Evaluating Company's Performances Using Multiple Discriminant Analysis

Muhammad Rubini Kertapati[1]
Bibin_ukm@yahoo.com
Nuradli Ridzwan Shah Bin Mohd Dali [2]
nuradli@kms.uniten.edu.my
Abdul Hadi Zulkifli[3]

Abstract

The global business environment is really demanding the investors to be prepared with the emerging and dynamic markets. Measuring company's performance is important for management, shareholders, government, customers, suppliers and other stakeholders that have importance or linkage with the wealth distribution directly or indirectly. To evaluate company's performance, we need tools that can be used to measure the performance and one of most popular tools is the financial ratio analysis. This paper will explore the use of multiple discriminant analysis using samples from the finance sector from Bursa Malaysia. Results shows that 5 variables are significant in the model development which are Net Working Capital Ratio, Return on Asset, Operating Profit Margin, Total Asset Turnover, and Sales to Fixed Asset Ratio.

Keywords: Multiple Discriminant Analysis, CAPM, Company's Performance, Multivariate Analysis

1. Introduction

The global business environment is really demanding the investors to be prepared with the emerging and dynamic markets especially in the stock market. Measuring company's performance is important for management, shareholders, government, customers, suppliers and other stakeholders that have importance or linkage with the wealth distribution directly or indirectly. To evaluate company's performance, we need tools that can be used to measure the performance and one of most popular tools is the financial ratio analysis.

Financial ratios are widely used for financial evaluation modeling purposes both by practitioners and researchers. The firm involves many interested parties, like the owners, management, personnel, customers, suppliers, competitors, regulatory agencies, and academics, and each party has its own view in applying the financial statement analysis in its evaluations. Practitioners use financial ratios, for instance, to forecast the future success of companies, while the researchers' main interest is to develop models exploiting these ratios.

As a matter of fact, the only information that is available is the financial statements prepared by management and audited by the auditors. These financial statements can be on quarterly, semiannually, or yearly basis. From these financial statements investors for example can interpret company's conditions and assess company's performance. Some financial ratios could be useful for that assessment. Sometimes the relationships between financial ratios are inversely related.
For example the company's liquidity ratios are inverse related to the solvability ratios. Sometimes confusions will arise for the investors to assess whether the company is in goods conditions or not and decision-making would be a cumbersome processes. This normally happens when we use univariate analysis[4]. To avoid the problems, one of the solutions is using multivariate analysis[5].

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[1] A master degree scholar at Universiti Kebangsaan Malaysia, Faculty of Business and Economics.
[2] A PhD scholar at Universiti Kebangsaan Malaysia, Faculty of Business and Economics. Currently attached with Universiti Tenaga Nasional in the Accounting and Finance Department, College of Business Management, Kampus Sultan Haji Ahmad Shah, Bandar Muadzam Shah 26700 Pahang.
[3] A PhD scholar at Universiti Malaya. Currently attached with Universiti Sains Malaysia.

[4] Univariate data consist of samples or measurements of a single quantitative variable
[5] Multivariate data consist of samples or measurements of a more than one quantitative variable

The objective of this paper is to introduce an alternative model using multivariate analysis; named Multiple Discriminant Analysis (MDA). We will develop this model using useful information that is financial ratios to evaluate companies' performance in Malaysia and to segregate them into two clusters or groups. The model will be derived from financial ratios in which the best financial ratios will be chosen to separate between performing and under-performed companies into two different groups.

From this model the investors could better predict using financial ratios that have been discriminated between performing and under-performed companies. This model could also be useful to predict the possibility of the company to be under performing in the future. The next objective of this paper is to make a ranking for companies that listed on BURSA MALAYSIA (Kuala Lumpur Stock Exchange).

2. Literature Review

Theory of investment (Scott, 1977) states that financial reports objectives are to give information to help investor, creditors, and others financial reports user to assess amount, time, uncertainty acceptance from cash dividends and interest for the future. Or in other word the financial reports will assist investors in gathering information about risk and return from investment activities.

Many researchers have tested the usefulness of financial report in investment decisions. Ball and Brown (1968) tested about the contents of profit information in share prices. Empirical evidence also shows that financial ratios can be useful to predict bankruptcy (Altman, 1968; Sinkey, 1975; Dambolera and Khoury, 1980; Thomson, 1990), to predict return (O'Conner, 1973; Ou and Penman, 1989), and to predict revenue growth (Freeman et al, 1982; Ou, 1990; Penman, 1992).

Basically, company's condition that is brittle to macroeconomic volatility could be identified early using company's financial performance. Beaver (1966) did a study about a brittle of the company five years before that company really failed. Altman (1968) also did the same like Beaver in order to identify the success and failure of banks.

Seeing macroeconomic volatility that affects the companies' performance today, we need a good model that more accurate in evaluating companies performance and predicting company's condition. In order to face macroeconomic volatility and uncertainty in the globalized business environment, a good model is required. The model should be able to be accurate in predicting company's failure, success and evaluating the overall company's performance.

3. Multiple Discriminant Analysis

Multiple Discriminant Analysis is a statistic technique that can be used in a situation where the dependent variable is categorical (non metric) while the independent variable is metric. For example, if we want to separate the credit or loans given to customers that have potential problem and no potential problem. Discrimination function analysis is also used to determine which continuous variables discriminate between two or more naturally occurring groups.

Discriminant analysis covers a differentiation of a variate, linear combination of two (or more) independent variables that will be used to distinguish an object among group categories. It can be achieved by defining the weight for every variable to maximize relatively inter group variance relative to within group variance. The linear combination for the discrimination function needs to be differentiated in a form:

$$Zi = W_1X_1 + W_2X_2 + W_3X_3 + \ldots + W_nX_n$$

Where :
Z : Discriminant score for company i
W_n : Discriminant weight for variable$_{-n}$
X_n : Independent variable$_{-n}$

The next step is to test the hypothesis whether the group mean from a set of independent variables, for two (or more) groups different or the same? To make the differentiation, discriminant analysis will use discriminant function to find the discriminant score for each individual company in analysis.

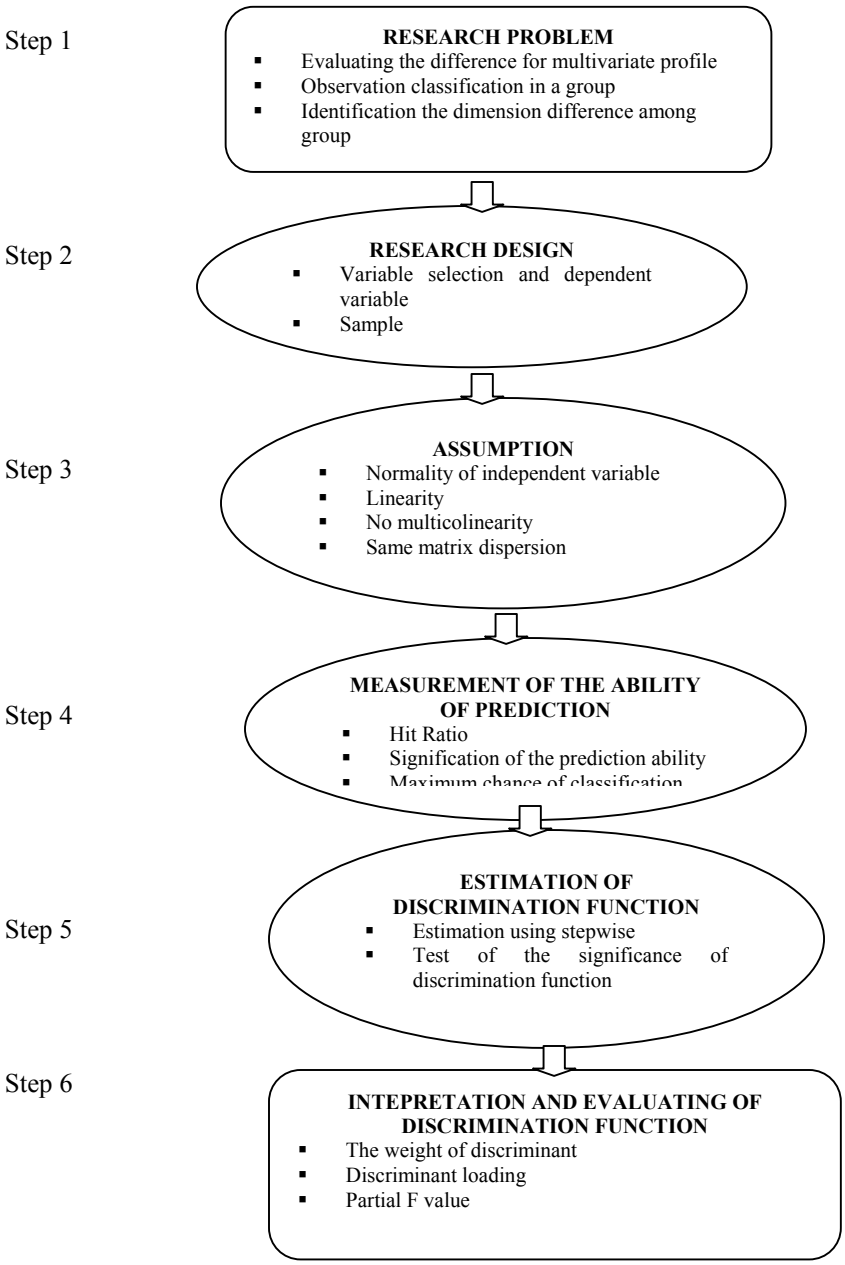
Then, individual company score in one group will be averaged to get the group mean. We call the group mean, CENTROID. If we observe two groups, than we will have two Centroids. The centroids show the important location for a group. The comparison between centroids will show how far the separation among those groups could be observed.

The significance test for discrimination function is a generalization result of a distance measurement among centroids. It measures with comparing discrimination score between two (or more) groups. If the distribution has a small overlapping, it means that the discrimination function is a good discriminator.

3.1 Stage of Discrimination Analysis

The discrimination analysis followed these six steps, in figure 2.1:

Figure 1
The Process of Discriminant Analysis



3.2 Statistical Tools

WILK's LAMBDA is a statistical tool to test the multivariate significance, which sometimes is called U statistics. Lambda has a value between 0 and 1. If the value of lambda approach to 0 it shows that the mean of the group is different. If the value approach to 1, it indicates that the mean of the group is not different.

In the stepwise method, U statistic is used to judge the ability to discriminate the model when the new variable is entered into the model. The independent variables that will be chosen in the model depend on its ability to decrease the value of U statistic significantly. The significance of U statistic is measured by F test. The stepwise process will be stopped if the value of U statistics cannot be reduced anymore.

The HIT RATIO is an individual percentage that is classified correctly by discriminant function. It measures the accuracy of discriminant function to predict the object of the group. Then we need to compare the **HIT RATIO** with the value of chance classification.

The statistic PRESS'S Q is used to measure the ability of discriminant function compared to the result of chance classification. Then the statistic value will be compared to the critical value according to chi-square distribution with 1 degree of freedom and required the significance level.

4. Jensen's Alpha

Jensen's alpha is used to evaluate historical performance of a portfolio. These method measures the difference between realized return and expected return for a period of time. The measurement of Jensen's alpha coefficient is differentiated from the estimation parameters of Capital Asset Pricing Model (CAPM), which we find the alpha and beta coefficient of a stock. The procedure to estimate beta is to regress between individual return (R_i) and market return (R_m):

$$R_i = \alpha + \beta R_m \tag{4.1}$$

Where :
α : Intercept
β : Slope of regression = Covariance (Rj,Rm)/σ_m^2
Slope of this regression shows the beta value, which is the risk of that stock.

The following is the well-known Capital Assets Pricing Model (CAPM) equation:

$$R_i = R_f + \beta(R_m - R_f) \tag{4.2}$$

Intercept from the regression can be used to measure performance of that stock at that time.
Then the CAPM model in equation (4.2) can be modified to equation (4.3):

$$R_i = R_f(1-\beta) + \beta R_m \tag{4.3}$$

From equation (4.3) is similar with regression form from equation (4.1); it will be shown that $R_f(1-\beta)$ from the CAPM model is similar to α and β with β. The comparison between α and $R_f(1-\beta)$ can be used to measure the performance of stocks at that time. So, if:

$\alpha > R_f(1-\beta)$ it means that during the estimation period, the performance of the stocks is good (Performing).

$\alpha = R_f(1-\beta)$. It means that during the estimation period the performance is as the same as it is expected.

$\alpha < R_f(1-\beta)$. It means that during the estimation period the performance of the stocks is poor (under performing).

The difference between α and R_f $(1-\beta)$ is called Jensen's alpha. The measurement is used to see whether the stocks are performing or under- performing.

5. Research Methodology

5.1 Variables and Measurement

The independent variables are the financial ratio. This ratio reflects the performance of the companies. The ratios are:

Table 5.1
The Independent Variables

Variables	Description	Variables	Description
X1	Current Assets/Current Liabilities	X7	Profit Margin
X2	(Current Assets-Inventory)/Current Liabilities	X8	Total Assets Turnover
X3	Working Capital/Total Assets	X9	Account Receivables Turnover
X4	Return on Equity	X10	Sales/Fixed Asset
X5	Return on Asset	X11	Debt to Equity Ratio
X6	Operating Profit Margin		

Variables	Types of Ratio
X1, X2, X3	Liquidity
X4, X5, X6, X7	Profitability
X8, X9, X10	Efficiency
X11	Solvency

The dependent variable is a categorical variable that consists of 0 and 1. If the company has a under performing it will be categorized into 0. On the other hand, the company will be categorized into 1 if it has a performing. This categorical procedure follows the Jensen's alpha method.

The individual return, $R_{i,}$ measured by monthly data from January 2000 until December 2003 using this formula:

$$R_{it} = (P_{it}-P_{it-1}+Dividend_{it})/P_{it-1}$$

Where :
P_{it} : Monthly price in period $_t$.
P_{it-1} : Monthly price in period $_{t-1}$.
$Dividend_t$: Dividend at period $_t$.

The market return, R_m, is measured by BURSA MALAYSIA monthly index. The formula is:

$$R_{mt} = (KLSE_{mt}-KLSE_{mt-1})/KLSE_{mt-1}$$

Where :
$KLSE_{mt}$: KLSE index at period$_t$
$KLSE_{mt-1}$: KLSE index at period$_{t-1}$

The risk free rate, $R_{f,}$ is measured by MGS monthly. Then we regress the market return to individual return to get α and β. If the Jensen's alpha is negative, we categorize it into under performing and if Jensen's alpha is positive, we categorize it into performing.
SPSS 12.0 is used to estimate the regression function and discrimination function.

6. The Result and Discussion

We measure Jensen's alpha using regression model (CAPM) to estimate beta coefficient and alpha coefficient. Table 5.1 gives the result as follow:

Table 2
The Sample and Jehnsen Alpha Measurement

Sample	Alpha	Beta	Rf	Jensen	(1-Beta)	Rf(1-Beta)	Performance	Category
Advance	0.060	0.121	0.057	0.067	-0.121	-0.007	Performing	1
Affin	0.060	0.029	0.057	0.062	-0.029	-0.002	Performing	1
Apex	0.060	0.035	0.057	0.062	-0.035	-0.002	Performing	1
Avenue	0.040	-0.034	0.057	0.038	0.034	0.002	Under Performing	2
Cmsb	0.050	-0.001	0.057	0.050	0.001	0.000	Under Performing	2
Commerce	0.060	0.073	0.057	0.064	-0.073	-0.004	Performing	1
Idaman	0.070	0.000	0.057	0.070	0.000	0.000	Performing	1
Jerneh	0.050	0.032	0.057	0.052	-0.032	-0.002	Under Performing	2
Hancock	0.040	-0.085	0.057	0.035	0.085	0.005	Under Performing	2
Kenanga	0.060	0.050	0.057	0.063	-0.050	-0.003	Performing	1
KLCC	0.080	0.060	0.057	0.083	-0.060	-0.003	Performing	1
LPI	0.050	-0.050	0.057	0.047	0.050	0.003	Under Performing	2
P Mas	0.050	0.005	0.057	0.050	-0.005	0.000	Under Performing	2
Utama	0.050	0.020	0.057	0.051	-0.020	-0.001	Under Performing	2

Based on the result, it can be found that the classification is according to Jensen's alpha. Thus, we can make the dependent variable, in which the company with Jensen's alpha positive is defined as in good performance "performing" and is categorized "1" and so the company with Jensen's alpha negative is put as in bad performance or "under performing" and is categorized "2". The groups contain 7 "performing" companies and also 7 "under performing" companies.

6.1 Estimation of Discriminant Function

6.1.1 The Estimation of the Functions

From the output analysis with using stepwise method, we get 5 variables; there are X_3, X_5, X_6, X_8 and X_{10}. The criteria that we used is to see the significance value (F to enter), in this terms is 22%. From the 5 variables chosen, we get the Wilk's Lambda, 0.027 and caonical correlation, 0.986.

Table 5.2
Summary of Caonical Discriminant Functions

Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	35.856(a)	100.0	100.0	.986

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From Table 4.2 it depicts that the discrimination function has a Wilk's Lambda value, 0.027. Lambda has a value between 0 and 1.The value of 0 indicates major difference and the value of 1 means no difference. The lambda value 0.027 means that the function has a great ability to distinguish the group. This ability is tested with Chi Square test. The result shows both of the groups can be discriminate significantly (the significant value < 0.22).

Other information can be pooled is caonical correlations value, 0.986. The square of this value depicts the variability of the dependent variable. This could be explained by the variability of independent variables using optimal weighted from discrimination function. The square of 0.986 is 0.972. It means that 97.2% of the variability of dependent variable can be explained with this discrimination function.
The objective of discriminant analysis is to get the linear combination in classifying the dependent variable according to some numerical independent variable. The criterion of classification is according to Wilk's Lambda statistic. Using the five variables that have been chosen, X_3, X_5, X_6, X_8 and X_{10}, we analyzed the discriminant to group 1 (Jensen's alpha > 0) and 2 (Jensen's alpha < 0).

The result is as follows:
Ho : No average vector difference between group 1 and group 2.
The Wilk's Lambda test, 0,027 or Chi Square, 19.839 with significance level 0.006 means reject Ho. This shows that until the significance level 99% we can see there are mean vector differences between group 1 and 2.

The discrimination function is:

$$Z = -6.057 + 21.835X_3 + 26.452X_5 – 1.474X_6 – 16.804X_8 + 9.432X_{10}$$

Where :
X_3 : Net Working Capital Ratio
X_5 : Return on Asset
X_6 : Operating Profit Margin
X_8 : Total Asset Turnover
X_{10} : Sales to Fixed Asset Ratio

Table 5.3
Coefficient of Discrimination Function
Canonical Discriminant Function Coefficients

	Function
	1
X3 x3	21.835
X5 x5	26.452
X6 x6	-1.474
X8 x8	-16.804
X10 x10	9.432
(Constant)	-6.057

Unstandardized coefficients

From this equation, it depicts that X_3 has a big influence, followed by X_5, X_6, X_8 and the last X_{10},
If we put in the mean value of these variables, we will get the value functions at group centroid.

Table 5.4
The Value of Function at Centroid Each Group
Functions at Group Centroids

Category	Function 1
1.00	5.356
2.00	-5.356

Unstandardized canonical discriminant functions evaluated at group means

6.1.2 Assessing Overall Fit

From centroid data, we can calculate the cut off that is to divide the discriminant score between group 1 and group 2. The cut off value is measured by:

$$Zcu = \frac{N1Z1 + N2Z2}{N1 + N2} = \frac{7(5.356) + 7(-5.356)}{7 + 7} = 0.0$$

N= number of samples
Z1=Value of Centroid for group 1
Z2=Value of Centroid for group 2

The result find the cut off is 0.0. Companies with Z score less than 0 (negative) will be grouped as a bad performance and if Z score is bigger than 0 will be grouped as a performing.

With this help from the cut off points, we can build classification matrix to measure the accuracy of discriminant function to classify the sample. From Table 4.5 it depicts that the function has an accuracy rate of 80%. The function enables us to recognize the member of group 1 and 2.

Table 5.5
Classification Result
Classification Results (a)

			Predicted Group Membership		
		Category	1.00	2.00	Total
Original	Count	1.00	7	0	7
		2.00	0	7	7
		Ungrouped cases	3	0	3
	%	1.00	100.0	.0	100.0
		2.00	20.0	80.0	100.0
		Ungrouped cases	100.0	.0	100.0

a 100.0% of original grouped cases correctly classified.

If we rank the discriminant score, we could see the rank is according to the Z score, which is from the performing to the under performing companies as shown at Table 5.6.

Table 5.6
The Rank According To Discriminant Score

No	Companies	Z Score
1	Cahya Mata Sarawak Bhd	-6.439
2	LPI Capital	-5.54
3	Avenue Capital Resources Bhd	-5.466
4	Pan Malaysia Capital Bhd	-5.27
5	John Hancock Life Insurance Bhd	-5.196
6	Utama Banking Group	-4.844
7	Jerneh Asia Bhd	-4.065
8	Kuala Lumpur City Corporation	3.677
9	Advance Synergy Capital Bhd	5.137
10	Idaman Unggul Bhd	5.513
11	Apex Equity Holdings Bhd	5.661
12	K & N Kenanga Holdings Bhd	6.801
13	Affin-Holdings Bhd	20.824
14	Commerce Asset-Holdings Bhd	43.435

6.2 Discussion

6.2.1 The Model

The model consists of five variables (X_3, X_5, X_6, X_8 and X_{10}). X_3 is the net working capital ratio, which is the working capital (current assets – current liabilities) divided by total assets. X_5 is the return on asset, which is considered as a measure of how effectively assets are used to generate a return. X_6 is the operating profit margin and X_8 is total assets turnover. The last ratio is sales to fixed assets ratio.

So, the differences between performing companies and under performing companies could be seen from these ratios. It is almost comprehensive proxies, because the representative ratios from liquidity, profitability, and efficiency ratios are significant in this model. Even though the solvency ratios are not included in the model because it is not significant in the result but we must also consider the solvency ratios in evaluating the company performance.

The use of CAPM as an estimation method of α and β is debatable. Then the same problem will also arise during the measurement of Jensen's alpha later on. One of the reasons is the assumption of CAPM seems cannot exist in capital market. The problem faced by CAPM is, there is a difference between the real Security Market Line (SML) and theoretical SML. The empirical test of SML sometimes finds the real SML bias if compared to theoretical SML. The real SML intercept is normally overestimated and the SML slope is too low. If we use this empirical SML to assess the financial performance, then for every portfolio with beta coefficient less than 1 will have a small differential return (If the differential return is positive) as compared to the differential return of theoretical SML.

6.2.2 The Rank

Even though this is not the main objective, but it is very interesting to see the result according to the rank of discriminant score. This could be a guide to the investor; whether to choose a share from the companies, or to select which company will be in the portfolio.

6.2.3 The Variables

To choose which ratio variables will be used to assess the performance of the companies, we must consider the accuracy of the financial ratios that will be used as the inputs of the analysis. For example, if we are conducting and

evaluation for the banking sectors, Inventory turnover may not an appropriate variable. In addition, the standardization of financial ratios should also be looked into especially in the measurement or calculation of financial ratios. This is in order to reduce the error of companies' performance evaluation due to inconsistency of ratio calculation.

7. Conclusions

As the global market is inevitable and impossible to be avoided, one must be prepared for competition from the borderless world. International companies will compete with the domestic companies in a level playing field. Therefore, in the inflows of many companies from all around the world, it is vital for investors to evaluate and select the optimal investment portfolio.

In accordance to the demand for globalization, the objective of this paper is to introduce an alternative model using multivariate analysis. The unique of this approach is the multivariate analysis, which does not depend on one variable. Another aspect that should be considered is the model validation. This could be done by using only half of the samples for model development and the other half for model validation.

However, in this research we are unable to conduct the model validation due to the sample size. Further research should be conducted covering wider samples or the whole population of the capital market. Lastly, the model also might be extended to predict company short-term future performance.

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