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Research on the Financial Performance Evaluation of Machinery Manufacturing Enterprises Based on the Entropy Value Method

Zhufeng Bai*

Shandong University of Technology, Zibo 255000, China

Corresponding author: Zhufeng Bai, 2507391579@qq.com

Abstract: As a key sector in advancing China's "carbon neutrality" goal, the machinery manufacturing industry has achieved remarkable development in recent years. Against this backdrop, the scientific and objective evaluation of the financial performance of machinery manufacturing enterprises has become a pressing issue in financial research. This topic is not only crucial for optimizing enterprise management and improving operational efficiency but also essential for enhancing overall industry performance and promoting sustainable development. This paper first introduces the concept of financial performance, followed by an analysis of related financial performance evaluation theories. It then focuses on the application of the entropy method in evaluating the financial performance of machinery manufacturing enterprises, detailing its analytical steps. Finally, a financial performance evaluation index system is constructed based on four dimensions: profitability, solvency, operational efficiency, and growth potential.

Keywords: Financial performance evaluation; Machinery manufacturing enterprises; Entropy value method; Enterprise management; Sustainable development

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1. Introduction

The evaluation of enterprise financial performance is not only an internal requirement for business development but also an external necessity with far-reaching implications for social stakeholders. With the rapid expansion of the market economy, machinery manufacturing enterprises are encountering unprecedented growth opportunities, characterized by increasing market demand and a surge in the number of enterprises. Given the substantial and frequent capital flows in the daily operations of these enterprises, financial management capabilities play a decisive role in their long-term stability and success. In this context, selecting scientific and rational evaluation methods and establishing a comprehensive financial index system is of great significance for conducting in-depth financial performance assessments. This paper focuses on machinery manufacturing enterprises, providing a detailed analysis of evaluation methods and the construction of a financial index system, with the aim of offering a solid theoretical foundation for future enterprise financial assessments.

2. The concept of financial performance

Financial performance refers to the financial outcomes and achievements generated by an enterprise through its production and operational activities within a specific accounting period. It comprehensively reflects the enterprise's operating conditions, results, and overall efficiency. Financial performance is generally evaluated across four key dimensions: profitability, which measures income generation; operational efficiency, which assesses management effectiveness; solvency, which evaluates the enterprise's ability to meet short- and long-term debt obligations; and risk resilience, which reflects the capacity to withstand uncertainties. Analyzing financial performance provides insights into an enterprise's operational status, development trends, and potential challenges, serving as a valuable reference for decision-making. Therefore, financial performance is not only a quantitative representation of an enterprise's financial condition but also a crucial indicator of its actual standing and future potential.

3. Financial performance evaluation-related theories

3.1. Contingency theory

The term "contingency" refers to the ability to adapt flexibly to various situations. Contingency theory, originating from the Western empiricism school, emphasizes that each organization possesses unique characteristics, and even under similar external conditions, internal differences persist. As a result, a single theoretical approach cannot be universally applied to all organizations. Contingency theory highlights the importance of considering the diversity of market environments and internal enterprise conditions, underscoring the complexity of constructing a financial performance evaluation system that is universally applicable. Therefore, when developing a financial performance evaluation framework, machinery manufacturing enterprises should integrate industry-specific characteristics and the prevailing market environment to establish a system tailored to their operational needs.

3.2. Strategic management theory

The theory of strategic management has evolved from classical strategy theory to competitive strategy theory and, subsequently, to strategic ecology theory, forming a well-established theoretical framework. As a fundamental pillar of enterprise management, strategic management enables enterprises to identify their position in an increasingly dynamic market environment, strengthen their core competencies, and enhance their competitive advantage, thereby ensuring long-term sustainability in the industry. Financial performance evaluation, as a critical tool for assessing operational effectiveness, not only reflects an enterprise's economic benefits but also serves as a benchmark for evaluating the success of strategic management. Consequently, machinery manufacturing enterprises increasingly regard financial performance evaluation as an essential component of enterprise management.

4. Financial performance evaluation methods

4.1. Principal component analysis method

Principal component analysis (PCA) is a highly practical statistical method primarily used to simplify complex multivariate data sets. Through dimensionality reduction, PCA transforms multiple overlapping indicators into a few comprehensive indicators, with each principal component reflecting distinct information from the original data. Jia *et al.* applied PCA to reduce the dimensionality of 10 indicators, including the asset growth rate of 45 listed companies providing home-based care services, thereby effectively mitigating the overlap between indicators [1]. Similarly, Lareina *et al.* selected listed pharmaceutical companies and constructed a financial

performance evaluation system from multiple dimensions, using PCA to refine the evaluation indicators [2].

4.2. Entropy method

The entropy method is a valuable mathematical tool for evaluating financial performance. By selecting indicators, standardizing data, calculating information entropy, and determining weights, this method enables a more objective and accurate assessment of the importance and dispersion of each index. Cai selected listed logistics companies as samples and developed a performance evaluation system based on three dimensions: solvency, profitability, and growth potential, utilizing the entropy method [3]. Similarly, Hu conducted research on listed electric power companies and constructed a financial performance evaluation system comprising 15 indicators [4]. After applying the entropy method to determine the weight distribution, it was found that the indicators were well-balanced, with no objective data deficiencies, ensuring the accuracy and reliability of the evaluation results.

4.3. DuPont analysis method

DuPont analysis is a classic financial evaluation method that centers on return on net assets and integrates factors such as asset management, financial leverage, and profitability. This approach provides a comprehensive perspective for assessing a company's financial performance. Meng *et al.* conducted an empirical analysis of the financial performance of express delivery companies using the DuPont analysis method [5]. Additionally, Zhang enhanced the DuPont analysis framework and applied it to performance evaluation in reclassified business sectors [6].

5. Construction of a financial performance evaluation system for machinery manufacturing enterprises based on the entropy method

5.1. Rationale for choosing the entropy method

The financial performance indicators of machinery manufacturing enterprises are primarily quantitative, and the necessary financial data are relatively easy to collect and organize. Additionally, the correlation among indicators within each dimension is low, and the sample size is moderate. Given the potential for subjective judgment bias when dealing with qualitative indicators, selecting a method that minimizes subjective influence and ensures objectivity in evaluation is particularly important. The entropy method is well-suited for this purpose, as it effectively mitigates subjective interference associated with qualitative indicators and determines indicator weights through objective calculations. This enhances the reliability and objectivity of evaluation results while maintaining strong practical applicability. Based on these factors, the entropy method was selected as the approach for measuring financial performance.

5.2. Analysis process of the entropy method

(1) In the analysis of enterprise financial indicators, it is essential to fully consider industry-specific differences that may influence indicator assessment. Given the diversity of financial indicators, they are categorized into positive, negative, and moderate indicators. To ensure comparability across indicators, non-negative transformation and standardization are particularly important. The following section provides a detailed explanation of this process, with specific steps outlined in **Formulas 1–3**.

Positive indicators:

$$x_{ij} = \frac{X_{ij} - min(X_i)}{max(X_i) - min(X_i)} + 0.01 \quad (1)$$

Negative indicator:

$$x_{ij} = \frac{max(X_i) - X_{ij}}{max(X_i) - min(X_i)} + 0.01 \quad (2)$$

Moderate index:

$$x_{ij} = 1 - \frac{|X_{ij} - X_0|}{max(|X_{ij} - X_0|)} + 0.01 \quad (3)$$

where *ij* represents the standardized value, *i* denotes the enterprise, and *j* represents the index serial number. X_0 is the determined standard value, with general standard values set at 1 for the quick ratio, 1 for the equity ratio, and 0.5 for the asset-liability ratio. The addition of 0.01 in the formula prevents a zero-dimensional occurrence, thereby ensuring the smooth progression of subsequent steps.

(2) Calculate the proportion of the index value for the *j*-th indicator in year *i*, as shown in **Formula 4**:

$$y_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \quad (4)$$

(3) Calculate the entropy value of the *j*-th indicator, with specific steps outlined in **Formula 5**:

$$e_j = -\frac{1}{ln(m)} \times \sum_{i=1}^{m} [y_{ij} \times ln(y_{ij})] \quad (5)$$

(4) Calculate the coefficient of variation for the *j*-th indicator, as shown in **Formula 6**:

$$d_j = 1 - e_j \quad (6)$$

(5) Determine the weight of each indicator, as shown in **Formula 7**:

$$w_j = \frac{d_j}{\sum_{j=1}^{n} d_j} \quad (7)$$

(6) Compute the comprehensive score for each year, as shown in **Formula 8**:

$$U_i = \sum_{j=1}^{n} (y_{ij} w_{ij}) \quad (8)$$

5.3. Design principles of the index system

When designing the financial performance evaluation index system, it is essential not only to carefully select performance indicators but also to balance the degree of integration among them. The following core principles should be followed to construct a suitable system:

(1) Prioritization of quantitative indicators, supplemented by qualitative indicators: Financial indicators are highly valued in both domestic and international enterprises due to their quantifiable nature. Quantitative indicators enable clear grading standards, ensuring that evaluation results remain objective and fair, and they are widely applied in various practices. In contrast, qualitative indicators are more susceptible to subjective influence, leading to ambiguous discrimination and lower reliability. Therefore, the index system should prioritize quantitative indicators. If qualitative indicators are introduced, they should be quantified using analytical tools to enhance evaluation objectivity.

(2) Testability principle: This principle requires that each indicator be measurable and practically applicable

in the evaluation process. The availability of indicator data must be assessed, and if data collection proves difficult or if indicators are unpredictable, they should be omitted in favor of more accessible alternatives. This ensures the effective implementation of the evaluation process.

(3) Goal consistency principle: This principle emphasizes that all indicators within the system should collectively support the same overarching performance objectives. Additionally, the selection of indicators should be comprehensive, fully reflecting the sub-goals of the evaluation subject across all dimensions to facilitate the achievement of the overall goal. Ensuring that the index system remains focused and all-encompassing provides a solid foundation for accurately assessing enterprise financial performance.

5.4. Selection of evaluation indicators

The selection of evaluation indicators is a crucial step in constructing a financial performance evaluation system, as it directly determines the accuracy and effectiveness of the system. Based on an extensive review of the literature, 14 financial indicators have been carefully selected across four key dimensions: solvency, operational capacity, profitability, and development ability. These indicators have been chosen in accordance with the financial characteristics and industry background of the machinery manufacturing sector to establish a comprehensive and scientific financial performance evaluation system, as shown in **Table 1**.

Table 1. Financial performance evaluation index system

Primary index	Secondary index	Indicator code
Solvency	Liquidity ratio	A1
	Quick ratio	A2
	Asset-liability ratio	A3
Operating capacity	Receivable turnover ratio	B1
	Inventory turnover	B2
	Turnover of total assets	B3
Profitability	Rate of return on total assets	C1
	Operating profit rate	C2
	Gross profit rate	C3
	Net profit rate	C4
Development ability	Total assets growth rate	D1
	Net assets growth rate	D2
	Operating income growth rate	D3
	Net profit growth rate	D4

The five categories of financial indicators are detailed below.

5.4.1. Solvency

Solvency is a key aspect of enterprise financial analysis and is typically divided into short-term and long-term solvency. To comprehensively evaluate an enterprise's financial stability and sustainable management capability, three representative financial indicators have been selected. In terms of short-term solvency, the current ratio and quick ratio are commonly used measures, while the asset-liability ratio is a key indicator for assessing long-term solvency. These three indicators provide a fundamental assessment of whether an enterprise is financially stable

and capable of sustained operations. They are considered moderate indicators, meaning their values should not be assessed simply as higher or lower but rather in a broader financial context. The calculation formulas for these indicators are presented in **Table 2**.

Table 2. Solvency indicators

Name	Calculation formula	Index property	Indicator code
Liquidity ratio	Current assets / Current liabilities	Appropriate	A1
Quick ratio	Quick assets / Current liabilities	Appropriate	A2
Asset-liability ratio	Total liabilities / Total assets	Appropriate	A3

5.4.2. Operational capacity

The analysis of operational capacity focuses on an enterprise's ability to generate profits through the effective utilization of its assets. This includes the turnover rates of current assets, fixed assets, and total assets. In this study, three key indicators have been selected: total asset turnover, accounts receivable turnover, and inventory turnover. These indicators provide insights into capital utilization and asset liquidity. Since all three are positive indicators, higher values indicate faster asset turnover, improved liquidity, and quicker conversion of assets into profits. The calculation formulas are shown in **Table 3**.

Table 3. Operational capacity indicators

Name	Calculation formula	Index property	Indicator code
Receivable turnover ratio	Net income from main business / Average accounts receivable balance	Forward direction	B1
Inventory turnover	Operating cost / Average inventory balance	Forward direction	B2
Turnover of total assets	Sales revenue / Total assets	Forward direction	B3

5.4.3. Profitability

Profitability is the fundamental measure of an enterprise's ability to generate earnings, which directly impacts its operations and future growth. Common indicators used to assess profitability include the net profit margin, gross profit margin, return on total assets, and return on net assets. In this study, four key indicators have been selected to evaluate an enterprise's profitability. These indicators reflect the firm's ability to generate revenue, its operational efficiency, and the overall profitability of its assets. Since they are all positive indicators, higher values generally indicate stronger profitability. The formulas for these indicators are provided in **Table 4**.

Table 4. Profitability indicators

Name	Calculation formula	Index property	Indicator code
Operating profit rate	Operating profit / Revenue	Forward direction	C1
Gross profit rate	Gross profit / Operating income	Forward direction	C2
Net profit rate	Net profit / Main business income	Forward direction	C3
Rate of return on total assets	Earnings before interest and tax / Average total assets	Forward direction	C4

5.4.4. Development ability

Development ability reflects an enterprise's capacity to expand its scale, accumulate resources, and sustain

long-term growth. This capability is essential for ensuring future value creation and competitiveness. Common indicators of development ability focus on asset growth, profit expansion, and revenue growth. Based on the characteristics of the machinery manufacturing industry and the ease of data collection, four widely used indicators have been selected: total assets growth rate, net assets growth rate, operating income growth rate, and net profit growth rate. The calculation formulas are presented in **Table 5**.

Table 5. Development ability indicators

Name	Calculation formula	Index property	Indicator code
Total assets growth rate	Asset growth this year / Total assets at the beginning of the year	Forward direction	D1
Net assets growth rate	Increase in current net assets / Total net assets in the previous period	Forward direction	D2
Operating income growth rate	Increase in operating income this year / Total operating income last year	Forward direction	D3
Net profit growth rate	Increase in current year's net profit / Last year's net profit	Forward direction	D4

6. Conclusion

To avoid the biased evaluation results associated with traditional analysis methods, a more comprehensive and objective approach—the entropy method—has been selected for comparison. The findings verify the feasibility of applying the entropy method to the comprehensive evaluation of financial performance. However, this study focuses solely on the machinery manufacturing industry, which may limit the generalizability of the results. Future research could expand the scope by analyzing other industries to explore broader, universally applicable principles.

Disclosure statement

The author declares no conflict of interest.

References

[1] Jia H, Sun L, Sun C, 2021, Financial Performance Evaluation of Home Care Service Supply Chain Based on Principal Component Analysis. Journal of Qingdao University (Natural Science Edition), 34(4): 133–137.

[2] Lareina C, Pu Q, Qiu Y, 2022, Research on Financial Performance Evaluation of Pharmaceutical Listed Companies Based on Principal Component Analysis. China Collective Economy, 2022(5): 147–148.

[3] Cai W, 2021, Research on Financial Performance Evaluation of Listed Companies in Transportation Logistics Industry Based on Entropy Method. Logistics Engineering and Management, 43(9): 159–162.

[4] Hu X, 2021, Evaluation of Financial Performance of Hydropower Enterprises Based on Entropy Method. Business News, 2021(22): 32–34.

[5] Meng T, Zhu J, Yin X, 2020, Evaluation of Financial Performance of Backdoor Listed Companies in Express Delivery Industry Based on Entropy-TOPSIS. Journal of Jiujiang University (Natural Science Edition), 35(2): 51–57.

[6] Zhang Y, Hu M, 2021, Research on DuPont System Based on the Division of Enterprise Activities: Empirical Evidence from Manufacturing Listed Companies. Friends of Accounting, 2021(7): 109–114.