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CAPITAL STRUCTURE AND FINANCIAL PERFORMANCE RELATIONSHIP BY TURKISH AND GERMAN MARKETS: EVIDENCE FROM A NONPARAMETRIC APPROACH[1]

Umut UYAR[2] , Abdirahman Rashid MOALINAHMED[3]

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Abstract

This study aims is to examine the relationship between the capital structure of manufacturing firms traded in different markets and their financial performance. For this purpose, annual data for the period 2011-2020 of Borsa Istanbul and Frankfurt Stock Exchange are analyzed. While the fast-calibrated aggregate quantile regression method which is a machine learning algorithm is preferred as the basis of the analysis, the panel data analysis is used to compare the findings. According to the findings of non-parametric approach, it is determined that there is a non-linear relationship between capital structure elements and debt ratios. Also, they vary depending on the quantiles. Non-linear and nonparametric relationships between variables support modern capital structure theories. Although the results of panel data analysis also support same theories, nonparametric findings provide more detailed outputs. The findings of the study contribute to the literature and to the real and financial authorities in terms of both comparing two developed and developing countries and investigating capital structure theories using two different methods.

Key Words: Capital Structure, Financial Performance, Panel Data Analysis, Nonparametric Regression, Machine Learning Algorithm

JEL: C14, G31, G32

TÜRK VE ALMAN PİYASALARINDA SERMAYE YAPISI VE FİNANSAL PERFORMANS İLİŞKİSİ: PARAMETRİK OLMAYAN BİR YÖNTEMDEN BULGULAR

Öz

Bu çalışma, farklı piyasalarda işlem gören imalat firmalarının sermaye yapıları ile finansal performansları arasındaki ilişkiyi incelemeyi amaçlamaktadır. Bu amaçla Borsa İstanbul ve Frankfurt Borsası'nın 2011-2020 dönemine ait yıllık verileri analiz edilmiştir. Analizin temeli olarak bir makine öğrenmesi algoritması olan hızlandırılmış toplamsal kantil regresyon yöntemi tercih edilirken, bulguları karşılaştırmak için panel veri analizi kullanılmıştır. Söz konusu parametrik olmayan yaklaşımın bulgularına göre, sermaye yapısı unsurları ile borç oranları arasında doğrusal olmayan bir ilişki olduğu belirlenmiştir ve kantillere bağlı olarak değişmektedir. Değişkenler arasındaki doğrusal ve parametrik olmayan ilişkiler, modern sermaye yapısı teorilerini desteklemektedir. Panel veri analizi sonuçları da aynı teorileri desteklemekle birlikte, parametrik olmayan bulgular daha ayrıntılı çıktılar sağlamaktadır. Çalışmanın bulguları, hem gelişmiş ve gelişmekte olan iki ülkeyi karşılaştırması hem de iki farklı yöntem kullanarak sermaye yapı teorilerini incelemesi açısından literatüre ve reel ve finansal otoritelere katkı sağlamaktadır.

Anahtar Kelimeler: Sermaye Yapısı, Finansal Performans, Panel Veri Analizi, Parametrik Olmayan Regresyon, Makine Öğrenmesi

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[2] Assoc. Prof. Dr., Department of Business Administration, FEAS, Pamukkale University, Denizli, TURKIYE, uuyar@pau.edu.tr. ORCID: 0000-0001-6217-8283

[3] Graduate Student, Department of Business Administration, Social Sciences Institute, Pamukkale University, abdirahmanrashid933@gmail.com. ORCID: 0000-0002-0655-9433

1. Introduction

Since the beginning of the 20th century, globalization and rapidly progressing technology have pushed firms to operate in a highly competitive market, creating potential risks and uncertainties. Despite this, firms strive to keep their business operations running smoothly and move toward their long-term objectives. With the growing impact of globalization, the idea of a capital structure has been regularly questioned in recent years (Graham and Harvey, 2001: 18-20). Companies require capital to have a solid financial basis and maintain the sustainability of their assets. The term "capital" is described as the financial resources that businesses require to fulfill their objectives. The structure of long-term debt and equity which the firms will use to fund their investments is known as the capital structure. Firms should consider this while making capital structure decisions because these decisions have a direct impact on the value of firms, financial performance, and the cost of capital. The primary objective of the firm as a financing policy is to acquire profits and maximize the wealth of the shareholders. To accomplish this aim, the firm must devise a low-cost and high-profit financial strategy. Another factor to examine is how much of the firm's capital structure should be designed as debt vs equity. The cost of different capital structure matters and directly affects the firm's value (Kapusuzoğlu and Ceylan, 2018: 22). For instance, it is obvious that the costs of short-term and long-term debt would vary as they have distinct maturity and risk structures. In addition, the weighted average cost of capital for the company rises because of equity investors' high expectations for returns relative to the risks they assume. At this point, the critical challenge is to maintain the firm's capital structure's competitiveness with other enterprises while taking into consideration the fact that different financing components have varying costs (Dağlı, 1999: 381).

In 1958, Modigliani & Miller's Nobel Prize-winning articles and their contribution to the finance literature led to the emergence of various financial theories related to capital structure and many studies subject to these theories. Because capital structure decisions differ from country to country, industry to industry, business to business, and over time, a consistent and widely acknowledged technique for optimal capital structure has yet to be defined. For this reason, the concept of capital structure is still up to date, to researchers seeking to show that companies can be more successful with more effective financing alternatives. The primary question for scholars and practitioners is whether or not there is an optimal capital structure. Thus, the relationship between financial resources and the value of firms was frequently studied in finance literature. The studies on capital structure theories mostly deal with the

question using traditional econometric models (e.g., panel data analysis). Although the common findings indicate that there is no generally accepted strategy for an optimal capital structure, there are some critiques of the traditional econometric model assumptions (Çağlayan and Sak, 2010; Uyar, 2021). These assumptions can be listed as follows: multicollinearity, cross-sectional dependency, heteroscedasticity, autocorrelation, etc. The point of criticism for traditional econometric models is that these assumptions are very strong for financial data and hard to satisfy. Hence, new techniques are needed for the investigation of optimal capital structure.

This study investigates whether the capital structure decisions of manufacturing firms traded in the stock markets of Turkiye, and Germany have an influence on firms' financial performance. For this purpose, the analytical findings of the firms in the manufacturing sector traded on the stock markets of the two countries will be compared to identify the similarities and differences. Since Turkiye and Germany are significant trading partners, it was decided to compare the manufacturing industries of the two countries in the study. By comparing two countries with different economic structures, the research aims to provide a deeper understanding of the effects on capital structures and financial performance and to make a novel contribution to the literature in this field. This study examines how economic differences between developed and developing countries are reflected in firms' capital structures and financial performance. While developed and developing countries are usually analyzed separately in the literature, this study aims to reveal the effects of differences in economic structures on capital structure more clearly by considering two different categories of countries together. By focusing on Germany and Turkiye with two different economic structures, it is planned to make a comparative analysis of the effects of factors such as access to capital markets, capital costs, and firm size on firms. As a result of the literature review, we preferred to examine the relationship with a different method called Fast Calibrated Additive Quantile Regression than traditional econometric methods. This method is a non-parametric econometrics technique that does not require the assumptions of the traditional methods and is shown among the machine learning algorithms in some studies. For comparison, the panel data analysis will also be examined, and the findings of models will be presented in our analyses. This is another important contribution of the study to the literature. We examine how firms' capital structure behavior responds to different points in the distribution of variables. For instance, the level of long-term debt of firms decreases after which level of growth and increases after which level of growth. It is planned to obtain findings that can be interpreted in this way for two different countries.

The structure of this paper is arranged as follows: Section 2 explains the literature review; Section 3 contains datasets, and Section 4 presents the research methodologies and models. The findings are discussed in Section 5, and the study's conclusion is highlighted in the last section.

2. Literature Review

The capital structure of a firm, which refers to the proportion of equity and debt used to finance its operations, has been the subject of much empirical research in the field of finance. Researchers have been interested in understanding how capital structure affects firm value in different countries, markets, and sectors, with the first studies on this topic dating back to the 1950s. Durand (1952) conducted one of the earliest studies on capital structure and found that it has no direct impact on the cost of capital.

Modigliani & Miller (1958) further developed this topic with their work on "The Cost of Capital, Corporation Finance, and the Theory of Investment," which posited that, in a perfect capital market, arbitrage transactions by investors with equal access to the market prevent changes in capital structure from impacting capital costs and market value. Modigliani and Miller (1963) later expanded on this idea with their study on "Corporate income taxes and the cost of capital: a correction," in which they introduced the concept of the tax shield on debt, which suggests that unlevered firms have a lower market value than levered firms due to the tax benefits of debt.

Subsequent research on capital structure has proposed various variables and models that are thought to affect capital structure and firm performance, such as agency costs (Jensen & Meckling, 1976), information asymmetry (Myers, 1984), and the costs of bankruptcy and financial difficulty (Titman, 1984). The most widely accepted theories in the literature include the "pecking order theory," the "trade-off theory," and the "agency cost theory," in addition to the original "MM theory."

The "pecking order theory," originally proposed by Modigliani & Miller (1963), suggests that firms prioritize their financial resources in order of cost, with retained earnings being the cheapest source, followed by bond issuance, and finally stock issuance as the most expensive financial resource. This theory was later supported and proposed by Myers & Majluf (1984). According to the "trade-off theory," companies aim to strike a balance between the dangers of financial instability and the tax advantages of debt to attain the optimal capital structure that enhances the value of the firm. The "trade-off theory," on the other hand, proposes that

firms strive for a balance between the risks of financial difficulty and the tax benefits of debt in order to achieve an optimal capital structure that maximizes firm value. The "agency cost theory" focuses on the relationship between stakeholders and company representatives (managers) and posits that there is a conflict of interest when agents (deputies) do not act in the best interest of the stakeholders (principals) they represent.

Many studies have been conducted on various financial markets to examine the relationship between firm performance and capital structure, yielding mixed results. Abor (2005) analyzed the relationship between profitability of firms and capital structure quoted on the Ghana Stock Exchange using 5-year data from 1998 to 2002 and found that the ratios of total debt to total assets and short-term debt to total assets had a positive impact on return on equity, while the ratio of long-term debt to total assets had a negative impact. Baum et al. (2006) studied the effect of using short-term and long-term debt on profitability by using data from firms listed in Germany for the period 1998-2000. In the dynamic panel data analysis, they concluded that firms using more short-term debt will achieve higher profitability. Akkaya (2008) analyzed the leather-textile companies listed on Borsa Istanbul between 1997-2006 and tried to reveal the causality relationship between capital structure, asset efficiency and profitability with regression analysis approach. While Tobin Q (market value/asset return) and leverage ratio, which measure firm performance, were used as dependent variables, systematic risk level (Beta), growth rate, tangible fixed assets ratio and logarithm of total assets were used as independent variables. In the research, it was concluded that there was a positive relationship between Tobin Q and systematic risk level, tangible fixed assets ratio and natural logarithm of total assets, and a negative and significant relationship with growth rate. It was also observed that there was a positive relationship between leverage ratio and natural logarithm of total assets, and a negative and significant relationship with growth rate. In the same year, Kabakçı (2008) examined the capital structure and financial performance in his research using the financial statements of 22 food sector companies traded on Borsa Istanbul between the years 2000-2005. The OLS method was used in the research. As a result of the analysis, it was determined that there was a negative relationship between the total debt-equity ratio, short-term and long-term debts and equity profitability. The author emphasized that companies in the food sector should prefer to use auto financing rather than external financing sources.

Azhagaiah & Gavoury (2011) studied the impact of capital structure on profitability using correlation and regression analysis on a sample of 102 IT firms listed on the Bombay Stock Exchange for the periods 1999-2000 and 2006-2007 and found that capital structure had a

significant positive impact on profitability. Doğan (2013) focused on the relationship between capital structure and profitability in his study using data from insurance companies registered on Borsa Istanbul between 2005 and 2011. In this study, which was applied with multiple regression analysis and correlation analysis, it was found that leverage ratio, current ratio, loss premium ratio and firm age had a statistically significant and negative effect on active profitability, while active size had a significant and positive effect on ROA. Akpınar (2016) used 81 non-financial companies operating in the BIST100 index as a sample in a study. The study investigated whether the capital structure affected the profitability of the company. The panel data analysis method was preferred in the study by using the data of the companies between the periods of 2010-2013. In the study, equity profitability and net profit margin were used as dependent variables, short-term debt ratio, long-term debt ratio and total debt ratio were used as independent variables, and firm size, current ratio, equity turnover and asset growth were used as control variables. As a result of the analysis, it was revealed that there was a negative and significant relationship between short-term debt ratio and firm size and equity profitability and net profit margin. No significant relationship was found between other capital structure variables and profitability. In this direction, it was said that results parallel to the financial pecking order theory were obtained in the study. It was also determined that firms with high profits had lower short-term borrowing opportunities. Avcı (2016) investigated whether the capital structure affects firm performance using the panel data analysis method. In his study, he used the data of 110 firms in the BIST manufacturing sector for the periods of 2003-2015. While the return on assets and return on equity were used as firm performance in the study, the debt-equity ratio, the ratio of short-term debts to total assets and the ratio of long-term debts to total assets were used as financial leverage indicators, and total active assets were used as control variables. The findings suggest that as short-term and long-term debts increase, the profitability of firms will decrease significantly; and as the assets of the company grow, profitability will increase. In other words, it was determined that short-term and long-term debts negatively affect the profitability of assets and equity. No significant relationship was found between the debt-equity ratio and profitability. Doğan and Topal (2016) used panel data method analysis to investigate the financial factors affecting profitability based on data from 136 manufacturing companies listed on Borsa Istanbul in the period 2005-2012. While ROA and ROE were used as dependent variables in the study, debt level, liquidity level, firm size and firm age were used as independent variables. As a result of the analysis, a negative and significant relationship was found between ROA and ROE and leverage ratio, and a positive and significant relationship was found

between total assets. However, no statistically significant relationship was found between ROA and ROE and firm age and current ratio. Akgüneş (2017) investigated the relationship between capital structure and profitability using panel data method in his study using data from 12 out of 14 companies in the IT sector. Using quarterly data from IT companies for the years 2010-2016, it was concluded that the equity/total resources ratio negatively affected equity profitability; short-term and long-term debts had no effect on equity profitability. In his study, Alsu (2017) investigated whether profitability was affected by changes in capital structure by using data from 2006-2015 of 100 companies listed on Borsa Istanbul. Panel regression method was preferred in the analysis. While active and equity profitability were used as dependent variables; equity ratio, long-term debt ratio and legal reserve ratio were used as independent variables. As a result of the analysis, it was concluded that equity and legal reserve ratios significantly and positively affected profitability, while long-term debt ratio did not have a significant effect on profitability. Yılmaz and Düzakin (2017) examined the factors affecting capital structure decisions using data from 2008 to 2016 for 6 firms in the chemical sector of Borsa Istanbul. In the study, total debts/total assets, long-term debts/total assets, short-term debts/total assets were used as dependent variables; firm size, non-debt tax shield, profitability and liquidity ratio were used as independent variables. As a result of the applied panel data analysis, it was revealed that there was a negative relationship between the total debts/total assets ratio and the liquidity ratio, and a positive and significant relationship between the other variables. In addition, it was emphasized that the results were in accordance with both the balancing and pecking order theory. Cevheroglu Acar (2018) investigated the factors affecting the capital structure decisions of 111 non-financial firms traded on Borsa Istanbul. The author obtained 8-year data from the financial statements of the firms in the period 2009-2016. In the study where the panel data analysis method was preferred, it was determined that profitability, non-debt tax shield, size, understandability and liquidity ratio were important factors affecting the capital structure. No statistically significant relationship was found between the other variables included in the study and the capital structure. As a result of the study, it was concluded that the pecking order theory was valid for non-financial firms. Dommes et al. (2019) tried to analyze the determinants of capital structure by using 2017 financial data of 44 companies traded on the Frankfurt Stock Exchange. As a result of the study using the multiple regression method, a statistically significant relationship was found between the leverage ratio and profitability, firm size and the firm's growth opportunities. On the other hand, it was found that there was no significant relationship between tangible fixed assets and profitability. According to the results of the study, it was indicated

that the companies included in the sample supported the trade-off theory and therefore had an optimal capital structure.

Elmas and Gözel (2020) preferred to use panel data analysis to determine whether there is a relationship between the capital structure of firms and their profitability of assets and equity. Borsa Istanbul used the data of firms in the automotive sector for the period 2009-2018. As a result of the analysis, it was concluded that firms should keep their debt ratio low in order to achieve higher profits, in other words, there is a negative and significant relationship between profitability and capital structure. Güngör and Dilmaç (2020) examined the capital structure of the Turkish banking sector during crisis periods using quarterly data for the periods 2002:4 - 2015:1. It was investigated whether the capital structure of 12 deposit banks in the sector affected the performance of the banks. According to the findings of the study using panel data analysis, it was determined that the performance of banks would increase if they preferred long-term financing rather than equity. It was also stated that the 2008 global crisis positively affected the performance. Abdullah and Tursoy (2021) analyzed non-financial firms listed on the Frankfurt Stock Exchange during the period 1993-2016 and investigated the reverse causality between firm performance and capital structure. The two-stage GMM estimator was used in the study. While the total debt ratio was used as the capital structure indicator, return on assets and stock price were used as firm performance indicators. In addition, sales growth and the size of assets were used as control variables. While return on assets and financial leverage positively affect each other; capital structure can negatively affect market performance. In addition, it was observed that stock price has a positive effect on the leverage ratio. The results probably show that non-financial firms in Germany borrow more to benefit from the tax shield and support the trade-off theory.

As a result of the detailed literature review, it was determined that the studies examining the capital structure generally focused on a country market and used classical econometric methods (e.g. time series and panel data analysis). The study aims to fill a gap in the literature in terms of the data set and methods used.

3. Data

In this study, the annual data of firms in the manufacturing sector listed on the Borsa Istanbul (Turkish dataset) and the Frankfurt Stock Exchange (German dataset) for the period 2011 to 2020 were analyzed. Finalizing the time dimension of the dataset in 2020 aims to eliminate the impact of the pandemic on the findings. The research aims to compare the two

country's capital structures in a theoretical framework, so the pandemic effect is excluded. The datasets are gathered from Thomson Reuters Database. The sample for this research consisted of 105 firms from Turkiye and 39 firms from Germany. Firms that did not have accessible data or regular and continuous data during the research period were excluded from the analysis. The variables used in the analysis were determined based on theoretical expectations and literature review. The debt ratio (TDR) and long-term debt ratio (LTDR) were used as dependent variables to represent capital structure, while profitability (PROFIT), asset structure (TANG), company size (SIZE), and growth (GROWTH) were employed as independent variables. The formulas and theoretical expectations of the variables are presented in Tables 1 and 2, respectively.

Table 1: Details of Dependent and Independent Variables

Dependent Variables
$Debt\ ratio\ (TDR) = \frac{Total\ Debt}{Total\ Assets}$
$Long-term\ debt\ ratio\ (LTDR) = \frac{Long-Term\ Debt}{Total\ Assets}$
Independent Variables
$PROFIT = \frac{Net\ Income}{Total\ Assets}$
$\text{SIZE} = \log(Total\ Assets)$
$TANG = \frac{Net\ Fixed\ Assets}{Total\ Assets}$
$GROWTH = \frac{\ln(Total\ Assets)_t}{\ln(Total\ Assets)_{t-1}}$

Table 2: The Theoretical Expectations

Variables	Trade-Off Theory	Agency Cost Theory	Pecking Order Theory
PROFIT	+	+	-
SIZE	+	+	-
TANG	+	+,-	-
GROWTH	-	-	+

Sources: Rajan & Zingales (1995), Bevan & Danbolt (2002). Note that the (+) and the (-) signs show positive and negative relationships, respectively.

Although the calculation steps and the theoretical sign expectations of the variables are presented in Tables 1 and 2, all dependent and independent variables need to be explained within the framework of finance theory. TDR, which is the ratio of total debt to total assets, is a measure of how much of a firm's investment is financed by borrowing. Total debt consists of long and short-term liabilities. LTDR, which is taken as the long-term liabilities/total assets ratio, reveals what percentage of assets is obtained from long-term liabilities. In other words, it shows how much of the foreign resources used by the firm to finance its assets comes from a long-term financing source. PROFIT shows how much profit a firm makes from its assets. In other words, this ratio, which is explained as return on assets, is used to calculate the profit remaining after deducting taxes for all investments made by a firm. According to the finance literature, balancing theory, signaling theory and agency cost theory support the expectation of a positive relationship between profitability and capital structure, while financial hierarchy theory advocates negative expectations. The SIZE variable is determined by the natural logarithm of a firm's total assets. In the literature, a positive relationship between firm size and leverage is expected. The reason for this is that as a firm grows larger, it has easier access to capital markets, less risk, and more advantageous borrowing compared to other firms. A positive relationship between firm size and leverage is expected according to the balancing theory, while a negative relationship is assumed according to the financial hierarchy theory. TANG is defined as the ratio of a firm's tangible assets to total assets. In other words, the share of tangible fixed assets in total assets indicates how much of a firm's asset structure is composed of tangible fixed assets. This ratio is considered as an important criterion to be taken into account in the risk assessment of credit providers. In the literature, according to the balancing theory, a positive relationship is expected between the asset structure variable, which is taken as the ratio of fixed assets to total assets, and leverage. On the other hand, according to the financial hierarchy theory, a negative relationship is assumed between the asset structure variable and leverage. Lastly, GROWTH is measured by the percentage change in firm assets compared to the previous year. Changes in firms' assets during balance sheet periods can be used to assess their growth status. While the balancing theory argues that there is a negative relationship between growth rate and financial leverage, the financial hierarchy theory assumes a positive relationship between growth and leverage.

The descriptive statistics for all independent and dependent variables for the Turkish and German datasets used in the study is given in Table 4, and the graphs of all variables are also presented in Figures 1 and 2, respectively.

Table 3: Descriptive Statistics of Turkish and German Datasets

Turkish	**TDR**	**LTDR**	**PROFIT**	**SIZE**	**TANG**	**GROWTH**
Mean	0.4935	0.1412	0.0464	6.0405	0.4473	0.1507
Median	0.5138	0.0992	0.0401	5.9346	0.4242	0.1280
Maximum	1.3663	0.6467	0.9954	10.9361	0.9412	2.4011
Minimum	0.0117	-0.0454	-0.3447	1.5989	0.0032	-0.1926
Std. Dev	0.2416	0.1308	0.0980	1.5985	0.2025	0.1539
Observations	1050	1050	1050	1050	1050	1050
German	**TDR**	**LTDR**	**PROFIT**	**SIZE**	**TANG**	**GROWTH**
Mean	0.5563	0.2245	0.0439	6.7574	0.4426	0.0545
Median	0.5799	0.2170	0.0426	6.6944	0.4378	0.0525
Maximum	1.0840	0.7892	0.3547	11.8987	0.8266	0.5022
Minimum	0.1179	-0.0192	-0.3717	3.5000	0.1152	-0.2738
Std. Dev	0.1884	0.1317	0.0788	1.8686	0.1367	0.0917
Observations	390	390	390	390	390	390

Figure 1: Variable Graphs for the Turkish Datasets

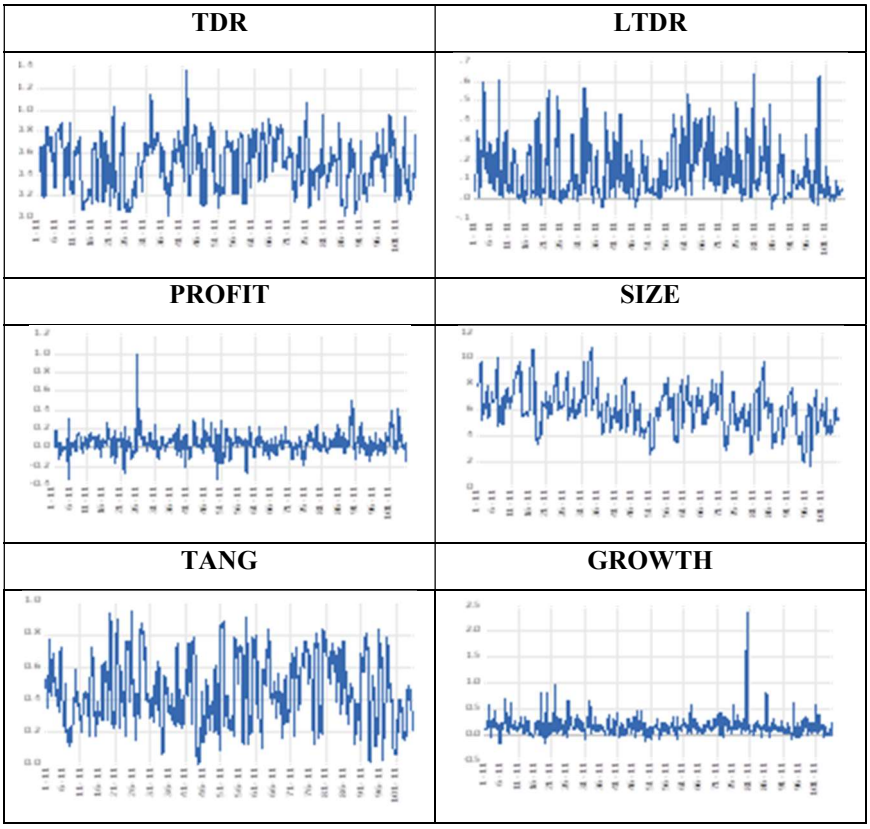
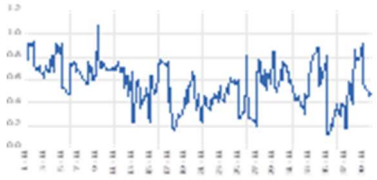
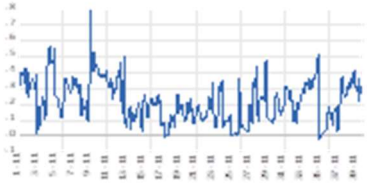
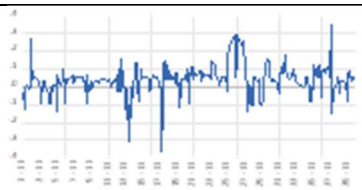
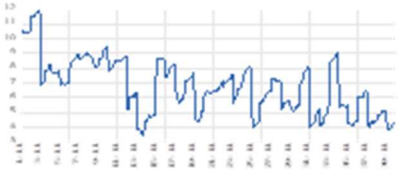
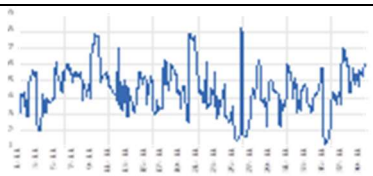
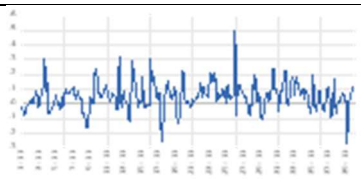


Figure 2: Variable Graphs for the German Datasets

TDR	LTDR
	
PROFIT	**SIZE**
	
TANG	**GROWTH**
	

According to the descriptive statistical results in Table 3, the average debt ratio for Turkish firms is 49.35%, with a standard deviation of approximately 22.2%, compared to 55.6% and 18% for German firms, respectively. The average value of this result is close to 50%, which is almost generally accepted as leverage for both countries. This means half of the total assets of the companies included in the sample are financed with equity. The maximum value of tangibility is 94% for Turkish firms, and 82% for German firms, which indicates that almost all the assets of some companies are fixed or noncurrent assets. As a matter of fact, when the average value is analyzed, it is seen that the tangibility is at the level of 44% for both country data sets. The fact that Turkish firms have higher tangibility in terms of maximum value can be evaluated from a number of different perspectives. These can be listed as differences in production technology, tax differences, differences in depreciation method or financing conditions (Turkish firms may need more materiality to obtain financing) between countries. In addition, according to the growth rate, the result indicates that Turkish manufacturing firms

with an average of 15% and a maximum of 240%, show that some firms can grow very quickly. This may indicate high growth potential. On the other hand, this may also be due to high volatility, risk and differences in market dynamics for Turkish firms. In this respect, the impact of this variable on firm capital structure needs to be analyzed.

Tables 4 and 5 presented correlation matrices for the variables for the Turkish and German datasets, respectively. Wooldridge (2015) states that a multicollinearity problem may arise if the correlation coefficient between two variables is greater than 75%. Explanatory variables with high correlation matrix values should not be included in the same model because it might lead to multicollinearity issues. The correlation value between the dependent variables will not be considered as a multicollinearity problem because it is included in the different models.

Table 4: Correlation Matrix for Turkish Datasets

Correlation	**TDR**	**LTDR**	**PROFIT**	**SIZE**	**TANG**	**GROWTH**
TDR	1					
LTDR	0.6553	1				
PROFIT	-0.3992	-0.3079	1			
SIZE	0.1335	0.2080	0.1695	1		
TANG	-0.0456	0.2882	-0.2766	0.0521	1	
GROWTH	0.1383	0.1788	0.0988	0.0835	-0.0153	1

Table 5: Correlation Matrix for German Datasets

Correlation	**TDR**	**LTDR**	**PROFIT**	**SIZE**	**TANG**	**GROWTH**
TDR	1					
LTDR	0.7325	1				
PROFIT	-0.4508	-0.3595	1			
SIZE	-0.4508	0.3978	-0.1289	1		
TANG	0.1482	0.4361	-0.2834	0.1494	1	
GROWTH	0.0470	-0.0047	0.2329	0.0328	-0.1006	1

When the correlation matrix in Tables 4 and 5 are examined, it is revealed that there is not a problem of multicollinearity for both Turkish and German firm variables, meaning that all variables could be included in the model estimation. The correlation relationships between the dependent and independent variables are generally similar for both country data sets. However, while the correlation between SIZE and TDR is positive for Turkish firms, it is

negative for German firms. This can basically be interpreted as Turkish firms financing their growth through borrowing. On the other hand, while the correlation between TANG and TDR is negative for Turkish firms, it is positive for German firms. It can be concluded that if the tangibility of Turkish firms increases, their total debt level decreases, whereas the opposite is true for German firms. It can be interpreted that German firms use borrowing for fixed asset acquisition, while Turkish firms prefer or are forced to use equity financing. The correlations of LTDR and GROWTH variables are positive for Turkish firms and negative for German firms. This finding can be accepted as an indicator that German firms evolve into a more conservative structure as they grow.

4. Methodologies and Models

The study used two different approaches to examine the association between manufacturing firms' financial performance and their capital structure. In accordance with the existing studies, panel data analysis, which is the traditional econometrics method, is extensively applied in capital structure research. However, this method receives serious criticism in the economic literature due to the fact that it makes certain definite assumptions that are inconsistent with the nature of financial data. For this reason, the fast-calibrated additive quantile regression method, which is a non-parametric econometric technique that does not rely on the assumptions of the panel data analysis method, was included in the research.

4.1. Fast Calibrated Additive Quantile Regression Method

Although Fasiolo et al. (2021) developed the method, Koenker & Bassett (1978) created the standard quantile regression method serves as the foundation for this technique. Due to its various advantages, it is a method used in different studies in the literature (Wood, et al. 2017; Waldman, et al. 2017; Spiegel, 2020; Fasiolo, et al. 2020; Youngman, 2020; Uyar, 2021). For various parts of the dependent variable's conditional distribution (quantiles, $\tau \epsilon (0,1)$), classic quantile regression enables us to quantify the link between a k-dimensional explanatory variables vector (x) and the dependent variable (y). The τ^{th} quantile of the conditional distribution of y, also known as the τ^{th} conditional quantile, is explained as $\mu = F - 1\ (\tau|x) = \inf\{y: F(y|x) \geq\ \tau\}$ when $F(y|x)$ is the conditional cumulative distribution function of y. Here the objective is to find the τ^{th} conditional quantile estimate that minimizes the following function, called the expected loss function:

$$L(\mu|x) = E\{\rho_\tau \times (y - \mu)|x\} = \int \rho_\tau \times (y - \mu) dF(y|x) \quad (1)$$

Here $\mu = \mu(x)$) and $\rho\tau$, stand for the control function or pinball loss and is expressed as:

$$\rho_\tau = (r - 1)\big(y - \mu(x)\big) I(y - \mu(x) < 0) + rI(y - \mu(x) \geq 0) \quad (2)$$

Since $\mu(x)$ in the case of the linear regression model is equivalent to $x'\hat{\theta}$, the anticipated loss function is updated, and the quantile estimate in Equation 3 is obtained:

$$\hat{\theta} = \underset{\theta}{argmin} \frac{1}{n} \sum_{i=0}^{n} \rho_t\{y_i - x_i'\hat{\theta}\} \quad (3)$$

In this case, x_i is the explanatory variables vector I, and θ is the regression coefficients vector. While the classic quantile regression technique implies that the connection between x and y is linear, the fast-calibrated additive quantile regression approach makes no assumptions regarding the functional form. In other words, by summing all betas, the method can reveal linear and non-linear relationships between dependent and independent variables. As a result, under the method, $\mu(x)$ has an undetermined functional form. This methodology generates a functional form from data and offers a flexible method for finding functional form. Furthermore, because $\mu(x)$ is additive, the impact of each independent variable on the dependent variable is considered to be independent for each quantile:

$$\mu(x) = \sum_{j=1}^{m} f_j(x) \quad (4)$$

In Equation 4, the function f expresses the non-parametric functions of the independent variables. Those non-parametric functions might be determined on a spline basis:

$$f_j(x) = \sum_{i=1}^{r} \beta_{JI} b_{ji}(x_i) \quad (5)$$

Here β_{ji} stands for the coefficients to be estimated, and $b_{ji}\big(x_j\big)$ for the spline functions. Spline is a non-parametric approach for analyzing nonlinear interactions between dependent and independent variables. It employs a piecewise linear regression model. The regression graph is computed in this model by splitting the sample into subgroups for each sample subset. Combining these lines yields the piecewise linear regression model. However, because the junction points of the combined lines, i.e., the jump points, are discrete, the first-order derivatives of the functions employed in the derivation of the regression lines are not continuous. Spline basic functions are employed to solve this problem. r is the basic dimension that

we picked to prevent over-smoothing. The penalty for deviations from f_j governs it, and the penalty term is given to β_{ji}. As a result, the penalized pinball loss is expressed as follows:

$$V(\beta, \lambda, \sigma) = \sum_{i=1}^{n} \frac{1}{\sigma} \rho_\tau \{y_i - \mu(x_i)\} + \frac{1}{2} \sum_{j=1}^{m} \lambda_j \beta' S_j \beta \quad (6)$$

Where $\lambda = \lambda_1, \lambda_2, \dots, \lambda_m\}$ is the smoothing parameter vector. $1/\sigma$ represents the learning rate that balances the loss and the penalty. S_j matrices are positive semidefinite matrices that punish oscillations of the associated effect. The maximum a posteriori (MAP) estimator is obtained by minimizing Equation 6 with respect to β for fixed λ. As a result, the fast calibrated additive quantile regression technique obtains the estimate of the nonparametric functions or f_j for each quantile by minimizing Equation 6. Fasiolo et al. (2021) explains the optimal selection of λ in detail.

Within the scope of the study, models assessing the association between capital structure and financial performance using the fast calibrated additive quantile regression approach are shown in Equations 7 and 8, respectively:

$$TDR_{it} = \gamma + f_{5it}(PROFIT_{it}) + f_{6it}(SIZE_{it}) + f_{7it}(TAN_{it}) + f_{8it}(GROWTH_{it}) + v_{it} \quad (7)$$

$$LTDR_{it} = \alpha + f_{1it}(PROFIT_{it}) + f_{2it}(BSIZE_{it}) + f_{3it}(TAN_{it}) + f_{4it}(GROWTH_{it}) + z_{it} \quad (8)$$

4.2. Panel Data Analysis Approach

Panel data is defined as data with more than one cross-section unit and a time series. The financial datasets are sets that include both more than one unit and time dimensions. For this reason, panel data analysis, which allows for bringing together more than one cross-sectional unit and time series, could be applied to financial data.

Panel data analysis is generally expressed as:

$$Y_{it} = \alpha_i + \beta_i X_{it} + \varepsilon_{it} \; i = 1, \dots, N \; t = 1, \dots, T \quad (9)$$

Where Y is the dependent variable in the model, X is the explanatory variable, β is the slope parameter, α is the constant parameter, and ε is the error term. i indicates a measurement unit (such as a country, city, individual, or business), t indicates time (Hsiao, 2007).

In the panel data analysis model, it is required to examine heteroscedasticity, autocorrelation, and cross-sectional dependency problems depending on the selected model. If these problems occur in the estimation, robust standard error estimators should be used. To produce

econometrically significant correlations between the variables in the model and to avoid biased conclusions, it will also be crucial to ascertain if the series meets the stationarity condition. Baltagi (2021) mentioned in his book that the stationarity of the series should be checked for macro panel data. However, it is emphasized that testing cross-section dependency and unit root tests are optional in a series with micro panel data, particularly when the time interval is short for each unit (firm). The analysis will be carried out in the way proposed by Baltagi. In this way, Hausman tests will be applied first to identify the models, followed by heteroscedasticity and autocorrelation tests. Depending on whether the panel data analysis assumptions are met, the models will be estimated using a robust estimator if necessary. For this study, Generalized Least Squares (GLS) is preferred as a robust estimator. For micro panel data ($N < T$[4]), the GLS estimator is robust to autocorrelation and heteroscedasticity. The GLS estimator also provides robustness against cross-sectional dependence by taking into account time effects across units.

Models created within the scope of the research aiming and literature to examine the effect of the capital structure of firms on financial performance are shown in Equations 10 and 11, respectively:

$$TDR_{it} = \alpha_{it} + \beta_1 PROFIT_{it} + \beta_2 SIZE_{it} + \beta_3 TANG_{it} + \beta_4 GROWTH_{it} + u_{it} \quad (10)$$

$$LTDR_{it} = \alpha_{it} + \beta_1 PROFIT_{it} + \beta_2 SIZE_{it} + \beta_3 TANG_{it} + \beta_4 GROWTH_{it} + \varepsilon_{it} \quad (11)$$

5. Findings

5.1. Findings of Fast Calibrated Additive Quantile Regression Method

The findings of this method are presented graphically rather than in tables. The outputs of the analysis are plotted separately for each explanatory variable and are based on three different quantiles. These quantiles represent the lower 25% (0.25Q), middle 50% (0.50Q), and upper 75% (0.75Q) of the data distribution, which correspond to firms with low, medium, and high debt structures, respectively. In the graphs, the vertical axis shows the effect (coefficients) of the explanatory variable on the dependent variable, and the horizontal axis shows the different levels of the explanatory variable. The dashed lines represent the confidence intervals. Figure 3 illustrates the relationship between the profitability ratio and TDR and LTDR models for the Turkish datasets.

[4] Where N is the unit dimension and T is the time dimension for the panel data design.

Figure 3: Estimation Results of Profitability for Turkish Datasets

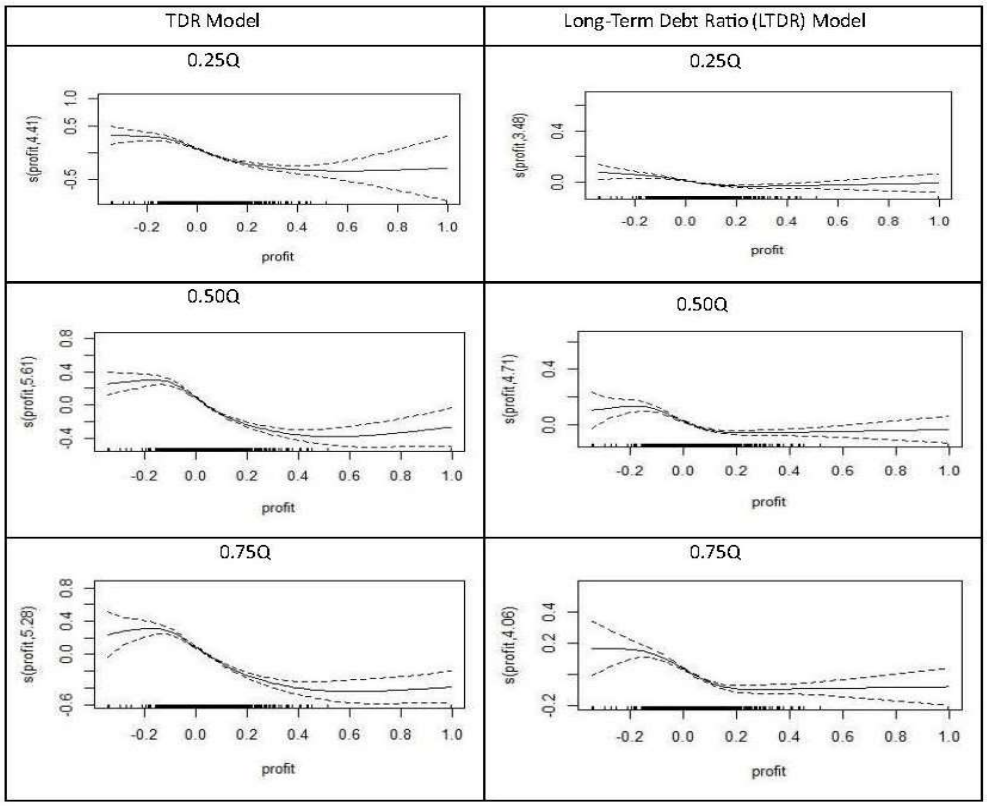


Figure 3 indicates that there is a non-linear and negative relationship between debt ratios and profitability in each quantile. This suggests that as a firm's profitability increases, its overall debt ratio and long-term debt ratio decrease. This result aligns with the pecking order theory, which proposes that firms prefer to use internal sources of financing before turning to external sources. The sudden drop in the total debt ratio in each quantile compared to the long-term debt ratio when profitability increases is due to the presence of short-term debt in the total debt ratio. This suggests that Turkish manufacturing firms tend to fund their assets more with working capital. However, it is worth noting that when firms' profitability reaches a certain level, there is a threshold in the coefficients of both models. This finding is consistent with the trade-off theory, which proposes that firms strive for a balance between the risks of financial distress and the tax benefits of taking on more debt. In addition, the coefficients in the LTDR model tend to decline more rapidly in the Q50 and Q75 quantiles, while the decline in the Q25 quantile is more limited. This indicates that firms with medium and high

debt levels tend to invest more in a financial capacity. Figure 4 illustrates the relationship between the Firm Size variable and TDR and LTDR models for the Turkish datasets.

Figure 4: Estimation Results of Size for Turkish Datasets

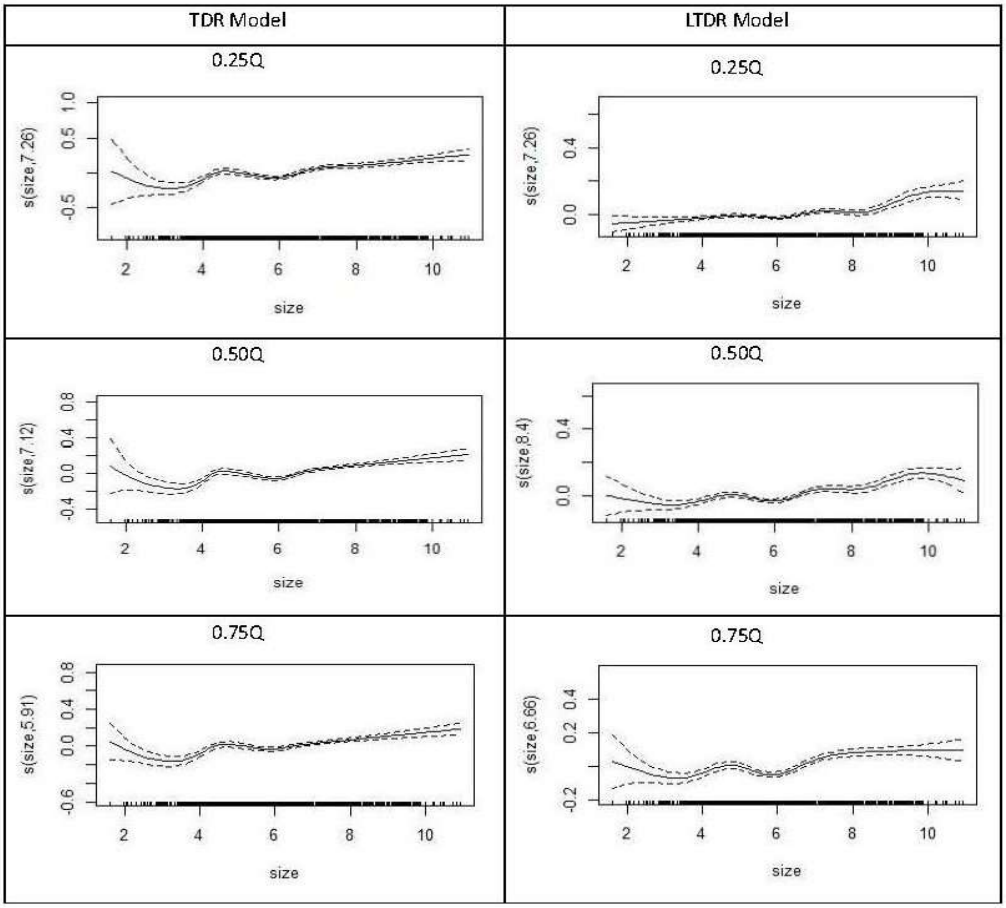
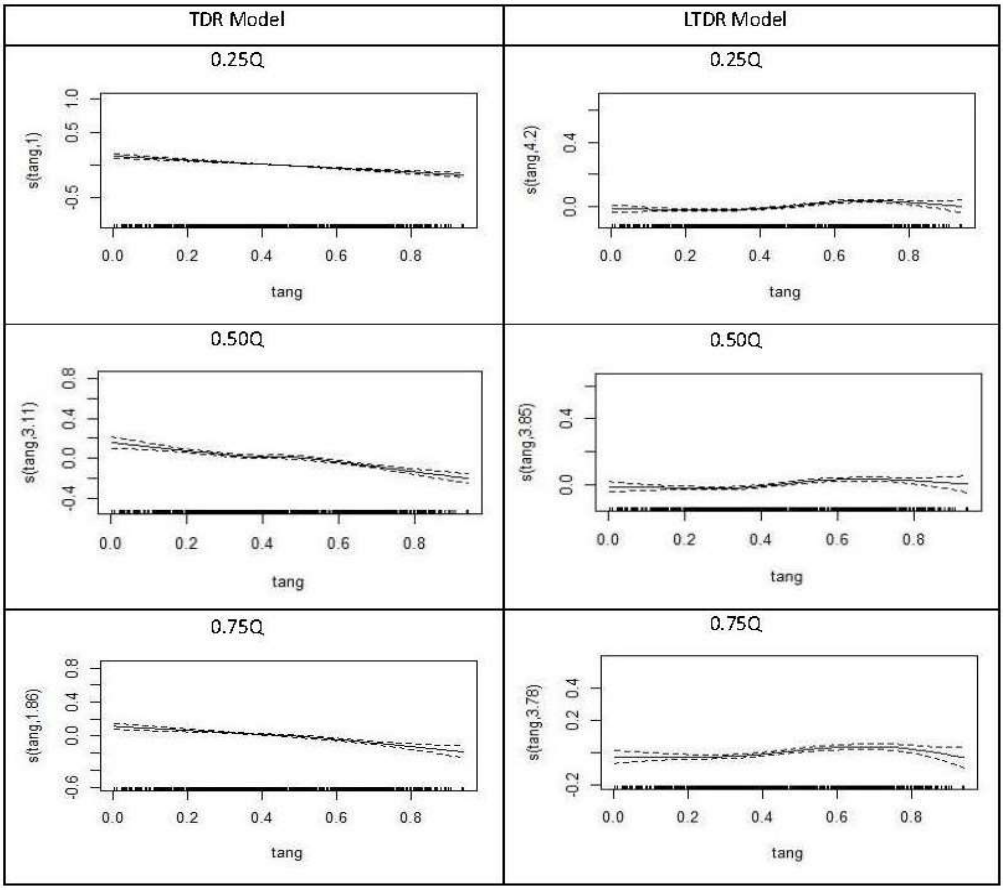


Figure 4 illustrates that there is a positive and non-linear relationship between firm size and debt ratios in each quantile. In all models, a positive relationship is clearly observed in the Q50 and Q75 quantiles. However, in the TDR model, there is a clear break in all quantiles compared to the LTDR model. As firm size increases, the effect of TDR and LTDR also increases, suggesting that expanding Turkish firms strengthen their financial position, invest in capacity, and capitalize on the tax advantages of debt. However, in the LTDR model, when the long-term debt ratio reaches a certain level in the Q25 and Q50 quantiles, the coefficients seem to show a downward trend. This suggests that Turkish manufacturing firms with low

and medium debt structures use economies of scale when they reach a certain size. It could also be interpreted that these firms consider the cost of bankruptcy at relevant levels and finance their capacity investments with their own resources instead of debt. This finding supports the trade-off theory and agency cost theory for Turkish manufacturing firms. Figure 5 illustrates the relationship between the tangibility variable and TDR and LTDR models for the Turkish datasets.

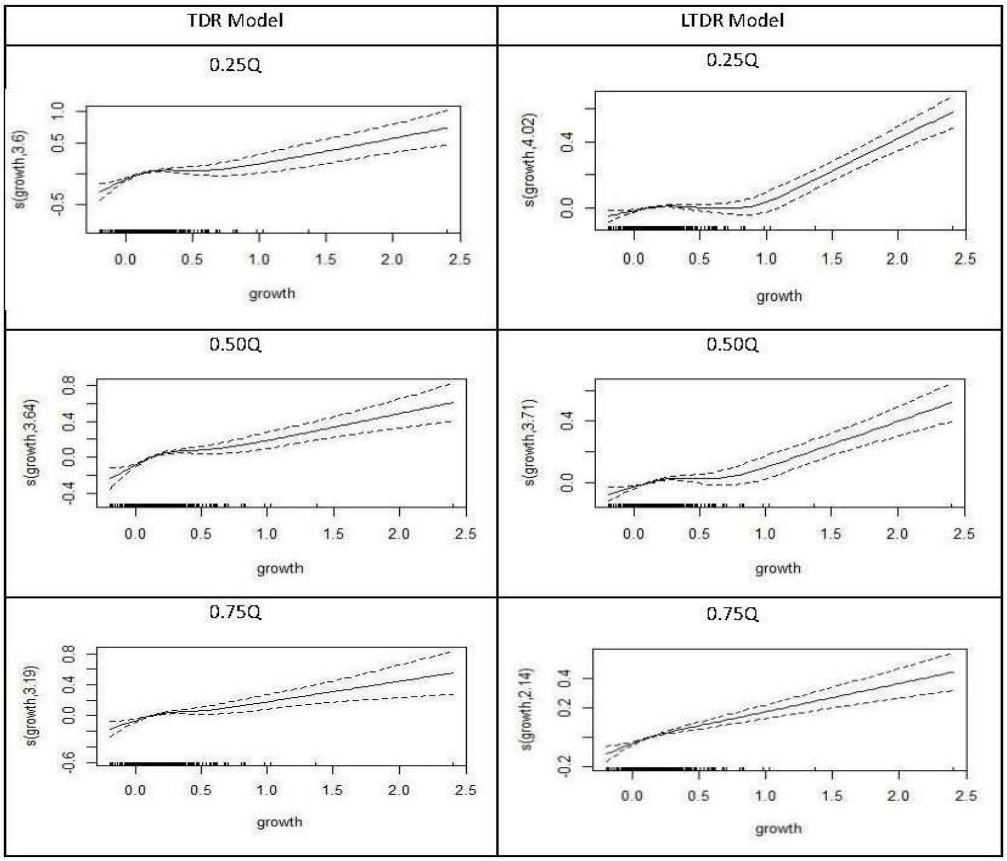
Figure 5: Estimation Results of Tangibility for Turkish Datasets



In Figure 5, a flat and almost linear relationship was observed between tangibility and the total debt and long-term debt ratios for all quantiles. While there is a relatively positive relationship between the tangibility variable and the long-term debt ratio, there is a relatively negative relationship between the same variable and the total debt ratio. The growth in LTDR as the value of fixed assets grows can be seen as a finance logic-suitable condition. This

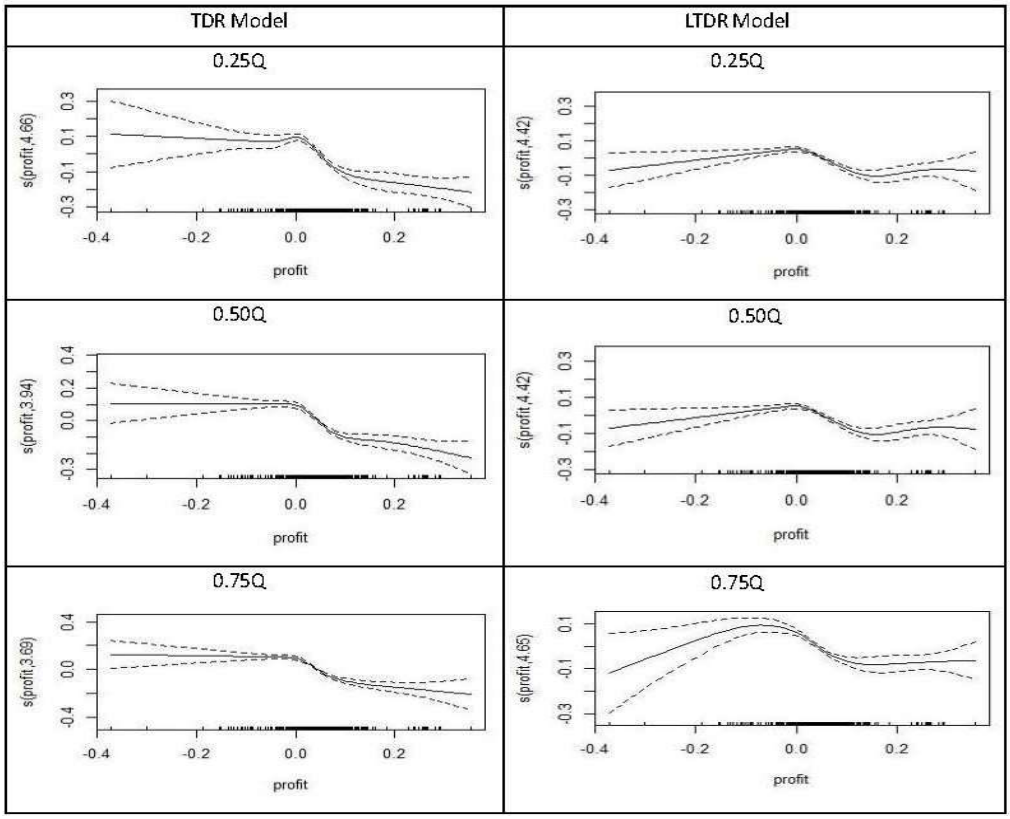
means that Turkish firms fund their assets mostly through long-term debt. The results are consistent with the pecking order and trade-off theories. Figure 6 shows the relationship between the Growth Opportunities variable and TDR and LTDR models for the Turkish datasets.

Figure 6: Estimation Results of Growth for Turkish Datasets



In Figure 6, a non-linear and positive relationship was found between the growth rate and debt ratios in all quantiles. In the TDR model, the total debt ratio slightly falls compared to the long-term debt ratio, which means firms use working capital to fund their short-term debts. However, despite obtaining growth, Turkish firms continue to use debt due to low capital accumulation. This finding shows the validity of the pecking order theory. It is assumed that firms first fund their investments using their own internal resources, then seek external resources to fund their projects. Figure 7 shows the relationship between profitability and TDR and LTDR models for the German datasets.

Figure 7: Estimation Results of Profitability for German Datasets



According to Figure 7, there is a non-linear and negative relationship between profitability and debt ratios for all quantiles. This result is related to the pecking order theory. Both debt and long-term debt ratios increase after a certain point, similar to the Turkish datasets. This shows the validity of the trade-off theory. However, it is seen that German firms behave differently from Turkish firms, especially in Q25 for both models. After a given level of profitability, there is a threshold in total debt and long-term debt ratios. This situation implies firms with a low level of debt are directing their earnings toward capacity investments (tangible fixed assets). Furthermore, it can be claimed that German manufacturing firms are more sensitive to bankruptcy costs and the risk of debt than Turkish firms. Figure 4.8 shows the relationship between the Firm Size variable and TDR and LTDR models for the German datasets.

Figure 8: Estimation Results of Size for German Datasets

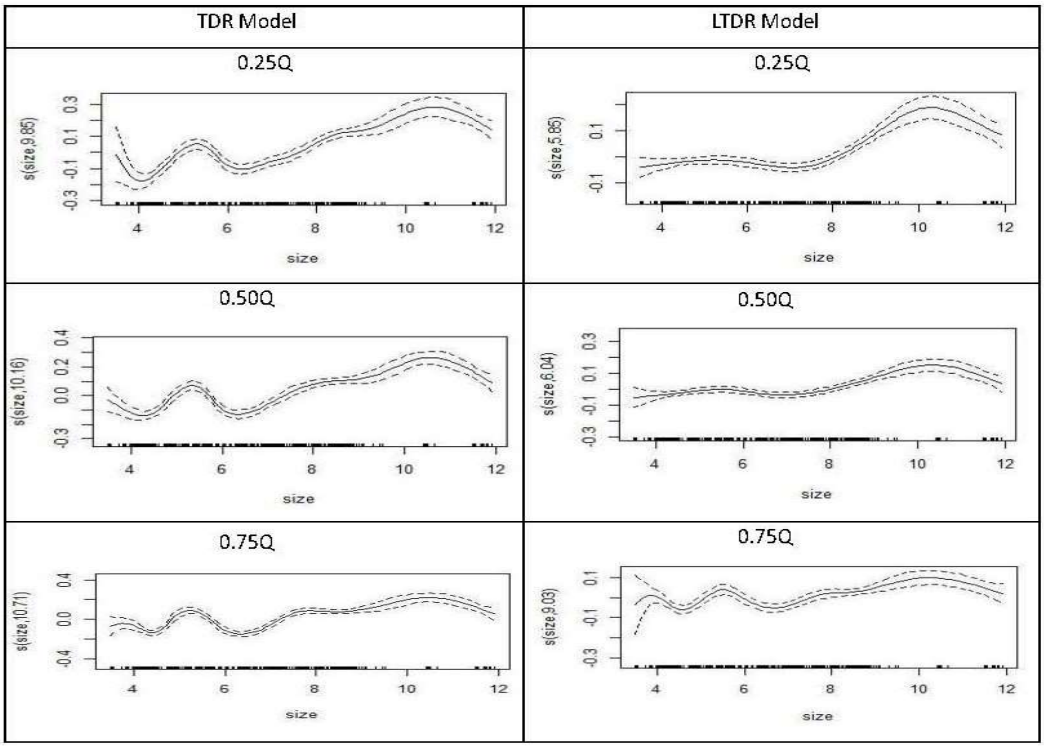
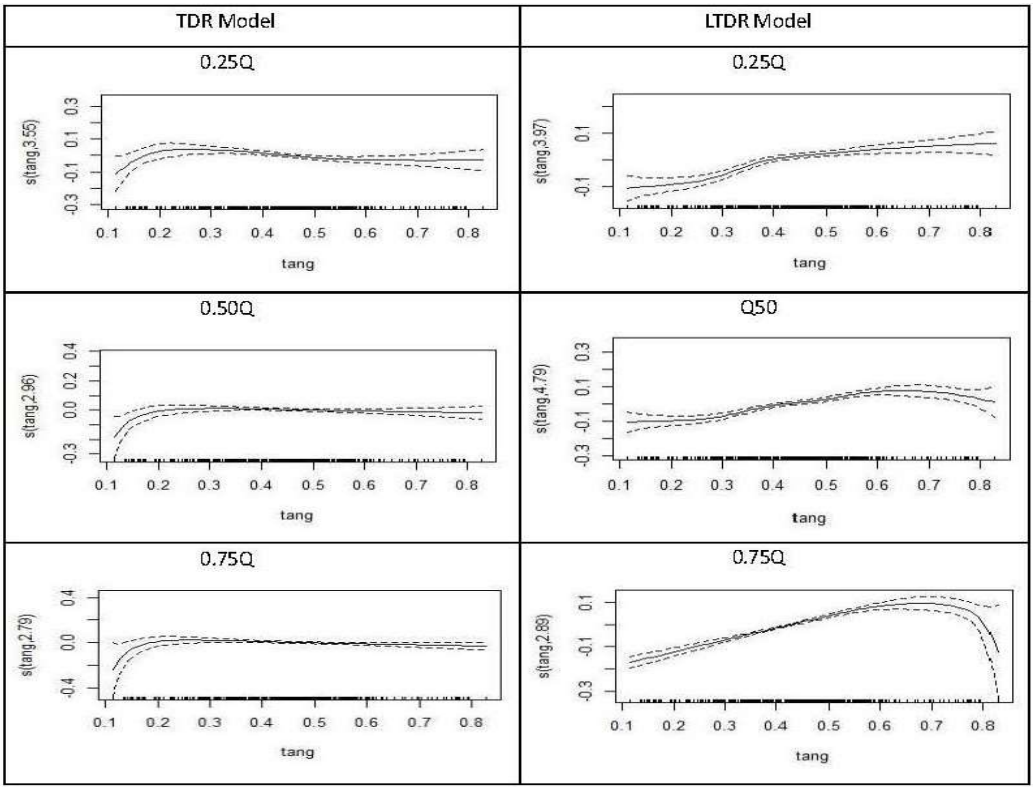


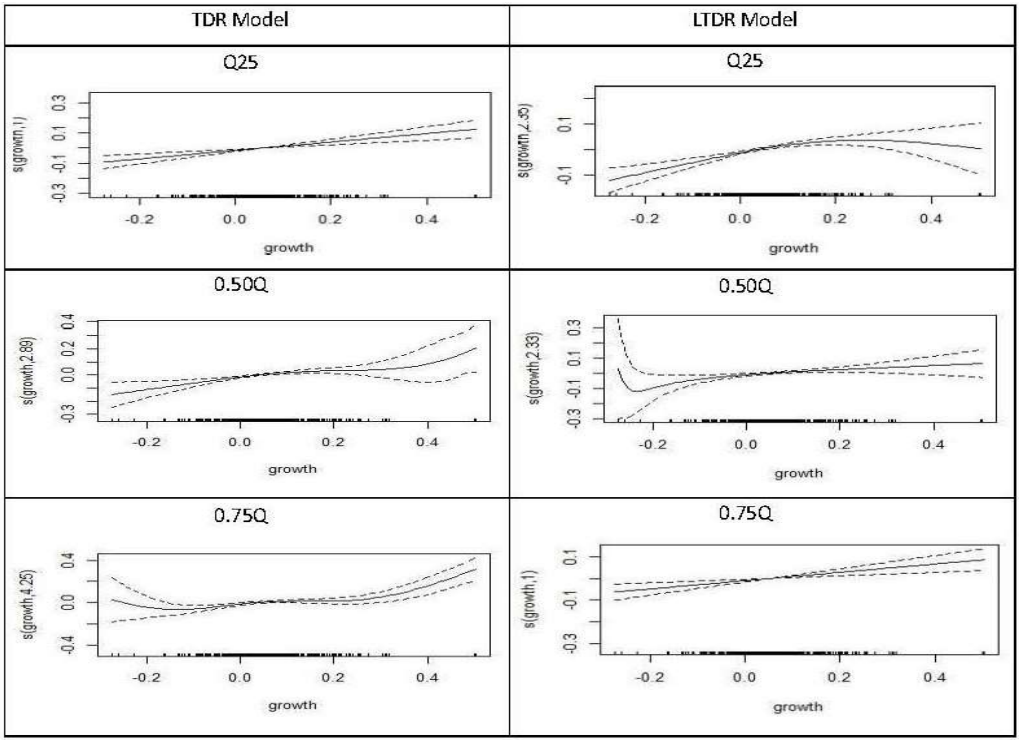
Figure 8 suggests there is a non-linear and positive relationship between firm size and debt ratios for all quantiles in both models. In the graph, there appears to be a substantial divergence in all quantiles in the TDR model compared to the LTDR model. Another remarkable point is that German manufacturing companies behave differently from Turkish companies, and the coefficients in all quantiles in both TDR and LTDR models tend to decrease after a certain level. This situation is interpreted as German manufacturing companies that reach a certain size seeking to maintain the optimum capital structure in a balanced way by avoiding the risk of bankruptcy costs that may arise from financial distress. This finding indicates the validity of the agency cost and trade-off theories. Figure 9 shows the relationship between the tangibility variable and TDR and LTDR models for the German datasets.

Figure 9: Estimation Results of Tangibility for German Datasets



When Figure 9 is examined, it is observed that there is a non-linear and positive relationship between the debt ratios and tangibility variable for all quantiles in both models. In the LTDR model, it is noteworthy that firms whose fixed assets reach a certain size in Q50 and Q75 tend to decrease their long-term debt ratios rapidly, especially in Q75. Q75 represents firms with a high level of indebtedness. This finding can be regarded as German firms making a shift from debt-to-equity capital, funding more capacity investments (fixed assets), and reducing the problems that may arise from the financial distress and risk of bankruptcy. The result is consistent with all the theories (pecking order theory, agency cost theory, and trade-off theory). Figure 10 shows the relationship between the Growth rate and TDR and LTDR models for the German datasets.

Figure 10: Estimation Results of Growth for German Datasets



According to Figure 10, there is a non-linear and positive relationship between size and debt ratios for all quantiles. The long-term and total debt ratios increase when firms grow. In the TDR model, the total debt ratio tends to increase after a certain level of size, especially for firms with high levels of debt (Q50 and Q75). This finding is related to the financial hierarchy theory. Another interesting finding to remark on is that in the LTDR model, in Q25, the long-term debt ratio tends to fall after the size reaches a certain level. This result can be interpreted as growing German manufacturing firms with a low level of debt funding their long-term assets with their own capital rather than debt, switching to firms with a high level of debt (Q50), and reducing the risk of financial distress.

5.2. Findings of Panel Data Analysis

In order to test the assumptions underlying panel data analysis, it is necessary to conduct certain tests on the data. One such assumption is the issue of cross-section dependence and whether the data contains a unit root. The datasets used in this study are considered micro

panel data and, as such, Baltagi (2021) suggests that it is not necessary to perform unit root tests and cross-section dependency tests on micro panels. Therefore, these tests were not applied in this study. Instead, the Hausman test was used to choose the most suitable model between the fixed effects and random effects models and to determine the most appropriate model for estimation. The results of the Hausman test are presented in Table 6.

Table 6: Statistics of Hausman Test

Turkish dataset	**Test Stat**	**p-value**
TDR Model	46.2820*	0.0000
LTDR Model	17.7025*	0.0014
German dataset	**Test Stat**	**p-value**
TDR Model	8.9942**	0.0612
LTDR Model	3.43630	0.4876

*0.01, **0.05, ***0.10 present significance levels, respectively.

When examining the Hausman test statistics in Table 6, it can be seen that the null hypothesis of "there is no correlation between unit effects and explanatory variables" is rejected at the 0.01 significance level for the TDR model based on the total debt ratio for the Turkish datasets, as well as for the LTDR model based on the long-term debt ratio. This indicates that both the fixed effects and random effects estimators are consistent for the Turkish datasets, and it was decided that the fixed effects estimator is the appropriate model to use. Similarly, the null hypothesis is rejected at the 0.01 significance level for the TDR and LTDR models for the German datasets, indicating that the fixed effects estimator is also the appropriate model to use for these datasets.

Two other assumptions that need to be tested in panel data analysis are heteroscedasticity and autocorrelation. Heteroscedasticity occurs when the variances in the error terms are not constant. There are various tests in the literature that can be used to verify the assumption of constant variance, and in this study, the Modified Wald Test was chosen (see Table 7).

Table 7: Statistics of Modified Wald Test

Turkish dataset	**Test Stat**	**p-value**
TDR Model	58833.36	0.0000
LTDR Model	2.1E+05	0.0000
German dataset	**Test Stat**	**p-value**
TDR Model	16928.16	0.0000
LTDR Model	10230.99	0.0000

*0.01, **0.05, ***0.10 present significance levels, respectively.

When examining the Modified Wald test statistics in Table 7, it was found that there was evidence of heteroscedasticity in the error term at the 0.01 significance level for all models for both the Turkish and German datasets. This indicates that the null hypothesis of "variances between error terms are constant" is rejected. To check the assumption of autocorrelation in the models being estimated, the Wooldridge Autocorrelation test was used, and the test statistics are presented in Table 8.

Table 8: Wooldridge Autocorrelation Test Statistics

Turkish dataset	**Test Stat**	**p-value**
TDR Model	8.036	0.0000
LTDR Model	5.482	0.0000
German dataset	**Test Stat**	**p-value**
TDR Model	59.052	0.0000
LTDR Model	25.363	0.0000

*0.01, **0.05, ***0.10 present significance levels, respectively.

According to the autocorrelation test statistics in Table 8, the null hypothesis is rejected at the 0.01 significance level in all models for both the Turkish and German datasets. This suggests that there are both heteroscedasticity and autocorrelation issues present in the TDR and LTDR models. As a result, a robust estimator is required for the analysis of the data. The results of the panel data robust estimator (GLS) for the Turkish datasets are shown in Table 9.

Table 9: GLS Estimation Results for Turkish Dataset

Dependent Variable: TDR **No. of Observations: 1050** **No. of Units: 105** **No. of periods: 10**			
Variables	**Coefficients**	**Std. Error (Robust)**	**p-value**
PROFIT	-1.2468*	0.0695	0.0000
SIZE	0.0326*	0.0041	0.0000
TANG	-0.2317*	0.0331	0.0000
GROWTH	0.2628*	0.0419	0.0000
CONSTANT (C)	0.4188*	0.0286	0.0000
Dependent Variable: LTDR **No. of Observations: 1050** **No. of Units: 105** **No. of periods: 10**			
Variables	**Coefficients**	**Std. Error (Robust)**	**p-value**
PROFIT	-0.4185*	0.0383	0.0000
SIZE	0.0192*	0.0023	0.0000
TANG	0.1241*	0.0182	0.0000
GROWTH	0.1642*	0.0231	0.0000
CONSTANT (C)	-0.0358**	0.0158	0.0230

*0.01, **0.05, ***0.10 present significance levels, respectively.

Table 9 presents the panel data analysis estimation results for the Turkish datasets for the period 2011-2020. It can be seen that all variables in the TDR and LTDR models are statistically significant at the 0.01 level. Profitability has a negative impact on both the TDR and LTDR, while firm size and growth rate have a positive impact. Additionally, tangibility has a positive impact on the LTDR and a negative impact on the TDR. This significant sign change is considered as an indication that Turkish firms fund their tangible fixed assets mostly with long-term liabilities. Moreover, as tangibility increases, the decrease in the level of total debt is associated with the cost of bankruptcy. Firms use long-term liabilities for fixed asset purchases, but also reduce their short-term liabilities to reduce risk. These findings align with financial theories such as agency cost theory, trade-off theory, and the pecking order theory. Specifically, size is consistent with agency cost and the trade-off theories, profitability and growth rate are consistent with the pecking order theory, and tangibility is consistent with both the trade-off and pecking order theories. The panel data robust estimator results for the German datasets are presented in Table 10.

Table 10: GLS Estimation Results for German Dataset

Dependent Variable: TDR **No. of Observations: 390** **No. of Units: 39** **No. of periods: 10**			
Variables	**Coefficients**	**Std. Error (Robust)**	**p-value**
PROFIT	-1.0180*	0.0950	0.0000
SIZE	0.0499*	0.0038	0.0000
TANG	-0.0465	0.0536	0.3860
GROWTH	0.2600*	0.0785	0.0010
CONSTANT (C)	0.2699*	0.0349	0.0000
Dependent Variable: LTDR **No. of Observations: 390** **No. of Units: 39** **No. of periods: 10**			
Variables	**Coefficients**	**Std. Error (Robust)**	**p-value**
PROFIT	-0.4068*	0.0729	0.0000
SIZE	0.0222*	0.0029	0.0000
TANG	0.3157*	0.0412	0.0000
GROWTH	0.1072***	0.0603	0.0750
CONSTANT (C)	-0.0533**	0.0268	0.0470

*0.01, **0.05, ***0.10 express significance levels.

Table 10 presents the panel data analysis estimation results for the German dataset for the period 2011-2020. The results of the analysis show that all variables in the TDR model are statistically significant at the 0.01 level, with the exception of the asset structure variable. In this model, profitability has a negative impact on the TDR, while firm size and growth rate have a positive impact. For the LTDR model, the growth rate has a 0.10 significance level, and all other variables are statistically significant at the 0.01 level. Profitability has a negative impact on the LTDR, while firm size, tangibility, and growth rate have a positive impact. The findings for the German dataset are similar to those observed for the Turkish dataset in both models. When comparing the results obtained from the panel data analysis, there is little difference between the TDR and LTDR models for Turkish and German manufacturing companies. Therefore, an alternative approach was used in addition to the panel data analysis.

6. Conclusion

The capital structure decision is among the crucial issues for firms in terms of financial management. To ensure their long-term goal of maintaining their activities, growing in an effective manner, and remaining competitive, firms must meticulously choose their capital structure. A firm's capital structure decisions directly affect the capital costs, capital budgeting, and market values. A wrong decision can lead to bankruptcy or financial difficulties. The capital structure decisions show how long-term foreign resources and how much equity should be used to provide the firms with the funds they require. For this reason, firm managers have difficulty in determining how and where to secure the necessary funds.

The purpose of this study is to investigate and compare the relationship between the capital structure of manufacturing sector firms traded in different markets and the financial performance of the firm. The annual data of 105 firms listed on the Turkish Stock Exchange and 39 firms listed on German Stock Exchange for the period 2011-2020 were used. Two different methods were applied in accordance with the data set to analyze the relationship between the financial performance and the capital structure of the firms.

When we evaluate the findings, almost identical outcomes were obtained in Turkish and German manufacturing companies in both estimated models. The negative relationship between debt ratios and profitability shows that Turkish and German firms will use internal financing as a priority to fulfill their funding requirements, i.e., the increase in profitability will reduce the firm’s external resource needs. Although German firms are large and have low-cost access to funds, they are similar to Turkish firms, suggesting that they may adopt a more cautious approach to debt. For German firms, high borrowing may negatively affect profitability as it increases risk. The positive relationship between debt ratios and size supports the trade-off and agency costs theories, and it can be concluded that larger firms operating in the market have higher debt consumption capabilities and are less likely to go bankrupt in the event of financial distress than smaller firms. Likewise, the positive relationship between the total and long-term debt ratios and the growth rate can be interpreted as that firms will tend to borrow instead of using their own internal resources to cover their financing needs. The growth rate supports the financial hierarchy theory. The Tangibility variable suggests the validity of all theories (Financial Hierarchy Theory, Agency Cost Theory, and Trade-Off Theory).

For Turkish dataset, since the effect of PROFIT and SIZE variables on debt variables is mostly negative in nonparametric model estimations, pecking order theory is valid. On the other hand, since the effect of GROWTH variable on debt variables is mostly positive, pecking order theory is valid. Besides, since the effect of TANG variables on debt variables can be both negative and positive depending on the degree of leverage of the firms, agency cost theory is valid. For German dataset, the effect of PROFIT and SIZE variables on debt variables is positive up to a certain debt level of firms and negative afterwards. This finding suggests that German firms support the Trade-Off and Agency Cost Theory up to a threshold level, after which the Pecking Order Theory prevails. On the other hand, since the effect of the TANG variable on debt variables is mostly positive, Trade-Off and Agency Cost Theory are valid. Moreover, since the effect of GROWTH variable on debt variables is mostly positive, Pecking Order Theory is valid. Overall, the study found that the financing behaviors of Turkish and German manufacturing firms have similarities and differences. Although the findings seem to be in line with the studies of Akpınar (2016), Yılmaz and Düzakin (2017), Acar (2018), Dommes et al. (2019), Elmas and Gözel (2020) and Abdullah and Tursoy (2021), the nonparametric findings reveal more than the findings of the related studies. The researchers recommend that investors interested in investing in the manufacturing sector should carefully evaluate the borrowing levels and debt repayment capabilities of the firms they are considering investing in, as a high level of debt can increase the risk level of the firm. In this respect, the research findings reveal a strong link between firms' debt levels and their financial performance for both countries. Investors are advised not to ignore this point when making asset diversification. Moreover, the results obtained can be interpreted from the perspective of company managers. In particular, the findings contain important outcomes in terms of how companies can shape their capital structures while they are planning to invest in another country. For example, it can be said that if a Turkish company obtains an investment opportunity in Germany, it can act according to the balancing and financial hierarchy theories. The main limitation of this study is the exclusion of the pandemic effect. In future studies, examining capital structure theories for the during pandemic, before and after the pandemic periods using a nonparametric method may produce valuable outputs for investors, firms, markets and policy makers.

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