

Research on Evaluation of the Efficiency of Internal Control of State Owned Listed Corporation Based on DEA

Shi Qiu, Hongqu He, Hongwei Guo, and Xi Huang

Abstract—Most listed corporations evaluated the effectiveness of internal control following the passage of the Sarbanes-Oxley Act of 2002(SOX) at the expense of the unprecedented assessment cost. But the quality of internal control rests with effectiveness and efficiency of internal control. Hence this paper puts forward the DEA method to evaluate efficiency of the internal control in China State-owned Listed Corporations. The empirical research finds that the efficiency value of internal control based on DEA method is fine generally except the wasting in the pure technology efficiency (PTE) and scale efficiency (SE). In addition, the DEA-based evaluation result is inconsistent with the DIB index, which is one of the predominant internal control indexes in China. Since these two strategies cannot be compared directly, we compare them with auxiliary of Tobin Q by the similarity computation. The results indicate that the DEA index outperforms the DIB index from the perspective that the good internal control should improve the enterprises' value while the bad one would not.

Index Terms—Internal control, operational efficiency, DEA, Tobin Q.

I. INTRODUCTION

Listed companies were required to assess the quality of their internal control systems, which is always a high-profile issue to the investors and stakeholders given the financial fraud, especially for the State-Owned Enterprises (SOE). In the world top 500 corporations announced by the American Fortune magazine in 2015, there were 106 Chinese companies and the SOE accounted for 80%. However, the defect of internal control had brought about great damage to the SOE. For example, the large losses of China National Aviation Fuel can be attributed to the speculation on financial derivative instruments and the huge waste of state-owned assets is blamed on the high price merger and acquisition. Therefore, after the enactment of SOX(Sarbanes-Oxley) Act of American in 2002, China has also began to establish the

Manuscript received May 24, 2017; revised October 27, 2017. This work was supported in part by National Natural Science Foundation of China (Grant No.61303043), Scientific Research Fund of Hunan Provincial Education Department (Grant No.13B142), Hunan Social Science Foundation of China (Grant No. 14YBA022),Hunan Provincial Philosophy and Social Science Foundation of China (Grant No. 14YBB007), Soft SCIENCE of Hunan Science and Technology Department(Grant No.2012ZK3001), Hunan Provincial Education Science '12th Five-Year' planning subject(XJK015QJG001).

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standard system of internal control gradually, including the Basic Internal Control Norms of Enterprise in 2008 (BICNOE) and The Enterprise Internal Control Guidelines in 2010 (the Guidelines hereafter). In 2012, the Treasury and SASAC(State-owned Assets Supervision and Administration Commission) handed out the Notice on the accelerating the construction of internal control system. But the circumstance of failure in the internal control is very serious. In 2015, the National Audit Office of PRC audited 14 SOEs and found that there were 56 cases of violation of laws and disciplines and the false amount of revenue, profit and asset were 29.765billion, 19.357 billion and 4.291billion respectively. Hence the question on the implementation of the internal control institution of SOEs needs to be answered at first.

Therefore, this paper evaluates the internal control of SOEs based on DEA (Date Envelopment Analysis) method. In the evaluation, the proposed schema showed a better result than the DIB method, which is one of the predominant internal control indexes in China.

II. RELATED WORK

Most studies focused on the elements of internal control [1]-[3] or the extent of realization in the goal of internal control [4]-[6] to evaluate the quality of internal control. While the Xiamen University and Shenzhen DIB Company (the first company studying internal control in China) keep doing the research on the internal control index. However, the quality of internal control depends on the effectiveness and efficiency of internal control. The above mentioned researches mainly evaluated the effectiveness of internal control, and little work has been performed on the efficiency of internal control. Our research is motivated by the fact about the gradual increasing cost of assessing internal control. Lianhua L, *et al.* [7] provided the framework of theory and instruments of measuring and evaluating the efficiency of internal control. CHI Guohua, *et al.* [8] also constructed a set of internal control quality evaluation index system and established the internal control index of listed corporations by integrating the 'elements', 'weakness' and 'targets' concepts of internal control. Nevertheless, there have been only a few attempts to evaluate the efficiency of internal control in theory, and no systematic attempts to the empirical research.

This paper is to study the efficiency of internal control of Hunan SOEs in 2013 using the DEA method by taking five elements of the internal control as the inputs and three targets of internal control as the outputs, and compare the result with the DIB index to discover the problems existed in the China SOEs, and make suggestions to improve the efficiency of internal control.

III. METHOD AND SAMPLE

This paper designs five-inputs and three-outputs when utilizing the DEA approach to evaluate the efficiency of internal control.

A. Input-indicators

According to the COSO internal control framework [9], the internal control contains five elements of control environment (CE), risk assessment (RA), control activities (CA), information and communication (IOC) and monitoring (M). We use the DIB company information disclosure index database of internal control to reflect the inputs of the five elements. This index database has 5 first-level indexes based on the 5 elements of internal control, 30 second-level indexes and 87 third-level indexes. The CE's data range is 0 to 19, RA's data range is 0 to 11, CA's data range is 0 to 14, IOC's data range is 0 to 6 and the M's data range is 0 to 16. The higher the indexes are, the higher the cost of establishing the internal control will be. Therefore, the study chooses the above indexes as the input-indicators.

B. Output-indicators

On the basis of COSO internal control framework, internal control influenced by the enterprise's board of directors, managers and other people, is a process to provide sound assurance for realizing the goal of effectiveness and efficiency of operations, reliability of financial reporting and compliance with applicable laws and regulations. As a result, this work chooses following three output-indicators. The first indicator is Operation measured by the return on equity (net profit divided by net-asset) to reflect the effectiveness and efficiency of operations, based on the fact that the weight of return on equity (ROE) is the biggest weight and can show the operating ability best according to the enterprise comprehensive performance evaluation index and weight table of 'Implementing Rules for the Comprehensive Performance Evaluation of Central Enterprises' enacted by the SASAC [10]. Because the data of the DEA model should be all nonnegative, we normalize all the data by the following formula.

$$\text{Normalized } ROE_i = \frac{ROE_i - \text{Min}(ROE)}{\text{Max}(ROE) - \text{Min}(ROE)} \quad (1)$$

where Min (*) and Max (*) mean the minimum and maximum value in the ROE set.

The second indicator is the report indicator reflecting the reliability of financial reports. Johnson *et al.* [11] have ever measured poor financial reporting quality by the absolute value of abnormal accruals. So, the study estimates the Reporting by the relative proportion of the absolute value of normal accruals to the sum of the absolute value of normal accruals and the absolute value of abnormal accruals [3]. The equation is as follow:

$$\text{Reporting} = \frac{|\text{Normal Accruals}|}{|\text{Normal Accruals}| + |\text{Abnormal Accruals}|} \quad (2)$$

Then the abnormal accruals are estimated via using the Modified Jones Model [12]. In this model, normal accruals are calculated as a function of the change in revenue minus change in accounts receivable and the level of properties,

plants and equipments. These variables control for changes in accruals that are driven by the changes in the firm's economic condition. Total assets at the beginning of the year adjust all the variables in the model. The abnormal accruals are calculated by the below equation.

$$TA_{it}/A_{it-1} = \beta_1(1/A_{it-1}) + \beta_2[(\Delta REV_{it} - \Delta REC_{it})/A_{it-1}] + \beta_3(PPE_{it}/A_{it-1}) + e_{it} \quad (3)$$

where

$t = \text{year}2013,$

$TA_{it} = \text{total accruals for firm } i,$

$A_{it-1} = \text{total assets for firm } i,$

$REV_{it} = \text{change in net revenues for firm } i,$

$REC_{it} = \text{change in accounts receivable for firm } i,$

$PPE_{it} = \text{gross property plant and equipment for firm } i, \text{ and}$

$e_{it} = \text{error term for firm } i.$

Total accruals are defined as income before extraordinary items minus operating cash flows. The error term of the regression model showed in equation (3.2) is the abnormal accruals (i.e., Abnormal Accruals). The normal accruals (i.e., Normal Accruals) are calculated as Total accruals subtract Abnormal Accruals.

TABLE I: DESCRIPTIVE STATISTICS

Variables	N	Mean	Median	Standard Deviation	Min	Max
CE	31	8.1	9.35	3.65	0	12.8
RA	31	5.68	5.77	1.05	3.06	7.51
CA	31	8.91	9.34	2.77	0	12.84
IOC	31	1.96	2.23	1.1	0	4.87
M	31	13.58	14.13	2.2	4.02	15.38
Operation	31	0.0283	0.0502	0.113	-0.4441	0.1277
Reporting	31	0.5363	0.5483	0.2222	0.0437	0.9216
Compliance	31	0.0003	0.0002	0.0003	0	0.0014

Data resource: DIB information disclosure index database of internal control

The third indicator is the compliance indicator reflecting the compliance with the applicable laws and regulations. O'Keefe *et al.* [13] found that the higher the audit fees paid by the company, the better the corporation abiding by the General Accepted Accounting Principles (GAAP). Thereby, we can measure the Compliance by the proportion of auditor's fees in total assets [4].

C. Sample Data Sources

We choose 31 Hunan SOEs in 2013 as research, after removing 2 unusual data from the 33 Hunan SOEs. The above mentioned data can be collected from DIB information disclosure index database of internal control and CNINF's annual report, internal control evaluation report and internal control audit report, etc.

IV. EMPIRICAL ANALYSIS OF THE EFFICIENCY OF INTERNAL CONTROL

A. Descriptive Statistics

The Table I describes the distribution of five input-indicators and three out-indicators. The total score of

CE index is 19 scores, and the mean value is 8.1 scores, minimum value is 0 and maximum is 12.8 scores, Standard Deviation is 3.65 scores. These scores show the control environment of Hunan SOEs is weak in general, and the gap among the enterprises is wide. The best ones barely meet the requirement and the worst ones don't disclose any information of control environment. The total score of RA index is 11 points while the true mean value is 5.68 points and reaches the half of the maximum score. This shows Hunan SOEs have the basic ability of risk assessment, identify, analysis and response. The total score of CA index is 14 points, and the actual mean value is 8.91 points and just qualified. The minimum value is 0 which indicates there isn't any control activities in Hunan SOEs. The total score of IOC index is 6, minimum value is 0 and the mean value is 1.96, all of which suggest the Hunan SOEs are not qualified in the IOC. The total score of M is 16 and the mean value is 13.58, which show a good performance in the internal monitoring compared with the other four indexes. The listed companies' evaluation and auditing of the internal control are beneficial to monitoring the internal control.

The range of the three output-targets value is 0 to 1. The Operation target is ROE and its mean value is 2.83%. The ROE mean value of enterprises supervised by the SASAC is

5.5% in 2013. The Hunan SOEs' operations don't catch up with the national average. As to the Reporting target, the mean and minimum values are 53.63% and 4.37% respectively, which indicate that the overall reliability of financial reports of Hunan SOEs is relative high and individual firms should make great efforts to improve the reliability of financial reports. Finally, the mean value of Compliance target is only 0.03%, which shows that the extent of observing the laws and regulations of Hunan SOEs is very low.

In summary, through the analysis using DEA, we can get the result that the five input-elements of internal control in Hunan SOEs just reach the standard, but the three output elements are low qualified. The left question is how to evaluate the efficiency of internal control in the Hunan state-owned enterprises.

B. The Efficiency Analysis of Internal Control by DEA Model

At first, we analyze the efficiency of internal control of the 31 Hunan SOEs, and get the technology efficiency (TE), pure technology efficiency (PTE) and scale efficiency (SE). The results are showed in the Table II.

TABLE II: THE RELATIVE EFFICIENCY OF INTERNAL CONTROL IN LISTED COMPANIES

Stkcd	Company name	TE	PTE	SE	Return to scale
000157	zommlion	0.928	0.937	0.991	irs
000419	Tongcheng Holdings	0.952	1.000	0.952	drs
000428	Huatian Hotel	0.937	0.952	0.984	drs
000430	Zhang Jia Jie Tourism	1.000	1.000	1.000	-
000548	Hunan Investment	1.000	1.000	1.000	-
000590	Tus-Guhan	1.000	1.000	1.000	-
000702	Hunan Zhenghong Science and Technology	1.000	1.000	1.000	-
000722	Hunan Development	1.000	1.000	1.000	-
000738	AVIC Aero-engine Controls	0.765	0.784	0.976	irs
000748	Greatwall Information Industry	1.000	1.000	1.000	-
000799	Jiugui Liquor	0.887	1.000	0.887	irs
000819	Yueyang Xingchang Petro-chemica Co.	1.000	1.000	1.000	-
000900	Xiandai Investment	1.000	1.000	1.000	-
000906	Zhejiang Materials Development	0.772	0.789	0.978	irs
000917	Hunan TV and Broadcast Intermediary	0.983	0.984	0.998	drs
000918	China Calxon	0.821	0.901	0.911	irs
000932	Valin Steel	0.766	0.832	0.921	irs
600127	JinJian Cereals Industry	1.000	1.000	1.000	-
600156	Hunan Huasheng	1.000	1.000	1.000	-
600390	Kingray New Materials Science and Technology	0.775	0.786	0.986	irs
600416	Xiangtan Electric Manufacturing	0.885	0.974	0.908	irs
600458	Zhuzhou Times New Material Technology	1.000	1.000	1.000	-
600476	Hunan Copote Sci.& Tech.	1.000	1.000	1.000	-
600479	Qianjin Pharmaceutical Company	0.958	1.000	0.958	drs
600731	Hunan Haili Chemical Industry	0.778	0.840	0.926	irs
600744	Huayin Electric Power	1.000	1.000	1.000	-
600961	Zhuzhou Smelter Group	1.000	1.000	1.000	-
600963	Yueyang Forest and Paper	0.833	0.892	0.934	irs
600969	Chendian International Development Share-holding Co.	1.000	1.000	1.000	-
600975	New Wellful	0.719	0.797	0.903	irs
601098	China South Publishing and Media Group Co.	1.000	1.000	1.000	-
	Mean	0.928	0.951	0.975	

Data sources: CNINF's network

Mean—average value; Peer —reference to similar companies;
irs- increasing returns to scale; drs-decreasing return to

scale
General speaking, the company is DEA-efficient (DEA Validity) while both the PTE and SE are 1, otherwise the

company is weak DEA-efficient (DEA Invalidity) when only the PTE or SE is 1 and is non DEA-efficient (DEA Invalidity) if the PET and SE are both not 1. From the table II, we find that there are 16 DEA Validity and 15 DEA Invalidity enterprises. This result indicates that half of the companies should optimize the efficiency of internal control. In addition, the mean value of the TE is 92.8%, showing that the efficiency of internal control waste almost 7%. The listed companies can improve the TE of internal control through improving the aspect of PTE and SE.

C. The Comparison between the DEA Index and the DIB Index

In order to analyze the performance of the two methods, we adopt the enterprise value to evaluate the effect of the two methods. Since internal control can optimize the capital structure and reduce the financial risk, thus it is expected to maximize the enterprise value by the good internal control [14], [15]. In addition, many researchers examined the relation between corporate governance and firm value, and found the good internal control is beneficial to the better

performance and higher firm value [16], [17].

To get the enterprise value data, the Tobin Q (stated by the James Tobin in 1969) has been used to measure the firm value by many researchers around the world [18], [19]. Specifically, we calculate the Tobin Q of Hunan State-owned corporations via the following formula [20].

$$Tobin\ Q = \frac{MVOS + MVNTS + BVL}{BVTA} \tag{3}$$

where

MVOS — the market value of the firm’s outstanding shares;

MVNTS— the market value of the firm’s non tradable shares;

BVL— the book value of the firm’s liabilities;

BVTA— the book value of the firm’s total assets.

Above values can be retrieved in www.cninfo.com.cn.

Then, we can get the following information about the two evaluating methods and firm value (Table III). The table is arranged by DIB index order.

TABLE III: THE INFORMATION OF DIB INDEX, DEA INDEX AND TOBIN Q

NO.	Stkcd	Company Name	DIB Index (rating)	DEA Index	TOBIN Q
1	000932	Valin Steel	767.750 (BBB)	0.766	0.918
2	000917	Hunan TV and Broadcast Intermediary	749.550 (BB)	0.983	1.390
3	000738	AVIC Aero-engine Controls	737.850 (BB)	0.765	2.181
4	601098	China South Publishing and Media Group Co.	737.800 (BB)	1.000	1.790
5	000906	Zhejiang Materials Development	732.270 (BB)	0.772	1.238
6	600963	Yueyang Forest and Paper	721.530 (BB)	0.833	0.910
7	600479	Qianjin Pharmaceutical Company	712.800 (BB)	0.958	2.385
8	000819	Yueyang Xingchang Petro-chemica Co.	712.190 (BB)	1.000	5.367
9	000419	Tongcheng Holdings	709.590 (BB)	0.952	1.303
10	000428	Huatian Hotel	701.640 (BB)	0.937	1.303
11	600458	Zhuzhou Times New Material Technology	689.870 (B)	1.000	1.619
12	600156	Hunan Huasheng	685.890 (B)	1.000	1.841
13	600390	Kingray New Materials Science and Technology	677.920 (B)	0.775	2.063
14	600416	Xiangtan Electric Manufacturing	672.740 (B)	0.885	1.120
15	600127	JinJian Cereals Industry	669.620 (B)	1.000	2.259
16	000157	zommlion	669.220 (B)	0.928	1.018
17	600975	New Wellful	665.920 (B)	0.719	1.675
18	600969	Chendian International Development Share-holding Co.	665.650 (B)	1.000	1.141
19	600961	Zhuzhou Smelter Group	661.900 (B)	1.000	1.356
20	600744	Huayin Electric Power	660.770 (B)	1.000	1.019
21	000900	Xiandai Investment	654.810 (B)	1.000	0.955
22	000748	Greatwall Information Industry	652.320 (B)	1.000	2.896
23	600731	Hunan Haili Chemical Industry	646.960 (B)	0.778	1.626
24	000722	Hunan Development	633.610 (B)	1.000	1.211
25	000430	Zhang Jia Jie Tourism	629.890 (B)	1.000	2.584
26	000702	Hunan Zhenghong Science and Technology	620.130 (B)	1.000	2.094
27	000548	Hunan Investment	612.280 (B)	1.000	1.456
28	000918	China Calxon	608.930 (B)	0.821	0.969
29	000799	Jiugui Liquor	590.110 (C)	0.887	1.886
30	600476	Hunan Copote Science and Technology	551.300 (C)	1.000	4.486
31	000590	Tus-Guhan	534.390 (C)	1.000	6.155

Data Resource: DIB Index (Rating) is obtained from DIB database
DEA Index is the TE value.

TABLE IV: THE CLASSIFICATION BY DIB, DEA INDEX AND TOBIN Q

Set Type	DIB Index	DEA Index	Tobin Q
High qualified set	{1,2,3,4,5,6,7,8,9,10}	{4,8,11,12,15,18,19,20,21,22,24,25,26,27,30,31}	{2,3,4,5,7,8,9,10,11,12,13,14,15,16,17,18,19,20,22,23,24,25,26,2,29,30,31}
Low qualified set	{11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31}	{1,2,3,5,6,7,9,10,13,14,16,17,23,28,29}	{1,6,21,28}

We compare the two methods on the premise that if the quality of internal control is good, the firm value should be high in most cases, and a bad internal control tends to decrease the firm value [14], [15]. The similarity computation based on Loss Of Information (LOI) [21], [22], which is calculated by the following formula, is adopted in the comparison.

$$SIM(R1, R2) = 1 - LOI(R1, R2) \tag{4}$$

$$LOI(R1, R2) = \frac{|R1 \cup R2| - |R1 \cap R2|}{|R1| + |R2|}$$

where

R1= The set of firms classified by DIB index or DEA index

R2= The set of firms classified by TOBIN Q

To get the data of the R1 and R2, we divide all the firms into two sets, high qualified and low qualified, according to the follow procedures. First, we divide the above 31 firms into two groups by the rating of DIB index. The firms whose rating of DIB index is above the BB are high qualified set, the rest firms belong to the low qualified set. Secondly, we divide the firms into two sets by the DEA index. The firms are high qualified set if the DEA index of the firm is 1, otherwise the firms are low qualified set. Thirdly, we divide the firms into two sets by the value of Tobin Q. The firms are low qualified set if the Tobin Q of the firm is lesser than 1, otherwise the firms are high qualified set (Table IV). In table IV, each number represents a corporation as shown in table III.

We can calculate the similarity between DIB index and Tobin Q, and DEA index and Tobin Q respectively (Fig.1). As depicted in the Fig. 1, we find the similarity of high qualified set between the DEA index and Tobin Q (70%) is much greater than the one between the DIB index and Tobin Q (43%), and the similarity of low qualified set between the DEA index and Tobin Q (32%) is two times as much as the one between the DIB index and Tobin Q (16%). Thus the DEA index outperforms the DIB index according to the aforementioned premise.

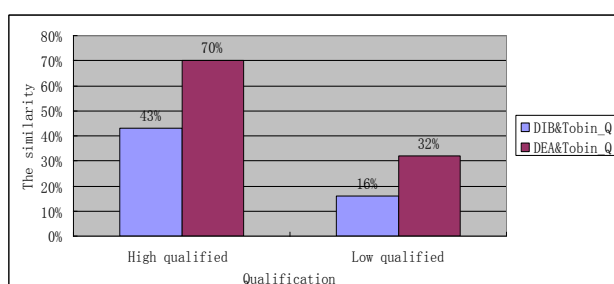


Fig. 1. The similarity between the internal control index and the Tobin Q.

It should be noted that the Tobin Q cannot be applied in evaluating the internal control directly because the high firm value does not necessarily mean a good internal control, and the low firm value does not necessarily mean a bad internal control for a corporation.

V. CONCLUSIONS

In conclude, the operating efficiency of internal control of Hunan state-owned listed companies is good in total, but many enterprises' pure technology efficiency (PTE) and scale

efficiency (SE) are relative low. Accordingly, the enterprises ought to optimize the resource scale and configuration of internal control. At then, through comparing the similarity between DEA and the value of Tobin Q, we find that the classification based on DEA index is closer to the classification based on the Tobin Q than the one based on the DIB index. The main reason can be attributed to that the DIB version evaluates the outcomes of internal control execution, while DEA method evaluates the relative economical efficiency of internal control.

In conclusion, the enterprises should pay more attention to the DEA index of internal control, reducing the resource costs in the internal control while pursuing the target of internal control.

ACKNOWLEDGMENT

The authors would like to appreciate the anonymous reviewers for their constructive comments.

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