Risk Management of Supply Chain Funds Based on Performance Evaluation Index System

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Abstract: With the rapid development of information network economy, modern logistics, and supply chain management, enterprises need to create and realize the value of the entire supply chain and realize the value-added of the enterprise, in order to meet the increasingly diverse and personalized needs of customers. This paper reviews domestic and foreign related research on supply chain performance evaluation system and supply chain capital management in recent years, combines the advantages of balanced score card (BSC) and SCOR model, and creatively constructs financial analysis based on global principal component analysis (GPCA). The model's supply chain management performance evaluation system quantifies indicators of different dimensions with financial data. Through the empirical analysis of a large amount of data in the GTA database, comprehensive evaluation is performed from the four dimensions of customer, supplier relationship, asset operation, and production operation, so as to evaluate the level of capital management performance of the company's supply chain and assess the funding risk of the supply chain, so as to provide constructive suggestions for realizing the supply chain performance and capital risk management of Chinese manufacturing enterprises.

1. Introduction

The global economic integration and the rapid development of modern logistics have transformed the form of competition between enterprises into competition between supply chains. The individualization and diversification of customer demand for products and services has strengthened our establishment of a restructured supply chain management performance evaluation system to synergistically integrate the internal and external funding flow, logistics and information flow of the supply chain enterprise to realize the value-added of the entire supply chain. At the same time, we need to make clear that the management of funds in the supply chain is no longer a simple corporate financial management activity. Effective fund management should be carried out from the perspective of the entire supply chain management activities to reduce the risk of supply chain capital and make the most efficient capital management of the enterprise supply chain, to maximize the benefits of the supply chain. How to scientifically and effectively quantify the non-financial activities in the entire supply chain business process and construct a comprehensive supply chain management performance evaluation index system will become a key way to improve the efficiency of supply chain capital utilization, reduce supply chain risks, and maximize the overall supply chain performance.

2. Research content

2.1 Performance Evaluation of Supply Chain Management

The common models in the supply chain performance evaluation model system are: business process-oriented supply chain operation reference model (SCOR), which establishes indicators system from the perspective of the three levels of the supply chain process (top level, configuration level and process unit level); A strategically-oriented balanced score card (BSC) evaluation system,

which establishes an evaluation system from a financial perspective, a customer perspective, an internal business management process perspective, an employee learning and innovation perspective, and plays a very important role in the group's strategic planning and execution management[1]. Responsibility-oriented key performance indicators (KPI) evaluation model, through the decomposition of the company's macro strategic goals, results in evaluation of the company's strategic development, overall performance and other business tactical goals of evaluation indicators; Value chain-oriented activity-based cost model (ABC), which comprehensively considers both financial and business aspects, and accurately evaluates the productivity and cost of business processes within the supply chain of an enterprise.[2]

In addition to the above models, scholars at home and abroad have proposed supply chain management performance evaluation index systems from different perspectives. Each of which has its own advantages, but the evaluation indicators in the performance evaluation model mainly involve two aspects. On the one hand, from the enterprise Supply chain business processes, such as procurement, distribution, storage, finance, etc. On the other hand, it is from outside the business processes, such as flexibility, risk, benefits, innovation, process efficiency, etc. By combining the SCOR model and the BSC model, this paper applies the financial perspective of the BSC model to the business processes of the SCOR model, and analyzes the supply chain performance evaluation from the financial information in the corporate financial statements.

2.2 Supply Chain Fund Management

Under the background of globalization, the fund management of enterprises has changed from the traditional single financial management to a fund management problem based on the entire supply chain of the market. Starting from the entire upstream and downstream systems of the supply chain, Hofmann (2002) redesigned the company's capital turnover model[3]; Stevn (2002) pointed out that product flow and capital flow will have an important impact on the operating efficiency of the company's supply chain, so companies need to coordinate Management between supply chain and working capital[4]; Harris (2005) pointed out that when building a supply chain system, enterprises should include suppliers and customers into the management cooperation system[5];Ionic Lizards (2009) selected the financial data of a number of listed companies as a sample to study the relationship between the capital management level and profitability of the company's supply chain, and concluded that there is a significant correlation between the two. It is found that the reasonable and effective management of cash, accounts receivable, and accounts payable by an enterprise can improve the profitability of the enterprise; Li Yuxia (2015) pointed out that the quality of working capital management depends directly on the management of business processes. Comprehensive analysis and improvement to achieve improvements in capital management[6]; Wang Yong (2015) proposed based on an empirical analysis of listed Chinese manufacturing companies that, in terms of cash holding management, enterprise supply chain management should integrate suppliers, enterprises and customers Jointly incorporated into the management category to ensure the smooth flow of corporate funds[7]; Tang Renheng (2019) established a link between supply chain management and working capital management, and analyzed the problems existing in the company's working capital management from a supply chain perspective, including accounts payable, Inventories, accounts receivable, cash holdings, etc. and corresponding countermeasures are given[8].

To sum up, at present, domestic and foreign scholars 'research on the management of supply chain enterprises' funds mainly focuses on the research of the problems or influencing factors and solutions of enterprise funds management, but rarely involves the perspective of the overall supply chain business. An analysis of the financial indicators in the financial statements, and a comprehensive evaluation of the supply chain evaluation indicator system.

3. Performance indicator system based on financial model

Supply chain performance evaluation indicators can evaluate the operation effect of the entire supply chain, and the level of supply chain performance can measure its capital operation risk. This

article is based on common models in supply chain management performance evaluation, such as the balanced scorecard model and SCOR model, combining the advantages of various models, and creatively using the financial situation of the supply chain to represent indicators of each dimension of the supply chain management performance evaluation in order to construct a supply chain performance evaluation index system based on the financial situation model.

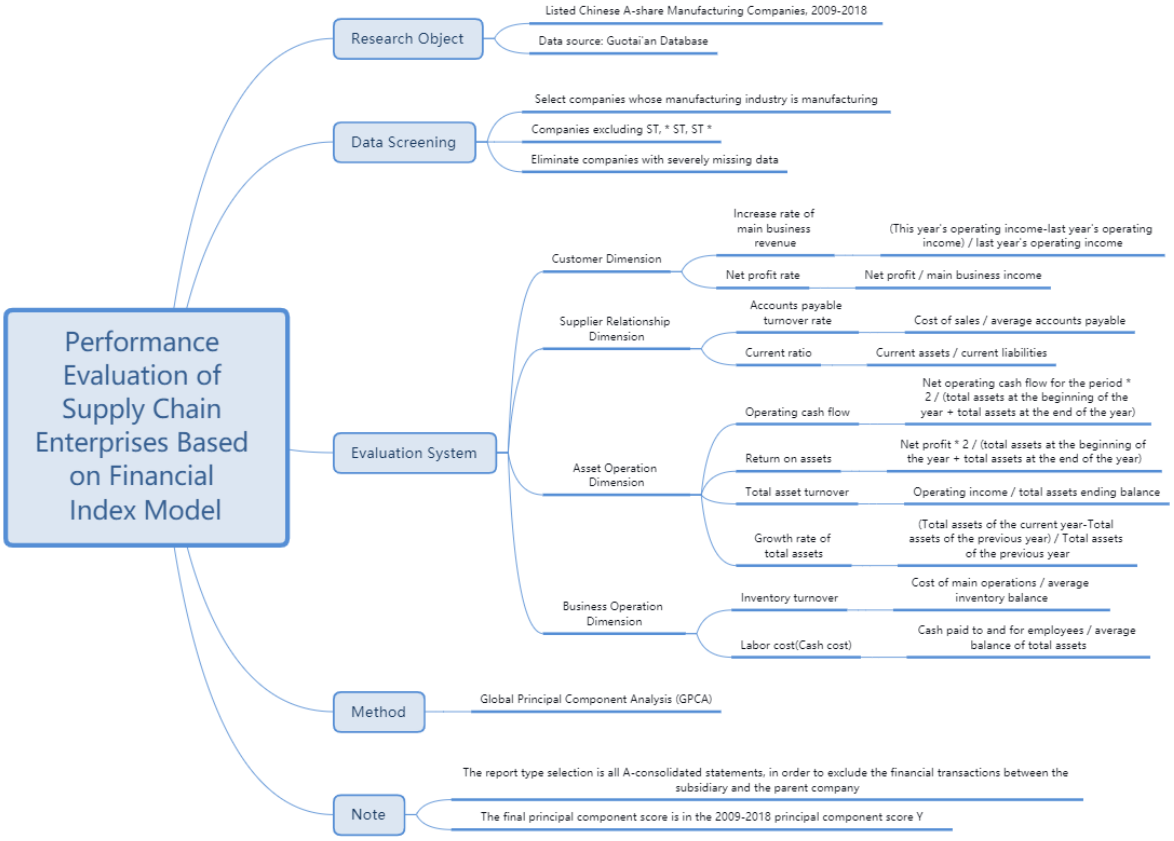

Figure 1 Technology Roadmap for Supply Chain Enterprise Performance Evaluation System Construction

3.1 Variable selection and description

This article divides the supply chain management performance evaluation into four dimensions, namely four first-level indicators, and further subdivides the second-level indicators under the first-level indicators.

(1) Customer dimension

The end of the supply chain acts on market customers. This indicator is based on customer needs. Through the establishment of good cooperative relationships, it provides customers with value-added products and services, improves customer satisfaction, and enhances the trust between customers and enterprises for increasing corporate market share ultimately. Customer relationships can be evaluated in terms of customer satisfaction, cooperation duration, sales volume information, and timeliness of payment recovery. Because some indicators are difficult to quantify, this article uses the accounts receivable turnover rate, operating income growth rate and net profit margin to measure customer relationships in the supply chain strategy.

(2) Supplier relationship dimension[2]

The evaluation indicators for measuring supplier relationships include transaction volume information, cooperation duration, timeliness of payment, quality and price stability, and timeliness of delivery. This article uses accounts payable turnover ratio and current ratio to quantify the relationship between suppliers.

(3) Asset operation dimension

Asset operation indicators directly reflect the capital status of the enterprise and manufacturing companies need to invest in all aspects of production and operation. Therefore, this article measures

the asset operation of the supply chain by operating cash flow, return on assets, total asset turnover and total asset growth happening.

(4) Business operation dimension

For manufacturing companies, from the initial order demand to the end user of the sale, multiple business processes together form the supply chain for product manufacturing. In the four processes of purchasing, production, inventory, and logistics management, including the cost of finished products, production capacity utilization, delivery level, and R & D investment and other influencing factors, this article selects inventory turnover rate (that is, inventory turnover rate) and labor costs Quantify the business operations of the supply chain.

Table 1 Variable description and calculation

Index Dimension	Variable Name	Symbol	Calculation Method
Customer Dimension	Increase rate of main business revenue	X1	(This year's operating income-last year's operating income) / last year's operating income
	Net profit rate	X2	Net profit / main business income
Supplier Relationship Dimension	Accounts payable turnover rate	X3	Cost of sales / average accounts payable
	Current ratio	X4	Current assets / current liabilities
Asset Operation Dimension	Operating cash flow	X5	Net operating cash flow for the period * 2 / (total assets at the beginning of the year + total assets at the end of the year)
	Return on assets	X6	Net profit * 2 / (total assets at the beginning of the year + total assets at the end of the year)
	Total asset turnover	X7	Operating income / total assets ending balance
	Growth rate of total assets	X8	(Total assets of the current year-Total assets of the previous year) / Total assets of the previous year
Business Operation Dimension	Inventory turnover	X9	Cost of main operations / average inventory balance
	Labor cost	X10	Cash paid to and for employees / average balance of total assets

3.2 Measurement method

The calculation of the composite index usually uses classical principal component analysis. Classical principal component analysis is a statistical method that transforms a set of possibly related variables into unrelated variables through orthogonal transformation. Because the data in this article is a large number of flat data sequences arranged in time, if the classical principal component analysis is performed, it is impossible to compare the evaluation results of the same sample at different points in time. To ensure the unity, integrity and comparability of the system analysis, the data can be used for the empirical analysis below. Therefore, this paper adopts the time series (global) principal component analysis method, integrates the plane tables at different times into a three-dimensional time series data table, and then uses the classic principal component analysis method for analysis. The investigation period is 2009-2018.

3.3 Model results and empirical analysis

In this paper, we select the relevant financial data of China A-share manufacturing listed companies from 2009-2018 (data missing in some years) from Guotai'an Database, select

companies in which the industry is manufacturing, and exclude ST, * ST, ST * companies and Companies with severely missing data.

(1) KMO and Bartlett inspection

First, the statistical analysis software SPSS is used for KMO and Bartlett sphericity tests. The KMO value is 0.501, which indicates that the data is suitable for principal component analysis. The significance P value of Bartlett's spherical test is 0.000 <0.05, which also indicates that the data is suitable for principal component analysis.

Table 2 KMO and Bartlett inspections

Sampling a sufficient degree Kaiser-Meyer-Olkin measure		.501
Bartlett's sphericity test	Approximate chi-square	557.568
	df	45
	Sig.	.000

(2) Extraction of principal components of financial indicators

The common factor variance table shows the common degree of the variables. Since the common value of each variable under the extracted column is basically greater than 0.5, it indicates that the extracted principal component has a higher degree of interpretation of the original variable. The common factor variance results are shown in the following table:

Table 3 Common Factor Variance Table

	Initial value	Extract value
Increase rate of main business revenue	1.000	.645
Net profit rate	1.000	.768
Accounts payable turnover rate	1.000	.556
Current ratio	1.000	.598
Operating cash flow	1.000	.576
Return on assets	1.000	.605
Total asset turnover	1.000	.477
Growth rate of total assets	1.000	.651
Inventory turnover	1.000	.543
Labor cost	1.000	.592

Then, according to the criterion that the feature value is greater than 1, the principal components are extracted separately, as shown in Table 4 below:

Table 4 Total Variance Explanation

Factor	Initial Eigenvalue			Extraction of Square Sum and Loaded		
	Total	Var. %	Cum. %	Total	Var. %	Cum. %
1	1.351	13.509	13.509	1.351	13.509	13.509
2	1.303	13.029	26.538	1.303	13.029	26.538
3	1.178	11.779	38.318	1.178	11.779	38.318
4	1.109	11.086	49.404	1.109	11.086	49.404
5	1.070	10.701	60.105	1.070	10.701	60.105
6	.928	9.278	69.383			
7	.854	8.544	77.927			
8	.787	7.868	85.795			
9	.724	7.244	93.039			
10	.696	6.961	100.000			

As can be seen from the above table, the contribution rates of the five principal component variances extracted are 13.509%, 13.029%, 11.779%, 11.086%, and 10.701%, and the cumulative

contribution rate reaches 60.105%. The first five principal component feature roots are 1.351, 1.303, 1.178, 1.109, and 1.070, respectively.

(3) Factor load and principal component equation

Table 5 Global principal component score coefficient matrix

	Factor				
	1	2	3	4	5
A1	-.050	.791	.074	-.006	-.105
A2	.348	.074	.247	-.296	.702
A3	.186	.050	-.487	.440	.295
A4	-.194	-.096	.492	.461	.310
A5	.534	.097	-.148	-.480	.170
A6	.421	.043	.539	.360	.077
A7	.633	-.015	-.100	.088	-.241
A8	-.121	.795	.062	.027	-.005
A9	.238	.127	-.468	.485	.129
A10	.470	-.019	.296	.102	-.523

The relationship between the transformation matrix, the principal component load matrix U and the factor load matrix A and the characteristic root λ of the principal component analysis is $U_i = \frac{A_i}{\sqrt{\lambda_i}}$,so the principal component load matrix U can be calculated from the two, and the expressions of the five principal components are:

$$Y_1 = -0.043017X_1 + 0.299400X_2 + 0.160024X_3 - 0.166907X_4 + 0.459424X_5$$
$$+0.362205X_6 + 0.544598X_7 - 0.104102X_8 + 0.204762X_9 + 0.404362X_{10}$$
$$Y_2 = 0.692954X_1 + 0.064828X_2 + 0.043802X_3 - 0.084101X_4 + 0.084977X_5$$
$$+0.037670X_6 - 0.013141X_7 + 0.696458X_8 - 0.111258X_9 - 0.016645X_{10}$$
$$Y_3 = 0.068180X_1 + 0.227575X_2 - 0.448700X_3 + 0.453307X_4 - 0.136361X_5$$
$$+0.496611X_6 - 0.092136X_7 + 0.057124X_8 - 0.431194X_9 + 0.272721X_{10}$$
$$Y_4 = -0.05698X_1 - 0.281077X_2 + 0.417818X_3 + 0.437759X_4 - 0.455801X_5$$
$$+0.341851X_6 + 0.083564X_7 + 0.025639X_8 + 0.460549X_9 + 0.096858X_{10}$$
$$Y_5 = -0.101507X_1 + 0.678649X_2 + 0.285187X_3 + 0.299688X_4 + 0.164345X_5$$
$$+0.074439X_6 - 0.232983X_7 - 0.004834X_8 + 0.124709X_9 - 0.505603X_{10}$$

In principal component analysis, the principal component score is obtained by substituting standardized data according to the principal component expression. Taking the contribution of the variance of each principal component as the weight, the expression of the comprehensive principal component of the comprehensive evaluation function is constructed as:

$$Y_{total} = \frac{\lambda_1 Y_1 + \lambda_2 Y_2 + \lambda_3 Y_3 + \lambda_4 Y_4 + \lambda_5 Y_5}{\lambda_1 + \lambda_2 + \lambda_3 + \lambda_4 + \lambda_5}$$

Substituting into the characteristic roots of the first 5 principal components, we get:

$$Y_{total} = \frac{1.351Y_1 + 1.303Y_2 + 1.178Y_3 + 1.109Y_4 + 1.070Y_5}{1.351 + 1.303 + 1.1778 + 1.109 + 1.070}$$
$$= 0.224773Y_1 + 0.216787Y_2 + 0.195990Y_3 + 0.18450Y_4 + 0.178022Y_5$$

Each coefficient is a positive number, indicating that all evaluation indicators have a positive impact on the comprehensive indicators, and the main component is a comprehensive measurement of all indicators, which can be used as a comprehensive average coefficient indicator of the supply chain management performance evaluation system,reflecting the relationship between supply chain

performance and customer relationships, supplier relationships, asset operations and production operations.

4. Model evaluation

4.1 Model advantages

1) Comprehensiveness and practicality of index selection. This model comprehensively considers the influencing factors of the processes in each node of the supply chain, and builds a supply chain management performance evaluation index system from multiple levels in four dimensions. In particular, the use of financial data to represent non-quantifiable indicators makes supply chain performance evaluation more practical.

2) Rigorousness of model construction. The model uses a global principal component analysis method. Several more representative and important explanatory variables were selected, which has strong significance and correlation, making the model universal.

3) Application value of the model. The existing supply chain management performance evaluation system has no normative expressions, and the design factors are chaotic and complicated. The difficulty of data acquisition is not conducive to the company's supply chain management decisions. This model selects several simple and easily available variables that can help companies more quickly quantify supply chain performance and assist risk management decisions.

4.2 Model disadvantages

1) The model is not accurate enough. Due to inadequate considerations, some influencing factors will inevitably be missed. Especially in the dimension of information sharing and transmission among supply chain companies, there is no good quantification of financial indicators.

2) The model is lagging. Because it takes a long time for data statistics and sorting and publishing, models often lose time value when they are applied.

3) Model dependence. In the process of statistics and release, due to some political or economic considerations, statistical agencies will beautify the data, causing the data to lose its due accuracy.

5. Conclusion

Scientific and effective customer management, supplier relationship management, asset operation management, and production operation process management can represent the overall supply chain management performance level and can objectively assess the overall supply chain capital risk. Based on previous research, this paper creatively builds a supply chain performance evaluation index system based on financial models. Through the analysis of the model, the results better support the relevant theories of this article, and make the value of the supply chain better quantified. In this way, companies in the supply chain can start from the performance evaluation system, improve their supply chain management capabilities, evaluate the funding risk of the supply chain, and ultimately maximize the value of the supply chain.

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