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Data Envelopment Analysis on Performance Measurement of Municipals

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Abstract
The process of evaluation of local government performance is a term which refers to regular measuring and reporting of activities of service units. Theoretical foundations for using performance measurement methods in local governments were laid in 1990s. In its most general sense, performance can be defined as assessing whether determined targets are achieved. This method is used in local governments with the purpose of ensuring sustainability, directing the distribution of resources needed for execution of programmes and services, and increasing satisfaction of those who benefit these services. Performance measurements generally refer to a multi-purpose decision-making and evaluation process and several techniques have been developed. In this paper, 39 district municipality of Istanbul province were examined with four basic models (financial model, development services model, water services model, garbage collection services model) for the year 2014 and their performances were analysed with Data Envelopment Analysis Method.
Keywords: Data Envelopment Analysis, DEA, Municipality, Performance

1. Introduction

Democratic institutions with public legal personality which perform the works necessary for meeting the basic needs of local people living on a certain geographic area are called local governments (Wikipedia). Municipalities are authorised in several areas such as urban transport, waste management, water procurement, control of air pollution etc. and are one of the most effective local governments in the life of the society. In municipalities where no competitive environment exists, the extent to which tasks are performed, and citizens are satisfied with offered services, can only be displayed by performance measurement.

One of the most important responsibilities of local governments is that public resources have to be used in an effective and efficient manner. In recent years, as a result the changes in public administration philosophy, accountability and transparency have become basic principles of public agencies. Efforts have been started to make accounting, budget and internal control systems of public sector compatible with accountability, responsibility and transparency. Efforts have also been initiated in public sector to raise service standards, take opinions of taxpayers and service users, create service areas in line with citizen expectations, and perform benchmarking and performance measurement. One of the most basic functions of performance measurement is being a tool for external accountability obligation against legislative body and even the public opinion

2. Performance Measurement in Local Government

Performance measurement does not have a universally accepted definition. Performance measurement can be defined by a generally accepted definition such as being a systematic initiative taken with the purpose of the extent to which services offered by government meet public needs; in short, it is a tool used for determining whether public sector performs production with an acceptable cost and quality (Epstein 1998). Another basic function of performance measurement is being a tool of external accountability obligation to the legislative body and even the public opinion. Performance measurement consists of such elements as definition of performance targets and indicators, creation of quantitative targets parallel to resources, and collection, monitoring and evaluation of data during the year. Performance measurement is an analytical process which aims at evaluating the products, services and/or results which emerge according to the previously-determined purposes and targets of an institution. In a more technical sense, it is a process through which an institution systematically and regularly collects, analyses and reports the data so as to monitor the resources it uses, goods and services it produces, and results it obtains (Court of Accounts 2002).

The purpose of performance measurement and evaluation is creation of target and result indicators, estimation of the resource needs of the institution, redistribution of resources, determination of institutional development strategies and increasing motivation so as to improve performance of employees (Holzer & Kaifeng 2004).

In the literature there are several studies on performance measurement for public sector and municipalities. According to an IISD (International Institute for Sustainable Development) report, indicators which will be used by local governments in performance measurement and evaluation has to have some characteristics, which can be listed as simplicity, validity, sensitivity, reliability, time-bound data, and compatibility of obtainable data (Ertekin & Erkut 2003).

3. Literature Review

One of the most fundamental economic struggle headings for several countries have been decreasing public spending without reducing the standard of public services and ensuring effective usage of public resources. The fact that world population is concentrated in cities means that control of the works of local governments which produce these services is essential. Such micro-level studies become directly effective on the economic performance of countries at macro level (Michailov *et al.* 2002).

The idea of performance measurement has its roots in the past especially parallel to the development of multi-variance data. Data enveloping method is frequently used in measurement of effectiveness of local governments or their services.

Kasarda and Janowitz (1974) concluded in their study on the relation between living area and satisfaction that residing in the same district for a long time increased satisfaction. Galster and Hesser concluded that high level of income, old age and long-residence past in the same district increased satisfaction. Kelly and Swindell (2002) related performance measurements and service assessments of municipalities with customer satisfaction. Mani et.al (2003), on the other hand, developed a performance measurement approach to ensure organisational excellence in Portugal Municipality and allied this approach on political leaders, managers, workers and the public. They concluded that performance has to be measured by taking the opinion of all individuals. Yuval and Vigoda (2003) examined the relation between managerial principle, administrative performance and the public trust to the government in public administration systems and compared three structural equation models. As a result, they concluded that the preliminary condition of trust was performance. Folz, (2004) measured performance of local governments by correlating with citizen satisfaction the findings obtained by dealing with the quality and efficiency of service. When studies performed on Turkey are examined; Ministry of the Interior of Republic of Turkey launched Performance Measurement in Municipalities Project (BEPER) in 2002. The purpose of this project was to determine performance indicators for goods and services offered by municipalities and develop a model which will allow for making comparison between municipalities. For this reason, seven pilot municipalities and 129 municipalities with a population of more than 100,000 were covered. Performance indicators determined within the project are aimed at monitoring and assessing the quantity and quality of goods and services provided by municipalities (Kaygısız & Girginer 2011). Gümüşoğlu et. al (2003), measured the perceived service quality expected from the municipality in Muğla province with servqual model. They found out differences in expectations of municipal managers and certain service dimensions n Muğla municipality. The study conducted by Bozlağan (2004) to measure satisfaction from urban public services in Istinye evaluated the findings on trust, representation and satisfaction, which are factors that directly affect satisfaction from some services provided by central government, municipalities and neighbourhood units, both in itself and in comparison to a study conducted by TESEV (Turkish Foundation of Economic and Social Surveys) in 1999 which reached similar conclusions. Examining forty five municipalities in Capadocia region, Doğan and Ilkay (2009) tried to determine with DEA the extent to which they effectively performed the services and works (output) that they had to perform, their resources (inputs) and how well they used these resources. Aiming at determining the factors that affect performance in small and medium size municipalities, Hazman (2009), determined that such factors as the scale of the municipality, technological infrastructure, effort and decisiveness to ensure performance and belief of local managers in performance measurement were effective. Gürcü and Kara (2010) aimed at comparing expectations and satisfaction of people using services of Yozgat municipality and concluded that in general either services were not sufficient or citizens were not informed on the services provided. Koyuncu (2011) examined the examples in Turkey and England for performance in local governments and, based on Portsmouth example, criticized Turkey for being a country where performance measurement has not taken hold yet and listed his suggestions.

De Borger and Kerstens (1996) used 5 different methods, including DEA, in order to determine cost-effectiveness in municipalities in Belgium. Cost-effectiveness measures were calculated using various parametric and non-parametric methods with the purpose of evaluating sensitiveness of limitations of municipalities in terms of reference technology and every effectiveness score calculated later was explained in terms of social, economic and political characteristics of municipalities. Prieto and Zofio (2001) evaluated the effectiveness of Spanish municipalities in four service areas, namely water, sewage system and waste water cleanliness, road and illumination and sportive and cultural facilities. Effectiveness scores obtained with DEA method were presented as a set of suggestions as regards resources that the central government will spare for municipalities. Tuer and Resende (2004) tried to measure relative effectiveness of government agencies providing water and sewage system services in Brazil as of 1996-2000 period. Labour expenses, operation expenses and other operation expenses were included in the analysis as input, and produced waste water, refined waste water, the population obtaining water services and population obtaining sewage services are evaluated as outputs. Effectiveness scores were calculated with DEA method and it was seen that service given in some units was lower than optimal. Woodbury and Dollery (2004) used six different DEA model in analysing the allocation and technical effectiveness of municipal water services in the states and cities in New South Wales region of Australia and obtained effectiveness scores. In addition, municipalities displaying best performance were determined and the reasons behind their effectiveness

in water services were examined. Sampaio de Sousa et al. (2005) measured the technical effectiveness of 4796 municipalities in Brazil with DEA. In the study effort was paid to decrease potential mistakes through contrasting values in the data set; calculations using different types of DEA models were made so that municipalities which showed high tendency/deviation could be identified and eliminated. Analysis are made based on four inputs and nine outputs and effectiveness results for Brazilian municipalities showed the clear correlation between the size of municipality and its effectiveness score. Accordingly, municipalities of smaller cities are less effective than the ones of big cities, and as the size of municipality grew, the quality of adjustment made at effective limit increased. In addition to the foregoing, it was stated that the reason for ineffectiveness of some municipalities could be uncontrollable external factors such as political problems, demographic and socio-economic characteristics. Balaguer-Coll et al. (2007) examined the effectiveness of municipalities in Comunitat Valenciana region of Spain. They first measured effectiveness with DEA and Free Disposal Hull (FHD) methods; in the second stage, they performed an analysis through which critical determinants of effectiveness were identified by focusing on political and financial variables. Such variables as wage and salary, spending on goods and services, current transfers, capital transfers, and changes in capital expenditures were taken as input, whereas population, number of illumination points, collected garbage (tons), street infrastructure surface area, registered surface area of public parks, and quality were taken as output. Results of the analysis showed that there was a direct proportion between the size of municipality and closeness to effective limit, and it was seen that small municipalities were far from their effective limits whereas large municipalities were close to theirs. In their paper Afonso and Fernandes (2008) evaluated by means of DEA and parametric analysis methods the relative effectiveness of public expenditures of municipalities and tried to determine the scope of improvements which can be made in 278 analysed municipalities depending on the limit where best practice existed. In the study, it was concluded that most of the municipalities had facilities for improving their performance without suffering significant increase in their expenditures.

4. Method and Data Set

Classical methods would prove insufficient for evaluating the non-profit municipal services as the proportioning of financial indicators in classical methods will not have much meaning in local governments when they are considered as service industry. When studies conducted in this area in the literature are examined, it can be seen that a model which will be valid for all organizations has not been developed. Choosing a model suitable for the organisation to measure looks rational. For example, Data Envelopment Analysis is effective in measuring the performance of an agency in service industry, whereas AHP method is more effective when performance benchmarking is to be made. Multi-variant methods such as VIKOR, COPRAS, and TOPSIS usually define a ranking but they cannot display with clarity such benchmarks as comparing decision-making units or determining non-effective decision-making units. In this study, a non-parametric optimization method, Data Envelopment Method, will be employed.

5. Data Envelopment Analysis

Data Envelopment Analysis (DEA) is a linear programming-based analysis which aims at measuring the relative performance of decision units in situations which make difficult comparing inputs and outputs with multiple and various measurement units (Kocak & Cilingirturk 2011).

There are several DEA models which assume that every system is able to choose the weight of its output and inputs in a manner that will optimize its degree of effectiveness. The model to be used is generally determined by the data to be used in the research. That decision units have constant or variable returns according to scale determined whether CCR (Charnes-Cooper-Rhodes) or BCC (Banker-Charnes-Cooper) model is going to be used. There are input-oriented or output—oriented models depending on the control of decision makers on inputs or outputs. This study will use CCR model which aims at constant-return output maximisation depending on the scale.

a. CCR (Charnes, Cooper, Rhodes) Model

CCR model is the first and basic DEA model which was developed by Charnes, Cooper and Rhodes (1978) based on the idea of effectiveness. CCR gathers the technical effectiveness and scale effectiveness of the unit in a single value and calculates total effectiveness. In other words, it measures effectiveness as total effectiveness under the assumption of constant return depending on scale. Although several models were developed later, CCR model is still the most widely used and recognized model. CCR model which aims at output maximization is presented below (Kocak, 2011)

Objective function

$$Mak\ h_k = \sum_{r=1}^{s} u_{rk} Y_{rk}$$

Limits

$$\sum_{r=1}^{s} u_{rk} Y_{rj} - \sum_{i=1}^{m} v_{ik} X_{ij} \leq 0 \qquad j = 1,2, \dots N$$

$$\sum_{i=1}^{m} v_{ik}X_{ik} = 1 \qquad (1)$$
$$u_{rk}, v_{ik} \geq \varepsilon \qquad r = 1,2,\dots s\,,\ i = 1,2,\dots,m$$

In the model given above;
h_k: effectiveness of k decision unit
u_{rk}: weight ok k decision unit for r outputs
v_{ik}: weight of k decision unit for i outputs
Y_{rk}: r. output value of k decision unit
X_{ik}: i. input value of k decision unit
Y_{rj}: r. output value of j decision unit
X_{ij}: i. input value of j decision unit
Ɛ: a small number very close to zero

It is decided that output-focused CCR model should be used in analysis so as to determine the amount of resources to be used for obtaining the output. Effectiveness scores of municipalities are calculated using CCR model which takes into consideration the constant return depending on scale. Effectiveness scores obtained from this model give a value smaller than 1 for non-effective decision units. However, effective municipalities can also be ranked among themselves. For this effect, super-effectiveness models are used.

b. BCC (Banker, Charnes, Cooper) Model

In *cases* when effectiveness is affected by the size of the scale, BBC models are used instead of CCR model which are developed under the assumption of variable transformation scale. The only difference of BCC models from CCR models is that they operate under the assumption of variable transformation scale instead of constant scale. They are obtained by adding to CCR models a convexity limitation (Kocak & Cilingirturk, 2011).

This model, which was first proposed in 1984 by R.D. Banker, A. Charnes, and W.W. Cooper, is named after the initials of their names (BCC). Output-oriented BCC model is formulized as follows (Cooper et. al. 1999):
Objective function

$$Mak\ h_k = \sum_{r=1}^{s} u_{rk}Y_{rk} - u_0$$

Limits

$$\sum_{r=1}^{s} u_{rk}Y_{rj} - u_0 - \sum_{i=1}^{m} v_{ik}X_{ij} \leq 0 \qquad j = 1,2,\dots N$$

$$\sum_{i=1}^{m} v_{ik}X_{ik} = 1 \qquad (2)$$
$$u_{rk}, v_{ik} \geq \varepsilon \qquad r = 1,2,\dots s\,,\ i = 1,2,\dots,m$$

Like CCR models, BCC models are also classified as input-oriented and output-oriented; they are also categorized ratio-weighted model and envelopment model. BCC models are interpreted in a way similar to CCR models.

c. Super-effectiveness Model

In DEA methods, CCR and BBC effectiveness studies give 1 effectiveness score to effective units whereas in non-effectiveness units, smaller than 1 is given as effectiveness score in input-oriented models and larger than 1 effectiveness score is given to output-oriented models. These methods can only determine effective models but does not allow for a ranking of effective units, namely, finding of effectiveness degrees. Several methods have been developed for this purpose.

Andersen and Petersen stated that effective decision-making units could be ranked among themselves. This approach is known as super-effectiveness model in DEA literature, and it is also named as AP model, after the capital letters of its founders. The basic idea in this method is to compare the examined decision units with linear combinations of all other decision making units. The decision units examined for this purpose are excluded from the reference set. The DEA effectiveness score obtained in this manner will protect the effectiveness of effective decision units while giving the highest increase score that can be seen in inputs. Those decision units with the highest super effectiveness score obtained here will be ranked first. Other decision units will be ranked according to their super effectiveness score. The effectiveness limit developed by effective decision units will not be affected by the changes in effective decision limits; therefore, the score here is equal to the DEA effectiveness score. Super effectiveness model is as follows (Charnes et al. 1981).
Objective Function

$$a_p^* = Min\ a_p$$

Limits

$$\sum_{j=1} \lambda_j X_j \leq a_p X_p$$

$$\sum_{j=1} \lambda_j Y_j \leq Y_p \qquad (3)$$
$$\lambda_j \geq 0 \qquad j = 1,2,\dots N$$

In the above a_p model X_j, shows the m sized input vector, Y_j, shows the s sized output vector, λ_j shows weights of decision units, p shows the examined decision unit, and a_p^* shows optimal value of objective function for p. decision unit. a_p model is similar to CCR and BCC models in structure. The only difference of this model from CCR and BCC models is that the unit below evaluation is not included in the reference set.

As for output-oriented CCR model, in order to exclude the examined decision units from reference set, values higher than 1 will be assigned to the units so that the effectiveness of decision units will be protected and the highest and lowest effectiveness values will be identified.

6. Dataset

In terms of scope, 39 districts in total within Istanbul province were included in the analysis. As all data for 2015 could not be obtained for districts, the year 2014 was preferred. The fact that local government units are political units is an essential factor. The study does not aim at promoting any specific municipality; thus, especially names of municipalities were defined as decision-making units. Within the study, the input and output variables used in measuring effectiveness of municipalities were interpreted by establishing models in light of obtainable data. The examined model and input and output variables used in this model are given in Table 1. Among the variables listed in Table 1, population of the service area of the municipality and the area within municipal borders are taken as uncontrollable variables. In other words, population and area of the municipality are variables which cannot be increased or decreased. Although the 39 district municipalities within the boundaries of Istanbul were taken as basis, not every model could be evaluated for all 39 municipalities as the data of some variables in the model could not be obtained.

Analysis in the study was made by creating 4 different models, namely:

M1: Financial Model

M2: Development Services Model

M3: Water Services Model

M4: Garbage Services Model. In Table 1 data to be used belonging to each model and input/output status of data are shown (Model and variables are arranged based on Ilkay and Doğan's study (2009)).

Table 1: Variables and models used in the study

Variables	Explanation	M1	M2	M3	M4
Population	Population of the district according to 2015 census	G			G
Area within municipal borders (km^2)		G	G		Ç
Tax revenues (TL.)		G			
Non-tax revenues (TL.)		G			
Current expenditures (TL.)		Ç			
Investment expenditures (TL.)		Ç			
Development personnel number	Number of personnel working at development works		G		
Improved land (m^2)			Ç		
Total number of construction licenses	Number of new and renewal construction licenses for the year 2014		Ç		
Amount of water given to the network (m^3/year)				G	
Total length of potable water network (km)				G	
Number of potable water personnel				G	
Total water consumption amount (m^3/year)				Ç	
Total number of subscribers				Ç	
Garbage personnel	Number of employees working at garbage collection service				G
Number of garbage vehicles	Sweeping and collecting vehicles				G
Amount of collected garbage (ton/year)					Ç

7. Result and Evaluation

Several package programs have been developed for DEA. The most frequent used ones are DEAP, DEA-Solver Pro, EMS, Frontier, IDEAS, On Front, and Warwick. The models subject to the alication were resolved with DEA-Solver Pro V5.

The study was conducted on 39 district municipalities belonging to 2014 using four CCR models. Table 2 and its derivatives show CCR effectiveness scores and rankings belonging to each model. Later, it was subjected to super effectiveness test including the internal limitations of effective decision units found for each model and thus ranking of effective units was obtained but the results were used in evaluation. Reference column shows the refer ability of each decision unit or which decision unit it refers to. Reference belonging to an effective decision unit shows how many times that unit is referred to. If it belongs to an ineffective decision unit, it shows which effective units and at which ratio it will refer to.

Table 2. Effectiveness scores according to the Model (M1) developed depending on financial data

CCR				CCR			
Decision units	**Effectiveness score**	**Status**	**Reference**	**Decision units**	**Effectiveness score**	**Status**	**Reference**
B1	0,65	Ineffective	**23(0,25) 4(0,60) 32(0,15)**	**B21**	0,88	Ineffective	**4(0,25) 32(0,77)**
B2	0,87	Ineffective	**23(0,35) 32(0,85)**	**B22**	0,75	Ineffective	**10(0,45) 33(0,48) 25(0,15)**
B4	1	Effective	**4**	**B24**	0,75	Ineffective	**11(0,45) 7(0,30)**
B5	0,99	Ineffective	**33(0,65) 32(0,80) 27(0,05)**	**B25**	1	Effective	**7**
B6	0,85	Ineffective	**10(0,45) 19(0,35) 37(0,15)**	**B26**	0,65	Ineffective	**33(0,55) 19(0,68)**
B7	1	Effective	**6**	**B27**	1	Effective	**2**
B8	0,75	Ineffective	**37(0,70) 14(0,38)**	**B30**	0,95	Ineffective	**14(0,80) 37(0,85)**
B10	1	Effective	**3**	**B31**	0,8	Ineffective	**11(0,65) 10(0,80)**
B13	0,91	Ineffective	**19(0,80) 25(0,23)**	**B33**	1	Effective	3
B14	1	Effective	**4**	**B34**	0,87	Ineffective	**33(0,45) 14(0,28) 25(0,15)**
B15	0,60	Ineffective	**25(0,15)**	**B36**	0,88	Ineffective	**7(0,90)**
B16	0,50	Ineffective	**7(0,45) 19(0,80) 25(0,15)**	**B37**	1	Effective	6
B17	0,88	Ineffective	**10(0,05) 19(0,72)**	**B38**	0,85	Ineffective	**11(0,25) 32(0,25) 33(0,45)**
B18	0,93	Ineffective	**11(0,45) 19(0,80) 25(0,15)**	**B39**	0,92	Ineffective	**11(0,45) 19(0,80) 25(0,15)**
B19	1	Effective	**6**				
B20	1	Effective	**3**				

Taking into consideration financial data, it can be seen that among 30 municipalities, only 10 are effective in total according to CCR, meaning output-maximization model. These municipalities obtained the highest output with minimum input. However, 7 municipalities were at 90%, meaning that they were very close to effectiveness limit. They can reach the level of reference municipalities with less inputs. When super effectiveness ranking is made, it was seen that the first 4 municipalities were B37, B19, B25 and B14 and their super effectiveness values were 179%, 133%, 120% and 107%, respectively. Taking financial data into consideration, B16, B15, B1 and B26 ranked last with 50%, 60%, 65% and 65% effectiveness scores, respectively. Municipality coded B25 was shown

in the reference set for 7 times according to CCR model.

Table 2.1 Evaluation of results obtained with M1 as regards financial services

	CCR-O
Effective municipality	10
Ineffective municipality	20
Median	0,874333333
Standard error	0,025205743
Standard deviation	0,138057543
Example variance	0,019059885
Smallest value	0,5
Largest value	1

Taking into consideration development services data, it can be seen that among 30 municipalities, 16 are effective in total according to CCR, meaning output-maximization model. These municipalities obtained the highest output with minimum input. However, 8 municipalities were at 90%, meaning that they were very close to effectiveness limit. They can reach the level of reference municipalities with less inputs. When super effectiveness ranking is made, it was seen that the first 4 municipalities were B20, B17, B32 and B3 and their super effectiveness values were 193%, 167%, 141% and 120%, respectively. Taking financial data into consideration, B21, B19, B21 and B29 ranked last with 65%, 69%, 75% and 75% effectiveness scores, respectively. Municipality coded B20 was shown in the reference set for 7 times according to CCR model.

Table 3. Effectiveness scores according to the Model (M1) developed depending on development services

CCR				**CCR**			
Decision units	**Effectiveness score**	**Status**	**Reference**	**Decision units**	**Effectiveness score**	**Status**	**Reference**
B1	0,88	Ineffective	**33(0,15) 27(0,63)**	**B21**	0,65	Ineffective	**20 (0,80) 32(0,22)**
B2	0,75	Ineffective	**10(0,45) 20(0,05) 33(0,45)**	**B22**	1	Effective	**3**
B3	1	Effective	**4**	**B23**	1	Effective	**4**
B4	1	Effective	**3**	**B24**	0,85	Ineffective	**14(0,80) 25(0,21)**
B7	1	Effective	**2**	**B25**	1	Effective	**5**
B8	0,85	Ineffective	**12(0,45) 3(0,35) 4(0,15)**	**B26**	0,8	Ineffective	**3(0,62) 19(0,03) 37(0,15)**
B9	0,69	Ineffective	**10(0,13) 28(0,80) 14(0,21)**	**B27**	1	Effective	**3**
B10	0,99	Ineffective	**4(0,75) 19(0,35) 37(0,15)**	**B28**	1	Ineffective	**2**
B11	0,8	Ineffective	**22(0,80) 28(0,35)**	**B29**	0,75	Ineffective	**7(0,45) 12(0,35) 22(0,15)**
B12	1	Effective	**2**	**B30**	0,95	Ineffective	**14(0,25) 28(0,60) 5(0,40)**
B14	1	Effective	**3**	**B32**	1	Effective	**6**
B15	0,79	Ineffective	**17(0,25) 32(0,25) 33(0,30)**	**B33**	1	Effective	**3**
B16	0,88	Ineffective	**12(0,45) 3(0,35) 4(0,15)**	**B34**	0,8	Ineffective	**19(0,80) 25(0,23)**
B17	1	Effective	**3**	**B35**	0,95	Ineffective	**14(0,25) 3(0,30) 5(0,70)**
B18	0,85	Ineffective	**23(0,55) 19(0,56) 28(0,48)**	**B37**	1	Effective	**4**
B19	1	Effective	**6**	**B38**	0,85	Ineffective	**3(0,70) 19(0,56) 22(0,28)**
B20	1	Effective	**7**	**B39**	0,92	Ineffective	**7(0,65) 33(0,52) 32(0,75)**

Table 3.1 Evaluation of results obtained with M2 as regards development services

	CCR-O
Effective municipality	16
Ineffective municipality	18
Median	0,911765
Standard error	0,01824
Standard deviation	0,106358
Example variance	0,011312
Smallest value	0,65
Largest value	1

Taking into consideration water services data, it can be seen that among 29 municipalities, 10 are effective in total according to CCR, meaning output-maximization model. These municipalities obtained the highest output with minimum input. However, 7 municipalities were at 90%, meaning that they were very close to effectiveness limit. They can reach the level of reference municipalities with less inputs. When super effectiveness ranking is made, it was seen that the first 4 municipalities were B7, B22, B12 and B39 and their super effectiveness values were 210%, 165%, 145% and 115%, respectively. Taking financial data into consideration, B16, B35, B24 and B27 ranked last with 50%, 65%, 69% and 69% effectiveness scores, respectively. Municipalities coded B22 and B7 were shown in the reference set for 6 times according to CCR model.

Table 4. Effectiveness scores according to the Model (M3) developed depending on water services

CCR				**CCR**			
Decision units	**Effectiveness score**	**Status**	**Reference**	**Decision units**	**Effectiveness score**	**Status**	**Reference**
B1	0,9	Ineffective	**2(0,17) 7(0,45)**	**B19**	1	Effective	**2**
B2	1	Effective	**5**	**B21**	0,7	Ineffective	**22(0,37) 7(0,29)**
B4	0,88	Ineffective	**8(0,23) 15(0,61)**	**B22**	1	Effective	**6**
B6	0,8	Ineffective	**22(0,41) 36(0,07) 8(0,13)**	**B23**	0,85	Ineffective	**36(0,25) 22(0,22)**
B7	1	Effective	**6**	**B24**	0,69	Ineffective	**2(0,45) 22(0,05)**
B8	1	Effective	**3**	**B26**	0,85	Ineffective	**11(0,45) 15(0,35)**
B9	0,75	Ineffective	**7(0,25) 15(0,27)**	**B27**	0,69	Ineffective	**7(0,05) 22(0,45)**
B10	0,93	Ineffective	**22(0,47)36(0,05) 39(0,50)**	**B30**	0,79	Ineffective	**15(0,35) 36(0,53)**
B11	1	Effective	**5**	**B31**	0,8	Ineffective	**36(0,45) 8(0,45)**
B12	1	Effective	**4**	**B32**	0,88	Ineffective	**19(0,55) 7(0,25)**
B13	0,83	Ineffective	**12(0,19) 6(0,61)**	**B35**	0,65	Ineffective	**11(0,07) 22(0,58)**
B15	1	Effective	**4**	**B36**	1	Effective	1
B16	0,5	Ineffective	**15(0,13) 2(0,48)**	**B38**	0,93	Ineffective	**39(0,25) 12(0,45)**
B17	0,88	Ineffective	**39(0,18) 5(0,57)**	**B39**	1	Effective	**3**
B18	0,93	Ineffective	**36(0,25) 8(0,36)**				

Table 4.1 Evaluation of results obtained with M3 as regards water services

	CCR-O
Effective municipality	10
Ineffective municipality	19
Median	0,87
Standard error	0,02464
Standard deviation	0,132692
Example variance	0,017607
Smallest value	0,5
Largest value	1

Taking into consideration garbage services data, it can be seen that among 36 municipalities, 15 are

effective in total according to CCR, meaning output-maximization model. These municipalities obtained the highest output with minimum input. However, 13 municipalities were at 90%, meaning that they were very close to effectiveness limit. They can reach the level of reference municipalities with less inputs. When super effectiveness ranking is made, it was seen that the first 4 municipalities were B15, B34, B6 and B24 and their super effectiveness values were 177%, 156%, 145% and 105%, respectively. Taking financial data into consideration, B1, B16, B4 and B32 ranked last with 50%, 50%, 69% and 75% effectiveness scores, respectively. Municipality coded B6 was shown in the reference set for 6 times according to CCR model.

Table 5. Effectiveness scores (references) according to the model developed based on garbage services (M3)

CCR				CCR			
Decision units	**Effectiveness score**	**Status**	**Reference**	**Decision units**	**Effectiveness score**	**Status**	**Reference**
B1	0,5	Ineffective	**23(0,33) 0(0,37)**	**B21**	0,88	Ineffective	**39(0,23)20(0,48)**
B2	0,88	Ineffective	**35(0,24) 9(0,29)**	**B22**	0,93	Ineffective	**31(0,75) 27(0,05)**
B3	0,93	Ineffective	**12(0,37) 7(0,61)**	**B23**	1	Effective	**3**
B4	0,69	Ineffective	**15(0,05) 8(0,72)**	**B24**	1	Effective	**3**
B5	0,88	Ineffective	**23(0,48) 5(0,51)**	**B25**	0,88	Ineffective	**24(0,34) 25(0,19)**
B6	1	Effective	**6**	**B26**	0,75	Ineffective	**31(0,29) 27(0,38)**
B7	0,85	Ineffective	**34(0,01) 7(0,29)**	**B27**	1	Effective	**5**
B8	1	Effective	**3**	**B28**	1	Effective	5
B11	1	Effective	**5**	**B29**	0,99	Ineffective	**15(0,22) 6(0,63)**
B12	1	Effective	**4**	**B31**	1	Effective	4
B13	0,83	Ineffective	**31(0,18) 9(0,16)**	**B32**	0,75	Ineffective	**24(0,01) 23(0,65)**
B14	0,91	Ineffective	**6(0,35) 11(0,48)**	**B33**	0,93	Ineffective	**20(0,18) 28(0,65)**
B15	1	Effective	**4**	**B34**	1	Effective	4
B16	0,5	Ineffective	**11(0,19) 2(0,21)**	**B35**	1	Effective	3
B17	0,88	Ineffective	**15(0,15) 8(0,65)**	**B36**	0,83	Ineffective	**8(0,52) 28(0,27)**
B18	0,93	Ineffective	**34(0,57) 28(0,41)**	**B37**	0,91	Ineffective	**31(0,22) 19(0,18)**
B19	1	Effective	**2**	**B38**	0,93	Ineffective	**11(0,22) 19(0,37)**
B20	1	Effective	**4**	**B39**	1	Effective	**3**

Table 5.1 Evaluation of results obtained with M4 as regards garbage services

	CCR-O
Effective municipality	15
Ineffective municipality	21
Median	0,904444
Standard error	0,021556
Standard deviation	0,129338
Example variance	0,016728
Smallest value	0,5
Largest value	1

When the analysis results of the developed models are evaluated collectively; it is observed that the number of effective municipalities are 10, 16, 10 and 15 respectively according to financial model, development services model, water services model and garbage services model. Especially in development and garbage services model it can be seen that almost half of the municipalities are effective. Development scores showed considerable increase especially after 2010, which became almost the locomotive sector of economy. Acceleration of urban

transformation works within municipal borders also required many municipalities to take active role in these activities. However, when all of the general models are taken; it can be seen that only two municipalities, B19 and B20, were effective in all models. 6 municipalities (B7, B11, B12, B23, B27 and B31) were observed o be effective in 3 models. Table 6 shows which municipalities are effective according to each model.

Table 6 Effective Municipalities in All Models

Financial model	**Development services model**	**Water services model**	**Garbage services model**
B4	B3	B2	B6
B7	B4	B7	B8
B10	B7	B8	B11
B14	B12	B11	B12
B19	B14	B12	B15
B20	B17	B15	B19
B25	B19	B19	B20
B27	B20	B22	B23
B33	B22	B36	B24
B37	B23	B39	B27
	B25		B28
	B27		B31
	B28		B34
	B32		B35
	B33		B39
	B37		

8. Conclusion

Municipalities which come to power after a political process have to take into consideration not only their supporters but all citizens living in the city. Performance measurement is based on determining the extent to which the provided services satisfy citizens. Based on all these premises, it might be thought that performance measurement also has contribution to democracy. Studies on public satisfaction are made frequently. However, considering that political preferences of people paly a very effective role in this process, models are needed for objective evaluation.

Measures used in allocation do not include opinions of citizens. However, evaluating performance with only input/output, production etc. measures is not true. If indicators showing the satisfaction of citizens from services and their trust in the municipal government re used, the model can yield healthier results.

Problems faced in performance measurement process can be summarised as the inability to obtain desired data, failure to renew indicators despite development of new services, lack of sensitiveness in measurement process in the part of inspected people due to their lack of belief in the system, and persons or agencies that do not want to be held accountable avoiding to give accurate information. Institutionalisation of the system and, when necessary, legislative steps as regards the topic, will make sure that healthier measurements are made. In addition, another must is the decisiveness of top management during all these efforts.

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