The Application of Principal Component Analysis on Financial Analysis in Property Company

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Abstract
The purpose of this research is to identify the important variables affecting property value for property companies listed in Bursa Malaysia. Based on 76 property companies listed in Bursa Malaysia in year 2012 until 2016, we classify them under several prominent factors using financial indicator. There are 6 variables, which are revenue, total assets, total equity, total expenditure, return of assets (ROA), and return of equity (ROE) in financial indicator. By using the Principle Component Analysis (PCA) as a method in this research, we will classify the performance of companies according to severalprominent indicators. PCA is a statistical method of dimension reduction that is used to reduce a large set of variables to a smaller set. The result of this study shows that only the first 2 principle componentsare retained in this research. The2 principle components can be grouped into fundamental indicator and return indicator. Fundamental indicator represents the revenue, total assets, total equity, and total expenditure, while return indicator represents the return of assets and return of equity.
Keywords: Principal component analysis, Real estate property, financial indicators

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I. INTRODUCTION

Property sector is one of the most profitable ventures which reflect a country's economic growth and its poverty level. Property companiesbelong to one of the domain sectors which help to develop the country's economy by embarking more or huge infrastructure projects. This property sector is an important component of economy due to its sizeable influence on employment, the demand for financing, basic materials, and consumer durable goods, such as home furnishings and appliances [1]. Therefore, it can attract and encourage more investors, includinghuge investment corporations to invest in the country. Nowadays, the real estate sector is seen as an important contributor to financial institutions in terms of mortgage loans and asset holdings. In terms of measuring the wealth of the country, the real estate prices are critical for the financial sector [2].

There is various property companies listed in Bursa Malaysia. Property companies in Bursa Malaysiaconduct activities, such as property development and construction, property investment, management, hotels, and leisure. For example, Sime Darby Property, SP Setia Berhad Group, and Mah Sing Group, the biggest property developers in Malaysia. A study by Shakir (2008) included 81 firms in the period of 1999 to 2005 where all of them are listed under the property sector on the main board of Bursa Malaysia [3]. This sector covers around 10.39% companies listed in Bursa Malaysia. The Malaysian property market is aggressively expanding today due to the country's high investment potential and high returns for both local and foreign investors[4]. Therefore, studies on property companies have been attracting significant research attention.

Despite the large number of property companies in Malaysia, identifying their value and performance in Bursa Malaysia is no easy task. Property companies serve as an investment medium with a performance level using financial indicator. Performance refers to the degree to which financial aims are being or have been proficient. Getting to know the financial status of property companies becomes essential as investorsare investing in them. There are manyways to evaluate a company's performance, such as operations variables, market performance, product quality, internal indicators, and financial factors. Financial indicators are vital tools to describe and analyse the business operation performance [5], [6]. Therefore, this study will focus on financial indicators that affect the value of property companies listed in Bursa Malaysia. Therefore, the aim of this study is to analyse the performance of property companies listed in Bursa Malaysia based on their ranking of performance using financial indicators. In order to rank a company's performance, this study utilizes the principle component analysis to form the model that represents the interrelationship among these financial indicators.

II. METHODOLOGY

2.1 Data Collection

The data from Bursa Malaysia listed 76 companies under the property sector. This study uses financial data starting from 2012 until 2016. The financial indicators are collected from their Annual Report. In this study, 6 financial indicators are used, such as income, total assets, total equity, total spend, return on assets (ROA), and return on equity (ROE).

2.2 Method of Data Analysis

The purpose of this study is to analyse the performance of property companies based on financial indicators. A model is developed with all financial indicators intended. Then, a comparison between companies is made from that model based on the ranking of each company. Therefore, in establishing the rankings of the companies, the analysis of the principal component model models will be formed to represent the relationship between these financial indicators.

The Principal Components Analysis (PCA) is a statistical technique for forming new variables, which are linear composites of the original variables. These new variables are not correlated with one another. The PCA is also a statistical method of dimension reduction that is used to reduce a large set of variables to a smaller set [7], [8].This method is generally used to emphasise the variation and capture strong patterns in a data set with minimum information loss.

The PCA method can be described as a linear transformation from the original variables, $x_1, \ldots, x_i$ to new variables, $y_1, \ldots, y_i$.

$$y_1 = a_{11}x_1 + a_{12}x_2 + \cdots + a_{1p}x_p$$
$$y_2 = a_{21}x_1 + a_{22}x_2 + \cdots + a_{2p}x_p$$

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$$y_p = a_{p1}x_1 + a_{p2}x_2 + \cdots + a_{pp}x_p$$

The original variable, $x_1, \ldots, x_i$ will transform to $y_1, \ldots, y_i$ principle component that is described by the covariance [9]. The meaning of coefficients is each new variable is selected in such a way that the *y* variable or principle component is orthogonal. Then, the coordinate axes are rotated such that the axes are still at the right angles while maximising the variable. In the original data matrix, every component is arranged according to a decreasing order of variable accounted. Besides, the number of achievable principle components is equivalent to the number of input variables. However, all components will not be maintained in the analysis as the primary goal of PCA is the simplification of data matrix.

III. FINDING

In this paper, we present the analysis for 2016. The same method was used to model the analyses for 2012 to 2015. In 2016, 76 companies were listed in Bursa Malaysia and 6 financial indicators are considered in this study. Table 1 listed the mean, median, standard deviation, minimum, and maximum value for each financial indicator in 2016 respectively.

Table 1: Descriptive Statistics for each Financial Indicator for Year 2016

Descriptive	Revenue (Million)	Total Asset (Million)	Total Equity (Million)	Expenditure (Million)	ROA (%)	ROE (%)
Mean	367.78	1800.67	1057.14	38.58	0.03	0.04
Standard deviation	640.42	3187.32	2063.38	68.97	0.06	0.11
Minimum	0.60	88.82	45.60	-81.97	-0.17	-0.57
Maximum	3024.94	22810.34	16015.84	358.28	0.20	0.29
Median	126.55	747.45	455.78	16.37	0.03	0.06

Table 2 gives the pairwise correlation between financial indicators. The 4 variables (revenue, total assets, total equity, total expenditure) have strong positive correlation among themselves, but weak correlation with ROA and ROE. Meanwhile, ROA and ROE have strong correlation among themselves, but weak correlation with others. Therefore, the principle component analysis can be conducted for this study.

Table 2:Correlation Matrix

	Revenue	Asset	Equity	Expenditure	ROA	ROE
Revenue	1	0.7986	0.7236	0.6847	0.1652	0.2192
Asset	0.7986	1	0.9807	0.3855	0.0286	0.0845
Equity	0.7236	0.9807	1	0.3013	0.0484	0.0815
Expenditure	0.6847	0.3855	0.3013	1	-0.017	0.0209
ROA	0.1652	0.0286	0.0484	-0.017	1	0.9166
ROE	0.2192	0.0845	0.0815	0.0209	0.9166	1

The interrelationship among 6 financial indicators to principal component analysis is obtained by computing the eigenvalues and eigenvectors of the correlation matrix. The eigenvalues in Table 3 give the amount variance accounted for by each principal component. For the first principal component (PRIN1), the eigenvalue is 3.0383, giving 50.64% variance in the data, and for the second principal component (PRIN2), the eigenvalue is 1.883, giving another 31.38% variance in the data. So, if we considered both PRIN1 and PRIN2 only, we would still be able to account for almost 82% of the variance of the original data. As a conclusion, out of 6 principle components, it will retain only the first 2 principle components because their variance is more than 82% of data.

Table 3:Eigenvalues of the Scree plot

	Eigenvalue	Difference	Proportion	Cumulative
1	3.0383	1.1553	0.5064	0.5064
2	1.8830	1.0302	0.3138	0.8202
3	0.8528	0.7200	0.1421	0.9624
4	0.1328	0.0502	0.0221	0.9845
5	0.0826	0.0722	0.0138	0.9983
6	0.0104		0.0017	1.0000
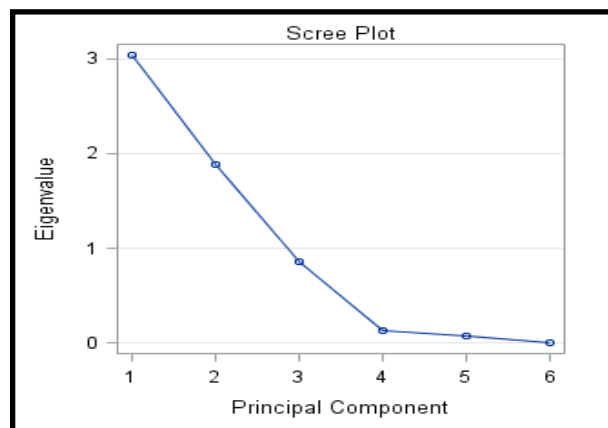
Figure 1:Scree plot

Figure 1 gives a scree plot based on eigenvalues for each principal component. This scree plot suggests that the 2 principal components can be retained. These 2 principal components can be explained by their eigenvectors. The eigenvectors give the weights that are used for forming the principal components to compute the new variables given in Table 4.

Table 4:Eigen Values

	PRIN1	PRIN2	PRIN3	PRIN4	PRIN5	PRIN6
Revenue	0.5367	-0.0339	0.2085	-0.7978	0.1112	0.1364
Asset	0.5309	-0.1415	-0.3371	0.1335	-0.1005	-0.7460
Equity	0.5083	-0.1281	-0.4374	0.3502	0.0563	0.6388
Expenditure	0.3564	-0.1290	0.8071	0.4516	-0.0303	-0.0017

ROA	0.1337	0.6929	-0.0001	0.1384	0.6871	-0.1040
ROE	0.1638	0.6824	0.0111	-0.0014	-0.7081	0.0773

The first and second principle components are defined as PRIN1 and PRIN2 respectively, and given as:

PRIN 1 = 0.5367Revenue + 0.5309Asset + 0.5083Equity + 0.3564Expenditure + 0.1337ROA + 0.1638ROE

PRIN 2 = -0.0339Revenue – 0.1415Asset – 0.1281Equity – 0.129Expenditure + 0.6929ROA + 0.6824ROE

The PRIN1 consists of 4 financial indicators, which are revenue, total assets, total equity, and total expenditure. This first principal component representsthe fundamental background of the property company. The PRIN1 is strongly correlated with the fundamental group of property companies. Meanwhile,PRIN2 consists of ROA and ROE, representingthe return performance of the property company. Based on PRIN1 and PRIN2, we can rank all the property companies by calculating their scores. The scores for the first and second principal componentsare projected in Table 5 and Table 6, respectively.

Table 5:Component Score for PRIN1

Company	Score	Revenue (Million)	Asset (Million)	Equity (Million)	Expenditure (Million)	ROA	ROE
IOIPG	5.59	3024.94	22810.34	16015.84	89.28	0.05	0.07
EcoWLD	3.02	2546.44	8841.98	3786.70	358.28	0.01	0.03
Mah Sing	2.82	2957.62	6220.16	3836.13	267.89	0.06	0.09
MRCB	1.92	2408.07	7506.59	3025.04	54.57	0.04	0.11
OSK	1.84	1305.67	7726.15	4442.89	150.36	0.03	0.06
IGB	1.57	1150.31	7786.20	4594.15	49.68	0.06	0.10
Matrix	1.09	912.20	1301.81	885.19	190.98	0.20	0.29
MKH	0.84	1265.87	3253.42	1310.66	65.59	0.07	0.16
LBS	0.77	993.62	2825.50	1207.02	150.83	0.03	0.07
BJAsset	0.64	387.09	3442.53	2200.04	184.29	-0.01	-0.02

Table 6:Component Score for PRIN2

Company	Score	Revenue (Million)	Asset (Million)	Equity (Million)	Expenditure (Million)	ROA	ROE
Matrix	2.46	912.20	1301.81	885.19	190.98	0.2004	0.2947
Menang	2.01	178.92	232.26	215.56	-7.88	0.1675	0.1805
LBI	1.65	27.27	160.69	133.56	-16.93	0.1342	0.1615
MBWorld	1.52	122.70	129.89	94.18	9.84	0.1216	0.1677
HuaYang	1.51	575.74	952.85	541.63	49.09	0.1155	0.2032
Ideal	1.24	153.35	222.98	86.96	9.80	0.0765	0.1961
Titijaya Lan	1.20	45.54	413.74	327.01	2.53	0.1044	0.1321
OIB	1.17	233.12	509.99	375.37	16.25	0.1013	0.1376
SHL Consolid	1.07	51.08	511.78	434.00	0.51	0.0988	0.1165
KSL	1.06	689.06	2844.47	2351.75	7.64	0.1106	0.1337

The top 10 companies for the first principle component represent the performance of property companies based on their fundamentals that are measured by revenue, total assets, total equity, and total expenditure. This principle component represents big company with good performance in revenue, total assets, total equity, and total expenditure. The top 10 companies for the second principle component represent the performance of return of the property companies based on ROA and ROE. The principal components scores can be plotted to further interpret the results in Figure 2. Based on Figure 2, the ranking of companies can be observed. For example, the good performance of company in PRIN1 is IOI Properties Group (50). Then, for PRIN2, the good return of company is Matrix Concepts Holdings (64).

Next, we conduct the same approaches to analyse property companies from 2012 to 2015. We used the principal component analysis to model the interrelationship between these 6 financial indicators.
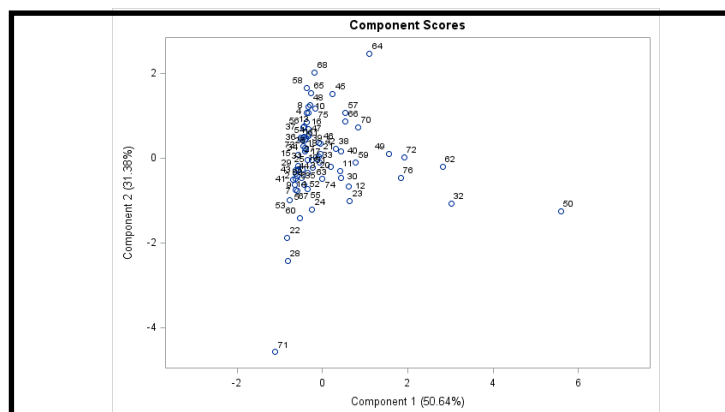

Figure 2: The principal component scores

Table 7: Eigenvectors for each Year

	2016		2015		2014			2013		2012	
	PRIN 1	**PRIN 2**	**PRIN 1**	**PRIN 2**	**PRIN 1**	**PRIN 2**	**PRIN 3**	**PRIN 1**	**PRIN 2**	**PRIN 1**	**PRIN 2**
Revenue	0.537	-0.034	0.524	0.110	0.501	-0.066	0.461	0.509	0.159	0.506	0.018
Asset	0.531	-0.142	0.591	0.108	0.587	-0.230	-0.115	0.566	-0.032	0.525	-0.177
Equity	0.508	-0.128	0.568	0.114	0.561	-0.204	-0.258	0.539	-0.023	0.468	-0.161
Expenditure	0.356	-0.129	0.203	-0.419	-0.031	-0.077	0.837	0.360	-0.217	0.432	-0.182
ROA	0.134	0.693	-0.098	0.618	0.191	0.677	-0.048	0.014	0.676	0.157	0.679
ROE	0.164	0.682	-0.063	0.637	0.228	0.661	0.073	0.027	0.685	0.195	0.670

Table 7 gives the eigenvectors for each year. Results show that from 2012 until 2016, only 2 principle components were retained, except 2014 because it has 3 principle components that were retained. We can group the variables in 2 groups, which are fundamental and return. Fundamental represents the revenue, total assets, total equity, and total expenditure, while return represents the return of assets and return of equity. The 4 variables in fundamental group vary closely so they are grouped together in the first principle component. However, in 2014 the total expenditure was separated from other principle components. One of the factors that influence the expenditure of the third principle component is the implementation of goods and services tax by the government. Furthermore, the other 2 variables in group return will be grouped once again in the second principle component.

Table 8: Top 10 based on the first principle component score

2016		2015		2014		2013		2012	
Company	**Score**	**Company**	**Score**	**Company**	**Score**	**Company**	**Score**	**Company**	**Score**
IOIPG	5.5944	IOIPG	5.5845	IOIPG	5.7413	IOIPG	4.0343	IGB	4.7508
EcoWLD	3.0228	Mah Sing	3.2920	Mah Sing	2.9891	IGB	3.7687	Mah Sing	3.7363
Mah Sing	2.8197	EcoWLD	2.4454	IGB	2.4658	Mah Sing	3.5491	MRCB	2.7900
MRCB	1.9202	IGB	2.1925	MRCB	2.1593	MRCB	2.0084	UEM Sunrise	1.9000
OSK	1.8401	MRCB	1.7276	UEM Sunrise	1.5541	UEM Sunrise	1.9203	Selangor Pro	1.0805
IGB	1.5659	UEM Sunrise	1.4519	KSL	1.1417	Tropicana Co	1.4927	Tropicana Co	1.0780
Matrix	1.0891	OSK	1.3069	Naim	0.7598	E&O	1.1018	Glomac	1.0425
MKH	0.8368	MKH	0.7781	Martix	-0.3914	BJAsset	1.0711	MKH	0.9171
LBS	0.7745	BJAsset	0.6829	BJAsset	-1.0897	KSL	1.0443	E&O	0.9050
BJAsset	0.6425	KSL	0.5523	MKH	-1.7879	MKH	0.9539	KSL	0.8698

In Table 8, IOI Properties Group was the top company in fundamental from 2013 until 2016. In 2012, the IOI Properties Group was not listed in Bursa Malaysia. Mah Sing Group Bhdwas in top 3 companies in in 2013 and 2016 and in top 2 companies in 2012, 2014, and 2015.

Table 9: Top 10 principle component 2 score

2016		2015		2014		2013		2012	
Company	**Score**	**Company**	**Score**	**Company**	**Score**	**Company**	**Score**	**Company**	**Score**
Matrix	2.4616	YTL Land & D	-0.4927	Farlim	3.2373	LBS	3.8183	LienHoe	3.4097
Menang	2.0095	YNH Property	0.7991	Menang	2.2686	DPS	2.6326	Cview	1.5972
LBI	1.6470	Y&G Corp Bhd	0.0041	Cview	2.1837	Cview	2.5054	Hua Yang	1.5067
MBWorld	1.5241	UEM Sunrise	-0.0950	Martix	1.9605	Martix	2.0877	Amprop	1.3513
HuaYang	1.5127	Tropicana Co	-0.3442	Selangor Pro	1.6600	Naim	1.8294	PLB Engineer	1.2253
Ideal	1.2427	Titijaya Lan	-0.1922	KSL	1.4132	Tambun Indah	1.5853	Meda	0.9422
Titijaya Lan	1.2003	Thriven Glob	-0.4979	Thriven Glob	1.3946	Y&G Corp Bhd	1.3671	MCT	0.9152
OIB	1.1661	Tambun Indah	0.2926	MCT	1.3209	Ibhd	1.2515	Glomac	0.8944
SHL Consolid	1.0733	Tadmax Resou	1.6404	Cresndo	1.2280	HuaYang	1.0921	Cresndo	0.8067
KSL	1.0614	Symphony Lif	1.4556	Amprop	1.1271	Menang	0.8876	Tambun Indah	0.7446

Based on Table 14, the top companies in return from 2012 to 2016 were Matrix, YTL Land, Farlim, LBS Bina Group Bhd, and Lien Hoe. Menang was the second top company for return in 2014 and 2016. In 2012, 2013, and 2015,Cview, DPS Resources Bhd, and YNH Property were the second top companies.

IV. CONCLUSION

By using PCA as a method in this research, we will observe the performance of companies that can be classified intoprominent indicators. PCA is a statistical method of dimension reduction that is used to reduce a large set of variables to smaller set. Theresults of this study indicate that only the first 2 principle components will retain in this research. The 2 principle components can be grouped in fundamental indicator and return indicator. Fundamental indicator represents the revenue, total assets, total equity, and total expenditure, while return indicator represents the return of assets and return of equity. PCA successfully differentiated fundamental and return in the first 2 principle components that can be retained. In conclusion, PCA could be considered a powerful tool in computing marketing information.

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