Measuring and analyzing the Super-Efficiency of industrial companies: an applied study in the Iraq Stock Exchange

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Abstract

This study aims to measure and analyze the superior efficiency of industrial companies, which listed in the Iraq Stock Exchange for the period (2017-2019), by using ES-DSM model, and Lingo 18 software, the data of (15) industrial companies were used, this study depend on two approaches they are:(total of assets and total expenses), and two outputs they are: (share price and total revenue).The study explored that there are seven companies that achieved 100% efficiency in 2017, five of them achieved superior efficiency, as (IBPM) which gain first ranked, while (IICM) and (IIEW) ranked last. In 2018, also seven companies achieved an efficiency rate of 100%, five of them also achieved superior efficiency, where (IBSD) ranked first, while (IICM) and (IIEW) ranked last, on the other hand, there were six companies that achieved an efficiency rate of 100% in 2019, four of them achieved maximum efficiency, and the first rank goes to (IBPM) company.And the last rank goes to the companies of both (IICM) and (IIEW), also, IBPM company achieved the first place during the study period, according to ES-DSM test, while IBSD ranked at second place, on the other hand, IBSD achieved the first place during (2017-2019), which achieved superior efficiency, while (IBPM) and (IMOS) were in the second place to become the best two companies that other companies can consider them as a typical companies.

Keywords: Super-Efficiency,Industrial Companies in Iraq, Iraqi economy.

Introduction

The industrial sector is one of the important sectors in the process of economic development, especially since it was working in a financial sector where transparency and regulation prevail, in a way that enables those interested in the activities of companies in this sector to conduct a continuous evaluation of their performance, therefore, some industrial companies which listed in the Iraq Stock Exchange have reservations about their financial data (Iraq Stock Exchange, 2013). This made reaching the goal of the study tainted by some difficulties, hence, in match with the economic developments that witnessed by Iraqi economy after 2010, the companies that listed in the industrial markets have searched for efficiency in their performance and increasing their economic resources.This has made companies in constant search for research and development processes for their tools and methods to achieve the requirements of customers and stay in the circle of intense competition **(Timothy, 2005)**, One of the most an important methods that used in efficiency measuring is the Data Envelope Analysis (DEA) method, which is based on comparison between companies and it gives a value that does not exceed a percentage (1) of the company's performance, regardless of its optimal production limits (**Daraio, 2007**). This allows us to make a comparison

between the industrial companies that included in the study of this model whether it was public or private, through ES-DSM model which depends on (total assets and total expenses), as inputs (share price and total revenue), thus, this issue is very close to the Pareto argument, which indicates that any production unit is inefficient if another unit can be able to produce the same amount of output with less input (**Charnes & et al, 1985**). According to the developments in the Iraqi economy and the application of the policies of financial liberalization and economic openness to the world, these companies have become in a situation where it is imperative that they appear stronger in order to compete with similar companies in the market. The problem of this study centers on determining the level of superior efficiency of the selected companies, whose results will be determining the level of weakness in the outputs in relation to the level of their inputs and work to increase those outputs to reduce losses. Thus, its production system will become efficient if its outputs are at their highest rate with the lowest possible level of inputs, without affecting the standard specifications. The development of the internal efficiency of this sector and the challenges that faces them to overcome the problems, including the lack of outputs compared with inputs increasing, is one of the main motives for conducting the study.

Our study aimed to apply the (ES) model of DEA that presented by Andersen and Petersen (1993). In order to measure the efficiency of industrial companies listed in the Iraqi Stock Exchange and to identify companies that have high efficiency, these companies were able to use the least amount of inputs to produce an optimal amount of output. In addition, this study enable access to an inefficient company that suffer from losses in the production process. This study also aims to determine the amount that must be increased or decreased in order to become the company operate at a high level of efficiency.

Reference review

A study by (**Tone,2001**) This study aimed to propose a high-efficiency measure to measure the superior efficiency of a group of Japanese companies using data envelope analysis (DEA), the study distinguished between two types of efficiency calculation methods, the first type is based on the (SDM) approach, which depends on stagnation in inputs / outputs, the second traditional one is the radiometric method, the study found the effectiveness of the proposed model and its applicability in similar studies, while the study of (**Emrouznejad & Yang, 2017**). Which aimed to measure the superior efficiency of (188) an educational institution in Germany by using boundary partial analysis. The study found that some small-sized educational institutions were more efficient than large institutions due to the better wise ways they follow in managing their limited resources. While a study of (**Emrouznejad & Yang, 2017**) came to measure the efficiency of (12) electric companies by comparing the inputs of the electric companies that expressed as supplies of electricity purchased with its outputs that expressed as consumed, number of beneficiaries and losses that lost, the study concluded that (4) companies are ineffective and therefore need to improve the quality of their performance.

As for the study of (**Bang, 2020**), it aimed to analyze the performance of energy projects by using super-efficiency (SE) which based on the data envelope. The study

concluded that the use of super-efficiency allows to use of varying inputs and reducing deviations in outputs. Another study by (**N. Zhu & Q. Huang, 2017**), its aimed to conduct a test to measure the efficiency of companies under conditions of risk and uncertainty by proposing the Data Envelope Model (DEA), and it reached to the efficiency of the model in conducting the test. Also, a study by (**Xiaobing Yu et.al 2019**) to measure the efficiency of 48 hotels in the United States of America it was found that 58% of these hotels are inefficient according to the international classification system. The results showed that hotels who have relatively efficient spend more on drinks and food, while inefficient hotels spend more on hotel procedures such as hiring a large number of employees and having a large number of rooms. On this basis, the researchers emphasized that management in the field of hotel should give more attention to the process of resource distribution rather than the process of resource management. A study by (**Al-Shammari-1999**) to measure efficiency according to the data envelope analysis method for (55) Jordanian industrial companies. Where it was found that only 12 companies are efficient according to this method. He also referred to the sources and rates of inefficiency in an inefficient company.

Methodology

The DEA method was first proposed by (**Charnes et al. 1978**). They noted that data envelope analysis was a mathematical, programmatic method for determining the relative efficiency of DMU. According to multiple input and output indicators, the DEA method was used to evaluate relative effectiveness, this method contains advantages in avoiding the influence of subjective factors, simplifying the recruitment process, and reducing errors that resulted during measuring the efficiency of units.

Traditional DEA model (CCR) (Charnes Cooper & Rhodes) and (BCC) (Banker Charnes & Cooper). On the one hand they did not take into account this input and output variables, and on the other hand the efficiency values for the traditional DEA model were between (0 - 1). Which belong to sectioned data (**Yang et al, 2015**). For DMU within the same effective range of data envelope analysis (DEA), this leads to the impossibility of making a comparison of proportionality and inappropriate quality of the study sample.

So (**Tone, 2002**) proposed the concept of super-efficiency SBM model which added recession variables to the target function in compared with the traditional DEA model, so that, the highly efficient SBM model not only deals with unwanted output, but can also compare effective DMU to other efficient units. In our study, the efficiency of the industrial companies listed in the Iraqi Stock Exchange was evaluated by using highly efficient SBM model, which deals professionally with undesirable outputs. Suppose there are DMUs with (m) and Input indicators $\mathbf{S}_1$ as desirable indicators for output and $\mathbf{S}_2$ indications for unwanted output, desirable inputs and undesirable outputs are expressed respectively ($x \in R^m$, $Y^g \in R^{s1}$ and $Y^b \in R^{s2}$), the input represents ($X = (x_{ij}) \in R^{mxn}$)while the desired output vector is ($Y^g = (y_{rj}) \in R^{s1xn}$)while the unwanted outputs was destined towards ($Y^b = (y_{rj}) \in R^{s2xn}$), the undesirable outputs of the SBM model were expressed as follows (**Apergis et al, 2015 & Tone, 2001**):

$$\min \rho^{\bullet} = \frac{1-\frac{1}{m}\sum_{i=1}^{m}\left(s_i^{-}/x_{io}\right)}{1+\frac{1}{s_1+s_2}\left(\sum_{r=1}^{s_1}\left(s_r^{g}/y_{ro}^{g}\right)+\sum_{r=1}^{s_2}\left(s_r^{b}/y_{ro}^{b}\right)\right)}$$

$$s.t.\begin{cases} x_o = X\lambda + s^{-} \\ y_o^{g} = Y^{g}\lambda - s^{g} \\ y_o^{b} = Y^{b}\lambda + s^{b} \\ \lambda, s^{-}, s^{g}, s^{b} \geq 0 \end{cases} \quad (1)$$

Whereas (**S^{-}, S^{g}& S^{b}**) The desired variables of input and output, and undesired output, are respectively and that (λ) represents the weight vector when ($\rho^{*} = 1$) and (S^{-} = 0, S^{g} = 0, S^{b} = 0) Then the (DMU) model will be effective and efficient in achieving optimal results. The super-efficient SBM model was expressed as follows (**Tone, 2002**):

$$\min \delta^{\bullet} = \frac{\frac{1}{m}\sum_{i=1}^{m}\left(\bar{x}/x_{io}\right)}{\frac{1}{s}\sum_{r=1}^{s}\left(\bar{y}_r/y_{ro}^{g}\right)}$$

$$s.t.\begin{cases} \bar{x} \geq X\lambda \\ \bar{y} \leq Y\lambda \\ \bar{x} \geq x_0, \bar{y} \leq y_0 \\ \lambda \geq 0, \bar{y} \geq 0 \end{cases} \quad (2)$$

According to both models (1,2), the highly efficient SBM model for undesirable output is expressed as follows: (**Li et al, 2013**).

$$\min \alpha^{\bullet} = \frac{\frac{1}{m}\sum_{i=1}^{m}\left(\bar{x}/x_{io}\right)}{1+\frac{1}{s_1+s_2}\left(\sum_{r=1}^{s_1}\left(s_r^{g}/y_{ro}^{g}\right)+\sum_{r=1}^{s_2}\left(s_r^{b}/y_{ro}^{b}\right)\right)}$$

$$s.t.\begin{cases} \bar{x} \geq X\lambda \\ \overline{y^{g}} \leq Y^{g}\lambda \\ \overline{y^{b}} \geq Y^{b}\lambda \\ \bar{x} \geq x_0, \overline{y^{g}} \leq y_0, \overline{y^{b}} \geq y_0^{b}, \lambda > 0 \end{cases} \quad (3)$$

Table (1) Descriptive statistical Characteristics of the input and output variables

Variable	Max	Min	Average	S.D.
Total assets	**226.91**	**1.01**	**20.56**	**50.44**
Total expenses	**211.18**	**0.14**	**16.89**	**50.38**
share price (closing price)	**77.00**	**0.37**	**5.91**	**15.10**
Total revenue	**241.32**	**0.05**	**17.24**	**57.12**

Source: Test results using Excel.

Table (1) shows the descriptive statistics indicators that will be used in this research, as it turns out that the highest value was for the total revenue indicator, which amounted to (241.32) Iraqi billiondinars. after that, the total assets index and total expenditures respectively, with a value of (226.91) and (211.18) Iraqi billion dinars. On the other hand, the lowest value for the total revenue index was also at (0.05) Iraqi billiondinars. The index of total expenditures and total assets came after it respectively, with values of (0.14) and (1.01) Iraqi billion dinars. these indicators witnessed a high dispersion in their values, which means that there are large and small other companies, this is confirmed by the standard deviation index (S.D.), whose value reached (57.12), (50.44) and (50.38), for total revenue, assets, and expenditures, respectively. So that, the share price index, in its highest value was (77.00) and its lowest value was (0.37), which is much less dispersion than other indicators, despite the great disparity between companies in terms of level economic activity, with a deviation rate of (15.10) which is also lower compared to the other indicators that are under study.

Table (2) determining factors of industrial companies' inefficiency for 2017

Companies	E	S1	S2	OS1	OS2
ITLI	0.12	0.455	0.000	1.199	0.092
IMIB	0.34	0.000	0.447	1.101	0.000
IELI	0.02	0.000	0.309	2.710	0.002
IICM	1.00	0.000	0.000	0.000	0.000
INCP	0.55	0.000	0.264	0.702	0.000
IIEW	1.00	0.000	0.000	0.000	0.000
IMCI	0.88	0.310	0.000	0.726	0.000
IMOS	1.00	0.000	0.000	0.000	0.000
IBSD	1.00	0.000	0.000	0.000	0.000
IBPM	1.00	0.000	0.000	0.000	0.000
IHLI	0.46	0.000	0.986	0.543	0.000
IKLV	0.66	0.000	0.000	1.682	0.000
IITC	1.00	0.000	0.000	0.000	0.000
IRMC	1.00	0.000	0.000	0.000	0.000
IMPI	0.14	0.141	0.255	1.832	0.000

Source: Test results using Lingo 18 software.

Table (2) shows that there are seven companies that have achieved full efficiency within the (E-SBM) test, While eight companies suffered from one or both of the constraints of efficiency, some of them suffered from a waste of resources (inputs) and suffered from a shortfall in production (outputs), like (ITLI) company, it was suffering from wastage (total assets) and needed to legalize and streamline the use of this resource by (455) Iraqi million dinars.Likewise, it was suffering from a deficit in (share price and total revenues), as it needed an increase in (share price) through value (1,199) points and an increase in (total revenues) by (92) Iraqi million dinars, and the same applies to other companies that did not achieve efficiency.

Table (3) The super-efficiency of industrial companies for the year 2017

Companies	SE	S1	S2	OS1	OS2
IICM	1.00	0.00	0.00	0.00	0.00
IIEW	1.00	0.00	0.00	0.00	0.00
IMOS	1.19	0.38	0.00	0.00	0.00
IBSD	1.00	0.59	0.00	0.00	0.00
IBPM	2.50	0.00	0.30	0.00	0.00
IITC	1.20	0.00	0.17	0.64	0.00
IRMC	1.23	0.00	0.00	2.28	0.00

Source: Test results using Lingo 18 software.

In order to know the company's ability to increase its use of resources (inputs) and achieve a deficit or decrease in the outputs, and the company remains efficient in facing the same constraints, so Table (3) shows the company's efficiency within the (ES-DSM) test, which showed that some companies were efficient and others were not. so that, (IBPM) company achieved the highest value of efficiency (2.5), it can increase (total expenses) by (300) million dinars and remain efficient. On the other hand, there were inefficient companies such as (IICM) and (IIEW), which achieved lowest level of efficiency by (1), the (IRMC) company came in second place as it achieved an efficiency level of (1.23), it can be able to reduce (the share price) by (2.28) points and remain efficient, as in same cases with other companies.

Table (4) rank of industrial companies based on the ES-DSM test for 2017

Companies	E	ES	Rank
ITLI	0.12	1.00	12
IMIB	0.34	1.00	10
IELI	0.02	1.00	13
IICM	1.00	1.00	5
INCP	0.55	1.00	8
IIEW	1.00	1.00	5
IMCI	0.88	1.00	6
IMOS	1.00	1.19	4
IBSD	1.00	1.00	5
IBPM	1.00	2.50	1
IHLI	0.46	1.00	9
IKLV	0.66	1.00	7
IITC	1.00	1.20	3
IRMC	1.00	1.23	2
IMPI	0.14	1.00	11

Source: Test results using Lingo 18 software.

Table (4) shows the sequence of companies according to the results of (ES-DSM) test, which showed that (IBPM) company achieved the first rank, while the last rank was for (IELI) company, and the other companies ranged in its levels between these two companies.

Table (5) ranking of industrial companies on the basis of reduced cost for the year 2017

Companies	Rank	S1	S2	OS1	OS2
IBSD	1	0.59	0.00	0.00	0.00
IMOS	2	0.38	0.00	0.00	0.00
IBPM	3	0.00	0.30	0.00	0.00
IITC	4	0.00	0.17	0.64	0.00
IRMC	5	0.00	0.00	2.28	0.00
IICM	6	0.00	0.00	0.00	0.00
IIEW	6	0.00	0.00	0.00	0.00

Source: Test results using Lingo 18 software.

Here table (5) shows that (IBSD) company has achieved the first rank that based on the sensitivity of companies in order to increase inputs and reduce output deficit, while the last rank goes for the two companies (IICM) and (IIEW), and the rest of the companies had their sequences distributed between these two companies.

Table (6) determining factors of industrial companies' inefficiency for 2018

Companies	E	S1	S2	OS1	OS2
ITLI	0.07	0.000	0.350	1.272	0.000
IMIB	0.60	0.000	0.446	0.409	0.000
IELI	0.04	1.034	0.411	2.972	0.000
IICM	1.00	0.000	0.000	0.000	0.000
INCP	0.13	0.000	0.412	1.496	0.000
IIEW	1.00	0.000	0.000	0.000	0.000
IMCI	0.75	1.572	0.000	1.887	0.000
IMOS	1.00	0.000	0.000	0.000	0.000
IBSD	1.00	0.000	0.000	0.000	0.000
IBPM	1.00	0.000	0.000	0.000	0.000
IHLI	0.13	0.000	0.728	1.065	0.065
IKLV	0.22	0.646	0.015	1.878	0.000
IITC	1.00	0.000	0.000	0.000	0.000
IRMC	1.00	0.000	0.000	0.000	0.000
IMPI	0.09	0.887	0.420	2.471	0.000

Source: Test results using Lingo 18 software.

Table (6) shows the efficiency levels for industrial companies which listed in the Iraq Stock Exchange, where seven other companies have achieved complete levels of efficiency within the (E-SBM) test, while eight companies suffered from one or both limitations of efficiency, some of them suffered from waste of resources (inputs) and shortages in production (outputs), such as (ITLI) company, as it was suffering from wastage (total expenses) and needed to be legalized and streamlined in the use of this resource by (350) Iraqi million dinars. Likewise, it was

suffering from a (share price) deficit, so it needed an increase (the share price) by (1,272) points, and the same applies to other companies that did not achieve efficiency.

Table (7) The super-efficiency of industrial companies for the year 2018

Companies	SE	S1	S2	OS1	OS2
IICM	1.00	0.00	0.00	0.00	0.00
IIEW	1.00	0.00	0.00	0.00	0.00
IMOS	1.31	0.33	0.00	0.00	0.21
IBSD	1.98	0.00	0.00	0.00	411.07
IBPM	1.80	0.10	0.30	0.00	0.00
IITC	1.08	0.00	0.11	0.00	0.00
IRMC	1.46	0.00	0.00	7.83	0.00

Source: Test results using Lingo 18 software.

Table (7) shows the company's efficiency within the results of the (ES-DSM) test in order to know the company's ability to increase the use of resources (inputs) and achieve a deficit or reduction in output, and the company remains efficient when it facing the same constraints, some companies were efficient and others were not, as (IBSD) company achieved highest level of efficiency by 1.98, and it can reduce (total revenue) till (411.070) million dinars and remain efficient, in contrast, there were incompetent companies such as (IICM) and (IIEW), which achieved lowest level of efficiency without exceeding (1). While the efficiency of other companies was between them, IBPM came in second place as it achieved an efficiency level of 1.80, as it can increase (total assets) by (100) Iraqi million dinars and increase (total expenses) by (300) Iraqi million dinars and remain efficient, as is the case for other companies.

Table (8) rank of industrial companies based on the ES-DSM test for 2018

Companies	E	SE	Rank
ITLI	0.069	1.00	13
IMIB	0.599	1.00	8
IELI	0.037	1.00	14
IICM	1.000	1.00	6
INCP	0.135	1.00	10
IIEW	1.000	1.00	6
IMCI	0.746	1.00	7
IMOS	1.000	1.31	4
IBSD	1.000	1.98	1
IBPM	1.000	1.80	2
IHLI	0.134	1.00	11
IKLV	0.220	1.00	9
IITC	1.000	1.08	5
IRMC	1.000	1.46	3

IMPI	**0.091**	**1.00**	**12**

Source: Test results using Lingo 18 software.

Table (8) shows the sequence of companies according to the results of the (ES-DSM) test, which showed that (IBSD) company achieved the first rank, while the last rank was for (IELI) company, and the other companies ranged in levels between these two companies.

Table (9) ranking of industrial companies on the basis of reduced cost for the year 2018

Companies	Rank	S1	S2	OS1	OS2
IBSD	**1**	**0.000**	**0.000**	**0.000**	**411.066**
IMOS	**2**	**0.329**	**0.000**	**0.000**	**0.209**
IBPM	**3**	**0.100**	**0.300**	**0.000**	**0.000**
IRMC	**4**	**0.000**	**0.000**	**7.835**	**0.000**
IITC	**5**	**0.000**	**0.107**	**0.000**	**0.000**
IICM	**6**	**0.000**	**0.000**	**0.000**	**0.000**
IIEW	**6**	**0.000**	**0.000**	**0.000**	**0.000**

Source: Test results using Lingo 18 software.

Table (9) shows that (IBSD) company achieved the first rank according on the sensitivity of companies to increase inputs and output deficit, while the last rank goes for two companies (IICM) and (IIEW), and the rest of the companies had their sequences distributed between these two companies.

Table (10) determining factors of industrial companies' inefficiency for 2019

Companies	E	S1	S2	OS1	OS2
ITLI	**0.08**	**0.000**	**0.207**	**0.894**	**0.009**
IMIB	**0.38**	**0.000**	**0.570**	**0.493**	**0.000**
IELI	**0.03**	**0.003**	**0.138**	**1.925**	**0.000**
IICM	**1.00**	**0.000**	**0.000**	**0.000**	**0.000**
INCP	**0.09**	**0.010**	**0.000**	**0.913**	**0.000**
IIEW	**1.00**	**0.000**	**0.000**	**0.000**	**0.000**
IMCI	**0.65**	**0.000**	**0.433**	**4.929**	**0.000**
IMOS	**1.00**	**0.000**	**0.000**	**0.000**	**0.000**
IBSD	**1.00**	**0.000**	**0.000**	**0.000**	**0.000**
IBPM	**1.00**	**0.000**	**0.000**	**0.000**	**0.000**
IHLI	**0.38**	**0.000**	**1.812**	**0.327**	**0.000**
IKLV	**0.15**	**0.000**	**0.020**	**1.836**	**0.000**
IITC	**0.76**	**0.918**	**0.000**	**0.684**	**0.000**
IRMC	**1.00**	**0.000**	**0.000**	**0.000**	**0.000**
IMPI	**0.08**	**0.000**	**0.183**	**2.327**	**0.000**

Source: Test results using Lingo 18 software.

Table (10) shows that there are six companies that have achieved a complete efficiency within (E-SBM) test, while nine companies suffer from one or both of the efficiency determinants, some of them were suffering from a waste of resources (inputs) and a deficit in production (outputs), such as the ITLI company, which was suffering from a waste of (total expenses) and

needed to be flexibility in the use of this resource by (207) Iraqi million dinars. Likewise, it was suffering from a deficit in (share price and total revenues), and it needed increasing in (share price) by (0.894) points and increasing in (total revenues) by (9) Iraqi million dinars, and the same applies to other companies that did not achieve efficiency.

Table (11) The super-efficiency of industrial companies for the year 2019

Companies	SE	S1	S2	OS1	OS2
IICM	1.00	0.00	0.00	0.00	0.00
IIEW	1.00	0.00	0.00	0.00	0.00
IMOS	1.22	0.00	0.00	0.00	0.40
IBSD	1.97	0.00	0.00	0.00	465.80
IBPM	2.84	0.00	0.25	2.27	0.00
IRMC	1.63	0.00	0.00	17.24	0.00

Source: Test results using Lingo 18 software.

The results of the (ES-DSM) test show the companies a superior efficiency, which is shown in Table (11) in order to know the company's ability to increase the use of resources (inputs) and achieve a deficit or reduction in output, and the company remains efficient in facing the same constraints, some companies were effective while others were not, As IBPM company that achieved the highest efficiency by (2.84), it can be able to increase input (total expenses) by (250) million dinars and reduce the output (the share price) by (2.27) points, and remain efficient. On the other hand, there were inefficient companies such as (IICM) and (IIEW), which achieved the lowest level of efficiency at an amount never exceed (1). If we compare other companies, IBSD came in second place, it achieved an efficiency level of (1.97), as it can reduce (total revenues) by (465,800) Iraqi million dinars and remain efficient.

Table (12) rank of industrial companies based on the ES-DSM test for 2019

Companies	E	SE	Rank
ITLI	0.082	1.00	12
IMIB	0.377	1.00	9
IELI	0.027	1.00	14
IICM	1.000	1.00	5
INCP	0.087	1.00	11
IIEW	1.000	1.00	5
IMCI	0.654	1.00	7
IMOS	1.000	1.22	4
IBSD	1.000	1.97	2
IBPM	1.000	2.84	1
IHLI	0.385	1.00	8
IKLV	0.154	1.00	10
IITC	0.757	1.00	6
IRMC	1.000	1.63	3
IMPI	0.079	1.00	13

Source: Test results using Lingo 18 software.

Table (12) shows the sequence of companies according to the results of (ES-DSM) test, which showed that (IBPM) achieved the first rank, while the last rank was given to (IELI) company and the other companies ranged in levels between these two companies.

Table (13) ranking of industrial companies on the basis of reduced cost for the year 2019

Companies	Rank	S1	S2	OS1	OS2
IBSD	**1**	**0.000**	**0.000**	**0.000**	**465.800**
IBPM	**2**	**0.002**	**0.248**	**2.271**	**0.000**
IRMC	**3**	**0.000**	**0.000**	**17.237**	**0.000**
IMOS	**4**	**0.000**	**0.000**	**0.000**	**0.403**
IICM	**5**	**0.000**	**0.000**	**0.000**	**0.000**
IIEW	**5**	**0.000**	**0.000**	**0.000**	**0.000**

Source: Test results using Lingo 18 software.

Table (13) shows that (IBSD) company achieved the first rank, because it contributed by increasing inputs and the output deficit, while the last rank goes to both (IICM) and (IIEW) companies, and the rest of companies had their sequences and distributed between these two companies.

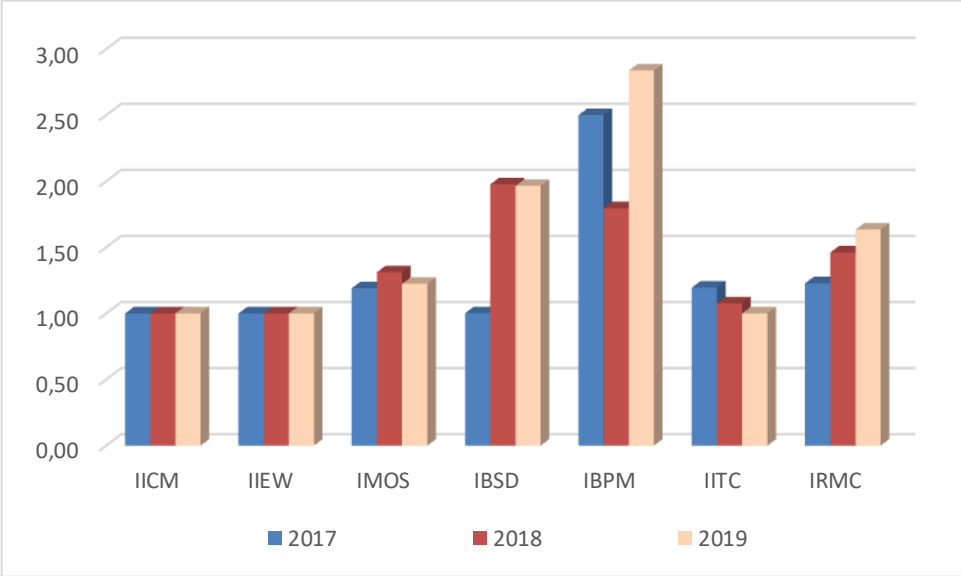

Figure (1):The super-efficiency of industrial companies for the period 2017-2019

Figure (1) shows that (IBPM) get the first ranked during the study period as a result based on (ES-DSM) test, while (IBSD) get the second ranked, in contrast to the sequence of (IICM) and (IIEW) companies who was the last and over the period, while the he rest of other companies have different levels between them.

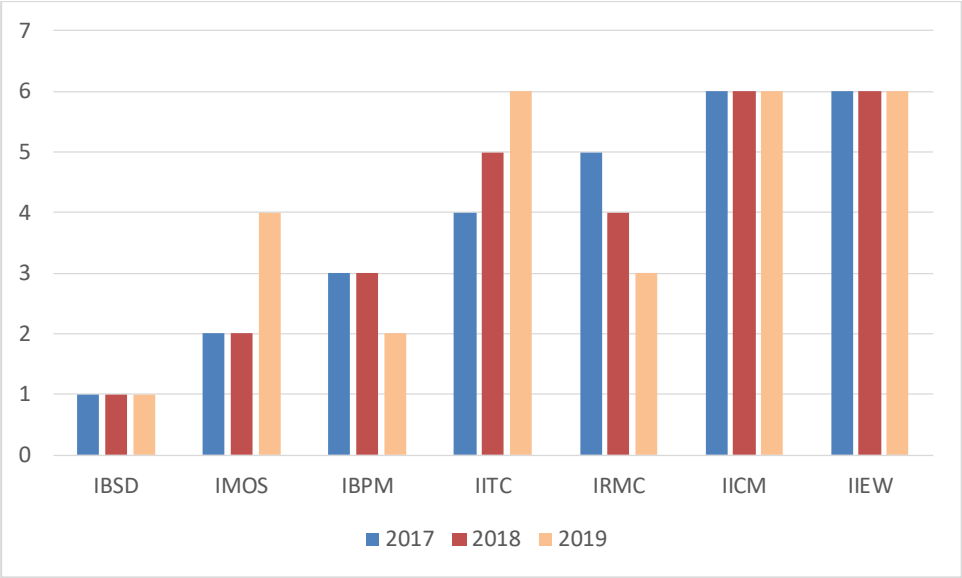

Figure (2):Ranking of industrial companies on the basis of reduced cost for the period 2017-2019

(IBSD) obtained first ranked during the period (2017-2019) among the companies that showed how to achieved superior efficiency and showed the ability of companies to reduce their outputs and increase their inputs.

Conclusion

Seven companies achieved 100% efficiency during 2017, five of them achieved superior efficiency, so (IBPM) ranked the first level, while (IICM) and (IIEW) ranked at the last level. In 2018, also there are seven companies achieved an efficiency rate of 100%, five of them achieved superior efficiency, as (IBSD) company which ranked at the first level, while (IICM) and (IIEW) companies ranked at the last level. On the other hand, during 2019 there were six companies that achieved an efficiency rate of 100%, four of them achieved a maximum efficiency, the first rank goes for (IBPM) and the last rank goes for both (IICM) and (IIEW) companies. At study period, (IBPM) company is considered the best company, it also achieved the first rank that based on the (ES-DSM) test, while (IBSD) ranked the second, and, IBSD Company achieved the first rank during (2017-2019) among the companies that achieved superior efficiency that based on companies' ability testing to reduce their outputs and increase their inputs. While (IBPM) and (IMOS) companies were ranked secondly to become the best two companies that other companies can consider them as a perfect company to follow them in their management of resources and achieve the best return, which was positively reflected on their financial and market indicators.

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Appendix (1) Inputs and outputs for industrial companies used in the analysis

Companies	Total assets	Total expenses	share price (closing price)	Total revenue
2017				
ITLI	**18.8**	**10.0**	**0.7**	**5.0**
IMIB	**5.8**	**4.8**	**0.9**	**3.0**

IELI	**37.2**	**13.5**	**1.4**	**7.0**
IICM	**2.4**	**2.2**	**0.7**	**0.5**
INCP	**12.4**	**12.8**	**0.8**	**11.8**
IIEW	**1.9**	**0.9**	**1.6**	**0.9**
IMCI	**5.1**	**2.1**	**39.8**	**2.4**
IMOS	**1.0**	**0.4**	**2.8**	**0.5**
IBSD	**188.5**	**208.1**	**3.0**	**232.2**
IBPM	**1.1**	**0.1**	**2.7**	**0.2**
IHLI	**4.2**	**5.4**	**0.6**	**1.0**
IKLV	**6.8**	**5.1**	**2.5**	**5.8**
IITC	**3.5**	**0.7**	**4.2**	**0.9**
IRMC	**3.2**	**1.7**	**5.0**	**1.7**
IMPI	**10.4**	**5.1**	**1.1**	**3.8**
2018				
ITLI	**15.1**	**7.6**	**0.7**	**2.2**
IMIB	**4.6**	**3.7**	**0.6**	**2.5**
IELI	**31.0**	**11.8**	**1.6**	**6.8**
IICM	**2.0**	**1.6**	**0.5**	**0.3**
INCP	**9.1**	**6.0**	**0.9**	**3.2**
IIEW	**1.7**	**0.5**	**0.9**	**0.3**
IMCI	**7.9**	**3.7**	**60.5**	**4.0**
IMOS	**1.2**	**0.5**	**3.5**	**0.6**
IBSD	**197.2**	**188.5**	**2.3**	**210.5**
IBPM	**1.1**	**0.2**	**1.7**	**0.1**
IHLI	**7.4**	**5.6**	**0.7**	**0.8**
IKLV	**6.4**	**1.1**	**1.3**	**0.9**
IITC	**3.2**	**0.7**	**4.3**	**0.9**
IRMC	**2.7**	**1.1**	**8.5**	**1.0**
IMPI	**11.6**	**4.5**	**1.5**	**2.2**
2019				
ITLI	**14.2**	**5.2**	**0.5**	**0.9**
IMIB	**3.4**	**2.2**	**0.5**	**0.6**
IELI	**26.9**	**6.5**	**1.0**	**2.8**
IICM	**1.7**	**0.8**	**0.4**	**0.2**
INCP	**7.7**	**4.3**	**0.5**	**2.0**
IIEW	**1.6**	**0.4**	**0.6**	**0.1**

IMCI	**9.9**	**8.2**	**77.0**	**8.4**
IMOS	**1.6**	**0.5**	**2.8**	**0.9**
IBSD	**226.9**	**211.2**	**2.9**	**241.3**
IBPM	**1.0**	**0.1**	**1.9**	**0.1**
IHLI	**3.3**	**4.4**	**0.4**	**0.8**
IKLV	**6.3**	**0.9**	**1.1**	**0.9**
IITC	**2.8**	**0.6**	**4.3**	**0.8**
IRMC	**2.7**	**1.3**	**13.6**	**1.1**
IMPI	**10.7**	**3.5**	**1.3**	**2.0**