

The difference of main operation ratios performance between energy industry and Electronics and appliances industry: a discriminant analysis from 19 listed companies

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Abstract. Companies in different industries have their own operation situation. Then, if companies in a same industry are facing some general same problems or advantages, will some financial performance of companies in an industry be distinguishable from companies in a different industry? Through using discriminant analysis, the paper gives out the outcome of differentiating two industries based on the combination of two ratios. Each industry is represented by a number of companies that is listed and successful. Five ratios have been adopted and combined, including Current Ratio, Operating Expense Ratio, Gross Profit Margin and EBIT Margin. The paper finds that the combination of Gross Profit Margin and Operating Expense Ratio have the highest Mahalanobis distance, which means the best way to distinguish two industries. However, the number is too small to effective, so people are hard to decide the industry of a company only based on its business performance.

keywords: Discriminant analysis; Business analysis; Technology industry; Energy industry.

1. Introduction

Mathematicians always devote themselves into the exploring on the truth of the world. Those formulas accumulate the wisdom of people. Through understanding the world in mathematics, we could utilize these laws on improving ourselves. Statistics study the collection, interpretation and utilization of data. Business, an industry of organization of social resources, always adopted statistics to improve their efficiency and performance. Different business has their own specialties. Researchers, however, still trying to study the potential sequence. As the result, multiple ratios that measuring different aspects of the business has been summarized and became a dominant way in analysis. Husna and Satria (2019) found that the Return on Asset have effects on the firm value. Lukic and Lalic (2019) conclude that an efficiency management on revenues, costs, profit, assets and financial structure is necessary for the long-term performance of the food trading companies in Serbia through studying their EBITDA margin. Yahya and Hidayat (2020) determine the effect of the variable Current Ratio, Total Debt to Total Assets, Total Assets Turnover, Return on Assets, on earnings persistence which is significantly influenced by return on assets.

Industries are also considered to be a valuable research direction. Hizam-Hanafiah and Soomro (2021) gives an insight on the companies which adopt Industry 4.0 technology, saying that “In terms of company type, certain Industry 4.0 technologies are more pertinent fit for manufacturing concerns like Autonomous Robots, whereas other Industry 4.0 technologies are more relevant for service concerns like Mobile Technologies.” Aslani and Mohaghar (2013) conclude that the renewable energy could provide business and economic opportunities at different levels. Aydalot and Keeble (1988) write that high-technology industry is innovative. Its products alter the behavior of both individuals and groups in society. There is also using ratios to analyze an industry. Kosov, Akhmadeev., Smirnov, Solyannikova. and Rycova (2018) have researched on energy industry through using net present value (NPV), profitability index (PI), weighted average cost of capital (WASS) and etc. Their research demonstrate that companies has done a bulk of investment and unable to afford other funding instruments.

However, even though we could see analysis focusing on an industry, there is little research on the difference between two industries. The specialty of each industry may have an effect on the operation of companies. Then, in order to answer the question “will some financial performance of companies in an industry be distinguishable from companies in a different industry?” in our analysis, the industry

of energy and the industry of electronics and appliances will be researched. According to the value ranking lists of 2022 published on website BrandFinance (<https://brandirectory.com/>), the paper chooses top nine oil and gas companies and top ten electronics and appliances companies to represent each industry. Energy companies includes Shell (SHEL), Saudi Aramco (2222), Petrochina (PTR), Sinopec (SNP), British Petroleum (BP), TotalEnergies (TTE), Chervon (CVX), PETRONAS (PNAGF) and Exxon-Mobil (XOM). Electronics and appliances companies includes Apple Computers (AAPL), Samsung (005930), Dell Technologis (DELL), LG Group (003550), Sony (SONY), Midea (000333), HP (HPQ), Xiaomi (XIACY) and Panasonic (PCRFY). Also, differentiating from the previous research, this paper will not be only comparing one variable of each industry. Through applying discriminant analysis, two industries could be distinguished by two variables.

2. Methodology

2.1 Variables

The data are gathered from Yahoo finance (<https://finance.yahoo.com.>). Most of data are published on December 30th, 2021. The financial data of Dell Technologis is published on January 30th, 2022. The financial data of Sony and Panasonic are published on March 3rd, 2022. The financial data of HP and is published on December 30th, 2021. This paper will use discriminant analysis to analyze. In order to apply discriminant analysis, Excel will be the tool to do the calculation. The process explained in Process part is based on using excel.

Current Ratio, Operating Expense Ratio, Gross Profit Margin, EBIT Margin and Total-Debt-to-Total-Assets Ratio measure different aspects of a company. These ratios will be adopted to studying the business.

Heikal, Khaddafi and Ummah. (2014) state that “Current ratio (CR) is a company's ability to pay off short-term debt with current assets of the company.” Current Ratio (CR) measures the ability to pay short-term debt. The formula is shown below.

$$\text{Current Ratio} = \frac{\text{Current assets}}{\text{Current liabilities}}$$

Rea, Reid, and Millar (1999) give an explanation on the operation expense that “consist of all fees and expenses relating to the management and administration of the fund.” Operating Expense Ratio (OER) measures the operation cost of each unit of revenue. The formula is shown below.

$$\text{Operating Expense Ratio} = \frac{\text{Total operating cost}}{\text{Total revenue}}$$

Shi, Huang, Wu, and Jin (2021) write that “gross profit margin is the starting point index to analyze the profitability of enterprise.” Gross Profit Margin measures the profit of each revenue after paying the direct cost of business. The formula is shown below.

$$\text{Gross Profit Margin} = \frac{\text{Gross Profit}}{\text{Net revenue}}$$

Where gross profit is calculated by subtracting the cost of goods sold from revenue.

Quon, Zeghal and Maingot (2012) used EBIT Margin to help explaining the risk of leverage of companies. EBIT Margin measures the operating income of each unit of revenue. The EBIT stands for earnings before interest, taxes. The formula is shown below.

$$\text{EBIT Margin} = \frac{\text{EBIT}}{\text{Total revenue}}$$

Sucipto and Hasibuan (2020) said that “The higher the Total-Debt-to-Total-Assets Ratio, it means that the bigger the assets that are financed with debt and it is more risky for the company.” Total-Debt-to-Total-Assets Ratio measures the debts of each unit of asset. The formula is shown below.

$$\text{Total – Debt – to – Total – Assets Ratio} = \frac{\text{Total Debt}}{\text{Total Asset}}$$

Discriminant analysis is a method that could separate objects through different criteria. Joy and Tollefson (1975) give an idea on the financial application of the discriminant analysis and discuss several obstacles on applying discriminant analysis (p.723). According to Brown and Tinsley (1983), Discriminant function analysis is “a technique which allows the researcher to examine and describe simultaneously the differences between two or more mutually exclusive groups with respect to several continuous variables”, which is also the definition of discriminant analysis in this paper. The result of discriminant analysis, named Mahalanobis distance, will measure the power of discriminating objects. Recently, the complicated process of analysis can be simplified by advanced calculators. Through the intelligence of machine, it is able to find out the sequence more easily and comprehensive.

2.2 Process

Table 1 shows each company's financial data. All number are in thousands. Some data are reported in other currency. The exchanged rate on of SAR, KRW and CNY are gathered from Exchange Rates UK (<https://www.exchangerates.org.uk/USD-KRW-spot-exchange-rates-history-2021.html>).

Table 1. Data of each company

Unit: \$	Current Assets	Current Liabilities	Total Assets	Total Debt	Total Revenue	EBIT	Gross Profit	Operating Expense
SHEL	128,765,000	95,547,000	404,379,000	89,086,000	261,504,000	33,435,000	35,849,000	13,566,000
2222	611,241,000	303,828,000	2,162,690,000	510,921,000	358,731,723	208,160,173	181,228,593	-24,358,537
PTR	480,838,000	518,158,000	2,502,262,000	470,298,000	2,614,349,000	173,246,000	613,061,000	456,604,000
SNP	558,024,000	641,280,000	1,889,255,000	315,521,000	2,740,884,000	123,052,000	548,539,000	425,074,000
BP	92,590,000	80,287,000	287,272,000	69,787,000	157,739,000	17,939,000	22,860,000	12,188,000
TTE	111,136,000	95,102,000	293,458,000	64,547,000	184,634,000	27,857,000	52,008,000	28,083,000
CVX	33,738,000	26,791,000	239,535,000	31,369,000	155,606,000	22,351,000	48,309,000	32,129,000
PNAG F	4,718,006	1,295,680	19,186,103	3,447,116	5,648,602	2,816,654	2,719,746	60,224
XOM	59,154,000	56,643,000	338,923,000	47,704,000	276,692,000	32,181,000	64,886,000	40,867,000
AAPL	134,836,000	125,481,000	351,002,000	124,719,000	365,817,000	111,852,000	152,836,000	43,887,000
005930	183,304,344	74,037,484	358,454,208	15,453,390	234,928,613	45,189,681	95,107,029	51,723,403
DELL	45,033,000	56,219,000	92,735,000	26,954,000	101,197,000	7,465,000	21,891,000	17,232,000
003550	4,661,467	2,368,800	21,568,190	691,126	5,763,055	2,028,354	2,347,198	280,177
NFLX	8,069,825	8,488,966	44,584,663	15,392,895	29,697,844	6,605,723	12,365,161	6,170,652
SONY	5,535,208,000	8,760,150,000	30,480,967,000	3,571,721,000	9,921,513,000	1,132,103,000	2,701,672,000	1,588,473,000
000333	36,360,841	32,560,156	56,681,633	8,149,206	50,167,413	5,124,718	11,503,696	7,485,121
HPQ	22,170,000	29,096,000	38,610,000	8,778,000	63,487,000	7,765,000	13,417,000	7,765,000
XIAC Y	185,851,401	115,727,471	292,891,870	30,680,411	328,309,145	27,258,490	58,260,941	38,229,595
PCRF Y	4,031,197,000	3,065,464,000	8,023,583,000	1,897,284,000	7,388,791,000	379,654,000	2,082,211,000	1,712,048,000

source: Excel

Then, through applying formulas, we could calculate out required ratios.

First, the paper selects two ratios, taking Current ratio and EBITD Margin as example, and set parameter a and parameter b. Then, giving a and b a random number, such as 1, 1.5, or etc. Next, for each company's ratio, we get the sum of multiplying the first ratio with a and the second ratio with b. The sum is set as c. The graph is shown below.

After finding the c, it is time to calculate the mean value and variance of each industry. The mean value and variance of energy industry is 1.7987 and 1.264847561. The mean value and variance of technology industry is 1.5130 and 0.432589922. Then, we find the difference between the mean value of each difference, which is 0.2857. Also, we should find out the pooled variance which is 14.01208979. Mahalanobis distance, which measures the discriminating power of two ratios, can be calculated out by squaring the difference between the mean value of each difference and divide it by pooled variance. However, to maximum the Mahalanobis distance, we need to change a and b.

Through the function solver in excel, we set a^2+b^2 equals 1. The result shows that a is 0.696077369 and b is 0.717965875. The Mahalanobis distance is 0.003640573.

Table 2. Ratios of each company

	Current ratio	Total-Debt-to-Total-Assets Ratio	EBIT Margin	Gross Profit Margin	Operating Expense Ratio
SHEL	1.34766136	0.22030323	0.127856553	0.137087769	0.051876836
2222	2.011799439	0.23624329	0.580266977	0.505192549	-0.067901821
PTR	0.927975637	0.187949144	0.066267358	0.234498531	0.17465304
SNP	0.870172156	0.167008159	0.044895005	0.200132147	0.155086461
BP	1.15323776	0.242930045	0.113725838	0.144922942	0.077266878
TTE	1.168597926	0.219953111	0.15087687	0.281681597	0.152100913
CVX	1.259303497	0.130957898	0.14363842	0.31045718	0.206476614
PNAGF	3.641335824	0.179667335	0.498646214	0.48149011	0.010661753
XOM	1.044330279	0.140751734	0.116306218	0.234506238	0.147698524
AAPL	1.07455312	0.355322762	0.305759437	0.417793596	0.119969821
005930	2.47583163	0.043111197	0.19235495	0.404833742	0.220166468
DELL	0.801028122	0.290656171	0.073767009	0.216320642	0.170281728
003550	1.967859799	0.032043768	0.351958081	0.407283704	0.048616054
NFLX	0.9506252	0.345250899	0.222431063	0.416365612	0.207781144
SONY	0.63186224	0.11717873	0.114105883	0.272304436	0.160103908
000333	1.116728098	0.143771551	0.102152329	0.229306139	0.149202851
HPQ	0.761960407	0.227350427	0.122308504	0.211334604	0.122308504
XIACY	1.605940227	0.104749958	0.083026898	0.177457564	0.116443893
PCRFY	1.315036484	0.236463435	0.051382425	0.281806726	0.231708814

Source: Excel

Table 3. The calculation process of companies on Current ratio and EBITD Margin

a	b	Firm	Current ratio	EBIT Margin	C
1	1.5	SHEL	1.34766136	0.127856553	1.53944619
		2222	2.011799439	0.580266977	2.88219991
		PTR	0.927975637	0.066267358	1.02737667
		SNP	0.870172156	0.044895005	0.93751466
		BP	1.15323776	0.113725838	1.32382652
		TTE	1.168597926	0.15087687	1.39491323
		CVX	1.259303497	0.14363842	1.47476113
		PNAGF	3.641335824	0.498646214	4.38930514
		XOM	1.044330279	0.116306218	1.21878961
		AAPL	1.07455312	0.305759437	1.53319228
		oo5930	2.47583163	0.19235495	2.76436405
		DELL	0.801028122	0.073767009	0.91167864
		OO3550	1.967859799	0.351958081	2.49579692
		NFLX	0.9506252	0.222431063	1.28427179
		(SONY)	0.63186224	0.114105883	0.80302106
		OOO333	1.116728098	0.102152329	1.26995659
		HPQ	0.761960407	0.122308504	0.94542316
		XIACY	1.605940227	0.083026898	1.73048057
		PCRFY	1.315036484	0.051382425	1.39211012

Source: Excel

3. Result

In the end, through applying the process introduced above, it is able to summarize the Mahalanobis distance of each combination of ratios.

The combination Gross Profit Margin and Operating Expense Ratio have the highest Mahalanobis distance. Among all the combination of ratios, energy industry and Electronics and appliances industry have a quiet different performance on the profit of each revenue and the operation cost of

each unit of revenue. However, the difference is too little, which means it is hard to conclude that companies in different industries have a various operation situation. Financial performance of companies in energy industry can't be distinguishable from companies in industry.

Table 4. The Mahalanobis distance of each combination of ratios

Combination of ratios	Mahalanobis distance
Current Ratio & Total-Debt-to-Total-Assets Ratio	0.006405075
Current Ratio & EBIT Margin	0.005940027
Current Ratio & Gross Profit Margin	0.00533422
Current Ratio & Operating Expense Ratio	0.00533422
Total-Debt-to-Total-Assets Ratio & EBIT Margin	0.003640573
Total-Debt-to-Total-Assets Ratio & Gross Profit Margin	0.00533422
Total-Debt-to-Total-Assets Ratio & Operating Expense Ratio	0.00533422
EBIT Margin & Gross Profit Margin	0.004630436
EBIT Margin & Operating Expense Ratio	0.004627065
Gross Profit Margin & Operating Expense Ratio	0.044563812

Source: Excel

4. Conclusion

The result of analysis demonstrates that companies in different industries do not have a fundamental difference on their operation performance. The difference of product or service cannot lead to a prominent operation specialty of an industry. Then, companies are unable to avoid their operation mistakes by study the whole industry. Also, most companies in different industries are facing same problem, which means setting law to change the situation of companies from different companies could be effective.

Still, there is some short come. The sample of analysis is not too much. Also, the number of ratios is little. If there are more companies and ratios in the analysis, the conclusion could be more accurate and convincible.

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