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Research on the Value of Stocks in The GEM Sector Based on Factor Analysis

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Abstract: The research question in this paper is a study of the investment value of stocks in the Growth Enterprise Market (GEM) sector. To address this question, 15 variables from 50 stocks in the GEM sector were randomly selected for factor analysis in this paper. Through steps such as KMO and Bartlett's spherical pre-test, the 15 variables were summarized into five common factors, namely: financial risk factor, profitability factor, growth factor, total asset utilization factor and collection capacity factor. Finally, based on the five common factors, the factor scores of each of the 50 stocks were calculated and ranked to obtain the five stocks with the most investment value: Goldfish, Win Style, Aier Eye Care, Anchor Innovation, Vacheron Constantin and the five stocks with the least investment value: Huatu Shanding, Venture Blackhorse, Mei Ansen, He Ren Technology, Gu Ao Technology. In the subsequent further validation, the top five stocks were found to have high investment value.

Keywords: Growth Enterprise Market, factor analysis, equity value

1. Introduction

The Growth Enterprise Market (GEM) was the securities market counterpart to the Main Board. It was established throughout China and overseas. It provided market access to financing for companies in high-technology industries that did not fully meet the listing requirements of the Main Board at the time. It complemented the Main Board of each country. With its prominent features of low entry barriers and stringent operational requirements, the GEM market provided favorable conditions for all types of potential enterprises to realize financing. Companies listed on the GEM market in China were mainly innovative high-tech industry companies with high growth expectations, but most were currently short-lived, small in size, and not very comparable. For Chinese investors, the GEM was a low-barrier, demanding, and relatively high-risk equity market and an incubator for innovative technology-based companies. Given its relatively short history, China's GEM market was a weak but effective market. In the course of its rapid development, a bubble had gradually developed that was difficult to ignore and had led to a number of factors affecting the value of the stock. In order to avoid risk, investors often used various valuation methods through multiple channels to understand the true value hidden beneath the surface of a company. Based on this, this paper will analyze the value of GEM stocks on the basis of factor analysis. This paper will provide quantitative criteria for portfolio construction, portfolio return prediction, and risk control, and establish a scientific GEM stock value system. This has important theoretical and practical significance for vigorously developing China's GEM market and helping GEM investors to make securities investments.

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Gounder introduced corporate financial information into the field of business valuation by adding DuPont analysis to the Ohlson valuation model [1]. The widely used Black-Scholes model and arbitrage pricing theory, which were based on the capital asset pricing model, had more virtual and derivative applications. Behera suggested that when using traditional valuation methods, the uncertainty of future returns on real options on high-tech companies should be assessed, and the level of risk of future returns and the discount rate of returns should be analyzed. Ren believed that the valuation of GEM-listed companies reflected the likely price of assets under the particular condition of the GEM market [2]. It was predictive, analog, and time-sensitive and should be more objective. Li Yang analyzed the main issues that needed to be faced in valuing GEM companies through an all-encompassing presentation of GEM-listed companies [3]. Wang used the generalized moment estimation method to observe the company's asset structure and operating performance [4].

However, objectively speaking, it was difficult to accurately assess GEM-listed companies as the model does not fully take into account the high growth and potentially high earnings of GEM companies. Li believed that the GEM had a high growth and high-risk nature and the results obtained using common valuation methods were prone to bias [5]. Therefore, Li combined the real options method with other methods to analyze the equity of GEM companies. Yang dissected the correlation between capital structure and the enterprise value of GEM-listed companies in China. Yang selected GEM-listed companies with fully published annual reports from 2017 to 2019 as the research object and conducted an empirical study using a linear regression model [6]. Li applied the theory of discounted free cash flow model to the valuation of GEM companies, focusing on the forecasting process of their future operating income. This validated the operability of the discounted free cash flow model as applied to companies in the same industry and refined the meaning of the valuation process [7]. In the process, valuation based on the discounted cash flow model was even proposed as a response to increasing the value of a business. Li Hui argued that an effective and appropriate valuation of a firm's value was related to the firm's decision-making [8]. Li Hui analyzed the basic theory and application steps, as well as the applicability and limitations of the then more commonly used discounted cash flow, relative value, and EVA valuation methods [9]. Qin took the GEM as the subject of his study and derives the negative impact of gearing and current liability ratios on the market valuation of GEM-listed companies, as well as the indicators involving current ratio and interest-bearing liabilities [10].

2. Method

2.1. Data Sources and Description

The data selected for this paper is derived from stock data on the Oriental Wealth Network. A total of 50 stocks in the GEM sector were randomly selected, with a sample period of 30 June 2022 to 30 September 2022, containing a total of 15 variables [11, 12]. To ensure the objectivity of the study and the correlation of the data, the 15 variables were selected from the secondary indicators under the five primary indicators such as per share indicator, growth capability indicator, profitability indicator, financial risk indicator oh and operational capability indicator (See table below for specific indicators).

2.2. Description of Indicator Selection

This paper uses 15 indicators to measure the value of a single stock. For ease of use, each of the 15 indicators is labelled X1-X15, as Table 1 shows.

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Table 1: Indicator selection and processing.

Indicators	Symbol	Unit
Basic earnings per share	X1	RMB
Net assets per share	X2	RMB
Undistributed earnings per share	X3	RMB
Total operating income	X4	RMB million
Net profit attributable to	X5	RMB million
Year-on-year growth in net profit	X6	%
Return on net assets	X7	%
Return on total assets	X8	%
Gross margin	X9	%
Current ratio	X10	%
Quick ratio	X11	%
Gearing ratio	X12	%
Total asset turnover days	X13	days
Total asset turnover	X14	times
Accounts receivable turnover rate	X15	times

2.3. Method

In this paper, the data processing method of factor analysis was used to group the 15 indicators into 5 indicators, taking into account the correlation of the data and the purpose of data processing. Factor analysis is a method of converting multivariate data into a small number of common factors by finding correlation values between a large amount of data. Finally, the stock value of individual stocks is analyzed specifically through the factor scores.

3. Results and Discussion

3.1. KMO Test

In Table 2, the KMO value = 0.594, which means factor analysis is available for the indicator. Also, the corresponding p-value is less than 0.5, indicating that the data are suitable for factor analysis.

Table 2: KMO Test.

KMO and Bartlett's test	
Adequate sampling of the Kaiser-Meyer-Olkin metric	0.594
Bartlett's test for sphericity	704.956
df	105
sig.	0

3.2. Contribution of Variance

This paper uses factor analysis on the selected variables. Finally, the 15 variables are grouped into 5 common factors, as table 3 shows.

Table 3 shows the five public factors reached 78.896%, i.e., a total of five public factors were extracted from the 15 factors. The cumulative total variance explained by the public factors remained

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unchanged after orthogonal rotation, and the variance contribution of each factor changed. This indicates that these five common factors contain most of the information of the 15 factors and can replace the original 15 factors to study the stock value of the GEM sector.

Table 3: Contribution of variance.

	Characteristic roots			Explanation of variance after rotation		
variable	Characteristic roots	Eigenvalue Variance	Cumulative	Characteristic roots	Variance after rotation	Cumulative
1	4.852	32.346	32.346	3.536	23.572	23.572
2	2.486	16.575	48.921	2.88	19.2	42.773
3	1.824	12.159	61.08	2.669	17.796	60.569
4	1.58	10.531	71.61	1.62	10.8	71.368
5	1.093	7.286	78.896	1.129	7.528	78.896
6	0.995	6.631	85.527			
7	0.674	4.491	90.018			
8	0.5	3.336	93.353			
9	0.33	2.2	95.553			
10	0.243	1.621	97.174			
11	0.164	1.092	98.266			
12	0.127	0.85	99.116			
13	0.11	0.735	99.852			
14	0.021	0.137	99.989			
15	0.002	0.011	100			

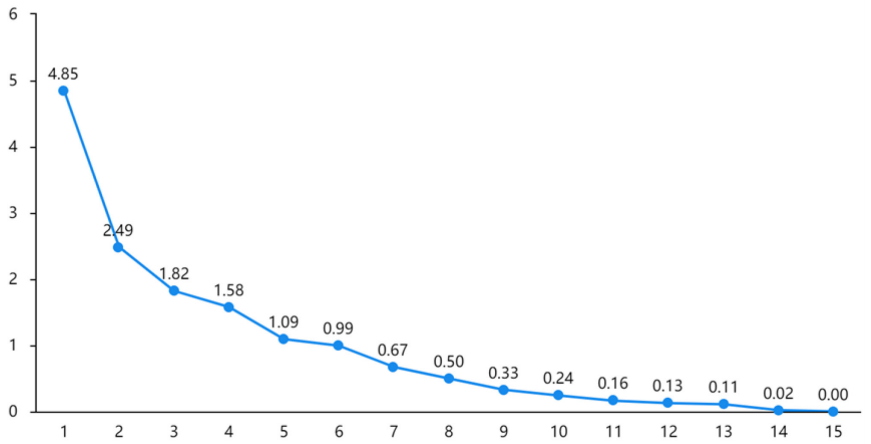

Figure 1: Eigenvalue gravel map.

A gravel plot is a graph that characterizes the relationship between factors and the eigenvalues. It can be used to determine the number of common factors extracted. The number of factors corresponding to the process can be used as a reference value for the number of factors extracted as the fold changes from steep to gentle, i.e., the slope changes towards small.

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As can be seen from fig.1, the folds for the first five factors are steeper and their slopes are much greater than the other folds, while the folds after the first five factors gradually flatten out. Therefore, the first five factors can significantly act on the GEM stock value study.

3.3. Factor Loading Matrix and Factor Naming

The five common factors were identified above by means of principal component analysis and gravel plots, and the factor loading matrix was rotated in order to further inform the specific economic significance of each common factor. Where the expression for the factor model is given by:

$$X_i = a_1F_1 + \ldots a_{im}F_m + a_iu_i \quad (1)$$

where F_1 ... F_m is the common factor, a_{ij} (j=1,2,....m) is the factor loading, which is the loading of the i-th variable on the j-th common factor; ui is the special factor, ai is the special factor loading.

In order to clarify the interpretation of the factors and make the data clearer, the most commonly used method of rotating factor loadings, namely orthogonal rotation with maximized variance, was chosen for this paper. The rotated original variables will reflect larger loadings on a particular factor, allowing the original economic variables represented by individual factors to be more visually identifiable and achieving a simplified model structure.

In Table.4, Factor 1 has a high loading on gross revenue, gross profit margin, current ratio, quick ratio and gearing ratio, and can be considered as a financial risk factor. Factor 2 has a high loading on net profit attributable, net profit attributable year-on-year growth, return on net assets and return on total assets, Therefore, factor 2 can be considered as a profitability factor. Factor 3 has large loadings on basic earnings per share, net assets per share and undistributed earnings per share, and can be considered as a growth factor.

Factor 4 has a large loading on total asset turnover days and its ratio. Therefore, factor 4 can be regarded as a total asset utilization factor. Factor 5 has a large loading on accounts receivable turnover, which can be considered as a collection capacity factor.

Through the above method, each of the five public factors has its own specific economic meaning, and these five public factors also contain most of the information, which are sufficient to replace the original 15 variables to study the stock value of the GEM sector.

Table 4: Factor Loading Matrix after Rotation.

Name	F1	F 2	F 3	F4	F5
X1	0.46	0.416	0.644	-0.107	-0.113
X2	0.264	-0.119	0.861	-0.117	-0.174
X3	0.068	0.071	0.898	-0.038	-0.058
X4	-0.563	0.152	0.478	0.239	0.354
X5	-0.339	0.564	0.47	0.128	0.307
X6	0.044	0.686	-0.058	0.019	-0.043
X7	0.27	0.884	0.118	-0.162	-0.129
X8	0.405	0.864	0.134	-0.135	-0.084
X9	0.607	0.403	-0.199	0.034	0.363
X10	0.833	0.252	0.241	0.039	0.075
X11	0.833	0.246	0.232	0.051	0.083
X12	-0.849	-0.032	-0.107	-0.003	0.072
X13	0.261	-0.161	-0.18	0.822	-0.041
X14	0.088	-0.19	-0.157	-0.101	0.828
X15	-0.088	-0.003	0.038	0.885	-0.038

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3.4. Factor Score

The analytical treatment of the data above has resulted in five common factors that affect stock values. In order to further obtain which stock have a high stock value and are recommended for investment, and which stocks have a low stock value and are not recommended for investment, this paper will calculate the stock value score for each of the five public factors for each stock and analyze each stock score to give certain investment recommendations. The specific calculation formula is as follows:

$$F_1 = \beta_1 X_1 + \beta_2 X_2 + \ldots \beta_{15} X_{15} \quad (2)$$

where F_1 is a stock's score on factor 1, $\beta_{1\ldots15}$ are the specific values of this stock on variables 1 to 15, and $X_{1\ldots15}$ are the factor loading coefficients of variables 1 to 15 on factor 1 (see Table 5). Similarly the specific scores for each stock on factors 1 to 5 can be obtained.

By comparing the scores of each of the 50 stocks on Factor 1 to Factor 5, we can determine the five stocks with the highest value and recommended for investment: Goldfish, Win Style, Aier Eye Care, Anchor Innovation and Vacheron Constantin. The five stocks with the lowest value and not recommended for investment: Huatu Shanding, Venture Blackhorse, Mei Ansen, He Ren Technology and Gu Ao Technology. The specific values are shown in the table.5.

Table 5: Factor score (Sorted in descending order).

Stock Name	F1	F2	F3	F4	F5	Ranking
Goldfish	566.3	176.3	556.3	354.9	631.6	1
Win Style	168.5	52.4	165.5	105.6	187.9	2
Aier Eye Care	43.3	19.5	45.0	26.9	50.2	3
Anchor Innovation	30.0	11.3	30.3	18.8	34.1	4
Vacheron Constantin	23.0	7.9	22.9	14.4	25.9	5
...	...	...	...	...	...	...
Gu Ao Technology	1.00	0.24	0.94	0.69	1.11	46
He Ren Technology	0.97	0.37	0.97	0.68	1.08	47
Mei Ansen	0.77	0.31	0.78	0.55	0.86	48
Venture Blackhorse	0.81	0.03	0.71	0.55	0.83	49
Huatu Shanding	0.23	0.09	0.23	0.22	0.25	50

4. Conclusion

In this paper, using factor analysis, 15 variables were grouped into five public factors based on data from 50 stocks in the GEM sector from 30 June 2022 to 30 September 2022, after going through methods such as KMO and Bartlett's spherical test, Contribution of variance, Factor loading matrix and factor naming. Based on the factor analysis, the specific scores of each stock on the five public factors were calculated using Factor scoring method. By ranking the factor scores in descending

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order, the high and low stock values of the 50 stocks were obtained and investment recommendations were given accordingly.

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