PERFORMANCE ASSESSMENT OF TECHNOLOGY COMPANIES IN MALAYSIA WITH ENTROPY-VIKOR MODEL

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ABSTRACT**:** *In this World Economy and Development, the development of the country can be enhanced through continuous improvement and development of the technology. In Malaysia, the performance of technology companies should be focused since it contributes to the economic development of the country. The objective of this paper is to propose a conceptual framework to assess and evaluate the financial performance of the technology companies in Malaysia with Entropy-VIKOR model. In this study, 17 companies from the technology sector in Malaysia are assessed from 2012 to 2017 by considering important financial ratios such as debt to equity ratio, debt to assets ratio, return on equity, return on asset, earnings per share and current ratio. The results show that the top five outstanding companies are MPI, GTRONIC, ECS, INARI and ELSOFT. The significance of this study is to determine the financial performance and ranking of the technology companies with the proposed conceptual framework based on Entropy-VIKOR model.*

Index Terms: Performance assessment; Conceptual framework; Financial ratio; Multi-criteria decision making

I. INTRODUCTION

In this World Economy and Development, the economy of the country can be enhanced through continuous improvement and development of the technology. Moreover, investment in technological activity can also be used to measure the economic success and sustainability of a country [1]. A country can be developed in a fast-paced if the level of its technological performance and usage is high [1]. Therefore, it is an ongoing task for the government to develop and improve the technology industry. In Malaysia, the technology industry is an important sector that stimulates the national economy.

VIKOR model is used to solve the multiple criteria decision making (MCDM) problems with contradictory and non-commensurable criteria [2-4]. Besides that, VIKOR model helps to rank the decision alternatives and determine the compromise solution that is the nearest to the positive ideal solution (PIS) as well as farthest from the negative ideal solution (NIS). VIKOR model has been widely applied in the field of location selection [5], environmental policy [6], renewable energy alternative [7], service quality of airports [8] and rotor spinning [9]. Entropy weight method assigns the weight of decision criteria according to the data analysis and information obtained [10]. Based on the past research, there is no comprehensive study done on the performance assessment of technology companies in Malaysia using Entropy-VIKOR model. Therefore, this paper proposes a conceptual framework to assess and evaluate the financial performance and ranking of the listed technology companies with Entropy-VIKOR model.

II. DATA AND METHODOLOGY

A. Conceptual Framework

The main objective of this study is to assess and evaluate the financial performance of the technology companies in Malaysia with Entropy-VIKOR model. The important financial ratios such as current ratio (CR), debt to assets ratio (DAR), debt to equity ratio (DER), earnings per share (EPS), return on asset (ROA) and return to equity (ROE) are considered in this study. CR, EPS, ROA and ROE are needed to be maximized. On the other hand, the financial ratios that needed to be minimized are DER and DAR [11]. In this study, the Entropy-VIKOR model is proposed to evaluate and compare the financial performance of the listed companies from technology sector in Malaysia from year 2012 to 2017 [12]. These companies represent the technology sector performance in Malaysia.

B. Entropy-VIKOR

The Entropy-VIKOR model consists of the following steps [13-15].

Step 1: Determination of weight of the decision criteria via entropy weight method. Compute the proportion "p_{ij}" of index value of alternative *m* under criteria *n*.

$$p_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}}, i = 1,2,...,m, j = 1,2,...,n \quad (1)$$

Step 2: Computation of the entropy "e_j" of alternative *m*.

$$e_j = -k\sum_{i=1}^{m} p_{ij}.\ln(p_{ij}), j = 1,2,...,n \quad (2)$$

where

$$k = \frac{1}{\ln(m)}$$

Step 3: Computation of the entropy weight "w_j" of alternative *m*.

$$w_j = \frac{1-e_j}{\sum_{j=1}^{n}(1-e_j)}, j = 1,2,...,n \quad (3)$$

Step 4: Find the best f_j^* and the worst f_j^- values of all criterion functions, where $j = 1,2,...,n$

Step 5: Compute the S_{ij} for $i = 1,...,m, j = 1,...,n$. *m* is the number of alternatives. *n* is the number of criteria. f_{ij} is refer to the score for alternative *i* with criterion *j*.

$$S_{ij} = \frac{w_j(f_j^* - f_{ij})}{(f_j^* - f_j^-)}, i = 1,...,m, j = 1,...,n \quad (4)$$

Step 6: Determine the S_i , R_i and Q_i values, $i = 1,...,m$. v is the weight for the strategy of maximum group utility and 1-v is the weight of the individual regret. v = 0.5 is set in this study.

$$S_i = \sum_{j=1}^{n} \frac{w_j(f_j^* - f_{ij})}{(f_j^* - f_j^-)}, i = 1,...,m \quad (5)$$

$$R_i = \max \frac{w_j(f_j^* - f_{ij})}{(f_j^* - f_j^-)}, i = 1,...,m \quad (6)$$

$$Q_i = v\frac{(S_i - S^*)}{(S^- - S^*)} + (1-v)\frac{(R_i - R^*)}{(R^- - R^*)} \quad (7)$$

where

$$S^* = \min(S_i, i = 1,...,m)$$
$$S^- = \max(S_i, i = 1,...,m)$$
$$R^* = \min(R_i, i = 1,...,m)$$
$$R^- = \max(R_i, i = 1,...,m)$$

Step 7: Rank the alternatives according to the Q values [16, 17]. Select the best alternative by choosing the smallest Q value.

III. EMPIRICAL RESULTS

Figure 1 presents the weights of financial ratios for the performance assessment of technology companies in Malaysia.

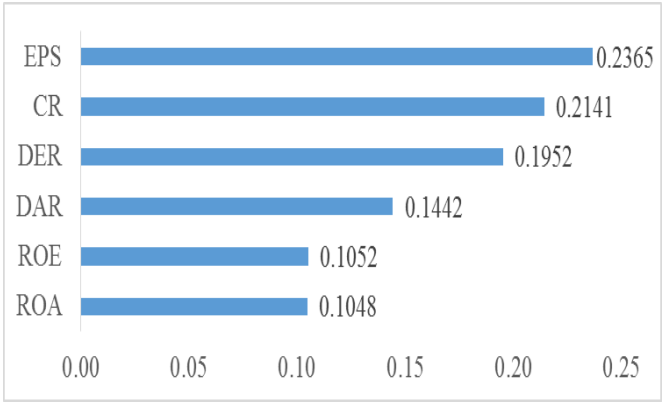

Fig 1. Weights of financial ratios for the performance assessment of technology companies in Malaysia

As shown in Figure 1, EPS (0.2365) gives the highest weight among the financial ratios followed by CR (0.2141), DER (0.1952), DAR (0.1442), ROE (0.1052) and finally ROA (0.1048). According to the results, EPS is the most important financial ratio to be considered for the performance assessment of the technology companies. EPS is the important metric to measure the profitability of the companies [18].

Figure 2 and Figure 3 show the best f_j^* and the worst f_j^- values with respect to each financial ratio respectively.

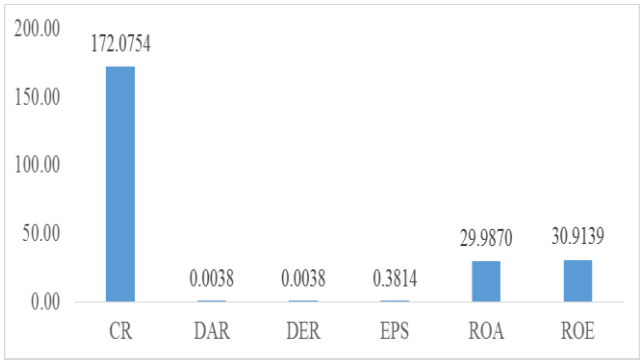

Fig 2. The best f_j^* values with respect to each financial ratio

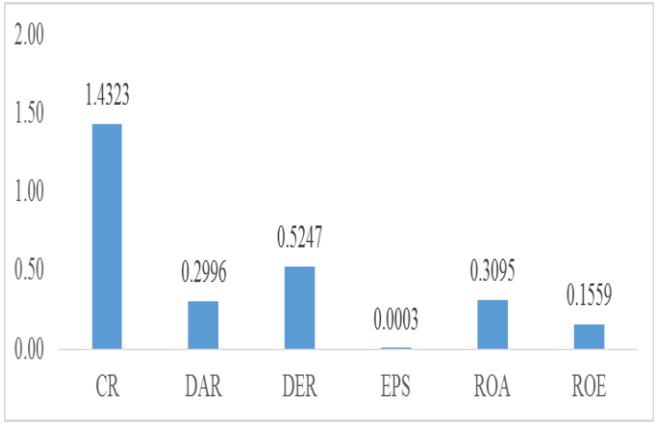

Fig 3. The worst f_j^- values with respect to each financial ratio

The best f_j^* and the worst f_j^- values with respect to each financial ratio have been identified and presented in Figure 2 and Figure 3 respectively. In this study, CR, EPS, ROA and ROE are needed to be maximized. On the other hand, the financial ratios that needed to be minimized are DER and DAR. Therefore, the best f_j^* for CR, DAR, DER, EPS, ROA and ROE are 172.0754, 0.0038, 0.0038, 0.3814, 29.9870 and 30.9139 respectively. On the other hand, the worst f_j^- for CR, DAR, DER, EPS, ROA and ROE are 1.4323, 0.2996, 0.5247, 0.0003, 0.3095 and 0.1559 respectively.

As mentioned in the steps for the Entropy-VIKOR, v is the weight of the strategy "of the majority of criteria". Here v = 0.50 is set for the performance assessment of the companies [2, 19-21]. Table 1 shows the values of S_i, R_i, Q_i and ranking of the technology companies. The values of S_i, R_i, Q_i are determined by using the Equation (5), (6) and (7) respectively. Besides that, the values of S^*, S^-, R^* and R^- have also been determined.

Table 1: Scores and Ranking Lists

Companies	Values *S*	Values *R*	Values *Q*	Ranking
AMTEL	0.6180	0.2221	0.7417	10
CENSOF	0.9673	0.2352	0.9961	17
DIGISTA	0.8874	0.2365	0.9503	16
ECS	0.4928	0.1939	0.5837	3
EFORCE	0.6658	0.2165	0.7556	12
ELSOFT	0.5007	0.1983	0.6012	5
GRANFLO	0.6206	0.2245	0.7501	11
GTRONIC	0.2779	0.1547	0.3385	2
INARI	0.4905	0.1966	0.5898	4
JCY	0.5101	0.2026	0.6193	6
KESM	0.5758	0.2095	0.6797	8
MPI	0.1634	0.0607	0.0000	1
NOTION	0.6509	0.2203	0.7570	13
PANPAGE	0.7007	0.2266	0.8061	14
UNISEM	0.7780	0.2141	0.8184	15
VITROX	0.5850	0.2086	0.6828	9
WILLOW	0.4625	0.2148	0.6243	7

Based on Table 1, $S^* = 0.1634,\ S^- = 0.9673,\ R^*$=0.0607, $R^- = 0.2365$ and v= weight for the strategy of maximum group utility =0.5. In this study, there are total of 17 technology companies evaluated based on six important financial ratios. As presented in Table 1, the values of *S*, *R*, *Q* and ranking of the preference order of all alternatives have been determined. In this study, MPI gives the best financial performance based on the lowest value of *Q*. Therefore, MPI obtains the first ranking among the technology companies, followed by GTRONIC, ECS, INARI, ELSOFT, JCY, WILLOW, KESM, VITROX, AMTEL, GRANFLO, EFORCE, NOTION, PANPAGE, UNISEM, DIGISTA and lastly CENSOF. Furthermore, the optimal values for each financial ratio as presented in Figure 2 and Figure 3 provide the recommendation for sustainability and future improvement of the technology companies.

IV. CONCLUSION

This paper proposes a conceptual framework to assess and evaluate the technology companies' financial performance with Entropy-VIKOR Model. In this study, MPI, GTRONIC, ECS, INARI and ELSOFT have been ranked as the top five technology companies in Malaysia based on their financial performance. Furthermore, the results indicate that EPS is the most important financial ratio followed by CR, DER, DAR, ROE and finally ROA. The significance of this paper is to propose a conceptual framework for assessing the financial performance of the technology companies in Malaysia with Entropy-VIKOR model.

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