

Research on the Investment Value of National Economy Stocks based on Factor Analysis

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Abstract. Scientific and technological innovation is a hot topic today, and companies on the STAR Board also have good performance and development prospects in the market. Many investors regard STAR Board stocks as key investment modules. This paper analyzes the factors influencing the investment value of the stocks of STAR Board enterprises listed from June to December 2021 in the first half of 2022. In this paper, nine indicators are selected to describe the market condition of each enterprise and the factors are narrowed down to four principal factors by factor analysis. Combined with the actual data analysis of the performance of each STAR Board enterprises in these four principal factors, score it to analyze the advantages and weaknesses of the corresponding enterprises of each stock, so as to provide investment reference for investors with investment needs. The dimension reduction and transformation function in SPSS are mainly utilized in entire research.

Keywords: Factor analysis, stock, investment value.

1. Introduction

The stock market is often seen as a microcosm of the macroeconomy, representing the current state of development of the corresponding industry. This field involves not only the participation of the securities trading industry, but also thousands of investors and shareholders. The STAR Board is a new sector independent of the existing Main Board market, focusing on leading enterprises in China's technological innovation and development, with significant long-term investment value. With the implementation of the strategy of rejuvenating the country through science and education, the enterprises on the science and technology innovation board have received strong support from the government, and most of them have achieved good business performance, which has driven the further development of the enterprises. In general, the successful practice of the STAR Board in recent years has driven the stocks of the STAR Board to attract the attention of shareholders. In order to allow investors to have a clearer understanding of the investment risks of stocks, avoid possible risks, form accurate investment judgments, and allow listed companies to judge the stock price level and then make pricing decisions, this paper will use factor analysis to construct a stock investment value evaluation system.

Many scholars have studied topics related to the value of stock investment in the past, and it can be seen that the value of stock investment is affected by many factors. There are many scholars who have continuously improved the model of stock pricing and built a model that is in line with the stock market. Fama and French combined and concluded that market returns, market capitalization and book-to-book ratio can be affected by market returns, stock market capitalization, book capitalization ratio, leverage ratio, and price-to-earnings ratio. In turn, they came up with the famous three-factor model of stock pricing [1]. Tian and Wang pointed out that trading volume plays a significant role in explaining stock returns. They believe that trading volume needs to be studied as a risk-pricing factor for yields, and that the current return of stocks is significantly correlated with historical trading volume. They examined the zero-investment strategy for turnover and turnover rate, constructed pricing factors, and constructed a five-factor model of stock pricing [2].

Miller and Modigliani proposed the MM theory, that is, the dividend independent theory, on the topic of dividends on firm value in stock price theory, arguing that the outcome of dividend decisions on corporate profits under strict ideal assumptions does not affect the value of enterprises [3]. However, these conditions are almost impossible to achieve in the real stock market, and since then,

many scholars have studied the impact of dividend policy from various angles, Niu believes that in the stock market, dividend policy also has a certain degree of impact on stock volatility. The dividend policy contains the fundamental information of the company, and the payment of cash dividends can play a role in stabilizing the stock price. Further urging listed companies to improve the investor return mechanism is beneficial to the healthy development of the A-share market [4].

It is known that STAR Board stocks are supported by policies, and we can see from the past literature that government actions also affect stock price fluctuations. Zhu explores the moderating role of economic policy uncertainty between equity structure and stock price collapse risk, and combines macroeconomic policy with micro-enterprise corporate governance to further enrich the economic consequences of economic policy uncertainty [5]. It concludes that economic policy uncertainty enhances the positive relationship between institutional investors and stock price crash risk. Baldacci Emanuele, Gupta Sanjeev, and Granados Carlos examined the impact of fiscal policy responses in developed and emerging markets to 118 systemic banking crises from 1980 to 2008 and found that equity markets were profoundly affected by policy support, reflected in their faster recovery [6]. Wang concretized it in combination with the latest policy situation, analyzed the impact of specific education policy applications on the stock prices of specific education and training institutions, believed that the "double reduction" policy did have a significant negative effect on New Oriental's stock price, and concretized the impact of the policy in macro analysis on the stock price of enterprises, and determined its correlation [7].

The stock price pricing of companies on the Star Market has its own characteristics. Dong analyzed that the stronger the scientific and technological innovation attribute, the higher the IPO price. The smaller the issuance, the greater the overvaluation; However, the P/E ratio of comparable companies and the reputation of underwriters have little impact on the pricing of new share offerings. Affected by the state's policy of vigorously supporting enterprise innovation, investors have a certain premium for companies with strong scientific and technological innovation attributes [8].

The science and technology innovation board are a concept that was only proposed in 2018 and has a shallow foundation in China's stock market. Guo and Zhang analyzed the current situation of the STAR Board market and believed that the STAR Market is still weak in its function of agglomeration and allocation of overseas financial resources. The lack of functional role of the STAR Board market caused by the imperfect institutional mechanism has led to prominent problems such as the unbalanced market structure of the existing STAR Board, the lack of significant policy effects, and the lack of risk management and control [9].

Enterprises on the Star Market have received policy support from equity incentives. Li analyzed the current situation and characteristics of equity incentives for enterprises on the STAR Board. It is believed that the equity incentive of enterprises on the STAR Board presents some new characteristics compared with the current A-share equity incentive plan, and the innovative equity incentive plan is more suitable for the development of enterprises on the STAR Board [10]. Zhang took the first batch of 25 stocks listed on the STAR Board as the research object, and used the conditional standard deviation fitted by the GARCH model as the measure of stock price volatility, constructed margin lending indicators to study the impact of margin trading on stock price fluctuations on the STAR Board, and found that margin trading on the STAR Board can reduce the volatility of stock prices, but the impact is small [11].

2. Method

2.1. Data Source

The purpose of this study is to analyze the investment value of 30 companies listed on the STAR Board from June to December 2021. The company's various capital statements can show their operating conditions, such as income statement, balance sheet, etc., and their investment prospects can be analyzed. Therefore, this article selects several types of indicators from these fund statements for financial analysis and discusses the investment value of stocks. After classification and screening,

this paper selects 9 financial indicators to construct the value evaluation system of listed companies on the STAR Board, as shown in Table 1.

Table 1. Index system for stock investment

Indicators	Indicator symbol
return on equity (ROE)	X ₁
net profit	X ₂
earnings per share (EPS)	X ₃
asset-liability ratio	X ₄
current ratio	X ₅
year-on-year growth rate of net profit	X ₆
growth rate of main business	X ₇
Book value Per Share (BPS)	X ₈
undistributed profit per share	X ₉

Using the data reported in the 2022 interim report, that is, a potential analysis of newly listed companies, the data is obtained from the Flush Data Center, as shown in Table 2.

Table 2. Data basis

	average value	standard deviation	maximum	minimum
ROE	2.910	4.834	14.029	-9.486
net profit	7.973E+07	1.514E+08	6.139E+08	-1.819E+08
EPS	0.538	0.850	3.600	-0.570
asset-liability ratio	25.104	20.006	73.971	2.591
current ratio	7.966	7.783	39.241	0.970
growth rate of net profit	27.676	250.666	1052.408	-771.502
growth rate of main business	24.458	45.652	117.751	-81.946
BPS	14.651	19.245	108.341	1.931
undistributed profit per share	1.825	2.081	8.084	-2.336

Due to the different orders of magnitude of capital circulation of each company, in order to make the data comparison more intuitive, the data of each indicator is dimensionless before data analysis, that is, the standardized processing of data:

$$X_j^* = \frac{X_j - \mu_j}{s_j} \quad (1)$$

Where μ_j, s_j is the sample mean and standard deviation of the j th indicator.

2.2. Factor Analysis

Factor analysis was first proposed by British psychologist C.E. Spearman, which is a statistical technique for extracting common factors from groups of variables. Factor analysis is suitable for multivariate statistical analysis, similar to principal component analysis, and is a generalization of principal component analysis. The principle of this method is to reduce the essentially same indicators into the same category, that is, become a factor, and reduce the number of indicators. Through the analysis of a few factors, the connections between multiple indicators can be described. This can not only maintain the integrity of the original information, but also the key factors can be extracted and the most important influencing factors can be quantitatively identified.

In the process of studying the value of stocks, this paper uses factor analysis to comprehensively analyze the potential of a stock. This paper classifies the influencing factors of each listed STAR Board stock, summarizes and analyzes the constraints affecting its value trend, and provides investors with a reference basis.

2.3. Statistical Tests

In this study, the correlation coefficients of each indicator are calculated before the formal analysis to get a general understanding of their situation. As can be seen from Table 3, there is indeed a correlation between these variables, so factor analysis can be performed.

Table 3. Relevance matrix

	X1	X2	X3	X4	X5	X6	X7	X8	X9
X1	1.000	0.816	0.603	-0.037	0.037	0.297	0.637	0.117	0.569
X2	0.816	1.000	0.648	0.085	-0.041	0.153	0.598	0.078	0.480
X3	0.603	0.648	1.000	-0.093	0.155	0.113	0.419	0.064	0.435
X4	-0.037	0.085	-0.093	1.000	-0.661	-0.257	0.111	-0.279	-0.042
X5	0.037	-0.041	0.155	-0.661	1.000	0.084	-0.279	0.342	0.122
X6	0.297	0.153	0.113	-0.257	0.084	1.000	0.443	0.071	-0.045
X7	0.637	0.598	0.419	0.111	-0.279	0.443	1.000	0.145	0.201
X8	0.117	0.078	0.064	-0.279	0.342	0.071	0.145	1.000	0.579
X9	0.569	0.480	0.435	-0.042	0.122	-0.045	0.201	0.579	1.000

To further test whether this data is suitable for factor analysis, KMO and Bartlett spherical tests are performed, and Table 4 shows the test results. The Bartlett test shows that the sig. is 0.000, which is less than 0.05, reject the assumption that each variable is independent. KMO test whether the partial correlation between the variables is large, the KMO value is greater than 0.7 indicates that the factor analysis effect is better, less than 0.5 indicates that it is not suitable for factor analysis, the KMO value of this question is 0.555, greater than 0.5, indicating that these data are suitable for factor analysis.

Table 4. KMO and Bartlett tests

KMO sampling relevance measure		0.555
Bartlett sphericity test	Approximate chi-square	128.278
	df	36
	Sig.	0.000

Table 5 shows the common factor variance, which indicates the extent to which the original information contained in the original nine variables was extracted to the common factor. This table shows that the common factors in the study data have strong explanatory power for each variable.

Table 5. Common factor variance

	initial	extract
ROE	1.000	0.838
Net profit	1.000	0.802
EPS	1.000	0.570
asset-liability ratio	1.000	0.800
current ratio	1.000	0.771
year-on-year growth rate of net profit	1.000	0.757
growth rate of main business	1.000	0.749
BPS	1.000	0.567
undistributed profit per share	1.000	0.830

3. Results and Discussion

3.1. Extraction of Principal Factors

The variance of the original indicator consists of two parts: the commonality of the variables and the variance of the special factors. The common factor variance (Table 6) shows that the commonality

of the nine indicators is between 0.567-0.838, indicating that 56.7%~83.8% of the indicators can be explained by common factors, the explanatory contribution of common factors is higher, and the loss information of each index is less.

Table 6. Total variance interpretation

factor	Initial eigenvalue			Rotate the sum of squares to load		
	total	variance %	cumulation %	total	variance %	cumulation %
1	3.373	37.474	37.474	3.329	36.988	36.988
2	2.012	22.354	59.828	2.044	22.709	59.698
3	1.3	14.44	74.268	1.311	14.57	74.268
4	0.958	10.644	84.911	1.428	15.869	84.911
5	0.406	4.509	89.421			
6	0.37	4.115	93.536			
7	0.316	3.513	97.049			
8	0.182	2.021	99.069			
9	0.084	0.931	100			

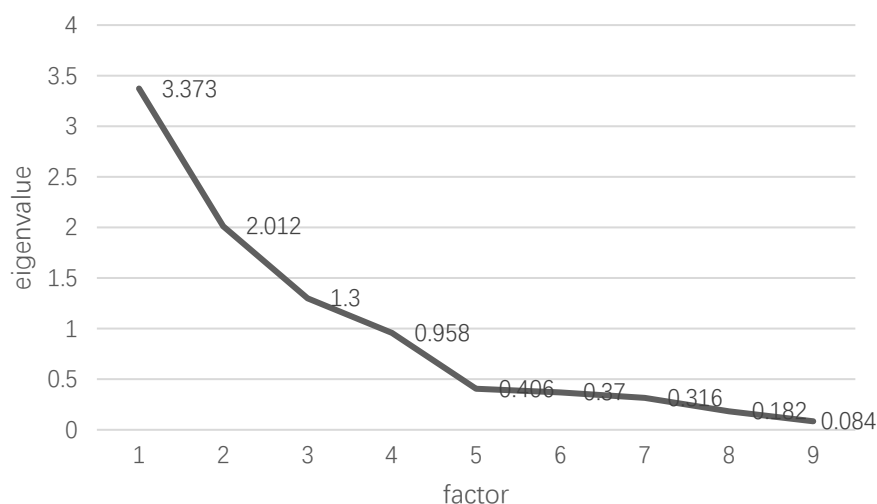


Figure 1. Gravel Map

Combined with the total variance interpretation results (Table 6), and then observe the gravel plot (Figure 1), the characteristic root on the left, the first factor can explain the most information, as the slope slows, the subsequent factors can explain less information. In Figure 1, it can be seen that the slope after the number of factors 5 is relatively flat, indicating that the information that can be interpreted by the fifth factor has been reduced more, and the first 4 factors can already cover most of the information, so the number of factors can be selected as 4.

In SPSS, through the rotation function in factor analysis, the maximum variance method is selected to obtain the total variance table of explanations (Table 5), through which the degree of loss of original information caused by factor analysis can be visually judged, so as to ensure that the extracted principal factors can reflect the original information of the data to the greatest extent. Since the common factors are predetermined to be 4, the principal component analysis method is used to estimate the factor load matrix to verify whether it is reasonable. Since the cumulative variance contribution of the first three factors is 74.27%, the cumulative variance contribution of the first four factors reaches 84.91%. $\lambda_4=0.958$ is close to 1, and it is reasonable to extract the four common factors to explain 84.91% of the information of the original index system, which is more likely to retain information than the three common factors.

3.2. Naming of Principal Factors

After analyzing the number of first-level factors, it is more important to analyze the meaning of each principal component to achieve the purpose of analyzing the investment value of the actual stocks on the STAR Board. We can obtain the load matrix of the principal components in the SPSS software, and rotate the factor load matrix in order to make the components of the common factor clearer and explain its actual meaning. The maximum variance method is used in the orthogonal rotation method. After the factor rotation, the load on each principal factor is separated as far as possible and differentiated towards 0 and ± 1 , and the factor load results after rotation are detailed in Table 7:

Table 7. Rotation component matrix

	composition			
	1	2	3	4
Net profit	0.897	-0.115	0.105	0.134
ROE	0.861		0.179	0.275
EPS	0.860	0.173		
current ratio		0.907	0.149	-0.102
asset-liability ratio		-0.881		-0.195
BPS		0.226	0.929	0.110
undistributed profit per share	0.523		0.754	-0.153
year-on-year growth rate of net profit		0.189		0.908
growth rate of main business	0.542	-0.313	0.133	0.652

According to the rotation component matrix (Table 7), it can be seen that compared with other indicators, Net profit, ROE, EPS has a large positive load on the first principal component, these three indicators are mainly used to measure the company's earnings, which can be defined as profitability factor (F_1). Current ratio and BPS have a positive load on the second principal component, these two indicators are mainly used to measure the efficiency of a company's capital flow, which can be defined as the activity factor (F_2). In the same way, BPS and undistributed profit per share have a large positive load on the third principal component, which can be defined as the expansion capacity factor (F_3). Year-on-year growth rate of net profit growth rate of main business and positive load on the fourth principal component can define it as a development potential factor(F_4).

3.3. Calculation of Factor Scores

From Table 8, the factor score of each original variable can be calculated, which in turn helps to determine the investment value of the selected STAR Board stocks.

Table 8. Component score coefficient matrix^a

	composition			
	1	2	3	4
ROE	0.293	0.01	-0.02	0.057
Net profit	0.344	-0.026	-0.075	-0.061
EPS	0.401	0.165	-0.208	-0.194
asset-liability ratio	0.004	-0.492	0.069	-0.128
current ratio	0.075	0.514	-0.049	-0.12
year-on-year growth rate of net profit	-0.122	0.086	-0.038	0.693
growth rate of main business	0.064	-0.193	0.075	0.427
BPS	-0.21	-0.031	0.703	0.125
undistributed profit per share	0.11	-0.077	0.476	-0.191

According to Table 8, the expression of the three principal components can be derived as follows:

$$F_1 = 0.293X_1^* + 0.344X_2^* + 0.401X_3^* + 0.004X_4^* + 0.075X_5^* + \dots + 0.11X_9^* \quad (2)$$

$$F_2 = 0.01X_1^* - 0.026X_2^* + 0.165X_3^* - 0.492X_4^* + 0.514X_5^* + \dots - 0.077X_9^* \quad (3)$$

$$F_3 = -0.02X_1^* - 0.075X_2^* - 0.208X_3^* + 0.069X_4^* - 0.049X_5^* + \dots + 0.476X_9^* \quad (4)$$

$$F_4 = 0.057X_1^* - 0.061X_2^* - 0.194X_3^* - 0.128X_4^* - 0.12X_5^* + \dots - 0.191X_9^* \quad (5)$$

Weighted by the progressive variance contribution rate of 4 common factors, the score formula of the composite factors is weighted to average:

$$F = (36.988\%F_1 + 22.709\%F_2 + 14.57\%F_3 + 15.869\%F_4) \div 84.911 \quad (6)$$

That is,

$$F = 0.43561 * F_1 + 0.26744 * F_2 + 0.17159F_3 + 0.18689F_4 \quad (7)$$

The comprehensive score F for each sample was calculated using the SPSS's data conversion function, and some of the results of the analysis will be mentioned in a later analysis.

3.4. Investment Value Analysis

Select the stocks with a positive overall score among these stocks and sort them in descending order as follows:

Table 9. Composite score table (F>0)

Stock Code	Stock Name	F1	F2	F3	F4	F	ranking
688105.SH	Vazyme Biotech	2.54	-0.13	-0.03	0.29	1.12	1
688766.SH	Puya Semiconductor	0.98	0.73	1.83	-0.90	0.77	2
688032.SH	Hoymiles	1.80	1.34	-1.62	-0.54	0.76	3
688778.SH	Xtc New Energy	2.53	-1.68	0.29	0.29	0.76	3
688230.SH	Prisemi Electronics	0.27	2.81	0.06	-0.91	0.71	5
688248.SH	Southern Power Grid Technology	-0.91	0.48	4.21	1.05	0.65	6
688776.SH	Guoguang Electric	0.82	-0.44	0.71	0.40	0.44	7
688112.SH	Siglent Technologies	0.11	1.35	-0.31	-0.01	0.36	8
688107.SH	Anlogic Infotech	-0.76	0.45	-0.82	3.41	0.29	9
688082.SH	Tongyizhong	0.22	0.08	-0.51	1.09	0.23	10
688722.SH	Acm Research	0.46	-0.41	-0.15	0.85	0.23	10
688257.SH	Shareate Tools	0.23	-0.36	0.88	-0.17	0.13	12
688786.SH	Yuean Advanced Materials	0.44	-0.29	-0.25	0.12	0.09	13
688206.SH	Primarius Technologies	-0.68	0.72	0.22	0.53	0.03	14
688511.SH	Tianwei Electronic	-0.12	1.13	-0.30	-0.91	0.03	14

Looking at the profitability factor (F1) score from Table 9, Vazyme Biotech (2.54), Xtc New Energy (2.53) scored extremely high, while Puya Semiconductor (0.98) and Guoguang Electric (0.82) scored high. Among these 15 stocks, 11 stocks have a positive profit factor and no low value, which means that the ability of the STAR Board companies in terms of profitability is good and balanced, and investors can refer to the scores of each stock to choose.

From Table 9, we can also recognize that Prisemi Electronics (2.81) and Siglent Technologies (1.35) are prominent in their activity factor (F2) scores, and topical and creative investors can consider investing in these two stocks. In table 9, About half of the stocks scored positive on the scalability factor (F3), with Southern Power Grid Technology (4.21) and Puya Semiconductor (1.83) standing

out in this regard. Hoymiles (-1.62) lacked performance. For expansion capacity, different enterprises have great differences.

In terms of the score of the development potential factor (F4), Anlogic Infotech (3.41) scored extremely high, indicating that this stock has good development prospects, and investors who are interested in long-term development can consider choosing it for investment. The order is as Figure 2 shows.

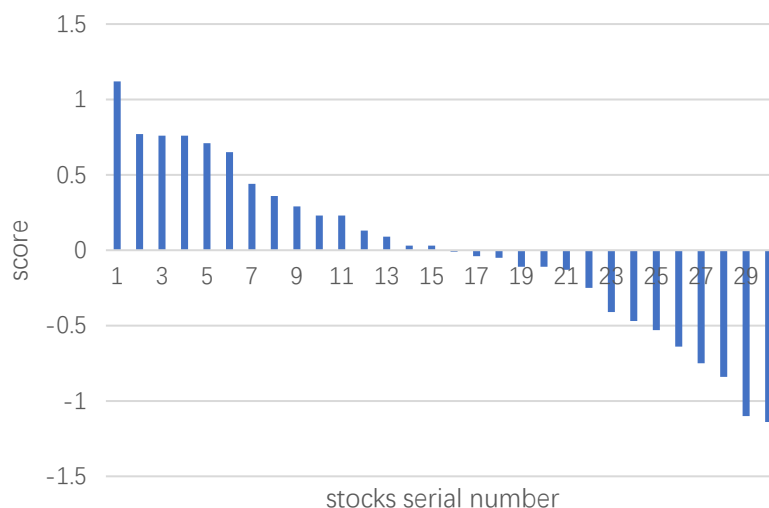


Figure 2. Score distribution

4. Conclusion

In this paper, the factor analysis method is first adopted to reduce the original nine indicators into four indicators: profitability, activity, expansion ability and development potential. Then, the comprehensive score is calculated according to the contribution degree of the four public factors, and 15 high-quality leading stocks with strong comprehensive strength are obtained.

The combined score of these 30 stocks ranged from -1.14 to 1.12, with 15 stocks scoring more than half of the stocks. The average value of these 30 stocks is 0.00, and the variance is 0.56, which means that the development of the stocks of the STAR Board is relatively balanced, and those who are not in a special advantage or disadvantage in the market have certain investment prospects.

Table 9 shows that among all stocks, Vazyme Biotech has the highest overall score, observing the scores of its various factors shows its advantages in profitability and development potential, and after investigation, it is found that it is a biotechnology company that conducts technology research and development and product development for functional proteins and polymer organic materials. Biotechnology is a hot topic in recent years and has good development prospects. Vazyme Biotech has excellent talent, superb technology, and an excellent track record in R&D innovation, which is perhaps why it has a good performance in the stock market. The biotechnology industry is a sunrise industry, and there will be a broader space for development in the future, and investors can pay long-term attention to this stock and make reasonable decisions.

Looking at these 15 high-scoring stocks in Figure 2, Puya Semiconductor, Xtc New Energy, Prisemi Electronics, Southern Power Grid Technology, Tongyizhong, and Primarius Technologies all scored positive in three factors, indicating that these companies are more balanced in all aspects. It can also be included in investment options. In general, the stocks of the Star Market have a good performance in the stock market and are an area with good momentum, and investors can choose according to their investment habits and goals according to the score of each stock in various factors and the comprehensive score.

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