## Study on Economic Responsibility Audit in China Based on Management Efficiency

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### Abstract

Economic responsibility audit, as an innovation of the modern audit system in china, is an economic supervision system of Chinese characteristic. This system is founded to supervise and evaluate the performance on the economic responsibility of party-government leaders and enterprise directing staff, so evaluating impartially is the key of this system and some kind of unfairness existing in the evaluation method can impose important influences on the executing of economic responsibility audit. In this paper, the author raises that the influences of objective foundation can be eliminated by the management efficiency and its binary relative evaluating method, therefore, the result can reflect the actual benefit achieved by the subjective efforts and capability of leaders. Aim of making study on this subject is to enrich and expand the theoretical research on economic responsibility audit and provide some theoretical support and technical guidance to its development.

**Keywords**: Binary relative efficiency, Economic responsibility audit, Leaders and cadres Management efficiency

#### 1. Introduction

Theoretically speaking, the economic responsibility audit is the action taken by the auditing institute to supervise, evaluate and identify the economic responsibility performance of the party-government leaders and enterprise directing staff by auditing some relevant economic activities the financial revenue and expenditure of the state-owned enterprises, regions and departments operated by those leaders. At present, the execution of audit in china is according to the "Provisional Regulation on the economic responsibility audit of the tenurial country-level party-government leaders and cadres" and "Provisional Regulation on the tenurial economic responsibility of stateowned and state-holding enterprise leadership" made by the central executive office and the state council in 1999<sup>[1-3]</sup>.

According to the different natures of objects, the economic responsibility audit can be divided into two kinds, one is the economic responsibility audit of partygovernment leaders, the other is the audit of the enterprise directing staff<sup>[4]</sup>, and this paper will focus on the latter. Although the object of economic responsibility audit is "people", their performance are usually manifested by the "units" operated by the objects. At present, the key of economic responsibility audit of enterprise directing stuff includes three aspects: first, auditing the financial revenue and expenditure and abidance of national financial regulations; second, the evaluation of operating achievements; third, the contents of personal narration of their own performance. Base on the foresaid

Proceedings of the 11th Joint Conference on Information Sciences (2008) Published by Atlantis Press © the authors information, the relevant audit institute should complete the report on the tenurial economic responsibility audit of leaders and cadres.

Viewing from the content of these three aspects, the first is the hard index which has to be achieved without any leeway, and the rest two indexes has some elasticity and the initiative of narration part depends on themselves. The second one is audited by the internal audit unit, so the leadership pays more attention to the operating achievement audit which is executed internally. The unfairness of performance evaluation is in the following two aspects: one is the objective technical obstacles on establishing the evaluation index system and the proper weight of each index; the other is that the present evaluation is influenced by the objective foundations of objects being evaluated, so the result only shows the comprehensive capability rather than the contribution of the objects' subjective efforts. As time passes, many worse performed enterprises will attribute the low efficiency to the inferior objective foundation and lack of the analysis on their insufficient efforts and incapability, so the motivation of performance evaluation will be reduced<sup>[5]</sup>. The result of this kind of evaluation will make most leaders try to go somewhere which has good foundation, because these units often have a good performance in the audit of yearly performing responsibility evaluation. However, to some units of inferior foundation, the result of audit can't show their efforts when compared transversely though they may achieved a lot when compared longitudinally with themselves, so the performances often be neglected. Sometimes people can conceive the differences between the units of good foundation and those of inferior foundation, but it is still very difficult to evaluate the exact contribution of the leaders' subjective efforts. This problem causes such a problem: leaders of some worseperformed enterprises will attribute their poor performance to the inferior foundation and neglect the reason from their subjective reasons, and leaders of betterperformed enterprises will be too optimistic to their own capability and neglect the factor of foundation. So it is not impartial enough to apply this method to evaluation the leaders' performance.

# 2. The ideological core of management efficiency

What the management efficiency research is the issue of efficiency, which kernel idea is that the efficient efforts can strengthen a enterprise, so the changes of actual strengths can reflect the managers' relative efficient effort extent.

Owing to the specialty of managers' behavior, it is easily-understood that the evaluation of subjective efforts is very important to know and motivate the attitude of managers. And the management efficiency is to eliminate the influences of objective foundations and reflect the actual extent of managers' efforts.

One enterprise's actual strength can be manifested by its scale, human resource and economic benefit. The improvement of economic benefit includes the efforts from the staff, especially the subjective efforts of managers. In other words, efficient efforts can change the strength, from which change we can also know the extent of efforts. Only the benefit brought by the subjective efforts of people is the true benefit of management, this is the core of management efficiency.

In the real economic system, differences among the foundations of the evaluated enterprises are objective. And they come from two aspects, one is the differences of the capital, technology, labor and other internal factors owned by

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the objects, the other is the differences of outside operating environment, such as regional and policy discrepancies and so on. From the previous study, we can find that the enterprises in better-economic condition region (such as, seaside region) usually perform better than those in worse-economic condition region (such as, the western and inland region). However, it does not mean the managers of worse-condition enterprises don't work as hard as those of better-condition ones. Therefore, how to eliminate the influence of objective foundation and make a accurate evaluation on the benefit of efficient effort and capability is the key to perfect and develop the performance evaluation theory.

There is no insurmountable divide between the actual strength of the evaluated objects and their subjective efforts and capability. During the consecutive operating of the evaluated enterprises, the effort extent and capability changes of the managers can impose some influences on the comprehensive strength, so the managers' efforts can be evaluated by the dynamic changing of their actual strengths. Based on the foresaid thought, some scholars use the past evaluation result as the reference index, the present result as the present index, and establish a possible set composed of the foresaid indexes. And by use of data envelopment analysis (for short DEA)<sup>[6-10]</sup>, they raise a binary relative benefit evaluation method, by which we can eliminate the impact of objective foundation and reflect the exact benefit brought by the subjective efforts and capability.

Because of the limitation of the traditional evaluation method, the binary relative evaluation method provides us a more scientific method, by way of which to calculate the benefit of management and computer the efficient efforts extent dynamically. So the result can be used as a reference of the selection and appointment of cadres, and enrich and expand the content of the tenurial economic responsibility audit of leadership and cadres.

### 3. The calculating method of management efficiency

#### **3.1.** The general thought of calculating management efficiency

Drawing lessons from the production efficiency theory, we can establish the calculating thought of management efficiency. If one production unit achieves a ideal object, we think it is efficient, otherwise inefficient. The scholars who studied the production efficiency theory earliest are Koopmans<sup>[11]</sup> and Debreu<sup>[12]</sup>. Since they came out the concept of production possible set in 1951, the production efficiency has an accurate economic meaning: outputting as more as possible by inputting as less as possible.

Production possible set is such a kind set of input and output:

 $T = \{(X, Y), \text{the output } Y \text{ can be produced by input } X\}$ 

This set has two parts: one is the boundary (production frontier), the other is the internal of the set. So we can define the relative efficiency of evaluated unit: the points on the boundary are efficient units, and those inside the set are inefficient, or we can judge the efficiency by the distance between the evaluated unit and boundary of the set, the units of strict positive distance are inefficient, those of 0 distance are efficient.

The thought of calculating the management efficiency to consider the reference index as the abscissa *X*, and the present index as the ordinate *Y*. Hypothesizing that there are three objects to be evaluated, and their index distribution are  $A(x_1, y_1)$ ,  $B(x_2, y_2)$ ,  $C(x_3, y_3)$ , and their position on the plane coordinate are showed in Fig.1. The reference index of *B* is between that of *A* and *C*, that is  $x_1 < x_2 < x_3$ . If the index condition  $B(x_2, y_2)$  is below the

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line linking of  $A(x_1, y_1)$  and  $C(x_3, y_3)$ , then we can conclude that the efficient subjective effort extent can't match that of Aand C.



Fig.1 Geometrical explanation of the subject effort of the measured unit



 $0 \qquad X \text{(reference index)} \\ Fig.2 \ Frontier \ of \ index \ possible \ set$ 

All the index condition of evaluated objects on the plane coordinate can be marked, and by way of the DEA we can obtain the frontier of index condition possible set. Any evaluated object (x, y) is between two different units which are on the frontier (Fig.2), marking the corresponding index y' on the frontier of the evaluated object's present index y, the ratio of y and y' is 7, which is a kind of measurement of the efficient effort extent.

The traditional method DEA can determine the relative benefits of same-type enterprises <sup>[13-14]</sup>, however, when solving the actual issues, we have to evaluate the relative benefits of different-type enterprises. When evaluating several enterprises of the same type, the objective foundations are different too, in order to eliminate the impact of different foundations and make the relative benefit evaluation more impartial and acceptable to the publics, Yingjun Feng came out the "binary relative benefit method".<sup>[15]</sup>

# **3.2.** The stages of calculating management efficiency

The first stage, after establishing the index system, applying some existed evaluation method, such as analytic hierarchy process(AHP) <sup>[16]</sup> and efficiency coefficient method  $^{[17]}$  and so on  $^{[18-21]}$ . The index coming from the result of evaluation on the enterprise's past actual strength reflects the condition of evaluated objects' foundation, so we call it "reference index". Certainly, we can use the same index system and method to calculate the present actual strength, and the index from this method is "the present index". Putting the reference index and present index together, we can have a pair of data, which is the index condition of the evaluated unit. Obviously, the index condition reflects the strength level in different stages. The second stage, take the reference index as input and the present index as output, by way of DEA method to determine the binary relative benefit of evaluated units. According to the features of DEA, different inputs have different production frontier projection, so this projected reference index can be taken as a reference standard of evaluation. As we know, the reference index reflects the objective foundation of evaluated object, so to different foundation; there are different evaluation standards for the present strength when using the binary relative benefit evaluation. Under different standards, the ratio between the strength achieved and that should be achieved can reflect the real subjective effort extent of the people by eliminating the impact of objective foundation.

## **3.3.** The mathematic model of calculating management efficiency

### (1) Reference index, present index and possible set of index condition

Assuming that there are *n* evaluated units, and after the establishment of evaluation index system, the AHP or efficiency coefficient evaluation result of the basal strength of j unit is  $x_j$ , we call  $x_j$  the reference index of j unit; Applying the same index system and same method to evaluate the present strength of the j unit, we mark the result  $y_j$ , then  $y_j$  is the present index of j unit; date pair  $(x_j, y_j)$  is the index condition of j unit. So all the index condition  $(x_j, y_j)$  of these n units can compose a set:

$$T = \{(\mathbf{x}, \mathbf{y}) \middle| \sum_{j=0}^{n} \lambda_j \mathbf{x}_j \le \mathbf{x}, \sum_{j=0}^{n} \lambda_j \mathbf{y}_j \ge \mathbf{y}, \lambda_j \ge 0, \sum_{j=0}^{n} \lambda_j = 1, j = 0, \dots, n \}$$
(1)

where  $(x_0, y_0) = (0, 0), j = 0, 1, \dots n$ . We call the set *T* determined by (1) is the possible set of index condition. Apparently, the *T* has the features of convexity, ineffectiveness and minimalness.

(2)Establishing the mathematical model and determining the binary relative benefit

Assuming there are *n* evaluated units, after defining the reference index  $x_j$ , present index  $y_j$ , and determining the possible set of index condition T, take the reference index  $x_j$  as input and present index  $y_j$  as output, we can establish a model:

 $\max Z$ 

$$S.t \qquad \sum_{j=0}^{n} \lambda_{j} x_{j} \leq x_{j0}$$

$$\sum_{j=0}^{n} \lambda_{j} y_{j} \geq Zy_{j0}$$

$$\sum_{j=0}^{n} \lambda_{j} = 1,$$

$$\lambda_{j} \geq 0, j = 0, 1, \dots n$$

$$(2)$$

Given a fixed arbitrary  $j_0$ , by solving the linear programming problem (2), the

frontier projection  $(\overline{x}_{j_0}, \overline{y}_{j_0})$  of the index condition of  $j_0$  evaluated unit can be determined, that is  $\overline{x}_{j_0} = x_{j0}$ ,  $\overline{y}_{j_0} = Z^0 y_{j_0}$ ,  $Z^0$  is the optimum solution of the linear programming problem (2). If  $Z^0=1$ ,  $(x_{j0}, y_{j0})$  will be on the frontier of the possible set, and  $Z^0<1$  means that  $(x_{j0}, y_{j0})$  is in the internal of the possible set *T*. Therefore,

 $\eta = y_{j_0} / \overline{y}_{j_0} \times 100\% = 1 / Z^0 \times 100\%$ (3)

This index reflects the deviation extent of the evaluated unit to the frontier. We call the  $\eta$  in (3) as the binary relative benefit of the  $j_0$ .  $\eta$  reflects the deviation extent of the  $j_0$  unit's present index  $y_{j_0}$ to its optimum condition  $\overline{y}_{j_0}$  under the given fixed reference index  $x_{j_0}$ . This deviation extent is determined by the effective effort extent, so it can be considered as a kind of measurement of effective ef-

According to the definition, management efficiency is to eliminate the impact of objective foundation and reflect the behavior features of the real benefit created by the managers' efforts. The binary relative benefit method is such a way to fulfill the foresaid requirements of management efficiency, so this is a good method to calculating the management efficiency.

fort extent.

### 4. An empirical study on management efficiency

#### 4.1. An example of measurement

Applying the binary relative benefit evaluation method, we have calculated the data ratio from 2004 to 2005 of the 15 productive enterprises affiliated to the Daqing petroleum administration. This calculation is based on the final scores of

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quantitative indexes made by the enterprise performance evaluation system of Treasury (efficiency coefficient method). The evaluation scores of recent 2 years represent both their strength and productivity during different years, and then we take them respectively as the reference index and present index to make the calculation by the binary relative benefit method, and the results are in the Tab.1:

Table.1 calculating results of the 15 affiliates and branches' management efficiency in 2004 and 2005

	Productivity in	Productivity in	Calculating results
unit	2004 reference	2005 present	of management
	index	index	efficiency in 2005
1.	72.2	73.0	0.8691
2.	75.6	73.9	0.853
3.	81.1	90.9	1
4.	80.2	82.3	0.9124
5.	74.4	81.4	0.9498
6.	77.7	79.0	0.8951
7.	75.3	78.3	0.9063
8.	50.4	25.1	0.3879
9.	75.1	75.8	0.8789
10.	61.0	75.3	1
11.	44.0	36.3	0.6226
12.	20.7	32.5	0.9755
13.	81.0	82.6	0.9095
14.	11.9	27.3	0.7853
15.	28.9	43.2	1

#### 4.2. Analysis on measurement results

The binary relative evaluation value provide us the general condition of a enterprise's management efficiency, but it can't reflect the reason why some can rank in the front however some are in the back, so in order to analyze whether the results are reasonable or not and find the concrete reason impacting the relative places of enterprises, some analysis about the evaluation results should be done.

The result-analysis can be divided into 2 processes: the first one is to analyze the rationality of the results, although the mathematical method we applied during the calculation is advanced, describing the whole complicated management activity by only one model obviously has some limitations, so in order to eliminate the relative errors caused by these limitations, we need to make some artificial correction. The second process is to find out the reasons impacting the places of enterprises. The binary relative evaluation value is based on the comprehensive index of each year's strength, which is calculated against kinds of financial indexes by the efficiency coefficient method. Therefore, based on the evaluation results of the binary relative benefit method, we can begin with the analysis on index system, and try to find the concrete reason by AHP.

First, the rationality of the results was analyzed. According to the analysis on the comprehensive index calculated by the Treasury, we found that the 14th unit and 15th unit is abnormal, their financial revenue indexes are too low, and have a big deviation to the level of previous years and the developing trendy that we know.

After the investigation, the 14th unit shows something abnormal because after its establishment in 2004, this enterprise has made the 0.23 billion (CNY) preparation of calculating the assets devalue to deal with the problems left by the previous years, so this activity has a great impact on the revenue of the 14th unit. As to the 15th unit, it is a manufacturing enterprise which resources are steels, so the 20% rise of price in 2004 has reduced its benefit seriously. Therefore, according to the actual situation, we adjusting the data and calculate the new management efficiency during 2004 and 2005 by way of the binary relative evaluation and the results are in Tab.2:

Drawing all the management efficiency points to the scatter fig, as Fig.3 We can found from the graph that the adjusted index frontier is composed of the unit 3 and unit 10, in fact, the elimination of impact imposed by the preparation of calculating the assets devalue means the impact caused by the limitations of DEA is also eliminated, so the adjusted results are reasonable.

Table 2 adjusted calculating results of management efficiency in 2004 and 2005

0			
	Productivity	Productivity	Calculating results
unit	result in 2004	result in 2005	of management
	reference index	present index	efficiency in 2005
1.	72.2	73.0	0.8691
2.	75.6	73.9	0.853
3.	81.1	90.9	1
4.	80.2	82.3	0.9124
5.	74.4	81.4	0.9498
6.	77.7	79.0	0.8951
7.	75.3	78.3	0.9063
8.	50.4	25.1	0.3942
9.	75.1	75.8	0.8789
10.	61.0	75.3	1
11.	44.0	36.3	0.6408
12.	25.7	32.5	0.8888
13.	81.0	82.6	0.9095
14.	21.9	27.3	0.8427
15.	38.9	43.2	0.8462

At last, we make some analysis on the results, the evaluated units of higher management efficiency (higher than 0.9) can be divided into two cases: one is that under the circumstances of higher reference index level, the next year's present index is still high, such as the unit 3 4 5 and 13, this shows the efforts paid by the better-condition enterprises to maintain the previous performance. The other is that the present index is not high enough or a little low, but the reference index improve a lot when compared with the present index, such as unit 10, and the feature of these units is there is a big improvement in the next year, so the evaluation results reflect the subjective efforts paid during the achievement of substantial progress. As the same way, the units of lower management efficiency (lower than 0.7) can also be divided into two cases: one is that both the reference index and the present index are very low, such as unit 11, this result shows that the management efficiency can't be evaluated unless the foundation is increased; the other is some units whose present index decreases a lot, such as unit 8, and its feature is that the foundation is not the worst, its reference index ranked in the 11<sup>th</sup> place in 2004, however, the reduction of

the present index is much larger than that of the reference index, and rank in the last place in 2005. This result has showed that this enterprise hasn't paid any substantial efforts to increase its own benefit. As to the units ranking in the middle places has a common that their effective efforts are not enough, and because this method puts all the enterprises into a situation that no progress means backwardness, these enterprises are relatively lagging although they have made some kind of efforts. The calculation of management efficiency provides the auditors a useful instrument to obtain substantial information, and with its help, the auditors can evaluate not only the past performance of a enterprise but also the people's subjective efforts.



Fig.3 adjusted index condition fig in the year of 2004 and 2005

#### 5. Conclusion

The binary relative benefit method of management efficiency thought has solved two problems; one is determining the different reference standards of enterprises with different foundations. The other is determining the specific method when evaluating the economic benefit of different enterprises. The method of taking reference benefit as the reference index (input) and present benefit as the output and using the DEA to calculate the relative benefit is the binary relative benefit. This method takes both the foun-

dation differences of evaluated units and the impact of each unit's management level, technical progress and the quality of staff into account. As the index of evaluating the relative benefits of different units, the binary relative benefit is more impartial and comparable. Applying this index successively can make every unit get into such a condition: no progress means backwardness, so the units of good foundation will not be able to rest easy, and those of inferior foundation will not feel hopeless to catch up with the enterprises of good performance because as long as the progress is big enough the binary relative benefit index can also be high. In a word, this index has an invigorative function on all the enterprises, and is also an effective instrument to the economic responsibility audit of leaders and cadres.

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