

Research on Comprehensive Quantitative Method of Internal Control Evaluation Based on Risk*

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Abstract In order to facilitate managements in designing, analyzing or evaluating their company's internal control system better so that ensure the realization of business objectives effectively, qualitative and quantitative methods are used together to study on quantitative method of internal control evaluation based on risk. According to the spiritual essence of Basic Norms of Internal Control issued by China's five ministries jointly, the internal control evaluation index system is designed by using AHP and fuzzy comprehensive evaluation method, and quantitative matrix model of internal control evaluation is constructed from the risk-based perspective, intending to evaluate the level of effectiveness of internal control quantitatively and comprehensively, so as to achieve the ultimate goal on improving enterprise's internal control evaluation.

Key words Risk management; Internal control; Internal control evaluation; Comprehensive quantitative evaluation.

1 Introduction

Affected by corporate boards, management and other staff interaction, internal control is a process designed to realize operational effectiveness and efficiency and the reliability of financial reports, to comply with applicable laws and regulations to provide reasonable assurance. It is noted in Basic norms of internal control that the internal control "is a process implemented to achieve control goals by the corporate board of directors, supervisors, managers and staff". "Its goal is to make a reasonable assurance that the legal compliance of enterprises' management, asset security, financial reports and related information is true and complete, to improve operational efficiency and effectiveness and promote enterprises' development strategies"^[1]. How to evaluate internal control in a scientific and reasonable way is an important topic of current interest in the global accounting theory circle and practice field.

After referring to the related documents of internal control and its valuation both at home and abroad, it is found that the evaluation system and methods of internal control are not very mature still. Although our related research staff have been studying on the qualitative and quantitative research methods of internal control evaluation step by step, in which, qualitative evaluation methods are mostly based on detailed and risk-based evaluation methods, etc., while quantitative evaluation methods include fuzzy comprehensive evaluation method and the maximum deviation method, etc. But these methods, especially quantitative evaluation methods are not rigorous, imperfect and with poor maneuverability. For enterprises, how to establish an evaluation index system of internal control and how to conduct a comprehensive, objective and efficient quantitative evaluation on internal control effectively are of great practical significance.

Risk management is that the enterprises have the risk planed, controlled and supervised through risk analysis activities like risk identification, risk quantification and risk evaluation, thus increase the opportunities for corporate to respond to the threat, complete and achieve the total goal successfully as a result. COSO believes that enterprise's risk management is a process in which companies participates broadly to make multi-point controls for the uncertainty which enterprises face, and achieve the organizational goals finally. In Enterprise Risk Management - Integrated Framework, enterprise's risk management is divided into eight interrelated elements: Internal Environment, Target Setting, Issue Identification, Risk Assessment, Risk Response, Control Activities, Information and Communication, and Monitoring, etc., each element runs throughout the process of company's management^[2].

Risk-based consideration, first of all in determining the evaluation indexes, internal control quantitative evaluation method should take the control of the business risks (including: strategic risk,

* This paper is part of "The Research for Evaluating Enterprise Internal Control Based on Risk Management Perspective", which is supported by Hubei Social Science Fund, No. [2010]087.

business risk, financial risk and market risk, etc.) as the starting point and destination, use analytic hierarchy method to make hierarchical classification, then use the principle of fuzzy to quantify the qualitative indexes, establish a mathematical model of comprehensive evaluation, finally make a comprehensive evaluation on the enterprise's internal control design and operation of the overall effectiveness and economy through the results of operations on the model.

2 Design for Internal Control Evaluation Index system

Internal Control Evaluation Index System can be comprehensively and systemically designed on the basis of the five elements: internal environment, risk assessment, control activities, information and communication, internal monitoring ruled by Basic Norms of Internal Control which was promulgated by five ministries in China in 2008.

So the specific design is taking the five basic elements of internal control as the first-level indexes of internal control evaluation, then further detail the evaluation system, establish an evaluation system including 28 secondary-level indexes. The specific design is shown as follows:

(1) Internal control environment. It is the foundation for enterprises to implement internal control generally including the management structures, institutional arrangements and division of responsibilities, internal audit, human resources policies and corporate culture, etc. These elements reflect the attitudes and understanding of the corporate management, board of directors and business owners to the business internal control, and it is also the engine to promote the control and the basis of all other components for internal control. Control environment elements includes values, incentive and induced mechanism, spiritual guidance, staff capacity, management philosophy and operating style, organizational structure, rules and regulations and personnel policies, etc. The main issue in evaluation is that the management should have a full explanation of the integrity of internal control; and have to make the employees throughout the organization with awareness and conscious attitude of the control, particularly the senior management should control actively, and meanwhile the staff's ability and its responsibility have to match. Therefore, we set up seven secondary-level indexes relatively.

(2) Risk assessment. It is about that the company timely identifies and systemically analyzes the risks associated with implementation of internal control objectives in operational activities in business, then determines the risks countermeasures reasonably. The elements of risk assessment include the attention to the overall goals and the development and convergence of the objectives of operational activities, risk identification and assessment, risk analysis including risk likelihood and risk impact on the business objectives, risk response mechanism. Therefore, here we set up 9 secondary-level indexes.

(3) Control activity. It is refers to provide reasonable assurance of enterprise's management goals, control the risks within the tolerance degree by using appropriate control measures according to the result of risk assessment. The elements of control activity should include the indexes of overall effectiveness on the control system which reflects every part of operations (including finance, investment, money, pay, purchase, production, sales, contracts, security, distribution, etc.) and ensure the authenticity and usefulness of information about accounting report, the index on whether the control system of properties change of sending and receiving is perfect or effective, the index on whether there is a feasible performance evaluation system and the index on its practical implementation. Because control activity relates to every aspect and corner of the production, operation and management of enterprise, and the evaluation cannot cover everything, here we set up four secondary-level indexes integrated: accounting process control, operating process control, property security control and performance evaluation.

(4) Information and Communication. It is refers to that the enterprise collects and transfers the related information of internal control timely and accurately so that the information be communicated effectively within the enterprise and external ones. As for the evaluation of internal control information, we have to pay attention to gathering and collating of internal information and external information, at the same time, in the communication we should pay attention to channels and methods of internal and external information exchange, especially in the modern highly developed information technology environment, we should also pay attention to the comprehensiveness, security and patency of information. Therefore here we set up four secondary-level indexes: information system, information quality, communication channels and communication ways.

(5) Internal supervision. It is refers to generic terms of the management and supervision of internal control by business management department and the re-monitoring and re-evaluation activities of internal control by internal audit and monitor departments. The enterprise supervises and inspects the

situation of establishment and implementation of internal control, evaluates its effectiveness, finds out its deficiencies and improves the process timely. The supervisory review of internal control can be carried out continuous or separately, or two together. The supervisory review process should mainly be concerned about the rationality of the report on internal control deficiencies and the adjustment of the policy process. Therefore, we correspondingly set up four secondary-level indexes: continuous monitoring, separate evaluation, report deficiency and deficiency rectification measures.

3 Construction of Quantitative and Comprehensive Internal Control Evaluation Model

According to the comprehensive evaluation index system, having applied the principle of fuzzy comprehensive evaluation, this article established a comprehensive internal control evaluation matrix model. Fuzzy comprehensive evaluation is in the so-called fuzzy environment, taking into account many factors, for the purpose of one thing to make a comprehensive decision-making approach. When influenced by many more factors, the weight distribution is the key issue, and because of that each component of the weight is small, the factors used in the synthesis of seeking evaluation results reduce to not work in single-factor evaluation matrix, the evaluation results are difficult to distinguish, then we can use the multi-level fuzzy comprehensive evaluation method to solve this problem.

The index system of internal control is with the branch based on the elements of internal control, forming a tree structure, and at first, the multi-level synthesis method will be used to integrate every branch of the model and then the evaluation of each sub-element will be integrated into evaluation of the main factors. The specific steps are just shown as follows:

3.1 Establish the target set

The target set is $X = (X_1, X_2, X_3, X_4, X_5)$, in which "X" is used to evaluate the strengths and weaknesses of the overall goal of internal control, and X_1, X_2, X_3, X_4, X_5 represent the sub-objectives: internal control environment, risk identification, control activities, information and communication and internal supervision, their corresponding weight set is $W = (W_1, W_2, W_3, W_4, W_5)$, and $W_1 + W_2 + W_3 + W_4 + W_5 = 1$. AHP can be used in weights' determination, and as well as the statistics of set value method, log sorting method, comprehensive expert evaluation method and fuzzy comprehensive ranking method. While the main method used in this paper is AHP, other methods are used comprehensively at the same time.

The so-called AHP method means to syndicate the required result by measuring and valuating the influence of the system by each part, and ensure the problem solved model have better applicability, effectiveness and systematicness. The basic principle is to divide a problem without a complex structure into a number of components or factors according to the nature of the problem and the objectives to be achieved, and group the factors so that can form an unrelated top-down dominance structure layer by layer in accordance with the properties of the various factors and group affiliation, the high level factors play dominant roles on the all or some of the next level factors, according to the high-level standard or requirement, value all the relevant next-level factors which cannot be measured precisely by the grades of importance through pair wise comparison, and make a consistency test on the results of comparison until it accords to the fact, intending to complete the transition from qualitative analysis to quantitative analysis, and finally evaluate the factors from the top to the bottom, gradually from the local to the overall, so as to solve a complex system problem^[3].

3.2 Set up the factor set

The factor set shall be the set of the indexes of the secondary-level factors listed upside.

(1) Based on the first-level index--internal control environment, because the internal control environment is the basis and vision for enterprises to implement internal control, reflecting the attitudes and understanding of the corporate management, board of directors and business owners on business internal control, so it plays a great role in promoting or hindering the internal control activities. The factor set is mainly composed by management quality, integrity and values (X_{11}), management philosophy and operating style (X_{12}), board of directors and audit committee (X_{13}), organizational structure (X_{14}), culture (X_{15}), distribution of rights and responsibilities (X_{16}), human resource policies and the implementation (X_{17}).

(2) Based on the first-level index--risk assessment, risk refers to the likelihood of the matter of adversely affect by the realization of business goal. Thus "risk assessment" developed primarily by four components : objective setting, risk identification, risk assessment and risk response, with a total of 9 factors: adaptability of goal-setting (X_{21}), scientificness of the development process of objectives (X_{22}),

level of goal-setting (X₂₃), appropriateness of the usage of risk identification techniques (X₂₄), appropriateness of risk assessment procedures (X₂₅), assessment techniques (X₂₆), risk likelihood (X₂₇), risk impact on business goals (X₂₈) and risk response mechanism (X₂₉).

(3) Based on the first-level index--control activities, therefore, we synthetically set up four secondary-level indexes: accounting process control (X₃₁), workflow control (X₃₂), property security control (X₃₃) and performance control(X₃₄).

(4) Based on the first-level index--information and communication, according the main purpose , we set up four secondary-level indexes: information system (X₄₁), information quality (X₄₂), communication channels (X₄₃) and communication means (X₄₄).

(5) Based on the first-level index-- internal supervision, the main purpose is to monitor the implementation of the internal control activities continuously, find out whether there are design flaws and poor implementation, urge the enterprises to improve and perfect the internal control system. Therefore, the corresponding four secondary-level indexes include: continuous monitoring (X₅₁), a separate evaluation (X₅₂), reported deficiency (X₅₃) and deficiency rectification measures (X₅₄).

Based on the analysis above, we set up the factor set as follows:

The factor set for the sub-objective is “X_i” (=X_{i1}, X_{i2}, ..., X_{ip_i}), which represents the factors listed upside (where i=1,2,3,4,5; j=1,2 ..., p_i; “p_i” is the number of X_i under the graded index), the corresponding weight set is “W_i” = (W_{i1}, W_{i2}, ..., W_{ip_i}), where “W_{ij}”(i=1,2,3,4,5; j = 1,2 ..., p_i) represents the proportion of “X_{ij}” in “X_i”, W_{i1} + W_{i2} + ... + W_{ip_i} = 1. The way of determination of weight is the same as above.

3.3 Determine the weight set

Since the vary degrees of each element’ influence on the evaluation system of internal control, we can use the experts’ estimate method, the analytical hierarchy method and so on to determine the index and the weight of the project in our practical work.

First, determining the weights of the five first-level indexes including internal control environment, risk assessment, control activities, information and communication, and internal supervision, this paper takes the experts’ appraisal approach. When giving internal evaluation, the expert can be composed by the authorities of charge departments within the enterprise, and after be organized to analyze the five elements comprehensively, giving the elements respective weights from experience judgment, integrate the experts to calculate a weighted average weight on the weight of each element by using weighted average method, then they take it as the weight level of the elements (external independent auditors could assess by using the level of the weight, or the audit team make a evaluation directly according to their experience and professional judgments).

The specific set is as follows: with the assumption that there are N experts, the weight of each level factor given by each expert is W_{iN}, the calculation of weighted average weight of each first-level element (W_i) is:

$$W_i = \frac{\sum_{N=1}^n W_{iN}}{n} \tag{1}$$

(Where i = 1,2,3,4; N = 1,2, ... n; “n” is the number of experts who make assessed on the weight of each first-level index; “W_{iN}” is the weight level assessed by each expert on every first-level index.)

Secondly, as for the weights of the secondary-level indexes, we get a judge matrix on the relative importance exerting the basic principles of the hierarchical analysis method, according to the importance of business organizations, management system and operation mode to the enterprise structure by comparing the various indexes, and calculate the normalized eigenvector, or calculate the eigenvalues and eigenvectors with sum method or root method. Then we should derive weight vector of combination from the determination of the consistency of test matrix, calculate the portfolio weight vector, and test the combination of consistency. Finally, derive the weight value of each index by testing the consistency. (Because its process of analysis and calculation is very complicated, we will not give the specific description here.)

3.4 Construct the reviews set

The reviews set is V = (V₁, V₂, V₃, V₄), where “V_k” (k = 1,2,3,4), indicating the reviews of index factors from good to bad. The indexes of reviews set include "excellent", "good", "Medium" and "poor" four grades. This paper expresses the grades of reviews by quantitative scores: “90 points or more” means “excellent”, “80-89 points” means “good”, “60-79 points” means “medium” and “60 points or less” means “poor”. The specific method is to calculate the average grade scores points of the

corresponding index for each secondary-level index first, just as:

$$v_{ij} = \frac{\sum_{l=1}^n v_{ijl}}{n} \tag{2}$$

(Where $i = 1,2,3,4,5$; $k = 1,2,3,4$; $j = 1,2, \dots p_i$; “ p_i ” is the number of “ X_i ” under the classification index; “ n ” is the number of experts scoring the evaluation of each secondary-level index; “ V_{ijl} ” indicates the scores given by experts), get an average score vector (if the evaluators are auditors, and if they operate independently, they can choose not to use the formula (1), and take the scores given by auditors directly), and then calculate the comprehensive evaluation score by fuzzy comprehensive evaluation method, which is the final score of each reviews grade.

3.5 Establish the comprehensive evaluation matrix model

The fuzzy evaluation matrix established from the target set “ X_k ” to the reviews set “ V ” is a calculation model which sets up the secondary-level matrix from the bottom to top based on the average scores of review grades corresponding to the secondary-level indexes:

(1) Calculate and determine the evaluation value of each factor (V_i):

$$V_i = [w_{i1} \quad w_{i2} \quad \dots \quad w_{ip_i}] \begin{bmatrix} v_{i1} \\ v_{i2} \\ \dots \\ v_{ip_i} \end{bmatrix} \tag{3}$$

Where: $i = 1,2,3,4,5$; W_{ij} (where $i = 1,2,3,4,5$; $j = 1,2, \dots p_i$) indicates the weights of each secondary-level index; “ v_{ij} ” indicates the average scores of the corresponding reviews rating of each secondary-level index.

(2) Calculate and determine the comprehensive evaluation value (V):

Where: W_i ($i=1,2,3,4,5$), indicates the weight of each element of the first-level index; “ v_i ” is the appraisal value that has been calculated for the various elements.

4 Conclusion

It is studied on that the comprehensive quantitative evaluation method of internal control

$$V = [w_1 \quad w_2 \quad w_3 \quad w_4 \quad w_5] \begin{bmatrix} v_1 \\ v_2 \\ v_3 \\ v_4 \\ v_5 \end{bmatrix} \tag{4}$$

combining with risk management, is created that a mathematical evaluation model of internal control from the risk-based perspective, and is evaluated that the level of internal control synthetically. All that it has done is of great significance especially for the internal risk measurement to improve control and the ability to cope with risks. Scientific evaluation with the mathematical model on the internal control system will be more facilitate for the managers to design, analysis or evaluate their internal control system, so as to ensure the business objectives be achieved effectively.

We focused on the comprehensive quantitative evaluation method of internal control in this article from a risk-based perspective, according to the spiritual essence of Basic Norms of Internal Control, and have designed the evaluation index system of internal control. We also have constructed a risk-oriented mathematical evaluation model for internal control by using the theory and idea of fuzzy comprehensive evaluation method.

However, due to our study constraints and too many factors involved in the evaluation of internal control, we treated the relative weights and review scores with some simple methods. Thus, the quantitative evaluation model of internal control based on risk should be further studied and improved.

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