Serbest Nakit Akışları İle Sermaye Yapısının İşletme Etkinliği Üzerindeki Etkisinin BİST 100'de Uygulaması

The Effect of Free Cash Flow and Capital Structure on The Company's Efficiency and an Application in ISE 100

Mustafa Rimaz[1]*
Yıldız Ayanoğlu[2]

* Sorumlu yazar
 Corresponding author

[1] Dr., Gazi Üniversitesi, Türkiye
Dr., Gazi University, Turkey
mustafa.rimaz@gmail. com,
ORCID ID 0000-0001-9708-2265

[2] Prof. Dr., Ankara Hacı Bayram Veli Üniversitesi, Türkiye,
Prof. Dr., Ankara Hacı Bayram Veli University, Turkey
yildiz.ayanoglu@hbv.edu.tr
ORCID ID 0000-0002-1024-2105

ÖZ

Günümüzde işletmelerin nihayi amacının değer maksimizasyonu olduğu kabul edilmektedir. Bu amacı gerçekleştirmek için verilen kararlar: yatırım, finansman ve temettü dağıtım kararları olarak sınıflandırılabilir. İşletme değerini etkileyen finansman kararların başında başarılı bir nakit yönetiminin olduğu düşünülmektedir. Nakit yönetimi kararları ile sağlanacak nakit mevcudu, işletmenin iktisadi faaliyetlerini sürdürebilmesi ve net pozitif değere sahip projelere yatırım yapabilmesi bakımından büyük öneme sahipken, ihtiyaçtan fazla nakitin bulundurulması temsil maliyetlerinin ortaya çıkmasına neden olabilecektir. Jensen, 1986 yılında ortaya koyduğu Serbest Nakit Akış Teorisinde, serbest nakit akışının kontrol altına alınmasıyla işletme değerinin artmasının sağlanabileceğini savunmaktadır. Bu teoriye göre serbest nakit akışı üzerinde düzenleyici role sahip olan faktörlerden biri işletmenin sermaye yapısı özellikle de yabancı kaynaklarıdır. Bu çalışma serbest nakit akışının sermaye yapısı ile birlikte işletme etkinliği üzerindeki etkisinin incelenmesi amacıyla yapılmıştır. Araştırmada 2009-2018 döneminde BİST 100'de imalat sanayi sektöründe faaliyet gösteren toplam 40 işletmenin verilerinden yararlanılmış, işletmelerin etkinliklerinin ölçülmesi için Charnes, Cooper ve Rhodes (CCR) - girdi yönelimli Veri Zarflama Analizi (VZA) yöntemi uygulanmıştır. İmalat sanayi sektöründe elde edilen bulgular, Jensen'ın Serbest Nakit Akışı Teorisiyle örtüşmüş olup, serbest nakit akışı ile işletme etkinliği arasında negatif; sermaye yapısı ile işletme etkinliği arasında pozitif (U biçimli), istatistiksel olarak anlamlı ilişki ortaya koymuştur. Diğer taraftan araştırmada bağımsız değişkenlerin işletme etkinliği üzerindeki etkilerinin gelecek dönemlerde tahmin edilebilirliği hakkında ayrı bir analiz yapılmıştır. Buna göre 2019 yılının ilk dokuz aylık verileri ele alınarak dönemin tamamı için tahmini etkinlik skorları, 2009-2018 dönemiyle ilgili geçmişe dönük tahmini etkinlik skorlarıyla karşılaştırılmıştır. Ulaşılan bulgular, imalat sanayi sektöründe, tüm değişkenler ile işletme etkinliği arasındaki ilişkilerin gelecek dönemlerde de aynı yönde olacağını göstermiştir.

Anahtar Kelimeler: Etkinlik, VZA, Serbest Nakit Akışı, Sermaye Yapısı, Temsil Maliyeti

ABSTRACT

Nowadays, it is accepted that the ultimate goal of firms is value maximization. Decisions made to achieve this aim are classified as investment decisions, financial decisions and dividend distribution decisions. It is thought that successful cash management is the leading financial decision that affects the firm's value. While the amount of cash that is provided by cash management decisions has a great importance for the company to continue its economic activities and to invest in projects with net positive value, having more cash than needed may cause agency costs. Jensen, with the Free Cash Flow Theory put forward in 1986, argues that, if free cash flow be brought under control it can eventually increase the firm's value. According to this theory, one of the factors that have a regulatory role on free cash flow is capital structure of the firm especially its foreign resources. This study was carried out to examine the effect of the free cash flow with capital structure on firm's efficiency. In the research, the data of a total of 40 companies operating in the manufacturing industry sector in Istanbul Stock Exchange (ISE) 100 within the period of 2009-2018 were used, Charnes, Cooper and Rhodes (CCR)-input oriented Data Envelopment Analysis (DEA) method was applied to measure the efficiency of the firms. The findings obtained in the manufacturing industry sector coincided with Jensen's Free Cash Flow Theory, and statistically revealed that free cash flow and capital structure had significant negative and significant positive (U shaped) relationship with firms' efficiency respectively. On the other hand, a separate analysis was made about the predictability of the effects of independent variables on firm's efficiency in coming periods. For this reason, by considering the data of the first 9 months of 2019, estimated efficiency scores for the whole period were compared with the historical efficiency scores for the period of 2009-2018. Findings have shown that there will be similar relationships between all variables and firm's efficiency in the manufacturing industry sector in the future.

KeyWords: Efficiency, DEA, Free Cash Flow, Capital Structure, Agency Cost

268

INTRODUCTION

In terms of finance science, the main purpose of companies is to maximize their own value. In order to achieve this goal, it is highly important for financial managers to make right decisions regarding investment, finance and profit distribution policies. Therefore, in order to establish appropriate financing policies, the effects of the capital structure on the efficiency and value of the firm urgently should be investigated. On the other hand, considering the importance of cash management in terms of the value of the company and the continuity of the firm, the effects of cash flows are also worth investigating.

The success of cash management will contribute to the efficiency of the firm and thus to increase its value. Cash has a great importance in terms of enabling firm's operations to continue and invest in projects with net positive value. On the other hand, while cash amount exceeds various needs such as continuing activities and realizing potential investments may cause agency costs in enterprises. According to the Free Cash Flow Theory developed by Jensen in 1986, it was argued that the free cash flow should be brought under control to increase the firm's value.

In addition, firms aim to reach maximum efficiency by using their scarce resources effectively. Therefore, not only their equity capital, but also debts obtained from out of the company should be used effectively in firm's activities. This efficiency can be achieved by making a meaningful and positive difference between the cost of the resources obtained and the value created using these resources. Proper adjustment of the debt and equity components that form the capital structure according to the economic conjuncture will contribute to both increasing the profitability of the firm and maximizing its value.

269

The capital structure and free cash flow are among the many factors affecting the value of the firm. The company's free cash flow is the cash after all expenses which needed cash – out and amounts classified as capital expenditures and working capital. The optimum capital structure and the proper management of cash flows will both increase the value of the firm and enable the investors to continue their activities in line with their interests. For this reason, determining the relationship between free cash flow and capital structure on the efficiency of the firm will significantly help the relevant interest groups in their decisions about the company.

This study, which aims to clearly reveal the relationship between the capital structure, free cash flow and the efficiency of the firms, with ISE 100 application, consists of four sections.

In the first two sections of the study free cash flow and capital structure, in the third section, concepts related to the efficiency and its measurement methods are explained. Thus, the conceptual framework that constitutes dependent and independent variables in statistical analysis is explained in these sections. In order for the variables in the application part to be understandable, the basic concepts in this part are organized in a

holistic approach and under subheadings. Following previous sections related studies is presented in literature review. Finally, in the last section of the study, an application research on manufacturing firms of ISE 100 is conducted. In this part, the efficiency of the enterprises is calculated with the DEA method and the relationships between the variables are presented statistically. In addition, statistical relationships emerging between the created variables and analyzes were made to predict the efficiency of the firms in the future periods.
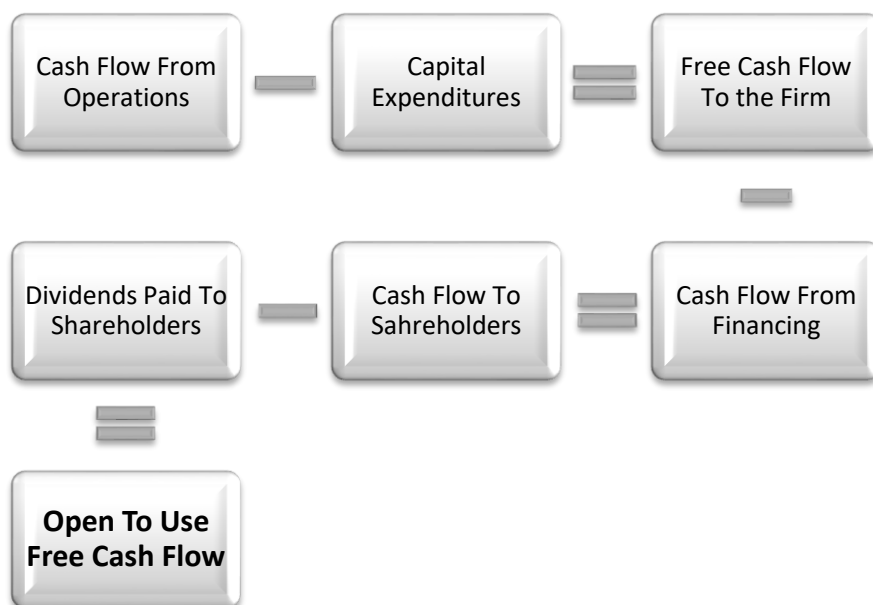
Free Cash Flow

The concept of free cash flow was first introduced by Jensen in 1986 and is defined as the part exceeding the cash required for the protection of assets and also for financing new investments (Richardson, 2006, p. 160). According to Mills et al. (2002, p. 38-39), free cash flow is the amount of cash remaining after the payments (profit share payments, current debt repayments, regular capital investment to maintain the existing activities) made in order for the firm to continue its activities. Free cash flow is also considered to be the remaining cash flow after deducting the capital expenditures required to maintain the existing capacity from the cash provided by the operating activities in the cash flow statement.

According to Karapınar and Zaif (2018, p.347), the deduction of investment expenditures from the cash flows provided from the firm's activities reveals free cash flows to the firm, and when the amount of financing activities is reduced from the free cash flow to the firm, free cash flow to the shareholders occurs and finally when the profit share paid to the shareholders is deducted from this amount, free cash flow available for use is calculated.

270

Calculation of free cash flow available for use could be shown on the figure as follows:

Figure 1. *Calculation of open to use free cash flow*

Since there is not a single and generally accepted application for calculating free cash flow, the study benefited from the Lehn Poulsen model (1989, p. 777), which is quite old and widely preferred in the literature.

$$FCF_{i.t} = \frac{INC_{i.t} - TAX_{i.t} - INTEP_{i.t} - DIV_{i.t}}{Total\ Assets_{i.t}}$$

INC$_{i,t}$: Operating Income Before Depreciation

TAX$_{i,t}$: Total Income Tax - Change in Deferred Tax Expenditure (Compared to the previous year)

INTEXP$_{i,t}$: Gross Financing Expenses of Short and Long Term Liabilities

DIV$_{i,t}$: Total Dividend Paid to Shares

Total Assets $_{i,t}$: Total Assets at the End of the Period

i,t: the relevant amount of company i in year t

Total assets were added to the formula later by some authors using this model (Sheikh et al. 2012, p. 35; Demirci 2017, p. 289).

Investors and creditors who provide funds to the firm take into account whether the company has cash and liquid assets at a level that can repay. In addition, the amount of cash plays an important role in making investment and financing decisions. This situation reveals the agency cost between these two sides.

"The agency relationship is the decision making transfer of one or several persons (represented) to a certain degree, to make a contract with another person (agent) who will act for his (represented) own benefit. Considering that both parties act in a way that maximizes their benefit in the relationship of representation, it is obvious that the agent will not always act in accordance with the interests of the represented. Starting to use company's resources in line with the agents own interests instead of increasing the interests of the representator creates the agency cost. In terms of managers, the more part of the company's financing needs is met from within the enterprise, the more the enterprise gets out of the control of investors lending under certain conditions" (Yakar, 2011, p. 19). The agency cost resulting from a conflict of interest between the shareholders and the managers caused the Free Cash Flow Theory to be revealed by Jensen.

According to this theory, when the manager and shareholder goals differ, the free cash flow produced by the enterprise (especially if this amount is more than the amount required to protect existing assets and finance projects which net present value is positive) has risk potential (Richardson, 2006, p. 159). One of these risks is extravagant investments and it is considered as one of the ways in which managers do not act in the interests of firm owners (Lavorskyi, 2013, p. 2).

271

Free cash flow is important in evaluating relevant opportunities to increase firm's value. Managers can contribute to the development of the company by entering new product or service production with the free cash flow they have, as well as investments with positive net present value. However, the use of free cash flow by the enterprise should be taken under control (Richardson, 2006, p. 161).

Determining the Capital Structure of the Company

Every company needs financial resources to start and continue its economic activities. It is thought that the decision to procure these financial resources from inside or outside the company according to their cost levels, is one of the most important duties of financial managers. Managers can reduce the cost of capital and maximize the value of the firm by providing a balance between risk and revenue by making the right decisions.

When it comes to capital structure; in a narrow sense, the relationship between equity and debt has been tried to explain. A firm generally provides the funds it needs from two sources, debt, and equity. Although the debt is obtained from outside the company, equity can be provided both from within the company by using undistributed profits, reserve funds, etc. and from outside the company by taking new partners, issuing dividend shares etc. (Rimaz & Ayanoğlu, 2020, p. 23).

According to Karadeniz and Kaplan (2016, p. 40), when choosing between debt and equity, the pros and cons of both sources should be calculated during making the capital structure decision. While evaluating the outside resource from these components, the advantages such as having the tax shield of the interest paid, the fact that its repayment remains constant depending on a certain maturity and the disadvantages such as ascending of the risk of the enterprise and the increase in the cost of capital over time should be taken into account. In addition, as a result of the activities, if the income or cash cannot be obtained to meet the principal and interest obligations related to the debt, the company will face the risk of bankruptcy. While evaluating the amount of equity from the components of the capital structure, its advantages such as not having a fixed burden and maturity on the company and contributing to the reduction of financial risk, priority right on firm's income, certainty in these revenues and also disadvantages such as the lack of tax shield effect in dividend payments, granting the right to participate in management should be considered together.

In finance literature, different studies have been conducted on whether there is an optimal capital structure and what the factors that affect decisions about this structure are, and theories have been developed on these subjects. These theories are generally divided into two groups as classical and modern approaches.

While classical capital structure theories try to explain the effects of capital structure decisions on the cost of capital and market value; modern capital structure theories have been developed to explain the variables that affect the capital structure decisions of enterprises (Karadeniz & Kaplan, 2016, p. 41).

In this study, financial leverage ratio ($\frac{Total\ Debt}{Total\ Assets}$) is used to represent the capital structure.

Efficiency and DEA as a Method to Measure Efficiency

Today, with globalization, the borders of countries have been crossed significantly. This situation has led to a rapid development of competition in the markets with the presence of multinational enterprises. Increasing competition has raised the pressure on companies day by day. In this fierce competitive environment, the continuity of firms depends on the effective continuity of their activities. For this reason, the performance of enterprises while carrying out their activities is considered as one of the most basic indicators in ensuring their continuity.

The efficiency is technically interpreted as the "output-input" ratio (Çoban, 2007, p. 23), according to Farrell (1957), it is also expressed as the success of the enterprise in producing the most possible output by using the input combination in the most appropriate and standard way. (Öztürk, 2009, p. 99). While the input is the resource or effort used to achieve a specific goal; output is the result obtained by using the input. To measure this concept numerically is the purpose of efficiency analysis, and the resulting index is called efficiency (Shin et al., 2018, p. 4).

In addition to ratio analysis, parametric and non-parametric methods are used to measure the financial efficiency of firms. Although there is strength and weakness of each method, the input-oriented model of Charnes, Cooper and Rhodes (CCR), which are non-parametric Data Envelopment Analysis (DEA) method models based on mathematical programming, was used in the measurement of efficiency.

DEA measures the relative performances of homogeneous decision-making units that have been measured with different scales or have different measurement units and have a large number of inputs and outputs, by converting a large number of outputs / inputs into a weighted sum of outputs / inputs (Tektüfekçi, 2010, p. 70). Unlike regression, the evaluations of this method are based on the best observed application (their weighted combination), not on any average (Toffalis & Sargeant, 2000, p. 1). It is determined that one or more of the decision-making units are full efficient. These are the reference set and the points where these units are located are called efficiency boundaries. It is assumed that all points on the border have 100% efficiency in DEA, the points below the border are said to be less effective and 'enveloped' by the border. This is the reason why the method is named (Toffalis & Sargeant, 2000, p. 3). Thus, the decision-making unit, which does not have 100% efficiency, is aimed to reach to efficiency border and be fully effective by making changes in its inputs or outputs.

Literature Review

Margaritis and Psillaki (2007, p. 1447) analyzed the relationship between efficiency and financial leverage using the data of 12,240 companies operating in New Zealand and

found evidence supporting the theoretical estimates of the Jensen and Meckling (1976) Agency Cost Model. In this study, the efficiency score was determined by DEA method. Using the quantile regression analysis method, it was observed that the causality effect of efficiency on leverage was positive at low and medium leverage level but negative at high leverage level. There is a negative relationship between firm size and leverage. While there is a positive relationship between tangible fixed assets and profitability level and leverage; It is concluded that there is a negative relationship between intangible assets and other assets and leverage.

Mok et al. (2007, p. 259), studied the role of leverage effect on firms' performance of the 238 toy producer companies, which were funded by foreign investment in South China. The researchers adopted a two-step approach in the study. In the first stage, they conducted Data Envelopment Analysis to estimate the technical efficiency of the sample firms, and in the second stage a regression analysis to examine the effects of leverage on efficiency and efficiency on profitability. Empirical results supported the view that the leverage ratio had a positive effect on the technical efficiency of the firm and that there was a positive relationship between technical efficiency and profitability.

Wang (2010, p. 408-418) investigated the effects of free cash flows and agency costs on the performance of enterprises listed on the Taiwan Stock Exchange. The results showed that the free cash flows resulting from the efficiency of the company's activities would contribute to the optimum performance of the enterprise. It was also stated that agency costs had a significant negative impact on corporate performance and stock returns. Discoveries revealed that free cash flows were positively associated with corporate performance criteria.

Bin Khidmat and Ur Rehman (2014, p. 1-25) examined whether there was a relationship between free cash flow, agency cost and operating performance in 123 enterprises belonging to eight different sectors listed on the Kerachi Stock Exchange (Pakistan) in the 2003-2009 period. The results indicated that there was a significant and positive relationship between free cash flows and agency cost, while revealing a significant negative effect of free cash flows on the performance of the firm. In addition, the impact of agency cost on firm's performance had also turned out to be significant and negative.

Hejazi and Moshtaghin (2014, p. 14-21) by considering the financial information of 101 enterprises listed on Tehran Stock Exchange in the 2007-2012 period; analyzed the effects of free cash flows and agency costs on dividend policy and leverage using a multivariate linear regression model. Researchers used the variables of size, risk, profit and growth to measure the agency cost level of firms; used the dividend and leverage mechanism to control the agency costs associated with free cash flow. Based on the results of the study, the agency cost of free cash flow had a significant positive effect on the dividend and leverage ratio. It had also been found that size and profitability had a significant positive effect on dividends and growth and risk did not have a significant effect on dividends.

Akpınar (2016, p. 290) examined 81 enterprises that were not in the financial sector, included in the BİST 100 index, in the 2010-2013 period, in order to determine the effect of capital structure on firm's performance. In the models in the panel data analysis, the company's return on equity and net profit margin were used as performance indicators, and short and long-term debt ratios and total debt ratio were applied as indicators of capital structure. Following the outcomes, it was revealed that the capital structure had a negative relationship with the firm's performance.

Floros and Voulgaris (2016, p. 385-401) analyzed the efficiency of the manufacturing sector in Greece during 1996-2011. Efficiency scores were calculated with DEA combined with Tobit analysis in order to observe that efficiency scores had a role in profitability and leverage. Depending upon the outcomes of 27 sub-sectors, it was determined that financial leverage did not affect the performance of the sectors in terms of technical efficiency, and sub-sectors with high technical efficiency had a higher level of profitability.

Ahmed et al. (2018, p. 49) examined whether there was a positive or negative relationship between free cash flow and firm's profitability. Data belonging to 28 companies listed on the Dhaka Stock Exchange of Bangladesh for the period of 2011-2016 were taken into consideration and analyzed by panel regression model. Return on equity and earnings per share were used as dependent variables to represent profitability and free cash flow as independent variables. As a function of the results, it had been determined that there was a positive relationship between free cash flow and the performance of the firm. This meant that managers could be able to reduce the agency cost if they were willing to use free cash flow properly for the purpose of generating greater return for shareholders.

Ali et al. (2018, p. 57) examined the effect of free cash flow on firm profitability by taking the data of 5 companies, operating in the automotive industry during the 2007-2010 period, listed on the German Stock Exchange. Regression results showed that there was a positive relationship between free cash flow and profitability. However, it had been demonstrated that financial leverage had a negative and insignificant effect on return on assets.

In the study which was applied by Siregar et al. (2019, p. 445), during 2012-2016 period the data of 16 agricultural enterprises, listed on the Indonesian Stock Exchange, were analyzed with the panel regression method to examine whether the capital structure and financial performance had an effect on the firms' value. Discoveries proved that capital structure and financial performance (ROA & ROE) had positive and significant effects on companies' value.

Considering the results obtained from the studies in the literature, in general, it is seen that Jenson's Free Cash Flow Theory has not been determined uniformly. For example, Margaritis and Pisillaki (2007) found a positive relationship between financial leverage and efficiency, while Akpınar (2016) concluded that there is a negative relationship

between capital structure and performance. Or Wang (2010), Ahmet et al. (2018) and Ali et al. (2018) determined that the relationship between FCF and performance is positive, while Bin khidmat and Ur Rehman (2014) concluded that there is a negative relationship between these two variables.

Research Method and Evaluation of Analysis Results

Due to the present research, it was aimed to determine whether there was a relationship between the free cash flows and capital structures of the manufacturing industry enterprises, traded in ISE 100 and their efficiency. After determining the average efficiency scores of the companies in 2009-2018 with the input oriented CCR DEA model, by the panel data method it was sought whether free cash flows and capital structures had a combined effect on efficiency or not. The reason for choosing the panel data method was that the data used in the calculation of dependent and independent variables had time and unit dimensions. The relationships between the created variables were estimated by selecting one of the Pooled Regression, Fixed Effects and Random Effects models belonging to the panel data method. The selection of the suitable model was decided by the Likelihood Ratio Test and Hausman Test. The process of which model to choose is summarized in the table below.

Table 1. *Panel data model selection process*

Panel Data Model Estimation Method		
Pooled Regression	**Fixed Effects**	**Random Effects**
Likelihood Ratio Test		**Hausman Test**	
P > 0.05	Pooled Regression	P > 0.05	Random Effects
P < 0.05	Fixed Effects	P < 0.05	Fixed Effects

As seen in Table 1, firstly one of the Pooled Regression or Fixed Effects models was selected with the Likelihood Ratio Test (by looking at the p value of the independent variables), the result obtained was compared with the Random Effects model by applying the Hausman Test in the second stage, and eventually the appropriate model was elected. After determining whether the cash flows and capital structure had an effect on the efficiency of the company as a result of the analysis, a second analysis was made in terms of whether the relationship between the dependent and independent variables in the regression model would continue in the future. Accordingly, the retrospective and future-predicted efficiency score for the 2009-2018 and 2019 periods, respectively, was calculated. Then, the change in this variable was compared with the changes in all other variables.

Determination of Efficiency Scores by DEA Method

The process followed in the calculation of the efficiency, which is the dependent variable in the study, is as follows:

a) **Decision Making Units (DMUs) Selecting:** financial report information included in the study dataset was taken from Turkey's Public Disclosure Platform (KAP) site. These firms must have been quoted to ISE until 31.12.2008, and during 2009 to 2018 they must have been:

- Operating in the manufacturing industry,

- Being active on the stock exchange continuously,

- all necessary data must have been available and,

- The book value of equity should not have been negative.

The information of the 40 firms included in the analysis as they met the previously mentioned criteria, are included in the table in Annex 1, where the average efficiency scores are presented.

b) **Determination of Input and Output Variables:** Input and output variables related to the research subject and how they are calculated are presented in Table 2.

Table 2. *Input and output variables used in DEA method*

Inputs	Outputs
1) Total Assets [natural logarithm of total assets] 2) Growth [(current year sales - previous year sales) ÷ past year sales] 3) Capital Structure [Financial Leverage Ratio = Total Liabilities ÷ Total Assets] 4) Operating Leverage [Percentage change of profit before interest and tax ÷ Percentage change in sales] 5) Cash Ratio [Liquid Assets[1] ÷ Short term liabilities] 6) Cash Flow from Operating Activities [Taken from the cash flow statement] 7) Free Cash Flow[2] [FCF = (INC$_{i, t}$ - TAX$_{i, t}$ - INTEP$_{i, t}$ - DIV$_{i, t}$) ÷ total assets]	1) Earnings Per Share [Earnings after interest and tax ÷ total number of shares] 2) Profit Before Interest Tax ÷ Rate of Sales

---

[1] Here, as cash and cash equivalents, "Cash and Equivalents" item in the financial status table of the companies is used. "According to the standard, cash includes cash in the enterprise and demand-deposits, and cash equivalents are short-term and highly liquid investments that can easily be converted into cash and whose exchange value is insignificant." Investments made in securities representing equity; It cannot be accepted as a cash equivalent due to the high risk in exchange value. For example, although stocks traded on the stock exchange are held for trading purposes and can be easily converted into cash at any time, they are not regarded as cash equivalents since they are disposed of with an amount above or below their value (Özerhan & Yanık, 2015, p. 86-87).

[2] The explanation of the abbreviations is included in the formula 1.

c) **Choosing the Data Envelopment Model and Calculating Efficiency Scores:** In the data envelopment analysis conducted in the study, the model which was introduced by Charnes, Cooper and Rhodes (1978), and known as the CCR model in the literature, was used. The reason for the application of input-oriented model was that the enterprises have control power over the input elements used in the model. Accordingly, improvement suggestions to be brought to ineffective firms can be made through input variables. Here, MATLAB-2018 Program was used in efficiency score calculations. The average efficiency scores of the enterprises are presented in the table in Annex 1.

Explanation of the Model to be Used in Creating and Testing Hypotheses

After determining the average efficiency scores of 40 enterprises in the data set using the input oriented CCR method, the phase of testing whether free cash flow and capital structure had a statistically significant effect on firm's efficiency had been started. The hypothesis and model established to determine the relationships between the dependent and independent variables of the research are as follows:

Hypothesis 1-0: Free cash flow with capital structure, had no significant effect on firm efficiency;

Hypothesis 1-1: Free cash flow with capital structure, had a significant effect on firm efficiency.

$$EFF_{i,t} = ß_0 + ß_1 FCF_{i,t} + ß_2 CS_{i,t} + ß_3 CS_{i,t}^2 + ß_4 \ln ASSET_{i,t} + ß_5 \ln ASSET_{i,t}^2 + \varepsilon_{i,t}$$

EFF - Efficiency Scores belonged to the firms

FCF - Free Cash Flow

CS - Capital Structure (Financial Leverage Ratio)[3]

LnASSET - Natural Logarithm of Total Assets[4]

In order to test the hypotheses, selected independent variables were used as ratios or natural logarithms. By developing the variables into the ratios, it was aimed to eliminate some differences which may have arisen from the scale such as the size of the company and the possible negative effects of that factor. Eviews 10 Program was used in hypothesis testing.

Testing Hypotheses and Evaluating Results

In the application of the panel data model, Likelihood Ratio Test and Hausman Tests were performed and it was decided according to which of the Pooled Regression, Fixed Effects and Random Effects models to determine the relationships between variables. The findings obtained as a result of the analyzes made are presented in Table 3.

---

[3] Financial Leverage Ratio for capital structure (CS) = Total Liabilities / Total Assets (Akpınar, 2016, p. 294; Dessi & Robertson, 2003, p. 912; Vijayakumaran, 2017, p. 567; Sayman, 2012, p. 212).

[4] LnAsset: the natural logarithm of total assets (Margaritis and Psillaki, 2007, p. 1455; Akpınar, 2016, p. 294; Demirci, 2017, p. 290).

Table 3. *The effect of free cash flow with capital structure on firm's efficiency*

Efficiency Score (Dependent Variable), Free Cash Flow and Capital Structure (Independent Variable)			
	Coefficients		
Variables	Pooled Regression	**Fixed Effects Model**	Random Effects Model
FCF	0.053 (0.558)	**-0.177** (-2.425)**	-0.139* (-1.942)
CS	-0.662*** (-3.671)	**0.414** (2.111)**	0.213 (1.152)
CS^2	0.681*** (3.978)	**-0.369** (-1.998)**	-0.152 (-0.888)
$Ln(asset)$	0.311*** (3.241)	**0.302*** (3.144)**	0.287*** (3.153)
$Ln(asset)^2$	-0.011*** (-3.561)	**-0.010*** (-3.051)**	-0.010*** (-3.234)
Invariable	-1.026 (-1.514)	**-1.486** (-2.164)**	-1.227* (-1.891)
	Peseran CD Statistics: 5.937 P- value: 0.0000	Peseran CD Statistics: 2.2240 P- value: 0.0261	Peseran CD Statistics: 1.716 P- value: 0.0861
	Likelihood Ratio Test F- Statistics: 18.315 P- value: 0.00000		Hausman Test Chi-square Statistics: 15.123 P- value: 0.0098
With the margin of error of * 10%, ** 5% and *** 1% show that the coefficients are statistically significant at 90%, 95% and 99%, respectively. Values in parentheses correspond to the t-statistics of the estimates.			

When the Likelihood Ratio Test and Hausman Test results are examined in Table 3, it is clear that the Fixed Effects Model among the three models is valid. According to the results, the effects of all variables are statistically significant. Free cash flow is negatively related to firm efficiency, and a 1% change (increase) in this variable causes a 0.177% decrease on company's efficiency. It is observed that the capital structure and total assets positively affect the firm efficiency and the 1% change (increase) in these variables causes 0.414% and 0.302% change (increase), on the firm efficiency respectively. In addition, it is determined that the effect of these two variables on efficiency is not linear, but U-shaped.

The results achieved showed that both independent variables had a simultaneous effect on efficiency across the ISE 100 manufacturing industry sector. It was determined that the free cash flow and capital structure (financial leverage ratio) of the company had a negative and positive relationship with the firm efficiency, respectively. As a result of the analysis, the negatively significant relationship of efficiency with free cash flow overlapped with Jensen's (1986) Free Cash Flow Theory. Situations where the free cash flow level was high caused the agency cost to increase, reducing the performance and thus the efficiency of the enterprise.

On the other hand, according to the results regarding the capital structure, after the enterprises benefited from external financing to the optimum point, the effect of this external resource turned into negative on efficiency. Because when you pass this point, the uncertainty of obtaining the expected return by the shareholders increases, as the

risk will increase, and as a result, the rate of return demanded by the shareholders increases. Therefore, the use of a lower leverage by the enterprises should be perceived by the funders as a sign that the company is powerful (Margaritis & Pisillaki, 2007, p. 1466). In addition, when the results of the total assets, which are the control variables, were examined, it was discernible that the enterprise scale (size) in the manufacturing industry sector had a positive effect on efficiency. However, this effect was also U-shaped. In other words, as the firm grew to an optimal level, its efficiency increased. After this optimum point, monitoring and representation costs arising from the hierarchical structure were thought to increase, reducing efficiency and firm's performance. Observed outcomes, confirmed that the hypothesis had a relationship option.

This result found about the effect of free cash flow on efficiency was consistent with the results of the study conducted by Bin Khidmat and Ur Rehman (2014, p. 1-25) as they argued free cash flow was negatively related to performance and contradicts with the study's finding which was leaded by Wang (2010, p. 408-418) who concluded free cash flow was positively correlated with performance.

Achieved results regarding the capital structure variable is in accordance with the findings of the study conducted by Margaritis and Psillaki (2007, p. 1447). This result also does not coincide with the findings of Akpınar (2016, p. 290), Karadeniz and Kaplan (2016, p. 38) where they asserted leverage negatively affects performance, Floros and Voulgaris (2016, p. 385-401) where they found out that leverage does not affect performance.

In the continuation of the research, the relationships which were determined statistically between the efficiencies of the enterprises and their free cash flows, capital structures and sizes were examined in terms of whether they will continue in the future periods or not.

a. **Analysis of the Continuity of the Relationships Between Firm Efficiency, Free Cash Flow and Capital Structure in the Future Periods**

In order to estimate the effects of the variables on firm's efficiency in the future periods, related to the regression model, namely free cash flow, capital structure and firm size, retrospective average efficiency score predictions were calculated using the data of the financial statements related to the variables considering the results obtained from the enterprises operating in the manufacturing industry for the period 2009-2018. Then, based on 9 months of 2019 data, the predicted-efficiency score for the future for this period was calculated.

Comparison of these historical and future scores was thought to contribute to the future predictions of the relationships between independent and dependent variables in Table 3 in section 6.3 of the study. The summary of these transactions and the results obtained are shown in Tables 4 and 5 below.

Table 4. *Percentage change of the efficiency of firm with dependent and independent variables*

A	$\dfrac{\sum(2009 - 2018)}{10}$	FCF_a	CS_a	$ASSET_a$	EFF_a
B	$\dfrac{(9\ month - part\ of\ 2019\ X\ 4)}{3}$	FCF_b	CS_b	$ASSET_b$	EFF_b
C	$\dfrac{B - A}{A}$	$\dfrac{FCFb - FCFa}{FCFa}$	$\dfrac{CSb - CSa}{CSa}$	$\dfrac{ASSETb - ASSETa}{ASSETa}$	-
Change		FCF	CS	ASSET	$(EFF_b - EFF_a)$
Manufacturing Industry		%52.5 Decrease	% 67.5 Increase	% 97.5 Increase	0.0507 Increase

Table 5. *Future forecast status of the determined relationships of dependent and independent variables of the enterprises in the sector regarding efficiency*

Efficiency Score and Related Statistics Results with DEA		Relation to Activity		
		FCF	**CS**	**ASSET**
		-	+	+
Retrospective and Future-Predicted Efficiency Scores and Future-Prediction of the Efficiency Score Statistics Results Obtained by DEA	%CHANGE	Decrease	Increase	Increase
	RESULT	Confirmed	Confirmed	Confirmed

In this analysis performed with the "Eviews 10" package program, instead of the efficiency scores calculated with DEA method for the period of 2009-2018, it was aimed to use the retrospective predicted efficiency score to be equivalent to the 2019 predicted efficiency score for the future. In addition, it was assessed that the average efficiency scores calculated with DEA in the 2009-2018 period, indicated a very low difference when compared to the retrospective efficiency scores. The average efficiency scores calculated by DEA method belonging to the sector are presented in Annex 1 of the research.

The retrospective estimated efficiency score average of the manufacturing industry enterprises for the period of 2009-2018 and the 2019 predicted-efficiency scores are displayed in Table 6 below.

Table 6. *Predicted-Efficiency score average of manufacturing industry enterprises for the period 2009-2018 and future - predicted efficiency score ranking for the period 2019*

Ranking	Firm Name	2009-2018 Predicted Efficiency Score Average	Ranking	Firm Name	2019 Future - Predicted Efficiency Score
1	Park Elektrik Production Mining Industry and Trade Inc.	0.9871	1	Karsan Automotive Industry and Trade Inc.	1.0000

2	Goodyear Tires Türk Inc.	0.9800	2	Aksa Akrilik Chemical Industry	0.9131
3	Sasa Polyester Industry Inc.	0.9751	3	Petkim Petrochemical Holding Inc.	0.9086
4	Bagfaş Bandırma Fertilizer Factories Inc.	0.9735	4	Borusan Mannesmann Pipe Industry and Trade Inc.	0.9045
5	Deva Holding Inc.	0.9675	5	Bagfaş Bandırma Fertilizer Factories Inc.	0.9034
6	Zorlu Energy Electricity Generation Inc.	0.9646	6	Soda Industry Inc.	0.9029
7	Ege Industry and Trade Inc.	0.9637	7	Kardemir Karabük Iron and Steel Industry and Trade Inc.	0.9022
8	Brisa Bridgestone Sabancı Tire Industry and Trade Inc.	0.9633	8	Aygaz Inc.	0.9009
9	Tüpraş-Türkiye Petroleum Refineries Inc.	0.9469	9	Göltaş Göller Region Cement Industry and Trade Inc.	0.9001
10	Çemtaş Steel Machinery Industry and Trade Inc.	0.9467	10	Goodyear Tires Türk Inc.	0.8980
11	Akenerji Electricity Generation Inc.	0.9459	11	Türk Tractor and Ziraat Machinery Inc.	0.8960
12	Kartonsan Karton Industry and Trade Inc.	0.9422	12	Ülker Biscuit Industry Inc.	0.8956
13	Soda Industry Inc.	0.9392	13	Kordsa Technical Textile Inc.	0.8956
14	Gübre Factories T.Inc.	0.9346	14	Afyon Cement Industry T.Inc.	0.8937
15	Aksa Akrilik Chemical Industry Inc.	0.9342	15	Gübre Factories T.Inc	0.8926
16	Aygaz Inc.	0.9313	16	Tofaş Türk Automobile Factory Inc.	0.8909
17	Kardemir Karabük Iron and Steel Industry and Trade Inc.	0.9260	17	Anadolu Glass Industry Inc.	0.8903
18	Doğtaş Kelebek Furniture Industry and Trade Inc.	0.9202	18	Tat Food Industry Inc.	0.8898
19	Petkim Petrochemical Holding Inc.	0.9152	19	Sasa Polyester Industry Inc.	0.8871
20	Otokar Automotive and Defense Industry Inc.	0.8891	20	Deva Holding Inc.	0.8848
21	Erbosan Erciyes Pipe Industry and Trade Inc.	0.8844	21	Trakya Glass Industry Inc.	0.8815
22	Karsan Automotive Industry and Trade Inc.	0.8729	22	Banvit Bandırma Vitaminli Feed Industry Inc.	0.8796
23	Türk Tractor and Ziraat Machinery Inc.	0.8244	23	Coca-Cola Beverage Inc.	0.8792

282

24	Borusan Mannesmann Pipe Industry and Trade Inc.	0.8184	**24**	Brisa Bridgestone Sabancı Tire Industry and Trade Inc.	0.8754
25	Kordsa Technical Textile Inc.	0.7987	**25**	Otokar Automotive and Defense Industry Inc.	0.8750
26	Banvit Bandırma Vitaminli Feed Industry Inc.	0.7956	**26**	Hürriyet Journalism and Printing Inc.	0.8699
27	Tat Food Industry Inc.	0.7912	**27**	Vestel Electronic Industry and Trade Inc.	0.8697
28	Ereğli Iron and Steel Factories T.Inc.	0.7878	**28**	Yataş Mattress and Duvet Industry and Trade Inc..	0.8680
29	Yataş Mattress and Duvet Industry and Trade Inc.	0.7434	**29**	Arçelik Inc.	0.8622
30	Vestel Electronic Industry and Trade Inc.	0.7419	**30**	Erbosan Erciyes Pipe Industry and Trade Inc.	0.8534
31	Arçelik Inc.	0.7306	**31**	Ege Industry and Trade Inc.	0.8479
32	Göltaş Göller Region Cement Industry and Trade Inc.	0.7145	**32**	Akenerji Electricity Generation Inc.	0.8478
33	Afyon Cement Industry T.Inc.	0.6705	**33**	Zorlu Energy Electricity Generation Inc.	0.8474
34	Tofaş Türk Automobile Factory Inc.	0.6588	**34**	Doğtaş Kelebek Furniture Industry and Trade Inc	0.8469
35	Hürriyet Journalism and Printing Inc.	0.6369	**35**	Anadolu Efes Brewery and Malt Industry Inc.	0.8423
36	Ülker Biscuit Industry Inc.	0.5893	**36**	Tüpraş-Türkiye Petroleum Refineries Inc.	0.8351
37	Anadolu Glass Industry Inc.	0.5734	**37**	Ereğli Iron and Steel Factories T.Inc.	0.8334
38	Trakya Glass Industry Inc.	0.5340	**38**	Park Elektrik Production Mining Industry and Trade Inc.	0.8094
39	Anadolu Efes Brewery and Malt Industry Inc.	0.4845	**39**	Kartonsan Karton Industry and Trade Inc.	0.8054
40	Coca-Cola Beverage Inc.	0.4503	**40**	Çemtaş Steel Machinery Industry and Trade Inc.	0.7988

As it is presented, the efficiencies of the enterprises in general are between 70-99%, and only 25% (8) of the enterprises operating in the relevant sector have an estimated efficiency score below this figure.

The comparison of estimated efficiency score ranking of the enterprises during 2009-2018 and 2019 can provide valuable information in predicting the relationships between efficiency and other variables. Since it would not be possible to examine all the firms

with changing efficiency scores one by one, in terms of the scope of the study, here the relationships between the changes in the variables of three companies that showed a significant change in their efficiency scores were mentioned.

Afyon Cement Industry Trade Inc. while it was 33rd (0.6705) in the efficiency score table in the 2009-2018 period; it rose to the 14th place (0.8937) in the 2019 ranking. When the financial information about the firm was analyzed, it was revealed that the free cash flow decreased by 4.86 (486%), the capital structure increased by 0.74 and the firm size increased by 1.56. Contrary to the fact that capital structure and firm size did not change drastically, free cash flow here showed a greater change with a 486 percent decrease.

Göltaş Göller Region Cement Industry and Trade Inc. with an estimated efficiency score of 0.7145 in the 2009-2018 period stood in 32nd ranking, bypassing 23 companies in 2019 with an estimated efficiency of 0.9001, ranking 9th. changes in the financial data of this firm, a 4.41 (441%) decrease in free cash flow, an increase of 0.4081 in the capital structure and an increase in firm size of 0.4774 occurred.

Çemtaş Steel Machinery Industry and Trade Inc. while it was 10th in the efficiency ranking in the 2009-2018 period (with a score of 0.9467); It fell to 40th place (with a score of 0.7988) in the 2019 period. Looking at the financial data of this enterprise, free cash flow showed an increase of 0.3317 (it had positive free cash flow), its capital structure decreased by 0.2163, and the size of the firm increased by 1.064.

284

As can be observed, the results obtained from these enterprises with changing efficiency scores coincide with the direction and significance of related variables in the manufacturing industry sector. On the other hand, when the changes in the data of 40 enterprises in the mentioned industry are monitored, the free cash flow on the basis of the number of enterprises decreased in 52.5% of the total enterprises, the capital structure increased in 67.5% and the total assets increased in 97.5%.

When the estimated efficiency scores that did not change at a very high rate were compared, it was seen that the average of these scores increased from 0.8262 (2009-2018) to 0.8769 (2019). This result is consistent with the results obtained by DEA method (look Table 3) and proves that the variables of free cash flow, capital structure and firm size are significantly and negatively, significantly, and positively, significantly and positively associated with firm efficiency, respectively. This reveals that the relationship between all relevant variables can continue in approximately the same way in the future. These findings also overlap with Jensen's Free Cash Flow Theory. The changes in the variables of the enterprises in the manufacturing industry and their relations with the efficiency in DEA method are shown in the table 7 below.

Table 7. *The relationship of the variables across the manufacturing industry with the percentage change in the 2009-2018 and 2019 period and the efficiency in DEA method*

Percentage Change of Variables Based on Total Number of Firms			
Free Cash Flow	Capital Structure	Firm Size	Direction of Change
0.475	**0.675**	**0.975**	Increase
0.525	0.325	0.025	Decrease
-**	+**	+***	The Relationship Between the Related Variable and Efficiency in DEA
With margin of error of ** 5% and *** 1% shows that the coefficients are statistically significant at 95% and 99%, respectively.			

It is deduced from the financial information of the companies in the manufacturing industry that other factors had an effect on the company's efficiency. For example, while considering the negative effect of increasing free cash flow on efficiency; despite a very high increase in free cash flow, contrary to financial leverage ratio and firm size variables, for example Anadolu Cam Sanayi (1389% increase) and Trakya Cam Sanayi (1053% increase), related firm efficiencies had increased, or while free cash flow was decreasing and financial leverage ratio and the size of the firm were increasing, the efficiency of the firm was in a downward trend. According to the information obtained from some companies examined, the financing method of current and fixed assets is thought to contribute to the improve the efficiency of these enterprises. This means that 30% of the enterprises in the past 10 years can increase their efficiency and operate in a better condition by choosing the capital structure policy correctly.

285

CONCLUSIONS

Managing the cash holdings correctly increases its value by creating a positive effect on the firm. Successful cash management reduces the risk ratio of the enterprise and facilitates the resource transfer decisions of those who provide funds to the enterprise because the risk of their assets decreases. As firms grow, the control of agency costs becomes even more important. In Jensen's Free Cash Flow Theory, financial decisions to be made regarding elements such as capital structure, financing expense and dividend payment constitute the basic framework of this control.

Free cash flow can increase the value of the firm when taken under control. This theoretical expectation in particular in firms operating in the ISE 100 index is aimed to reveal whether it is valid. For this reason, the efficiency scores of enterprises during 2009-2018 period of the manufacturing sector were calculated separately via DEA - CCR input-oriented method. As a result of the statistical analysis made, the following findings were obtained:

- The effects of free cash flow and capital structure on efficiency were negative and positive, respectively. The negative relation of free cash flow with efficiency

overlapped with Jensen's Free Cash Flow Theory. The positive and U-shaped effect of the capital structure on efficiency indicates that the debt used by the company had a positive effect on efficiency up to its optimum point, and after this point its effect turned into negative (due to the risk arising from excessive borrowing).

- On the other hand, when looking at the discoveries achieved on total assets, which was control variable, it had a positive and U-shaped effect on efficiency. In other words, as the firm grew to an optimal level, its efficiency increased. In our opinion, after this optimum point, the monitoring and agency costs arising from the hierarchical structure increased, and efficiency and consequently the performance of the enterprise decreased.

In addition, in the study, an analysis was made about the predictability of the relationship between efficiency scores calculated by DEA method and free cash flow, capital structure and firm size in future periods. In this analysis, retrospective average estimated efficiency scores of the manufacturing industry were calculated by using the financial information of free cash flow, capital structure and firm size variables for the period 2009-2018.

With this calculation, based on the financial information for the first-nine-month of 2019, the Predicted-Efficiency score for the whole year was revealed. By making a comparison between these two estimated efficiency scores, the predictability of the relationships between the efficiency of the relevant sectors and the independent variables in the research in the future periods, in terms of the significance and direction of the variable coefficient, was evaluated.

When the estimated efficiency scores of enterprises in the manufacturing industry in the periods of 2009-2018 and 2019 were compared, it was appeared that these scores had increased from 0.8262 to 0.8769. In addition, free cash flow decreased in 52.5% of enterprises; the financial leverage ratio increased in 67.5% of the enterprises and the firm size increased in 97.5% of the total enterprises. These results are consistent with the statistical results obtained by DEA method, and it is predicted that free cash flow, capital structure and firm's size's respectively significant negative, positive and positive relationships, will continue in the same way in future periods.

Using different inputs and outputs in calculating the efficiency scores of enterprises in these sectors in future studies will naturally differentiate the outcomes obtained. In addition, by applying DEA-BCC method instead of DEA-CCR method used in this study, the probability of more firms to be effective will increase. In addition, firms' dividend payments that have been used in the calculation of free cash flow can be classified into two categories as dividend distributing and non-distributing entities, to find that whether there is a difference between these two categories. In summary, since there can be quite a lot of different studies on the subject in this field, the contributions to the literature can be increased.

286

REFERENCES

Ahmed, W. U., Hasan, M. M. Hoquo, M. A. ve Alam, M.J. (2018). Impact of free cash flow on profitability: an empirical study on pharmaceutical company. *Journal of Jessore University of Science and Technology, 3*(01), 49-57.

Akpınar, O. (2016). The impact of capital structure on firm performance: An application on Borsa Istanbul. *Kastamonu University Journal of Economics and Administrative Sciences*, 290-302.

Ali, U., Ormal, L. and Ahmad, F. (2018). Impact of free cash flow on profitability of the firms in automobile sector. *Journal of Economics and Management Sciences*, 57-67.

Bin Khidmat, W. and Ur Rehman, M. (2014). The impact of free cash flows and agency costs on firm performance an empirical analysis of kse listed companies of Pakistan. *Journal of Financial Engineering*, 1-25.

Çoban, O. (2007). Industrial productivity and efficiency in Turkish automotive industry. *Erciyes University Faculty of Economics and Administrative Sciences Journal*, 17-36.

Demirci, N. S. (2017). The effect of free cash flows on company value: Dynamic panel data analysis on bist 100 index in the context of free cash flow theory. *Journal of Business Studies*, 283-299.

Dessi, R. and Robertson, D. (2003). Debt, incentives, and performance: Evidence from UK panel data. *The Economic Journal*, 903–919.

Floros, C. and Voulgaris,F.(2016). Efficiency, leverage and profitability: The case of Greek manufacturing sector. *Global Business and Economics Review, 18*(3/4), 385-401.

Hejazi, R. and Moshtaghin. F.S. (2014). Impact of agency costs of free cash flow on dividend policy, and leverage of firms in Iran. *Journal of Novel Applied Sciences*, internet: www.jnasci.org, 14-21.

Karadeniz, E., Kaplan, F. (2016). The effect of capital structure decisions on profitability: a research on borsa Istanbul tourism companies. *Journal of Travel and Hotel Management, 13*(3), 38-55

Karapınar, A. and Zayıf, F. (2018). *Financial analysis*. 5th Edition. Ankara: Gazi Publishing House.

Lavorskyi, M. (2013). *The impact of capital structure on firm performance: Evidence from Ukraine.* Unpublished MA Thesis, Kyiv School of Economics, Ukraine.

Lehn. K. and Poulsen, A. (1989). Free cash flow and stockholder gains in going private transactions. *The Journal of Finance*, (3), 771-787.

Margaritis, D. and Psillaki, M. (2007). Capital structure and firm efficiency. *Journal of Business Finance & Accounting, 39*(10), 1447–1469.

Mills, J., Bible, L. and Masson, R. (2002). Defining free cash flow. *The CPA Journal*, 36-41.

287

Mok, V., Yeung, G., Han, Z. and Li, Z. (2007). Leverage, technical efficiency, and profitability: An application of DEA to foreign-invested toy manufacturing firms in China. *Journal of Contemporary China*, *16*(51), 259–274.

Özerhan, Y. and Yanık, S. (2015). *TMS / TFRS compliant with IFRS / IAS*. Ankara: Türmob Publications.

Öztürk, Y.E. (2009). Data envelopment analysis and its use in measuring hospital efficiency. *Selcuk University Social Sciences Vocational School Journal*, *1-2*(12), 97-118.

Richardson, S. (2006). Over-Investment of free cash flow. *Rev Acc Stud*, *11*, 159-189.

Rimaz, M. (2020). *The effect of free cash flow on the company's efficiency and an application in ISE 100*. Unpublished PhD Thesis, Gazi University Institute of Social Sciences, Department of Business Administration, Accounting and Finance Department, Ankara.

Rimaz, M. and Ayanoğlu, Y.(2020). Capital structure-free cash flow correlation: An analysis on manufacturing sector businesses in BİST 100. *Journal of Accounting and Auditing Overview*, *60*, 19-36.

Sayman, Y. (2012). *Effects of ownership structure on company's performance and capital structure: an application in manufacturing companies traded in the ISE*. Unpublished PhD Thesis, Ankara University, Institute of Social Sciences, Department of Business Administration, Ankara.

Sheikh, M.J., Lazemi Chalak, S. and Mohammadnejad, S. (2012). Jarayanhaye naqdiye azad: Ahammiyat, karbord va naqshe an dar modiriyyate sud. *Motaleate Hesabdari va Hesabrasi, 1*(2), 30-43.

Shin, K., Lee. D., Shin.K. and Kim.E. (2018). Measuring the efficiency of U.S. pharmaceutical companies based on open innovation types. *J. Open Innov. Technol. Mark. Complex.*, (4)34, 1-21.

Siregar, R.Y.D., Anggraeni, L. and Pranowo, K. (2019). Impact of capital structure and firm financial performance on firm value: Evidence of agribusiness firms in Indonesia stock exchange. *Russian Journal of Agricultural and Socio-Economic Sciences*, (85)1, 445-451.

Tektüfekçi, F. (2010). Evaluation of financial efficiency by data envelopment analysis (DEA) in ISTANBUL stock exchange (ISE) listed publicly traded technology companies. *Journal of Organization and Management Sciences*, (2)2, 69-77.

Toffalis, C. and Sargeant.A. (2000). Assessing charities using data envelopment analysis. performance measurement 2000: past, present and future ed. a.d.neely. *Centre for Business Performance*, 1-9.

288

Vijayakumaran, R. (2017). Capital structure decisions and corporate performance: evidence from Chinese listed industrial firms. *International Journal of Accounting and Financial Reporting*, *7*(2), 562-576.

Yakar, R. (2011). *Capital structure theories and an empirical study in the ISE.* Unpublished Master Thesis, Selçuk University, Konya.

Wang, G. Y. (2010). The impacts of free cash flows and agency costs on firm performance. *J. Service Science and Management*, *3*, 408-418.

Annex 1. *Table of Average Efficiency Score of the Manufacturing Industry Sector for 2009 – 2018*

Manufacturing Industry Efficiency Score Table - Results of CCR DEA Analysis

Ranking	Firm Name	Efficiency Score Average for the 2009-2018 Period
1	Park Elektrik Production Mining Industry and Trade Inc.	0.9965
2	Bagfaş Bandırma Fertilizer Factories Inc.	0.9831
3	Goodyear Tires Türk Inc.	0.9799
4	Sasa Polyester Industry Inc.	0.9750
5	Deva Holding Inc.	0.9675
6	Ege Industry and Trade Inc.	0.9651
7	Zorlu Energy Electricity Generation Inc.	0.9646
8	Brisa Bridgestone Sabancı Tire Industry and Trade Inc..	0.9633
9	Çemtaş Steel Machinery Industry and Trade Inc.	0.9469
10	Tüpraş-Türkiye Petroleum Refineries Inc.	0.9468
11	Akenerji Electricity Generation Inc.	0.9459
12	Kartonsan Karton Industry and Trade Inc.	0.9422
13	Soda Industry Inc.	0.9391
14	Gübre Factories T.Inc.	0.9346
15	Aksa Akrilik Chemical Industry Inc.	0.9342
16	Aygaz Inc.	0.9313
17	Kardemir Karabük Iron and Steel Industry and Trade Inc.	0.9259
18	Doğtaş Kelebek Furniture Industry and Trade Inc.	0.9202
19	Petkim Petrochemical Holding Inc.	0.9152
20	Otokar Automotive and Defense Industry Inc.	0.8891
21	Erbosan Erciyes Pipe Industry and Trade Inc.	0.8842
22	Karsan Automotive Industry and Trade Inc.	0.8728
23	Türk Tractor and Ziraat Machinery Inc.	0.8243
24	Borusan Mannesmann Pipe Industry and Trade Inc.	0.8183
25	Kordsa Technical Textile Inc.	0.7987
26	Banvit Bandırma Vitaminli Feed Industry Inc.	0.7955
27	Tat Food Industry Inc.	0.7912
28	Ereğli Iron and Steel Factories T.Inc.	0.7877
29	Yataş Mattress and Duvet Industry and Trade Inc.	0.7434
30	Vestel Electronic Industry and Trade Inc.	0.7419
31	Arçelik Inc.	0.7305
32	Göltaş Göller Region Cement Industry and Trade Inc.	0.7144
33	Afyon Cement Industry T.Inc.	0.6704
34	Tofaş Türk Automobile Factory Inc.	0.6588
35	Hürriyet Journalism and Printing Inc.	0.6393
36	Ülker Biscuit Industry Inc.	0.5893
37	Anadolu Glass Industry Inc.	0.5734
38	Trakya Glass Industry Inc.	0.5339
39	Anadolu Efes Brewery and Malt Industry Inc.	0.4844
40	Coca-Cola Beverage Inc.	0.4503

290