Factor Analysis-based Performance Evaluation of Listed Companes in Petroleum Industry of China

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Received: August 17, 2011 Accepted: September 13, 2011 Published: January 16, 2012
doi:10.5539/ijbm.v7n1p137 URL: http://dx.doi.org/10.5539/ijbm.v7n1p137

The study is one of research achievements of "China petroleum and petrochemical industry M & A performance study"(2011YYS083), which is financed by Basal Research Fund of central universities' basic research operating expenses of China University of Geosciences (Beijing)

Abstract

In this paper, authors select 13 listed companies in the petroleum industry, and make an empirical analysis of their financial indexes in the year 2009 by SPSS, according to the factor analysis method in multivariate statistical analysis. Authors further establish a model that reflects composite scores of companies based on financial data, rank these companies according to their overall competitiveness, and analyze and evaluate their business performances.

Keywords: Factor analysis, SPSS, Empirical research, Performance evaluation

1. Introduction

Since the year 2010, the overall petroleum industry in China operates well. Economic growth turns into stable development from rapid growth. In first three quarters, the output of main products is in a continued and fast growth, market supply and demand are basically stable, the rise of price of product is steady and tends to be slow, and foreign trade makes great progresses. However, because of rising prices of raw materials, growing industrial costs, and more uncertainties in the process of world economic recovery, the export of petroleum industry may face more severe and complicated situations. In the petroleum industry, large enterprises, especially listed companies occupy an important position undoubtedly in the industry. In this context, the performance evaluation of listed companies of this industry is particularly important. In general, for the evaluation of profit-maximizing enterprises, the most scientific and objective way is to start from the perspective of finance. In this paper, authors use the factor analysis method to evaluate the performance of 13 listed petroleum companies according to the financial indicators. All raw data are from Dongxing Securities and Exchange software in the year 2009.

2. The establishment of indicators for evaluation and analysis

Financial analysis indicators can convey financial information and explain fianncial activities and results by means of concise forms and data.

2.1 Indicator of growth

To analyze the growth of listed companies is to observe the business development in certain period. The base for the growth of stock limited companies is the profitability. The fundamental goal is to maximize the value of shareholders.

2.2 Indicator of profitability

Profitability is the company's ability to earn profits. It is the joint reflection of companies' financial structure and business performance. The purpose of company is to pursue profits and ensure the continued growth and development of business.

2.3 Indicator of business efficiency

We usually use the turnover rate to measure and evaluate the business efficiency. The faster the turnover of asset is, the higher the efficiency is, and the greater the profits are.

2.4 Indicator of solvency

Solvency is the company's capability of repaying long-term and short-term debts using the assets. Whether a company is capable of paying cash and solvency is the key for its healthy survival and development. Business solvency is an important indicator reflecting the financial conditions and business operation.

Based on the four-financial-indicator system, in ths paper authors select 13 listed companies to collect necessary financial indicators and analyze the performances(see Table 1).

3. Data processing

In this paper, authors use factor analysis to process data. The factor analysis is a technique to simplify data (Qian Liu & Guozhen Lan, 2008, p130, 105). By studying the inner dependent relationship of many variables, it probes into the basic structure of observing data and uses several hypothetical variables to represent the basic data structure. The several hypothetical variables can reflect the dominant information of oringinal data. Original variables are observable explicit variables and the hypothetical variables are unobservable implicit variables, called factors (Yifan Xia, 2009). In this paper, authors hope to use factor analysis to process the 13 original financial indicators (explicit variables) and find the implicit variables, comprehensively evaluating the performance of listed companies. The SPSS helps to make factor analysis in this paper.

The original data of financial indicators of 13 listed companies in petroleum industry are in Table 2.

In order to make factor analysis by SPSS, we shoulf firstly perform KMO and Barlett Test of Sphericity. Results show that the selected indicators are suitable for factor analysis. Make orthogonal rotation by variance maximum. The eigenvalue and contribution rate are in Table 3.

The lowest standard for variance analysis is usually that the accumulated contribution rate reaches 80% (Ping Chen, 2008). Table 3 shows that the accumulated rate of the four factors is above 80%, reaching 91.535%, meeting the requirements for the number of factors and contribution rate. Therefore, the four common factors can describe these indicators better. Here, use F_1, F_2, F_3, and F_4 to represent the dominant factors.

In order to show the contribution rate of each indicator of every factor more clearly, this paper adopts the variance maximum (Varimax) rotation, so that the absolute values of factor loadings are in polarization from 1 to 0 by columns, and get the factor loading matrix after the rotation. See the Table 4.

According to the Table 3, considering the principle of contribution rate ≥ 65% (Libin Wang, 2010), the value of F_1 is larger in X_8, X_9, X_{12}, X_{13}, the value of F_2 is larger in X_1, X_4, X_5, X_6, the value of F_3 is larger in X_7, X_{10}, X_{11}, and the value of F_4 is larger in X_2 and X_3.

Indicators closely related with F_1 are about the solvency. So here, we define F_1 as the operating risk factor. Indicators closedly related with F_2 are about the profitability. So here, we define F_2 as the revenue-generating factor. Indicators closedly related with F_3 are about the growth of corporate assets. So here, we define F_3 as the business efficiency factor. F_4 determines the rise of corporate earnings. So here, we define F_4 as the growth factor.

In order to evaluate the performance of 13 listed companies, we need to calculate the score of each factor and get the composite score according to the weight. First, we can get the dominant compoment score coefficient matrix

according to the factor-loading matrix (see Table 5).

The estimation method is the first column divided by the square root of the first factor variance contribution, the second column divided by the square root of the second factor variance contribution, and so on. Then, the formula for calculating the scores of the four dominant component factors is:

$$\begin{aligned} Z_1 &= 0.04x_1 + 0.051x_2 - 0.17x_3 - 0.16x_4 + 0.064x_5 \\ &+ 0.0351x_6 + 0.027x_7 + 0.115x_8 + 0.27x_9 + 0.017x_{10} \\ &- 0.175x_{11} + 0.274x_{12} + 0.264x_{13} \end{aligned} \tag{1}$$

$$\begin{aligned} Z_2 &= 0.251x_1 + 0.063x_2 + 0.073x_3 + 0.256x_4 + 0.245x_5 \\ &+ 0.254x_6 + 0.018x_7 - 0.006x_8 - 0.029x_9 + 0.22x_{10} \\ &- 0.11x_{11} + 0.028x_{12} + 0.032x_{13} \end{aligned} \tag{2}$$

$$\begin{aligned} Z_3 &= 0.05x_1 + 0.1x_2 + 0.285x_3 + 0.083x_4 - 0.182x_5 \\ &- 0.0098x_6 + 0.392x_7 - 0.084x_8 + 0.057x_9 - 0.461x_{10} \\ &+ 0.112x_{11} + 0.004x_{12} - 0.033x_{13} \end{aligned} \tag{3}$$

$$\begin{aligned} Z_4 &= -0.032x_1 - 0.409x_2 + 0.398x_3 + 0.082x_4 + 0.068x_5 \\ &- 0.011x_6 + 0.073x_7 + 0.265x_8 - 0.277x_9 + 0.165x_{10} \\ &- 0.251x_{11} - 0.095x_{12} - 0.033x_{13} \end{aligned} \tag{4}$$

Integrate these formulas and get:

$$Z = 0.41139Z_1 + 0.24326Z_2 + 0.14095Z_3 + 0.11975Z_4 \tag{5}$$

According to the formula above, get the score of each factor and the overall factor score (in Table 6).

4. Performance evaluation

Sort these listed companies into three types according to the overall factor score and the score of each factor.

The first type includes Guangju Energy, Taishan Petroleum, Maohua Shihua, Yueyang Xingchang, and Huaiyou Stock. These listed companies have better indicators and performances. However, some of them rank behind due to the score of one factor. These listed companies need to imrove these indicators in the future development.

The second type includes Oriental Energy, Jereh Stock, Guochuang Hi-tech, and Sinopec. These companies rank middle with ordinary performances. They should focus on an overall improvement in the future development.

The third type includes Lurun Stock, Sinopec Shanghai, China Oilfield Services, and China National Petroleum. These listed companies rank behind for most of their factors. Only for few factors, they rank forward. These companies need to improve most of indicators in the future operation.

Take the Guangju Energy for example. The company ranks No.1 because of the highest score of overall factor. For the high scores of operating risk factor and business efficiency factor, it ranks the top. However, for the low scores of revenue-generating factor and growth factor, it ranks the bottom. It means the profitability and development of the company are not in a good state, though it has lower operating risks and higher business efficiency. Therefore, the company should pursue an overall development by developing the advantages and avoiding disadvantages in the future.

According to the analyses above, except for the overall factor since it does not count, the 13 listed companies rank high or low for the scores of the four dominant component factors. No company is totally good or bad. It means the overall performance of listed companies in petroleum industry is good. However, considering the differences of actual situations in every company, the performances are various.

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Table 1. The system of indicators of performance evaluation

Indicator of growth	Indicator of profitability	Indicator of business efficiency	Indicator of solvency
Growth rate of shareholders equity (X_1)	Rate of return on common stockholders' equity (X_4)	Turnover rate of asset (X_7)	Debt asset ratio (X_{11})
Main business' increasing rate of income (X_2)	Net profit margin (X_5)	Inventory turnover (X_8)	Current ratio (X_{12})
Growth rate of net profit (X_3)	Earining per share (X_6)	Account payable turnover rate (X_9)	Quick ratio (X_{13})
		Total rate of expenses of operation, management, and finance (X_{10})	

Table 2. Original data of financial indicators

Listed company	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13
Guangju Energy	-5.55	-48.57	-14.71	6.77	12	0.21	0.53	44.46	81.47	10.14	10.27	4.19	4.05
Taishan Petroleum	-2.87	-0.58	-94.21	0.95	0.29	0.02	3.08	35.83	43541.35	4.08	3.73	11.3	8.16
Maohua Shihua	7.58	-28.3	1261.35	20.41	5.6	0.34	3.33	35.3	125.69	4.47	19.58	3.36	2.92
Yueyang Xingchang	2.85	-37.83	-47.88	11.61	4.43	0.26	2.23	29.4	350.85	5.1	16.38	4.05	3.6
Huaiyou Stock	-2.36	7.97	-49.07	3.17	3.91	0.11	0.45	15.24	3.05	15.02	47.84	1.03	0.99
Oriental Energy	7.4	43.96	47.83	6.7	1.61	0.17	1.79	13.85	36.72	2.79	59.61	1.15	0.92
Jereh Stock	74.56	54.86	104.38	52.8	26.39	2.09	1.41	3.41	7.08	6.6	34.07	2.35	1.67
Guochuang Hi-tech	10.22	0.97	19.25	21.56	5.72	0.44	1.18	6.67	3.4	6.63	70.76	1.24	0.98
Sinopec	14.27	-6.87	115.47	16.25	4.56	0.71	1.65	8.72	67.96	6.05	53.77	0.63	0.16
Lurun Stock	-12.6	12.02	111.86	5.74	0.99	0.08	1.4	9.61	40.43	2.23	69.27	0.77	0.56
Sinopec Shanghai	10.87	-14.24	125	10.18	3.02	0.22	1.77	7.5	135.89	5.89	48.65	0.63	0.15
China Oilfield Services	12.67	47.59	1.07	14.06	17.09	0.7	0.31	14.6	5.66	7.11	63.39	1.96	1.8
China National Petroleum	7.09	-4.97	-9.35	12.17	10.12	0.56	0.77	6.16	44.71	10.85	37.4	0.76	0.47

Table 3. The variance contribution and contribution rate of dominant component factor

Component	Variance contribution	Contribution rate (%)	Accumulated contribution rate (%)
1	5.348	41.139	41.139
2	3.162	24.326	65.465
3	1.832	14.095	79.560
4	1.557	11.975	91.535

Table 4. The factor-loading matrix after the rotation

	Component			
	1	2	3	4
Growth rate of shareholders equity (X_1)	-.064	.959	.076	-.162
Main business' increasing rate of income (X_2)	-.173	.433	.099	.765
Growth rate of net profit (X_3)	-.186	.148	.578	.667
Rate of return on common stockholders' equity (X_4)	-.160	.955	.142	.017
Net profit margin (X_5)	-.016	.892	-.347	-.011
Earining per share (X_6)	-.102	.973	-.040	-.146
Turnover rate of asset (X_7)	.412	-.061	.830	.278
Inventory turnover (X_8)	.657	-.273	-.014	.608
Account payable turnover rate (X_9)	.878	-.195	.207	-.257
Total rate of expenses of operation, management, and finance (X_{10})	-.091	.045	.876	.187
Debt asset ratio (X_{11})	-.773	-.101	.073	-.564
Current ratio (X_{12})	.980	-.079	.150	.055
Quick ratio (X_{13})	.968	-.086	.085	.152

Table 5. The dominant component factor score coefficient matrix.

	Component			
	1	2	3	4
Growth rate of shareholders equity	.040	.251	.050	-.032
Main business' increasing rate of income	.051	.063	.100	-.409
Growth rate of net profit (X_3)	-.170	.073	.285	.398
Rate of return on common stockholders' equity	-.016	.256	.083	.082
Net profit margin	.064	.245	-.182	.068
Earining per share	.035	.254	-.009	-.011
Turnover rate of asset	.027	.018	.392	.073
Inventory turnover	.115	-.006	-.084	.265
Account payable turnover rate	.270	-.029	.057	-.277
Total rate of expenses of operation, management, and finance	.017	.022	-.461	.165
Debt asset ratio	-.175	-.100	.112	-.251
Current ratio	.274	.028	.004	-.095
Quick ratio	.264	.032	-.034	-.033

Table 6. The factor score and the ranking of performances

Listed company	Z_1	Rank	Z_2	Rank	Z_3	Rank	Z_4	Rank	Z	Rank
Guangju Energy	11780.91	1	-1269.879	13	2451.3338	1	-12089.91	13	3435.3868	1
Taishan Petroleum	-179.099	13	93.41254	1	363.25646	2	485.58899	1	58.394219	2
Maohua Shihua	103.8821	2	-12.64774	12	0.649	10	-95.42966	12	28.323159	3
Yueyang Xingchang	-13.4705	11	46.96073	2	39.91861	6	14.1252	4	13.200067	4
Huaiyou Stock	7.89585	5	5.69118	5	45.57832	3	9.4351	5	12.186828	5
Oriental Energy	28.18516	3	-3.97718	10	-13.49592	12	3.37401	6	9.1293919	6
Jereh Stock	-9.04827	9	9.82121	3	40.4662	5	20.9882	2	6.8837876	7
Guochuang Hi-tech	8.86485	4	1.73642	8	-2.13714	11	-18.61643	8	1.5387648	8
Sinopec	-3.86221	8	3.31756	7	25.65387	7	-19.53498	9	0.4947542	9
Lurun Stock	-18.5977	12	-0.5406	9	41.50994	4	14.88243	3	-0.149429	10
Sinopec Shanghai	-3.09928	7	7.9044	4	6.7341	9	-29.79608	11	-1.971098	11
China Oilfield Services	-12.7326	10	4.08266	6	11.77514	8	-6.81529	7	-3.401346	12
China National Petroleum	3.87251	6	-6.43978	11	-16.28104	13	-28.62292	10	-5.695836	13