



Comprehensive Performance Evaluation of Listed Manufacturing Firms in China

Wu Ganglong^{1,2*} Syed Ahmed Salman¹

¹Lincoln University College, Wisma Lincoln, No. 12-18, Jalan SS 6/12, 47301 Petaling Jaya, Selangor Darul Ehsan, Malaysia

²Liming Vocational University, No.298 Tonggang West Street, Fengze District, Quanzhou City, Fujian Province, China

*Corresponding Author's Email: ganglong@lincoln.edu.my

Abstract

This study aims to assess the level of comprehensive performance of listed manufacturing firms in China by constructing a comprehensive performance evaluation system that is applicable to these firms. The annual data of 1983 listed manufacturing firms in China's Shanghai and Shenzhen A-shares in the year 2023 are selected as the research samples. The comprehensive performance evaluation function of listed manufacturing firms is constructed by using principal component analysis and using this function to evaluate the firm's comprehensive performance. The results show that, firstly, the comprehensive performance level of China's listed manufacturing firms is still low. Only a very small number of firms exhibit very high performance, while the majority of firms' comprehensive performance scores are concentrated in the lower range. Secondly, the number and performance levels of Chinese manufacturing firms remain uneven and disparate. East China and South China are the two regions with the highest concentration of manufacturing firms in China. The comprehensive performance scores of firms in Southwest China and East China are positive, while those in South China, North China, Northeast China, and Northwest China are all negative. Thirdly, the comprehensive performance scores of firms with different factors show large differences. Chinese listed manufacturing firms are weak in terms of solvency, operating capability, and growth capability, while they are relatively strong in terms of profitability. Finally, the average scores of the factors in different regions show significant differences. The Southwest region has positive scores on the four dimensions of solvency, profitability, operational capability, and growth capability, indicating superior comprehensive performance. In contrast, the Northeast, North China, and Northwest regions have negative scores on three factors, indicating that these regions have significant deficiencies in comprehensive firm performance. Based on the above findings, four recommendations are made. Firstly, the overall performance level of manufacturing firms should be improved. Secondly, the performance gap between regions should be reduced. Thirdly, the solvency and operational capacity of firms should be strengthened. Finally, the balanced development of inter-regional factors should be actively promoted.

Keywords: Factor Analysis; Listed Firms; Manufacturing; Performance Evaluation

Introduction

Under the background of profound changes in the global economy and industrial restructuring, listed manufacturing firms, as an important pillar of China's economic development, undertake the important task of enhancing national competitiveness and promoting industrial upgrading. In recent years, China's

Received: 8th June 2024; Revised version received on: 28th June 2024; Accepted: 30th June 2024

manufacturing industry has made remarkable achievements in technological innovation, product upgrading, and market expansion, especially in the process of responding to the challenges of global epidemics, showing strong resilience and adaptability (Aceto, Persico, & Pescapé, 2020; Huang *et al.*, 2023). However, despite a complex and changing international environment and increasingly fierce market competition, Chinese manufacturing firms still face many challenges in terms of comprehensive performance. Comprehensive performance evaluation, as an important tool for firm strategic management, can systematically and comprehensively reflect firms' performance in terms of operational efficiency, financial status, market competitiveness, and sustainable development (Hsu, Ou, & Ou, 2015). Scientific and accurate performance evaluation not only helps firms understand their own strengths and weaknesses and formulate practical improvement strategies, but it also provides important references for investors, management, and policymakers and promotes optimal resource allocation and long-term healthy development of firms. Through comprehensive performance evaluation, firms can maintain a keen insight and flexible response ability in the changing market environment, thus enhancing their overall competitiveness. At the critical stage of China's manufacturing industry moving towards high-quality development, it is of considerable theoretical and practical significance to conduct comprehensive performance evaluations of listed manufacturing firms. Through in-depth analysis and assessment of the comprehensive performance level of a firm, it not only helps to gain an in-depth understanding of its current situation and development potential but also provides a scientific basis for firms to optimize their management and enhance their competitiveness. Therefore, how to build a scientific and reasonable comprehensive performance evaluation system to assess the comprehensive performance level of listed manufacturing firms has become an important issue of common concern for academics and firms.

In existing research on firm performance evaluation, scholars have used a variety of indicators to measure firm performance (Hanci-Donmez & Karacay, 2019; Li, Liu, & Shao, 2021; Rezaei & Ort, 2018; Xu & Li, 2022), but there is no uniformity, which makes comparisons between different studies and comprehensive analyses difficult. Meanwhile, there are extensive studies on firm performance evaluation in the existing literature, but research on comprehensive performance evaluation for Chinese listed manufacturing firms is still relatively limited. As an important pillar of the Chinese economy, the construction of a performance evaluation system for the manufacturing sector is of great significance, but research in this area has not yet been fully developed.

The contribution of this study is mainly manifested in the following two aspects: firstly, based on the multi-dimensional and multi-indicator analysis method, it establishes a comprehensive performance evaluation system applicable to listed manufacturing firms, which enriches the theoretical research on the comprehensive performance evaluation of manufacturing firms; secondly, it provides an in-depth discussion on the performance of firms in different regions of China in terms of comprehensive performance, revealing the key factors that affect the firm's performance and offering valuable references for firms' practice.

Literature Review

In recent years, there has been rich research literature related to firm performance evaluation systems. It is found that there are numerous indicators used by scholars to measure firm performance, and there is no uniform standard. Scholars (Ali *et al.*, 2022; Arif, Isa, & Mustapha, 2023; Homburg & Wielgos, 2022) employ a single indicator measure, asserting that ROA primarily determines the firm's performance. There is a combined measure using multiple indicators (Cahyono & Ardianto, 2024) that argues that firm performance is determined by two indicators: return on assets and return on equity. By analyzing the data of 1,151 non-financial companies listed on the Indonesian Stock Exchange during the period from 2018 to 2022, the study analyzes the relationship that exists between intellectual capital and firm performance. (Carnini *et al.*, 2022) contend that two indicators, EBITDA and ROA, serve as the primary measures of firm performance. Xu & Li (2022) measure firm performance in terms of EBIT, ROA, and ROE, and investigate the interrelationship between intellectual capital and firm performance. (Farooq, Noor, & Ali, 2022; Ghardallou, 2022, consider return on assets, return on equity, and Tobin's Q three factors as the primary measures of firm performance. Here are also some scholars who

measure firm performance from the perspective of financial indicators. Five corporate governance mechanisms are examined on two financial performance indicators, return on assets and Tobin's Q, employing cross-sectional regression methodology (Kyere & Ausloos, 2021). Gross profit margin, cost expense ratio and total asset turnover are selected to measure the overall economic performance of listed companies (Peng & Tao, 2022). Based on the three major indicators of financial statements, namely, cost and expense, solvency and operating ability, the operating performance of information service companies is discussed to provide basis for management to make operational decisions (Lee, 2023). Finally, some scholars measure firm performance using a combination of financial and non-financial synthesis. Panno (2020) Choose a consistent set of financials, such as net profit, profitability ratio, available room revenue, occupancy rate, and some cost-benefit ratio. As well as non-financial metrics such as customer satisfaction, number of complaints, number of new and repeat customers, and employee competence. Used to track hotel performance. Arabeche *et al.* (2022) used four indicators to measure firm performance: financial performance, community performance, sustainable development performance, and customer performance.

In summary, this study combines the new trend of China's firm development in recent years, takes the manufacturing industry as the research point, constructs the index system of the comprehensive performance of listed manufacturing firms, and carries out empirical analyses to make up for the deficiencies in the existing research on the comprehensive performance of firms involving relevant studies on the performance of firms in the manufacturing industry.

Selection and Evaluation of Comprehensive Performance Indicators for Listed Manufacturing Firms

Selection of Performance Evaluation Indicators

Factor analysis employs a limited number of factors to depict the relationship between numerous indicators or factors. This entails grouping several closely related variables into a single category, and each category of variables serves as a factor. This approach reflects the majority of the original data with a reduced number of factors (Shrestha, 2021). Considering the availability and completeness of data for a comprehensive evaluation of firm performance, the selection of evaluation indicators is primarily based on Lee's (2023) research on firm performance. Furthermore, key indicators for the financial analysis of listed manufacturing firms in 2023, as presented by the Oriental Wealth Network, are also referenced. Following a detailed review and sorting process, 4 first-level indicators and 12 second-level indicators were identified, as shown in Table 1.

Table 1: Comprehensive Performance Evaluation Indicators for Listed Manufacturing Firms

No.	1st Level Indicators	2nd Level Indicators
1	Profitability	X ₁ : return on equity
		X ₂ : net interest rate on total assets
		X ₃ : return on invested capital
2	Solvency	X ₄ : current ratio
		X ₅ : <i>cash ratio</i>
		X ₆ : quick ratio
3	Operating Capability	X ₇ : current asset turnover ratio
		X ₈ : total asset turnover
		X ₉ : working capital turnover ratio
4	Growth Capacity	X ₁₀ : year-on-year growth rate of total assets
		X ₁₁ : year-on-year growth rate of total operating revenue
		X ₁₂ : year-on-year growth in total operating costs

Sample Sources and Data Processing

Based on the Oriental Wealth Choice database, the data of listed firms in China's Shanghai and Shenzhen A-share manufacturing industries in the year 2023 is used as the research sample. During the sample selection process, firms labeled as ST (Special Treatment) and *ST were excluded, and firms with missing data were excluded, resulting in a final data sample of 1983 firms. SPSS 24.0 software was used to process the collected data information. In order to ensure the accuracy and comparability of the data, the data were first standardized to eliminate the influence of the quantitative outline on the analysis results.

Data Validity Tests

In order to examine the degree of authenticity of the design indicators to the measurement of content, this study carried out a validity test of the indicator data. The results show that the KMO value of the data indicators is 0.805, and the Bartlett's test of sphericity value is 20938.407, corresponding to the *P*-value of 0.000, through the test of significance, which indicates that the indicators are of good validity and are suitable for factor analysis. As shown in Table 2.

Table 2: KMO and Bartlett's Test

Items		Value
KMO number of sampling suitability measures		0.805
Bartlett's test of sphericity	Approximate chi-square	20938.407
	Degree of freedom	66
	Significance	0.000

Analysis of Empirical Evaluations

According to the correlation coefficient matrix of the original variables, the factors were extracted using principal component analysis. The results show that the cumulative variance contribution rate of the four factors reaches 75.723%, indicating that the four extracted factors can better express the information embedded in the 12 secondary indicators in the original data. As shown in Table 3.

Table 3: Total Variance Explained

Component	Initial Eigenvalues			Extracting the Sum of Squared Loads			Rotating Load Sum of Squares		
	Total	Percentage of variance/%	accumulative /%	Total	Percentage of variance/%	accumulative /%	Total	Percentage of variance /%	accumulative /%
1	3.437	28.639	28.639	3.437	28.639	28.639	2.991	24.927	24.927
2	2.801	23.341	51.980	2.801	23.341	51.980	2.755	22.960	47.886
3	1.497	12.471	64.451	1.497	12.471	64.451	1.730	14.418	62.304
4	1.353	11.272	75.723	1.353	11.272	75.723	1.610	13.418	75.723
5	0.958	7.986	83.708						
6	0.704	5.863	89.571						
7	0.637	5.307	94.878						
8	0.257	2.143	97.021						
9	0.224	1.869	98.890						
10	0.072	0.604	99.494						
11	0.045	0.372	99.866						
12	0.016	0.134	100.000						

Extraction Method: Principal Component Analysis.

After rotating the component matrix, the principal component 1 with the highest correlation is X_6 、 X_4 、 X_5 , which is defined as the solvency of listed manufacturing firms; the principal component 2 with the highest correlation is X_3 、 X_2 、 X_1 , which is defined as the profitability of listed manufacturing firms; the principal component 3 with the highest correlation is X_8 、 X_7 、 X_9 , which is defined as the operating capacity of listed manufacturing firms; the principal component 4 with the highest correlation is X_{12} 、 X_{11} 、 X_{10} , which is defined as the growth capacity of listed manufacturing firms. As shown in Table 4.

Table 4 Component Matrix after Rotation*

Items	1	2	3	4
X_6 : quick ratio	0.984	0.080	-0.076	0.002
X_4 : current ratio	0.979	0.078	-0.071	0.000
X_5 : cash ratio	0.969	0.066	-0.053	-0.004
X_3 : return on invested capital	0.040	0.969	0.059	0.127
X_2 : net interest rate on total assets	0.157	0.925	0.047	0.155
X_1 : return on equity	0.032	0.913	0.016	0.070
X_8 : total asset turnover	-0.134	0.134	0.900	0.061
X_7 : current asset turnover ratio	-0.217	-0.033	0.885	-0.010
X_9 : working capital turnover ratio	0.053	0.007	0.332	-0.001
X_{12} : year-on-year growth in total operating costs	-0.045	-0.079	-0.049	0.758
X_{11} : year-on-year growth rate of total operating revenue	-0.082	0.187	0.061	0.707
X_{10} : year-on-year growth rate of total assets	0.145	0.221	0.035	0.697
*Rotation has converged after 5 iterations. Extraction method: principal component analysis. Rotation method: kaiser normalized maximum variance.				

Comparing with the construction of comprehensive performance evaluation indexes of firms in the previous section, the indicator variables included in the factors this time have not changed (only the order has been slightly adjusted), and the significance represented is relatively concentrated and prominent, which is in line with the expectation. After collating and calculating the weights of the factors, the comprehensive performance evaluation index system of listed manufacturing firms is finally determined and constructed, as shown in Table 5.

Table 5 Comprehensive Performance Evaluation Index System of Listed Manufacturing Firms

No.	1st Level Indicators	2nd Level Indicators	Factor Weight
1	Solvency	X_6 : quick ratio	0.3292
		X_4 : current ratio	
		X_5 : cash ratio	
2	Profitability	X_3 : return on invested capital	0.3032
		X_2 : net interest rate on total assets	
		X_1 : return on equity	
3	Operating Capability	X_8 : total asset turnover	0.1904
		X_7 : current asset turnover ratio	
		X_9 : working capital turnover ratio	
4	Growth Capacity	X_{12} : year-on-year growth in total operating costs	0.1772
		X_{11} : year-on-year growth rate of total operating revenue	
		X_{10} : year-on-year growth rate of total assets	

Table 6: The Matrix of Component Score Coefficients Was Obtained Using Regression, As Shown in

Items	1	2	3	4
X_1	-0.049	0.359	-0.045	-0.079
X_2	0.001	0.341	-0.014	-0.022
X_3	-0.044	0.371	-0.022	-0.049
X_4	0.341	-0.031	0.057	0.001
X_5	0.340	-0.036	0.068	-0.001
X_6	0.342	-0.031	0.054	0.002
X_7	0.019	-0.053	0.525	-0.019
X_8	0.040	-0.001	0.531	0.007
X_9	0.054	-0.022	0.210	-0.006
X_{10}	0.048	-0.018	0.013	0.438
X_{11}	-0.029	-0.019	0.006	0.446
X_{12}	-0.008	-0.131	-0.042	0.519

Extraction method: principal component analysis. Rotation method: Kaiser normalized. maximum variance.

Based on Table 6, the score function for a single common factor F_i ($i=1, 2, 3, 4$) was analysed and obtained:

$$F_1 = -0.049X_1 + 0.001X_2 + \dots - 0.008X_{12} \quad (1)$$

$$F_2 = 0.359X_1 + 0.341X_2 + \dots - 0.131X_{12} \quad (2)$$

$$F_3 = -0.045X_1 - 0.014X_2 + \dots - 0.042X_{12} \quad (3)$$

$$F_4 = -0.079X_1 - 0.022X_2 + \dots + 0.519X_{12} \quad (4)$$

From the principal components rotated sum of squares loaded into the corresponding variance contribution ratio as weights, the evaluation function (regression equation) of the comprehensive performance of listed manufacturing firms is constructed as:

$$F = 0.3292F_1 + 0.3032F_2 + 0.1904F_3 + 0.1772F_4 \quad (5)$$

Where F is the comprehensive performance score of listed manufacturing firms and F_i ($i=1, 2, 3, 4$) is the score of each factor.

The scores of the above factors are brought into the evaluation function to evaluate the comprehensive performance of the firm.

Comprehensive Performance Evaluation of Listed Manufacturing Firms

Table 7 shows the distribution table of the comprehensive performance scores of the 1983 listed manufacturing firms in China in the year 2023. It was made using the modified indicator system and the firm's comprehensive performance evaluation function formula from the previous section.

In terms of comprehensive performance scores, among the 1983 listed manufacturing firms in the A-share market, there are only 2 firms with scores more than or equal to 4; there are only 2 firms with scores between 3 and 4; there are 10 firms with scores between 2 and 3; there are 48 firms with scores between 1 and 2; there are 856 firms with scores between 0 and 1; there are 1018 firms with scores between -1 and 0; and there are 47 firms with scores between -2 and -1. There are 918 firms with scores more than 0, accounting for 46.29%, indicating that the comprehensive performance level of these firms is higher than the average level of the industry; there are 1,065 firms with scores less than 0, accounting for 53.71%, indicating that the comprehensive performance level of these firms is lower than the average level of the industry; the number of firms with scores less than 0 is more than the number of firms with scores more than 0, and the median of the firms' comprehensive performance scores is -0.0301, indicating that the overall performance level of Chinese listed manufacturing firms is still low.

Table 7: Distribution of Firms' Comprehensive Performance Score, 2023

Firm Comprehensive Performance Score Range	Number of Firms	Percentage	Median Comprehensive Performance Score for Firms	No. of firms with a comprehensive performance score more than 0	No. of firms with a comprehensive performance score of less than 0
≥4	2	0.1%	-0.0301	918	1065
≥3 and <4	2	0.1%			
≥2 and <3	10	0.5%			
≥1 and <2	48	2.42%			
≥0 and <1	856	43.17%			
≥-1 and <0	1018	51.34%			
≥-2 and <-1	47	2.37%			

According to the Oriental Wealth Choice database's division of regions (excluding Hong Kong, Macao, and Taiwan), Northeast China includes Liaoning, Jilin, and Heilongjiang; South China includes Guangdong, Guangxi, Hainan, Hunan, and Hubei; East China includes Anhui, Fujian, Jiangsu, Jiangxi, Zhejiang, Shandong, and Shanghai; North China includes Beijing, Hebei, Henan, Inner Mongolia, Shanxi, and Tianjin; Northwest China includes Gansu, Ningxia, Xinjiang, Qinghai, and Shaanxi; and Southwest China includes Tibet, Guizhou, Chongqing, Sichuan, and Yunnan. The number of firms and average comprehensive performance scores for each region are shown in Table 8.

Table 8: Average Comprehensive Performance Scores of Firms from Different Regions

Region	No. of Firms	Average Comprehensive Performance Score
Southwest China	136	0.0702
East China	1073	0.0203
South China	409	-0.0063
North China	217	-0.0222
Northeast China	68	-0.1359
Northwest China	80	-0.1837

From the perspective of regional distribution of the number of firms, the regional distribution of manufacturing firms is wide. East China and South China are the two regions with the most listed manufacturing firms in China, reaching 1,073 and 409, respectively, and the least number of manufacturing firms is in Northeast China, with only 68 firms. From the point of view of the average comprehensive performance score of firms, the level of comprehensive performance of firms in different regions shows some differences; only the Southwest region and East China have positive comprehensive performance, respectively 0.0702 and 0.0203, with the number of firms reaching 136 and 1073, indicating that the level of comprehensive performance of manufacturing firms in Southwest China and East China is relatively high. The comprehensive performance of firms in South China, North China, Northeast China, and Northwest China is negative, respectively -0.0063, -0.0222, -0.1359, and -0.1837. On the whole, the number of firms and the level of performance of China's manufacturing industry are still unbalanced and with a large gap.

The comprehensive performance scores of firms with different factors show a large variation, as shown in Table 9.

Table 9: Scores of Listed Manufacturing Firms on Each Factor

Firms factor score	1	2	3	4
	Solvency	Profitability	Operating Capability	Growth Capacity
≥0	556	1064	768	872
<0	1427	919	1215	1111
Percentage of firms with a score <0	71.97%	46.34%	61.27%	56.03%

From the perspective of each factor score of the firms, there are 1,427 firms with solvency scores less than 0, 919 firms with profitability scores less than 0, 1,215 firms with operating capability scores less than 0, and 1,111 firms with growth capability scores less than 0. This indicates that listed manufacturing firms are weaker in the areas of solvency, operating capability, and growth capability in the year 2023, with 71.97%, 61.27%, and 56.03% of firms with performance scores less than average, while relatively strong in profitability, with only 46.34% of firms with performance scores less than 0.

The average scores for each factor in the different regions also show large differences, as shown in Table 10.

Table 10 Average Scores of Listed Manufacturing Firms in Different Regions on Each of the Factors

Region	Average			
	Solvency	Profitability	Operating Capability	Growth Capacity
Northeast China	-0.2266	-0.2718	0.2082	-0.1048
South China	-0.0027	-0.0627	0.0542	0.0184
East China	0.0126	0.0468	-0.0162	0.0286
North China	-0.0071	0.0516	-0.0342	-0.1633
Northwest China	0.0077	-0.3263	-0.2574	-0.2159
Southwest China	0.0290	0.0651	0.0669	0.1592

Looking vertically, in terms of solvency, Southwest, East China, and Northwest China perform better overall, with Northeast being the weakest; in terms of profitability, Southwest, North China, and East China score positively, suggesting that their overall performance is better, while Northeast and Northwest perform poorly; in terms of operating capacity, Northeast, Southwest, and South China are above average, but East China, North China, and Northwest China are below average; in terms of growth capability, the best performers are the Southwest, East China, and South China regions, respectively, while the worst performers are the Northeast, North China, and Northwest regions.

Looking horizontally, only Southwest China has positive scores in solvency, profitability, operating capability, and growth capability, followed by East China with positive scores in solvency, profitability, and growth capability but negative scores in operating capability. The Northeast, North, and Northwest regions all have negative scores for three factors.

Discussion

Discussion on the Distribution of Comprehensive Performance Scores of Firms in the Year 2023

In terms of the distribution of firms' comprehensive performance scores, there are significant differences in the comprehensive performance of Chinese listed manufacturing firms, with only a very small number of firms exhibiting very high performance, while most firms' comprehensive performance scores are concentrated in the lower range. This reflects the fact that Chinese manufacturing firms have more room for improvement in terms of business management and performance enhancement. Reasons for lower firm performance may include inefficient organisational management (Shan & Qiu, 2022), insufficient technological innovation capability (Steil, Victor, & Nelson, 2021), intense market competition, and changes in the policy environment (Liu *et al.*, 2022).

The percentage of firms with scores more than 0 is 46.29%, while the percentage of firms with scores less than 0 is 53.71%, indicating that the performance level of most firms is lower than the industry average. Although some firms have performed relatively well in terms of business management, overall, Chinese listed manufacturing firms still need to make more efforts to improve their comprehensive performance.

The median comprehensive performance score of firms is -0.0301, further indicating that most firms perform below expectations. This phenomenon may reflect some common problems faced by the industry as a whole, such as the adjustment of industrial structure (Ma & Zhu, 2022), the urgency of technological upgrading (Steil, Victor & Nelson, 2021), and the uncertainty of the international market (Sadeh & Dvir, 2020).

Discussion of Regional Distribution and Level of Performance

Overall, there are still large regional disparities in the number and performance levels of Chinese manufacturing firms.

The relatively high comprehensive performance of firms in East and Southwest China is mainly due to the fact that East China, as one of the most economically developed regions in China, is endowed with abundant resources, good infrastructure, and high-quality talents and has formed a relatively well-developed industrial chain and supply chain. Southwest China has made significant progress in policy support and infrastructure development in recent years, attracting a large number of investments and talents. Southwest China has made remarkable progress in recent years in terms of policy support and innovation capacity enhancement. The supportive policies of the government, the cooperation of research institutions, and the innovation investment of firms have provided a strong guarantee for the growth and development of manufacturing firms (Steil, Victor, & Nelson, 2021). With strong market demand and a better competitive environment in East and Southwest China, firms are able to continuously improve their comprehensive performance in the fierce market competition (Liu *et al.*, 2022).

In contrast, the comprehensive performance of firms in South China, North China, and Northeast and Northwest China is lower, mainly due to the following reasons: these regions are facing greater challenges in the process of economic restructuring and industrial upgrading, and the competitiveness of some traditional industries has declined, resulting in a low level of overall performance (Ma & Zhu, 2022). The Northeast and Northwest regions have certain constraints in terms of resources and environment, which affect the development potential of manufacturing firms (Choi, Lee, & Kang, 2020). Although the government has introduced a series of policies to support the development of the manufacturing industry, there are some problems in the implementation and enforcement process, resulting in the effects of the policies failing to fully emerge.

Discussion of Sub-Indicators

Weak solvency of firms. This may be due to a number of factors, including excessive debt ratios, poor cash flow management, and the impact of the macroeconomic environment. This finding reminds firms that they need to focus on optimizing their financial structure, reducing debt ratios, and improving the stability of cash flows to enhance their solvency.

The profitability of firms is relatively strong. It indicates that firms are able to achieve relatively solid profitability through effective cost control, innovation, and market expansion. However, close to half of the firms still performed poorly in terms of profitability, indicating that while the overall profitability level of the industry is relatively good, some firms may have deficiencies in operation management and market competitiveness, which need to be further improved.

Poor operational and growth capabilities. The data reflect widespread problems with operational efficiency and growth potential among manufacturing firms. Weak operating capability may be caused by inefficient production, poor inventory management, and supply chain issues, while insufficient growth capability may be related to a firm's innovation capability, market expansion strategy, and investment capacity.

Overall, although some firms are performing better in terms of profitability, on the whole, Chinese listed manufacturing firms still need to improve significantly in terms of solvency, operating capability, and growth capability. It is difficult to ensure long-term stable development by relying on profitability alone.

Firms need to find a balance between the various capabilities, especially by strengthening their focus on financial structure, operational management, and strategic development.

Discussion on Regional Comprehensive Capability

The vertical comparison shows that there are significant differences in comprehensive performance between regions. It reflects the impact of the level of regional economic development and industrial structure on firm performance. The Southwest region has experienced rapid economic development in recent years, and manufacturing firms have achieved some success in their operations and management, while the Northeast region faces the challenges of economic transformation and structural adjustment, and the performance of firms has been affected to some extent as a result.

The horizontal comparison shows that the Southwest region has positive comprehensive performance scores on all four dimensions, indicating that it has a strong competitive advantage overall. The East China region scores negatively on operational capability but still performs relatively well on the other three dimensions. In contrast, the Northeast, North China, and Northwest regions have negative scores on several dimensions, reflecting that manufacturing firms in these regions have significant shortcomings in comprehensive performance and need to take targeted measures to improve their overall competitiveness.

Limitation of the Study

This study uses a sample of Chinese Shanghai and Shenzhen A-share listed manufacturing industries in 2023, which is a single source of data and a short time span. Although such a sample design is able to reflect the performance level of Chinese manufacturing firms in a specific time period, it is unable to comprehensively show the performance of firms in different economic cycles and market environments and lacks a grasp of the long-term trend.

The performance evaluation indicators selected for this study mainly focus on financial indicators, such as profitability, solvency, operational capability and growth capability, while non-financial indicators, such as innovation capability, social responsibility and environmental performance, are not adequately included. Although financial indicators can objectively reflect an enterprise's operating conditions, ignoring non-financial factors may lead to an insufficiently comprehensive assessment of a firm's comprehensive performance. The performance of a firm in terms of sustainable development and social contribution cannot be adequately captured.

In this study, principal component analysis was used to extract the key factors affecting firm performance, but the subjectivity of this method in the process of factor selection and rotation may lead to uncertainty in the results.

Conclusion

Based on the above empirical analyses and discussions, the following four conclusions are drawn:

First, under the background of profound changes in the global economy and industrial restructuring, the overall performance level of Chinese listed manufacturing firms remains low. Only a very small number of firms exhibit very high performance, while the majority of firms' comprehensive performance scores are concentrated in the lower range. Second, the number and performance levels of Chinese manufacturing firms remain uneven and disparate. East China and South China are the two regions with the highest concentration of manufacturing firms in China. The comprehensive performance scores of firms in Southwest China and East China are positive, while those in South China, North China, Northeast China, and Northwest China are all negative. Third, the comprehensive performance scores of firms with different factors, show large differences. Chinese listed manufacturing firms are weak in terms of solvency, operating capability, and growth capability, while they are relatively strong in terms of profitability. Fourth, the average scores of the factors in different regions show significant differences. The Southwest region has positive scores on the four dimensions of solvency, profitability, operational capability, and growth capability, indicating superior comprehensive performance. In contrast, the

Northeast, North China, and Northwest regions have negative scores on three factors, indicating that these regions have significant deficiencies in comprehensive firm performance.

Future study may consider increasing the time span and adopting panel data analysis in order to study the dynamic trend of firm performance and the factors influencing it in the long run, so as to improve the generalizability and extrapolation of the findings.

In future study, the inclusion of more non-financial indicators will be considered in order to construct a more comprehensive firm performance evaluation system.

In future study, causal analysis methods such as structural equation modelling, panel data modelling or instrumental variable method can be combined in order to explore the causal relationship between performance factors and firm performance. This will help to validate the correlations found in this study and further reveal the specific paths of factor influence on firm performance, providing a scientific basis for firm performance improvement.

Significance of the Study

This study constructs a comprehensive performance evaluation system applicable to listed manufacturing firms in China. It enriches the theoretical research on firm performance evaluation, especially providing a new perspective on the performance evaluation of manufacturing firms. In addition, the multi-dimensional and multi-indicator approach to evaluation provides a scientific and reasonable indicator system for the evaluation of comprehensive performance of firms and promotes the improvement and development of performance evaluation methods.

The results of the study provide a reference for manufacturing firms to identify their strengths and weaknesses, which will help them to adopt targeted strategies to improve their comprehensive performance. The study reveals inter-regional differences in performance, provides data support for the government's formulation of regional industrial policies, and helps to promote balanced regional economic development. Through the scientific evaluation of firm performance, the study provides investors and managers with decision-making references and promotes the optimal allocation of resources and the long-term healthy development of firms.

Recommendations

Based on the findings of the study, the following four recommendations are made:

First, the overall performance level of manufacturing firms should be raised. Upgrading enterprise technology and management through government support, technological innovation, financial subsidies, tax incentives and the introduction and training of highly qualified personnel. Enterprises are encouraged to explore international markets and participate in global supply chains in order to enhance international competitiveness and overall enterprise performance.

Second, narrowing the performance gap between regions. The Government should formulate differentiated industrial policies, in particular to increase resource inputs and policy support for weak manufacturing regions such as the northeast and northwest, improve infrastructure conditions, promote regional cooperation and coordinated industrial development, and narrow the performance gap between regions.

Third, strengthening the solvency and operational capability of firms. Enhance the level of financial management, optimize the capital structure, control the debt ratio, strengthen risk management, and improve operational efficiency and risk resistance. Through the introduction of professional consultants and advanced management techniques, we will enhance the solvency and operational efficiency of the enterprise.

Fourth, promoting the balanced development of interregional factors. According to the characteristics of each region, formulate supportive policies tailored to local conditions, and promote the transformation and upgrading of traditional manufacturing industries to high-end manufacturing industries. Strengthening regional scientific and technological innovation capacity, increasing investment in

research and development, upgrading the level of talent training, optimizing the industrial structure and promoting the overall competitiveness of the region.

Conflict of Interest

The authors declare that they have no conflict of interests.

Acknowledgement

The authors are thankful to the institutional authority for completion of the work.

References

- Aceto, G., Persico, V., & Pescapé, A. (2020). Industry 4.0 and health: Internet of things, big data, and cloud computing for healthcare 4.0. *Journal of Industrial Information Integration*, 18, 100129. <https://doi.org/10.1016/j.jii.2020.100129>
- Ali, A., Alim, W., Ahmed, J., & Nisar, S. (2022). Yoke of corporate governance and firm performance: A study of listed firms in Pakistan. https://mpr.ub.uni-muenchen.de/113579/1/MPRA_paper_113579.pdf
- Arabeche, Z., Soudani, A., Brahmi, M., Aldieri, L., Vinci, C. P., & Abdelli, M. E. A. (2022). Entrepreneurial orientation, organizational culture and business performance in SMEs: Evidence from emerging economy. *Sustainability*, 14(9), 5160. <https://doi.org/10.3390/su14095160>
- Arif, K., Isa, C. R., & Mustapha, M. Z. (2023). Do Powerful CEOs Benefit Firm Performance in Pakistan? *Asian Journal of Business and Accounting*, 16(2), 75–106. <https://doi.org/10.22452/ajba.vol16no2.3>
- Cahyono, S., & Ardianto, A. (2024). Intellectual Capital, Political Connection, and Firm Performance: Exploring from Indonesia. *Risks*, 12(7), 105. <https://doi.org/10.3390/risks12070105>
- Carnini Pulino, S., Ciaburri, M., Magnanelli, B. S., & Nasta, L. (2022). Does ESG disclosure influence firm performance? *Sustainability*, 14(13), 7595. <https://doi.org/10.3390/su14137595>
- Choi, S. B., Lee, W. R., & Kang, S. W. (2020). Entrepreneurial orientation, resource orchestration capability, environmental dynamics and firm performance: A test of three-way interaction. *Sustainability*, 12(13), 5415. <https://doi.org/10.3390/su12135415>
- Farooq, M., Noor, A., & Ali, S. (2022). Corporate governance and firm performance: empirical evidence from Pakistan. *Corporate Governance: The International Journal of Business in Society*, 22(1), 42-66. <https://doi.org/10.1108/CG-07-2020-0286>
- Ghardallou, W. (2022). Corporate sustainability and firm performance: the moderating role of CEO education and tenure. *Sustainability*, 14(6), 3513. <https://doi.org/10.3390/su14063513>
- Hanci-Donmez, T., & Karacay, G. (2019). High-performance human resource practices and firm performance: mediating effect of corporate entrepreneurship. *International Journal of Organizational Leadership*, 8, 63-77. <https://ssrn.com/abstract=3337660>
- Homburg, C., & Wielgos, D. M. (2022). The value relevance of digital marketing capabilities to firm performance. *Journal of the Academy of Marketing Science*, 50(4), 666-688. <https://doi.org/10.1007/s11747-022-00858-7>
- Hsu, L. C., Ou, S. L., & Ou, Y. C. (2015). A Comprehensive performance evaluation and ranking methodology under a sustainable development perspective. *Journal of Business Economics and Management*, 16(1), 74-92. <https://doi.org/10.3846/16111699.2013.848228>
- Huang, K., Wang, K., Lee, P. K., & Yeung, A. C. (2023). The impact of industry 4.0 on supply chain capability and supply chain resilience: A dynamic resource-based view. *International Journal of Production Economics*, 262, 108913. <https://doi.org/10.1016/j.ijpe.2023.108913>
- Kyere, M., & Ausloos, M. (2021). Corporate governance and firm's financial performance in the United Kingdom. *International Journal of Finance & Economics*, 26(2), 1871-1885. <https://doi.org/10.1002/ijfe.1883>
- Lee, C.-C. (2023). Analyses of the operating performance of information service companies based on indicators of financial statements. *Asia Pacific Management Review*, 28(4), 410-419. <https://doi.org/10.1016/j.apmr.2023.01.002>
- Li, Q., Liu, L. G., & Shao, J. B. (2021). The Effects of Digital Transformation and Supply Chain Integration On Firm Performance: The Moderating Role of Entrepreneurship. *Business and Management Journal*, 43(10), 5-23. <https://doi.org/10.3868/s070-007-022-0022-6>
- Liu, Q., Qu, X., Wang, D., Abbas, J., & Mubeen, R. (2022). Product Market Competition and Firm Performance: Business Survival Through Innovation and Entrepreneurial Orientation Amid COVID-19 Financial Crisis. *Frontiers in Psychology*, 12, 790923. <https://doi.org/10.3389/fpsyg.2021.790923>

Ma, D., & Zhu, Q. (2022). Innovation in Emerging Economies: Research On the Digital Economy Driving High-Quality Green Development. *Journal of Business Research*, 145, 801-813. <https://doi.org/10.1016/j.jbusres.2022.03.041>

Panno, A. (2020). Performance measurement and management in small companies of the service sector; evidence from a sample of Italian hotels. *Measuring Business Excellence*, 24(2), 133-160. <https://doi.org/10.1108/MBE-01-2018-0004>

Peng, Y., & Tao, C. (2022). Can Digital Transformation Promote Enterprise Performance? —From The Perspective Of Public Policy And Innovation. *Journal of Innovation & Knowledge*, 7(3), 100198. <https://doi.org/10.1016/j.jik.2022.100198>

Rezaei, J., & Ortt, R. (2018). Entrepreneurial Orientation and Firm Performance: The Mediating Role of Functional Performances. *Management Research Review*, 41(7), 878-900. <https://doi.org/10.1108/MRR-03-2017-0092>

Sadeh, A., & Dvir, D. O. V. (2020). The Effect of Technological Risk, Market Uncertainty and The Level of Complexity ON New Technology Ventures'success. *International Journal of Innovation Management*, 24(05), 2050047. <https://doi.org/10.1142/S1363919620500474>

单慧敏, & 邱羚. (2022). 高管激励视角下制造业企业组织冗余对企业绩效的影响作用研究.[Research on the Influence of Organizational Slack on Enterprise Performance of Manufacturing Enterprises from the Perspective of Executive Incentives]. *Advances in Applied Mathematics*, 11, 7738. <https://doi.org/10.12677/AAM.2022.1111818>

Shrestha, N. (2021). Factor Analysis as A Tool for Survey Analysis. *American journal of Applied Mathematics and statistics*, 9(1), 4-11. <https://doi.org/10.12691/ajams-9-1-2>

Steil, B., Victor, D. G., & Nelson, R. R. (Eds.). (2002). *Technological Innovation and Economic Performance*. Princeton University Press. United States.

Xu, J., & Li, J. (2022). The Interrelationship Between Intellectual Capital and Firm Performance: Evidence from China's Manufacturing Sector. *Journal of Intellectual Capital*, 23(2), 313-341. <https://doi.org/10.1108/JIC-08-2019-0189>