
Evaluating Charity Foundation Websites with Benchmarking and SBM-DEA

Cang Yan ^a, Lingling Shen* and Qian gang ^b

School of Management Science and Engineering, Nanjing Normal University, Nanjing
210046, China

*Corresponding author Email: llshen509@163.com

^ayancang0909@163.com, ^bqgmail@vip.sina.com

Abstract

In China, the charity foundation websites have helped numerous unfortunate social individuals and disadvantaged groups with their powerful propaganda to raise money. This paper sets up an efficiency evaluation index system about Chinese Charity Foundation Websites from the perspectives of input and output. 11 input index data and 5 output index data were collected by Web Analyst Maxamine and Alexa tools. Both of the DEA model, which is based on slack variables, and the Super-Efficiency SBM-DEA model, which can rank relatively effective decision making units, were used to evaluate the input and output efficiency resources, including 19 public offering charity foundation websites and 6 non-public offering charity foundation websites in China. The managers of Chinese charity foundation can accord the benchmarking of websites to find its own shortcomings and then from the angel of slack variable to optimize the allocation of resources and improve the efficiency of relatively ineffective charity foundation websites.

Keywords

Data envelopment analysis, charity foundation websites, efficiency, benchmarking.

1. Introduction

More and more people and organizations in China are getting help from Charity Foundation, and most of them get information and then apply for help from its website. The website is an important platform for charity. Meanwhile, capital is collected by public donation. So, in order to let love be fully reflected, it is very necessary to evaluate the efficiency of the charity foundation websites.

At present, the evaluation of the charity foundation websites is relatively uncommon, and it is only focused on the theoretical analysis and qualitative evaluation. By studying the construction of students exchange network, a public service website, Xie Rongjian [1] shows the information ecological planning, information construction, psychology and other theories in the construction of public service websites; From the difference between Chinese college and social Internet platform, Li Jiarun, Luo Ying, Wang Zitong [2] propose the future development of the internet platform for public welfare; Wang Xin [3] combs the historical context of Chinese charity, to explore the current situation and the problems of public charity so that to find ways to improve the dissemination of public charity. The above theses conduct study by qualitative evaluation methods, which are affected by anthropogenic influences. It is not better than the quantitative method. The data envelopment analysis (DEA) method is an excellent method of quantitative evaluation.

However, most of research of websites with DEA is about government, commerce, agriculture, universities and so on. Using conceptual considerations to posit an ideal specification, Drew, J, Kortt, M et al[4] has carried an system analysis on Australian municipal; General approach to analyze the

efficiency of commerce enterprise websites comes from the point of input / output or model[5]; In addition to government and commerce, there are number of studies related to agriculture and universities:from the point of design and maintenance, Sun Yanling and He Yuan use DEA evaluate the efficiency of China's agricultural website, then it forms website efficiency figure of flying wild goose; Some scholars have creatively joined Theil index approach or Environmental Impact Quotient (EQI) and so on in agriculture [6]; Trying to see how a plan has affected efficiency in teaching and research at Mexico's universities, Marti Sagarra, Cecilio Mar-Molinero and Tommaso Agasisti [7] use a combined approach that includes traditional ratios together with Data Envelopment Analysis models. This mixture allows them to assess changes in efficiency at each individual university and explore if these changes are related to teaching, to research, or to both; Technical efficiency of the learning-teaching process, pattern of teaching and research performances are also under study. Overall, the data envelopment analysis (DEA) method as an excellent method of quantitative evaluation has been used in many fields. However, it has not been applied in the field of charity foundation websites researching. From the perspectives of input and output, we use DEA to assess the efficiency of each charity foundation website. Based on the results of the study. On the one hand, we know the development scale and level of Chinese charity foundation websites; on the other hand, the managers can improve the efficiency of relatively ineffective Charity foundation websites which will promote the development of Chinese charity foundation Websites.

2. Research method

2.1 DEA model

Measuring the efficiency of a website implies the development of a complex model. It relates a set of input and output variables associated to measurements of the website operation costs and benefits. So scholars have suggested the implementation of DEA which is a seminal idea proposed by Farrell [8].It is a mathematical non parametric multi-criteria technique [9]. Particularly, DEA adopts linear programming to identify a production frontier as locus of efficient units. Data Envelopment Analysis (DEA) provides a measure of the relative efficiency of a number of units based on a not necessarily known or pre-defined conversion process of inputs into outputs .

To analyze the efficiency of charity foundation websites, we use the non-radial model with slacks-based measure (SBM) by Tone [10]. This model used a fractional objection function, which depends on input and output slacks rather than a simple radial efficiency variable. In addition, there is no distinction between input-orientation and output-orientation under SBM. The efficiency score computed by the SBM model is between 0 and 1. If the efficiency score of website is 1, DMU is called SBM-efficient. Otherwise, it is called SBM-inefficient. The following is the overall efficiency of the standard SBM- DEA model:

$$\left\{ \begin{array}{l} \min \frac{1 - (\frac{1}{m}) \sum_{i=1}^m \frac{S_i^-}{x_{i0}}}{1 + (\frac{1}{s}) \sum_{r=1}^s \frac{S_r^+}{y_{r0}}} \\ x_{i0} = \sum_{j=1}^n X_{ij} \lambda_j + S_i^- \\ y_{r0} = \sum_{j=1}^n Y_{rj} \lambda_j - S_r^+ \\ \lambda \geq 0, S^- \geq 0, S^+ \geq 0 \end{array} \right. \quad (1)$$

To distinguishing SBM-efficient DMUs further, Tone[11] designed a super-efficiency model (S-SBM model) to examine its super-efficiency score. So it can make SBM-efficient DMUs be ranked and compared based on the super-efficiency model. This model was creatively developed by Andersen and Petersen. The super-SBM-DEA model as follows:

$$\left\{ \begin{array}{l} \min \frac{1}{m} \sum_{i=1}^m \frac{\bar{X}_i}{X_{i0}} \\ \frac{1}{s} \sum_{r=1}^s \frac{\bar{Y}_r}{Y_{r0}} \\ \bar{X} \geq \sum_{j=1, \neq 0}^n X_j \lambda_j \\ \bar{Y} \geq \sum_{j=1, \neq 0}^n Y_j \lambda_j \\ \bar{X} \geq X_0, \bar{Y} \leq Y_0, \bar{Y} \geq 0, \lambda \geq 0 \end{array} \right. \quad (2)$$

Here m is the total number of input index and $i=1,2,\dots,m$; $j=1, 2,\dots,n$, $r=1,2,\dots,s$; s is the total number of output indicators. Accordingly, X_{ij} represents the amount of the ith inputs to the jth website; Y_{rj} represents the rth amount of output ; S^-, S^+ respectively for the input and output slack variables. Namely, for the DMU:

- ① if $\sum_{j=1}^n \lambda_{ij} = 1$, there is constant return to scale;
- ② if $\sum_{j=1}^n \lambda_{ij} < 1$, there is decreasing return to scale;
- ③ if $\sum_{j=1}^n \lambda_{ij} > 1$, there is increasing return to scale.

By using above models to make comprehensive analyses of the variable input and output, we can get the relatively effective websites and its sort. Meanwhile, managers of Chinese charity foundation websites can according the benchmark of websites to find its own shortcomings and then from the angel of slack variable to optimize the allocation of resources and improve the efficiency of relatively ineffective Charity foundation websites.

2.2 Website indicators

In SBM-DEA model, different variables combination can produce different efficiency scores. Thus, it is important to choose appropriate indicators in efficiency measurement. Gener, L . Wilkinson propose a 11 indicators based on study and analyze the characteristics of websites information resources. Feng Yuan, Junting Chen, Xiangli Shao conceptualize insurance e-commerce websites as a computer information system and sales channel. Data measuring input and output variables in their model are collected from six different aspects: Website size, website links, website promotion, website promotion, customer response time, customer experience. Moreover, there is different quantity of secondary level indicators under senior level. Some research sum up and summarize the designing principles of the indicator system from four aspects: definition of indicators, the evaluation result of indicators, the efficiency of the indicators operation process, indicators system.

Referring to the previous research and considering the applicability of DEA model and the availability of data, website quality is measured from web content design, structure design, users' experience and so on. The input used to be: total number of web pages(TNP), average pages' size(APs), total number of web objections (TO), total number of web links (TL), foreign link percentage(FLP), link integrity(LI), connected percentage (CP), tagged percentage(TP), returning percentage(RP), easy to reach percentage (ERP), update rating(UDP). The output variables were: website security(WS), website access speed(WAS), total number of foreign sites references(TFS),

daily IP traffic(DIP), daily pages' views(DPV). The figure on the right side is input indicators; The figure on the right side is output indicators.Details are provided in figure 1.

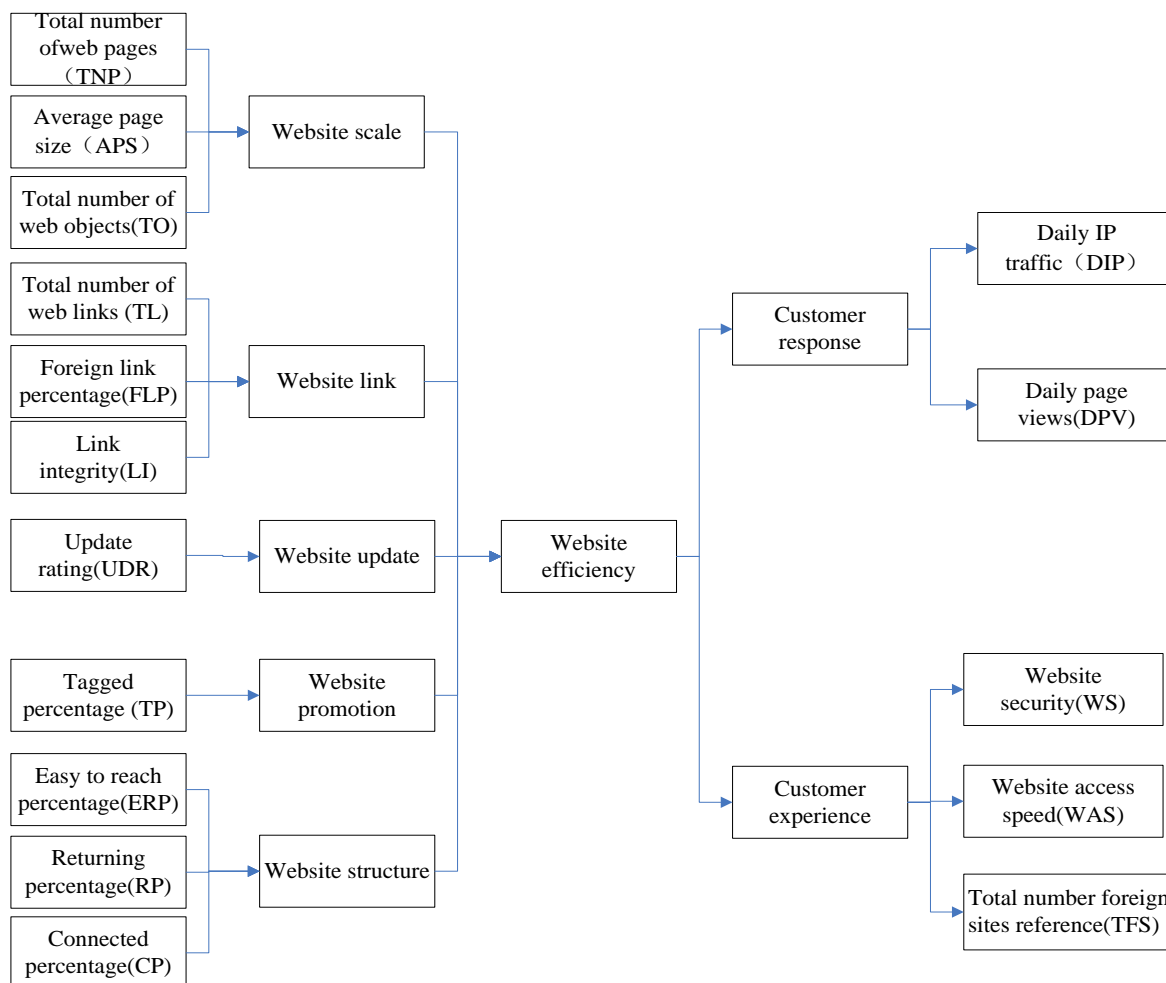


Fig. 1 Charity Foundation Websites efficiency evaluation theory model

3. Results and discussion

3.1 Data selection and preparation

Forbes magazine is one of the oldest and the most influential business magazines in the world ,so we chose 25 charity foundation from 2015 Forbes China Charity Foundation list ([http://www. Charityalliance.org.cn/org/6677.jhtml](http://www.Charityalliance.org.cn/org/6677.jhtml)). Analyzing these charity foundations from methods of fundraising can we find that some foundations (A1-A19) are public offering and others(B1-B6) are non-public offering. Their specific information of the 25 charity foundation websites is listed in Table 1.

Table 1 Information of DMUs

	Site Names	Websites
A1	Shanghai Cherished Dream Charity Foundation Charity Foundation	www.adream.org
A2	China foundation for poverty alleviation	www.cfpa.org.cn
A3	China Youth Development Foundation	www.cydf.org.cn
A4	China Social Welfare Foundation	www.zgshfljjh.org
A5	Chinese red cross foundation	www.redcross.org.cn
A6	China children's Charity Relief Foundation	www.ccafc.org.cn

A7	Yunnan Youth Development Foundation	www.ynprojecthope.org
A8	China Population Welfare Foundation	www.cpwf.org.cn
A9	China Siyuan foundation for poverty alleviation	www.syvoc.org.cn
A10	Heilongjiang Youth Development Foundation	web.lq.org.cn
A11	Shenzhen One Foundation Charity Foundation	www.onefoundation.cn
A12	Beijing Youth Development Foundation	www.bjydf.cn
A13	Yangtze River science technology foundation for poverty alleviation	www.ccriver.org
A14	Shanghai Song Qingling Foundation	www.sself.com
A15	Zhejiang Youth Development Foundation	hope.zj.com
A16	China Guanghua Science and Technology Foundation	www.ghstf.org
A17	Amity Foundation	www.amity.org.cn
A18	Dalian Youth Development Foundation	www.dlydf.org.cn
A19	China children and teenagers Foundation	www.cctf.org.cn
B1	Love woo Charitable Foundation	www.ayfoundation.org
B2	China Social Entrepreneur Foundation	www.youcheng.org
B3	Fujian province is proud of the foundation	www.zrgy.org
B4	Narada Foundation	www.naradafoundation.org
B5	Amway Charitable Foundation	www.amwayfoundation.org
B6	Beijing Chunmiao children rescue fund will	www.cmjjh.org

Table 2 Efficiency values of charity foundation websites

DMU	SE-DEA	Sort	PTE	TE	RTS	DMU	SE-DEA	Sort	PTE	TE	RTS
A1	1.220	17	1	1	Increasing	A14	1.322	16	1	1	Decreasing
A2	135.507	5	1	1	Decreasing	A15	7.626	9	1	1	Decreasing
A3	0.711	21	1	0.711	Decreasing	A16	5.458	10	1	1	Decreasing
A4	1.374	15	1	1	Constant	A17	1.583	14	1	1	Increasing
A5	156.449	4	1	1	Increasing	A18	349.1304	2	1	1	Increasing
A6	2.318	13	1	1	Decreasing	A19	125.680	6	1	1	Decreasing
A7	2.460	12	1	1	Decreasing	B1	1.013	20	1	1	Decreasing
A8	1.083	18	1	1	Increasing	B2	0.701	22	0.728	0.963	Increasing
A9	0.621	23	1	0.621	Increasing	B3	256.569	3	1	1	Decreasing
A10	928.405	1	1	1	Constant	B4	0.553	24	1	0.553	Decreasing
A11	2.691	11	1	1	Decreasing	B5	1.026	19	1	1	Increasing
A12	0.196	25	0.702	0.279	Increasing	B6	18.515	7	1	1	Decreasing
A13	16.281	8	1	1	Increasing	Mean	80.741	-	-	-	-

Using Maxmine Web Analyst to analyses these charity foundation websites will generate 25 statistical reports. We can extract 11 input and 5 output indexes. Considering charity foundation websites' data update cycle, all data of indicators acquisition is completed on the same day, in order to ensure the accuracy of the analysis results. (Statistical time: April 18, 2016). After that, according to the analysis about correlation of indexes, we find Daily IP traffic(DIP) and daily pages' views(DPV) correlation coefficient was 0.819, which indicates the two output variables have a high correlation. Therefore, the two output indicators are transformed into one indicator –the site traffic

(ST) (weight coefficient of 0.5). The correlation among other indicators is small .Accordingly, it can be used for data analysis SBM-DEA.Considering the influence of slack variables on the evaluation results, using SBM-I-C model into various websites can get the efficiency of the total input/output values of TE (technical efficiency). To get websites scale invariant of value of PTE (pure technical efficiency), we use SBM-I-V model. And according to the formula $TE=SE \cdot PTE$ can obtain SE (scale efficiency) which is based on the constant slack variables under pure technical efficiency; By applying the super efficiency DEA model(SE-DEA), each website can get its ranking the effectiveness which were shown in Table 2.

3.2 Analysis

(1) From the perspective of super efficiency,20 charity foundation websites are efficient and 5 are inefficient. Table 2 clearly shows the input and output of the two kinds of websites , high-ranking websites and low-ranking. For example, websites designed by charity foundation of Heilongjiang Youth Development Foundation (A10) occupy the top place.Its various indicators of output produce the best outcomes: access speed 0.2S, website security 100 points (maximum mark is100). B1 is efficient, its super efficiency value is only 1.013 in the middle and lower reaches of the efficiency websites. From the point view of the correlation analysis results ,we know that the input of the average page size is negatively related to the safety of the website. The average page size is greater, the security of the website is lower. From the aspect of total number of web links, maintaining B1 website cost a significant investment , but all the output indicators of the website does not have a corresponding growth.

(2) Viewed in Slack variables and their optimization, according to SBM-DEA, we can get the slack variables which are input and output excess. Excess quantity is the quantity that needs to be reduced under the condition of the current output; Insufficient quantity is the quantity of output which needs to be increased. The slack variables describe the improvement direction and degree of websites efficiency in order to optimize the efficiency of the websites. It is shown in Table 3.

Table 3 Charity foundation Websites slack variables

DMU	TNP	APS	TO	TL	FLP	LI	CP	TP	RP	ERP	UDR	WS	WAS	TFS	ST
A3	-0.62	-0.98	-0.79	-0.12	-0.03	-0.73	-0.76	-0.27	-0.24	-0.52	-0.65	0.22	0.00	0.25	0.15
A9	0.00	-0.19	-0.17	0.00	-0.14	-0.14	0.00	-0.12	-0.05	-0.48	-0.59	0.06	0.06	0.16	0.10
A12	-0.27	-0.12	-0.35	0.00	-0.06	-0.18	-0.18	-0.09	-0.02	-0.57	-0.15	0.76	0.01	0.03	0.21
B2	0.00	-0.02	-0.18	-0.34	0.00	-0.14	-0.40	-0.27	-0.13	-0.44	0.00	0.02	0.00	0.21	0.12
B4	-0.41	-0.31	-0.03	-0.05	-0.01	-0.08	0.00	-0.21	-0.14	-0.22	-0.93	0.00	0.03	0.14	0.10
Mean	-0.26	-0.32	-0.30	-0.11	-0.05	-0.25	-0.27	-0.19	-0.12	-0.45	-0.46	0.21	0.02	0.16	0.14

As it is shown in Table 3, the 15 indicators are all input redundancy or output insufficient. ERP, UDP input redundancy is the most prominent and the two have reached the redundancy 40%. This shows that the number of pages from the home page through three links becomes fewer. There are more difficulties for users. The manager should strengthen the rationality of the websites construction structure, and reduce the depth of page links; Update page (UDP) suggest the novel and maintenance frequency of websites information. The websites information need update in a timely manner. However, if the update rate is too high, websites in the maintenance of the information content of construction investment will be higher. The manager need to improve the efficiency of updating websites information, reducing maintenance cost; Websites output indicators are positive .It shows that all aspects have promotion space. Specific reference benchmarks [12] are shown in Table 4.

Table 4 Benchmarking for inefficiency websites revision

Inefficiency websites	SE Reference website	PTE Reference website	TE Reference website
A3	A10		A19

A9	A10		A19
A12	A15	A13	A15
B2	A10	A10	A10
B4	A10		A19

4. Conclusion

This study contributes to the literature by investigating input and output indicators on the efficiency of Chinese charity foundation websites. It plays an important guiding role in using of public donations. We compare public offering website and non-public offering websites and conclude that the input and output will have different efficiency. Public offering websites are more efficient than non-public offering websites. In addition, we suggest that manager should improve the quantity proportion between input and output. The analysis results show the direction of improving.

Further work is needed to resolve in our experiment: First, our study only relies on research indicators available from a random day. We should collect more data from different period to get data panel in order to do scientific analysis. Second, this study does not include the websites of charity foundation in the world, only one country. In future work, it can extend to the world. Finally, because this study addresses non-profit organizations only, profit-oriented organizations should be cautious when applying this study's suggestions.

References

- [1] Xie Rongjian. Ecological Planning of Information and IA about Charity Website [D]. Wuhan University, 2013.
- [2] Luo Ying, Li Jiarun, Wang Zitong. Research on the Innovation and Development of China's Internet Public Service Platform [J]. China Youth Study, 2015, 07:20-24.
- [3] Wang Xin. Study on the Dissemination of network public welfare [D]. Northwestern University, 2010.
- [4] Drew Joseph, Kortt Michael, Dollery Brian. What Determines Efficiency in Local Government? A DEA Analysis of NSW Local Government [J]. ECONOMIC PAPERS, 2015, 243-256
- [5] Coelho D A. Association of CCR and BCC Efficiencies to Market Variables in a Retrospective Two Stage Data Envelope Analysis [C]. Lecture Notes in Computer Science 2014:151-159.
- [6] Atici K B, Podinovski V V. Using Data Envelopment Analysis for the Assessment of Technical Efficiency of Units with Different Specialisations: An Application to Agriculture ☆ [J]. Omega, 2015, 54:72-83.
- [7] Guccio C, Martorana M F, Mazza I. Efficiency Assessment and Convergence in Teaching and Research in Italian Public Universities [J]. Scientometrics, 2016:1-32.
- [8] Farrell, M. The measurement of productive efficiency [J]. Journal of the Royal Statistical Society, 1957, Series A (General), 120(3), 253-290.
- [9] Storto C L. Evaluating Ecommerce Websites Cognitive Efficiency: An Integrative Framework based on Data Envelopment Analysis [J]. Applied Ergonomics, 2013, 44(6):1004-1014.
- [10] Tone, K. A Slacks-based Measure of Efficiency in Data Envelopment Analysis [J]. Eur. J. Oper. Res, 2001, 130, 498-509.
- [11] Tone, K. . A Slacks-based Measure of Super-efficiency in Data Envelopment Analysis [J]. Eur. J. Oper. Res, 2002, 143, 32-41.
- [12] Joo S. Benchmarking Efficiencies and Strategies for Resale Operations of a Charity Organization [J]. Brain, 2013, 120 (Pt 11)(11):1929-1936.