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Determination of Financial Performance Efficiency with Data Envelopment Analysis: Evidence from Borsa İstanbul (BIST) Transportation and Storage Sector

Veri Zarflama Analizi ile Finansal Performans Etkinliğin Tespit Edilmesi: Borsa İstanbul (BIST) Taşıma ve Depolama Sektörü

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ÖZ

Finansal rasyolar şirketlerin finansal yapılarını ve etkinliklerini açıklayan temel kriterler arasında yer almaktadır. Bu araştırmanın temel amacı BIST'de yer alan taşıma ve depolama sektörü şirketlerinin pandemi dönemindeki finansal etkinliklerinin DEA ile tespit edilmesidir. Araştırmada taşıma ve depolama sektöründe faaliyet gösteren 10 şirket ele alınmıştır. Şirketlerin etkinlik düzeylerinin tespit edilmesinde çıktı odaklı Charnes Cooper ve Rhodes (CCR) Model kullanılmıştır. DEA modelinin girdi ve çıktı kriterleri şirketlere ait finansal tablolardan elde edilen rasyo verilerinden oluşturulmuştur. Girdi kriterleri olarak cari oran, finansal kaldıraç oranı, finansman oranı verileri kullanılmıştır. Çıktı kriterleri olarak aktif karlılık oranı, özkaynak karlılık oranı ve Tobin Q oranı verileri kullanılmıştır. Bulgulara göre 10 şirketin 7'si tam etkinlik düzeyinde olduğu, 3'nün tam etkinlik düzeyinde olmadığı tespit edilmiştir. Tam etkinlik düzeyinde olmayan şirketlerin tam etkinlik düzeyine ulaşabilmek için hangi girdi değişkenlerine yönelmesi gerektiği tespit edilmiştir. Ayrıca girdi ve çıktı kriterlerin ağırlıkları tespit edilmiştir. Araştırma sonucunda şirketlerin tam etkinlik düzeyine ulaşabilmesi için öneriler sunulmuştur.

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ABSTRACT

Financial ratios are among the basic criteria that explain the financial structures and efficiency of companies. The main purpose of this research is to determine the financial efficiency of the transportation and storage sector companies in the BIST during the pandemic period with data envelopment analysis. In the research, 10 companies operating in the transportation and storage sector have been discussed. The output-oriented Charnes Cooper and Rhodes (CCR) Model has been used to determine the efficiency of the companies. The input and output criteria of the DEA model have been created from the ratio obtained from the financial statements of the companies. Current ratio, financial leverage ratio, financing ratio data have been used as input criteria. Return on assets ratio, return on equity ratio, Tobin's Q ratio data have been used as output criteria. According to the findings, 7 of the 10 companies have been found to be at full efficiency level, and 3 of them have not been found at full efficiency level. It has been determined which input variables should be directed to reach the full efficiency level of the companies that are not at the full efficiency level. In addition, the weights of the input and output criteria have been determined. As a result of the research, suggestions are presented for companies to reach full efficiency level.

1. Introduction

The Covid-19 pandemic has played an active role in the deterioration of international economic activities as well as human health. International trade is shown among the victims of the pandemic (Zhang et al., 2021). The main

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reasons for the deterioration and stagnation of the international trade structure are the deterioration of supply chain structures and the decrease in logistics activities (Butt, 2021). Recently, there are many studies examining the effect of the pandemic on the supply chain structure in the literature (Chowdhury et al., 2021). Studies indicate that the pandemic has disrupted supply chain structures and negatively affected companies operating in the logistics sector (Xu et al., 2021). There are studies supporting that logistics service providers operating in Turkey are adversely affected by the uncertainty and risky environment created by the pandemic conditions (Gultekin et al., 2022). In addition, the deterioration in the Turkish logistics service providers has also led to deterioration in their financial structures.

Regardless of the size of the logistics companies providing services at national and international level, the pandemic conditions have negative effects on the financial structures of the companies. In the literature, there are studies dealing with the effects of the Covid-19 pandemic on companies and sectors operating in the Turkish Stock Exchange (BIST) (İşler & Güven, 2021, Karakoç & Gündüz, 2021). Yücel and Durak (2021) presented evidence that the manufacturing sector companies in the BIST were affected by the pandemic conditions in terms of liquidity. Kehribar et al. (2021) determined the financial performance of companies operating in the food and beverage sector in the BIST during the pandemic process. Şenol and Otçeken (2021) drew attention to the existence of a causal relationship between the financial and industrial sector and the pandemic. Kılıç (2022) has obtained findings that the financial ratios of transportation and tourism companies in BIST are affected by Covid-19.

Different analytical approaches are applied in determining the financial performance and efficiency levels of companies in the BIST. In the evaluation of financial performance, faire un choix adéqua technique was used by Baydaş (2021). Baydaş and Elma (2021) applied PROMETHEE, TOPSIS and WSA techniques to determine the financial performance of companies operating in the manufacturing sector. Turhan and Aydemir (2021) preferred weighted AHP and gray relational analysis in the financial performance analysis of Information and Technology companies. İç et al. (2022) used AHP and VIKOR techniques to determine the financial performance of retail and wholesale trade companies. There are also studies that determine the financial efficiency analyzes of different sectors operating in BIST with the data envelopment analysis (DEA) method (Bakırcı et al., 2014; Aytekin & Kahraman, 2015; Kaya & Coşkun, 2016; Arslan, 2019; Soylu, 2020; Konak & Ayan Civelek, 2021; Yayla & Özer, 2022). In the research conducted on 6 e-commerce companies operating in the China stock market, Li and Chen (2010) used AHP and DEA analysis. In a study conducted on all property companies in the Malaysian stock market, Ismail et al. (2012) determined the efficiency of the companies using the technical efficiency DEA model. In a study on companies traded in the Korean stock market, Lim et al. (2014) applied the DEA cross-efficiency technique in portfolio selection. In the Zagreb Stock Market, Gardijan and Škrinjarić (2015) used time-dependent DEA Window Analysis for portfolio selection. Kahveci and Taliyev (2016) used the DEA method to measure efficiency in manufacturing firms in the Russian Stock Market.

In this research, the financial structures of companies in the Transportation and Storage sector in BIST for 2021 are discussed. It is aimed to apply DEA analysis to determine the financial efficiency of Transportation and Storage companies that continue their activities under the pandemic conditions of 2021. In this direction, the literature review and criteria selection are presented in the second part. Methodology is given in the third part. In the fourth part, the DEA analysis findings are included. In the fifth part, the results based on the findings are presented. In the last part of the research, the implications and limitations are explained.

2. Literature Review and Criteria Selection

Financial ratios are the basic indicators that explain the financial structures and financial orientations of companies. Financial ratios are widely used in determining the financial efficiency of companies in DEA applications and are accepted as input and output parameters in evaluating the financial performance of companies. In the literature, it is seen that financial ratios are used on financial efficiency. In the 1997-2004 period of the Standard and Poors 500 operating companies, Edirisinghe and Zhang (2010) determined the input and output selection with DEA. Based on expert opinions, a total of 18 input and output ratios that can be used in DEA models were determined in the research. These ratios are "return on equity, return on assets, net profit margin, earnings/share (eps), receivables turnover, inventory turnover, asset turnover, current ratio, quick ratio, debt to equity ratio, leverage ratio, solvency ratio-i, solvency ratio-ii, price to earnings ratio, price to book ratio, revenue growth rate, net income growth rate, EPS growth rate". Dizkırıcı (2014) used DEA analysis to determine the financial efficiency of companies operating in the food and beverage sector in the BIST in 2010-2012. In this study, current ratio and leverage ratio were used as input variables. In the Korean Stock Market for the period 2002-2011, Lim et al. (2014) used 9 input and 7 output criteria. Input criteria are receivable turnover, inventory turnover, asset turnover, current ratio, quick ratio, debt to equity ratio, leverage ratio, solvency ratio-i, solvency ratio-ii. output criteria are return on equity, return on assets, net profit margin, earnings per share (EPS), revenue growth rate, net income growth rate, earnings per share growth rate. Kahveci and Aliyev (2016) measured the 2009 efficiency level of manufacturing companies in the Russian Stock Market. In the research, public disclosure index, total assets were used as input variables. Market value, market to book ratio, Tobin's Q ratio were used as output variables.

Köse and Çekici (2016) used the DEA analysis, which determined the financial activities of the companies

included in the BIST Industrial index for the years 2011-2015. Input variables of DEA model are current ratio, inventory turnover, account receivable turnover, financial leverage ratio and financing ratio, while output variables are market to book ratio, return on equity, return on assets, and price earnings ratio. In the research that determined the financial efficiency of companies operating in the cement sector, Öztürk (2016) used the criteria of return on assets ratio and return on equity ratio among the model outputs. Abacıoğlu and Ünal (2017) determined the financial efficiency of BIST companies operating in the weaving, clothing, and leather Industry between 2013 and 2016. According to the research, financial leverage ratio was accepted among the input criteria, return on assets ratio, and return on equity ratio were accepted among the output criteria. In the study evaluating the portfolio optimization of the stocks traded in the Indian Stock Market for the period 2006-2013, Jothimani et al. (2017) used the PCA-DEA model. As input and output criteria in the research, "debt to equity ratio, quick ratio, current ratio, solvency ratio I-II, leverage ratio, asset turnover, inventory turnover, receivables turnover, return on assets, earnings per share, net profit margin, return on equity, revenue growth rate, earnings per share growth rate, net income growth rate, price to earnings ratio and price to book ratio" are used.

Akbulut and Rençber (2018) determined the financial efficiency levels of 17 Cement companies included in the BIST between 2011 and 2014 with DEA. In the study, current ratio and financial leverage ratio criteria are used as input criteria, return on assets ratio, and return on equity ratio are used as output criteria. Gürbüz and Dumlu (2018) used DEA to determine the financial efficiency of companies operating in the BIST sustainability index. In the DEA model, return on assets ratio and return on equity ratio are used as output criteria. Bardi (2020) determined the financial efficiency level of 22 companies in the BIST Food and Beverage Index between 2014-2018. In the DEA model of the research, current ratio and financial leverage ratio were used as input criteria. Return on assets Ratio is among the output criteria. In the cost-effectiveness analysis of 19 companies in the textile, clothing, and leather sectors in the BIST, Kıllı and Uludağ (2020) used DEA. Şengül (2020) used DEA analysis to determine the financial efficiency levels of the Basic Metal Industry companies traded in the BIST. Acid-test ratio, current ratio, total debt/ equity, total assets were used as input variables in the research. Net income, return on equity, net profit margin and Tobin's Q ratio were used as output variables.

In the study, it is aimed to benefit from financial ratios in determining the financial activities of companies providing transportation and storage services in 2021. In the study, current ratio, financial leverage ratio and financing ratio have been used as input variables, and return to assets ratio, return to equity ratio and Tobin's Q ratio have been used as output variables. The literature review of the ratios used as input and output is also presented in Table 2.

Table 2. Inputs and Outputs Criteria

Inputs		
I1	Current Ratio (Current Assets / Current Liabilities)	Edirisinghe and Zhang (2010), Dizkırcı (2014), Lim et al. (2014), Köse and Çekici (2016), Jothimani et al. (2017), Akbulut and Rençber (2018), Bardi (2020), Şengül (2020)
I2	Financial Leverage Ratio (Total Debt / Total Assets)	Edirisinghe and Zhang (2010), Dizkırcı (2014), Lim et al. (2014), Köse and Çekici (2016), Abacıoğlu and Ünal (2017), Jothimani et al. (2017), Akbulut and Rençber (2018), Bardi (2020)
I3	Financing Ratio (Equity / Total Debt)	Lim et al. (2014), Köse and Çekici (2016)
Outputs		
O1	Return on Assets Ratio (Net Income / Total Assets)	Edirisinghe and Zhang (2010), Lim et al. (2014), Köse and Çekici (2016), Öztürk (2016), Abacıoğlu and Ünal (2017), Jothimani et al. (2017), Akbulut and Rençber (2018), Gürbüz and Dumlu (2018), Bardi (2020), Kıllı and Uludağ (2020)
O2	Return on Equity Ratio (Net Income / Equity)	Edirisinghe and Zhang (2010), Lim et al. (2014), Köse and Çekici (2016), Öztürk (2016), Abacıoğlu and Ünal (2017), Jothimani et al. (2017), Akbulut and Rençber (2018), Gürbüz and Dumlu (2018), Kıllı and Uludağ (2020), Şengül (2020)
O3	Tobin's Q Ratio [(Total Passive – Equity) + Market Value] / Total Assets	Kahveci and Taliyev (2016), Şengül (2020)

Notes: Financial ratio calculations are presented in parentheses.

The current ratio shows the relationship between the current assets and short-term debts of the enterprise and shows whether the current assets can pay the short-term debts. The value of the current ratio may vary according to the sector in which the enterprise is located. In general, a current ratio of around 1.5 is considered sufficient. A high current ratio indicates that the company has a high ability to pay its short-term debts. However, what matters for companies is not the absolute size of current assets, but the speed of their conversion into cash. Analysts state that the excessive current ratio is due to the excess of idle funds in the hands of the enterprise.

Financial leverage ratio shows what percentage of the company's assets are financed by liability. A financial leverage ratio of around 0.50 is generally considered sufficient. However, after this level, debt may increase the operating risk and cause the business to enter financial distress. The high financial leverage ratio indicates that the margin of safety is low for the lenders and that the company is in trouble while paying its debts due to "interest and principal payments". For this reason, the people or organizations that will give credit to the business want this rate to be low.

Financing ratio shows the financial adequacy of the enterprise. It is desirable that the financing ratio be at least 1 because a ratio of 1 indicates the balance between equity and total debt. A ratio greater than 1 indicates that most of the assets are financed by equity, while a ratio less than 1 indicates that most of the assets are financed by debt. The fact that most of the assets are financed with debts shows that the business should bear the interest expenses as well.

Return to assets ratio determines the profitability of the investment made in the assets of the business and whether the business assets are used effectively. The high rate of return on assets indicates how successful the company is in profit.

Return to equity ratio measures the performance of the equities owned by the enterprises and determines whether the equities are used effectively or not. A high return on equity ratio indicates that the company has made a good investment and is able to control its expenses.

Tobin's Q ratio is the ratio of a company's market value to its assets' replacement cost. A Tobin's Q ratio greater than 1 indicates that the current asset ratio of the company is evaluated at a higher level by the market. If the ratio is less than 1, it is attributed to the fact that the company cannot evaluate its current assets with profitable options, and therefore the investment decisions of the investors about the company in question will be adversely affected.

3. Methodology

3.1. Units of Analysis

There are companies operating in different sectors in Borsa Istanbul. The aim of this research is to analyze the financial activities of transportation and storage service companies operating in BIST on a sectoral basis. There are a total of 10 companies in the transportation and storage sector group in BIST (KAP, 2022). General information about the companies is in Table 1. In this research, all 10 companies have been determined as decision making units (DMU). To determine the general financial efficiency levels of 2021, the financial statements of these companies for the year 2021 have been used.

Table 1. Decision Making Units (DMU)

Code	Company Name	Field of Activity
BEYAZ	Beyaz Filo Rent a Car Inc.	The company provides motor vehicle trade and after-sales service.
CLEBI	Çelebi Ground Handling Inc.	The firm provides airport ground handling services.
DOCO	DO & CO Aktiengesellschaft	The firm provides airline catering services, international organization catering services, and passenger lounge services.
GRSEL	Gür-Sel Tourism Transportation and Service Trade Inc.	The firm provides personnel and student transportation, travel and tourism transportation, international road passenger transportation and transportation services.
GSDDE	GSD Maritime Real Estate Construction Industry and Trade Inc.	The firm provides national and international sea transportation and ship ownership services.
PGSUS	Pegasus Air Transport Inc.	The company provides all kinds of air transportation services in the country and abroad.
RYSAS	Reysaş Transportation and Logistics Trade Inc.	The company provides transportation and logistics activities services.
THYAO	Turkish Airlines Inc.	The company provides all kinds of air transportation services in the country and abroad.
TLMAN	Trabzon Port Management Inc.	The firm provides port management services.
TUREX	Tureks Tourism Transportation Inc.	The company provides personnel transportation, individual and fleet car rental, construction machinery rental services.

3.2. Output Oriented CCR-O Analysis Model, Indices, and Parameters

In the CCR model, it is calculated as the sum of the weighted outputs and the weighted inputs for each DMU. The main goal is to maximize this ratio of weighted outputs to weighted inputs. In the output oriented CCR model (CCR-O), it is aimed to maximize the output level (Charnes et al., 1989).

The objective function and constraints of the CCR-O model are shown in Eq.1 and Eq.2, respectively.

$$\min e_k = \sum_{i=1}^{m} v_i x_{ik} \quad (1)$$

$$\sum_{i=1}^{m} v_i x_{ij} - \sum_{r=1}^{s} u_r y_{rj} \geq 0 \quad j = 1, \dots, n$$

$$\sum_{r=1}^{s} u_r y_{rk} = 0$$

$$u_r, v_i \geq 0; \; r = 1, \dots, s; \; i = 1, \dots, m \quad (2)$$

The dual models of the objective function and constraints of the CCR-O model are shown in Eq.3 and Eq.4, respectively.

$$\text{Max } Z_k \quad (3)$$
$$\sum_{j=1}^{n} \varphi_{jk} x_{ij} - x_{ik} \leq 0$$
$$z_k y_{rk} - \sum_{r=1}^{s} \varphi_{jk} y_{rj} - x_{ik} \leq 0$$
$$\varphi_{jk} \geq 0;\ r = 1, \dots, s;\ i = 1, \dots, m; j = 1, \dots, n \quad (4)$$

To determine the financial activities of Transport & Storage Sector companies, 3 ratios were accepted as inputs and 3 ratios as outputs. There is also a total of 10 DMUs. The indices and parameters of the study are as follows:

Indices:

i financial ratios input (m=3) i = 1,…,m

r financial ratios output (s=3) r = 1,…,s

j Transport & Storage Sector companies (n=10) j = 1,2…,n

Parameters:

v_i : "i" weight given to financial ratios input.

u_r : "r" weight given to financial ratios output.

x_{ik} : "k" score of the "i" financial ratios input of the decision unit.

y_{rk} : "k" score of the "r" financial ratios output of the decision unit.

$v_i\, x_{ij}$: "j" Transport & Storage Sector companies weighted input score.

$u_r\, y_{rj}$: "j" Transport & Storage Sector companies weighted output score.

4. Empirical Analysis Findings

The correlation relationships between the ratio variables used in the DEA analysis are shown in the Table 3. The correlation between Current Ratio and Financial Leverage Ratio is negative and significant ($p<0.05$). The correlation between Current Ratio and Financial Leverage Ratio is positive and significant ($p<0.01$). The correlation between Current Ratio and Financing Ratio is positive and significant ($p<0.01$). The correlation between Financial Leverage Ratio and Financing Ratio is negative and significant ($p<0.05$). The correlation between Financial Leverage Ratio and Return on Assets Ratio is negative and significant ($p<0.05$). The correlation between Financing Ratio and Return on Assets Ratio is positive and significant ($p<0.01$). The correlation between Return on Assets Ratio and Return on Equity Ratio is positive and significant ($p<0.01$).

Table 3. Correlation Results

	Current Ratio	Financial Leverage Ratio	Financing Ratio	Return on Assets Ratio	Return on Equity Ratio	Tobin's Q Ratio
Current Ratio	1					
Financial Leverage Ratio	-0.696*	1				
Financing Ratio	0.819**	-0.959**	1			
Return on Assets Ratio	0.828**	-0.842**	0.872**	1		
Return on Equity Ratio	0.446	-0.505	0.463	0.778**	1	
Tobin's Q Ratio	0.412	-0.533	0.596	0.589	0.396	1

Notes: * Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

An output-oriented DEA model has been developed to determine the financial efficiency of BIST companies operating in the transportation and storage sector. Model features of the DEA model are presented in Table 4.

Table 4. Features of the DEA Model

	Model Features
Model Name	Financial efficiency analysis of BIST companies (Transport & Storage Sector)
Model Type	CCR-O
Model Orientation	Output-Oriented
Model Efficiency Type	Tech
Model RTS	Constant
Model Description	The Charnes Cooper and Rhodes Model called CCR. This model was first introduced in 1978 and assumes CONSTANT RTS.

The dataset has been obtained by Finnet (2022) for 2021. The raw data of the input and output variables used in the model are presented in Table 5. DMUs are Transport & Storage Sector companies. Current ratio (I1), financial leverage ratio (I2), financing ratio (I3), return on assets ratio (O1), return on equity ratio (O2) and Tobin's Q ratio (O3) values are calculated according to the 2021 financial reports. Obtained ratio values have been used as raw data in the model. The visualization of the raw values is presented in the Figure 1.

Table 5. Raw Data of Inputs and Outputs

DMU Name	**I1**	**I2**	**I3**	**O1**	**O2**	**O3**
BEYAZ	1.55	0.55	0.83	9.04	21.54	2.55
CLEBI	1.14	0.74	0.36	12.97	62.37	1.56
DOCO	1.88	0.87	0.16	1.25	9.5	1.95
GRSEL	0.82	0.5	0.98	12.62	26.3	1.6
GSDDE	5.09	0.3	2.3	23.99	35.86	0.93
PGSUS	1	0.87	0.15	- 4.81	- 32.19	1.03
RYSAS	0.57	0.7	0.42	- 2.01	- 8.47	1.07
THYAO	0.73	0.74	0.34	3.04	12.62	0.82
TLMAN	4.74	0.26	2.87	33.07	44.43	3.83
TUREX	1.7	0.32	2.13	11.1	17.86	2.54

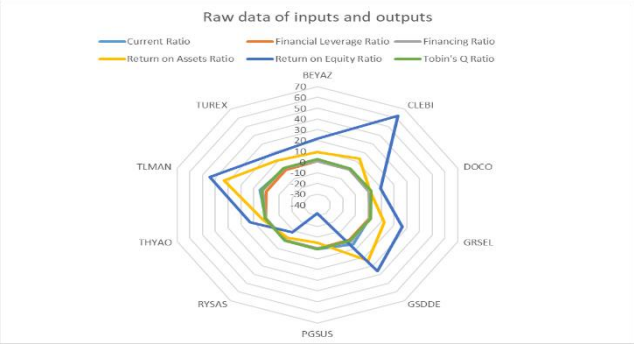


Figure 1: Raw Data of Inputs and Outputs Charts

The descriptive statistics of the input and output variables used in the DEA model and the correlation relations between the variables are presented in Table 6. According to Table 6, the correlation between "return on assets ratio" and all input variables is significant. however, the relationship between "return on assets ratio" and "financial leverage ratio" is negative. The correlation relationship between the output variables “return on equity ratio” and “Tobin's Q ratio” and the input variables in the tool is not significant. The correlation between “return on equity ratio” and “Tobin's Q ratio” and input variables is not significant.

Table 6. Descriptive Statistics and Correlation

Variables	Mean	Std. Dev.	I1	I2	I3	O1	O2	O3
I1	1.922	1.636105	1					
I2	0.585	0.233155	- 0.696*	1				
I3	1.054	1.004083	0.819**	- 0.959**	1			
O1	10.026	11.711037	0.828**	- 0.842**	0.872**	1		
O2	18.982	26.622694	0.446	- 0.505	0.463	0.778**	1	
O3	1.788	0.954100	0.412	- 0.533	0.596	0.589	0.396	1

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

To determine the efficiency level of the companies, output oriented CCR analysis has been carried out with the OSDEA package program. According to the analysis findings, 7 out of 10 companies have been found to be at full efficiency level. It has been determined that the remaining 3 companies (GSDDE, PGSUS, THYAO) are not at the full efficiency level. In Table 7, the efficiency levels of companies operating in the Transport & Storage Sector are presented.

Table 7. The Efficiency Levels of the Companies

DMU Name	Objective Value	Efficient
BEYAZ	1	Yes
CLEBI	1	Yes
DOCO	1	Yes
GRSEL	1	Yes
GSDDE	0.867790949	
PGSUS	0.911181491	
RYSAS	1	Yes
THYAO	0.7212932	
TLMAN	1	Yes
TUREX	1	Yes

The projections values are presented in Table 8. The visualization of the projection values is presented in the Figure 2. When the projections values are compared with the raw values, it is seen that the values of the companies with full efficiency level remain the same. The steps that companies that are not at full efficiency should take to reach full efficiency are as follows:

- GSDDE should reduce current ratio (I1) from 5.09 to 3.86. That is, the company needs to reduce the current ratio (I1) by about 25%. Accordingly, return on assets ratio (O1) increased from 23.99 to 27.64 (approximately 15%). return on equity ratio (O2) increased from 35.86 to 42.96 (approx. 20%), Tobin's Q Ratio (O3) increased from 0.93 to 3.20 (approximately 250%).

- PGSUS should reduce financial leverage ratio (I2) from 0.87 to 0.51. That is, the company needs to reduce the current ratio (I1) by about 15%. Accordingly, return on assets ratio (O1) increased from -4.81 to 3.67 (approximately 175%). return on equity ratio (O2) increased from -32.19 to 19.02 (approx. 160%), Tobin's Q ratio (O3) increased from 1.03 to 1.13 (approximately 10%).

- THYAO should reduce financial leverage ratio (I2) from 0.74 to 0.32. That is, the company needs to reduce the Current ratio (I1) by about 55%. Accordingly, return on assets ratio (O1) increased from 3.04 to 5.54 (approximately 80%). Return on equity ratio (O2) increased from 12.62 to 19.60 (approximately 55%), Tobin's Q ratio (O3) increased from 0.82 to 1.13 (approximately 40%).

Table 8: Projections Values of Inputs and Outputs

DMU Name	I1	I2	I3	O1	O2	O3
BEYAZ	1.55	0.55	0.83	9.04	21.54	2.55
CLEBI	1.14	0.74	0.36	12.97	62.37	1.56
DOCO	1.88	0.87	0.16	1.25	9.5	1.95
GRSEL	0.82	0.5	0.98	12.62	26.3	1.6
GSDDE	**3.86**	0.3	2.3	**27.64**	**42.96**	**3.20**
PGSUS	1	**0.51**	0.15	**3.67**	**19.02**	**1.13**
RYSAS	0.57	0.7	0.42	-2.01	-8.47	1.07
THYAO	0.73	**0.32**	0.34	**5.54**	**19.60**	**1.13**
TLMAN	4.74	0.26	2.87	33.07	44.43	3.83
TUREX	1.7	0.32	2.13	11.1	17.86	2.54

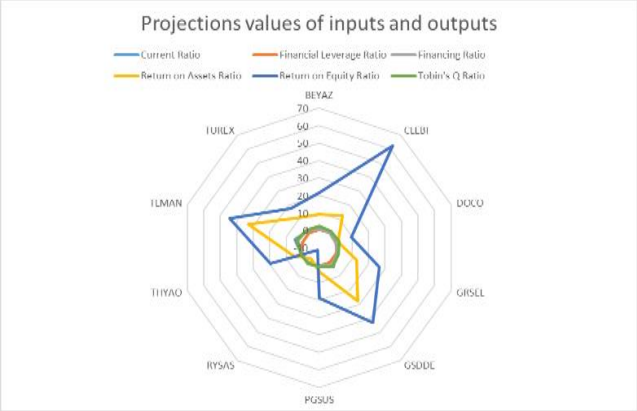


Figure 2: Projections Values of Inputs and Outputs Chart

Projections are calculated by considering the raw data of DMUs in the calculation of values. The reference company groups and Lambda (λ) values of companies that are not at the full efficiency level are presented in the Table 9. The peer group companies considered in calculating the projection value of the GSDDE company are CLEBI and TLMAN. The peer group companies considered in calculating the projection value of the PGSUS company are CLEBI and DOCO. The peer group companies considered in calculating the projection value of the THYAO company are BEYAZ and CLEBI.

Table 9. Lambdas (λ) and Peer Groups of Companies

DMU	BEYAZ	CLEBI	DOCO	GRSEL	RYSAS	TLMAN	TUREX	Peer
BEYAZ	1	0	0	0	0	0	0	BEYAZ
CLEBI	0	1	0	0	0	0	0	CLEBI
DOCO	0	0	1	0	0	0	0	DOCO
GRSEL	0	0	0	1	0	0	0	GRSEL
GSDDE	0	0.129	0	0	0	0.785	0	CLEBI,
PGSUS	0	0.246	0.382	0	0	0	0	CLEBI,
RYSAS	0	0	0	0	1	0	0	RYSAS
THYAO	0.321	0.203	0	0	0	0	0	BEYAZ,
TLMAN	0	0	0	0	0	1	0	TLMAN
TUREX	0	0	0	0	0	0	1	TUREX

In CCR model, it is suggested that the ratio of weighted outputs to weighted inputs should be maximum. In this research model, the weights of the inputs and outputs to reach the maximum level are as shown in Table 10. At this point, the variables that play a role in determining the financial efficiency of the companies are determined. For example, the input variables considered in calculating the financial efficiency of BEYAZ are current ratio (I1) and financing ratio (I3). The only output is Tobin's Q ratio (O3) among the variables. In Figure 3, the weights of the input and output variables are visualized. According to Figure 3, it is understood that the return on assets ratio and return on equity ratio output criteria are considered at a very low level in determining the financial activities of the companies in the transportation and storage sector.

Table 10. Weights of Input and Output Variables

DMU Name	I1	I2	I3	O1	O2	O3
BEYAZ	0.381	0.000	0.494	0.000	0.000	0.392
CLEBI	0.199	1.045	0.000	0.000	0.011	0.184
DOCO	0.469	0.000	0.736	0.000	0.000	0.513
GRSEL	0.270	0.780	0.397	0.079	0.000	0.000
GSDDE	0.000	0.520	0.433	0.042	0.000	0.000
PGSUS	0.888	0.000	1.394	0.000	0.000	0.971
RYSAS	0.961	0.000	1.077	0.000	0.000	0.935
THYAO	1.184	0.000	1.536	0.000	0.000	1.220
TLMAN	0.103	0.298	0.151	0.030	0.000	0.000
TUREX	0.253	0.911	0.131	0.012	0.006	0.298

5. Conclusion

It is clearly known that companies providing transportation and storage services during the Covid-19 pandemic period are affected by global supply chain disruptions. The closing of borders of states within the scope of pandemic measures has prevented both human mobility and the supply and supply of human needs. However, the importance of cold chain logistics, which plays an active role in the supply of vaccines, has also emerged. Companies operating in the transportation and storage sector have implemented various policies to avoid the uncertainty created by the pandemic conditions and to take precautions. In this research, it is aimed to determine the financial efficiency of the transportation and storage companies in the BIST in 2021 as a result of the policies implemented. As a result of the DEA, it was determined that 7 of the 10 companies operating in the transportation and storage sector (WHITE, CLEBI, DOCO, GRSEL, RYSAS, TLMAN and TUREX) are at full efficiency level and 3 of them (GSDDE, PGSUS and

THYAO) are not at full efficiency level.

CLEBI (0.129) and TLMAN (0.785) companies should be taken as a reference for the GSDDE company to reach its full efficiency level. Based on reference values, the GSDDE company needs to focus on the current ratio to maximize its financial output values. According to the analysis findings, the current ratio should be reduced by approximately 25%. This will enable the firm to reach the expected level in return on assets ratio, return on equity ratio and Tobin's Q ratio. In addition, the importance level of the input criteria of the GSDDE is financial leverage ratio, financing ratio and current ratio, respectively. The importance level of the output criteria is return on assets ratio, return on equity ratio and Tobin's Q ratio, respectively.

CLEBI (0.246) and DOCO (0.382) companies are the companies that should be taken as reference for the PGSUS to reach its full efficiency level. PGSUS company needs to focus on financial leverage ratio to maximize its financial output values. According to the analysis findings, it should be reduced by about 40%. This will enable the firm to reach the expected level in return on assets ratio, return on equity ratio and Tobin's Q ratio values. In addition, the importance of the input criteria in the financial efficiency of the PGSUS company is financing ratio, current ratio and financial leverage ratio, respectively. The importance level of the output criteria are Tobin's Q ratio, return on assets ratio and return on equity ratio, respectively.

WHITE (0.321) and CLEBI (0.203) are the companies that should be taken as reference for the THYAO company to reach its full efficiency level. THYAO company needs to focus on Financial leverage ratio to maximize its financial output values. According to the analysis findings, it should be reduced by approximately 55%. This will ensure that the firm's financial output values reach the expected level. In addition, the importance level of the input criteria in the financial efficiency of THYAO is financing ratio, current ratio and financial leverage ratio, respectively. The importance level of the output criteria are Tobin's Q ratio, return on assets ratio and return on equity ratio, respectively.

6. Implications and Limitations

The current ratio of the GSDDE company is well above the generally accepted value. The reason why the ratio is so high is that the company has a lot of idle funds. The company's total assets are large. However, the low rate of cashing in total assets may cause financial problems in the future. To reach the full efficiency level, there may be an increase in the return on assets ratio, return on equity ratio and Tobin's Q ratios along with the reduction of the current ratio. Financial leverage ratios of PGSUSS and THYAO companies are above the generally accepted value. This ratio shows how much of a company's assets are financed with debt. Such a high debt burden may increase the interest burden and may also cause difficulties in paying the debts. To reach full efficiency level, PGSUSS and THYAO companies need to lower their financial leverage ratio. However, there may be an increase in return on assets ratio, return on equity ratio and Tobin's Q ratios. As a result of the increase in the return on equity ratio and Tobin's Q ratios, the success of the companies in generating profits, the more effective use of equities, and the higher evaluation of the current asset ratio of the companies by the market can be achieved.

The limitations of this research are as follows: (i) The transportation and storage sector companies in the BIST have been determined as the sample area. (ii) The data of the research have been obtained from the companies' financial reports for 2021. (iii) Output-oriented CCO analysis has been used as the research method. (iv) Financial ratios have been used to determine financial efficiency. Suggestions for researchers are as follows: (i) The findings can be compared to different sectors in BIST. (ii) This research can be carried out based on 2022 data with the same sector and the same DEA model, and the findings obtained can be compared to determine the differences in financial efficiency levels between the pandemic period and the post-pandemic period. (iii) The developed DEA model can be applied to the financial markets of different countries.

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