BÜTÜNLEŞİK VZA ve GİA YÖNTEMLERİYLE BÜYÜKŞEHİR BELEDİYELERİNİN MALİ ETKİNLİK ANALİZİ: TÜRKİYE ÖRNEĞİ

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ÖZ

Bu çalışmanın amacı Türkiye'deki büyükşehir belediyelerinin mali hizmetlerdeki etkinliklerini belirleyerek performanslarına göre sıralamaktır. Öncelikle 14 büyükşehir belediyesinin mali hizmetlerindeki etkinlikleri üç girdi ve üç çıktı içeren bir VZA (Veri Zarflama Analizi) modeli ile belirlenmiştir. VZA, etkin olmayan karar verme birimlerine ilişkin performans iyileştirme bulguları ortaya koysa da, etkin karar verme birimleri için herhangi bir sıralama sağlayamamaktadır. Bu nedenle, VZA ile mali hizmetlerde etkin olarak belirlenen büyükşehir belediyeleri GİA (Gri İlişkisel Analiz) ile sıralanmışlardır. Böylelikle mali hizmetlerini başarılı bir şekilde yürüten belediyelerin kendi aralarında sıralanması sağlanmıştır. Bunun yanı sıra etkin belediyelerin performanslarına etki eden faktörler de GİA ile belirlenebilmiştir. VZA ve mali hizmetlerinde etkin olan belediyelere (Gaziantep, Erzurum, Eskişehir, Antalya, Samsun, Adana, Ankara veİstanbul BüyükşehirBelediyeleri) uygulanan GİA sonuçlarına göre, İstanbul Büyükşehir Belediyesi en yüksek performansa, Anakara Büyükşehir Belediyesi ise en düşük performansa sahip belediyedir.

Anahtar Kelimeler: Belediye, Etkinlik, Veri Zarflama Analizi, Gri İlişkisel Analiz.

JEL Sınıflandırması:C44

FINANCIAL EFFICIENCY ANALYSIS OF METROPOLITAN MUNICIPALITIES WITH INTEGRATED DEA AND GRA: THE CASE OF TURKEY

ABSTRACT

The aim of this study is to identify the activities of metropolitan municipalities in Turkey in terms of monetary services and sequence them according to their performances. First, the monetary services activities of 14 metropolitan municipalities have been identified by a DEA (Data Envelopment Analysis) model that is related to three inputs and three outputs. DEA provides the performance improvement findings of decision-making units which are not efficient; however, any sequence for efficient decision making units cannot be attained via DEA. Therefore, the municipalities identified as efficient in terms of monetary services with DEA are sequenced with GRA (Grey Relation Analysis). In this way, the municipalities carrying out their monetary services efficiently could be sequenced among themselves. In addition, the efficient factors in the performances of the efficient municipalities could be identified with GRA. The results of applying DEA and GRA to the efficient municipalities (Gaziantep, Erzurum, Eskisehir, Antalya, Samsun, Adana, Ankara and Istanbul Metropolitan Municipalities) in terms of monetary services indicate that Istanbul Metropolitan Municipality has the highest performance and Ankara Metropolitan Municipality has the lowest performance.

Keywords: Municipality, Efficiency, Data Envelopment Analysis, Grey Relation Analysis.

JEL Classification: C44

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1.Introduction

The significant increase in the importance of the concept of competence in today's world for organizations in the private and public sectorshas caused organizations to think strategicallyand develop various performance measurement systems in this area. By measuring the successes of institutions in reaching their goals via performance measurement, it is possible for organizations to use both financial and social resources most efficiently. This change in performance measurement has generated the need to measure the performance of municipalities in local authorities. Municipalities whose main aim is to increase the quality of life of citizens via their investments and services have to use existing resources more efficiently and feasibly. The aim of using efficient and feasible resources is based on two factors in terms of economics: the first is to find sufficient and necessary resources that can finance municipality services; in other words, to provide enough share to be separated from the national revenue for municipality services.The second is to provide the most efficient use of the attained resource for the good of society.

In the finance of municipality services, the provision of sufficient and necessary resourcesto municipalities is dependent on the resourcedistribution performed by the state. In the distribution of scarce resources of the state to the municipalities, it is not ethical to provide a resource that dominates the investments and hinders some municipalities by restricting their resources against them. Increasing the resources supplied to municipalities by the state and each increase in the expenses depending on this, does not mean that there is an increase in municipality services directly and that there is an improvement in the welfare levels of the citizens.It also does not mean that the resources set asidefor municipality services are used economically. Therefore, when assigning resources, municipalities should be given priority in line with the expenses to be spent for these service units by taking into consideration the activities conducted in the various service units of all municipalities.

There are many service areas (asphalt-road maintenance, cleaning-trashes, and monetary services) in themunicipalities. Monetary Services, which is one of these areas, isthe unit in which the personnel and travelling allowance costs of municipalities are paid, service, consumption and fixture intakes are carried out, and all types of investment and transfer expenses are paid. In addition, tax and nontax revenues that form the largest revenue items of the municipalities, and also the revenues attained from aids and funds, are provided by the related unit. Therefore, the Monetary Services unit in which revenue and expenditure accounts are held and in which investment decisions are reached has a great importance in identifying the performance levels of the metropolitan municipalities.

When studies related to the efficiency of municipalitiesare examined, evidence indicates that DEA is more frequently used in identifying efficiency (Kloot, 1999; Poister and Streib, 1999; Prieto and Zofio, 2001; Çağlar, 2003; Woodbury and Dollery, 2004; Sousa and Stosic, 2005; Doğan, 2006;Loikkanen and Susiluoto,

2006;Balaguer-Coll et al., 2007;Afonso and Fernandes, 2008; Nijkamp and Suzuki, 2009;Boetti et al., 2009, Kalb, 2010a; Kalb et al., 2012, Giordano and Tommasino, 2011;Storto, 2013). However, no studies have been undertaken in which efficient units are sequenced according to their performances and these efficiencies are examined within themselves. The referenced studies are related to the performance improvement of units that are not always efficient with the opportunities provided by DEA. Therefore, the evaluation of efficient units within themselves using techniques such as DEA and GRA has not been encountered in the literature. Due to this gap in the literature, this study uses GRA, which is a decision-making technique with many criteria, together with DEA to identify the efficiencies of municipalities. In addition to providing suggestions related to the performance improvement of municipalities that are not efficient by identifying the performance levels in terms of the monetary services of metropolitan municipalities in Turkey, the aim of this study is to identify the important factors in efficiency by sequencing the municipalities that are successful in terms of the performance of their monetary services.

2.Material and Methods

In the study, DEA has been used to identify the efficiencies of sixteen metropolitan municipalities in Turkey in terms of monetary services. In addition to sequencing and comparing the metropolitan municipalities in terms of their performances, this study also proposes suggestions related tothe potential improvement ratios needed in inputs and outputs for the municipalities to reach the efficiency level which hasbeen identified as efficient; DEA is the appropriate technique to meet these aims. The efficiency scores have been attained by measuring the performance levels in terms of the monetary services of municipalities with DEA.

In the second stage of the study, GRA has been applied in the sequencing in terms of the efficiency of metropolitan municipalities which have been identified as efficient via DEA. Currently, few details are known about DEA and the decision making units that are efficient. Via DEA, suggestions can be proposed to increase performance improvement for less efficient units. However, it is also important for the efficiencies of efficient units to be evaluated and sequenced according to their performances. Within this scope, the municipalities identified as efficient via DEA have been sequenced in terms of their input and output variables according to their performances via GRA. In this way, efficient decision making units have also been sequenced in terms of their efficiencies amongthemselves.

2.1.Identifying the Efficiencies of Municipalities Using Data Envelopment Analysis

The mathematical structure of the DEA model was first introduced as a fractional programming model by Charnes, Cooper and Rhoders (Charnes et al., 1978). DEA is a widely practiced method used for performance benchmarking and comparison, and the first application of the DEA technique was topublic sector service enterprises. It is currently a method applicable in many fields. DEA is a technique

based on linear programming that seeks to measure the relative performance of decision units in cases where inputs and outputs are measured by multiple scales, a fact that poses challenges in the execution of the comparison (Karacaer, 1998). It is necessary for the decision units being analyzed to have similar functions focusing on the same objective and to operate under the same market circumstances. It is also imperative for all units in the group to be identical in terms of the factors identifying their efficiencies, excluding unit size and intensity. In addition, all inputs and outputs should be represented by positive numbers, and there should be no null input or output (Kuosmanen, 2001). DEA compares the production units, considered to be identical, to identify the best observation as the efficiency frontier. Other observations are assessed by reference to this frontier. The inefficiency level and its roots and causes in every decision unit are identifiable by the use of the DEA. This provides insights for executives and top administrators regarding how to decide whether to increase the amount of inputs and/or decrease the amount of outputs (Behdioğlu and Özcan, 2009). DEA models are analyzed in two separate groups: input-oriented and output-oriented. Because the output-oriented DEA model is employed in the present study, a general formulation forthis type of DEA model is provided below:

Objective Function: $Enb\ h_{\ k} = \sum_{r=1}^{s} u_{rk} y_{rk}$; k=1,2,3,…,n

Restrictive conditions: $\sum_{r=1}^{s} u_{rk} y_{rj} - \sum_{i=1}^{m} v_{ik} x_{ij} \le 0$;j=1,2,3,…,n

$\sum_{i=1}^{m} v_{ik} x_{ik} = 1$; $u_{rk} \ge 0$; r = 1,2,3,…,s

$v_{ik} \ge 0$; ; i = 1,2,3,…,m

m: number of inputs,

s: number of outputs,

n: number of decision units,

x_{ij}: amount of i. input used by the jth decision making unit,

y_{rj}: amount of r. output produced by the jth decision making unit,

u_{rk}, v_{ik}: The weights that were given by decision making unit for i. inputs and r outputs.

The DEA performs the following steps in the measurement of relative efficiency (Yolalan, 1993):

i. Identification of the best observations (or the decision making units on the efficiency frontier) generating the largest composition of output by use of the least combination of input within a given observation group

ii. Radial measurement of the distance from the inefficient decision making units to the identified frontier, considered as reference point.

The decision making units in the DEA application are the metropolitan municipalities, due to their using similar inputs and producing similar outputs. Although 16 metropolitan municipalities have been identified for analysis, 14 of them have sufficient data for analysis in terms of model input and output variables. The input variables in the model are current expenditures (X1), investment expenditures (X2) and transfer expenditures (X3); output variables are tax revenues (X4), nontax revenues (X5) and the revenues attained from aid and funds (X6). Prior studies in the literature have been consideredwhen selecting the aforementioned input and output variables.

In DEA applications, special attention should be paid to make sure that decision making units are not smaller than required under the linear programming model to be employed in the study. The number of selected inputs is referred to as m, and the number of outputs as s, so the leastnumber of decision making units should be m+s+1 for the research to be credible (Boussofianee et al., 1991). This restriction has been taken into account for the model in this study. Frontier Analyst Professional version 3.0 has been used tosolve the model.

The data used in the analysis have been attained from the municipalities as a result of the applications to related Knowledge Acquisition Directorships of the municipalities. The findings from this study are valid for the year 2011 with the input and output composition used. Because DEA is a subjective performance measurement tool, it is possible to attain a different result in different years depending on the input and output compositions used and observation clusters. In the analysis, because the municipalities in the public sector are output maximization oriented instead of input maximization oriented, a BBC (Banker, Charnes and Cooper) model has been used which is variable-yield related to output maximization.

In addition to the input-output model decision in DEA, it is also necessary to choose the yield-type depending on the scale. When the inputs and outputs in the study are taken into consideration, a BBC model with variable-yield has been used in the study because it is more realistic to use variable-yield model.

While decision units whose efficiency is equal to 100% are identified efficiently by DEA, reference groups should be formed for the inefficient decision units. According to the efficiency ratios in Table 1, Gaziantep, Erzurum, Eskisehir, Antalya, Samsun, Adana, Ankara and Istanbul Metropolitan Municipalities have been identified as efficient in terms of monetary services, and the other six metropolitan municipalities have been identified as inefficient. The subjective efficiency ratio of

Izmir Metropolitan Municipality belonging to the monetary services model has been identified as 98.29%. This value shows that the success of Izmir Metropolitan Municipality in providing maximum output with the inputs used is 98.29%.In other words, its success in attaining maximum revenue with its expenditures is 98.29%. The success of Bursa Metropolitan Municipality, which has the lowest efficiency score among the inefficient municipalities, in attaining the maximum revenue with the existing expenditures is 67.22%. The other inefficient municipalities in are, in order, Mersin (98.14%), Kocaeli (96.91%), Sakarya (94.97%) and Konya Metropolitan Municipalities (88.90%).

Table 1: The Efficiency Ratios of Metropolitan Municipalities Belonging to the Monetary Services Model and Their Reference Frequencies

Metropolitan Municipalities	Efficiency Scores	Efficiency State	Reference Frequencies
Gaziantep Metropolitan Municipality	100	Efficient	0
Erzurum Metropolitan Municipality	100	Efficient	1
Eskisehir Metropolitan Municipality	100	Efficient	5
Antalya Metropolitan Municipality	100	Efficient	1
Samsun Metropolitan Municipality	100	Efficient	1
Adana Metropolitan Municipality	100	Efficient	6
Ankara Metropolitan Municipality	100	Efficient	0
Istanbul Metropolitan Municipality	100	Efficient	2
Izmir Metropolitan Municipality	98.29	Not Efficient	0
Mersin Metropolitan Municipality	98.14	Not Efficient	0
Kocaeli Metropolitan Municipality	96.91	Not Efficient	0
Sakarya Metropolitan Municipality	94.97	Not Efficient	0
Konya Metropolitan Municipality	88.90	Not Efficient	0
Bursa Metropolitan Municipality	67.22	Not Efficient	0

One of the superior properties of DEA is the ability to set reachable targets for the inefficient decision making units to improve their performances. It is presumed that the inefficient decision making units can reach the same efficiency level by applying the methods applied by the efficient units. Potential improvement values have been calculated for six metropolitan municipalities thathave been identified as inefficient, and thesevalues are shown in Table 2.

Table 2: The Potential Improvement Values of Inefficient Metropolitan Municipalities in the Monetary Services Model and Reference Clusters

Municipalities		Factors	Actual	Target	Potential improvement (%)	Reference Groups
Izmir	Input	Current Expenditures	690323078,34	690323078,34	0	Adana Istanbul
		Investment Expenditures	538662169,32	451042489,92	-16,27	
		Transfer Expenditures	207248055,20	207248055,20	0	
	Output	Tax Revenues	35453276,33	74048462,74	108,86	
		Nontax Revenues	1592444101,35	1620141440,20	01,74	
		Aid and Funds	1271032,69	21430642,52	1586,08	
Mersin	Input	Current Expenditures	178372762,60	178372762,60	0	Adana Eskisehir
		Investment Expenditures	165072994,53	73639210,44	-55,39	
		Transfer Expenditures	3240156,04	3240156,04	0	
	Output	Tax Revenues	7717619,70	9245312,05	19,79	
		Nontax Revenues	294337231,40	294337231,40	0	
		Aid and Funds	710927,34	3605686,73	407,18	
Kocaeli	Input	Current Expenditures	653155789,0	653155789,0	0	Adana Eskisehir
		Investment Expenditures	449779220,0	260755694,17	-42,03	
		Transfer Expenditures	3053145,0	3053145,0	0	
	Output	Tax Revenues	4755728,21	28223939,41	493,47	
		Nontax Revenues	1026833266,17	1059564595,09	03,19	
		Aid and Funds	3684721,34	12411013,10	236,82	
Sakarya	Input	Current Expenditures	93733010,42	87290379,13	-06,87	Antalya Eskisehir
		Investment Expenditures	28880573,55	28880573,55	0	
		Transfer Expenditures	206667,43	206667,43	0	
	Output	Tax Revenues	4160825,20	4727227,31	13,61	
		Nontax Revenues	117692199,54	123924636,01	05,30	
		Aid and Funds	843783,76	1159208,64	37,38	
Konya	Input	Current Expenditures	240714103,50	230802601,26	-04,12	Adana Eskisehir Samsun
		Investment Expenditures	117688611,17	117688611,17	0	
		Transfer Expenditures	15496423,97	15496423,97	0	
	Output	Tax Revenues	8614869,25	18658399,90	116,58	
		Nontax Revenues	384582481,80	432605012,24	12,49	
		Aid and Funds	6193975,31	6967412,43	12,49	
Bursa	Input	Current Expenditures	364711814,00	364711814,00	0	Adana Istanbul
		Investment Expenditures	467770640,00	200040802,60	-57,24	
		Transfer Expenditures	56838333,00	56838333,00	0	
	Output	Tax Revenues	17730139,0	47589478,11	168,41	
		Nontax Revenues	549916071,00	818130016,14	48,77	
		Aid and Funds	4917673,0	11490783,66	133,66	

The difference shown in Table 2 between the existing values and the target values show the potential improvement values. Potential improvement values are the variance ratios that should be performedwith input and output variables for the inefficient decision making units to reach an efficient position. While a positive poten-

tial improvement value shows that the related input and output variable of the decision making unit should be increased, a negative potential improvement value shows that the related input or output variable of decision making unit should be decreased.

By taking advantage of these variance ratios, evaluations can be conducted related to the fact that ratio improvement can be conducted using the inputs, causingthe less efficient decision units to become relatively efficient. If Izmir Metropolitan Municipality decreases its expenditures by a ratio of 16.27%, and increases tax revenues by the ratio of 108.86%, nontax revenues by 01.74%, and aid and funds by 1586.08%, which is incredibly high, it willbe an efficient municipality in monetary conditions similar to the other metropolitan municipalities in the reference cluster it is in. This shows that Izmir Metropolitan Municipality's revenue from aids and funds is very low. If Mersin Metropolitan Municipality does not change its current and transfer expenditures, decreases its investment expenditures by the ratio of 55.39%, tax revenues by 19.79%, and nontax revenues by 01.90% and increases its revenue from the aids and funds by a ratio of 407.18%, which is extremely high, it seems possible that it will be an efficient municipality in terms of monetary services.

Inthe last column of Table 2, there are the metropolitan municipalities which shall be taken as references by inefficient metropolitan municipalities. The units that are the references, and the inefficient units they are reference for, are units that have the same efficiency structure. Therefore, any inefficient unit can become efficient by applying activities that are appropriate for the structures of the units identified as references to itself. The number of units that are references to the inefficient units shows that these units have strong efficiency structures. According to this, Adana and Eskisehir Metropolitan Municipalities have the strongest efficiency structures in terms of monetary services, according to the reference frequency shown in Table 2. Therefore, these two municipalities are the ones that attain most revenue with their existent expenditures. In other words, they carry out monetary services in the best way. On the contrary, Ankara and Gaziantep municipalities have not been taken as references by any inefficient municipality although they are efficient.

2.2. Ranking the Efficient Municipalities Using Grey Relational Analysis

Deng (1982) introduced "The Grey System Theory" to supplement the limitations of using traditional statistical methods. Grey System Analysis (GRA) is useful for capturing the correlations between the reference factor and other factors which can be compared within a system (Deng, 1988). One of the features of GRA is that both qualitative and quantitative relationships can be identified among complex factors with insufficient information (relative to conventional statistical methods). Under such a condition, the results generated by conventional statistical techniques may not be acceptable without sufficient data to achieve desired confidence levels. In contrast, GRA can be used to identify major correlations among factors of a system with a relatively small amount of data. Thus, one of the major advantages of GRA is that it can generate satisfactory outcomes using a relatively small amount of data or

with great variability in factors because it can increase the data regularity with proper data treatment (Li et al., 1997). The procedure for calculating the GRA is as follows(Wu et. al, 2010):

1. Calculate the Grey Relation Grade

Let X_0 be the referential series with k entities (or criteria such as financial ratios in this study) of X_1, X_2,, …X_i, ….X_N (or N measurement criteria). Then,

$X_0=\{x_0(1), x_0(2), \ldots, x_0(k)\}$,
$X_1=\{x_1(1), x_1(2), \ldots, x_1(k)\}$,
.
.
$X_i=\{x_i(1), x_i(2), \ldots, x_i(k)\}$,
.
.
$X_N=\{x_N(1), x_N(2), \ldots, x_N(k)\}$

The grey relation coefficient between the compared series X_i and the referential series of X_0 at the j-th entity is defined as:

$$\gamma_{0i}(j)=\frac{\Delta\min+\Delta\max}{\Delta_{0i}(j)+\Delta\max} \qquad (1)$$

Where $\Delta_{0i}(j)$ is the absolute value of difference between X_0 and X_i at the j-th entity, that is $\Delta_{0i}(j)=\left|x_0(j)-x_i(j)\right|$, and

$$\Delta_{\max}=Max_i \max_j \Delta_{0i}(j)$$

$$\Delta_{\min}=Min_i \min_j \Delta_{0i}(j)$$

The grey relational grade (GRG) for series of X_i is given as:

$$\Gamma_{0i}=\sum_{j=1}^{K} w_j \gamma_{0i}(j) \qquad (2)$$

Where, w_j is the weight of j-th entity. If it is not necessary to apply the weight, take $\omega_j = \frac{1}{K}$ as an average.

2. Data Normalization (or Dimensionless Data)

Before calculating the grey relation coefficients, the data series can be treated, based on the following three types of situation and the linearity of data normalization, to avoid distorting the normalized data (Hsia and Wu, 1997).

These are:

a) Benefit target: Upper-bound effectiveness measuring (i.e., larger-the-better)

$$x_i^*(j) = \frac{x_i(j) - \min_j x_i(j)}{\max_j x_i(j) - \min_j x_i(j)} \tag{3}$$

b) Cost Target: Lower bound effectiveness measuring (i.e., smaller-the-better)

$$x_i^*(j) = \frac{\max_j x_i(j) - x_i(j)}{\max_j x_i(j) - \min_j x_i(j)} \tag{4}$$

c) Medium Target: Moderate effectiveness measuring (i.e., nominal-the- best)

If $\max_j x_i(j) \le x_{ob}(j)$, then

$$x_i^*(j) = \frac{x_i(j) - \min_j x_i(j)}{x_{ob}(j) - \min_j x_i(j)} \tag{5}$$

If $\min_j x_i(j) \le x_{ob}(j) \le \max_j x_i(j)$, then

$$x_i^*(j) = \frac{\left| x_i(j) - x_{ob}(j) \right|}{\max_j x_i(j) - \min_j x_i(j)} \tag{6}$$

If $x_{ob}(j) \le \min_j x_i(j)$, then

$$x_i^*(j) = \frac{\max_j x_i(j) - x_i(j)}{\max_j x_i(j) - x_{ob}(j)} \tag{7}$$

where $x_{ob}(j)$ is the objective value of entity j.

The GRA calculation process explained above has been applied as shown below in steps in line with the purpose of the study.

Step 1: Establishing decision making matrix

This decision making matrix is shown Table 3.

Table 3: The Decision Making Matrix for Municipalities

Municipalities	Expenditures/Revenues					
	Inputs			Outputs		
	X1	X2	X3	X4	X5	X6
Gaziantep	209104443,3	94643118,92	33645	7345893,72	296247418,7	1916787,06
Erzurum	66656074,07	22356012,4	6063319,99	2280861,11	103294004,7	431740,27
Eskisehir	116951649,5	46178608,01	40000	4729930,42	187496878,6	2176722,15
Antalya	279371992,7	51679330,34	1951320	23861096,82	279755385,4	314454
Samsun	114763016,4	99492680,82	700000	2499269,31	161999206,9	8452027,62
Adana	176859901,5	95509243,3	25502571,64	23408899,57	395256422,5	5578825,88
Ankara	1317292870	543115370,4	315346770,8	91899013	2397200950	2000032
Istanbul	2694987063	2538128556	1878976524	117018236	7093489569	80239697

Step 2: Normalizing Data

After establishing a decision making matrix (Table 3), normalization data were computed using Equation 3 (for X4, X5 and X6) and Equation 4 (for X1, X2 and X3). It was establishedthat the referential series can be X_0 = {1.00, 1.00, 1.00, …, 1.00}.

Table 4: Summary of Normalization Data

Municipalities	Expenditures/Revenues $X_i^*(j)$, j=1,2,…,8					
	Inputs			Outputs		
	X1	X2	X3	X4	X5	X6
Reference	1.00	1.00	1.00	1.00	1.00	1.00
Gaziantep	*0.946*	*0.971*	*1.00*	*0.044*	*0.028*	*0.02*
Erzurum	*1.00*	1.00	0.997	0.00	0.00	0.001
Eskisehir	0.981	0.991	0.999	0.021	0.012	0.0233
Antalya	0.919	0.988	0.998	0.188	0.025	0.00
Samsun	0.982	*0.969*	*0.999*	*0.002*	*0.008*	*0.102*
Adana	0.958	0.971	0.986	0.184	0.0417	0.066
Ankara	*0.524*	0.793	0.832	0.781	0.328	0.021
Istanbul	0.00	0.00	0.00	1.00	1.00	1.00

Step 3: Computing absolute values [$\Delta_{0i}(j)$]

$\Delta_{0i}(j)$, is the absolute value of difference X_0 (differential series) and Xi at the j-th factors. Computed $\Delta_{0i}(j)$ is displayed Table 5.

Table 5: Absolute Values $\Delta_{0i}(j)$

Municipalities	Expenditures/Revenues $X_i^*(j)$, j=1,2,…,8					
	Inputs			Outputs		
	X1	X2	X3	X4	X5	X6
Gaziantep	*0.0542*	*0.029*	*0.00*	*0.956*	*0.972*	*0.979*
Erzurum	*0.00*	0.00	0.003	1.00	1.00	0.998
Eskisehir	0.0191	0.009	0.000003	0.979	0.988	0.977
Antalya	0.0801	0.012	0.001	0.812	0.975	1.00
Samsun	0.018	*0.031*	*0.0003*	*0.998*	*0992*	*0.898*
Adana	0.042	0.029	*0.0135*	0.816	0958	0.934
Ankara	*0.476*	0.207	0.168	0.219	0.672	0.978
Istanbul	1.00	1.00	1.00	0.00	0.00	0.00

Step 4: Computing Grey Relation Coefficients [$\gamma_{0i}(j)$]

The relational coefficients, $\gamma_{0i}(j)$, were computed using Equation 1.

Table 6: Grey Relation Coefficient $\gamma_{0i}(j)$

Municipalities	Expenditures/Revenues $X_i^*(j)$, j=1,2,…,8					
	Inputs			Outputs		
	X1	X2	X3	X4	X5	X6
Gaziantep	*0.902*	*0.945*	*1.00*	*0.343*	*0.339*	*0.337*
Erzurum	*1.00*	1.00	0.993	0.333	0.333	0.333
Eskisehir	0.963	0.981	0.999	0.338	0.336	0.338
Antalya	0.861	0.977	0.997	0.381	0.339	0.333
Samsun	0.965	*0.942*	*0.999*	*0.333*	*0.335*	*0.357*
Adana	0.923	0.945	0.973	0.379	0.342	0.348
Ankara	*0.512*	0.707	0.748	0.695	0.426	0.338
Istanbul	0.333	0.333	0.333	1.00	1.00	1.00

Step 5: Computing Grey Relation Grade

Equation 2 was applied for each municipality as the sum of the grey relation coeffi-cients. Table 7 summarizes these results.

Table 7: Performances of Municipalities

Municipalities	Γ_{0i}	Rank
Gaziantep	*64.48%*	*7*
Erzurum	*66.57%*	2
Eskisehir	*65.96%*	3
Antalya	*64.82%*	6
Samsun	*66.55%*	4
Adana	*65.21%*	5
Ankara	*57.14%*	8
Istanbul	*66.66%*	*1*

When the grey relation rank coefficients are examined in Table 7, it is seen that the Istanbul Metropolitan Municipality has a higher performance when compared to the other efficient metropolitan municipalities in this service area in terms of performance in monetary services. In other words, Istanbul Metropolitan Municipality has become a municipality that maximizes its revenues by minimizing current, investment and transfer expenditures, and has a much stronger structure. In contrast, it is seen that Ankara Metropolitan Municipality is the municipality that has the lowest performance when compared to the other metropolitan municipalities, which are efficient in terms of monetary services.

Table 8: Grey Relation Grades and Ranks of Factors in the Model

Factors	Γ_{0i}	Rank
Current Expenditures	*80.74%*	*3*
Investment Expenditures	*85.40%*	2
Transfer Expenditures	88.08%	1
Tax Revenues	*47.56%*	4
Nontax Revenues	*43.15%*	5
Aid and Funds	*42.34%*	6

In Table 8, when the importance degrees of the factors which are efficient in the performances of efficient municipalities are shown, it is seen that the variable that affects the performance in monetary services most is transfer expenditures.The revenue type attained from aid and funds is the variable that affects the performance least.

3.Conclusions and Discussions

This study, which is related to identifying the performance levels of 14 metropolitan municipalities in Turkey in terms of their monetary services, has been aimed at sequencing the efficient municipalities amongthemselves in terms of their

performances and putting forth the important factors in their efficiencies by proposing suggestions related to the performance improvement of municipalities which are inefficient in their monetary services. First, the performance levels of the municipalities have been measured and their efficiency scores have been attained. It has been shown which indicators should be changed via the findings of DEA for the municipalities which are not efficient within the scope of monetary services. These municipalities therefore cannot carry out their monetary services efficiently in thecorrect way like the municipalities they take as reference in terms of structure.

Suggestions related to performance improvement are proposed for the inefficient units via DEA. It isimportant for the efficient units to be sequenced within themselves in terms of their performances, and their efficiencies should also be evaluated. In the study, the municipalities found to be efficient via DEA have been sequenced in terms of the same input and output variables according to their performances with the use of GRA. The use of GRA in sequencing the performances of efficient units is one of the unique contributions of this study. In addition, the sequencing via GRA of the factors that are efficient in the performances of efficient municipalities differentiates this study from other performance-oriented studies in the literature.

When the findings from the two techniques used in the study are evaluated, it is notable that the efficient municipalities which have never been taken as reference (Ankara, Gaziantep) are last in the efficient units sequence in GRA. This condition may stem from the fact that the units that have not been referenced are not similar to the inefficient units structurally and, therefore, the performances of these efficient municipalities have not been seen as strong enough by the inefficient municipalities. This result may be a starting point for studies related to a relationship between reference frequency in DEA and the sequencing of efficient units. Again, in the later studies in which DEA and GRA techniques are used together, this condition can be based on a scientific reason after the examination of this relationship.

In today's world in which the efficient assignment of scarce resources carries great importance, especially wheremunicipalities that attain the major share of subsidies separated for local management are concerned, it is expected that this study should propose important data for the state managers. The findings attained from this study are thought to help inefficient municipalities attain an efficient structure. When the importance of the topic in terms of municipalities and the state is taken into consideration, it is necessary for similar studies to be updated permanently and revised depending on changing conditions. Therefore, when the deficiencies in the literature are taken into consideration, it is thought that this study will contribute to the literature by forming a starting pointfor further studies to be conducted later.

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