

Research Article

Empirical Research on the Competitiveness of Listed Companies in Food Industry

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Abstract: In market-oriented economy, the competitiveness decides the success of the enterprise. To capture the market, companies must have strong competitive edge. Different industries have their own characteristics, the investigation for enterprise competitiveness is also different. This paper studies on the evaluation of the competitiveness in food industry and discusses the evaluation methods and index system. This study is with a significant value on both theoretical and practical application. Based on the composition of enterprises competitiveness, this study establishes a food enterprise competitiveness evaluation index system. Then 79 listed companies from Shanghai stock exchange and Shenzhen stock exchange are chosen as research subjects. The comprehensive evaluation of the food enterprises' competitiveness from 2011 to 2013 is calculated by using factor analysis. Finally, combined with the analysis above, some suggestions are presented to improve the competitiveness of the food listed companies in China.

Keywords: Competitiveness, evaluation index system, factor analysis, food industry

INTRODUCTION

Enterprise competitiveness in the food industry is a comprehensive concept. It refers to the food enterprises' ability to provide consumers with high quality products and achieve their enterprise value based on the available resources and capabilities. Food enterprises have a broad business scope and complex business environment. Food listed companies not only have the general characteristics to provide products that meet people's demand for food, but also have the characteristics of the food industry (Tang and Xu, 2011). The quality of their products directly affect people's health, so to evaluate the competitiveness of the food companies cannot be limited to corporate resources and management ability. Competitiveness of food enterprise should be comprehensive studied from different perspectives (Ping *et al.*, 2013).

Porter proposed the market structure theory, he believed that the study of enterprise competitiveness should begin in the competitive environment of the industry. The key to improve their own competitiveness lies in how to formulate competitive strategies and how to implement effectively. In Porter's Five Forces Model, there are five competitive forces affecting the developing of enterprises. Porter argued that companies can adopt different strategies to reduce the negative impact of the five competitive forces. He proposed three basic strategies: Overall Cost Leadership, Differentiation and Focus. Prahalad and Hamel (1990) is the founder of the enterprise core competence theory. They believed that the competitive advantage is derived

from the company's core competence. The core competitiveness of enterprises is the comprehensive ability to use resources and capabilities throughout the organization. It is difficult to be imitated, so it can improve the sustainable competitiveness of enterprises. Scholars studying transnational management theory thought that competitive advantage comes mainly from transnational investment. John H. Dunning, Peter J. Buckley and Mark Casson were concerned about enterprise transnational investment and elaborated on the competitive advantage of multinationals' internal transaction (Dunning and McQueen, 1982).

So far, the theoretical study of corporate competitiveness has not formed a complete system in China. Domestic scholars were interested in the study of competitiveness and summarized a series of representative conclusions. For the concept of enterprise competitiveness, there is no uniform definition at present. According to the available literature, several typical definitions are listed below. Xiaoping (1999) proposed that enterprise competitiveness is the capability to compete for market share, expand production scale, cope with the challenges, etc., Lihong (2000) hold that the main factors that affect the enterprise competitiveness are resources, capabilities and environment. Bei (2003) pointed out that the competitiveness of enterprises refers to provide products or services continuously and gain advantage effectively to develop their own capabilities in the competitive market environment. There are several typical enterprise competitiveness evaluation index systems. The enterprise

competitiveness evaluation index system designed by Jin Bei includes two aspects. On the one hand, the measurement index describes the condition of the competitiveness. On the other hand, the analysis index reflect the actual strength specifically. Based on the characteristics of enterprise competitiveness, Hu (2003) established the index system to reflect the company's competitive advantage and potential advantages. He tried to make specific and comprehensive assessment of competitiveness of enterprise. Jinchang (2002) established the index system on the basis of corporate profitability and measured the strength of the enterprise competitiveness by using quantitative methods. Youjun *et al.* (2002) and other scholars design the index system to reflect the survival and development of the company by using analytic hierarchy process. They divided the enterprise competitiveness into four aspects, the basic elements, the evaluation elements, the index and the operation. Xiao *et al.* (2002) established multi-index system after analyzing the company's economic capacity, human capital capacity, technology development capability, information resources application capability, technological innovation capability and solvency.

Based on the characteristics of the food industry, this paper established the food industry competitiveness evaluation system and tried to analysis the specific indicators' explanatory power of food enterprise competitiveness. Factor analysis is carried out to evaluate the competitiveness of listed companies in food industry.

PRINCIPLE AND METHODS

Factor analysis is a multivariate analysis method using dimensionality reduction. In the field of psychology, some individual mental abilities often cannot be measured directly, they can only be measured by some external behavior. Researchers attempted to find the common factor to represent the mental capacity from the measurable overt behavior (variable). Therefore, factor analysis is a mathematical model using a few factors to explain the relationship between the relevant variables. It uses the correlation coefficient between the variables to identify potential common structure (factor) among a group of variables. With the development of computer technology and application of statistical software, factor analysis is not only a very effective tool in psychometrics and educational measurement, but also has been widely applied in sociology, economics, demographics and natural sciences fields (Song *et al.*, 2013).

Factor analysis is often used to evaluate the competitiveness of enterprises. Multiple indicator variables are replaced by several irrelevant indicators to reflect its interpretation capabilities. Its basic idea is based on mathematical calculations. The correlation matrix and covariance matrix of the variables are

analyzed to identify the structure of the sample data. Eventually, several unrelated comprehensive index are extracted to interpret the data. The extracted index are able to reflect the most information of the original index. The principal component analysis is a method commonly used to extract factors. From the process of factor analysis, the method is objectivity for the empowerment after mathematical calculations. Without human disturbance, the method is scientific. The common factors extracted can reflect indicators to a large extent and reduce the correlation between indicators. This method will help enterprises find the key factors to enhance competitiveness and ensure the measurement of the enterprise competitiveness.

The principle of factor analysis: Assuming the sample size is n , the original variables are X_1, X_2, \dots, X_n and the original variables can be classified as a series of common factors (F_1, F_2, \dots, F_p). The factor model is usually presented the form of the following equation:

$$\begin{cases} x_1 = a_{11}F_1 + a_{12}F_2 + \dots + a_{1p}F_p + \varepsilon_1 \\ x_2 = a_{21}F_1 + a_{22}F_2 + \dots + a_{2p}F_p + \varepsilon_2 \\ \dots \\ x_m = a_{m1}F_1 + a_{m2}F_2 + \dots + a_{mp}F_p + \varepsilon_m \end{cases} \quad (1)$$

where, $\varepsilon_1, \varepsilon_2, \dots, \varepsilon_p$ is specific factor, which means that apart from the common factors, the original variables are also affected by other factors. The matrix composed by all the coefficient called factor loading matrix. The matrix composed by all factors in the factor model above called factor loading matrix:

$$A = (a_{ij})_{m \times p} = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1p} \\ a_{21} & a_{22} & \dots & a_{2p} \\ \dots & \dots & \dots & \dots \\ a_{m1} & a_{m2} & \dots & a_{mp} \end{bmatrix}$$

From the rows of the factor loading matrix, the elements in the row i are the coefficients of the i^{th} expression, which reflect the i^{th} variable's dependence on the common factors (F_1, F_2, \dots, F_p). From the column of the factor loading matrix, the elements in the column j are the coefficients of the j^{th} common factor, which reflect the j^{th} common factor's importance for each variable. The greater the coefficient is, indicating the more important to explain the role of the corresponding variable. In fact, a_{ij} is the correlation coefficient of the i^{th} variable and the j^{th} common factor.

Significance of several importance concepts in statistics:

Load factor: The expression of factor loading matrix reflects the correlation coefficient between the i^{th} variable and the j^{th} common factors. The statistical

significance is the i^{th} variable's load on the i^{th} common factors and also reflects the relative importance of the i^{th} variable on the j^{th} common factor.

Commonality of variables: The commonality of variables refers to the sum of squares of the elements in the i^{th} row in the factor loading matrix. The formula is as follows:

$$h_i^2 = \sum_{j=1}^m a_{ij}^2 \quad i = 1, \dots, p$$

The commonality of variables reflects the common factor's contribution to the variable x_i . The value of the commonality of variables is between 0~1. If the commonality of variables is close to 0, it means that the common factors have a weak effect on variables and there are some special factors affecting the variables. If the commonality of variables is close to 1, it shows that the extracted common factors can reflect most of the information the variable contains.

Variance contribution of common factors: The variance contribution of common factors refers to the sum of squares of elements in each column in the factor loading matrix. The formula is as follows:

$$S_j = \sum_{i=1}^p a_{ij}^2 \quad j = 1, \dots, m$$

The formula represents the sum of the common factor's variance contribution for all variables, which can measure the relative importance of the common factors.

Factor rotation: When the structure of the loading matrix is not clear, it is not conducive to explain the common factors. Therefore, to interpret common factors, factors need to be rotated to simplify the structure of factor loading matrix. The frequently used conversion method of factor loading matrix is factor axis rotation. Load of each variable is concentrated on a common factor and the load of the other factor is small. At present, there are many rotation method used, such as orthogonal rotation, oblique rotation and so on.

Factor score: The mathematical process of factor analysis is to express the variables as common factor. In practical applications, the common factor represents the original variables, which is expressed as the linear combination of variables. The formula is listed below:

$$F_j = \beta_{j1}X_1 + \dots + \beta_{jp}X_p \quad j = 1, \dots, m$$

The above formula is the expression of factor score, which is used to calculate the factor score of each sample. There are many ways used to estimate the factor score, such as weighted least squares method and regression method.

Comprehensive evaluation model: This study evaluate the competitiveness of listed companies in food industry through the establishment of comprehensive evaluation index and common factor analysis indicators. The common factor analysis indicators are explained by specific scores of each common factor. Each sample date's specific value on each factor is the factor score. The factor's influence on the sample is judged by scores. In the evaluation of competitiveness, the enterprise competitiveness in the industry is often measured by factor score. The method to estimate the coefficients of factor score model is linear regression, as well as Bartlette method anderson-Rubin method and some other methods (Xin *et al.*, 2010). Based on the above analysis, this paper constructs a comprehensive index evaluation model, the formula is as follows:

$$F = \frac{\lambda_1}{\sum_{m=1}^p \lambda_m} F_1 + \frac{\lambda_2}{\sum_{m=1}^p \lambda_m} F_2 + \dots + \frac{\lambda_p}{\sum_{m=1}^p \lambda_m} F_p$$

EXAMPLE AND RESULT ANALYSIS

Sample selection and data sources: This study selected listed companies in food industry from Shanghai stock exchange and Shenzhen stock exchange, calculate indicators and evaluate the competitiveness of 79 listed companies from 2011 to 2013.

Index selection: To calculate the competitiveness of the listed companies in food industry, this study selected 18 financial indicators: receivables turnover ratio (X_1), inventory turnover ratio (X_2), current asset turnover ratio (X_3), fixed asset turnover ratio (X_4), total asset turnover ratio (X_5), current ratio (X_6), quick ratio (X_7), debt asset ratio (X_8), ROA (X_9), ROE (X_{10}), operating profit ratio (X_{11}), EPS (X_{12}), total assets growth rate (X_{13}), net profit growth rate (X_{14}), revenue growth rate (X_{15}), total assets (X_{16}), operating income (X_{17}), total profit (X_{18}). The financial indicators are shown in the Table 1.

Factor analysis: Use SPSS19.0 to calculate the competitiveness of listed companies in food industry. According to the Table 2, the KMO is 0.676, which illustrate the correlation between indicators. Bartlett's test value is 4000.283 (Sig. = 0.000), it get through the significant inspection.

Factor analysis uses principal component analysis to extract factor variables, select factors with eigenvalues greater than 1 as the final main ingredient. The results are shown in the Table 3 (Fig. 1).

From the factor analysis, five factors explained 74.462% of the variance among the 18 variables. After extracting the first five factors as the common factor,

Table 1: Description of index

Index type	Symbol	Index name
Operational capacity	X ₁	Receivables turnover ratio
	X ₂	Inventory turnover ratio
	X ₃	Current asset turnover ratio
	X ₄	Fixed asset turnover ratio
Debt-paying ability	X ₅	Total asset turnover ratio
	X ₆	Current ratio
	X ₇	Quick ratio
Profitability	X ₈	Debt asset ratio
	X ₉	ROA
	X ₁₀	ROE
	X ₁₁	Operating profit ratio
Development capability	X ₁₂	EPS
	X ₁₃	Total assets growth rate
	X ₁₄	Net profit growth rate
Scale capacity	X ₁₅	Revenue growth rate
	X ₁₆	Total assets
	X ₁₇	Operating income
	X ₁₈	Total profit

Table 2: KMO and Bartlett's test

Kaiser-Meyer-Olkin measure of sampling adequacy		0.676
Bartlett's test of Sphericity	Approx. chi-square	4000.283
	df	153
	Sig.	0.000

Table 3: Total variance explained

	Initial eigen values			Extraction sums of squared loadings		
	Total	Variance (%)	Cumulative (%)	Total	Variance (%)	Cumulative (%)
1	4.592	25.511	25.511	4.592	25.511	25.511
2	3.905	21.696	47.207	3.905	21.696	47.207
3	2.224	12.354	59.561	2.224	12.354	59.561
4	1.483	8.241	67.801	1.483	8.241	67.801
5	1.199	6.661	74.462	1.199	6.661	74.462
6	0.990	5.501	79.963			
7	0.771	4.281	84.244			
8	0.709	3.939	88.184			
9	0.576	3.201	91.385			
10	0.490	2.723	94.108			
11	0.354	1.968	96.076			
12	0.252	1.400	97.476			
13	0.188	1.042	98.518			
14	0.112	0.620	99.138			
15	0.074	0.413	99.551			
16	0.033	0.182	99.733			
17	0.031	0.170	99.904			
18	0.017	0.096	100.000			

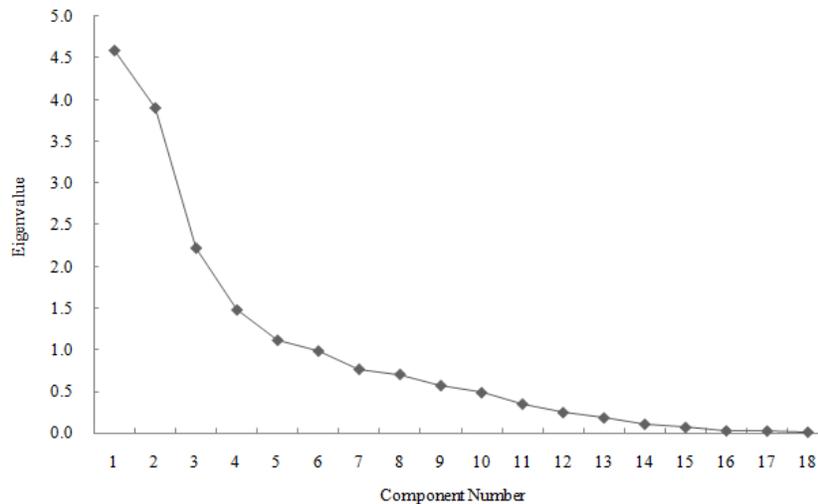


Fig. 1: Scree plot

Table 4: Component matrix^a

	Component				
	1	2	3	4	5
X ₁	0.514	-0.233	-0.304	-0.303	-0.007
X ₂	0.216	0.766	0.374	-0.111	-0.069
X ₃	0.331	0.841	0.251	-0.097	-0.088
X ₄	0.481	0.520	0.357	0.039	-0.040
X ₅	0.381	0.818	0.303	-0.063	-0.128
X ₆	-0.032	-0.555	0.704	-0.355	0.116
X ₇	-0.018	-0.524	0.715	-0.364	0.122
X ₈	-0.198	0.527	-0.553	0.040	0.076
X ₉	0.760	-0.260	0.067	0.337	-0.195
X ₁₀	0.306	-0.132	0.211	0.480	-0.494
X ₁₁	0.641	-0.534	0.184	0.361	-0.179
X ₁₂	0.833	-0.342	-0.229	-0.118	-0.023
X ₁₃	0.385	0.050	0.215	0.464	0.483
X ₁₄	-0.012	-0.048	0.053	0.201	-0.096
X ₁₅	0.109	0.036	0.100	0.435	0.715
X ₁₆	0.787	-0.044	-0.336	-0.280	0.148
X ₁₇	0.705	0.428	0.014	-0.196	0.201
X ₁₈	0.838	-0.279	-0.300	-0.232	0.055

Extraction method: Principal component analysis; a: 5 components extracted

Table 5: Rotated component matrix^a

	Component				
	1	2	3	4	5
X ₁	0.696	-0.072	0.014	-0.023	-0.110
X ₂	-0.124	0.875	-0.042	-0.089	-0.005
X ₃	-0.006	0.928	-0.175	-0.067	-0.006
X ₄	0.114	0.758	0.038	0.147	0.146
X ₅	0.005	0.953	-0.133	0.010	-0.003
X ₆	-0.028	-0.122	0.961	-0.073	-0.006
X ₇	-0.025	-0.087	0.958	-0.083	-0.002
X ₈	-0.090	0.088	-0.723	-0.300	-0.030
X ₉	0.535	0.112	0.108	0.677	0.182
X ₁₀	0.002	0.110	0.057	0.782	-0.054
X ₁₁	0.454	-0.108	0.324	0.729	0.197
X ₁₂	0.894	-0.018	0.087	0.262	0.049
X ₁₃	0.109	0.176	0.049	0.203	0.748
X ₁₄	-0.054	-0.078	-0.094	0.192	0.018
X ₁₅	-0.041	-0.019	-0.028	-0.059	0.847
X ₁₆	0.891	0.153	-0.084	-0.053	0.082
X ₁₇	0.550	0.628	-0.075	-0.109	0.211
X ₁₈	0.954	0.008	0.044	0.114	0.044

Extraction method: Principal component analysis; Rotation method: Varimax with Kaiser normalization; a: Rotation converged in 5 iterations

the scree plot is generated according to the calculated characteristic roots. The scree plot showed that the characteristic roots of the five factors are greater than 1.

In the Table 4, the structure of loading matrix is not clear and interpretation of the factors is not conducive. Therefore, the factor loading matrix is rotated by varimax orthogonal rotation method.

Use orthogonal solution to get the five factors as follows:

$$F_1 = 0.696X_1 - 0.124X_2 - 0.006X_3 + 0.114X_4 + 0.005X_5 - 0.028X_6 - 0.025X_7 - 0.090X_8 + 0.535X_9 + 0.002X_{10} + 0.454X_{11} + 0.894X_{12} + 0.109X_{13} - 0.054X_{14} - 0.041X_{15} + 0.891X_{16} + 0.550X_{17} + 0.954X_{18}$$

$$F_2 = 0.072X_1 + 0.875X_2 + 0.928X_3 + 0.758X_4 + 0.953X_5 - 0.122X_6 - 0.087X_7 + 0.088X_8 + 0.112X_9 + 0.110X_{10} - 0.108X_{11} - 0.018X_{12} + 0.176X_{13} - 0.078X_{14} - 0.019X_{15} + 0.153X_{16} + 0.628X_{17} + 0.008X_{18}$$

$$F_3 = 0.014X_1 - 0.042X_2 - 0.175X_3 + 0.038X_4 - 0.133X_5 + 0.961X_6 + 0.958X_7 - 0.723X_8 + 0.108X_9 + 0.057X_{10} + 0.324X_{11} + 0.087X_{12} + 0.049X_{13} - 0.094X_{14} - 0.028X_{15} - 0.084X_{16} - 0.075X_{17} + 0.044X_{18}$$

$$F_4 = -0.023X_1 - 0.089X_2 - 0.067X_3 + 0.147X_4 + 0.010X_5 - 0.073X_6 - 0.083X_7 - 0.300X_8 + 0.677X_9 + 0.782X_{10} + 0.729X_{11} + 0.262X_{12} + 0.203X_{13} + 0.192X_{14} - 0.059X_{15} - 0.053X_{16} - 0.109X_{17} + 0.114X_{18}$$

$$F_5 = -0.110X_1 - 0.005X_2 - 0.006X_3 + 0.146X_4 - 0.003X_5 - 0.006X_6 - 0.002X_7 - 0.030X_8 + 0.182X_9 - 0.054X_{10} + 0.197X_{11} + 0.049X_{12} + 0.748X_{13} + 0.018X_{14} + 0.847X_{15} + 0.082X_{16} + 0.211X_{17} + 0.044X_{18}$$

According to the Table 5, the first characteristic factor's positive load is larger on total profit (X₁₈), EPS (X₁₂), total assets (X₁₆), receivables turnover ratio (X₁), which indicate that the first factor represents the company's scale capacity. The positive load of second characteristic factor is larger on total asset turnover ratio (X₅), current asset turnover ratio (X₃), inventory turnover ratio (X₂), fixed asset turnover ratio (X₄), operating income (X₁₇), indicating that the second factor represents the company's operational capacity. The third characteristic factor's load on current ratio (X₆), quick ratio (X₇), debt asset ratio (X₈) is large, which means that the third factor represent the company's debt-paying ability. For the fourth characteristic factor, ROE (X₁₀), operating profit ratio (X₁₁), ROA (X₉), net profit growth rate (X₁₄) is larger, indicating that the fourth factor represent the profitability of the company. The revenue growth rate (X₁₅) and total assets growth rate (X₁₃) have more than 70% of the load on the fifth common factor, indicating that the fifth factor represent development capability of listed companies in food industry.

After rotation, the variance contribution of common factors changed. According to the Table 6, the comprehensive score model can be established:

$$F = (21.317\% F_1 + 20.207\% F_2 + 14.276\% F_3 + 10.651\% F_4 + 8.011\% F_5) / 74.462\%$$

Based on comprehensive evaluation scores, each enterprise competitiveness can be ranked. In the Table 7, the results show that in 79 listed companies in 2013, keichow moutai (600519) ranks first, the second is new hope group (000876), the third is Yili (600887) and the fourth place is wuliangye (000858). Compared keichow moutai with new hope group, keichow moutai

Table 6: Contribution after rotation

	Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	Variance (%)	Cumulative (%)	Total	Variance (%)	Cumulative (%)
1	4.592	25.511	25.511	3.837	21.317	21.317
2	3.905	21.696	47.207	3.637	20.207	41.524
3	2.224	12.354	59.561	2.570	14.276	55.800
4	1.483	8.241	67.801	1.917	10.651	66.451
5	1.199	6.661	74.462	1.442	8.011	74.462

Table 7: Enterprises factor ranking

Stock code	F ₁	F ₂	F ₃	F ₄	F ₅	F
600519	1	4	3	5	3	1
000876	2	1	1	1	1	2
600887	4	2	2	2	2	3
000858	3	5	4	6	5	4
000895	5	3	5	3	4	5
600600	6	6	6	4	6	6
002304	7	7	7	8	7	7
000729	8	11	8	7	8	8
600597	11	9	9	9	9	9
000568	9	15	15	19	14	10

plays well in scale capacity, while new hope group plays well in its operational capacity, debt-paying ability, profitability and development capability. In summary, imbalance exists in the development of every enterprises. Companies need to avoid weakness for sustainable development.

- There are five main factors that determine the competitiveness of the food industry: scale capacity, operational capacity, debt-paying ability, profitability and development capability. Companies in food industry should improve these factors to enhance their competitiveness.

CONCLUSION

The companies in food industry are related to China's national economic development and affect the development of China's economic growth. In recent years, the number of domestic food enterprises to enter the international market gradually increased. Compared with the competitiveness of international leading companies, there still exists a big gap. Domestic food companies need improve their competitiveness constantly. Based on the food industry characteristics, the purpose of this paper is to establish indicators and methods to evaluate the competitiveness and provide guidance to enhance the competitiveness of food industry.

This paper is based on the theory of enterprises competitiveness and competitiveness evaluation and quantitative analysis method is used in the study. The result shows that:

- Receivables turnover ratio, inventory turnover ratio, current asset turnover ratio, fixed asset turnover ratio, total asset turnover ratio, current ratio, quick ratio, debt asset ratio, ROA, ROE, operating profit ratio, EPS, total assets growth rate, net profit growth rate, revenue growth rate, total assets, operating income and total profit constitute the factor combination which largely determines the enterprise competitiveness in the food industry. These factors are crucial to improve the competitiveness of enterprises in the food industry.

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