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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

DETERMINANTS OF CAPITAL STRUCTURE IN ENERGY SECTOR: EVIDENCE FROM BORSA İSTANBUL

ENERJİ SEKTÖRÜNDE SERMAYE YAPISININ BELİRLEYİCİLERİ: BORSA İSTANBUL ÜZERİNE BİR ARAŞTIRMA

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Abstract

This study aims to examine the determinants of capital structure in the energy sector of Türkiye and their relation to relevant theories. The panel data analysis method was used to analyze annual data from 8 energy companies operating in Borsa Istanbul between 2014 and 2021. Results of the analysis showed that while the median debt ratio on a sector basis affects leverage positively; asset structure, growth opportunities, profitability, liquidity, industrial production and distribution index, and GDP annual growth variables negatively affect leverage. No significant relationship was found between the size of the business, non-debt tax shield, inflation, tax revenue, and leverage. It has been noted that the findings are in line with the previous studies, and the capital structure of the Turkish energy sector is generally compatible with the pecking-order theory.
Keywords: Capital Structure, Energy Sector, BIST
JEL Codes: G32, C33

Öz

Bu çalışma, Türkiye enerji sektöründe sermaye yapısının belirleyicilerini ve bunların ilgili teorilerle ilişkisini incelemeyi amaçlamaktadır. Borsa İstanbul'da faaliyet gösteren 8 enerji şirketinin 2014 ve 2021 dönemi yıllık verilerini kapsayan veri seti panel veri analizi yöntemi ile analiz edilmiştir. Yapılan analiz sonucunda, sektör bazında medyan borç oranının kaldıracı olumlu etkilediği; varlık yapısı, büyüme fırsatları, kârlılık,

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likidite, sanayi üretim ve dağıtım endeksi ve GSYH yıllık büyüme değişkenlerinin kaldıracı olumsuz etkilediği görülmüştür. İşletmenin büyüklüğü, borç dışı vergi kalkanı, enflasyon, vergi geliri ile kaldıraç arasında anlamlı bir ilişki saptanmamıştır. Elde edilen bulguların literatür ile benzer sonuçlara sahip olduğu ve Türkiye enerji sektörü sermaye yapısının genel itibariyle finansman hiyerarşisi teorisi ile uyumlu olduğu gözlemlenmiştir.
Anahtar Kelimeler: Sermaye Yapısı, Enerji Sektörü, BIST
JEL Sınıflandırması: G32, C33

1. Introduction

Studies on capital structure started in the early 1950s; it came to the fore with the article "The Cost of Capital, Corporation Finance and the Theory of Investment" by Modigliani and Miller (1958). This article focuses on capital structure factors as well as increasing the firm value and decreasing capital costs to the lowest level. The discussion in the literature primarily revolves around determining the optimal capital structure level and its determinants, while another aspect under consideration is the impact of capital structure on firm values and performance (Avcı, 2016). Especially for the energy sector, the studies from America and Europe to Asia have continued to increase in order to fill the gap in the literature. According to the analysis of capital structure factors of 352 energy sector companies from Europe and North America in their study, Riise and Yssen (2022) concluded that capital choices vary according to companies. It was also emphasized that the sector cannot be based entirely on a single theory and contains different components from the theories. In this context, the field of capital structure, which is based on a broad literature base but is still controversial, continues to be examined comprehensively, with factors varying from country to country and sector to sector.

Energy, which is the basic resource in production, is a necessary element for increasing the welfare level of societies and is used in almost every aspect of daily life. Considering the increase in consumption and the limited and unequal distribution of resources around the world, it can be said that the concept of energy has a global impact beyond its local and regional importance. The fact that the concept of energy was increasingly becoming a part of the 'real wealth of nations' by Lindsay (1971: 383) in the early 1970s has not lost its validity today. Beyond the supply and accessibility of energy, the control and provision of energy hold critical significance in terms of national security and political strategies. At the same time, the connection of international energy markets with financial markets has strengthened after the 2008 global financial crisis and energy prices appear to exhibit financial characteristics (Zhang, 2018). Factors such as access to energy resources, energy dependence, and energy trade can influence political relations between countries. In this context, the development of the energy sector is crucial.

On the other hand, the close relationship of the concept of energy with the environment should not be ignored. According to the Global Risk Report 2023, five of the top ten risks in the next two years and six of the top ten risks in the next ten years are environmental (World Economic Forum, 2023). Moreover, environmental risk finds itself at the top of the risk table every year. Therefore, duties and responsibilities regarding the future state of energy are gaining importance. In recent years, renewable energy has emerged as an area where companies focus on investments and as an

alternative to energy consumption. It also has an upward trend in terms of supply. When the Paris Climate Agreement commitments are followed, it is estimated that the share of renewable energy in the total energy supply will double in 2030 and quadruple in 2050 compared to 2021 (IEA, 2022). As the transition to clean energy sources such as solar, wind, or hydroelectric energy instead of fossil fuels accelerates, carbon emissions are expected to decrease, and environmental risk will decrease in parallel.

This study aims to examine the components that determine the capital structures of companies by taking BIST 100 energy companies as a sample. The study, in which the components are categorized as company-based, sector-based, and country-based, aims to determine which theory energy companies follow, together with the relationship and impact of the capital structure and the related factors in the energy sector. In this context, the following section will focus on the concept of capital structure and then the tradeoff theory and the pecking order theory, which are the most popular theories of capital structure. The third section will provide an overview of studies that have explored the factors impacting capital structure within the energy sector. Following that, the fourth section will lay out the methodology of the research and present findings. Finally, the conclusion section will evaluate the results obtained from the analysis.

2. The Concept of Capital Structure

The notion of capital, initially rooted in the enumeration of people and animals throughout history, became linked to wealth during the Ancient Roman era. However, its widespread adoption in Europe can be traced back to its utilization by Italians in the 13th century, as highlighted by Braudel (1982) in his work 'Civilization and Capitalism'. In that same century, the concept evolved to signify the monetary wealth of a merchant (Hodgson, 2014). Today, although the concept of capital is handled very differently by economists, financiers, or sociologists, it continues to evoke expressions of wealth and valuable resources in terms of semantics. In terms of accounting, capital is the source of money, goods, or labor held to produce goods and services (Benligiray, 2006).

Capital structure, in simple terms, is about how companies use equity and long-term debt to manage their financial resources (Shapiro, 1998). It is also crucial for companies wishing to continue their operations or take steps to facilitate new investments to determine the structure of their financing sources. Financing decisions determine which source companies will choose to finance assets and how long they want to benefit from these sources. The capital structure, which changes depending on time and conditions, has a dynamic structure that needs to be constantly monitored (Sayılgan, 2011).

Table 1. Traditional Theories

The Traditional Theories		
Net Income Theory	David Durand	1952
Net Operating Income Theory	David Durand	1952
Traditional Theory	Ezra Solomon	1955

Early capital structure theories try to explain the relationship between the capital structure of the enterprise, the cost of capital, and enterprise value. Studies in literature started with the net income and net operating income theories developed by Durand in 1952. Theories claim that borrowing at a reasonable or low cost will reduce the average cost of capital and thus, a positive increase in the market value of the company will occur. The propositions of Modigliani and Miller marked a turning point for the conceptual framework; moreover, it initiated the development of modern theories (Harris & Raviv, 1991). They argued that capital structures changed through borrowing would not affect firm value in ideal economies. Moreover, there is no connection between capital structure and market value (Modigliani & Miller, 1958). In their article titled 'The Cost of Capital, Corporation Finance and the Theory of Investment' (1958: 261-297), Modigliani and Miller assumed a market with both adequate and rational buyers and sellers based on the absence of tax, transaction, risk, and bankruptcy costs.

Table 2. Modern Theories

The Modern Theories		
Modigliani-Miller Theory	Franco Modigliani & Merton H. Miller	1958 & 1963
Trade-Off Theory	Alan Kraus & Robert Litzenberger	1973
Agency Cost Theory	Michael C. Jensen & William H. Meckling	1976
Signalling Theory	Stephen A. Ross	1977
Pecking-Order Theory	Stewart C. Myers & Nicholas S. Majluf	1984
Market Timing Theory	Malcolm Baker & Jeffrey Wurgler	2002

While the Modigliani and Miller (1958) proposition was groundbreaking at the time, the theory has been widely criticized. According to Brigham and Ehrhardt (2013), this situation arises from the incompatibility of theory assumptions with reality. This led to literature continuing to evolve and expand. Agency cost theory suggests a conflict among managers, investors, and creditors, whereas signaling theory argues that managers possess more information compared to investors. Therefore, managers possessing insider knowledge strategically employ methods to signal information to the market, leading to an anticipated increase in firm values with leverage in competitive equilibrium, as the market validates these signals (Ross, 1977). Market timing theory also suggests that capital structure decisions are influenced by market timing, prompting companies to adjust their leverage levels in response to changes in market valuations (Baker & Wurgler, 2002).

As Myers (2003) stated, there is no universally accepted theory; various theories based on different factors such as agency costs, different types of information, and taxes have been proposed. Similarly, DeAngelo (2022) argues that a 'laundry list' of frictions affects the capital structure, thereby indicating that a single model cannot explain its behavior. While DeAngelo (2022) acknowledges the dominance of tradeoff theory and pecking order theory in the literature and emphasizes their significant empirical deficiencies, an examination of the literature reveals that these two theories come to the fore and, thereby, should be examined.

2.1. Tradeoff Theory

Kraus and Litzenberger, who discussed the work of Modigliani and Miller, developed the Tradeoff Theory (TOT) in their article 'A State-Reference Model of Optimal Financial Leverage', published in 1973, based on the tax advantage and financial distress costs that arise with obtaining financing through debt. As the borrowing or equity usage ratios in companies' financing preferences increase, the weighted average cost of capital decreases due to lower debt financing costs. On the other hand, the increase in the use of debt financing causes financial distress and agency costs. At this point, it is essential for companies that have to determine the optimum capital structure to determine the debt-to-equity ratio after carefully evaluating the advantages and disadvantages of costs (Kraus & Litzenberger, 1973).

Miller (1977), another important name for the TOT, argued that the tax advantage provided by debt financing is not large enough to eliminate financial distress and agency costs. Moreover, he likened this balance to a recipe for horse and rabbit stew, stating that the costs of bankruptcy are quite small compared to the advantages of debt. However, although financial distress and agency costs do not eliminate the tax advantage provided by borrowing and financing, taxes on individuals' incomes will cause this debt to offset the tax benefit (Miller, 1977). However, DeAngelo and Masulis (1980) emphasize that the balance to be established between the tax benefit of the debt arising from the tax deduction of interest payments and the financial distress costs that arise with increasing debt will determine the optimum or target capital structure. They argued that the optimal capital structure will be established at this point and therefore, Miller's analogy is opposed.

2.2. Pecking Order Theory

The foundations of the financing hierarchy theory were laid by Donaldson (1961); it was developed by Myers and Majluf (1984). According to the Pecking Order Theory (POT), companies meet their financing needs in a certain order. Donaldson (1961) states that managers prefer retained earnings to debt and debt to equity capital to fund new investments. In other words, companies reduce their leverage ratios by keeping their profits in equity during profitable periods and tend to increase their leverage by using debt in unprofitable periods. Donaldson (1961) stated that the tax advantage of companies that come with debt financing disappears in the long term, and therefore, financing their long-term financing needs from internal sources will provide an advantage over debt financing (Donaldson, 1961).

In the same period, with the increase in studies on information asymmetry, the fact that the study results contained similar results to the financing hierarchy inspired the development of the theory by Myers and Majluf in 1984 (Yiğit, 2016). According to them, companies do not have the targeted or, in other words, optimum balance of debt and equity. Companies must meet their financing needs according to the financing order with internal resources, debt, and equity (Myers & Majluf, 1984). If companies meet this need from internal sources by not providing financing through borrowing,

they will prevent financial distress costs and bankruptcy costs by ensuring that companies keep their borrowing levels under control.

Myers and Majluf (1984) evaluated the concept of asymmetric information and the financing hierarchy theory together. Companies prefer equity financing to last due to asymmetric information. The concept of information asymmetry states that managers have more information about the company's prospects, risks, and value than investors. Therefore, the choices made by company managers when providing internal/external financing or debt/equity financing are affected by asymmetric information. The existence of asymmetric information causes hierarchy in companies' financing preferences. According to this approach, companies should first choose their internal resources in their financing choices, then they should prefer to finance with debt, and finally, they should prefer to finance with equity (Myers & Majluf, 1984).

3. Literature

Studies on the concept of capital structure have identified factors affecting capital structure over time. In parallel, these factors were tested in various sectors. However, the consensus that could not be reached over the conflicts enriched the literature in the capital structure field. Among the studies examining the determinants of capital structure, apart from the energy sector; there are many sectors such as manufacturing, service, automotive, food, banking, insurance, tourism, airline, high technology, forestry, pharmaceutical industry, and leather-textile. In this part, priority will be given to studies focusing on the energy sector.

In his master's thesis, Saeed (2007) applied three different capital structure theories – static TOT, POT, and agency cost theory – to examine the relationships between 22 distinct energy businesses that were listed on the Karachi stock exchange between 2001 and 2005. Leverage was the dependent variable in the study, whereas the independent factors were non-debt tax shields (NDTS), size, profit, growth, and collateralizable value of assets (CVA). Only the independent variables size, growth, and NDTS were found to have a positive connection with financial leverage as a result of the analysis. It was determined that the POT is the only hypothesis that could account for the analysis in terms of debt finance. The research is consistent with agency cost theory and static trade-off theory because Pakistani energy businesses' leverage ratio rises parallel to their size. In a similar vein, only the POT explains why the usage of debt rises as business growth rates do. Another significant conclusion is that debt-free investments are made by Pakistani energy businesses; in this regard, the pecking order hypothesis was validated, although results contradicting the static trade-off theory were obtained. Consequently, the hypothesis of the POT and static TOT has been found to have some validity.

In the study, İskenderoğlu et al. (2017) presented a comparative analysis between the Turkish and European energy sectors, as well as determining the variables of the capital structure of companies in the Turkish energy sector. According to the analysis results, the only meaningful variable for Turkish energy sector enterprises was determined to be profitability, while the meaningful variables for European energy sector enterprises were the current ratio used as liquidity variable, asset structure,

and equity turnover rate. While the decrease in the borrowing rate as profitability increases in Turkish energy sector enterprises can be explained by the POT, the decrease in the borrowing rate as the current ratio increases in European energy sector enterprises can be explained by the POT, and the increase in the borrowing rate as the share of tangible assets in total assets and the equity turnover rate increases can be explained by the balancing theory.

In Zhang et al.'s (2018) study, the components affecting the capital structure of 16 Pakistan oil and energy companies were studied between 2010 and 2015. As a result of the analysis made with the dependent variable, debt to equity ratio, and the independent variables, profitability, size, tangibility, and tax rate, only the relationship between the dependent variable and the tax rate was found to be negative; the relationship between other variables and leverage was determined to be positive. In this regard, it can be said that the capital structure choices of the Pakistani oil and energy sector are compatible with the trade-off theory.

In Braskerud and Jarbo's study (2018), the capital structure preferences of 48 energy companies listed on the Oslo Stock Exchange between 1998 and 2016 are analyzed. In the study, the relationship between the dependent variable debt ratio and the independent variables consisting of profitability, growth, firm size, asset tangibility, and risk is examined. In the analysis where macroeconomic variables interest rate and oil prices were added as controls, a positive relationship was found between debt ratio and firm size, profitability, and interest rate. On the other hand, a negative relationship was found between debt ratio and tangibility and risk. According to the analysis results, the study emphasizes that a single theory cannot explain Norwegian energy companies' capital structure.

In their research, Chakrabartis (2019) used the panel data analysis method to examine the capital structure choices made by 141 Indian energy companies from 2006 to 2016. The age, turnover, liquidity, and size of the firms—the independent variables—and the dependent variable show a positive correlation, according to the findings. The following conclusions have been reached borrowing in Indian energy companies declines as profitability rises; the source of debt becomes internalized as organizations get older and larger; and there is an inverse association between capital structure-related variables.

In Ahmed and Sabah's study (2020), the sample consisted of 6 Gulf Council Countries, Saudi Arabia, United Arab Emirates, Kuwait, Oman, Qatar, and Bahrain. The study focused on 22 different oil and gas companies between 2010 and 2019. It was revealed that while capital structure has a positive relationship with the size and concreteness of the company, the profitability variable has a negative relationship. In the analysis, which was also evaluated according to the flow levels of the companies, it was determined that downstream companies had a significant impact. In contrast, middle-stream and upstream companies had no impact. Finally, the study concluded that in terms of theories, the Gulf Council countries are compatible with both trade-off and pecking-order theory.

In Şahin's (2020) study, the capital structure of energy companies whose financial statements were accessed between 2009 and 2019 was examined with the generalized moment methods model. To determine how and in what direction Turkish energy companies, which are foreign-dependent in the

field of energy, are affected by macro variables that react differently to different risk situations, only macroeconomic-related variables were taken as capital structure variables, and micro variables were ignored. As a result of the study, it was revealed that there is a positive and significant relationship between capital structure and lagged value of leverage ratio, interest rate, exchange rate, industrial production index, and tangible fixed assets.

In their study, Nga and Long (2021) used the financial statements of 250 enterprises in the Vietnam energy sector between 2010 and 2019 and examined the capital structures of these enterprises with the generalized least square method. Growth, profitability, property structure, company size and age, short-term solvency, and deferred tax depreciation factors were analyzed in the study. According to the results obtained from the study, while there was a positive effect for the size of the firm and asset structure factors, it was revealed that there was a negative effect for other factors. Finally, research findings support the POT.

In their study, Jaworski and Czerwonka (2021) applied panel data analysis on 6122 companies from 25 different EU countries between 2011 and 2018 to determine the main determinants of the capital structures of energy sector companies in the European Union. Although there were no significant differences between energy enterprises and other enterprises within the European Union, positive and negative judgments have been made on some factors. A positive correlation was observed between indebtedness, tangibility, size, and growth factors. Otherwise, a negative correlation was determined with profitability, liquidity, and non-debt tax shield factors. As a result of the findings, the capital structure of energy companies was considered to be compatible with the POT based on the literature.

In the Wieczorek-Kosmala et al.'s (2021) study, the relationship between capital structure and profitability was analyzed for energy companies in four central European countries of Hungary, Poland, Slovakia, and the Czech Republic between 2015 and 2019. In the study where the effects of total debt, short-term, and long-term were investigated, the total debt level and long-term debts were found to be related to profitability. According to the results of the analysis, total and long-term debt in central European countries have consistent results compatible with POT and long-term debt with TOT.

Based on the energy scarcity and demand in South Asian countries, Ghani et al. (2023) analyzed the capital structure of energy companies through the sample of Pakistan, India, Bangladesh and Sri Lanka, the member countries of the South Asian Association for Regional Cooperation (SAARC). In the panel data analysis conducted on 34 energy companies between 2007 and 2020, the relationship between the dependent variable debt to total asset ratio and the independent variables current ratio, asset tangibility, non-debt tax shield, return on equity, and annual gross domestic product is investigated. According to the analysis results, it has been revealed that current ratio and asset tangibility are of dominant importance for energy companies and that the companies act according to the Dynamic Trade-Off theory.

Capital structure models differ from country to country and even from sector to sector, and therefore, it is difficult to determine an optimum structure. Hence, it is still beneficial to continue working in this

field. This study will contribute to the literature by analyzing Turkey's capital structure preferences, especially the energy sector and macroeconomic variables, in addition to firm-based variables.

4. Research Methodology and Findings

This part of the study will analyze what variables affect the capital structure of energy enterprises in the energy sector and which of the capital structure theories the capital structures of energy enterprises are compatible with. The reason for choosing the energy sector is that, while the demand and dependence on energy continue to increase, it also has a global impact. Panel data analysis was determined as the analysis method in the Stata package program. Panel data combines time series and cross-sectional data that consider periods and collect series related to the same units in different time sections under a single roof (Baltagi, 2005). Panel data analysis allows time and units to be analyzed together, allowing working with a wider data set; one of the advantages of choosing it as an analysis method is that it makes it possible to make highly reliable parameter estimates in series with more than one unit and time (Yerdelen Tatoğlu, 2018).

An important point of the study is that in addition to the impact of all independent variables, it is also classified as company-based, sector-based, and country-based. Studies in the literature are generally based on firm-based variables and a small number of macroeconomic variables. It is important to examine sectoral variables and obtain information about whether they have an impact or in what direction. For this reason, four different modeling analyses enabled the effect of independent variables on the dependent variable to be evaluated and interpreted in detail.

Table 3. Companies Included in the Sample

BIST Code	Company Name
AKENR	AKENERJİ ELEKTRİK ÜRETİM A.Ş.
AKSEN	AKSA ENERJİ ÜRETİM A.Ş.
AKSUE	AKSU ENERJİ VE TİCARET A.Ş.
AYEN	AYEN ENERJİ A.Ş.
ODAS	ODAŞ ELEKTRİK ÜRETİM SANAYİ TİCARET A.Ş.
PAMEL	PAMEL YENİLENEBİLİR ELEKTRİK ÜRETİM A.Ş.
ZEDUR	ZEDUR ENERJİ ELEKTRİK ÜRETİM A.Ş.[1]
ZOREN	ZORLU ENERJİ ELEKTRİK ÜRETİM A.Ş.

In determining the sample and variables, the annual financial reports of Electricity, Water, and Gas sector companies published on the Kamuyu Aydınlatma Platformu (KAP) for the period 2014 – 2021 were reviewed. There are 8 companies in the electricity, water, and gas sector whose financial reports can be accessed for 8 consecutive years between 2014 and 2021. Accordingly, although there are 26 companies in this sector, only 8 of them could be included in this study. In the analysis based on 8 years and 8 companies, 64 observations were made.

1 Formely Zedur Enerji Elektrik Üretim A.Ş.

Table 4. Dependent and Independent Variables

Abbreviation	Variable	Adapted from
Dependent Variable		
CS	Capital Structure (Total debt ratio)	Saeed (2007), İskenderoğlu, Karadeniz & Ayyıldız (2017), Bayrakdaroğlu, Ege & Yazıcı (2013), Chakrabarti & Chakrabarti (2019), Şahin (2020), Nga & Long (2021), Uzun (2023)
Independent Variables		
TANG	Assets Structure (Tangibility)	Mazur (2007), Ghani & Bukhari (2010), İskenderoğlu, Karadeniz & Ayyıldız (2017), Bayrakdaroğlu, Ege & Yazıcı (2013), Zhang et all. (2018), Chakrabarti & Chakrabarti (2019), Nga & Long (2021)
SIZE	Size of the Enterprise	Chen (2004), Saeed (2007), Chakrabarti & Chakrabarti (2019), Nga & Long (2021), Uzun (2023)
GROWTH	Growth Opportunities	Nga & Long (2021)
PROFIT	Profitability	Saeed (2007), Bayrakdaroğlu, Ege, & Yazıcı (2013), Zhang et all. (2018), Nga & Long (2021), Chen (2004)
LIQUIT	Liquidity	Mazur (2007), İskenderoğlu, Karadeniz & Ayyıldız (2017), Işık & Ersoy (2021)
NDTS	Non-debt Tax Shield	Chen (2004), Mazur (2007), Nga & Long (2021), Bayrakdaroğlu, Ege & Yazıcı (2013)
DRIND	Debt Ratio Median in Country/Industry	Jaworski & Czerwonka (2021)
ENENDKS	Industrial Production and Distribution Index	Şahin (2020)
ANNGROW	Annual Growth of GDP	Jaworski & Czerwonka (2021), Uzun (2023)
INF	Inflation	Jaworski & Czerwonka (2021), Uzun (2023)
TAXRV	Tax Revenue	Jaworski & Czerwonka (2021)

Based on the literature, one dependent and 11 independent variables have been identified to determine the components of capital structure as listed in Table 4.

In this study, the relationship between leverage ratio and basic components of capital structure is discussed in the following four different models:

Model 1. $CS_{i,t} = \beta_0 + \beta_1 TANG_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 GROWTH_{i,t} + \beta_4 PROFIT_{i,t} + \beta_5 LIQUID_{i,t} + \beta_6 NDTS_{i,t} + \beta_7 DRIND_{i,t} + \beta_8 ENENDKS_{i,t} + \beta_9 ANNGROW_{i,t} + \beta_{10} INF_{i,t} + \alpha + \varepsilon$

Model 2. $CS_{i,t} = \beta_0 + \beta_1 TANG_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 GROWTH_{i,t} + \beta_4 PROFIT_{i,t} + \beta_5 LIQUID_{i,t} + \beta_6 NDTS_{i,t} + \alpha + \varepsilon$

Model 3. $CS_{i,t} = \beta_0 + \beta_1 DRIND_{i,t} + \beta_2 ENENDKS_{i,t} + \beta_3 LIQUID_{i,t} + \beta_4 TANG_{i,t} + \alpha + \varepsilon$

Model 4. $CS_{i,t} = \beta_0 + \beta_1 ANNGROW_{i,t} + \beta_2 INF_{i,t} + \beta_3 TAVRV_{i,t} + \beta_4 LIQUID_{i,t} + \beta_5 TANG_{i,t} + \alpha + \varepsilon$

α: Constant value

ε: Error term

i; company and t; time shows.

Table 5. Summary of Descriptive Statistics

VARIABLE	OBS	MEAN	STD. DEV.	MIN	MAX
CS	64	0.70	0.182	0.219	1.019
TANG	64	0.833	0.149	0.168	0.986
SIZE	64	19.99	2.296	15.41	23.75
GROWTH	64	0.258	0.297	-0.212	1.173
PROFIT	64	-0.039	0.102	-0.273	0.488
LIQUID	64	15.955	19.355	1.561	115.138
NDTS	64	0.024	0.018	-0.041	0.061
LOGDRIND	64	18.45	0.962	16.358	19.454
LOGENENDKS	64	5.704	0.329	5.357	6.303
ANNGROW	64	0.046	0.033	0.009	0.114
INF	64	0.15	0.089	0.082	0.361

After identifying the models, a summary of descriptive statistics related to the variables was compiled. Accordingly, the average financial leverage level of the companies examined in the study is approximately 70%. This shows that the companies in the sample finance more than half of their assets with debt. The fact that the standard deviation and the difference between the minimum and maximum values are low indicates that an evaluation can be made to determine that the distributions of the variables are appropriate.

Before proceeding with the analysis, it was tested whether there is multicollinearity among the independent variables. Multicollinearity is important because it may cause incorrect estimation of regression coefficients, exaggeration of standard errors of regression coefficients, and, therefore, incorrect results (Topal et al., 2010). The variance inflation factor (VIF) test was preferred in the study. VIF, which measures the severity of multicollinearity between variables, allows estimating the interaction or correlation between independent variables. While a VIF value between 0-5 can be considered low and a value between 5-10 can be considered moderate, a value greater than 10 causes multicollinearity problems with high correlation results (James et al., 2013).

Table 6. VIF Test Results

All Independent Variables	VIF	1/VIF	**Independent Variables, excluding TAXRV**	VIF	1/VIF
INF	42.547	.024	LOGDRIND	4.775	.209
TAXRV	38.099	.026	TAXRV	-	-
LOGDRIND	35.897	.028	LOGENENDKS	4.232	.236
LOGENENDKS	20.785	.048	ANNGROW	2.222	.45
ANNGROW	2.253	.444	INF	2.024	.494
GROWTH	1.93	.518	GROWTH	1.923	.52
LIQUID	1.355	.738	LIQUID	1.316	.76
SIZE	1.232	.812	SIZE	1.231	.812
PROFIT	1.175	.851	PROFIT	1.16	.862
TANG	1.153	.867	NDTS	1.15	.87
NDTS	1.151	.869	TANG	1.15	.87
MEAN VIF	13.416	.	MEAN VIF	2.118	.

As also summarized in Table 6, initially, all independent variables were examined, and it was noted that the VIF values for INF, TAXRV, LOGDRIND, and LOGENENDKS variables are quite high. The TAXRV variable, which has a significantly higher VIF value among others, was removed from the analysis to address the multicollinearity problem. As a result, revised VIF values are all lower than 10. Accordingly, it appears that the issue of multicollinearity has been resolved in all models by excluding the variable TAXRV.

To determine whether the fixed effects or random effects models should be preferred in panel data analysis, the Hausmann test was used. For the Hausmann test, the significance level was taken as P = 0.05 and the following hypotheses were tested:

H0 = There is a random effect.

H1 = There is no random effect.

Table 7. Hausmann Test Result for Models

Function	Chi-square	Probability
Model-1	5.52	0.854
Model-2	1.58	0.954
Model-3	0.69	0.952
Model-4	0.50	0.992

According to the Hausmann test results in Table 5, probability values for all models were found to be greater than 0.05 (P = 0.854 > 0.05, P = 0.954 > 0.05, P = 0.952 > 0.05, P = 0.992 > 0.05). Thus, it was concluded that the H0 hypothesis was accepted for all models and it would be appropriate to use the random effects model as a basis.

Diagnostic test results consisting of cross-sectional dependence, autocorrelation, and heteroskedasticity tests will be checked on the models. Cross-sectional dependence investigates

whether all cross-sectional units in the panel data are affected by this shock in the same way when a certain shock occurs in the series. Autocorrelation refers to situations where there is a relationship between error terms. The heteroscedasticity test examines the assumption that the variances of error terms between units in panel data models are the same; in other words, they are constant. As a result, it was determined that there was an autocorrelation problem for the random effects estimator for all models, and there were no cross-sectional dependence and heteroscedasticity problems. In this case, it was evaluated that applying the Generalized Least Square (GLS) estimator, which is sensitive to first-degree autocorrelation, to the models would give consistent results (Hoechle, 2007).

Table 8. Generalized Least Square Estimator (GLS)

CS	Coef.	St.Err.	t-value	p-value
TANG	-0.212	0.090	-2.36**	0.018
SIZE	-0.003	0.018	-0.18	0.860
GROWTH	-0.112	0.041	-2.72***	0.006
PROFIT	-0.581	0.127	-4.58***	0.000
LIQUID	-0.002	0.001	-2.72***	0.007
NDTS	0.626	0.859	0.73	0.466
LOGDRIND	0.031	0.016	1.94	0.052
LOGENENDKS	-0.211	0.068	-3.11	0.002
ANNGROW	-1.031	0.423	-2.44**	0.015
INF	0.001	0.226	0.01	0.995
TAXRV	-1.058	1.434	-0.74	0.461

**** p<.01, ** p<.05, * p<.1*

According to the results summarized in Table 8, there is no significant relationship found between the variables SIZE, NDTS, INF, TAXRV, and leverage. On the other hand, a one-unit increase in the TANG, GROWTH, PROFIT, LIQUID, and LOGENENDKS variables will reduce the CS dependent variable by 0.212, 0.112, 0.581, 0.002, and 0.211 units, respectively. It is determined that a one percent increase in the LOGDRIND and ANNGROW variables would cause an increase of 0.031 and 1.031 units on CS, respectively. These coefficients are statistically significant at the 5 percent level.

Table 9. Results of the Analysis

Variables	Results of Analysis	TOT	POT	Related Theory
TANG	-	+	-	POT
SIZE		+	-	
GROWTH	-	-	+	TOT
PROFIT	-	+	-	POT
LIQUID	-	+	-	POT
NDTS		-	-	
DRIND	+			
ENENDKS	-			
ANNGROW	+			
INF	-			
TAXRV				

A comparison was made between the results of the analysis and the assumptions of pecking-order and trade-off theories, as summarized in Table 9. No significant relationship was found between the SIZE, NDTS, and TAXRV variables and the dependent variable. Although the DRIND, ENENDKS, ANNGROW, and INF variables have a relationship with the dependent variable, the results could not be explained by existing theories. It was concluded that tangibility, profitability, and liquidity were compatible with the pecking-order theory, and only the growth variable was compatible with the trade-off theory. Accordingly, the results show that the capital structure decisions of the Turkish energy sector companies are based on the pecking-order theory. This finding is consistent with the conclusion reached by İskenderoğlu et al (2017).

In addition to the model that includes all variables, three more models based on company, sector, and country were used. For Model 1, where the effects of all variables were analyzed, no significant relationship was detected between SIZE, NDTS, LOGDRIND, LOGENENDKS, and ANNGROW and the dependent variable. TANG, GROWTH, PROFIT, LIQUID, and INF negatively affect leverage. For Model 2, where company-based variables were analyzed, no significant relationship was detected between SIZE and NDTS and the dependent variable. TANG, GROWTH, PROFIT, and LIQUID negatively affect leverage. There is no insignificant variable for Model 3, where sector-based variables are analyzed. While the LOGDRIND variable affects leverage positively, LOGENENDKS affects leverage negatively. For Model 4, where country-based variables were analyzed, no significant relationship was detected between INF and TAXRV and the dependent variable. The ANNGROW variable affects leverage positively.

5. Conclusion

The capital structure is an extensively researched field in finance and accounting. It is also a concept widely discussed in the finance departments of companies. The lack of consensus suggests that further research in this field will be valuable. This study aimed to empirically examine the factors influencing the capital structure within the Energy sector of Borsa Istanbul, comprising eight companies, from 2014 to 2021.

Based on the results, the average financial leverage level of the examined companies was found to be approximately 70%. Accordingly, it is seen that Turkish energy companies finance their resources predominantly with debt. When the literature is examined, it is seen that İskenderoğlu et al. (2017) and Şahin (2020) reached similar conclusions. According to Wieczorek-Kosmala et al. (2021), the debt ratio for Central European countries is around 60%. Similarly, Mjøs (2008) found that the energy sector in Norway has one of the highest debt ratios (83%). The energy companies may face increased financial risk due to their high level of leverage especially when it contends with the pressure of meeting debt obligations during periods of declining earnings or worsening economic conditions.

When the findings were evaluated, the relationship between the total debt ratio and debt ratio median in industry and the annual growth of GDP was found to be positive. In this context, it can be said that companies tend to favor the use of debt, and an increase in macroeconomic growth also

leads to an increase in the company's liabilities. The relationship is negative for tangibility, growth, profit, liquidity, industrial production and distribution index, and inflation variables affecting the capital structure of energy companies. Parallel findings have been found in the literature for profitability (İskenderoğlu et al., 2017; Jaworski & Czerwonka, 2021; Nga & Long, 2021; Chakrabarti & Chakrabarti, 2019), liquidity (Jaworski & Czerwonka, 2021; Nga & Long, 2021; Chakrabarti & Chakrabarti, 2019), tangibility (Braskerud & Jarbo, 2018), and inflation (Jaworski & Czerwonka, 2021) variables. On the other hand, no significant relationship was found for the variable size, non-debt tax shield, and tax revenue.

When comparing the predictions of the theories with the results of the analysis, companies act by the POT. This finding is parallel with prior studies by İskenderoğlu et al. (2013) for Türkiye's energy sector and Wieczorek-Kosmala et al. (2021) for central European countries' energy companies.

It is expected that this study will contribute to the development of the literature on capital structure in the energy sector. To gain further insights, it would be beneficial to explore periods with a higher number of companies and making cross-sector and cross-country comparisons. This could lead to new and additional insights.

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