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When does capital structure hurt economic value? Nonlinear evidence from Turkey

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Abstract

This paper addresses the question of how much debt contributes to the creation of economic value, which is heavily debated in capital structure theories. This research aims to fill the literature gap of empirical studies investigating the existence of optimal capital structure in Turkey with nonlinear models. In addition, as an indicator of firm performance in the study, a variable other than ROA and ROE is suggested, contrary to what is usual in the literature. The authors employ the advanced panel threshold regression developed by Hansen (1999) to investigate the existence of the threshold(s) effect of firm leverage on firm value. The author has used data from among 133 biggest manufacturing firms determined by the Istanbul Chamber of Commerce in Turkey during 2010–2020. Research results revealed a robust, linear, and positive effect of firm leverage on firm value in the presence of three controlling variables (firm size, assets growth, and sales growth). Firm value is found to be affected by asset size and sales growth.

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1. Introduction

One of the most important and most researched issues in the field of finance is the borrowing decisions of companies. Debt financing can have both positive and negative effects on the value of the firm. Debt increases the capacity of the firm with the leverage effect and the value of the firm with the tax-saving effect. On the other hand, increasing debt ratios increase the risk of bankruptcy of the firm. It can be argued that debt affects the company positively up to a certain point and negatively after a certain point. For this reason, knowing this point is extremely important for managers trying to maximize company value. The optimal debt level helps to minimize the overall cost of capital while enhancing the profitability of a firm.

Past studies in literature using linear models have proven a mixed relationship between leverage and value (Friend and Lang, 1988; Barton et al., 1989; Petersen and Rajan, 1994; Molik, 2005; Berger and Bonaccorsi, 2006). What appears from the mixed results is that the relationship between debt and value may not be linear. Therefore, using a nonlinear panel threshold model developed by Hansen (1999) can assist to determine the optimal debt level of the firm. This model can answer the question of what level of debt becomes toxic for the firm. In other words, it will be revealed at what point the marginal benefit of the tax advantage of leverage and the marginal loss of the probability of bankruptcy created by debt is equal. Nieh et al. (2008) and Lin and Chang (2009) show that debt ratios exceeding the 75.31 percent and 40.15 percent thresholds, respectively, will not increase the value of the firm in Taiwan.

There are many studies on the capital structure of companies operating in Turkey. Almost all of them have tested the capital structure theories that are valid in Turkish enterprises. Demirhan (2009), Okuyan and Taşçı, 2010a; Okuyan and Taşçı, 2010b; Toraman and Okuyan, 2009; Kara and Acar Erdur, 2015; Kakıllı Acaravcı, 2015; Dinçergök (2017). In most of the studies, results supporting the financial hierarchy theory have been reached, but there are also studies supporting the static trade-off theory. The common point of the studies on Turkey is that they used linear models. This is not an appropriate approach to reveal a relationship that we are sure is not theoretically linear.

This study aims to determine whether there is an ideal debt ratio in the real sector firms producing in Turkey and to reveal the point at which debt begins to harm the economic value of the firm. This study fills the gap in the finance literature by providing evidence on how capital structure affects economic value in Turkish biggest manufacturing firms. To the best of our knowledge, no previous study has used the value-added created by the firm variable as a measure of firm performance or economic value. We think that the study will contribute to the literature in terms of both being the first study to examine nonlinear relationships in Turkey's data and proposing a different variable other than ROA/ROE as the economic value of the firm.

Robb and Robinson (2014), Margaritis and Psillaki (2010), Chandrakumarmangalam and Govindasamy (2010), and Gill et al. (2011) support the positive effect of capital structure on performance. Robb and Robinson (2009) argue that the returns from increased capacity as a result of borrowing are greater than the interest expense from borrowing, i.e. the firm gains from its debt-incorporated capital structure. This result can be explained in the context of previous influential studies such as Modigliani and Miller (1958), and Jensen (1986) suggesting that profitable firms use leverage to highlight the firm's growth potential, resulting in a positive relationship between leverage and profitability. Some have obtained contradictory results with these studies. Studies by Fama and French (2002), Simerly and Li (2000), Negash (2001), Phillips and Sipahioglu (2004), Zeitun and Tian (2007), and Soumadi and Hayajneh (2012)

have stated that leverage does not affect firm performance. Fama and French (2002) suggested that the firm's debt ratio leads to agency problems, which predict a negative relationship between leverage and profitability.

In the literature, there are related studies examining the nonlinear relationships between the capital structure of the firm and its performance such as Cheng et al. (2010), Ahmad and Abdullah (2013), Jaisinghani and Kanjilal (2017), Hanna and Iatridis (2017), Mishra and Dasgupta (2019). Cheng et al. (2010), analyzed 650 A-shares of Chinese listed companies between 2001 and 2006 and concluded that there is a triple threshold between the variables. These results are consistent with the static trade-off theory (Myers, 1977), which argues that firms seek debt levels that balance the gains and costs of debt financing. Ahmad and Abdullah (2013) studied 467 companies in Malaysia between 2005 and 2009 to indicate whether there are positive and negative impacts of leverage on firm value. They argued that the debt ratio increased the value of the firm up to 64.33 percent, but the debt exceeding this ratio did not make a positive contribution to the firm value. Cuong and Canh (2012) used the panel threshold model to examine the panel threshold effect of leverage on firm value in Vietnam from 2005 to 2010. The empirical results strongly indicate that there exists a double threshold effect between debt ratio and firm value. Besides, the coefficient is positive when the debt ratio is less than 59.27 percent, which implies that debt financing can improve firm value. Mishra and Dasgupta (2019) investigated the impact of debt and performance for firms in developed and emerging bank-based economies. As the data set, the annual panel data of 400 companies over 27 years between 1990 and 2016 has been selected. In the study, Germany, France, and Japan were chosen as the developed economies; Argentina and Sri Lanka were chosen as bank-based developing countries. A negative correlation was found between performance and debt in firms in developed economies. This finding was interpreted as the agency problems between managers and lenders increase when firms use debt beyond a threshold limit and firm performance is negatively affected. For developing economies, a positive debt-performance relationship has been reached in line with the "static trade-off theory".

2. Data and Econometric Methodology

The Istanbul Chamber of Industry announces Turkey's top 500 and second top 500 industrial enterprises every year. These lists were combined by us to create a list of 1,000 companies. Turkey's Top 500 Industrial is a traditional study that was initiated by the Istanbul Chamber of Industry in 1968 with 100 large enterprises in order to reveal the giants of Turkish industry and has been expanded to 1,000 enterprises over time and has continued to the present day. Companies are ranked according to their “sales from production”. Sales from production excludes goods that are sold as received (merchandise) without going through the production process. All public and private organizations operating in the industrial sector (mining and quarrying, manufacturing industry and electricity generation) within Turkey are eligible to participate in the ISO 500 survey. The data in the study are collected from firms through a questionnaire together with financial statements and supporting documents. In this way, data not included in the financial statements can also be obtained. Only a portion of all data collected is disclosed to the public. The disclosed data include title, total assets, sales from production, profit before tax, EBITDA, exports, net sales, gross value added, shareholders' equity and number of employees. Data can be accessed at the Istanbul Chamber of Industry website (iso500.org.tr).

The data set of the study consists of companies that are on the list every year for 10 consecutive years between 2011 and 2020. By excluding companies with incomplete data, a balanced panel of 1330 observations for 10 periods of 133 companies was formed.

Most of the studies described in the introduction that investigated the relationship between debt and profitability used ROA/ROE variables as profitability indicators. Instead of ROA or ROE, it may be more accurate to reveal the effect of capital structure on economic value. Because profitability varies depending on accounting practices, legal regulations in different industries, and even depreciation methods. Added value is the value that a company obtains by converting goods and services into buyable products. When the gross value added produced by all sectors in a country is added together, national income is generated. In other words, the variable that grows the national economy and increases per capita income is gross value added. Value added is not the price of the product but the balance that emerges after deducting the elements purchased from others to produce the product. Therefore, what is fundamental for high value added in a product is to increase the amount of national value added as well as to increase the benefit of the product from the procurement of raw materials to its production and until it reaches to the customer. Thus, what is needed to close the foreign trade deficit is not only high value-added high technology or design products, but also high technology or design products with high national value added. In addition, the use of the value added concept will eliminate the profitability changes arising from tax advantages and incentives granted to certain sectors. Especially in data sets consisting of a large number of sectors, it can provide a more reliable comparison. Especially in developing economies, tax advantages and incentives for selected sectors are more common than in developed economies. For these reasons, this study will use the value added created by the company as the dependent variable instead of traditional profitability measures. We use the ratio of the gross value added created by the firm to total assets as a representation of the firm's economic value. On the other hand, in macroeconomic terms, especially in the international comparison the most basic 'output' measure that can be used is value-added. If the added value is found in two countries by similar methods, international comparisons can be made based on key productivity indicators. When firms produce different products, 'unit output' becomes an appropriate measure of 'output'.

Added value is the value that a company obtains by converting goods and services into buyable products. A productivity ratio is created by associating value-added with labor and capital. The physical outputs defined in terms of units produced are important for audit and control, as well as showing the efficiency of the operation of the production process. Added value does not only reflect the efficiency of production but is also a measure of the additional welfare created by the firm. Added value also measures effectiveness and quality.

The concept of added value brings with it the concepts of production and distribution of welfare. From this point of view, there are two ways of calculating the added value: While the production of welfare can be calculated by the “method of subtraction”, the creation of welfare by the “method of addition” can be shown.

Net Value Added = Sales-Purchases
Net Value Added = Salary and Wages + Net Profit + Interest + Direct Taxes

Gross value added is a variable calculated by adding depreciation and net indirect taxes to the net value-added. The net added value consists of salaries and wages paid, interests paid, and net profit. Economic value (EV) is calculated as the ratio of gross value added to total assets. Since not all ISO500 companies are publicly traded and ISO is not authorized to publish

financial statements, only summary data of ISO500 companies are published. In the data published by ISO, it is explained that the variable is calculated with the addition method and the calculation details are included. Therefore, the Net Value Added variable in this study is calculated using the method of addition.

Leverage (debt ratio) is the explanatory variable of the study and also the threshold variable. In different studies in the literature, capital structure has been used with various proxies. In this study, Leverage (LEV) was determined as the ratio of total debt to total assets which is also the regime-dependent explanatory variable in panel threshold estimation.

Three control variables that can affect firm value are selected. In Hansen's (1999) panel threshold estimation, explanatory variables can be considered in two categories. The debt ratio *(total debt to total assets)* is considered a threshold variable to determine whether leverage has a non-linear threshold effect on the economic value created by the firm. The second category of variables is used to control the validity of other factors such as the growth of sales (SG), the growth of total assets (AG), and size (SZ), which can be assumed to affect the economic value of the firm. Jaisinghani and Kanjilal (2017) and Ibhagui and Olokoyo (2018) emphasized that the size of the firm is an important variable in the relationship between the debt ratio and firm performance. In this study size is the natural logarithm of total assets. The growth of sales and assets shows the change in the data from the previous year. These proxies have also been used by Simpson and Gleason (1999), Mak and Kusnadi (2005), and Ahmad and Abdullah (2013). The growth of sales and growth of the assets represents the firm's growth capacity; the size represents the firm's capability to invest.

Table 1. Descriptive statistics and correlations.

	Economic Value	Debt Ratio	Size	Sales Growth	Assets Growth
	EV	LEV	SZ	SG	AG
Panel A. Decriptive Statistics					
N	1330	1330	1330	1330	1330
Mean	0.306	0.507	20.075	17.606	19.092
Std. Dev.	0.462	0.232	1.258	33.900	33.844
Median	0.250	0.523	19.846	14.199	15.473
Max	6.461	1.156	24.549	297.858	292.432
Min	–0.101	0.029	17.574	–90.606	–96.299
Panel B. Correlations					
EV	1				
LEV	–0.001	1			
SZ	0.106	0.171	1		
SG	0.006	0.150	0.100	1	
AG	–0.022	0.218	0.166	0.461	1

Table 1 shows the descriptive statistics for the variables. According to the results obtained, the average value of the economic value (EV), which is the dependent variable, is 30.6 percent and the median is 25 percent. The mean value of the threshold variable, LEV, is 50.7 percent and the median value is 52.3 percent. This shows that about half of the total assets are financed by debt and a firm's total cost of capital is heavily influenced by the ratio of debt to total resources. Table 1 also clearly shows that none of the correlations between different variables are very high. Therefore, the data set is not affected by the multicollinearity problem. Confirming the stationarity of the variables constitutes the first step of the panel regression estimation. If the series is not stationary with the original data at the level, the stationarity test is done by taking

the difference. If a time series needs to be differentiated d times, it is d-order integrated, or I(d). After the data is stabilized, analysis can be started. In this study, four different panel stationarity tests were performed to test the stationarity. Panel data unit root tests used in the study are Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1979), Phillips P-Fisher X^2 (Phillips and Perron, 1988), Levin, Lin and Chu (2002) and Im, Pesaran and Shin (2003). The null hypothesis of the tests is the existence of a unit root.

After confirming that all variables are stationary, the threshold autoregressive model developed by Hansen (1999) can be estimated. Hansen (1999), i represents individual effects, t represents time proposes an $\{y_{it}, q_{it}, x_{it}; 1 \leq i \leq n, 1 \leq t \leq T\}$ estimation for the balanced panel data set. The model with only one possible threshold can be shown as:

$$y_{it} = \mu_i + \beta_1' x_{it} I(q_{it} \leq \gamma) + \beta_2' x_{it} I(q_{it} > \gamma) + e_{it} \quad (1)$$

Here, y_{it} is the dependent variable, q_{it} is the threshold variable, x_{it} is a k dimensional vector of exogenous regressors; $I(.)$ represents the indicator function and $e_{it} \sim (0, \sigma^2)$ represents the independent and identically distributed (iid) error term. The γ specified in the model is the threshold and the observations are divided into two "regimes" depending on whether q_{it} is greater or less than γ. β values are the slope parameters of two different regimes. The following expression can be rewritten for equation (1):

$$y_{it} = \begin{matrix} \mu_{it} + \beta_1 x_{it} + e_{it}, & q_{it} \leq \gamma \\ \mu_{it} + \beta_2 x_{it} + e_{it}, & q_{it} > \gamma \end{matrix} \quad (2)$$

In this method used, $H_0: \beta_1 = \beta_2$ is established to test the significance of the threshold value. The null hypothesis of the form indicates that there is no threshold effect. Equation (1) has only one threshold; however, in some cases, it may be necessary to test models with two or more threshold values. The double threshold model can be written as:

$$y_{it} = \mu_i + \beta_1' x_{it} I(q_{it} \leq \gamma_1) + \beta_2' x_{it} I(\gamma_1 < q_{it} \leq \gamma_2) + \beta_3' x_{it} I(\gamma_2 < q_{it}) + e_{it} \quad (3)$$

Here the threshold values should be $\gamma_1 < \gamma_2$. Hansen (1999) shows that higher-order threshold models can be easily derived from the two-threshold models. For this reason, in Hansen's (1999) study, firstly, an estimation is made for the equation (3), then the presence of a double threshold is determined. Finally, confidence intervals are created for the threshold value parameters for γ_1, γ_2. When the multiple threshold model is evaluated, the hypotheses are: $H_0: \beta_1 = \beta_2, H_1: \beta_1 \neq \beta_2$. The rejection of the null hypothesis indicates that there is at least one threshold value.

In the study, the following hypotheses were formulated to test the existence of the threshold effect, which implies that the relationship between the firm's leverage and the economic value is not linear. If a nonlinear relationship can be proven, the existence of the optimal capital structure is determined based on the analysis of the slopes of the different regimes of panel threshold regression.

H_0: Threshold effect doesn't exist in the effect of a firm's leverage on the economic value.
H_1: Threshold effect exists in the effect of a firm's leverage on the economic value.

If a single threshold is found to be statistically significant, the same analysis can be performed to test for the presence of a double threshold as shown in equation (3) and a triple threshold that can be derived.

The single-threshold model to be used in the study is shown below. The model can be modified if there are double or more thresholds.

$$EV_{it} = \begin{cases} \mu_{it} + \beta_1 LEV_{it} + \theta_1 SG_{it} + \theta_2 AG_{it} + \theta_3 SZ_{it} + e_{it}; & (LEV_{it} \leq \gamma) \\ \mu_{it} + \beta_2 LEV_{it} + \theta_1 SG_{it} + \theta_2 AG_{it} + \theta_3 SZ_{it} + e_{it}; & (LEV_{it} > \gamma) \end{cases} \quad (4)$$

Where,
EV_{it} is the economic value (the dependent variable).
LEV_{it} is firm leverage (the threshold variable).
SG_{it} is sales growth (controlling variable).
AG_{it} is assets growth (controlling variable).
SZ_{it} is the size (controlling variable).
μ_{it} is a given fixed effect used to grasp the heterogeneity of different firms under different operating conditions.
γ is the hypothesized specific threshold value.
β_1 is the threshold coefficient when the threshold value is lower than or equal to γ.
β_2 is the threshold coefficient when the threshold value is higher than γ.
θ_1 represents the coefficient estimate of sales growth.
θ_2 represents the coefficient estimate of assets growth.
θ_3 represents the coefficient estimate of firm size.
e_{it} is the process of white noise.
The subscript i represents different firms and subscript t represents different periods.

3. Empirical Results

The unit root test results of the variables are shown in Table 2. Table 2 shows the panel unit root tests of Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1979), Phillips P-Fisher X^2 (Phillips and Perron, 1988), Levin, Lin and Chu (2002) and Im, Pesaran and Shin (2003). According to the panel unit root test results, it is seen that the H(0) hypothesis was rejected at the 1% significance level, and all the variables are stationary at I(0). These results indicate that the dataset is suitable for applying panel threshold regression analysis.

Table 2. Panel Unit Root Test Results

Variables	LLC	IPS	ADF–Fisher X^2	PP–Fisher X^2
EV	–65.124 (0.000)*	–16.214 (0.000)*	1275.48 (0.000)*	1539.86 (0.000)*
LEV	–142.842(0.000)*	–34.184 (0.000)*	1473.47 (0.000)*	1846.37 (0.000)*
SG	–85.176 (0.000)*	–27.981 (0.000)*	1547.19 (0.000)*	1894.24 (0.000)*
AG	–217.241(0.000)*	–24.012 (0.000)*	1367.75 (0.000)*	1671.54 (0.000)*
SZ	–69.452 (0.000)*	–22.146 (0.000)*	1501.24 (0.000)*	1798.79 (0.000)*
Critical Values 1%				

The numbers in brackets represents p values. * Significant at 1% percent.

In Table 3, F statistics and bootstrap p values for single, double, and triple threshold effects are shown together. 300 bootstrap replications have been applied for each of the three bootstrap tests. The F statistic of the first threshold parameter is greater than the critical values of 1%, 5%, and 10%. Also, the p-probability value is 0,000. This result shows that the $H(0)$ hypothesis

is rejected at 1%, therefore there is no linear relationship between leverage and economic value, and there is a threshold effect. The F statistics of the double and triple threshold parameters are less than all three critical values, and the p-probability values are 0.248 and 0.756, respectively. These results show that the 2γ and 3γ threshold parameters are not significant in the model. Accordingly, the single threshold level estimates show that regime change occurs after leverage exceeds a certain level. The results indicate that the debt ratio has a single threshold effect on the economic value of the firm in the largest Turkish manufacturing firms.

Table 3. Test For Threshold Effects

Test for Single Threshold	
62.18	
F_1	72.092
p value	(0.000)*
(critical values for 10%, 5%, 1% respectively)	(17.14, 22.34, 29.13)
Test for Double Threshold	
54.43	
62.18	
F_2	8.742
p value	0.248
(critical values for 10%, 5%, 1% respectively)	(13.85, 19.42, 24.17)
Test for Triple Threshold	
24.94	
54.43	
62.18	
F_3	3.458
p value	0.756
(critical values for 10%, 5%, 1% respectively)	(7.34, 9.57, 20.17)

* Significant at %1 percent.

Table 4. Single Threshold Model: Estimated Coefficient

Regressors	Coefficients	OLS SE	t_{ols}	White SE	t_{white}
Sales Growth	0.0088	0.0028	3.1247**	0.0041	2.7128**
Asset Growth	0.000048	0.00085	0.4385	0.000047	0.2312
Size	0.00478	0.00094	8.1453**	0.0415	2.8416**
Leverage	–0.00942	0.00247	4.2471**	0.002745	4.1974**
$\gamma_1 \leq 62.18$ %	0.3415	0.1247	2.8421**	0.1874	2.2140**
$\gamma_1 > 62.18$ %	0.0008	0.1024	0.0841	0.0942	0.0742

** Significant at 5% percent. γ_1 refers to the first regime and γ_2 refers to the second regime; OLS SE and White SE are the conventional OLS standard errors (considering homoscedasticity) and White-corrected standard errors (considering heteroscedasticity)

As seen in Table 4, leverage has a significant negative on the economic value of the firm. The regression coefficients of the regimes are different from each other. The estimated coefficient of the first regime is 0.3415 percent. This implies that economic value increases 0.3415 percent with an increase of 1% debt ratio in the firms whose debt ratio is less than 62.18 percent. With this result, it can be argued that raising the debt ratio above the threshold value of 62.18 percent will have no effect on the economic value of the firm and will only increase the leverage of the firm. This finding is consistent with Nieh et al. (2008) from Taiwan, Ahmad and Abdullah (2013) from Malaysia, and Jaisinghani and Kanjilal (2017) from India. The control variables

considered in this study show that asset size and sales growth rate are positively and significantly related to leverage and economic value. This means that the larger the asset size and the growth rate of sales, the higher the economic added value that the firm will create. Estimated coefficients of asset size and growth rate in sales are 0.00478 and 0.0088, respectively. Although it is observed that the rate of increase in assets has a positive effect on firm value, both OLS standard errors and White corrected standard errors results are not significant.

4. Conclusion

This study aims to investigate whether the ratio of debt used by the firm has a threshold effect on the economic value of the firm. For this purpose, using the data of the largest manufacturing companies in Turkey, it has been investigated whether there is a debt ratio that will maximize the value of the company. The study differs from previous empirical studies in terms of the variables it uses and adds to the existing literature. In this study, a different variable is suggested for firm value. In current studies, ROA and ROE are usually used as a proxy of firm value. ROA and ROE are criticized by us, especially in developing countries such as Turkey, because they are affected by both sectoral incentives and different tax and accounting practices, as they cannot be a complete indicator of firm value. We think that it is more appropriate to use Gross Value Added, which is calculated by adding depreciation and net indirect taxes to Net Value Added, which is expressed as (Salary and Wage + Profit + Interest + Direct Taxes) to measure firm performance. This variable is much more significant than ROA and ROE. In addition, this study is the first to measure the threshold effect on the capital structures of Turkish companies as far as we know.

In the study, a panel threshold regression model developed by Hansen (1999) was used to measure the effect of the debt ratio on the economic value of the firm. The results show that the effect of the debt ratio on economic value can be explained by a single threshold. It has been determined that the detected threshold divides the data into two regimes that only the first regime is significant. This result indicates that the effect of debt on firm value does not remain after a certain point.

This article detects the existence of the threshold debt ratio, a relationship that has not been examined before with Turkey data. This ratio was estimated to be 62.18 percent for the largest manufacturers in Turkey. This result partially supports the static trade-off theory that firms seek a level of debt that balances the utility of debt and the increased cost of debt financing. This result relatively supports the static equilibrium theory, which suggests that firms try to reach equilibrium at a level of debt that balances the benefits and costs of debt. However, this view is only true if the debt ratio is equal to or below the specified threshold level. After this threshold value, it has been determined that the benefit of the debt is no longer available. The level at which the marginal cost of debt exceeds the marginal benefit was found to be 62.18 percent. From this study, a policy implication can be deduced that if a firm's leverage ratio is low, firm managers may be advised to increase their borrowing level to 62.18 percent. Likewise, firms with leverage above this ratio can maximize the benefit of debt by decreasing their debt ratio to this level. Because raising the debt level above the threshold level does not add value to the firm and may cause the cost of debt to exceed its benefits. The variables that significantly explain the performance in this study are the sales growth rate and the asset size ratio. In future studies, variables such as ownership structure, firm-specific and market-specific variables, and firm size, which are assumed to affect firm value, may also be included in the model.

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