

## Research Article

# Study on the Effectiveness Evaluation of Internal Control of Food Enterprises based on the Improved Matter-element Model

Gaoyan Xu, Juqin Shen and Bo Liu

Department of Accounting, School of Business, Hohai University, Nanjing, China

**Abstract:** The internal control plays an important role for enterprise operation management and also becomes the effective method for enterprise to prevent and resist risk. Facing fierce international competition, China's food industry must strengthen its own management to promote its core competence; therefore, the study of effectiveness evaluation of internal control of food industry can avoid slowing down its development because of its internal defect. The effectiveness evaluation index system of internal control of food enterprises is established based on the internal environment, risk assessment, control activity, information and communication, internal supervision, etc. and the effectiveness assessment model is built based on matter-element model, which provide support for the effectiveness evaluation index system of internal control of food enterprises.

**Keywords:** Effectiveness evaluation, internal control of food enterprises, matter-element model

## INTRODUCTION

With the enterprises system reform and change of enterprises operation mode, the internal control plays a more and more important role for enterprise operation management and also becomes the effective method for enterprise to prevent and resist risk. Internal control as a system arrangement can not only promote enterprises' self-management level, but also maintain public interests and finally serves the ultimate aim of enterprises. Therefore, the internal control system built in each enterprise should be based on its own situation, thus to ensure to get long-term development of enterprise in the fierce market competition.

In recent years, the growth rate of china's food industry keeps higher than GDP, which is one of the fastest development industries in national economy. Moreover, more and more Chinese enterprises obtain the licenses to enter into the international market. However, the amount of China's food export of international export is not high. It shows that China's food industry still has a tough journey on international competition (Turnbull Review Group, 2005). Facing fierce international competition, China's food industry must strengthen its own management to promote its core competence; and the effectiveness of internal control is an important index to measure its development. Therefore, the study of effectiveness evaluation of internal control of food industry can avoid slowing down its development because of its internal defect.

## MATERIALS AND METHODS

**Definition of internal control effectiveness of food enterprise:** Internal control refers to the total of a series of method, means and measures, including self-adjustment, constraint, programming, evaluation and control in the internal enterprise in order to realize its operation target, protect safety and integrity of its assets, ensure the correct and reliable accounting information, make sure the implementation of its operation policy and ensure economy, efficiency and effectiveness of the business activities. Effectiveness refers to the degree of planned activity completing and planned result reaching (James and Donald, 2004).

Based on the above conception, the internal control effectiveness of food enterprise refers to result of a series of internal environment construction, risk management, control activity, information system construction and supervision activity implemented in internal enterprises in order to realize its own development goal.

**Establishment of the effectiveness evaluation index system of internal control of food enterprises:** The work content should be considered as the basis of the building of the effectiveness evaluation index system of internal control of food enterprises. According to the Basic Norms of Internal Control prepared by Chinese government in 2008, the factors for building and implementing effective internal control of food industry should include (Krishnan, 2005):

Table 1: Effectiveness evaluation index system of internal control of food enterprises

Target	First grade index	Secondary grade index
Effectiveness evaluation of internal control of food enterprises (O)	Internal environment X <sub>1</sub>	Governance structure X <sub>11</sub>
		Organization establishment and distribution of rights and liabilities X <sub>12</sub>
		Internal auditing X <sub>13</sub>
		Human resource policy X <sub>14</sub>
		Enterprise culture X <sub>15</sub>
	Risk assessment X <sub>2</sub>	Risk reorganization X <sub>21</sub>
		Risk assessment X <sub>22</sub>
		Counter-risk strategy making X <sub>23</sub>
		Counter-risk implementation X <sub>24</sub>
		Risk feedback X <sub>25</sub>
	Control activity X <sub>3</sub>	Separation control of incompatible duties X <sub>31</sub>
		Authorization examining and approving control X <sub>32</sub>
		Accounting system control X <sub>33</sub>
		Financial protection control X <sub>34</sub>
		Budget control X <sub>35</sub>
	Information and communication X <sub>4</sub>	Operation analysis control X <sub>36</sub>
		Performance evaluation control X <sub>37</sub>
		Internal information collection X <sub>41</sub>
		External information collection X <sub>42</sub>
		Information communication and feedback X <sub>43</sub>
Internal supervision X <sub>5</sub>	Information system X <sub>44</sub>	
	Internal supervision system X <sub>51</sub>	
	Internal supervision body X <sub>52</sub>	
	Supervision activity X <sub>53</sub>	
	Self-assessment of internal control X <sub>54</sub>	
		verifiability of internal control process X <sub>55</sub>

- Internal environment:** It is the basis for an enterprise to implement internal control, generally including governance structure, organization establishment, distribution of rights and liabilities, internal audit, human resources policy, enterprise culture, etc.

**Risk assessment:** Enterprise timely recognizes and systematically analyzes the relevant risks for achieving the internal control target and reasonably makes countermeasures of risks.
- Control activity:** According to the risk assessment result, enterprise controls risk to an affordable range by taking corresponding control measures.
- Information and communication:** Enterprise timely and accurately collects and passes on information related to internal control and makes sure the information is effectively communicated among internal departments of the enterprise and between the enterprise and the outside.
- Internal supervision:** Enterprise supervises and inspects the building and implementing of internal control, evaluates its effectiveness, finds its defects and improves it timely.

According to the above analysis, the establishment of effectiveness evaluation index system of internal control of food enterprises can be shown in Table 1.

**Establishment of effectiveness evaluation model of internal control of food enterprises:** After the index system establishment, the next is to build an effectiveness evaluation model. This study attempts to improve the traditional matter-element model and applies it to the effectiveness evaluation model building of internal control of food enterprises.

The processes of effectiveness evaluation model building of internal control of food enterprises based on matter-element model improvement (Yuping *et al.*, 2003; Lixia and Guoqing, 2005; Yuanxin *et al.*, 2013):

**Step 1: Determine the classical domain and section domain:** In this study, the virtues or defect degree of the effectiveness can be classified as higher, high, general, low, lower. Therefore, each evaluation index of the effectiveness can be classified as five grades from first to fifth, first grade represents poorest, secondary grade represents poorer, third grade represents average, fourth grade represents good and fifth grade represents better.

Under the first grade index of internal entertainment (X<sub>1</sub>), classical domain R<sub>0j</sub> and R<sub>pi</sub> of each grade as:

$$R_{01} = \begin{bmatrix} 1level & X_{11} & 0-20 \\ & X_{12} & 0-20 \\ & X_{13} & 0-20 \\ & X_{14} & 0-20 \\ & X_{15} & 0-20 \end{bmatrix}, \quad R_{02} = \begin{bmatrix} 2level & X_{11} & 20-40 \\ & X_{12} & 20-40 \\ & X_{13} & 20-40 \\ & X_{14} & 20-40 \\ & X_{15} & 20-40 \end{bmatrix},$$

$$R_{03} = \begin{bmatrix} 3level & X_{11} & 40-60 \\ & X_{12} & 40-60 \\ & X_{13} & 40-60 \\ & X_{14} & 40-60 \\ & X_{15} & 40-60 \end{bmatrix}, \quad R_{04} = \begin{bmatrix} 4level & X_{11} & 60-80 \\ & X_{12} & 60-80 \\ & X_{13} & 60-80 \\ & X_{14} & 60-80 \\ & X_{15} & 60-80 \end{bmatrix},$$

$$R_{05} = \begin{bmatrix} 5level & X_{11} & 80-100 \\ & X_{12} & 80-100 \\ & X_{13} & 80-100 \\ & X_{14} & 80-100 \\ & X_{15} & 80-100 \end{bmatrix}$$

Section domain  $R_{p1} = [(\text{internal environment})]$ :

$$R_{p1} = \begin{bmatrix} X_{11} & 0-100 \\ X_{12} & 0-100 \\ X_{13} & 0-100 \\ X_{14} & 0-100 \\ X_{15} & 0-100 \end{bmatrix}$$

The classical domain and section domain of each grade under each index can be also got in this way.

**Step 2: Determine the weight of evaluation index  $X_i$  and  $X_{is}$ :** This study uses Group Analytic Hierarchy Process (GAHP) to determine index weight, GAHP is improved based on AHP and removes the defect of the traditional AHP that it cannot solve single decision. Set the weight division of the first evaluation index  $X_i$  as  $a_i$  ( $i = 1, 2, \dots, 5$ , the first grade index weight vector  $A = (a_1, a_2, \dots, a_5)$ , which meets  $a_i \geq 0$

$\sum_{i=1}^5 a_i = 1$  and  $\sum_{i=1}^5 a_i = 1$ ; set the weight division of the secondary evaluation index as  $a_{is}$  ( $= 1, 2, \dots, 5; = 1, 2, \dots$ ), each secondary weight vector  $A_i$

$= (a_{i1}, a_{i2}, \dots, a_{in})$  and meet  $a_{is} \geq 0, \sum_{s=1}^{n_i} a_{is} = 1$ .

**Step 3: Determine the to-be evaluated matter-element:** Invite many experts evaluate the grade of the overall situation of the internal control effectiveness of food enterprises respectively according to the above index system and evaluation standard and take the mean given by each expert as the magnitude of this index  $u_{in}$ . According to the index system, the to-be evaluated matter-element  $m$  is 6 in the internal control effectiveness evaluation of food enterprises. Set the to-be evaluated object as  $P_m$  ( $m = 0, 1, \dots, 5$ ), each calculation result can be represented by matter-element  $R_m$ , which is called to-be evaluated matter-element. Then the to-be evaluated matter-element of the internal control effectiveness evaluation of food enterprises can respectively be:

$$R_1 = \begin{bmatrix} P_1 & X_{11} & x_{11} \\ X_{12} & x_{12} \\ X_{13} & x_{13} \\ X_{14} & x_{14} \\ X_{15} & x_{15} \end{bmatrix}, R_2 = \begin{bmatrix} P_2 & X_{21} & x_{21} \\ X_{22} & x_{22} \\ X_{23} & x_{23} \\ X_{24} & x_{24} \\ X_{25} & x_{25} \end{bmatrix},$$

$$R_3 = \begin{bmatrix} P_3 & X_{31} & x_{31} \\ X_{32} & x_{32} \\ X_{33} & x_{33} \\ X_{34} & x_{34} \\ X_{35} & x_{35} \\ X_{36} & x_{36} \\ X_{37} & x_{37} \end{bmatrix}, R_4 = \begin{bmatrix} P_4 & X_{41} & x_{41} \\ X_{42} & x_{42} \\ X_{43} & x_{43} \\ X_{44} & x_{44} \end{bmatrix},$$

$$R_5 = \begin{bmatrix} P_5 & X_{51} & x_{51} \\ X_{52} & x_{52} \\ X_{53} & x_{53} \\ X_{54} & x_{54} \\ X_{55} & x_{55} \end{bmatrix}, R_0 = \begin{bmatrix} P_0 & X_1 & x_1 \\ X_2 & x_2 \\ X_3 & x_3 \\ X_4 & x_4 \\ X_5 & x_5 \end{bmatrix}.$$

In which,

$R_0$  = The evaluation matter-element for internal control effectiveness of food enterprises

$R_1$  = The evaluation matter-element for the internal environment of food enterprises

$R_2$  = The evaluation matter-element for the risk assessment of food enterprises

$R_3$  = The evaluation matter-element for the control activity of food enterprises

$R_4$  = The evaluation matter-element for the information and communication of food enterprises

$R_5$  = The evaluation matter-element for the internal supervision of food enterprises

$x_i$  ( $i = 1, 2, \dots, 5$ ) - The weighted value of the first index.

**Step 4:** Determine the correlation degree of the to-be evaluated matter-element with each grade  $j$ :

Set:

$$K_j(x_i) = \begin{cases} \frac{\rho(x_i, x_{0ji})}{\rho(x_i, x_{pi}) - \rho(x_i, x_{0ji})}, & \rho(x_i, x_{pi}) - \rho(x_i, x_{0ji}) \neq 0 \\ -\rho(x_i, x_{0ji}) - 1, & \rho(x_i, x_{pi}) - \rho(x_i, x_{0ji}) = 0 \end{cases} \quad (1)$$

In which,

$$\rho(x_i, x_{0ji}) = \left| x_i - \frac{1}{2}(a_{0ji} + b_{0ji}) \right| - \frac{1}{2}(b_{0ji} - a_{0ji}) \quad (2)$$

$$\rho(x_i, x_{pi}) = \left| x_i - \frac{1}{2}(a_{pi} + b_{pi}) \right| - \frac{1}{2}(b_{pi} - a_{pi}) \quad (3)$$

In the above formula,  $\rho(x_i, x_{0ji})$  is the distance between point  $x_i$  and interval  $x_{0ji}$ ,  $\rho(x_i, x_{pi})$  is the distance between point  $x_i$  and interval  $x_{pi}$ .

**Step 5:** Calculate the correlation degree of the to-be evaluated matter  $P_m$  with each grade  $j$ : If the weight coefficient of index  $X_i$  is  $a_i$  and

$$\sum_{i=1}^n a_i = 1, \text{ then:}$$

$$K_j(p) = \sum_{i=1}^n a_i K_j(x_i) \quad (4)$$

In the formula,  $K_j(p)$  is the combination value of the to-be evaluated matter with the correlation degree of each grade under the consideration of index weight.

This formula is not only the correlation calculation model of grade  $j$  with each evaluation model, but also the correlation calculation model of grade  $j$  with the whole to-be evaluated matter.

**Step 6: Grade evaluation:** If

$$K_{j_0}(p) = \max_{j \in \{1, 2, \dots, m\}} K_j(p), \text{ the evaluate } P_m \text{ belongs to grade } j_0.$$

Through this method we can see that it cannot only evaluate from the effectiveness of internal control of food enterprise on the whole, but also can totally reflect the internal environment, risk assessment, control activity, information and communication and internal supervision of the effectiveness of internal control of food enterprise, thus to provide information to know internal control of food enterprise and to provide support for the improvement of internal control.

### CONCLUSION

With the rapid development of the food industry, it should face increasingly fiercer and fiercer competition. In order to get a better survival and development chance, it must strengthen its own management. The effectiveness of internal control is an important indicator of the enterprise governance effectiveness. Based on this, according to Basic Norms of Internal Control, the effectiveness evaluation index system of internal control of food enterprises is built on the basis of the internal environment, risk assessment, control activity, information and communication, internal supervision, etc. and the effectiveness assessment model is built based on matter-element model, which

provide support for the effectiveness evaluation index system of internal control of food enterprises.

### ACKNOWLEDGMENT

This study is supported by: Humanity and Social Science Youth foundation of Ministry of Education of China, (13YJC630191) and Soft Science Fund Project of Science and Technology Department of Jiangsu province in China, (BR2013064).

### REFERENCES

- James, R. and E. Donald, 2004. The Matrix Revisited. The Internal Auditor, pp: 145-178.
- Krishnan, J., 2005. Audit committee quality financial expertise and internal control: An empirical analysis. Account. Rev., 19(3): 137-158.
- Lixia, Z. and S. Guoqing, 2005. Comprehensive assessment on matter element model of urbanization in Jiangsu province. J. Huaqiao Univ., Nat. Sci. Edn., 2: 210-214.
- Turnbull Review Group, 2005. Review of the Turnbull Guidance on Internal Control Chartered Accountants. pp: 256-289.
- Yuanxin, L., Z. Yan and Z. Xing, 2013. Small hydropower's construction and relative financial analysis. J. Chem. Food Res., 5(9): 263-267.
- Yuping, H., R. Benqing, X. Jiancang and H. Mingcong, 2003. Application of matter element model in comprehensive evaluation of regional water resources. J. China Agr. Univ., 1: 31-36.