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Ranking of Iranian Executive Agencies Using Audit Court Budget Split Indexes and Data Envelopment Analysis

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Abstract

One of the critical concerns in the audit court is to study budgetary deviations of the executive organizations. Audit court seeks methods to evaluations the executive organizations based on their budget deviations. The aim of this study is to rank executive agencies aimed at the improvement of their performance. We use a ranking method based on data envelopment analysis that can simultaneously use multi-indexes for ranking and we use budget split indexes of the audit court for ranking of executive organizations. The results enable managers to identify the best and worst executive agencies based on the considered indexes of the budget split of the audit court. The objectives of this paper are to investigate which executive organizations have more budget deviations. Any organization that had a lower rank shows that it has based on the indexes under evaluation more deviation. To study the performance process of each of the executive agencies, we collected data for two years and analyzed the performance of the executive agencies during these two years.

Keywords: Data envelopment analysis, Ranking, Audit court, Executive agency.

1 | Introduction

The audit court of the country is one of the institutions affiliated with the Islamic Consultative Assembly, which its duty is the investigation of the financial accounts of the country. The budget document as a governmental fiscal plan reflects all the activity profiles within an outline of incomes and costs. The audit court of the country audits and investigates the total accounts of the ministries, governmental institutions and companies, and other agencies, which use the public budget. The duty of the state audit court is to probe into any budgetary deviations, and if there are cases that the audit court investigates, this does not signify that economic embezzlement or corruption has occurred. The audit court of the country collects accounts and related documents as required by law, and submits a report on the budget split for each year, to the Islamic Consultative Assembly. Hghighi et al. [1] investigated the law challenges of the supreme audit court supervision of Iran in contrast of corruption and its Crimes in Executive Agencies.

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Lari dasht bayaz et al. [2] and Darabad [3] studied about the audit court and executive agencies. The objective of this paper is to demonstrate the application of a rank method to evaluate the executive agencies.

Given the importance of the executive agencies in the country, any performance evaluation method has to answer questions such as:

- *How to evaluate the performance of agencies individually?*
- *How to compare the performances of two agencies?*
- *How to identify agencies or groups of agencies with excellent performance levels, that may serve as a reference or benchmarking for the remaining ones?*

Data Envelopment Analysis (DEA) is a non-parametric method to evaluate the efficiency or performance of various Decision-Making Units (DMUs) with multiple and similar inputs and outputs. This was initially introduced by Charnes et al. [(CCR model) [4]. Subsequently, Banker et al. [5] introduced the BCC model, which has the characteristic of Variable Returns to Scale (VRS).

The use of the DEA technique in audit court allows managers to develop scenarios for the existing situations which can facilitate the comparison between the units under evaluation and identify the strong and weak points of each unit.

The aim of this paper is to demonstrate a method to rank the executive agencies of the audit court. Through the study of managerial and organizational practices of the agencies analyzed it is hoped that the performance of the whole set of agencies is improved. The scope of the study has been restricted to the Iranian executive agencies. The study can suggest several managerial recommendations to better manage the executive agencies. It is hoped that managers can analyze the performance of the executive agencies and the managers of the agencies with a lower rank improve their future efficiency. DEA results are obtained without considering the restrictions. The managers can skillfully use these results as a support system for decision-making, analyzing the agencies.

This paper is organized as follows: in Section 2, explanations have been rendered, in relevance with the audit court of the country, in fact, the study context is brought under focus. In Section 3, the DEA technique and its applications are presented. In Section 4, the models of the third section have been run on the basis of real data of executive agencies under assessment for the years 2015-2016 and the process of performance of the executive agencies are examined. The conclusion and explanations are discussed in Section 5 of the paper.

2 | Audit Court

After the Islamic Revolution, the supreme audit court segregated from the ministry of economic affairs and finance and operates under the direct supervision of parliament but acts independently in carrying out its roles and responsibilities. It is the duty of the supreme audit court to give independent assurance to the parliament and the citizens about how the public budget has been spent in a given financial year.

As stated on the website of the court of audit, as a governing body, the supreme audit court exerts its supervision on the performance of executive agencies (in the public sector) through undertaking audits, preparing annual audit reports, and conducting prosecution and jurisdiction. It endeavors to safeguard Public Treasury, prevent corruption, detect and disclose irregularities in a timely and online manner, secure the national trust and make proper, efficient, and effective use of public facilities, properties, and funds.

As stated on the website of the court of audit, some long-term objectives of the audit court are as follow:

- *Promoting productivity, agility, value-creation, and organizational excellence in the supreme audit court.*
- *Enhancing capacity of trustworthy and professional human capitals who are predominant on modern information technologies.*
- *Upgrading the role of supreme audit court in assisting the authorities of the country in making and taking decisions, especially in the field of Resistive Economy.*
- *Deepening the public trust in the supreme audit court and enhancing its public acceptance.*
- *Making use of novel approaches of comprehensive audit, annual audit reporting, and prosecution.*
- *Developing the requirements and mechanisms of transparency in performance and financial soundness of executive agencies.*
- *Consolidating relationships and playing an outstanding role at the regional and international levels.*
- *Boosting and strengthening the mechanisms of preventive, guiding, and authoritative supervision.*

Also, the duties and powers of the audit court according to the existing regulations are:

- *Auditing or inspecting the entire accounts of revenue, cost, other receives, payments, and also fiscal records and documents in relevance with agencies in conformity with financial rules and regulations.*
- *Investigating the occurrence of financial operations in the agencies in order to be confident of receives and on-time and accurate transmits of earning and or the cost incurs and other receives and payments.*
- *Handling the inventory of account of the assets of the agencies and*

As can be observed, investigating the violations of executive agencies is one of the hot topics in audit courts. As a result, research about ranking executive agencies are based on the violations performed is of specific importance. When we rank the agencies, according to the budget split indexes of the audit court, which are used for studying their violations, as a result, the agencies with lower rankings make efforts to promote their performance for the future years and do fewer violations.

Currently, there are not any indicators in the Iranian audit court for ranking executive agencies' performance.

There are many kinds of methods for ranking. We use non-parametric approaches such as DEA to ranking. DEA is a new science but its applications in various fields and also, its combination with other sciences has made remarkable development over the last few years. DEA is used as a multi-criteria performance assessment tool. DEA is a method for assessing the homogeneous units with a multi-input and multi-output.

DEA is the most appropriate performance measurement tool that is applied for a multiple dimension evaluation of executive agencies. One of the advantages of this technique is its ability to help managers to identify best practices that can be used as guides for managers of agencies towards maximizing the efficiency of executive agencies.

DEA models can be able to consider simultaneously the following important aspects:

- *We can measure resource performance in each agency.*
- *We can distinguish efficient agencies from non-efficient ones.*
- *We can compare efficient and non-efficient agencies to each other.*
- *Which resources have been inefficiently allocated?*
- *Which agencies have the best ranking in performing?*

In continuation, we will explain the considered model in DEA that we will use for ranking.

3 | Model Used

DEA is a non-parametric method to evaluate the efficiency or performance of various DMUs with multiple and similar inputs and outputs. This was initially introduced by Charnes et al. [4] and they proposed CCR model. Subsequently, Banker et al. [5] introduced the BCC model (see [6] and [7]).

DEA can be used for ranking of DMUs. Sexton et al. [8] proposed a method for the ranking of DMUs, which has been referred to as Cross-Efficiency. In this method, the efficiency score of each DMU is calculated based on the optimal weight of the other DMUs, and then the average of these scores is used for ranking each of the DMUs. Cook et al. [9] introduced models for ranking the efficient units in DEA. They have categorized the DMUs into two sets, efficient and inefficient, and then imposed constraints on their weights. Andersen and Petersen [10] proposed the Super-Efficiency model for ranking the efficient DMUs. Their method was in such a manner that, the DMU under evaluation, for example, DMU_o, is eliminated from the production possibility set, and then, the model is implemented for the remaining DMUs. Many methods for ranking in fuzzy, stochastic, interval and uncertainty environments have been proposed ([11] - [19]). In order to review articles related to ranking in DEA, refer to Adler et al. [20] and Hosseinzadeh Lotfi et al. [21].

The model that we are going to use for ranking executive agencies is the Khodabakhshi and Aryavash [22] model which has denoted by “KHA”. In the said model it is assumed that the sum of efficiency scores (θ)

of the entire DMUs taken into consideration is equivalent to 1, i.e., $\sum_{j=1}^n \theta_j = 1$.

The efficiency of DMUs is defined as the weighted sum of outputs divided by the weighted sum of inputs. The weight v_i ($i=1, 2, \dots, m$) and u_r ($r=1, 2, \dots, s$) are assigned to inputs and outputs, respectively. The following equations are used to determine the efficiency values of DMUs.

$$\theta_j = \frac{\sum_{r=1}^s u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \quad j = 1, 2, \dots, n \tag{1}$$

s.t. $\sum_{j=1}^n \theta_j = 1.$

Eq. (1) can be used to compute the minimum and maximum values for θ_j ($j = 1, \dots, n$), as Model (2) and Model (3), but can not be used to determine the unique values.

Min θ_o

$$\text{s.t. } \theta_j = \frac{\sum_{r=1}^s u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \quad j = 1, 2, \dots, n \tag{2}$$

$$\sum_{j=1}^n \theta_j = 1,$$

$$v_i, u_r, \theta_j \geq 0. \quad \forall i, j, r$$

$$\begin{aligned}
 & \text{Max} \quad \theta_o \\
 & \text{s.t.} \quad \theta_j = \frac{\sum_{r=1}^s u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}}, \quad j = 1, 2, \dots, n \\
 & \quad \quad \quad \sum_{j=1}^n \theta_j = 1. \\
 & \quad \quad \quad v_i, u_r, \theta_j \geq 0. \quad \forall i, j, r
 \end{aligned} \tag{3}$$

So, the efficiency score of each DMU is in the following interval:

$$\theta_j^{\text{Min}} \leq \theta_j \leq \theta_j^{\text{Max}}. \tag{4}$$

The value which is finally reported as an efficiency score is as the following convex combinations:

$$\theta_j = \theta_j^{\text{Min}} \lambda_j + \theta_j^{\text{Max}} (1 - \lambda_j), \quad 0 \leq \lambda_j \leq 1 \quad j = 1, 2, \dots, n \tag{5}$$

In order to have equal and fair conditions for all DMUs, it is assumed that:

$$\lambda = \lambda_1 = \lambda_2 = \dots = \lambda_n. \tag{6}$$

Hence, we have

$$\lambda = \frac{1 - \sum_{j=1}^n \theta_j^{\text{Max}}}{\sum_{j=1}^n (\theta_j^{\text{Min}} - \theta_j^{\text{Max}})}. \tag{7}$$

Next, by utilizing *Eq. (5)* and the obtained value for λ (*Eq. (7)*), the value of θ_j is computed for each DMU (*Eq. (8)*). The unit which has a higher efficiency score gains a better ranking.

$$\theta_j = \theta_j^{\text{Min}} \lambda + \theta_j^{\text{Max}} (1 - \lambda). \quad j = 1, 2, \dots, n \tag{8}$$

In the next section, we implement the stated model for the real data of the executive agencies in 2015-2016. Inputs and outputs are the same as the budget split indexes of the audit court, which are used to evaluate the deviations of the executive agencies.

4 | Methodology, Computational Results and the Analysis of Models

The existing problem comes from the need to rank the executive agencies in Iran. In this paper, we intend to rank the executive agencies of the country by budget split indexes and DEA technique. For the ranking of executive agencies, it is necessary to take the factors that affect their budget deviations' performance as input or output indexes.

The total numbers of executive agencies in the country, which have been studied in this paper, are 24 cases. Using the AHP method and the opinion of experts, finally we selected the introduced indicators in *Table 1* for ranking. The audit court budget split indexes that we want to use for the ranking of the executive agencies have been shown in *Table 1*.

Table 1. Indexes extracted from the audit court budget split reports.

Indexes	
Input	Percentage of the number of protested cases of the agency relative to the total number of protested cases of all the agencies.
Output	Percentage of the number of notes and articles of each agency which have been absolutely observed to divided by the total number of articles and notes relevant to the same agency.
Input	Percentage of the number of notes and articles of each agency that have been fully or partially disregarded divided by the total number of articles and notes relevant to the same agency.
Input	Percentage of the number of notes and articles of each agency which obligatorily lacks performance divided by the total articles and notes in relation to the same agency.
Input	Percentage of the number of notes and articles of each agency which prescriptively lacks performance divided by the total articles and notes in relation to the same agency.
Input	Percentage of the number of notes and articles of the agency where the objectives of the legislator have not been achieved, divided by the total of objectives of the legislator that have not been achieved of the entire agencies.

In order to rank the executive agencies, the following scenario has been considered:

Percentage of the number of notes and articles of each agency which have been absolutely observed to divide by the total number of articles and notes relevant to the same agency is taken into contemplation as an output. The larger this number, as a result the more articles and notes have been observed and be more desirable. The rest of the indexes are selected as inputs.

The main objective of this analysis is to survey the managerial practices adopted and conducted by executive agencies. The mentioned scenario has been implemented for KHA model by using real data, on the basis of the indexes stated in *Table 1*. Ranking takes place on the basis of budget split indexes of the audit court, used to scrutinize the budgetary deviations of the country's executive agencies.

For the case study that we have considered, the final efficiency score (*Eq. (8)*) shows how successful the executive agencies have been in terms of the budget split indexes. At each implementation, the constraints of the model determine the efficiency of the executive agencies in such a way that the sum of these efficiency scores becomes one, and the minimum or maximum efficiency score is obtained for the decision-making unit under evaluation.

Results attained from implementing the models rank the agencies in accordance with the amount of their budget deviation. Results have been shown in *Table 2* for real data in 2016.

Based on the results attained from the model, the Housing Foundation of the Islamic Revolution, Ministry of Justice, and the Atomic Energy Organization of Iran are in the first to the third positions. This shows that, by using the considered budget split indexes of the Audit Court, these agencies have committed fewer deviations, in respect to other agencies, as a result they have a better performance.

In order to see the process of the performance of the executive agencies, KHA model has also been implemented out for the data of the year 2015 too. The results are shown in *Table 2*. Based on the results achieved in 2015, the Ministry of Justice, Martyr Foundation and Veteran Affairs, and Housing Foundation of the Islamic Revolution are in the preeminent positions.

Table 2. Results relative to 2016 and 2015.

2016 Executive Agencies	θ^{KHA}	2015 Executive Agencies	θ^{KHA}
Housing Foundation of the Islamic Revolution	0.453	Ministry of Justice	0.437
Ministry of Justice	0.194	Martyr Foundation and Veterans Affairs	0.189
Atomic Energy Organization of Iran	0.066	Housing Foundation of the Islamic Revolution	0.058
Devices supervised by the Supreme Leader	0.066	Ministry of Defense and Armed Forces Support	0.055
Ministry of Defense and Armed Forces Support	0.054	Devices supervised by the Supreme Leader	0.047
Islamic Republic of Iran Broadcasting Organization	0.047	Cultural Heritage, Handicrafts and Tourism Organization	0.039
Justice of the Islamic Republic of Iran	0.029	Plan and Budget Organization	0.030
Plan and Budget Organization	0.015	Ministry of Information and Communications Technology	0.021
Presidential Administration	0.015	Presidential Administration	0.019
Ministry of Information and Communications Technology	0.014	Justice of the Islamic Republic of Iran	0.016
Ministry of Sport and Youth	0.008	Ministry of Cooperatives, Labor, and Social Welfare	0.013
Ministry of Agriculture Jihad	0.007	Ministry of Economic Affairs and Finance	0.013
Ministry of Interior	0.007	Ministry of Health and Medical Education	0.012
Ministry of Education	0.007	Ministry of Sport and Youth	0.009
Ministry of Health and Medical Education	0.005	Ministry of Education	0.008
Ministry of Economic Affairs and Finance	0.003	Ministry of Science, Research and Technology	0.008
Ministry of Industry, Mine and Trade	0.003	Ministry of Interior	0.007
Ministry of Roads and Urban Development	0.002	Ministry of Agriculture Jihad	0.004
Ministry of Cooperatives, Labor, and Social Welfare	0.002	Ministry of Industry, Mine and Trade	0.004
Ministry of Petroleum	0.002	Ministry of Petroleum	0.004
Ministry of Energy	0.001	Ministry of Roads and Urban Development	0.003
Ministry of Science, Research and Technology	0.000	Ministry of Energy	0.002
Cultural Heritage, Handicrafts and Tourism Organization	0.000	Atomic Energy Organization of Iran	0.000
Martyr Foundation and Veterans Affairs	0.000	Islamic Republic of Iran Broadcasting Organization	0.000

The obtained results have rounded to three decimal places.

Table 3 and Table 4 showed the statistical information related to the data used in this article.

Table 3. Statistical information related to the data (2016).

Index	Min	Max	Mean	Standard Deviation
I1	0.112	15.140	4.052	4.104
I2	0	100	42.428	32.839
I3	0	20	1.696	4.801
I4	0	33.333	4.248	9.285
I5	0	21.277	4.167	4.502
O1	0	100	51.628	32.278

Table 4. Statistical information related to the data (2015).

Index	Min	Max	Mean	Standard Deviation
I1	0.054	14.493	4.013	3.995
I2	0	100	24.281	20.983
I3	0	10	0.590	2.111
I4	0	100	14.050	21.462
I5	0	13.636	4.167	3.650
O1	0	100	61.078	23.417

Fig. 1 compares the rank of executive agencies in 2015-2016, based on the model under discussion. By using Fig. 1, it can be observed that the Devices supervised by the Supreme Leader, Ministry of Interior, Justice of the Islamic Republic of Iran, Ministry of Education, Ministry of Sport and Youth, Housing Foundation of the Islamic Revolution, Ministry of Energy, Atomic Energy Organization of Iran, Ministry of Agricultural Jihad, Ministry of Roads and Urban Development, Ministry of Industry, Mine and Trade and the Islamic Republic of Iran Broadcasting Organization (IRIB), stand in better ranks in 2016. This illustrates that the performance of these agencies, amongst the other executive agencies, has improved in terms of evaluating budget deviations.

Also, Fig. 1 depicts that the Presidential Administration and the Ministry of Petroleum have not changed in their position, in comparison with 2015, regarding the ranking of agencies. The other executive agencies are in a more inferior ranking position in 2016 in comparison with 2015. As a result, it is essential that these agencies revise in their performances.

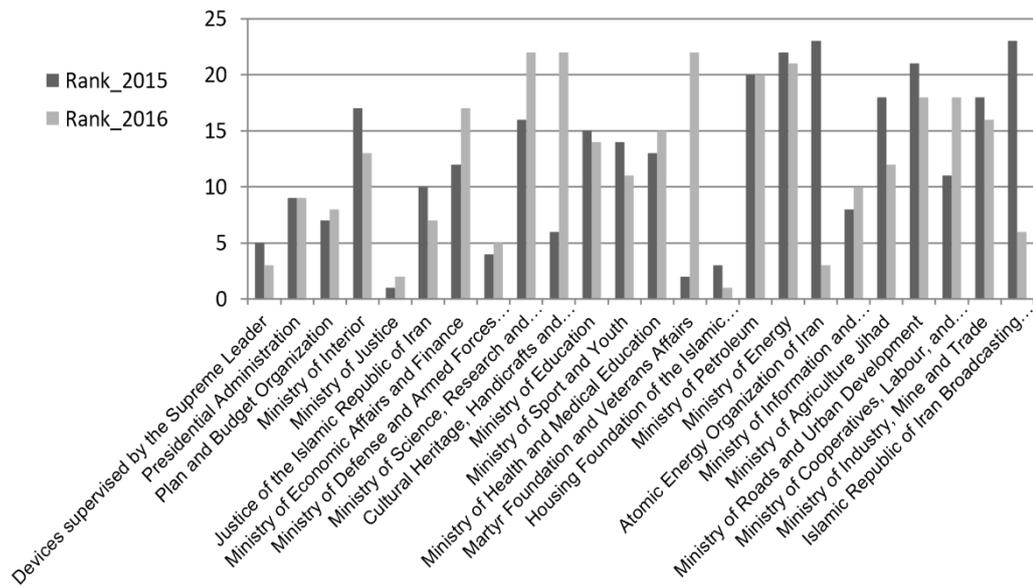


Fig. 1. A comparison of the ranking of the executive agencies in two varied years using the KHA model.

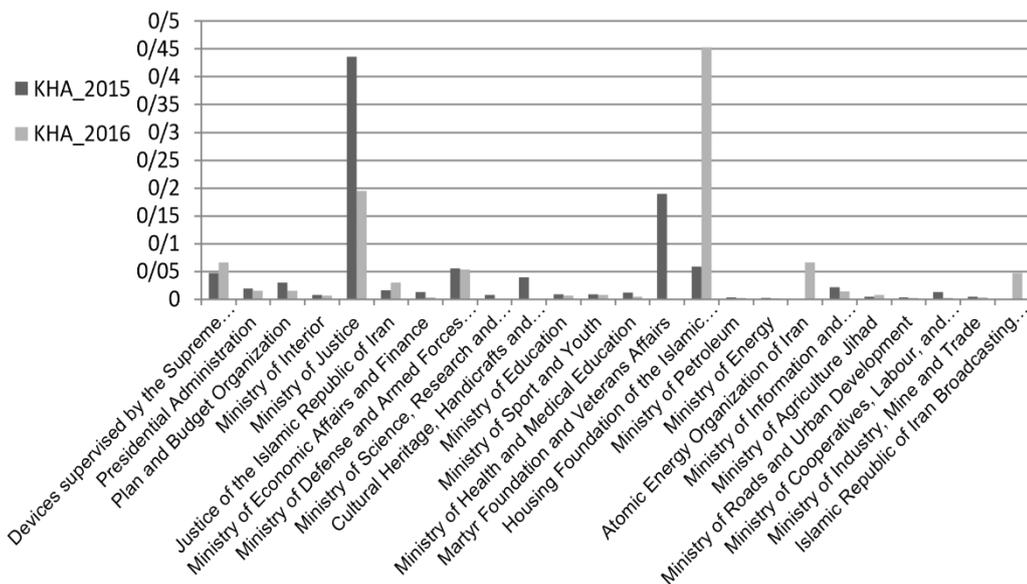


Fig. 2. A comparison of the performance of the executive agencies in 2015-2016 utilizing the KHA model.

Fig. 2 compares the performances of the executive agencies in 2015 and 2016, by using the model proposed. By utilizing *Fig. 2*, it is shown that the performances of the executive agencies such as the Devices supervised by the Supreme Leader, Justice of the Islamic Republic of Iran, Housing Foundation of the Islamic Revolution, Atomic Energy Organization of Iran, Ministry of Agriculture Jihad and Islamic Republic of Iran Broadcasting Organization (IRIB), have improved in 2016 in comparison with 2015. Likewise, by using *Fig. 2*, it is shown that the Ministry of Interior did not show changes in its performance in comparison with 2015. The performance of other executive agencies has alleviated in the year 2016 in comparison with 2015, and it is necessary that these agencies revise in their performance.

DEA is a method for a measure of performance, offering recommendation targets for improving the performance of DMUs. Although the DEA results have technical sense, some targets cannot be valued in an organizational sense. It is worth recalling that the obtained results can work as managerial guidelines.

5 | Conclusion and Policy Recommendations

The main objective of this study was to ranking executive agencies. The results enable managers to identify the best and worst executive agency based on the considered indexes of the budget split of the audit court. Ranking of the executive agency by using the DEA technique is very useful to managers seeking to find the performance of the units as a whole or of a specific individual unit. Any agency with a lower-ranking position shows that it had based on the indexes under evaluation more budget deviation. Studies that are performed in these fields are of great importance because they can determine the rank of executive agencies based on budget deviations.

Results attained from implementing such studies in the court of audits are crucial, as by utilizing the results of the models, we can determine which of the agencies has the most budgetary deviation. Another benefit of such studies is that the agencies can be ranked simultaneously using multiple indexes and report an overall ranking for the positioning of each executive agency. The amount of allocated budget to the agencies is based on the performance they intend to conduct. As a result, if an agency is stricken with deviation, it indicates that the agency has not been able to use its budget appropriately, to achieve its objectives. If an executive agency is ranked lower, more attention should be paid to the budget allocated to it. Budget deficiencies are critical problems in many countries. Hence, endeavors must be made to allocate the budget in an appropriate manner between the agencies. After the budget allocation is done between the agencies, it is important that is monitored each agency so its budget allocated towards its determined objectives in the best mode and confronted with fewer deviations. This issue is subjected to evaluation by the audit court.

The notes and articles which have failed for a consecutive number of years or did not have a suitable performance must be taken under review so that their iteration in subsequent time-periods is prevented and or if requisite, amendments must be imposed. In order to continually evaluate executive agencies and ministries, it is necessary to develop an intelligent decision support system to evaluate their performance and study the trend of progress and regress of the agencies each year. It is hoped that managers can analyze the performance of the executive agencies and the managers of the agencies with a lower rank improve their future efficiency. DEA results are obtained without considering the restrictions. The managers can skillfully use these results as a support system for decision-making, analyzing the agencies. Managers, using the done ranking, can take corrective solutions for the executive agencies with lower-ranking based on the DEA results.

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Conflicts of Interest

All co-authors have seen and agree with the contents of the manuscript and there is no financial interest to report. We certify that the submission is original work and is not under review at any other publication.

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