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İŞLETMELERİN GÖRECELİ ETKİNLİKLERİNİN VERİ ZARFLAMA ANALİZİ İLE ÖLÇÜLMESİ: İMALAT SANAYİNDE BİR UYGULAMA*

EVALUATION OF RELATIVE EFFICIENCY OF BUSINESSES BY USING DATA ENVELOPMENT ANALYSIS: AN APPLICATION TO MANUFACTURING INDUSTRY

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Abstract

In study, quarterly data of year 2012 gathered from financial reports of 26 businesses –of which stocks being traded in Borsa İstanbul- operating through a sub-sector of manufacturing industry, namely "Stone and Earth Industry" was evaluated. Performance analysis of business is very vital on one hand for business owners or employers, managers, competitors and creditors and current and potential investors on the other. The aim of study is to evaluate performance of aforementioned businesses and make a comparison between their performance rates. In this context, Data Envelopment Analysis (DEA) is used to evaluate business efficiency, relative efficiency of input-output and determination of decision-making units.

*Bu makale Crosscheck sistemi tarafından taranmış ve bu sistem sonuçlarına göre orijinal bir makale olduğu tespit edilmiştir.

As Data Envelopment Analysis is relevant to input and output, input and output data included in study was collected in accordance with literature. Ratios such as current ratio, acid-test ratio, receivable turnover ratio, stock turnover ratio and total debt to total asset ratio were used as input data while ratios like net profit to total asset ratio, net profit to equity ratio and net profit to net sales ratio were used as output data. After analysis, full efficient firms were determined and necessary increase or decrease rates for input and output data were established in order to transform inefficient firms into efficient ones. In addition, it was shown that some firms were efficient during all periods while some others had varying levels of efficiency periodically.

Key Words: Efficiency and Productivity, Performance Comparison, Data Envelopment Analysis

Öz

Çalışmada, Borsa İstanbul'da işlem gören ve imalat sanayinin alt dallarından olan; "Taş ve Toprağa Dayalı Sektör'e ait 26 işletmenin 2012 yılına ait mali tablolarından veriler üçer aylık dönemler halinde incelenmiştir. İşletmelerin performansların analiz edilmesi, işletmenin sahipleri, yöneticileri, rakipleri ve kreditörleri açısından oldukça önemli olmasının yanı sıra mevcut ve potansiyel yatırımcılar için de önem arz etmektedir. Çalışmada söz konusu işletmelerin performanslarının ölçülmesi ve elde edilen performansların karşılaştırılması amaçlanmıştır. Bu amaçla işletmelerin etkinlikler, karar birimlerinin belirlenmesi ile girdi ve çıktıya yönelik göreceli etkinliklerinin ölçülmesine olanak tanıyan olanak tanıyan "Veri Zarflama Analizi" (VZA) yöntemi kullanılarak analiz edilmiştir.

Veri Zarflama Analizi girdi ve çıktıya yönelik olduğu için araştırmada kullanılacak girdiler ve çıktılar literatürle uyumlu olarak belirlenmiştir. Cari oran, asit-test oranı, alacak devir hızı, stok devir hızı ve toplam borçlar / toplam aktifler oranı girdi olarak kullanılırken net kar/ toplam aktif oranı, net kar/ öz sermaye oranı ve net kar/ net satışlar oranı ise çıktı olarak kullanılmıştır. Analiz sonucunda tam etkin çalışan firmalar tespit edilmiş olup, etkin olmayan firmaları etkin hale dönüştürmek için referans alınan firmalar ile girdi ve çıktılarda yapılması gereken artırma veya azaltma oranları saptanmıştır. Ayrıca çalışma sonucunda, bazı firmaların incelenen tüm dönemlerde etkin olduğu, bazı firmaların ise etkinliğinin dönemsel olarak değiştiği tespit edilmiştir.

Anahtar Kelimeler: Etkinlik ve Verimlilik, Performans Karşılaştırması, Veri Zarflama Analizi

1. INTRODUCTION

As a result of globalization and rapid and continuous transformation process, businesses need to maintain their current competitive powers. To put it in a different way, they should have sustainable levels of competitive power. By meeting their

unlimited needs with limited resources and aiming to have sustainable levels competitive power, most businesses tend to focus on concepts like efficiency or to put it technically "productivity".

Today's competitive business environment forces firms to use their resources optimally or in the most efficient way. Firm managers periodically need evaluations and assessments in order to determine deviations from business plans and monitor both their own and competitors' market positions (Yalama and Sayım, 2008: 89). Such evaluations and assessments are very vital for businesses' stakeholders, potential investors, employees and credit agencies on one hand, and public and private researchers aiming to perform economic studies on the other.

Performance is a qualitative and quantitative statement about an individual's, group's or enterprise's achievement and succeeding of a goal aimed at a specific business task (Kasnaklı, 2002: 131). A fundamental measure of performance, namely productivity (Dwyer and others, 2010: 275) is generally defined as the relation between an output created by a production or service system and input used in creation of that output (Prokopenko, 1987: 3). One may define productivity in a number of ways but most commonly and simply it can be defined as input / output ratio (McConnell, 1993: 93). Efficiency refers to the level of achieving a goal and the relation between intended and actual effect. While focusing on efficiency-related topics it is very important to make a sharp distinction between outputs and results. It is harder to evaluate and assess results than to evaluate and assess inputs and outputs (Gülcü and others, 2004: 91). Farrell (1957) groups a firm's efficiency into two: a- technical efficiency and b-allocative efficiency (Farrell, 1957: 254-255). The former measures performance of a firm in producing maximum output by using given inputs and called as technical or production efficiency and the latter refers to the performance of a firm in choosing optimal inputs in terms of given input prices (Sengupta, 1999: 209). Allocative efficiency is selection of input components with minimum cost for producing desired output (Coelli and others, 2005: 5).

Allocative efficiency and technical efficiency determine a firm's level of cost efficiency as an indicator of its production capabilities with minimum costs (Aktaş, 2001: 164). Efficiency evaluation enables a firm to monitor its market position in a competitive environment and refers to firm's level of performance in producing outputs by using given inputs (Yolalan, 1993: 6). Though it is thought that efficiency and productivity concepts are synonymous words, they in fact have different meanings. Eliminating this ambiguity plays an important role on evaluation of business's performance.

Ratio analysis, one of the methods that are used for quantitative evaluation of business performance and analysis of its financial condition, measures financial power,

efficiency and productivity level of business (Siddiqui and Siddiqui, 2005: 623-625). In ratio analysis approach which is simply defined as ratio of one input to one output, each ratio evaluates only one of performance dimensions and thus this can be regarded as a weakness of ratio analysis. Another weakness of evaluations using ratios is that they need to be compared to different factors necessarily (Gülcü and others, 2004: 82).

To put differently, unidimensionality of ratio analysis and parametric methods requiring data about functional structure between inputs and outputs limits the use of ratio analysis with parametric methods. For this reason, non-parametrical methods are widely used in evaluation of efficiency and productivity (Özer and others, 2010: 234). In study, we also used Data Envelopment Analysis, one of the non-parametric methods used in efficiency and productivity analysis of businesses.

2. LITERATURE REVIEW

Soba and others (2012), by using financial ratios and applying Data Envelopment Analysis and TOPSIS method, evaluated efficiency and performance levels of 25 businesses from metal fabrication and machinery equipment sector and 26 businesses –of which stocks being traded in Borsa Istanbul- from stone and earth sector between 2008-2010. According to their results; they concluded that the number of efficient businesses in stone and earth sector was 14 in 2008, 8 in 2009 and finally 11 in 2010. The number of relatively efficient businesses in metal fabrication and macninery equipment sector in 2008 and 2009 was 9. In this sector, the number of efficient businesses was 11 in 2010. In their study, Soba et al. observed that data envelopment analysis was appropriate in measuring business efficiency while TOPSIS analysis could be used in evaluating firm performance.

Altın (2010), by using financial ratios, tested finacial efficiencies of 142 companies registered in İMKB Industry Index. Research period covers balance as at december 31, 2012. Data Envelopment Analysis is based on assumption of constant returns to scale. In this context, efficiency consists of two stages; a-fundamental efficiency and b- super efficiency. According to study results, 44 out of 142 registered companies were found to be efficient during balance period.

In their study, Kaya and others (2010), by using data collected from balance sheets and income statements of year 2008 (in the form of four quarters) of 25 companies operating through metal fabrication and machinery equipment sector, compared performance levels of these businesses by applying data envelopment analysis. According to their analysis results, they found that 5 businesses were efficient during all quarters of 2008. In their study, after determining efficient businesses through sector, they also offered some proposals for inefficient firms to improve themselves as they computed required recovery ratios.

In their study, Ata and Yakut (2009), by using data envelopment analysis, evaluated efficiencies of firms operating through Turkish manufacturing sector between 1996-2006. In addition, they also performed an efficiency analysis in terms of

pre-determined variables of input and output by using financial ratios. In their analysis, they computed an efficiency score for every sector and they also determined efficient and inefficient sectors. Finally, they made some proposals for inefficient firms to improve their efficiency capabilities.

Yıldız (2007), by using financial ratios, evaluated scale efficiencies of businesses from manufacturing industry –these businesses were registered to İMKB- and showed that in average these businesses had an efficiency level of nearly 70 %.

In his study, Bakırcı (2006) evaluated efficiencies of 13 automotive firms that were ranked in top 500 firms in Turkey in 1994 and 2004. Data regarding these firms was fully accessible. In study, Bakırcı, by applying a comparative approach and using data envelopment analysis, measured efficiency levels of these firms. He found that 6 out of these 13 firms were inefficient in terms of input while small sized firms were more efficient.

In their study, Yalçıner and others (2005), analysed stock yields of a number of companies by using semi-annual data (six sets of data in total) regarding period between December 2000 – June 2003. In study, they performed a data envelopment analysis and a total factor productivity index analysis in order to determine efficiency levels of companies and variations among them. After determining the efficient companies by using data envelopment analysis, they concluded that there was a positive correlation between efficiency of company and stock yields of concerned period.

Kayalıdere and Kargın (2004), by using data envelopment analysis, evaluated efficiency levels of a number of businesses –registered to İMKB- that operate through textile and cement sectors. By using data regarding 2002, they performed 4 different types of analysis including 15 businesses from cement sector and 27 from textile sector. According to their results, 3 businesses in 1st analysis, 4 in 2nd, 5 in 3rd and 5 in 4th were found to be efficient while remaining businesses were found to be inefficient in terms of input-output values.

3. METHOD AND APPLICATION

In this study, quarterly data of year 2012 gathered from financial reports of 26 businesses –of which stocks being traded in Borsa İstanbul- operating through a sub-sector of manufacturing industry, namely "Stone and Earth Industry" was used. By using Frontier analysis program, these data were evalauted seperately as input-oriented and output-oriented. In study, a common instrument used by researchers, namely Data Envelopment Analysis (DEA) is used to evaluate business efficiency, relative efficiency of input-output and determination of decision-making units. In study, Ratios such as current ratio, acid-test ratio, receivable turnover ratio, stock turnover ratio and total debt to total asset ratio were used as input data while ratios

like net profit to total asset ratio, net profit to equity ratio and net profit to net sales ratio were used as output data.

The aim of study is to evaluate relative efficiency levels of businesses operating through aforementioned sector and to determine efficient and inefficient businesses. In addition, we also aim to determine the required levels of input/output ratio for inefficient businesses in order to improve themselves in comparison with efficient ones in sector.

3.1. Data Envelopment Analysis

This analysis, known in literature as Data Envelopment Analysis (DEA), was first introduced by Farrell in 1957 in his study evaluating relative efficiency concept. Then in 1978, in their study, Charnes, Cooper and Rhodes applied this model (Charnes and others, 1978) for evaluating efficiency of decision-making units.

For Data Envelopment Analysis to be applied, it is first required to choose decision-making units that have similar organizations and implement same decisions. To evaluate efficiency levels of decision-making units, one should determine input and output variables of these units (Atan, 2002: 61). Because, DEA method is applied to input and output variables (Charnes and others, 1981: 669). Input-oriented approach focuses on minimum amount of input for producing a specific output (input minimization) while output-oriented approach focuses on maximum output amount that can be produced by using a specific input (output maximization) (Keskin Benli, 2012: 371).

Relative efficiency evaluation method of data envelopment analysis can be summarized as follows (Yolalan,1993: 27-28):

i) to determine "best" observations (or decision-making units forming efficiency limit) from any observation set that produce maximum output combination by using minimum input combination.

ii) to evaluate, by taking that limit as "reference", distance (or efficiency levels) of inefficient decision-making units to this limit "radially".

Below mathematical equation shows output/input ratio that can be maximized for n number of organizational decision-making units that have m number of input and s number of output (Ulucan 2002):

Productivity = Output /Input

$$\text{Max}h_k = \frac{\sum_{r=1}^{s} u_{rk} y_{rj}}{\sum_{r=1}^{s} v_{ik} x_{ij}}$$

in which $x_{ij}>0$ parameter denotes output amount i used by decision-making unit j and $y_{rj}>0$ parameter denotes output amount r used by decision-making unit j. Variables for this decision problem consist of weighted values of input and output determined by decision-making unit k. These variables are denoted as v_{ik} and u_{rk} in turn.

Below inequation shows the limitation that prevents time efficiencies of other decision-making units exceeding %100 when weighted values of decision-making unit k are used by other decision-making units.

$$\frac{\sum_{r=1}^{s} u_{rk} y_{rj}}{\sum_{r=1}^{s} v_{ik} x_{ij}} \leq 1;\ j = 1,\ldots\ldots\ldots n$$

Finally, below equation shows the limitation that prevents input and output weights having a negative value.

$u_{rk} \geq 0$; r =1,.....,s

$v_{ik} \geq 0$; i =1,.....,m

To transform these inequation sets into lineer programming form and solve them by using Simplex or similar algorithms, one should equalize denominator of objective function (in the form of maximization) to 1 and transform it into a limitation.

Objective function;

$$\text{Max}h_k = \sum_{r=1}^{s} u_{rk}\, y_{ri}$$

Limiting Conditions;

$$\sum_{i=1}^{m} v_{ik}\, x_{ik} = 1$$

$$\sum_{r=1}^{s} u_{rk}\, y_{ri} - \sum_{i=1}^{m} v_{ik}\, x_{ik} \leq 0$$

$u_{rk}, v_{ik} \geq 0$

h_k= efficiency coefficient, h_k is always smaller than 1 or equal to it. If $h_k < 1$, then decision-making unit is not relatively efficient. If $h_k = 1$, then decision-making unit is relatively efficient. Aim of output-oriented CCR model ise to determine input and output weights that minimize actual input/actual output ratio in terms of target decision-making unit. These limitations lead to actual input/actual output ratio having a minimum value of 1 and all input and output weights taking positive values (Özer vd., 2010: 239).

One of output factors, net profit for period, may sometimes have negative values for some businesses. Therfore, this condition violates positivity of variables assumption of DEA method, these values are transformed into positive ones by using normalization equation (Yıldız, 2005: 291).

$$\frac{Xrj - Xj\,Min}{Xj\,Max - Xj\,Min}$$

Xrj = value of output r for decision-making unit j

Xj Min = minimum r value

Xj Max = maximum r value

3.2. Efficiency Analysis and Findings

Table 1 shows pre-determined input and output variables for stone and earth sector which is a sub-sector of manufacturing industry and also registered to Borsa İstanbul.

Table 1. Input and Output Variables Used in Study

Inputs	Outputs
Current Ratio	Net Profit/ Total Assets (Return on Assets)
Acid-Test Ratio	Net Profit/ Equity (Return on Equity)
Receivables Turnover Ratio	Net Profit/ Net Sales (Return on Sales)
Stocks Turnover Ratio	
Total Debts / Total Assets	
Current Liabilities/Total Liabilities	

Table 2 shows codes and company names of 26 businesses – registered to Borsa İstanbul- operating through stone and earth sector which is one of sub-sectors of manufacturing industry.

Table 2. Businesses Operating Through Stone and Earth Sector Included in Study

No	Kod	Şirket Adı	No	Kod	Şirket Adı
1	ADANA, ADBGR, ADNAC	ADANA ÇİMENTO	**14**	DOGUB	DOĞUSAN
2	AFYON	AFYON ÇİMENTO	**15**	ECYAP	ECZACIBAŞI YAPI
3	AKCNS	AKÇANSA	**16**	EGSER	EGE SERAMİK
4	ANACM	ANADOLU CAM	**17**	GOLTS	GÖLTAŞ ÇİMENTO
5	ASLAN	ASLAN ÇİMENTO	**18**	HZNDR	HAZNEDAR REFRAKTER
6	BOLUC	BOLU ÇİMENTO	**19**	IZOCM	İZOCAM
7	BSOKE	BATISÖKE ÇİMENTO	**20**	KONYA	KONYA ÇİMENTO
8	BTCIM	BATI ÇİMENTO	**21**	KUTPO	KÜTAHYA PORSELEN
9	BUCIM	BURSA ÇİMENTO	**22**	MRDIN	MARDİN ÇİMENTO
10	CIMSA	ÇİMSA	**23**	NUHCM	NUH ÇİMENTO
11	CMBTN	ÇİMBETON	**24**	TRKCM	TRAKYA CAM
12	CMENT	ÇİMENTAŞ	**25**	UNYEC	ÜNYE ÇİMENTO
13	DENCM	DENİZLİ CAM	**26**	USAK	UŞAK SERAMİK

According to analysis results; firms having codes of ADANA, AKCNS, ASLAN, BSOKE, CIMSA, DENCM, ECYAP, HZNDR, MRDN and USAK were found to be fully efficient during all four study periods. In addition, it is also shown that firms having codes of ANACM, CMENT and KONYA increased their efficiency levels periodically and firm having code of KONYA began to work full efficiently since 3rd quarter. The efficiency levels of firms having codes of AFYON, BOLUC, BUCIM, CMBTN, GOLTS, IZOCM, NUHCM and TRKCM were found to decrease their efficiency levels in transition from 1st to 2nd quarter and again from 2nd to 3rd quarter while their efficiency levels increased in transition from 3rd to 4th quarter. Efficiency level of firm having code of BTCIM was shown to decrease in transition from 1st to 2nd quarter but to increase in following quarters.

Table 3. Efficiency Table for Decision-Making Units for Quarters of 2012

	I. 3 Aylık Dönem			II. 3 Aylık Dönem			III. 3 Aylık Dönem			IV. 3 Aylık Dönem		
Firma	CCR	BCC	Ölçek	CCR	BCC	Ölçek	CCR	BCC	Ölçek	CCR	BCC	Ölçek
ADANA	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00
AFYON	96,53	100,00	0,97	79,27	100,00	0,79	63,40	65,25	0,97	70,19	81,00	0,87
AKCNS	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00
ANACM	83,00	91,29	0,91	89,35	90,28	0,99	94,14	94,24	1,00	100,00	100,00	1,00

ASLAN	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00
BOLUC	100,00	100,00	1,00	93,70	100,00	0,94	89,52	100,00	0,90	96,52	100,00	0,97
BSOKE	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00
BTCIM	99,52	100,00	1,00	92,58	92,58	1,00	92,91	100,00	0,93	97,35	100,00	0,97
BUCIM	73,83	90,21	0,82	64,82	84,00	0,77	61,43	73,00	0,84	72,72	89,00	0,82
CIMSA	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00
CMBTN	100,00	100,00	1,00	69,71	83,21	0,84	67,77	77,18	0,88	82,87	92,82	0,89
CMENT	89,78	92,70	0,97	90,27	100,00	0,90	98,87	100,00	0,99	100,00	100,00	1,00
DENCM	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00
DOGUB	100,00	100,00	1,00	15,40	100,00	0,15	28,40	100,00	0,28	12,74	100,00	0,13
ECYAP	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00
EGSER	94,86	97,34	0,97	100,00	100,00	1,00	87,26	87,85	0,99	100,00	100,00	1,00
GOLTS	96,50	96,56	1,00	93,63	93,79	1,00	79,17	80,14	0,99	85,18	92,43	0,92
HZNDR	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00
IZOCM	100,00	100,00	1,00	87,87	88,70	0,99	85,84	88,63	0,97	89,18	96,01	0,93
KONYA	89,21	91,62	0,97	98,18	100,00	0,98	100,00	100,00	1,00	100,00	100,00	1,00
KUTPO	100,00	100,00	1,00	100,00	100,00	1,00	91,11	99,38	0,92	100,00	100,00	1,00
MRDIN	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00
NUHCM	90,26	94,40	0,96	89,01	91,23	0,98	88,67	88,68	1,00	99,39	100,00	0,99
TRKCM	90,20	91,03	0,99	89,60	90,55	0,99	79,60	81,52	0,98	100,00	100,00	1,00
UNYEC	99,95	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00
USAK	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00	100,00	100,00	1,00

Firm having code of DOGUB was shown to be full efficient during 1st quarter while its efficiency level tended to decrease in 2nd quarter. Efficiency level of this firm again was found to increase in 3rd quarter while it again decreased in final quarter. Firm having code of EGSER was found to increase its efficiency level in transition from 1st to 2nd and again from 3rd to 4th quarter, however EGSER was shown to be full efficient during 2nd and 4th quarters. In addition, KUTPO firm was found to be full efficient other than 3rd quarter while UNYEC being full efficient other than 1st quarter. Table 3 shows efficiency table for decision-making units for quarters of 2012.

Table 4 shows reference firms that were found to be efficient in efficiency analysis in 1st quarter of 2012 and numbers of being referenced by inefficient firms. Firms having codes of BOLUC, CMBTN, DOGUB and HZNDR, though they were found to be efficient, were not referenced by analysis program.

Table 4. Reference Firms in 1st Quarter and Their Frequencies of Being Referenced

Firm Name	Freq. Ref.
ADANA	11
MRDIN	5
KUTPO	3
ECYAP	3
DENCM	3
CIMSA	3
BSOKE	3
ASLAN	3
AKCNS	2
USAK	1
IZOCM	1

11 inefficient firms observed in CCR model according to data of 1st quarter of 2012 were given a number of proposals in order to achieve a full efficiency level and these proposals were investigated in an alphabetical order of firm names.

Factors maintaining efficient working of firm having code of AFYON were found to be ratios such as current ratio, acid-test ratio, receivable turnover ratio, stock turnover ratio, productivty ratio of total assets and productivity ratio of equity. In terms of output-oriented and constant returns to scale assumptions, this firm should decrease its current ratio, acid-test ratio, receivable turnover ratio and stock turnover ratio in proportion with %71,22; % 64,24; % 31,02 and %3,47 in turn. In contrary, AFYON firm, by using its current inputs, should increase its productivity ratio of total assets and productivity of equity in proportion with %204,74 and %554,89 in turn. By achieving this ratios, the firm is expected to gain efficiency in terms of inputs like total debts/total assets and current liabilities/total liabilities and outputs like net profit/net sales. Firms being referenced to AFYON include ADANA, DENCM and MRDIN firms.

For ANACM firm to work full efficiently, it should rearrenge its ratios in terms of all inputs and outputs other than net profit/net sales. This firm should decrease its current ratio, receivables turnover ratio, total debts to total aseets ratio, acid-test ratio, stock turnover ratio and current liabilities to total liabilities ratio in proportion with % 48,52; % 17,1; % 43,21; % 17 and % 17 in turn. By being full efficient in terms of output of net profit to net sales ratio and current inputs, ANACM firm should increase its productivity of total assets ratio by % 10,67 and productivity of equity by % 5,5. Firms being referenced to ANACM include ADANA, CIMSA and MRDIN firms.

It is shown that BTCIM firm being efficient in terms of all outputs and input of current liabilities to total liabilities ratio. Firm should decrease its current ratio by %0,48, acid-test ratio by % 6,13, receivables turnover ratio by % 19,29, stock turnover

ratio by % 13,02 and total debts to total assets ratio by % 38,03. Firms being referenced to BTCIM include ADANA, AKCNS, BSOKE and ECYAP.

BUCIM firm should decrease its current ratio by % 40,57, acid-test ratio by % 45,83, receivables turnover rate and current liabilities to total liabilities ratio by % 26,17, stock turnover ratio by % 40,18, and total debts to total assets ratio by % 47,81. Firm was found to be full efficient in terms of all outputs. Firms being referenced to BUCIM include ADANA, ASLAN, ECYAP and KUTPO firms.

CMENT firm was only efficient in terms of net profit to net sales ratio. Firms was found to be inefficient in other outputs and all inputs. It should increase its productivity of total assets ratio by % 16,01 and productivity of equity ratio by % 10,24. In addition, it should decrease its current ratio and current liabilities to total liabilities ratio by % 10,22, acid-test ratio by % 14,95, receivables turnover ratio by % 12,8, stock turnover ratio by % 19,22 and total debts to total assets ratio by % 32,61. Firms being referenced to CMENT include ADANA and CIMSA firms.

EGSER firm was shown to be efficient in terms of outputs such as productivity of total assets and net profit to net sales ratio while it being inefficient in terms of all inputs and output of productivity of equity. This firm should decrease its current ratio, receivable turnover ratio and total debts to total assets ratio by %5,14, acid-test ratio by % 14,64, stock turnover rate by % 34,59 current liabilities to total liabilities ratio by % 6,69. In addition, productivity ratio of equity should be increased by %2,11. Firms being referenced to EGSER include ASLAN, KUTPO, MRDIN and USAK firms.

GOLTS firm was shown being inefficient in terms of inputs other than current liabilities to total liabilities ratio and output of net profit to net sales ratio. In contrary, the firm was efficient in terms of outputs such as productivity of total assets and equity ratios. Firm should decrease its current ratio and acid-test ratio by % 3,5, receivables turnover ratio by % 46,81, stock turnover ratio by % 5,19 and total debts to total assets ratio by % 50,12. In order GOLTS firm to work more efficiently, in addition to these ratio improvements, it should also increase its net profit to net sales ratio %4,69. Firms being referenced to GOLTS include ADANA, AKCNS, BSOKE and ECYAP.

KONYA firm was shown to be inefficient in terms of outputs other than net profit to net sales and all inputs. Firm, in order to achieve its efficiency level, should decrease its current ratio by %29,19, acid-test ratio by % 47,43, receivables turnover ratio by % 11,51, stock turnover ratio and total debts to total assets ratio and current liabilities to total liabilities ratio by % 10,79 while it should increase its productivity of total assets ratio by %21,16 and its productivity of equity by %25,92. Firms being referenced to KONYA include ADANA, DENCM and MRDIN.

NUHCM firm should increase its productivity ratio of total assets by %5,82 and productivity ratio of equity by %4,87. Firm is efficient only in terms of output of net profit to net sales ratio. By achieving stated increase ratios in terms of outputs, NUHCM firm should also increase its current ratio and current liabilities to total

liabilities ratio by %9,74, acid-test ratio by % 29,41, receivable turnover ratio by % 10,97, stock turnover ratio by % 67,91 and total debts to total assets ratio by % 32,04. Firms being referenced to NUHCM include ADANA and CIMSA.

TRKCM firm was found to be efficient only in terms of output of net profit to net sales ratio. In order to maintain its efficiency, the firm should decrease its current ratio by % 49,51, acid-test ratio by % 56,93, receivables turnover ratio, stock turnover ratio and total debts to total assets ratio by % 46,13 while it again should increase its productivity ratio of total assets and equity by %18,32 and %9,02 in turn. Firms being referenced to TRKCM include ADANA, BSOKE and DENCM.

UNYEC firm should make minor changes in order to gain its efficiency so that it should decrease its acid-test ratio by % 15,5, stock turnover ratio by % 5,48 and total debts to total assets ratio by % 3,23 while it should increase its productivity ratio of equity by % 3,29. Firm was shown to be efficient in terms of inputs of current ratio, receivable turnover ratio and current liabilities to total liabilities ratio and outputs of productivity ratios of total assets and net profit to net sales. Firms being referenced to UNYEC include ADANA, IZOCM, KUTPO and MRDIN.

Table 5 shows reference firms that were found to be efficient in efficiency analysis in 2nd quarter of 2012 and numbers of being referenced by inefficient firms. Firms having codes of EGSER, HZNDR and KUTBO, though they were found to be efficient, were not referenced by analysis program.

Table 5. Reference Firms in 2nd Quarter and Their Frequencies of Being Referenced

Firm Name	Freq. Ref
ADANA	11
ASLAN	7
UNYEC	5
MRDIN	4
CIMSA	4
ECYAP	2
DENCM	2
USAK	1
BSOKE	1
AKCNS	1

13 inefficient firms observed in CCR model according to data of 2nd quarter of 2012 were given a number of proposals in order to achieve a full efficiency level and these proposals were investigated in an alphabetical order of firm names.

Factors maintaining inefficient working of firm having code of AFYON were found to be ratios such as current ratio, acid-test ratio, receivable turnover ratio, stock turnover ratio, total debts to total assets ratio and productivty ratios of total assets and equity. In terms of output-oriented and constant returns to scale assumptions, this firm should decrease its current ratio, acid-test ratio, receivable turnover ratio and total debts to total assets ratio, stock turnover ratio and current liabilities to total liabilities ratio in proportion with %26,55; % 20,73; % 20,73; % 20,73; % 35,84 and % 36,81 in turn. In contrary, AFYON firm, by using its current inputs, should increase its productivity ratio of total assets and productivity of equity in proportion with % 1280,47 and %771,07 in turn. By achieving these ratios, the firm is expected to gain efficiency in terms of outputs like net profit/net sales. Firms being referenced to AFYON include ADANA, ASLAN and UNYEC.

For ANACM firm to work full efficiently, it should rearrenge its ratios in terms of all inputs and outputs other than net profit/net sales. This firm should decrease its current ratio, stock turnover ratio and current liabilities to total liabilities ratio by % 10,65, acid-test ratio by % 14,64, receivable turnover ratio by % 37,6 and total debts to total assets ratio by % 37,6. By being full efficient in terms of output of net profit to net sales ratio and current inputs, ANACM firm should increase its productivity of total assets ratio by % 25,33 and productivity of equity by % 22,43. Firms being referenced to ANACM include CIMSA, MRDIN and USAK.

It is shown that BOLUC firm being efficient in terms of output of net profit to net sales. Firm should decrease its current ratio by % 9,22, acid-test ratio, receivables turnover ratio and current liabilities to total liabilities ratio by % 6,3, stock turnover ratio by % 37,33 and current liabilities to total liabilities ratio by % 33,86. . In addition, BOLUC should increase its productivity ratio of total assets and equity by % 19,03. Firms being referenced to BOLUC include ADANA, ASLAN and UNYEC.

It is shown that BTCIM firm being efficient in terms of all outputs other than productivity ratio of total assets. Firm should decrease its current ratio, acid-test ratio and current liabilities to total liabilities ratio by % 7,42, receivables turnover ratio by % 37,43, stock turnover ratio by % 30,07 and total debts to total assets ratio by % 30,93. In addition, firm, in order to maintain a full efficiency level, should increase productivity ratio of total assets by % 5,84. Firms being referenced to BTCIM include ADANA, ASLAN and CIMSA.

BUCIM firm should decrease its current ratio by % 48,79, acid-test ratio by % 38,62, receivables turnover ratio and current liabilities to total liabilities ratio by % 35,18, stock turnover ratio by % 40,55, and total debts to total assets ratio by % 36,73. Firm was found to be efficient in terms of output of net profit to net sales ratio and it should increase its productivity ratios of total assets and equity by % 8,78 and % 5,09 in turn. Firms being referenced to BUCIM include ADANA and ASLAN.

CMBTN is efficient only in terms of output of net profit to net sales ratio. The firm was shown not to be full efficient in other outputs and in all inputs. CMBTN

should increase its ratio of productivity of total assets by % 140,36 and equity by % 344,27. In addition, it should decrease its current ratio, receivable turnover ratio and total debts to total assets ratio by % 30,29, acid-test ratio by % 44,52, stock turnover ratio by % 94,13 and current liabilities to total liabilities ratio by % 39,33. Firms being referenced to CMBTN include ADANA, AKCNS and ASLAN.

CMENT firm should decrease its current ratio, acid-test ratio and current liabilities to total liabilities ratio by % 9,73, receivables turnover ratio by % 28,88, stock turnover ratio by % 30,11, and total debts to total assets ratio by % 15,55. In addition, CMENT should increase its ratio of productivity of total assets by % 37,73 and equity by % 50,57. Firm was found to be full efficient in terms of output of net profit to net sales. Firms being referenced to CMENT include ADANA, ASLAN and CIMSA.

DOGUB firm is efficient only in terms of output of equity productivity ratio. DOGUB should decrease its current ratio by % 99,02, acid-test ratio by % 96,79, receivable turnover ratio by % 98,31, stock turnover ratio and total debts to total assets ratio by % 84,6. In addition, it should increase its productivity ratio of total assets by % 74,18 and net profit to net sales ratio by % 76,91. Firms being referenced to DOGUB include ECYAP and UNYEC.

GOLTS firm was shown being inefficient in terms of all inputs and output of net profit to net sales ratio. In contrary, the firm was efficient in terms of outputs such as productivity of total assets and equity ratios. Firm should decrease its current ratio and current liabilities to total liabilities ratio by % 6,37, acid-test ratio by % 13,87, receivables turnover rate by % 62,56, stock turnover ratio by % 38,75 and total debts to total assets ratio by % 36,42. In order GOLTS firm to work more efficiently, in addition to these ratio improvements, it should also increase its net profit to net sales ratio %4,47. Firms being referenced to GOLTS include ADANA, ECYAP and MRDIN.

IZOCM firm was shown being inefficient in terms of inputs while it being efficient in terms of all outputs. In order to work full efficiently, the firm should decrease its current ratio and total debts to total assets ratio by % 12,13, acid-test ratio by % 16,17, receivables turnover ratio by % 18,56, stock turnover ratio by % 71,57 current liabilities to total liabilities ratio by % 34,93. Firms being referenced to IZOCM include ADANA, MRDIN and UNYEC.

KONYA firm was shown to be efficient in terms of outputs of net profit to net sales and productivit ratio of equity and in terms of input of total debts to total assets ratio. Firm should decrease its current ratio by % 39,44, acid-test ratio by % 44,81, receivables turnover ratio and stock turnover ratio by % 1,82 and current liabilities to total liabilities ratio by % 20,07 while it should increase its productivity of total assets ratio by % 0,8. Firms being referenced to KONYA include ADANA, BSOKE and UNYEC

NUHCM firm was shown to be efficient only in terms of output of net profits to net sales ratio. The firm, in order to work full efficiently, should increase its current ratio by % 16,24, acid-test ratio, receivable turnover ratio and total debts to total assets ratio by % 18,6. In addition, the firm should increase its productivity ratio of total assets by % 9,77 and equity by % 10,59. Firms being referenced to NUHCM include ADANA, ASLAN and CIMSA.

TRKCM firm, in order to maintain its efficiency, should decrease its current ratio by % 40,88, acid-test ratio by % 48,83, receivables turnover ratio by % 28,06, stock turnover ratio and current liabilities to total liabilities ratio by % 24,73 while it again should increase its productivity ratios of total assets by % 14,89 and equity by % 14,89. Firms being referenced to TRKCM include ADANA and DENCM.

Table 6 shows reference firms that were found to be efficient in efficiency analysis in 3rd quarter of 2012 and numbers of being referenced by inefficient firms. Firm having code of KONYA, though it was found to be efficient, was not referenced by analysis program.

Table 6. Reference Firms in 3rd Quarter and Their Frequencies of Being Referenced

Firm Name	Freq. Ref.
ASLAN	12
CIMSA	7
ADANA	4
USAK	3
ECYAP	3
UNYEC	2
BSOKE	2
MRDIN	1
HZNDR	1
DENCM	1
AKCNS	1

14 inefficient firms observed in CCR model according to data of 3rd quarter of 2012 were given a number of proposals in order to achieve a full efficiency level and these proposals were investigated in an alphabetical order of firm names.

AFYON firm was found to be efficient only in terms of output of net profit to net sales. The firm should decrease its current ratio by % 37,11, acid-test ratio, receivable turnover ratio and total debts to total assets ratio by % 36,6, stock turnover ratio by % 58,98 and current liabilities to total liabilities ratio by % 51,53. AFYON firm, by using its current inputs, should increase its productivity ratio of total assets and productivity of equity in proportion with % 4754,09 and % 1265,74 in turn. Firms being referenced to AFYON include ADANA, BSOKE and UNYEC.

For ANACM firm to work full efficiently, it should rearrenge its ratios in terms of all inputs and output of productivity ratio of total assets. This firm should decrease its current ratio, stock turnover ratio and current liabilities to total liabilities ratio by % 5,86, acid-test ratio by % 85,7, receivable turnover ratio by % 40,09 and total debts to total assets ratio by % 22,71. In addition, ANACM firm should increase its productivity of total assets ratio by % 8,23. Firms being referenced to ANACM include ASLAN, CIMSA and USAK.

It is shown that BOLUC firm being efficient only in terms of output of net profit to net sales. Firm should decrease its current ratio, receivable turnover ratio and total debts to total assets ratio by % 10,48, acid-test ratio by % 17,16, stock turnover ratio by % 47,05 and current liabilities to total liabilities ratio by % 32,15. In addition, BOLUC should increase its productivity ratio of total assets by % 3,98 and equity by % 6,21. Firms being referenced to BOLUC include ADANA, ASLAN and UNYEC.

BTCIM firm should decrease its current ratio by % 15,8, acid-test ratio and current liabilities to total liabilities ratio by % 7,09, receivables turnover ratio by % 64,79, stock turnover ratio by % 42,64 and total debts to total assets ratio by % 36,13. In addition, firm, in order to maintain a full efficiency level, should increase productivity ratio of total assets by % 24,21 and of equity by % 28,21. Firms being referenced to BTCIM include ASLAN and CIMSA.

BUCIM firm was shown to be efficient only in terms of output of net profit to net sales. The firm should decrease its current ratio by % 43,72, acid-test ratio by % 38,57, total debts to total assets ratio by % 46,66 and current liabilities to total liablities ratio by % 38,57. Firm should increase its productivity ratios of total assets and equity by % 19,1 and % 20,01 in turn. Firms being referenced to BUCIM include ADANA and ASLAN.

CMBTN firm was shown to be efficient in terms of output of net profit to net sales. CMBTN should increase its ratio of productivity of total assets by % 97,42 and of equity by % 196,73. In addition, it should decrease its current ratio, receivable turnover ratio and total debts to total assets ratio by % 32,23, acid-test ratio by % 53,57, stock turnover ratio by % 95,84 and current liabilities to total liabilities ratio by % 50,69. Firms being referenced to CMBTN include ASLAN, CIMSA and USAK.

CMENT firm was found efficient only in terms of input of total debts to total assets and output of net profit to net sales. The firm should decrease its current ratio by % 1,13, acid-test ratio by % 1,18 and current liabilities to total liabilities ratio by % 13,37, receivables turnover ratio by % 25,55, stock turnover ratio by % 26,65, In addition, CMENT should increase its ratio of productivity of total assets by % 38,78 and of equity by % 78,52. Firms being referenced to CMENT include ASLAN and CIMSA.

DOGUB firm is efficient in terms of outputs of total assets and equity productivity ratio while it is inefficient in terms of all inputs and outputs of net profit to net sales. DOGUB should decrease its current ratio by % 96,89, acid-test ratio by % 91,64, receivable turnover ratio by % 94,46, stock turnover ratio and current liabilities to total liabilities ratio by % 71,6 and total debts to total assets ratio by 85,56. In addition, it should increase its net profit to net sales ratio by % 460,95. Firms being referenced to DOGUB include ASLAN and HZNDR.

EGSER firm is efficient only in terms of output of total assets productivity ratio. EGSER should decrease its current ratio by % 16,56, acid-test ratio, receivable turnover ratio , stock turnover ratio and total debts to total assets ratio by % 12,74 and current liabilities to total liabilities ratio by % 25,52. In addition, it should increase its productivity ratio of equity by % 13,37 and net profit to net sales ratio by % 5,14. Firms being referenced to EGSER include ECYAP, ASLAN, CIMSA and MRDIN.

GOLTS firm was shown being inefficient in terms of all outputs other than net profit to net sales ratio and of all inputs. In order to work full efficiently, firm should decrease its current ratio by % 20,83, current liabilities to total liabilities ratio by % 20,83, acid-test ratio by % 26,94, receivables turnover ratio by % 73,95, stock turnover ratio by % 55,14 and total debts to total assets ratio by % 46,33. In addition to these ratio improvements, it should also increase its productivity ratio of total assets by % 12,09 and of equity by % 8,37. Firms being referenced to GOLTS include ADANA and ASLAN.

IZOCM firm should increase its productivity ratios of equity by % 4,11 and of net profit to net sales ratio by % 7. Firm was shown being efficient only in terms of output of productivity ratio of total assets. In order to work full efficiently, the firm should decrease its current ratio by % 16,28, acid-test ratio and receivables turnover and total debts to total assets by % 14,16, stock turnover ratio by % 34,75 and current liabilities to total liabilities ratio by % 26,62. Firms being referenced to IZOCM include AKCNS, ASLAN and ECYAP.

KUTPO firm is efficient only in terms of output of net profit to net sales. In order to maintain its efficiency, the firm should decrease its current ratio by % 36,59, total debts to total assets ratio by % 9,12, acid-test ratio by % 31, receivables turnover ratio and stock turnover ratio by % 8,89, current liabilities to total liabilities ratio by % 31,67. The firm should increase its productivity ratio of total assets by % 1,87 and of equity by % 3,15. Firms being referenced to KUTPO include ASLAN and DNCM.

NUHCM firm was shown to be efficient only in terms of output of net profits to net sales ratio. The firm, in order to work full efficiently, should decrease its current ratio, receivable turnover ratio, stock turnover ratio by % 59,96 and total debts to total assets ratio by % 15,7. In addition, the firm should increase its productivity ratio of total assets by % 10,41 and of equity by % 11,11. Firms being referenced to NUHCM include USAK, ASLAN and CIMSA.

TRKCM firm was found efficient only in terms of output of net profit to net sales ratio. In order to maintain its efficiency, the firm should decrease its current ratio by % 40,71, acid-test ratio by % 45,68, receivables turnover ratio by % 31,77, stock turnover ratio and current liabilities to total liabilities ratio by % 20,4 and total debts to total assets ratio by % 44,84 while it again should increase its productivity ratios of total assets and equity by %18,38 and %16,24 in turn. Firms being referenced to TRKCM include ADANA and BSOKE.

Table 7 shows reference firms that were found to be efficient in efficiency analysis in 4th quarter of 2012 and numbers of being referenced by inefficient firms. Firm having code of KONYA, KUTPO, TRKCM, CMENT and EGSER, though they were found to be efficient, were not referenced by analysis program.

Tablo 7. Reference Firms in 4th Quarter and Their Frequencies of Being Referenced

Firm Name	Freq. Ref
ADANA	6
ASLAN	5
USAK	4
CIMSA	4
UNYEC	2
ECYAP	2
BSOKE	2
AKCNS	2
MRDIN	1
HZNDR	1
DENCM	1

9 inefficient firms observed in CCR model according to data of 4th quarter of 2012 were given a number of proposals in order to achieve a full efficiency level and these proposals were investigated in an alphabetical order of firm names.

AFYON firm was found to be efficient only in terms of output of net profit to net sales. The firm should decrease its current ratio, receivable turnover ratio and total debts to total assets ratio and current liabilities to total liabilities by % 29,81, acid-test ratio by % 34,41 and stock turnover ratio by % 60,91. AFYON firm, by using its current inputs, should increase its productivity ratio of total assets and productivity of equity in proportion with % 708,57 and % 2682,75 in turn. Firms being referenced to AFYON include ADANA, ASLAN, BSOKE and UNYEC.

BOLUC firm, in order to work full efficiently, should make some rearrengements in terms of all outputs and outputs other than net profits to net sales.

Firm should decrease its current ratio, receivable turnover ratio and total debts to total assets ratio by % 3,48, acid-test ratio by % 4,89, stock turnover ratio by % 31,75 and current liabilities to total liabilities ratio by % 5,5. It is shown that BOLUC firm being efficient only in terms of output of net profit to net sales. In addition, BOLUC should increase its productivity ratio of total assets by % 13,76 and of equity by % 14,88. Firms being referenced to BOLUC include ADANA, ASLAN and UNYEC.

BTCIM firm was shown to be efficient only in terms of output of net profit to net sales and input of current liabilities to total liabilities. The firm should decrease its current ratio by % 3,4, acid-test ratio and receivables turnover ratio by % 2,65, stock turnover ratio by % 20,86 and total debts to total assets ratio by % 37,27. Firm should increase its productivity ratios of total assets and equity by % 21,68 and % 20,9 in turn. Firms being referenced to BUCIM include ADANA, BSOKE and CIMSA.

BUCIM firm should decrease its current ratio by % 35,67, acid-test ratio, receivables turnover rate and current liabilities to total liabilities ratio by % 27,28, stock turnover ratio by % 45,14, and total debts to total assets ratio by % 53,15. Firm was found to be efficient in terms of output of net profit to net sales ratio and it should increase its productivity ratios of total assets and equity by % 27,57 and % 26,96 in turn. Firms being referenced to BUCIM include ADANA, USAK and ASLAN.

CMBTN firm was shown to be efficient in terms of output of net profit to net sales. CMBTN should increase its ratio of productivity of total assets by % 41,99 and of equity by % 6,08. In addition, it should decrease its current ratio, receivable turnover ratio and total debts to total assets ratio by % 17,13, acid-test ratio by % 41,54, stock turnover ratio by % 93,33 and current liabilities to total liabilities ratio by % 30,58. Firms being referenced to CMBTN include AKCNS, ECYAP and USAK.

DOGUB firm is efficient in terms of outputs of total assets and equity productivity ratio while it is inefficient in terms of all inputs and outputs of net profit to net sales. DOGUB should decrease its current ratio by % 96,84, acid-test ratio by % 94,64, receivable turnover ratio by % 96,84, stock turnover ratio and current liabilities to total liabilities ratio by % 87,26 and total debts to total assets ratio by % 94,36. In addition, it should increase its net profit to net sales ratio by % 165,36. Firms being referenced to DOGUB include ADANA and HZNDR.

GOLTS firm was shown being efficient only in terms of all output of net profit to net sales ratio. In order to work full efficiently, firm should decrease its current ratio and current liabilities to total liabilities ratio by % 14,82, acid-test ratio by % 20,53, receivables turnover ratio by % 42,85, stock turnover ratio by % 30,98 and total debts to total assets ratio by % 35,76. In addition to these ratio improvements, it should also increase its productivity ratio of total assets by % 18,75 and of equity by % 17,03. Firms being referenced to GOLTS include ADANA and CIMSA.

IZOCM firm was shown being efficient only in terms of output of productivity ratio of total assets. Firm should increase its productivity ratios of equity by % 1,72 and

of net profit to net sales ratio by % 5,84. In order to work full efficiently, the firm should decrease its current ratio, receivables turnover ratio and total debts to total assets ratio by % 10,82, acid-test ratio by % 17,36, stock turnover rate by % 64,53 and current liabilities to total liabilities ratio by % 13,85. Firms being referenced to IZOCM include MRDIN, ASLAN and ECYAP.

NUHCM firm was shown to be efficient only in terms of output of net profits to net sales ratio and input of current liabilities to total liabilities. The firm, in order to work full efficiently, should decrease its current ratio, acid-test ratio and receivable turnover ratio by % 0,61, stock turnover ratio by % 40,76 and total debts to total assets ratio by % 13,66. In addition, the firm should increase its productivity ratio of total assets by % 11,78 and of equity by % 13,66. Firms being referenced to NUHCM include USAK, ASLAN and CIMSA.

4. CONCLUSION

In study, by using Frontier Analysis program, evaluation of efficiency levels of firms was performed comparatively in terms of both input and output-oriented approaches. Input-oriented approach, by using CCR model and constant returns to scale technique, focuses on minimum amount of input for producing a specific output (input minimization) while output-oriented approach, by using BCC model and varying returns to scale technique, focuses on maximum output amount that can be produced by using a specific input (output maximization).

In evaluating whether firms are efficient or not, scores of referenced firms were taken into account. According to analysis results:

Some firms (namely, ADANA, AKCNS, ASLAN, BSOKE, CIMSA, DENCM, ECYAP, HZNDR, MRDN and USAK) were found to be full efficient during all four quarters of 2012. In addition, some other firms (ANACM, CMENT and KONYA) were found to increase their efficiency levels quarterly.

Firms' efficiency levels were found to experience periodical changes and some firms were found to be efficient in terms of some ratios while at the same time being inefficient in terms of other ratios. For instance, CMENT firm was found to be efficient only in terms of output of net profit to net sales ratio while at the same time being inefficient in terms of all inputs.

Some proposals –in terms of making the necessary rearrengements by increasing or decreasing the concerned ratios- were given to inefficient firms. For example, it is stated that BUCIM firm should decrease its current ratio by % 40,57, acid-test ratio by % 45,83, receivable turnover ratio and current liabilities to total liabilities ratio by % 26,17, stock turnover ratio by % 40,18 and total debts to total assets ratio by % 47,81.

Consequently, the efficiency levels of these firms were evaluated comparatively. In addition, after stating scores of reference firms, some proposals were given in terms of what kind of rearrengements should be done.

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