Relative Financial Efficiency and Its Relation with Earning per Share for Public-Joint Companies Active in Automotive Parts Industry: Evidence from Iran

M. Dadkhah, A. Hadi-Vencheh, M. Tavassoli Kajani and M. Mirjaberi

Islamic Azad University, Khorasgan Branch, Khorasgan, Isfahan, Iran

Abstract: This paper is initially due to the relative financial efficiency (RFE) evaluation for public-joint companies active in the automotive parts industry using data envelopment analysis (DEA), and thereupon, testing the relations between companies’ RFE and earning per share (EPS). The research hypotheses involve: 1) There exists a significant relation between companies’ RFE and EPS; 2) The EPS of efficient companies are greater than the EPS of inefficient companies. The methods applied for testing the 1st hypothesis are: Regression analysis, significance testing of B (the slope of regression line), and Pearson’s correlation coefficient, R, analysis. For testing the 2nd hypothesis, two societies mean comparison is applied. The results of the 1st hypothesis testing show that there is a significant relation between companies’ RFE and EPS, whereas, the results of the 2nd hypothesis testing reject companies’ EPS order according to their efficiency.

Key words: Data Envelopment Analysis (DEA), Efficiency, Earning per Share (EPS), Public-joint companies, Automotive parts industry.

1. Prologue:

Men always search the optimum use of limited economics’ resources. From managing point of view, aspects like labor division, standards enactment, timing, motion assessment, and codifications of corresponding scientific fundamentals are all in order to increase production using specific amount of resources. Earning the maximum output from men efforts, using the minimum inputs, is a concerning subject for both divine and scientific doctrines.

Therefore, entities, organizations, and governments need an attribute for measuring their success to achieve the goal and providing them with feedbacks to show their deviation from it. Hence, productivity and efficiency discussion is raised.

In this paper, in addition to the efficiency measurement and companies ordering, the relation between the efficiency and EPS would be studied. For this purpose, having the present discussions on the relation between efficiency and EPS been studied, the relation between these variables are explained.

Farrell (1957) emphasized on units weighted sums to make a virtual unit, and as a usual measure, defined the technical efficiency as the outputs weighted sum to the inputs weighted sum ratio. This definition results to the followings:

a) Efficiency has inverse relation with inputs (direct material costs, direct wage costs, manufacturing overhead, sales distribution, general, administrative, and financial expenses). Increase in these variables implies the efficiency decrease.

b) Efficiency has a direct relation with outputs (sales, net profit). Increase in these variables implies efficiency increase.

On the other hand, the efficiency is calculated as:

\[ r_e = \left( \frac{p_t - p_{t-1}}{d_t} + d_t \right) \times 100 \]

Where:

- \( p_t \) = Share price at the end of period \( t \);
- \( p_{t-1} \) = Share price at the beginning of period \( t \) (or at the end of period \( t-1 \));
- \( d_t \) = Distributed profit per share at the period \( t \).

Since \( d_t \) is a function of companies’ income, and the companies’ income also has inverse relation with input variables and direct relation with output variables, it is concluded that:

a) EPS has inverse relation with input variables and increase in these variables yield to EPS decrease;

b) EPS has direct relation with output variables and increase in these variables yield to EPS increase.

Corresponding Author: M. Dadkhah, A. Hadi-Vencheh, Islamic Azad University, Khorasgan Branch, Khorasgan, Isfahan, Iran
E.mail. abdh12345@yahoo.com
The aforementioned discussion shows that the changes direction of companies’ RFE and EPS are identical. Accordingly, the research hypotheses are:

*Hypothesis I:* There exists a significant relation between companies’ RFE, using DEA, and EPS.

*Hypothesis II:* The EPS of efficient companies are greater than the EPS of inefficient companies.

It should be noted that after companies RFE evaluation and ordering, companies are divided into two groups of efficient companies and inefficient companies.

2. **Background:**

Data envelopment analysis (DEA) techniques are widely applied for evaluating the performance and productivity of many different kinds of entities engaged in various economic sectors as manufacturing, services, and trading. One reason is that DEA has opened up possibilities for use in cases which reflects complex and often unknown nature of relations between inputs and outputs (Charnes *et al.*, 1978; Cooper *et al.*, 2007)

This section is concerned with a brief introduction to the subject of DEA for the scope of this paper. However, the interested reader is referred to Cooper *et al.*, 2007.) for detailed discussions.

In general, performance evaluations take a variety of forms in customary analyses. Examples include cost per unit, satisfaction per unit, and so on, which are measures stated in the form of an output to input ratio. The usual measure of “productivity” also assumes a ratio form when used to evaluate worker or employee performance.

For the scope of this paper, among all available DEA models, the slacks-based measure of efficiency (SBM) is applied due to the following properties:

1. The measure is invariant with respect to the unit of measurement of each input and output item. (Unit invariant)
2. The measure is monotone decreasing in each input and output slack. (Monotone)

2-1 **Definition of SBM:**

Supposing the problem under study is the efficiency evaluation of some decision making units (DMUs). These DMUs may include different branches of a Chain Store to air bases. The share point of these DMUs is the input and output items. Assume that \( X \in \mathbb{R}^{m \times n} \) and \( Y \in \mathbb{R}^{r \times n} \) denote the input and output matrices, respectively. In fact, the entry \( x_{ij} \) denotes the input item \( i \) for DMU \( j \). Correspondingly, the entry \( y_{jr} \) denotes the output item \( r \) for DMU \( j \).

In order to estimate the efficiency of a DMU with input vector \( x_o \) and output vector \( y_o \), the following fractional program in \( \lambda, s^-, \) and \( s^+ \) is formulated:

\[
\begin{align*}
\min_{\lambda, s^-} & \quad \frac{1}{1 + \frac{1}{m} \sum_{i=1}^{m} s_i^-/x_{io}} \\
\text{s. t.} & \quad x_o = X\lambda + s^- \\
& \quad y_o = Y\lambda - s^+ \\
& \quad \lambda \geq 0, s^- \geq 0, s^+ \geq 0
\end{align*}
\]

In this model, it is assumed that \( X \geq 0 \). If \( x_{io} = 0 \), then the term \( s_i^-/x_{io} \) in the objective function is eliminated. If \( y_{ro} \leq 0 \), then it would be replaced by a very small positive number so that the term \( s_r^+/y_{ro} \) plays a role of penalty.

The variables \( s^- \) and \( s^+ \) are input excess and output shortfalls, respectively. It is readily verified that an increase in either \( s_i^- \) or \( s_r^+ \), all else held constant, will decrease the objective value and, indeed, do so in a strictly monotone manner. It is also established \( 0 \leq \rho \leq 1 \).

**Definition 2-1-1 (SBM efficient):** A DMU \( (x_o, y_o) \) is SBM-efficient if and only if \( \rho^* = 1 \), where \( \rho^* \) is the optimal value of model (1).
This condition is equivalent to \( s^- = \theta \) and \( s^+ = \theta \), that is, no input excess and no output shortfall in an optimal solution.

**Definition 2-1-2 (Reference set):** The set of indices corresponding to positive \( \lambda_i^+ s \) is called the reference set for \((x_o, y_o)\).

For alternative optimal solutions, in absence of degeneracy, the reference set is not unique. However, any one may be selected to meet the purpose.

In order to simplify equation (1) let \( \theta = 1 - s_i \) and \( \varphi_r = 1 + s_r^+ \). Putting these values in equation (1) yields:

\[
\begin{align*}
\min_{\lambda \neq 0} & \quad \rho = \frac{s}{m} \sum_{i=1}^{m} \theta_i \\
\text{s.t.} & \quad \theta x_o - X = 0 \\
& \quad \varphi y_o - Y = 0 \\
& \quad \lambda \geq 0, \theta \geq 0, \varphi \geq 0
\end{align*}
\]

Solving the fractional programming given in equation (2) is still difficult. However, in order to transform it into a linear programming, variable \( \tau \) is defined such that \( \tau \sum_{r=1}^{s} \varphi_r = 1 \). Note that by definition, \( \tau > 0 \). Hence, the equation (2) becomes:

\[
\begin{align*}
\min_{\lambda \neq 0} & \quad \rho = \frac{s}{m} \sum_{i=1}^{m} \tilde{\theta}_i \\
\text{s.t.} & \quad \sum_{r=1}^{s} \tilde{\varphi}_r = 1 \\
& \quad \theta x_o - X = 0 \\
& \quad \varphi y_o - Y = 0 \\
& \quad \tilde{\lambda} \geq 0, \tilde{\theta} \geq 0, \tilde{\varphi} \geq 0
\end{align*}
\]

In real situations, the SBM-efficient DMU may not be unique. This results in not being able to rank all DMUs. To overcome this difficulty, super-efficiency methods are proposed. In these methods, the model is modified such that the efficiency score can exceed 1. In this study, Tone’s method is applied.

SBM super-efficiency measure, introduced by Tone (2001), is defined as:

\[
\begin{align*}
\min_{\lambda \neq 0} & \quad \kappa = \frac{s}{m} \sum_{i=1}^{m} \xi_i \\
\text{s.t.} & \quad \sum_{r=1}^{s} \psi_r = 1 \\
& \quad \xi x_o - \sum_{j=1}^{n} x_j \lambda_j \geq 0, \quad i = 1, \ldots, m \\
& \quad -\psi y_o + \sum_{j=1}^{n} y_j \lambda_j \geq 0, \quad r = 1, \ldots, s \\
& \quad \lambda_j \geq 0 \quad j = 1, \ldots, n \\
& \quad \xi_i \geq 1 \quad i = 1, \ldots, m \\
& \quad \psi_r \geq 0 \quad r = 1, \ldots, s
\end{align*}
\]

3. **Research strategy:**

This section offers an overview of the research from aspects of methodology, the society, and both data gathering and analyses.
The nature of research is descriptive and comparative while distinguishing DMUs’ efficiency and overall rankings are sought, and, it is descriptive inference, correlative, while the relation between efficiency and EPS is hunted.

The case study includes the public-joint manufacturing companies whose fiscal year ends on March, 20 and their shares are continually traded in during the years 2002-2007. The sample under study is automotive parts manufacturing companies.

The research time scope, according to the used data, is from March 21, 2002 to March 20, 2007. Since the numerical data are extracted from the statements of public-joint companies, the data collection method is library.

In this study, in order to evaluate the relative efficiency and rank the companies, DEA model is solved using DEA Microsoft® Excel Solver. Also, for testing the 1st hypothesis, suitable tests like regression analysis and Pierson’s correlation is applied. The 2nd hypothesis is analyzed by societies mean comparison test using SPSS.

While the company performances are evaluating with system approach, generally, inputs, outputs, and the process under which inputs are translated into outputs are considered. In DEA, any organization as a DMU, according to the process of translating inputs into outputs with respect to other DMUs, is evaluated.

In this study, fifty public-joint automotive parts manufacturing companies, according to the both Stock Exchange and companies’ forensic auditor reports, are selected as DMUs for the research time scope (10 companies for each fiscal year).

Then, the input and output variables, considering the limitations in selecting them with particular attention to the statements’ operational variables, are selected by Delphi method. Due to discretionary inputs, the SBM model is applied for evaluating DMUs’ technical efficiencies and returns to scale. This model also proposes solutions for translating inefficient DMUs on the efficient frontier. Finally, DMUs with efficiency score equals 1 are ranked using Tone’s super-efficiency method.

After all, statistical methods are applied to test the research hypotheses. The 1st hypothesis tests the existence of a significant relation between companies RFE and EPS. In order to test this hypothesis, both regression and correlation analyses are applied. The 2nd hypothesis tests if the EPS of efficient companies are greater than the EPS of inefficient companies. For this purpose, T-student test is applied to compare the means of two societies.

4. Research implementation:

This study is implemented through the following steps:

(a) SBM model is run for DMUs in order to reveal their efficiency scores. Then, DUMs with efficiency scores equal 1 are ranked by Tone’s method.

(b) Having DMUs are ranked; the 1st and 2nd hypotheses are tested.

The research variables according to the simplicity, understanding, being quantitative, data accessibility, and applicability are chosen based on expert consultations. These variables are also categorized into computational and statistical variables.

4-1 Computational variables:

Computational variables are applied for both evaluations and measurements of DMU efficiencies. The major factor for determining the input and output variables is DMUs income statements because it shows DMUs annual yield and its contents helps extracting DMUs financial information. Both inputs and outputs variables should include the following properties:

(a) They should be similar and having the same direction. Similarity means the same variables should be applied for all DMUs. Having the same direction means increases or decreases in either inputs or outputs have the same impact on DMU efficiency. For instance, if increase in any output variables yields to efficiency increase, then increase in an undesirable variable as wastes should also increase the efficiency.

(b) All input and output variables should be calculated for the same period.

(c) Total number of both inputs and output variables should not exceed one-third (1/3) of DMUs.

Considering the above properties, the computational variables for this study are recognized as:

(a) Input variables
   - Direct materials
   - Direct pay
   - Manufacturing overhead
   - Distribution, sales, general, and administrative expenses
   - Financial costs

(b) Output variables
   - Sale
Net profit
(c) Input and output variables
• Direct materials
• Direct pay
• Manufacturing overhead
• Distribution, sales, general, and administrative expenses
• Financial costs
• Sale
• Net profit

4-2 Statistical variables:
These variables are relative efficiency and EPS as the independent and dependent variables, respectively between which the relationship is tested in this study. Table below would clarify the idea:

<table>
<thead>
<tr>
<th>Variables</th>
<th>Type</th>
<th>Calculation method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative Efficiency</td>
<td>Independent</td>
<td>According to SBM and Tone models</td>
</tr>
<tr>
<td>EPS</td>
<td>Dependent</td>
<td>[EPS_{t+1} = \left(\frac{P_t - P_{t-1}}{P_0}\right) + DPS_t + R + S \times 100]</td>
</tr>
</tbody>
</table>

Where:
\(EPS_{t+1}\) : EPS in the fiscal year \(t + 1\);
\(DPS_t\) : DPS at the end of year \(t\);
\(P_t\) : Stock price at the end of fiscal year \(t\);
\(P_{t-1}\) : Stock price at the end of fiscal year \(t - 1\);
\(R\) : Priority shares;
\(S\) : Awarding stocks

It should be noted that, in order to test the study hypotheses, the efficiency of each fiscal year is compared with the EPS of next year due to the impact of company’s performance on EPS of next fiscal year is desired.

4-3 Research hypotheses test:
In this study, for the 1st hypothesis test, i.e. there exists a significant relationship between companies’ RFE and EPS, regression analysis, significant test of regression slope \((\beta)\), and Pearson’s correlation coefficient \((r)\) analysis are applied.

For the 2nd hypothesis test, i.e. EPS of efficient companies are greater than EPS of inefficient companies, the comparison test of two communities is applied.

The 1st hypothesis test: Statistical inference about the slope of regression line:

Research hypothesis: \((H_1)\): There exists a significant relationship between Companies’ EPS and RFE.

Statistical hypothesis: \((H_0)\): There is no significant relationship between Companies’ EPS and RFE.

In mathematical notations:
\[
\begin{align*}
H_0 : \beta &= 0 \\
H_1 : \beta &\neq 0
\end{align*}
\]

In Table below, mean, standard deviation, and the number of variables are illustrated. Thus, the dependent variables (EPS) and independent variables (RFE) mean are respectively 19.94 and 2.28.

The 1st hypothesis test: Correlation analyses:
In table below Pearson’s correlation coefficients, as well as, the significance level between the variables are illustrated. Thus, at 95% confidence level, there is a direct relatively weak correlation \((r = 0.351)\) among the variables.
Table 2: Descriptive statistics.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Number of variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPS</td>
<td>19.9408</td>
<td>50.53468</td>
<td>50</td>
</tr>
<tr>
<td>RFE</td>
<td>2.2751</td>
<td>2.00428</td>
<td>50</td>
</tr>
</tbody>
</table>

Table 3: Coefficients.

<table>
<thead>
<tr>
<th>Model</th>
<th>Non-standardized coefficients</th>
<th>Standardized coefficients</th>
<th>Statistics</th>
<th>Significance</th>
<th>95% confidence interval for $\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\beta$</td>
<td>Std. Error</td>
<td>$\beta$</td>
<td></td>
<td>Lower Bound</td>
</tr>
<tr>
<td></td>
<td>$\beta$</td>
<td>Std. Error</td>
<td>$\beta$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EPS</td>
<td>$-0.220$</td>
<td>10.285</td>
<td>$-0.21$</td>
<td>0.983</td>
<td>$-20.899$</td>
</tr>
<tr>
<td>RFE</td>
<td>8.861</td>
<td>3.407</td>
<td>0.351</td>
<td>2.601</td>
<td>0.012</td>
</tr>
</tbody>
</table>

The critical values at 95% confidence level and 48 degrees of freedom 48 equals ±2.01. That is, $t_{0.025,48} = t_{0.025,48} = 2.01$. Since $t = 2.601 \notin [-2.01, 2.01]$, at the confidence level 95%, the hypothesis $H_0$ is rejected. In other words, at the confidence level 95%, there is a significant relationship between EPS and RFE.

Table 4: Correlation analyses.

<table>
<thead>
<tr>
<th></th>
<th>Pearson’s correlation</th>
<th>Significance (1-tailed)</th>
<th>Number of DMUs</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPS</td>
<td>1.000</td>
<td>EPS</td>
<td>50</td>
</tr>
<tr>
<td>RFE</td>
<td>0.351</td>
<td>RFE</td>
<td>50</td>
</tr>
<tr>
<td>EPS</td>
<td>.006</td>
<td>EPS</td>
<td>50</td>
</tr>
<tr>
<td>RFE</td>
<td>0.006</td>
<td>RFE</td>
<td>50</td>
</tr>
</tbody>
</table>

In table below the coefficient of determination equals 0.124 ($r^2 = 0.124$). It means that at 95% confidence level only 0.124 of EPS changes are due to the RFE changes.

Table 5: Model summary.

<table>
<thead>
<tr>
<th>Model</th>
<th>$r$</th>
<th>$r^2$</th>
<th>Adjusted $r^2$</th>
<th>Std. Error of the estimates</th>
<th>$r^2$ change</th>
<th>$F$ change</th>
<th>$dF_1$</th>
<th>$dF_2$</th>
<th>Sig. $F$ change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.351</td>
<td>0.124</td>
<td>0.105</td>
<td>47.80107</td>
<td>0.124</td>
<td>6.765</td>
<td>1</td>
<td>48</td>
<td>0.012</td>
</tr>
</tbody>
</table>

The 2nd hypothesis test:

For the 2nd hypothesis test, the comparison test of two communities is applied. Consequently, results of various stages of testing are as follows:

Research hypothesis: ($H_1$): The EPS of efficient companies are greater than the EPS of inefficient companies.

Statistical hypothesis: ($H_0$): The EPS of efficient companies are not greater than the EPS of inefficient companies.

In mathematical notations:

\[
\begin{align*}
H_0 &: \mu_1 \leq \mu_2 \\
H_1 &: \mu_1 > \mu_2 
\end{align*}
\]

In table below, the mean, standard deviation, and the number of variables are listed:

Table 6: Group statistics.

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of variables</th>
<th>Mean</th>
<th>Std. Error</th>
<th>Mean</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5</td>
<td>21.2200</td>
<td>42.86682</td>
<td>19.17062</td>
<td>7.71246</td>
</tr>
<tr>
<td></td>
<td>45</td>
<td>19.7987</td>
<td>51.73678</td>
<td>7.71246</td>
<td></td>
</tr>
</tbody>
</table>

The statistics of the research hypothesis equals 0.265 ($t = 0.265$):

The critical value at 95% confidence level and 48 degrees of freedom equals 1.68. That is, $t_{0.025,48} = t_{0.025,48} = 1.68$. Since $t = -1.55$ is less than the critical value, the test statistics does not belong to the critical region. Thus, at 95% confidence level the hypothesis $H_0$ is accepted. In other words, at 95%
confidence level, it cannot be concluded that EPS of efficient companies are greater than EPS of inefficient companies.

<table>
<thead>
<tr>
<th>Table 7: Independent samples test.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levie’s test for equality of variances</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Equal variance assumed</td>
</tr>
<tr>
<td>Equal variance not assumed</td>
</tr>
</tbody>
</table>

**Conclusion:**

The results of this study shows that in automotive parts industry, with the assumption of producing scale resemblance, companies with less direct material expenses are more effective than other ones. Hence, this study is an appropriate reference for inefficient companies to resolve their deficiencies and decreasing their accrued expenditures by optimal use of resources which yields to efficiency improvement.

**REFERENCES**


Frankfurter, G., Elton G. McGoun, 1996. Toward Finance with Meaning, the Methodology of Finance: what it is and what it can be, JAJ press Inc.


