

Identification and Prevention of Enterprise Financial Risk Path Based on ISM - MICMAC Model

Yuxin Xie^{1, #}, Yufan Jiao^{2, #}, Ge Cai^{3, #, *}

¹Alibaba Business school, Hangzhou Normal University, 311121, Hangzhou, China

²School of Economics & Management, Shanghai Maritime University, 201306, Shanghai, China

³School of Economics, Hangzhou Normal University, 311121, Hangzhou, China

*Corresponding author: vj162774@163.com

equally contributed to this works

Abstract: In this paper, through literature collection, combined with the economic environment and the actual situation in the field of enterprise financial risk, 15 obstacle factors related to enterprise financial risk are selected, and the multi-level structure diagram of the influencing factors is constructed by using the Interpretative Structural Model (ISM), and then the hierarchical structure of each factor and the path of influencing enterprise financial risk are analyzed, and the driving force and dependence of 15 influencing factors are analyzed by using Matrix Impacts Cross-reference Multiplication Applied to a Classification(MICMAC).

Key words: Financial risk; ISM; MICMAC; path identification.

1. Introduction

With the rapid development of modern social economy and the rapid growth of China's international trade, the number and scale of financial activities that enterprises participate in are increasing, the uncertainty of market factors is further increased, and the financial risk of enterprises is also rising, resulting in the expected losses of many enterprises.. However, the transmission path of enterprise financial risk is not clear. Further research on the transmission path of financial risks helps enterprises alleviate or hedge financial risks of enterprises, and improves business results and efficiency. At present, many scholars have carried out analyses and research on this issue.

In recent years, more and more scholars have paid attention to the research of enterprise financial risk factors. Lu et al.[1]used Copula function and constructed a difference-in-differences model to analyze the economic impact of corporate social responsibility under various crises, and concluded that corporate social responsibility helps maintain financial stability in the face of crises. Xiong et al. [2] used the Probit model to analyze the differences in the impact of private credit reporting institutions and public credit reporting institutions on corporate financing constraints, explained the relationship between the financing difficulties of relevant enterprises in China and the structure and system of the financial industry, and gave relevant countermeasures. Ouyang et al.[3]adopted DCC-GARCH to calculate systemic financial risk, and then used the TVP-SV-VAR model to study the time-varying relationship between public health emergencies, economic policy uncertainty and systemic financial risk. It is concluded that public health emergencies, economic policy uncertainty and systemic financial risk have time-varying characteristics, and public health emergencies can directly affect systemic financial risk.Liu and Yuan[4]examined the expansion of financial openness, the improvement of financial efficiency and the volatility of China ' s economy by establishing a new macroeconomic model and empirical econometric model of open economy. The results show that China ' s continued expansion of financial openness must simultaneously improve financial efficiency. Ma and Du[5]constructed the related enterprise risk model, and drew a conclusion that digital finance can effectively improve enterprise risk-taking through resource effect (alleviating financing constraints) and information effect (reducing stock price synchronicity). Meanwhile, a higher corporate governance level and lower uncertainty of economic policy will also strengthen the positive relationship between digital finance and enterprise risk-taking.

Although existing studies have explored the impact of enterprise attributes, managerial characteristics, institutional environment, macroeconomic environment and other factors on corporate financial risk-taking, most of them started from a certain aspect, ignoring the comprehensive role of multiple elements and the mutual transmission path between different elements. By using the Interpretative Structural Model (ISM) and Matrix Impacts Cross-reference Multiplication Applied to a Classification (MICMAC), this paper explores the various levels of factors affecting the financial risk of enterprises and their internal mechanism, and clarifies the impact of various factors on the financial development of enterprises. Based on the method of structural hybrid mapping, this paper highlights the hierarchical advantages of research elements, and deeply analyzes the transmission path and influence of enterprise financial risk from the defects of relevant national policies and mechanisms to the imperfect rules and regulations and management of enterprises. The results not only enrich the theoretical research on the financial risk transmission path of enterprises, but also provide a new comprehensive solution for enterprises to deal with related problems to promote the efficient development of enterprises and improve the competitiveness of enterprises.

2. Building an indicator system of barriers

2.1 Construction of enterprise external obstacle degree system

The external impacts of enterprises on financial risks mainly include the macroeconomic environment, national policies, emergency events, and industrial competition. At present, the domestic economy is subject to uncertain emergencies such as the new coronal epidemic, which leads to the instability of the domestic macroeconomic environment. The country adopts relatively stable fiscal and monetary policies, and international trade and import and export fluctuate greatly. Therefore, this paper refers to the literature [6-9] to get the index as the external obstacle factors of the enterprise system.

2.2 Construction of enterprise internal obstacle degree system

The internal influence on financial risk mainly includes enterprise management, enterprise culture, enterprise staff, enterprise decision-making, enterprise organization structure, etc. The unreasonable management of enterprises, the lack of management system and the incomplete organizational structure of enterprises will lead some employees to manipulate, tamper with and delete relevant data and processes, which will increase the financial risks of enterprises. The lack of corporate culture will also lead to the weak centripetal force and cohesion of employees, leading to the prevarication of work and the decline of corporate operating efficiency. The quality and skills of employees will also affect the company's operation to a large extent. Therefore, this article refers to the literature [9-13], thus obtaining the index as the enterprise system internal aspect barrier factor. In summary, the indicator system of corporate financial barriers constructed in this paper is shown in Table 1.

Table 1 Indicator system of obstacles

Primary factors	Secondary factors	Code	References
External enterprise system	Imperfect financial guarantee mechanism	X_1	[6]
	Unrest in the national economic environment	X_2	[7]
	Financial market policies are unclear	X_3	[6]
	Interference of emergency events	X_4	[8]
	Impact of policy economic orientation	X_5	[7]
	Low openness of financial markets	X_6	[9]
	Strong industry competition	X_7	[9]
Internal enterprise system	Lack of internal management of enterprises	X_8	[10]
	Low quality of enterprise staff	X_9	[11]
	Lack of corporate cultural cohesion	X_{10}	[12]
	Invalid and mistake of enterprise decision	X_{11}	[13]
	Enterprise rules and regulations are not clear	X_{12}	[10]
	Enterprise financing difficulties	X_{13}	[9]
	Inefficient capital transfer in enterprises	X_{14}	[9]
	Imperfect organizational structure of enterprises	X_{15}	[10]

3. Construction of the ISM model

Interpretative Structural Model (ISM), first developed by John N. Warfield, is an analytical method for studying the logical relationships between factors within a system. The model is based on the principle of decomposing a complex system into a number of hierarchical subsystems with the aid of a computer platform, and by constructing a matrix step by step, thus further determining the directed relationships between the factors and reflecting the internal structure of the complex system. The most prominent advantage of this model is its ability to combine human experience with machine learning, enabling systems with unclear internal structure, numerous variables and intricate interrelationships to be presented in a clear, logically rigorous hierarchical diagram. In this paper, the methodology will be used to identify the paths of each negative factor that poses a risk to corporate finance, and thus the influence degree of each factor in the system can be obtained. The analysis process of the ISM model is as follows.

Step1: Summarise the influencing factors. The various barriers that pose a risk to corporate finance are summarized from the literature and form the set of negative factors S. The equation n indicates that there are n influencing factors.

$$S = \{S_1, S_2, S_3 \dots \dots, S_n\} \quad (1)$$

Step2: Determine the logical relationship between any two factors. Collect the opinions of relevant experts, score the correlation between the factors two by two, and construct the structural self-

interaction matrix R accordingly. The construction rule is: if there is a direct influence relationship between the element S_i and the element S_j , then $A = [a_{ij}] = 1$, if there is no direct influence relationship between the element S_i and the element S_j , then $A = [a_{ij}] = 0$. Establish the adjacency matrix A .

Step3: Construct the reachability matrix. The adjacency matrix reveals only the direct relationship between the factors, not the indirect relationship between the elements. Adding the adjacency matrix A to the unit matrix E and performing a power operation on the result, the Boolean iteration is continuously performed until the following equation holds, where r is determined according to the number of iterations.

$$(A + E)^{r+1} = (A + E)^r \neq (A + E)^{r-1} \neq \dots \neq (A + E)^2 \neq (A + E) \quad (2)$$

The reachability matrix $M = (A + E)^{r+1} = (A + E)^r$. The reachability matrix shows whether there are connecting paths between elements, indicating the direct and indirect effects between elements $S_1 - S_n$ and their reachability.

Step4: Hierarchical partitioning of the reachable matrix. The set of influences in the row of influence factor S_i containing the column corresponding to number 1 is recorded as the reachable set $G(S_i)$, the set of influences in the column of influence factor S_i containing the row corresponding to number 1 is recorded as the prior set $H(S_i)$, and the intersection between the reachable set $G(S_i)$ and the prior set $H(S_i)$ is taken as the intersection $I(S_i)$. According to the principle of hierarchical processing,

$$L = \{S_i | G(S_i) \cap H(S_i) = G(S_i)\} \quad (3)$$

First, determine the set of elements of the highest level L_1 according to the equation, then delete the rows and columns corresponding to the factors of the first level to get the reachable matrix M_1 . Then, based on M_1 , calculate the set of elements of the second level L_2 according to the above equation, and repeat the above operation to continuously get a new reachable matrix until the elements of the last level are divided.

Step5: Build the recursive structure model. According to the results of the hierarchical division, the influencing factors are arranged from the higher level to the lower level, the logical relationships between the factors are linked with arrows, and the parsing of the explanatory structural model is carried out.

4. Construction of the MICMAC model

DUPERRIN and GODBT proposed matrix Impacts Cross-reference Multiplication Applied to a Classification, (MICMAC) in 1973 as a method to analyze the driving forces and dependencies between factors in a system to determine the role and position of each factor in the system. Its main principle is to calculate each factor's driving forces and dependencies based on the ISM analytical method reachable matrix and derive a cluster of factors with four different influencing properties by constructing a two-dimensional coordinate system. This model is an extension of the ISM model and can compensate for the shortcomings of the ISM by further analyzing the influence and dependency relationships between the factors. MICMAC The specific analysis steps are as follows:

Step1: Calculate the driving force and the degree of dependency. The driving force $D(S_{ij})$ is the influence that the element has on other elements, and the dependency $R(S_{ij})$ is the influence that other elements have on the element. The calculation formula is as follows:

$$\begin{cases} D(S_{ij}) = \sum_{j=1}^n S_{ij} \\ R(S_{ij}) = \sum_{i=1}^n S_{ij} \end{cases} \quad (4)$$

Step2: Calculate the drive mean $\overline{D(S_{ij})}$ and the dependency means $\overline{R(S_{ij})}$ for all elements.

$$\begin{cases} \overline{D(S_{ij})} = \frac{1}{n} \sum_{j=1}^n S_{ij} \\ \overline{R(S_{ij})} = \frac{1}{n} \sum_{i=1}^n S_{ij} \end{cases} \quad (5)$$

Step3: Establish a two-dimensional coordinate system for barrier factor dependency-drive. The horizontal axis represents dependency and the vertical axis represents drive. $\overline{D(S_{ij})}$ is used as the middle boundary of the horizontal axis and $\overline{R(S_{ij})}$ is used as the middle boundary of the vertical axis. Accordingly, the coordinate system is divided into four regions, representing four clusters of factors with different influencing properties. All factors are filled into the coordinate system, corresponding to independent clustering, dependent clustering, linkage clustering and independent clustering.

In summary, the MICMAC analysis allows for a more comprehensive and systematic study of the overall interrelationship between the factors of corporate financial barriers in the ISM approach, thus making the research process more complete, rational and scientific.

5. Empirical analysis

5.1 ISM model building and analysis

5.1.1 Building the adjacency matrix

In this paper, through literature collection, the economic environment and the actual situation in the field of corporate financial risk are combined to screen out 15 obstacle factors related to corporate financial risk, which involve two dimensions, external to the corporate system and internal to the corporate system. It is suitable for studying the directed relationship between the influencing factors within the corporate financial risk system and identifying each influencing factor's driving forces and dependencies to propose effective corporate financial risk solutions, which are of high analytical value.

Currently, experts scoring assessment to derive the influence degree data among elements is the most prominent method applied to ISM model analysis by relevant scholars. For example, Wang et al. optimized the impact degree of indicators through expert scoring. In this paper, ten experts in financial risk assessment from enterprises and universities were invited to score the binary directed relationships of the barrier factors, and the scoring results of the ten experts for each barrier factor were averaged and assigned a threshold value of 0.5, greater than 0.5 to 1 and less than 0.5 to 0. And then quantify the assessment results in a matrix. For example, if the mean value of X_i 's influence on X_j is 0.75, then X_{ij} is assigned a value of 1. Conversely, if the mean of X_i 's influence on X_j is 0.35, then X_{ij} is assigned to 0. The adjacency matrix A_1 is constructed based on the assessment results, as shown in Table 2.

Table 2 Adjacency matrix

Barrie-rs	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}
X_1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
X_2	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0
X_3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
X_4	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
X_5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
X_6	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
X_7	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
X_8	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
X_9	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
X_{10}	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
X_{11}	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
X_{12}	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
X_{13}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
X_{14}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
X_{15}	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

5.1.2 Calculating the reachability matrix

The new matrix A_2 , obtained by adding the adjacency matrix to the unit matrix, reflects whether there is a direct relationship between the risks of the barriers. It is not yet clear whether there is an indirect transmission relationship between the barriers, so the results need to be obtained with the help of the reachability matrix. Using SPSSAU software, a Boolean iterative operation was performed on A_2 to output a reachable matrix.

5.1.3 Hierarchical structure division

Before the hierarchy, the accessible set $G(X_i)$ and the prior set $H(X_i)$ of the barriers X_i are listed, and their intersection $L = G(X_i) \cap H(X_i)$ is calculated according to the principle of hierarchical processing. After processing the sets, a hierarchical decomposition of each obstacle element is performed. Based on the principle of $G(X_i) = L(X_i)$, the topmost barrier factor is first identified, and the barrier is removed from the remaining set. Based on this result, the above operation was repeated, and the elements of each level are divided until the last element of that level is divided.

5.1.4 Presentation of ISM model and path analysis of the barriers

The hierarchical distribution and influence paths of the barriers are shown in Figure 2.

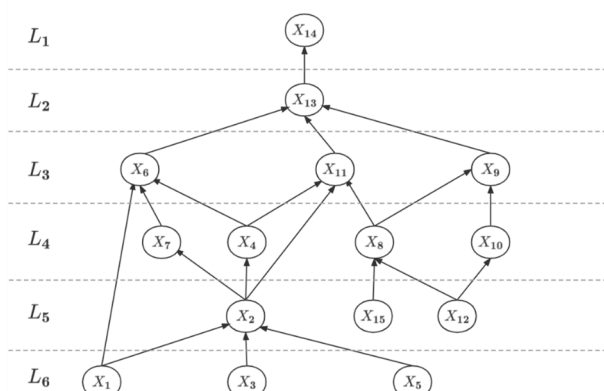


Figure 2 ISM model diagram

According to the impact path diagram, the factors affecting corporate financial risk are divided into a six-level recursive structure, which logically, in turn, allows for the classification of the individual barriers at the top (L_1), middle (L_2, L_3, L_4, L_5) and bottom (L_6) levels, which were called direct, indirect and fundamental impact factors respectively.

Fundamental Influencing Factors: The factors located at L_6 are the fundamental influencing factors, which are X_1, X_3, X_5 . The fundamental impact factors are risk barriers that affect individual enterprises, industries and even the whole national economy, as policies and mechanisms are set by the government and monetary authorities and are not something that individuals can regulate, and enterprises can only adjust their own business behaviors to avoid these three global risks.

Indirect Influencing Factors: located at the L_5 , are the turbulent national economic environment (X_2), unclear corporate regulations (X_{12}) and inadequate corporate organizational structure (X_{15}). The national economic situation is subject to policy performance. It can indirectly affect individual firms' financing and liquidity risks through upward transmission paths such as influencing the overall financing situation of the industry and influencing internal corporate decisions across levels. In particular, X_{12} and X_{15} are source impediments, which are not subject to underlying factors, independently affect the enterprise's management and cultural cohesion, and are controllable intra-firm factors that play a key role in the intra-firm risk system. Besides, the barriers located in L_3, L_4 , are specific manifestations of factors on L_5, L_6 , and play a mainly transitory role in the risk system, with the overall financing and competition of the market, the internal functioning of the enterprise, and the professionalism of the employees all affect the capital risk of the enterprise relatively quickly. And the difficulty of raising funds for the enterprise (X_{13}) is at the top of the intermediate tier and directly influences the top factor, indicating that the "difficulty of raising funds" for the enterprise directly determines the enterprise's liquidity.

Direct Impact Factor: Inefficient flow of corporate funds (X_{14}), at the top level of L_1 , is the direct impact factor. Inefficient flow of corporate funds will lead to the immediate development of corporate financial risks, so solving the problem of inefficient flow of corporate funds is the final goal of avoiding corporate financial risks.

5.2 Barrier classification: MICMAC analysis

Based on the MICMAC model equation (4), the values of driving power and dependency power of each factor were calculated using the reachability matrix, and the MICMAC model diagram was drawn to analyze the degree of influence between the barriers. The results are given in Figure 3.

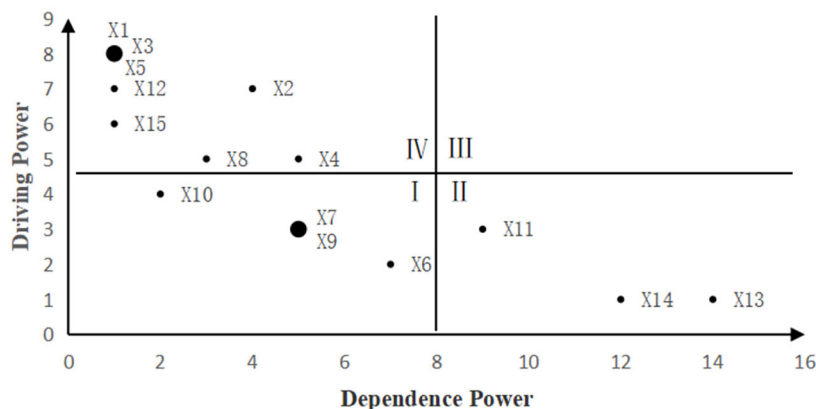


Figure 3 MICMAC model for barriers diagram

The distribution was divided into four quadrants, respectively named Autonomous Cluster (quadrant I), Dependent Cluster (quadrant II), Linked Cluster (quadrant III) and Independent Cluster (quadrant IV). The results of the classification show that all the barriers are distributed in quadrant I, II, III, and there are no elements belonging to the linkage cluster, which shows that the independence of the selected elements is guaranteed and that the whole system does not react in a linkage when individual elements change. The three clusters are explained as follows: Autonomous Clusters: The barrier indicators belonging to the autonomous cluster are X_6, X_7, X_9, X_{10} , which are less dependent and less driven, but all four factors are in the middle level and can play a certain role in linkage. Dependent Clusters: Indicators of barriers belonging to the dependent cluster are X_{11}, X_{13}, X_{14} , concentrating in this cluster are highly dependent but weakly driven, and often need to be addressed after barriers of other clusters were tackled, especially the difficulties of corporate financing (X_{13}) and the inefficient flow of corporate funds (X_{14}), which are direct triggers of corporate financial risk. Independent clusters: Barriers belonging to independent clusters are $X_1, X_2, X_3, X_4, X_5, X_8, X_{12}, X_{15}$, having strong driving power but weak dependency power, usually located deep and at the bottom of the risk hierarchy pathway, are a prerequisite for addressing other influencing factors and need to be prioritized and addressed.

6. Recommendation

Establishing and improving financial mechanisms and various economic policies. The government and other relevant departments can introduce financial policies conducive to national or regional economic stability and the flow of funds to enterprises, according to the country's economic development or specific region and the financing situation of enterprises. For example, taxation measures such as tax rebates and tax reductions for enterprises can be used to ease the pressure on their cash flow. The central bank and other relevant financial institutions can identify existing loopholes in the market and the financial activities of enterprises through financial innovations such as enterprise data monitoring, so as to improve the financial protection mechanism and introduce policies on reasonable financing for enterprises on the premise of effectively predicting the economic development and risks.

Adjust monetary policy to market conditions. The central bank can decide whether to implement a loose monetary policy or tight monetary policy according to the company's overall business conditions and risk resistance in the market. A loose monetary policy means a lower interest rate level, correspondingly, a higher net worth of companies and the alleviation of the cash flow problems of the enterprise. However, an excessively loose monetary policy can also lead to a credit boom, so it is necessary to make appropriate adjustments according to the actual conditions.

Establish clear credit risk management practices. The relevant national financial regulatory authorities should urge the formulation of clear financial market policies, increase the number of

restrictive clauses on corporate fundraising and financing practices by financial intermediaries and the securities market, and include in loan contracts provisions that restrict borrowers (enterprises) from engaging in high-risk activities, so as to ensure that enterprises can enforce the restrictive clauses when they engage in non-compliant financial activities to hedge corporate risks.

7. Conclusion

(1) the deficiencies of relevant national policies and mechanisms can fundamentally lead to the generation of corporate financial risks, and priority needs to be given to the rationality of the formulation of the content; (2) the intermediate layer of obstacle factors also play a crucial role in risk transmission, especially the two source risks of unclear corporate regulations and imperfect corporate organizational structure, but these two points are quite controllable at the corporate management level; (3) attacking the problem of corporate capital flow difficulties is the ultimate goal of corporate financial risk avoidance, once the lower and middle-level factors lead to corporate fundraising and financing difficulties, it will induce corporate capital flow difficulties. The findings of this paper clarify the influence path of corporate financial risk and the degree of influence of risk-barrier factors, which are important for avoiding actual financial risks.

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