then $\sum_{j=1}^m M_{g_i}^j$stretch composite fuzzy ideal for i th objective is defined as follows:

If m, then l operand by the analysis of fuzzy ideals m is defined as follows:

$$\sum_{j=1}^{j} M_{g_i}^j = (l_{i1}, m_{i1}, u_{i1}) + (l_{i2}, m_{i2}, u_{i2}) + \cdots + (l_{im}, m_{im}, u_{im})$$

$$=\left(\sum_{j=1}^m l_{ij}, \sum_{j=1}^m u_{ij}\right) = (l_i', m_i', u_i')$$

So to obtain$\left[\sum_{i=1}^n \sum_{j=1}^m \sum_{g_i}^j\right]^{-1}$ the operator is applied the phase we have:

$$\sum\sum M_{g_i}^j = \sum_{i=1}^n \left(\sum_{j=1}^m l_{ij}, \sum_{j=1}^m m_{ij}, \sum_{j=1}^m u_{ij}\right) = \left(\sum_{i=1}^n l_i', \sum_{i=1}^n m_i', \sum_{i=1}^n u_i'\right)$$

$$\left(\sum_{i=1}^n \sum_{j=1}^m M_{g_i}^J\right)^{-1} = \left(\frac{1}{\sum_{i=1}^n u_i'}, \frac{1}{\sum_{i=1}^n m_i'}, \frac{1}{\sum_{i=1}^n l_i'}\right)$$

$$S_i = \sum_{j=1}^m M_{g_i}^J * \left[\sum_{i=1}^n \sum_{j=1}^m M_{g_i}^J\right]^{-1}$$

Then

$$(l_i', m_i', u_i') * \left(\frac{1}{\sum_{i=1}^n u_i'}, \frac{1}{\sum_{i=1}^n m_i'}, \frac{1}{\sum_{i=1}^n l_i'}\right) = \left(\frac{l_i'}{\sum_{i=1}^n u_i'}, \frac{m_i'}{\sum_{i=1}^n m_i'}, \frac{u_i'}{\sum_{i=1}^n l_i'}\right) = (l_i, m_i, u_i)$$

$$S_k = \sum_{j=1}^n M_{ij} \otimes \left[\sum_{i=1}^m \sum_{j=1}^n M_{ij}\right]^{-1} \qquad (1)$$

Where k represents the number of rows, and i and j, respectively, indicate options and indices. Second, the method of calculating Sk must obtain order of magnitude higher than generally, M1 and M2 are two triangular fuzzy numbers, a large degree of M1 and M2 is defined as follows:

We have:

If $m_i \geq m_k$

Otherwise $$V(M_i \geq M_k) = 1$$ (2)

$$V(M_i < M_k) = hgt(M_i \cap M_k)$$

$$hgt = (M_i \cap M_k) = \frac{U_i - L_k}{(U_i - L_k) + (m_k - m_i)} \qquad (3)$$

Third stage: the size of a triangular fuzzy number of other triangular fuzzy number k is calculated as follows:

$$V(M_1 \geq M_2, \ldots, M_k) = V(M_1 \geq M_2) and \ldots and\ V(M_1 \geq M_k) \qquad (4)$$

The weights used to calculate the matrix of paired comparisons backwards as follows:

$$w'(x_i) = min\{V(S_i \geq S_k)\} \qquad k = 1,2,3, \ldots, n, k \neq i \qquad (5)$$

Stage IV: The weight vector of indicators will be as follows:

$$w'(x_i) = [w'(x_1), w'(x_2), \ldots, w'(x_n)]^t \qquad (6)$$

The non-normal vector is coefficients. To obtain normal vectors are as follows:

(7)

$$w(x_k) = \frac{w'(x_k)}{\sum_{k=1}^n w'(x_k)}$$

This process is done for all paired comparisons tables; they are normalized to weight gain.

Data analysis:

To determine the contribution of each of the four criteria set out in the Portfolio Selection and each of their subsidiaries before using Fuzzy AHP method is used to analyze the development of Chang. To gather feedback on the test criteria of membership functions of linguistic variables described in Table 1 were used. It has since been considered equal weight to the opinion of all experts, geometric mean formula is said to come. Fuzzy AHP paired comparison matrix in Table 3, the geometric mean of the field. In the above table, the bottom diameter of the core values of inverse values obtained for the entries above the main diagonal is used.

Table 3: Comparisons matrix test criteria

C_4	C_3	C_2	C_1	
(0/915, 1/136, 1/407)	(1/366, 1/68, 1/994)	(0/611, 0/694, 0/79)	(1,1,1)	C_1
(0/868, 1/017, 1/174)	(2/31, 3/028, 3/727)	(1,1,1)	(1/265, 1/44, 1/636)	C_2
(0/236, 0/283, 0/357)	(1,1,1)	(0/268, 0/33, 0/432)	(0/501, 0/595, 0/732)	C_3
(1,1,1)	(2/801, 3/533, 4/237)	(0/851, 0/983, 1/152)	(0/71, 0/88, 1/092)	C_4

The method according to EA, for each row of the matrix of paired comparisons, the value of SK, which is a triangular fuzzy number, the formula (1) is calculated.

$$\sum_{j=1}^{4} M_{g_1}^{j} = (1,1,1) + (0.608, 0.741, 0.921) + (1.34, 1.546, 1.782) + (0.4, 0.471, 0.579)$$
$$+ (0.435, 0.484, 0.551) + (0.835, 0.954, 1.112) = (4.618, 5.196, 5.945)$$

$$\sum_{j=1}^{4} M_{g_2}^{j} = (6.768, 7.542, 8.0408) \qquad \sum_{j=1}^{4} M_{g_3}^{j} = (3.448, 3.91, 4.561)$$

$$\sum_{j=1}^{4} M_{g_4}^{j} = (7.763, 8.738, 9.788\ ) \qquad \sum_{j=1}^{4} M_{g_5}^{j} = (8.383, 9.179, 10.561)$$

$$\sum_{j=1}^{4} M_{g_6}^{j} = (4.824, 5.339, 5.936)$$

$$\sum_{i=1}^{3}\sum_{j=1}^{3} M_{g_i}^{j} = (35.804, 39.904, 45.199) \qquad \left(\sum_{i=1}^{3}\sum_{j=1}^{3} M_{g_i}^{j}\right)^{-1} = (0.022, 0.0250, 0.0279)$$

S_1= (0/102, 0/130, 0/166) S_2= (0/149, 0/189, 0/234)
S_3= (0/076, 0/097, 0/127) S_4= (0/171, 0/218, 0/273)

The order of magnitude of each of the values obtained SK, calculated relative to the rest of them. The following values are large degree, $V(S_i \geq S_K)$, obtained for each of the SK come.

$$V(S_1 \geq S_2, \ldots, S_4) = Min(V(S_1 \geq S_2), \ldots, V(S_1 \geq S_4) = 0.069$$
$$V(S_2 \geq S_1, \ldots, S_4) = Min(V(S_2 \geq S_1), \ldots, V(S_2 \geq S_4) = 0.546$$
$$V(S_3 \geq S_1, \ldots, S_4) = Min(V(S_3 \geq S_1), \ldots, V(S_3 \geq S_4) = 0.057$$
$$V(S_4 \geq S_1, \ldots, S_3) = Min(V(S_4 \geq S_2), \ldots, V(S_4 \geq S_3) = 0.888$$
$$W' = (0.069, 0.546, 0.057, 0.888)$$
$$W_N = (0.044, 0.35, 0.036, 0.56)$$

The results of the application of fuzzy AHP shows the priority of each of these factors, the customer is shown in table 5:

Table 4: Weighting of criteria from the point of view of experts

Factors affecting the choice of stock portfolio	Degree of importance derived from fuzzy AHP	Ranked in terms of importance
Market Cluster	./044	3
growth Cluster	./35	2
Clustering of risk	./036	4
Cluster profitability	./56	1

As shown in Table 4 is a cluster of factors affecting the profitability of the portfolio selection with 56 weights / in the first place is important this indicates that in the opinion of experts, these factors are more

important. After weighing the cluster of 35 / second and then clusters and cluster market risks in order of importance are the following.

Sub-criteria analysis of the factors:

Table 5: Matrix paired comparisons of the profitability of the cluster

C_5	C_4	C_3	C_2	C_1	
(0/371, 0/451,0/554)	(0/915, 1/136,1/407)	(1/366, 1/68, 1/994)	(0/611, 0/694, 0/79)	(1,1,1)	C_1
(0/683, 0/791,0/916)	(0/868, 1/017,1/174)	(2/31, 3/028, 3/727)	(1,1,1)	(1/265, 1/44, 1/636)	C_2
(0/214, 0/252,0/305)	(0/236, 0/283,0/357)	(1,1,1)	(0/268, 0/33, 0/432)	(0/501, 0/595,0/732)	C_3
(0/623, 0/717,0/816)	(1,1,1)	(2/801, 3/533,4/237)	(0/851, 0/983,1/152)	(0/71, 0/88, 1/092)	C_4
(1,1,1)	(1/225, 1/394,1/605)	(3/278, 3/968,4/672)	(1/091, 1/264,1/464)	(1/805, 2/217,2/695)	C_5

All calculations related to factors such as the results obtained from the calculations can be avoided. The results are as follows.

$$\sum_{j=1}^{5} M_{g_1}^{j} = (5.453, 6.493, 7.668) \qquad \sum_{j=1}^{5} M_{g_2}^{j} = (7.556, 9.077, 10.654)$$

$$\sum_{j=1}^{5} M_{g_3}^{j} = (2.592, 2.901, 3.365) \qquad \sum_{j=1}^{5} M_{g_4}^{j} = (7.381, 8.824, 10.371\ )$$

$$\sum_{j=1}^{5} M_{g_5}^{j} = (9.764, 11.46, 13.342) \qquad \sum_{j=1}^{5} M_{g_6}^{j} = (4.835, 5.676, 6.667)$$

$$\sum_{i=1}^{4}\sum_{j=1}^{4} M_{g_i}^{j} = (37.581, 44.43, 52.068) \qquad \left(\sum_{i=1}^{4}\sum_{j=1}^{4} M_{g_i}^{j}\right)^{-1} = (0.0192, 0.022, 0.026)$$

S_1= (0.1047, 0.146, 0.204) S_2= (0/145, 0/204, 0/283)
S_3= (0/049, 0/065, 0.089) S_4= (0/141, 0/198, 0/275)
S_5= (0/187, 0/257, 0/355)

$$V(S_1 \geq S_2, \ldots, S_5) = Min(V(S_1 \geq S_2), \ldots, V(S_1 \geq S_5) = 0.129$$
$$V(S_2 \geq S_1, \ldots, S_5) = Min(V(S_2 \geq S_1), \ldots, V(S_2 \geq S_5) = 0.641$$
$$V(S_3 \geq S_1, \ldots, S_5) = Min(V(S_3 \geq S_1), \ldots, V(S_3 \geq S_5) = 0.035$$
$$V(S_4 \geq S_1, \ldots, S_5) = Min(V(S_4 \geq S_2), \ldots, V(S_4 \geq S_5) = 0.598$$
$$V(S_5 \geq S_1, \ldots, S_4) = Min(V(S_5 \geq S_1), \ldots, V(S_5 \geq S_4) = 1$$
$$W' = (0.129, 0.641, 0.035, 0.598, 1) \rightarrow$$
$$W_N = (0.0536, 0.2667, 0.01456, 0.248, 0.416)$$

For all sub-components of the 4 main factors we repeat the operation to achieve their weight. The results obtained according to the following table.

Table 6: weights obtained for each criteria and sub-components by using the FAHP.

Dimension	Weight	Rank	Abbreviation	Index	Weight	Rank
Market	0/044	3	C_1	The ratio of market value to book	0/534	1
				Price-earnings ratio	0/337	2
				Dividend ratio	0/129	3
Growth	0/35	2	C_2	Earnings growth rate	0/182	4
				Growth in net profit	0/354	1
				Rate of earnings per share	0/243	2
				Sustainable growth rate	0/221	3
Risk	0/036	4	C_3	Business risk	0/15	3
				Financial risk	0/482	1
				Systemic risk	0/368	2
Profitability	0/56	1	C_4	Return on Assets	0/01456	5
				Net profit margins	0/0536	4
				Earnings per share	0/248	3
				Return on equity	0/2667	2
				Operating margin	0/416	1

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Conclusion:

The main research question was raised and prioritize the important factors in choosing a stock portfolio view of how stock investors. You can view the results of reviews of investors, brokers, and experts in order of importance in Figure 1 are represented. The most important options of respondents and is a priority, the main results of this research field. After reviewing the research literature related to this topic, 4 factors were identified as the factors identified include market cluster, cluster development, a cluster of risk and profitability cluster. After analyzing the results, as shown in Figure 0.56 profitability cluster weight in the first place and then cluster 0.35 weight gain was second in importance.

Figure 1 the model stock portfolio shows the factors affecting the choice of strategic direction. As has been shown, among the factors affecting the profitability of the cluster, the operating profit margin from the point of view of experts and expertise it has gained more weight and importance.

The recommended:

Investors invest in companies in order to reduce the risk of your investment which of these factors is in fact higher priority.

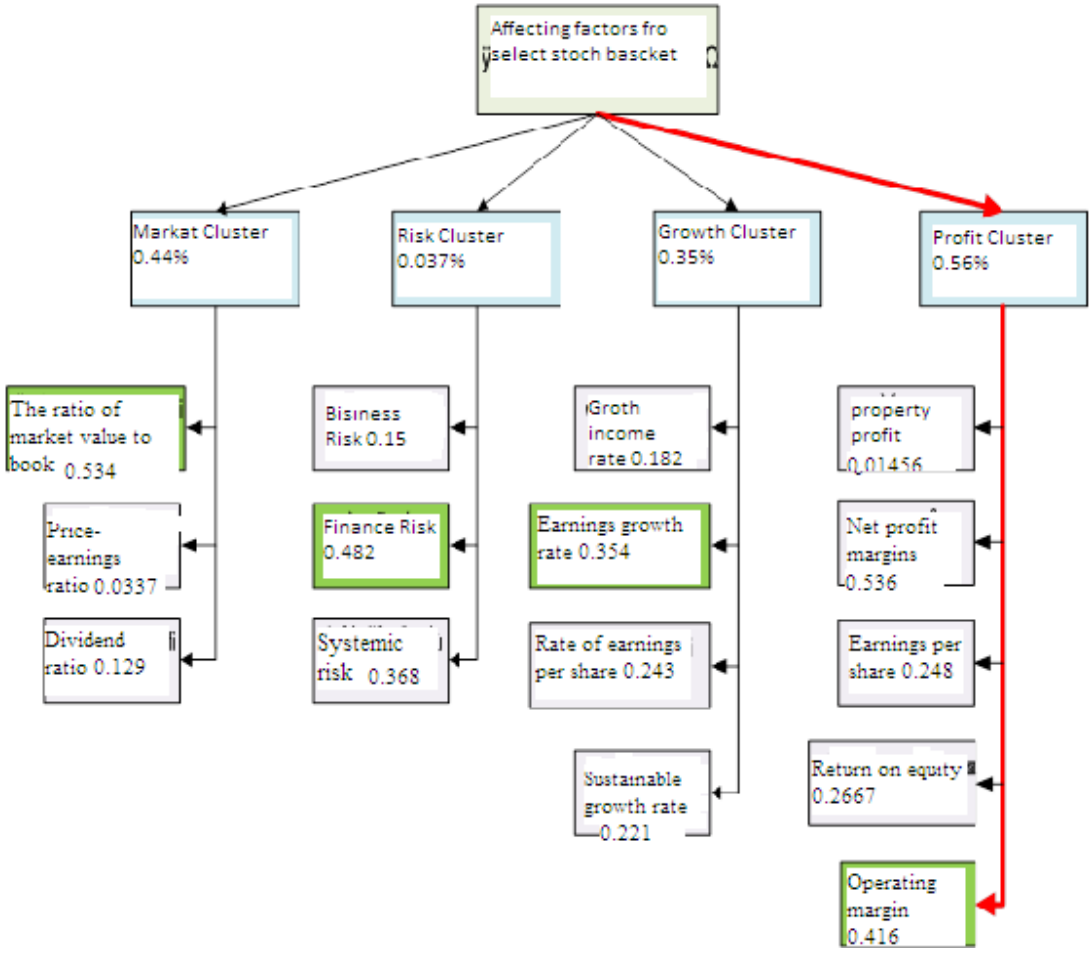

Fig. 1: Model for Portfolio Selection factors influencing the strategic direction.

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