Proceedings of the 2nd International Conference on Financial Technology and Business Analysis
DOI: 10.54254/2754-1169/55/20231003

# *Analysis of Stock Value in the Science and Technology Innovation Board Market: A Principal Component Analysis Approach*

**Jing Luo**[1,a,*]

[1]*Hunan University of Information Technology, Hunan Province, China*
*a. 1911121215@mail. sit.edu.cn*
**corresponding author*

***Abstract:*** The factors influencing stock returns have been extensively studied in the current academic sphere. In this study, the factor analysis method is employed to assess the investment value of stocks in the Science and Technology Innovation Board market (STAR Market) using indicators such as asset-liability ratio, current ratio, quick ratio, gross profit amount, YoY growth rate of net assets, asset return rate A, return on equity ratio ROEA, operating net profit margin, earnings per share of net assets, sales operating profit margin, and YoY growth rate of total assets. Factor scores are derived using principal component analysis. The obtained factor scores are ranked in descending order, revealing that Juchen Corporation holds a factor score of 1.11, ranking first among all companies and demonstrating the highest investment value. Following closely are EastMicro Semiconductor and Baochu Electronics. Additionally, this paper summarizes the stock performance of 20 other companies, offering investors a reference for value-based investment decisions. The quantitative findings of this study facilitate informed decision-making for investors, serving as a valuable reference for their investment strategies.

***Keywords:*** stock returns, quick ratio, factor scores

## 1. Introduction

Entering the 21st century, China's economy has demonstrated a sustained and stable development trend, with significant progress in the growth of the capital market [1-2]. In July 2019, China's capital market entered the "era of the Science and Technology Innovation Board" (STAR Market).

The advent of the STAR Market has garnered considerable attention from a multitude of investors, leading some to transition from the main board market to the STAR Market [3-4]. However, compared to traditional blue-chip stocks, investing in the STAR Market carries higher risks.

Enterprises listed on the STAR Market are characterized by rapid technological iterations, long investment cycles, and substantial uncertainties. As a result, investors need to focus more on information disclosure and engage in rational investment analysis [5]. The stock market entails risks; thus, investment requires prudence. This paper takes an investor's perspective to quantitatively analyze the investment value of stocks from 156 companies listed on the STAR Market, aiding investors in stock selection and investment decisions.

DOI: 10.54254/2754-1169/55/20231003

The paper categorizes complex relationships among certain indicator variables, employing a multivariate statistical analysis method that utilizes a few key factors to explain correlations between multiple original data variables. This approach simplifies data and reduces variable dimensions [6-7]. Factor analysis, with its goal of simplifying original variables, aims to extract a small number of factors while ensuring these factors are interpretable, achieving the role of explaining all variables. Therefore, factor analysis proves to be an ideal method for evaluating the growth levels of companies listed on the STAR Market. This study employs 11 indicators for factor analysis, revealing that Juchen Corporation boasts a factor score of 1.11, ranking first among all companies and demonstrating the highest investment value. Following closely are EastMicro Semiconductor and Baochu Electronics. Additionally, this paper summarizes the stock performance of 20 other companies, providing investors with a basis for value-based investment decisions.

The structure of this paper is as follows: the second section describes data selection, the third section presents results analysis, and the fourth section concludes the article.

## 2. Data Selection

The data for this study is sourced from the Oriental Fortune Choice Financial Terminal database. Financial statement data up to December 31, 2021, was chosen for analysis. In order to provide a comprehensive depiction of the practical operational dynamics of companies listed on the Science and Technology Innovation Board (STAR Market), and to avoid biases in the experimental outcomes, samples with missing data and instances of abnormal financial statement data were excluded. Consequently, a total of 156 companies listed on the STAR Market were selected as the study's sample. Table 1 illustrates the mean, minimum, maximum values, and other various financial indicators for each individual listed company.

Table 1: Statistical Descriptions.

| Variable | Observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Current Ratio | 156 | 7.566394 | 7.986263 | 0.619971 | 40.1724 |
| Quick Ratio | 156 | 6.842838 | 7.718028 | 0.461185 | 39.6011 |
| Debt-to-Asset Ratio | 156 | 0.244555 | 0.172029 | 0.026145 | 0.747348 |
| Sales Operating Rate | 156 | 2.923077 | 10.66391 | -30.9 | 34.3 |
| Gross Profit Amount | 156 | 8.93E+08 | 1.75E+09 | -1.00e+07 | 9.50E+09 |
| Earnings per Share | 156 | 19.39741 | 17.25912 | -0.466 | 107.77 |
| YoY Net Asset Growth | 156 | -0.29431 | 6.478734 | -61.209 | 34.8906 |
| YoY Total Asset Growth | 156 | -1.07172 | 10.26657 | -76 | 52 |
| Asset Return Rate A | 156 | 0.032242 | 0.075302 | -0.30066 | 0.212118 |
| Return on Equity A | 156 | 0.042755 | 0.10207 | -0.61709 | 0.252004 |
| Operating Net Margin | 156 | -60.5161 | 756.5889 | -9449.73 | 0.605428 |

According to Table 1, the highest value for the Current Ratio is 40.1724, the lowest value is 0.619971, the mean is 7.986263, and the standard deviation is 7.566394. For the Quick Ratio, the maximum value is 39.6011, the minimum value is 0.461185, the mean is 7.718028, and the standard deviation is 6.842838. As for the Debt-to-Asset Ratio, the maximum value is 0.747348, the minimum value is 0.026145, the mean is 0.172029, and the standard deviation is 0.244555. Lastly, in the case of the Sales Operating Rate, the highest value is 34.3, the lowest value is -30.9, the mean is 10.66391, and the standard deviation is 2.923077.

DOI: 10.54254/2754-1169/55/20231003

# 3. Results Analysis

## 3.1. Results of Factor Analysis

This study focuses on analyzing the investment value of stocks from 156 companies listed on the Science and Technology Innovation Board (STAR Market) with the goal of aiding investors in stock selection and investment decisions. Financial statements, including balance sheets, cash flow statements, statements of changes in equity, and income statements, reflect a company's operational status and form the foundation for assessing its investment value. Thus, a micro-level financial analysis of listed companies can be conducted to explore their stock investment value. In order to comprehensively assess the overall capabilities of listed companies, this paper selected 11 financial indicators to construct the evaluation framework for the STAR Market.

Table 2: Indicator System.

| Indicator | Indicator Code | Nature |
|---|---|---|
| Debt-to-Asset Ratio | X1 | Moderate |
| Current Ratio | X2 | Moderate |
| Quick Ratio | X3 | Moderate |
| Gross Profit Amount | X4 | Positive |
| YoY Net Asset Growth | X5 | Positive |
| ROA | X6 | Positive |
| ROEA | X7 | Positive |
| Operating Net Profit Margin | X8 | Positive |
| Earnings per Share | X9 | Positive |
| Sales Operating Profit Margin | X10 | Positive |
| YoY Total Asset Growth | X11 | Positive |

For the evaluation framework of the investment value of stocks from listed companies, refer to Table 2.

## 3.2. Data Preprocessing

Given the significant variability in financial data from companies listed on the STAR Market, data preprocessing, involving both data positivization and standardization, is necessary before conducting factor analysis [8]. The experimental software used in this study is SPSS23, which automates data standardization for factor analysis. Thus, only positivization treatment is required.

From Table 1, it is evident that only the Debt-to-Asset Ratio, Current Ratio, and Quick Ratio are moderate indicators that require positivization. These three variables are positively transformed using the formula (1):

$$Y_{ij} = -|X_{ij} - E| \tag{1}$$

In the formula (1), $Y_{ij}$ represents the positivized value, $X_{ij}$ is the original value, and E is the mean of the variable. Standardization is used to convert the original data into standardized data, and its formula is as follows:

$$z = (x - \mu)/\sigma \tag{2}$$

DOI: 10.54254/2754-1169/55/20231003

Where z represents the standardized data, x is the original data, μ is the mean of the original data, and σ is the standard deviation of the original data.

The correlation analysis of various indicators is presented in Table 3. It is observed that the Quick Ratio and Current Ratio exhibit a correlation of 0.997, while the Debt-to-Asset Ratio has the lowest correlation with the Current Ratio at -0.6496. Other correlation relationships among indicators are summarized in Table 3. Significant correlations exist among variables, thus warranting consideration for Principal Component Analysis (PCA).

Table 3: Correlation Analysis.

| - | Current Ratio | Quick Ratio | Debt-to-Asset Ratio | Sales Operating Profit Margin | Gross Profit Amount | Earnings per Share | YoY Net Asset Growth | YoY Total Asset Growth | Asset Return Rate A | Return on Equity A | Operating Net Margin |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Current Ratio | 1.00 | | | | | | | | | | |
| Quick Ratio | 0.997 | 1.00 | | | | | | | | | |
| Debt-to-Asset Ratio | -0.65 | -0.64 | 1.00 | | | | | | | | |
| Sales Operating Profit Margin | -0.03 | -0.03 | -0.02 | 1.00 | | | | | | | |
| Gross Profit Amount | -0.03 | -0.03 | 0.04 | -0.01 | 1.00 | | | | | | |
| Earnings per Share | 0.06 | 0.06 | -0.08 | -0.16 | 0.22 | 1.00 | | | | | |
| YoY Net Asset Growth | 0.06 | 0.06 | -0.12 | 0.04 | 0.03 | -0.08 | 1.00 | | | | |
| YoY Total Asset Growth | -0.07 | -0.07 | 0.01 | -0.02 | 0.02 | -0.04 | -0.02 | 1.00 | | | |
| Asset Return Rate A | 0.08 | 0.07 | -0.14 | 0.19 | -0.13 | -0.08 | 0.08 | 0.06 | 1.00 | | |
| Return on Equity A | 0.04 | 0.03 | -0.08 | 0.15 | -0.07 | -0.08 | 0.14 | 0.06 | 0.95 | 1.00 | |
| Operating Net Margin | -0.27 | -0.29 | 0.10 | -0.04 | 0.03 | -0.11 | -0.00 | -0.02 | 0.14 | 0.10 | 1.00 |

## 3.3. Data Feasibility Testing

Table 4 presents the results of the Kaiser-Meyer-Olkin (KMO) and Bartlett's Sphericity tests. The KMO value obtained is 0.554, indicating the suitability of the data for factor analysis since it exceeds the recommended threshold of 0.5 [9-10]. The Bartlett's Sphericity Test resulted in an approximate Chi-Square value of 1315.680, with 55 degrees of freedom, and a p-value of 0, suggesting strong intercorrelations among variables and supporting the appropriateness of the dataset for factor analysis.

Table 4: KMO and Bartlett's Test.

| KMO Value | 0.554 |
|---|---|
| Bartlett's Sphericity Test | Approx. Chi-Square: 1315.680, df: 55, p-value: 0 |
| Degrees of Freedom (df) | 55 |
| p-value | 0 |

DOI: 10.54254/2754-1169/55/20231003

### 3.4. Variance Contribution

The communalities of selected variables were tested, and the results are illustrated in Table 5. The majority of communal variances for the selected variables tend to be equal to or greater than 1. This suggests that the original variable information can be well explained by the extracted main factors. Thus, the application of factor analysis can yield conclusions with substantial explanatory power.

Table 5: Variance Contribution.

| Factor | Eigenvalue | Difference | Proportion | Cumulative |
|---|---|---|---|---|
| Factor1 | 2.68327 | 0.57648 | 0.2439 | 0.2439 |
| Factor2 | 2.10679 | 0.9111 | 0.1915 | 0.4355 |
| Factor3 | 1.19569 | 0.15678 | 0.1087 | 0.5442 |
| Factor4 | 1.03892 | 0.03347 | 0.0944 | 0.6386 |
| Factor5 | 1.00545 | 0.02899 | 0.0914 | 0.73 |
| Factor6 | 0.97646 | 0.10534 | 0.0888 | 0.8188 |
| Factor7 | 0.87112 | 0.19396 | 0.0792 | 0.898 |
| Factor8 | 0.67716 | 0.27231 | 0.0616 | 0.9595 |
| Factor9 | 0.40485 | 0.36712 | 0.0368 | 0.9963 |
| Factor10 | 0.03773 | 0.03516 | 0.0034 | 0.9998 |
| Factor11 | 0.00257 | | 0.0002 | 1 |

From the analysis, five factors have eigenvalues greater than 1. Consequently, we will proceed with a factor analysis involving these five factors to select appropriate stocks. Notably, the eigenvalue for Factor 1 is 2.68327, for Factor 2 is 2.10679, for Factor 3 is 1.19569, for Factor 4 is 1.03892, and for Factor 5 is 1.00545. The Scree Plot, shown in the Figure 1, further validates the rationale for selecting these five factors.

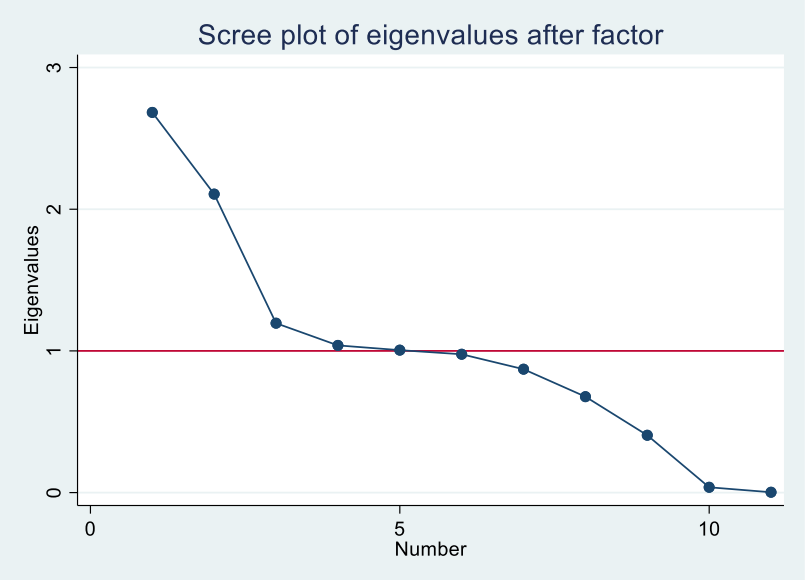


Figure 1: Scree plot of eigenvalues after factor.

DOI: 10.54254/2754-1169/55/20231003

Table 6: Factor Component Analysis.

| Variable | Factor1 | Factor2 | Factor3 | Factor4 | Factor5 | Uniqueness |
|---|---|---|---|---|---|---|
| Current Ratio | 0.9476 | -0.171 | -0.0361 | -0.0299 | -0.0508 | 0.0681 |
| Quick Ratio | 0.9446 | -0.1815 | -0.0419 | -0.0291 | -0.0446 | 0.0702 |
| Debt-to-Asset Ratio | -0.792 | 0.0337 | -0.0163 | -0.035 | 0.0711 | 0.3651 |
| Sales Operating Profit Margin | 0.0292 | 0.3282 | -0.2945 | 0.3321 | 0.568 | 0.3717 |
| Gross Profit Amount | -0.0768 | -0.2009 | 0.6711 | 0.3315 | 0.3024 | 0.3021 |
| Earnings per Share | 0.0863 | -0.2893 | 0.7367 | -0.0559 | 0.001 | 0.363 |
| YoY Net Asset Growth | 0.1519 | 0.1881 | -0.0261 | 0.6205 | 0.1548 | 0.5318 |
| YoY Total Asset Growth | -0.0675 | 0.1119 | 0.0787 | -0.6265 | 0.5028 | 0.3314 |
| Asset Return Rate A | 0.2597 | 0.9168 | 0.1967 | -0.1057 | -0.0501 | 0.0398 |
| Return on Equity A | 0.2182 | 0.9136 | 0.2354 | -0.0649 | -0.0224 | 0.0577 |
| Operating Net Margin | -0.3302 | 0.2978 | 0.1081 | 0.1401 | -0.5495 | 0.4691 |

We have also derived the component scores of different indicators within each factor. Among them, the component score of Current Ratio in Factor 1 is 0.948, in Factor 2 is -0.171, in Factor 3 is -0.0361, in Factor 4 is -0.0299, and in Factor 5 is -0.0508. Additionally, the factor component scores for other indicators are presented in the results shown in Table 6. Notably, within Factor 1, Gross Profit Amount obtains the lowest score of -0.0768.

Through the aforementioned analysis, I have obtained the final factor score values for different stocks and subsequently arranged them. The stocks were ranked in descending order based on their factor scores, and the top 20 rankings were selected. The results are as follows: It was discovered that these 20 stocks are comparatively suitable for investors. Among them, Jucheng Shares achieved the highest score, followed by East Microelectronics and Baichu Electronics, with scores of 0.919 and 0.917, respectively.

Table 7: Factor Score Results.

| **Code** | **Name** | **Score** | **Rank** |
|---|---|---|---|
| 688123 | Jucheng Shares | 1.111089 | 1 |
| 688261 | East Microelectronics | 0.919491 | 2 |
| 688188 | Baichu Electronics | 0.916987 | 3 |
| 688267 | Zhongchu MediTech | 0.90717 | 4 |
| 688091 | Shanghai Yizhong | 0.887627 | 5 |

DOI: 10.54254/2754-1169/55/20231003

Table 7: (continued).

| | | | |
|---|---|---|---|
| 688176 | Yahuang Pharmaceutical | 0.831304 | 6 |
| 688200 | Huafeng Measurement & Control | 0.823753 | 7 |
| 688053 | Sikerui | 0.747106 | 8 |
| 688016 | XinMai Medical | 0.736466 | 9 |
| 688114 | HuaDa ZhiZao | 0.732205 | 10 |
| 688163 | SAILUN BIOLOGY | 0.730169 | 11 |
| 688196 | Excellence New Energy | 0.701501 | 12 |
| 688222 | Chengdu XianDao | 0.613684 | 13 |
| 688212 | AOJ Medical | 0.594666 | 14 |
| 688220 | Aojetek | 0.582973 | 15 |
| 688270 | ZenRay Technology | 0.548842 | 16 |
| 688202 | MeidiXi | 0.538272 | 17 |
| 688130 | Jinghua Micro | 0.517866 | 18 |
| 688298 | Orient Bio | 0.504279 | 19 |
| 688231 | Longda Shares | 0.498396 | 20 |

In conclusion, the above list reflects the factor score results for the different stocks, ranked accordingly, and demonstrates the investment suitability of the top 20 stocks. Notably, Jucheng Shares secured the highest score, closely followed by East Microelectronics and Baichu Electronics with scores of 0.919 and 0.917, respectively.

## 4. Conclusion

This study employs factor analysis method and utilizes principal component analysis to construct factor scores using indicators such as asset-liability ratio, current ratio, quick ratio, gross profit amount, year-on-year growth rate of net assets, return on assets (ROA), return on equity (ROEA), operating net profit rate, earnings per share, sales operating profit rate, and year-on-year growth rate of total assets. The aim is to assess the investment value of stocks in the Growth Enterprise Market (GEM). The obtained factor scores are arranged in descending order, revealing that Jucheng Shares obtained a factor score of 1.11, ranking first among all companies and displaying the highest investment value. East Microelectronics and Baichu Electronics follow suit as the next valuable options. The study also provides a summary of 20 other company stocks for reference, serving as a foundation for value-based investment decisions. The quantitative analysis results in this study facilitate better decision-making for investors and provide valuable insights for their choices.

However, this study does have certain limitations. For instance, it does not include stock return rate data to explore the relationship between factor scores and stock price returns, thereby not delving into the influencing factors of stock price returns. In the future, this study intends to further incorporate the principal component scores into the Fama-French factor model to evaluate their impact on stock price returns.

## References

[1] *Hou, K., Xue, C., & Zhang, L. (2015). Digesting anomalies: An investment approach. The Review of Financial Studies, 28(3), 650-705.*

[2] *Lyandres, E., Sun, L., & Zhang, L. (2008). The new issues puzzle: Testing the investment-based explanation. The review of financial studies, 21(6), 2825-2855.*

[3] *Fama, E. F., & French, K. R. (2015). A five-factor asset pricing model. Journal of financial economics, 116(1), 1-22.*

DOI: 10.54254/2754-1169/55/20231003

[4] *Naffa, H., & Fain, M. (2022). A factor approach to the performance of ESG leaders and laggards. Finance Research Letters, 44, 102073.*

[5] *Naffa, H., & Fain, M. (2020). Performance measurement of ESG-themed megatrend investments in global equity markets using pure factor portfolios methodology. PloS one, 15(12), e0244225.*

[6] *Tai, S., Sun, C., & Zhang, S. (2016). Exploring factors affecting owners' trust of contractors in construction projects: a case of China. SpringerPlus, 5(1), 1-8.*

[7] *Gurbaxani, A., Thakkar, J., Pathak, S., Mathur, A., & Raees, S. (2023). ExAMINING FACTORS INFLuENCING INVESTMENT IN DIGITAL GOLD AND GOLD ETF uSING THE PCA TECHNIquE. Innovations, 20(2), 160-170.*

[8] *Berk, M., Berk, L., Dodd, S., Jacka, F. N., Fitzgerald, P. B., de Castella, A. R., ... & Stafford, L. (2012). Psychometric properties of a scale to measure investment in the sick role: the Illness Cognitions Scale. Journal of evaluation in clinical practice, 18(2), 360-364.*

[9] *Rajaoarisoa, T. A., & Ravalison, F. A. (2015). Using principal component analysis to determine key factor of rural electrification development investment. Journal of Systems and Industrial Project Engineering, 1(1), 10-17.*

[10] *Júlio, P., Pinheiro–Alves, R., & Tavares, J. (2013). Foreign direct investment and institutional reform: evidence and an application to Portugal. Portuguese Economic Journal, 12, 215-250.*