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

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PLAGIARISM

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ÖZET

Firmaların kurulması, gelişmesi ve faaliyetlerini sürdürmesi aşamalarında sermaye yapısının büyük önemi vardır. Literatürde çokça tartışılan kavramlardan biri olan sermaye yapısının belirlenmesi hem kar etme amacına sahip hem de varlıkları ve yükümlülükleri ile kendisini idame etmeye çalışan bir işletme için faydalı olacaktır. Benzer şekilde, eşit biçimde dünya üzerinde bulunmayan enerji kaynakları ile onların tükenme potansiyeli sebebiyle yenilenebilir enerji yatırımlarında gözlemlenen artış ve teknolojik gelişmelerle birlikte enerjiye olan bağımlılığın vazgeçilmez bir hale dönüşmesi enerji sektörünün yakından incelenmesini gerektirmektedir. Çalışmada 2014 ile 2021 yılları arasında Borsa İstanbul'da işlem gören 8 Enerji şirketinin sermaye yapısı değişkenleri panel veri yöntemi ile incelenmiştir. Bağımsız değişkenler firma, sektör ve ülke bazlı olarak kategorize edilerek literatüre katkı sağlanması amaçlanmıştır. Analiz sonucunda, firma bazlı değişkenlerden varlık yapısı, büyüme fırsatları, karlılık ve likidite değişkenleri kaldıracı olumsuz yönde etkilediği belirlenmiştir; işletmenin büyüklüğü ve borç dışı vergi kalkanı ile bağımlı değişken arasında anlamlı bir ilişki saptanamamıştır. Sektör bazlı değişkenlerden sektör bazında medyan borç oranı kaldıracı olumlu yönde etkilerken, sanayi üretim ve dağıtım endeksi ise kaldıracı olumsuz yönde etkilemektedir. Son olarak, ülke bazlı değişkenlerden GSYİH yıllık büyümesi değişkeni kaldıracı olumsuz yönde etkilerken, enflasyon ve vergi geliri ile bağımlı değişken arasında anlamlı bir ilişki saptanamamıştır.

Anahtar Kelimeler: *Sermaye Yapısı, Enerji, Enerji Sektörü, BIST 100, Panel Veri Analizi*

ABSTRACT

Capital structure is of significant importance in the establishment, development, and operation of companies. Determining the capital structure, which is one of the concepts that is widely discussed in the literature, will be advantageous for a firm that has the purpose of making a profit and tries to maintain itself with its assets and liabilities. Similarly, the energy sector requires a close examination because of the increase in renewable energy investments due to energy resources that are not equally available in the world and the fact that dependence on energy has become indispensable with technological developments. In the study, the capital structure variables of 8 Energy companies traded in Borsa Istanbul between 2014 and 2021 were examined by panel data method. It is aimed to contribute to the literature by categorizing the independent variables on the basis of firm, sector and country. As a result of the analysis, it was determined that the firm-based variables tangibility, growth opportunities, profit and liquidity affect leverage negatively; no significant relationship was found between the size and non-debt tax shield and the dependent variable. Debt ratio median in industry which is one of the sector-based variables affects the leverage positively, while the industrial production and distribution index variable affects negatively. Finally, the annual growth of GDP which is one of the country-based variables negatively affects the leverage; no significant relationship was found between inflation and tax revenue and the dependent variable.

Key Words: *Capital Structure, Energy, Energy Sector, BIST 100, Panel Data Analysis*

ÖNSÖZ

Her aşamasıyla uzun ve zorlu olan bu süreçte başından sonuna kadar alanındaki değerli tecrübe, bilgi ve birikimiyle bana yol gösteren, belirsizlikler karşısında yolumu aydınlatan ve bana inanarak tezimin her aşamasında önemli destek ve yardımı olan tez danışmanım Doç. Dr. Tuba Şavlı'ya sonsuz teşekkür ederim. Her zaman yanımda olan eşim Ata Güneş'e ve kıymetli ailelerime hayatım boyunca minnettarlığımı göstermeyi bir borç bilirim.

Beyza Bayraktar Güneş

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BIST: Borsa İstanbul

CVA: Collateralizable value of assets

EU: European Union

Et al.: And others

IAEA: International Atomic Energy Agency

IEA: International Energy Agency

IRENA: International Renewable Energy Agency

KAP: Public Disclosure Platform

kWh: Kilowatts

M&M: Modigliani & Miller

Mtoe: One Million Tonne of Oil Equivalent

NEEAP: National Energy Efficiency Action Plan

NDTS: Non-Debt Tax Shields

NI: Net Income

NOI: Net Operating Income

OECD: Organization for Economic Co-operation and Development

POT: Pecking-Order Theory

TOT: Trade-Off Theory

UNFCCC: United Nations Framework Convention on Climate Change

VIF: Variance Inflation Factor

INTRODUCTION

Nowadays the use of energy has penetrated almost every field and also together with technological developments, industrialization, and the increase in the world population reinforce the indispensability of the concept of energy. Energy, which is the main source of manufacturing, is an essential element for increasing the prosperity level of societies and is used in almost every area of daily life. Therewithal, the energy needs of the economies of developed or developing countries are increasing the importance of the limited energy resources in the world.

Türkiye is on its way to becoming a country that is gaining gradually significance in zonal and global energy markets. It is among the countries where energy supply and demand are increasing rapidly with its developing economy, increasing population, and advancing technological infrastructure. In addition, it has strategic importance in terms of its proximity to global energy markets due to its location. Conversely, Türkiye's dependence on foreign sources, especially in the supply of fossil fuels, is one of its important disadvantages in the field of energy. However, the oil and natural gas discoveries in the recent past have the potential to contribute to reducing Türkiye's dependence on foreign sources, and studies on this subject proceed.

The decisions of the enterprises operating in the energy sector regarding the method of financing their resources are significant in minimizing the capital cost and maximizing the firm value and profitability. However, the absence of an agreed capital structure requires companies and even the sector to have knowledge of the factors affecting it.

The major purpose of this study is to examine the capital structure determinants of 8 energy companies traded in Borsa Istanbul (BIST). The study is designed into four parts.

In the first part, fundamental information about the concept of capital structure will be given; then, classical and modern theories will be explained.

In the second part, knowledge about the general view of the energy sector will be given. The concept of energy and its sources will be explained. Data on the general view and current state of energy in the world and in Türkiye will be examined; the study will be supported with figures on energy supply, consumption and emission values. Then,

information will be given about the energy policies of Türkiye and some world countries and the leading international organizations in their field. Finally, the development and current situation of the energy sector will be mentioned.

In the third part, a literature review will be created by mentioning some studies on the effect of capital structure determinants in the energy sector and then in other sectors.

In the last part, the aim, scope, importance and limitations of the research will be mentioned. Then, information about the research method, data set and variables will be given. In the study, the capital structure determinants of 8 energy companies between 2014 and 2021 will be analyzed using panel data method. Analysis models will be created by examining basic statistical data and performing multiple linear correlation tests. Then, the panel data method to be applied in the analysis will be determined according to the Hausman test result. Along with the panel data results, the relationship status and direction of the variables will be determined. Finally, the validity of the approaches for Türkiye will be tested by comparing them with the expectations of capital structure approaches.

CHAPTER ONE

THE CONCEPT AND THEORIES OF CAPITAL STRUCTURE

The concept of capital, which emerged as the counting of people and animals, began to be associated with wealth in the Ancient Roman period; however, the spread of the word in Europe begins with the use of the word by Italians since 1211, as Fernand Braudel emphasizes in his book Civilization and Capitalism, and in the same century, when the concept gained the meaning of "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 the expressions of wealth and valuable resources in the semantic sense. In the field of accounting, the concept of capital is a source of money, goods or labor held in order to produce goods and services. These resources consist of cash, receivables, stocks, tangible and intangible assets included in the assets of the balance sheet.

Capital structure simply refers to the financial resource structure that is based on companies' preferences in long-term debt and equity utilization ratios. Determining the structure of the financial resources of the companies on the basis of the steps that want to continue their activities or lay the groundwork for new investments is also important in terms of determining the course. Financing decisions determine which source companies will prefer to finance assets and how long they want to benefit from these resources. In other words, in this process where the optimal capital structure is determined, the necessity of choosing between company value, performance evaluation and alternatives arises. The capital structure, which changes depending on time and conditions, has a dynamic structure that needs to be constantly monitored (Sayılgan, 2011).

Financial structure is similar to capital structure as it contains both long-term and short-term resources. In the literature, short-terms are included in the capital structure measurement, which should focus on long-term liabilities. As Tevfik (2005) mentioned, this situation causes the difference between the concepts to disappear and it should be accepted that it is in the capital structure. The ratio of total debt to total assets is commonly used to measure capital structure. However, the balance of short-term and long-term

liabilities relative to the total assets is also a parameter. In particular, it is frequently used to measure the similarities or differences between short-term and long-term liabilities.

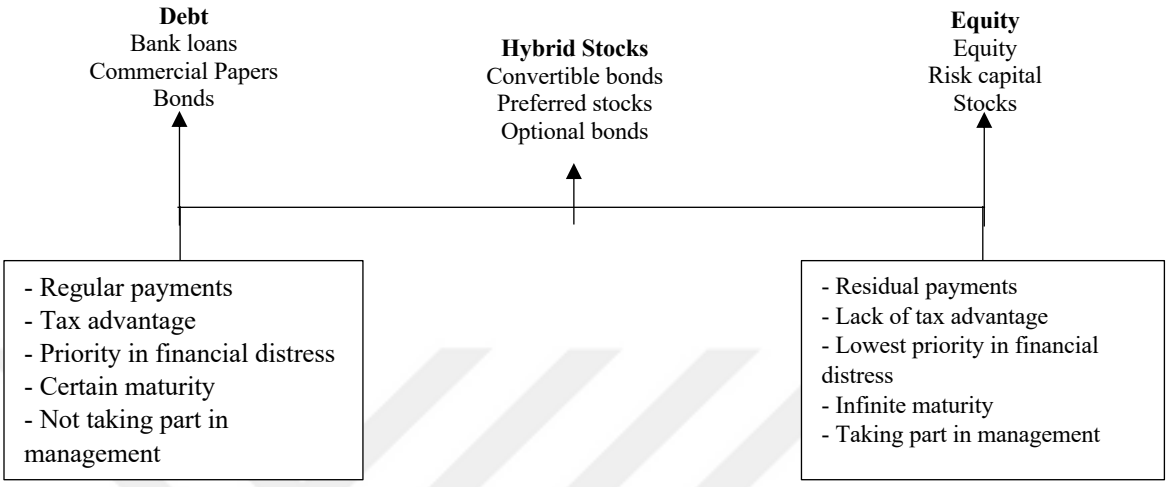
Today, economic and financial crises occur at more frequent intervals and in a global context, each within a wider sphere of influence than the other. For this reason, businesses need to take cautious and realistic steps in their future goals and plans, and moreover, they need to strongly protect and keep their financial structures under control. One way to do this is to keep their capital strong, which they frequently monitor for returns and costs. There are two different capital cost approaches in capital structure preferences: weighted average, and marginal cost of capital.

The weighted average cost of capital is the weighted average of the costs of the resources available in the balance sheet of the enterprise at a given date. According to this method, basically, the cost of equity of a company is as effective as the capital ratio, while the cost of borrowing is as effective as the leverage ratio. The marginal cost of capital is figured out by adding it to the cost of the last resource provided by the enterprise. In this method, in which each additional source generally has an increasing capital cost compared to the previous source, in some cases such as incentive aid or low-interest loan, the marginal cost of capital may be lower than the weighted average cost of capital.

The goal of capital structure preference is to achieve the lowest weighted average cost of capital and maximize the company's value, profits, and industry position in a similar direction, although there are some limitations. As Yener and Karakuş (2012) stated, one of the most important of these limitations is the insufficient development of the financial system in the country where the company operates. There are two main sources, namely third party source, which is also expressed as debt, which can be used by businesses for asset financing, and equity resources, which are their own resources. While there is an equity-weighted structure in countries with limited credit facilities, it is observed that this weight decreases in countries with developed credit facilities and a large number of financial instruments (Akkaya, 2008). In addition to debt financing, it can be said that different methods are followed in equity financing methods in countries with good depth, diversity and institutionalization in the capital markets.

Table 1

Debt and Equity Financing Preferences



Note. From (Kılıç, 2017)

Financing for companies is divided into three as debt, equity and hybrid. Debt financing simply covers bank loans, commercial paper and bonds; equity financing also covers equity and stocks. Hybrid financing includes bonds and stocks at the same time. There are various reasons between companies' financing preferences. Firms that are newly established or that have low sales and profits and have high business risks and therefore have difficulty in finding loans, turn to equity financing in the stage of finding funds. In equity financing, there is flexibility in determining the payment amount and the number of terms. Bank loans and commercial bonds also cover a certain maturity with the obligation to make regular payments. Conversely, the use of equity becomes an option for companies that want to avoid resource costs and interest expenses. Expenditure and interest payments made in debt financing are considered as expenses and benefit more from tax advantages compared to equity financing. Additionally, the cost of the manager's time and effort in debt financing should not be ignored. Finally, companies avoid borrowing during periods when the economy is unstable and the future is uncertain, thus reducing the risk during the financial distress process.

In this part of the study, the capital structure's theories is examined. Theories divided into two as traditional and modern in the literature.

1.1 Traditional Capital Structure Theories

Table 2

Summary of Traditional Theories History

Traditional Theories	Theorists	Release date
Net Income Theory	David Durand	1952
Net Operating Income Theory	David Durand	1952
Traditional Theory	Ezra Solomon	1955

Traditional capital structure theories try to clarify the relation among the firm's capital structure, cost of capital, and firm value. Studies in the literature started with the Net Income and Net Operating Income theories developed by David Duran. It is aimed for companies to minimize capital costs by changing their capital structures, and to maximize the market value of stocks and company value.

The basic assumptions on which traditional capital structure theories are based can be summarized as follows (Van Horne, 1971:201);

- The fundamental assumption is that there is no corporate tax.
- A business's debt-to-equity ratio is balanced by two-ways; one is increasing equity to reduce debt and the second is borrowing to decrease equity.
- Businesses distribute all of their income as dividends.
- It is expected that the operating income of the enterprises will not grow.
- It is based on the assumption that business risk always remains constant. Thus, acceptance of one or more investment proposals does not change the operating risk composition.

Traditional approaches are based on limited assumptions that companies only use debt and equity in investment financing, ignoring transaction, issuance, financial hardship and bankruptcy costs, and tax impact. On the other hand, although empirical studies and findings have not yet proven which view or approach is more valid on capital structure, the relationships between the cost of capital and the market value of the enterprise, the

interaction between investment and financing decisions, the traditional view has more supporters (Türko, 2002: 512).

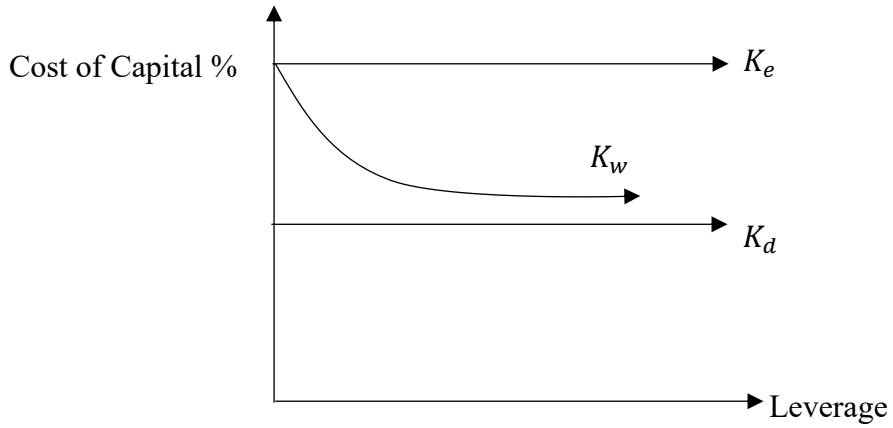
1.1.1 Net Income Theory (NI)

The Net Income (NI) Theory, developed by David Durand in 1952, argues that by increasing the degree of leverage, companies can decrease the cost of capital and, accordingly, rise the value of the company (Durand, 1952). The more debt and equity increase, the better for the company because its weighted average cost will decrease. When the cost of debt is compared with the cost of equity, it assumes that the cost of capital of debt is low and recommends using debt in these cases. In this way, it is aimed to reduce the average cost of capital.

In NI Theory, it is accepted that debt and equity costs are independent of the capital structure. Since the invisible cost of debt is not taken into account, the cost of equity is not influenced by the company's use of more debt (Aydın et al, 2004: 277). Finally, there are two possible situations in which the theory is based on the cost of capital. First, it's possible that the cost of equity is higher than the cost of debt. Second, the cost of debt equals the cost of equity.

Figure 1

Graph of Debt, Equity, and Weighted Average Costs of Capital According to Net Income Approach



Note. From (Chandra, 2009:479)

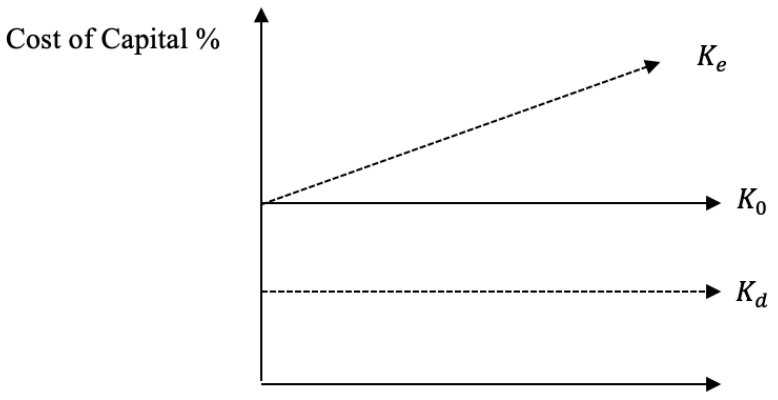
However, this assumption is criticized with the idea that if the company's debts increase, its costs will also increase. As the firm's financing load increases, the probability and therefore the risk of cash shortage due to debt payments will increase. On the other hand, the increase in the borrowing rate will raise the return expectations of the parties providing financing to the company in parallel (Aydın et al, 2004:277). Contrary to the theory's fundamental assumption that the cost of debt and equity remains constant, it is expected to increase with the debt burden.

1.1.2 Net Operating Income Theory (NOI)

Like the NI Theory, the Net Operating Income (NOI) Theory was also developed by David Durand. However, both theories have a contradiction in terms of the thoughts that is defend. While the net income approach contends that the capital structure and firm value are related, the net operating income theory contends that there is no connection between the capital structure and the firm's market value. The theory further contends that the weighted average cost of capital and firm value are unaffected by changes in the business's capital structure in light of the no relationship thesis (Durand, 1952). The company's value is based on revenue and business risk, not financial leverage.

Figure 2

Cost of Capital According to Net Operating Income Theory



Note. From (Van Horne, 1971)

According to the NOI Theory, the increasing effect of debt use on the cost of equity has important consequences for financing decisions. The real costs of debt financing and

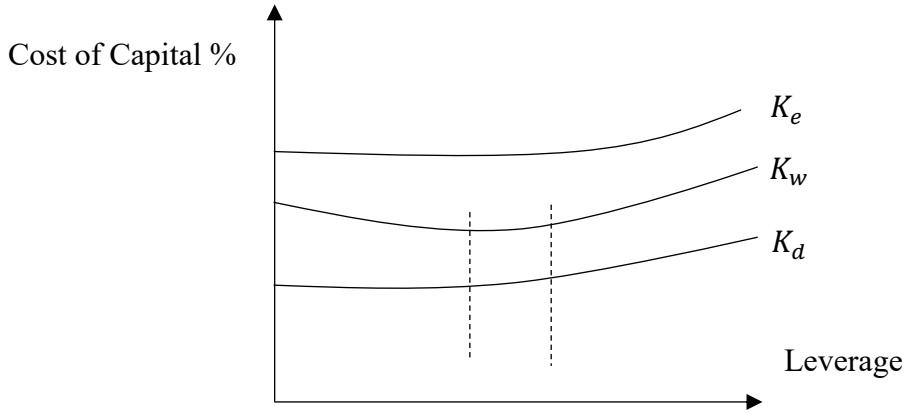
equity financing are equal from a business perspective. In the approach, considering the invisible cost of using debt, in other words, the increase in the expectations of the lenders to the enterprise in debt financing after a certain level, it is argued that the cost of equity will rise as the debt is used, and accordingly the weighted average cost of capital for all capital structures will remain constant. In other words, the advantage that will occur as a result of using cheap debt will increase the cost of equity and the cost of capital will not change. For these reasons, all capital structures are optimal for any company (Durand, 1952:257).

1.1.3. Traditional Theory

According to the Traditional Theory developed by Ezra Solomon in 1955, every company should achieve an optimal capital structure. At this point, it is important for companies to use debt, which is a cheaper resource than equity, and to try to decrease the cost of capital by paying attention to the balance of debt ratio. While borrowing at a reasonable rate can protect the market value of the company by lowering the average cost of capital, otherwise, the company borrowing at an above reasonable rate reduces the market value of the company by raising the risk and average cost of capital. The reason for the increase in the ratio of creditors who will give credit to the company is due to the increase in the financial risk of the company with borrowing and the possibility of bankruptcy. Therefore, the theory emphasizes the similarity of keeping the financial leverage ratio of companies in balance and keeping the average cost of capital to a

Figure 3

The Relationship between Cost of Capital and Leverage According to Traditional Theory



Note. From (The Institute of Company Secretaries of India, n.d.:97)

The Traditional Theory explains that the cost of equity is greater than the cost of debt because interest on debt can be written off as an expense, while dividends distributed to shareholders do not have this advantage. The theory has produced the antithesis to the thesis that only the cost of equity should respond to the unlimited use of debt advocated by the net income theory and the increased risks advocated by the net operating income theory.

1.2. Modern Capital Structure Theories

Table 3

Summary of Modern Theories History

Modern Theories	Theorists	Release date
Modigliani-Miller Theory	Franco Modigliani Merton H. Miller	1958 & 1963
Trade-Off Theory	Alan Kraus Robert Litzenberger	1973
Pecking-Order Theory	Stewart C. Myers Nicholas S. Majluf	1984
Market Timing Theory	Malcolm Baker Jeffrey Wurgler	2002

Many theories have been put forward regarding the capital structures of firms from Modigliani and Miller to the present. In most of these theories, it has been tried to explain why the capital structure is important and to what extent the preferences in capital structuring affect the profitability and value of the firm in general. Contrary to the rigid assumptions and idealized rules of classical theories, modern theories are based on the current economic situation and company behavior.

1.2.1. Modigliani-Miller (MM) Theory

Traditional theories argue that reasonable or low-cost borrowing will lower the average cost of capital, and thus a positive rise in the market value of the company. Researchers Franco Modigliani and Merton H. Miller, on the other hand, went beyond traditional theories and the current belief of the period and argued that capital structures

changed by borrowing in ideal economies would not have an effect on firm value. The model developed by Modigliani-Miller (M&M), who will win the Nobel prize to its theorists, has an important place in the literature because it can be calculated and tested mathematically.

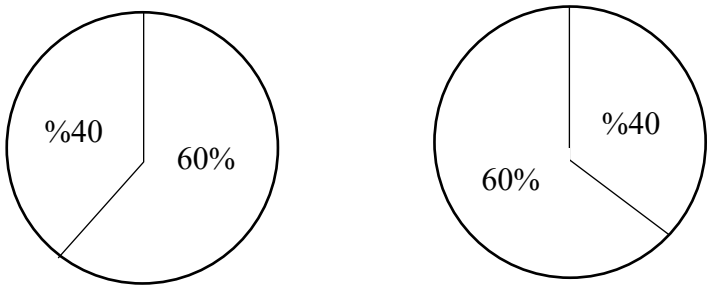
The following are the assumptions that put forward in their article named 'The Cost of Capital, Corporation Finance and the Theory of Investment' (1958: 261-297);

- There is no tax to accrue on income.
- There are no bankruptcy costs.
- There are no transaction costs in purchasing and selling shares.
- There are enough purchaser and supplier in the market.
- All investors borrow and lend at the same rate. At the same time, they are rational.
- Businesses do not differ in the scale of business risk. The difference comes from the scale of businesses in the same risk group.

According to M&M proposals, market value and capital structure have no relationship. The difference of two figures is needed to calculate the market value of the firm; first, the firm's future returns, and second, the discount rate determined by the risk class of the firm (Modigliani & Miller, 1958). In ideal economies, it does not create a positive or negative variable between the weight of the capital structure and the market value of two companies in the same risk class (Öztürk ve Şahin, 2013). The concept of ideal economy states that two completely equal goods or services cannot be sold at two different prices (Solomon quoted in İçerli, 1995:20).

Figure 4

The Pie Models of Capital Structure



Note. From (Ross et al, 2008)

What is mentioned at the point of capital structure weight is that a firm's capital structure consists of only equity or a combination of equity and foreign resources. As Ross (2008) calls the 'Pie Model' in Figure 4, the liabilities section or right side of a company's balance sheet can be compared to a round cake. According to this idea, the distribution of foreign resources and equity in the pie, or in other words, its slice, does not affect the size of the pie.

M&M theorists, who ignored the corporate tax in their work in 1958, made a re-evaluation of the theory by considering the existence of taxes with the article named 'Taxes and Cost of Capital: A Correction' in 1963. As a result of the re-evaluation, it is confirmed that debt financing is more advantageous compared to equity financing, mainly due to the tax savings of the firm (Modigliani & Miller, 1963). The shielding effect of tax against debt appears due to the deduction of expenses such as interest which arise through borrowing from the tax base. However, there is no such advantage in equity payments such as dividends.

The tax deduction for debt related expenses arises in the context of a capital structure that has increased its debt burden. This reduces the average cost of capital and, therefore, rises firm value. Thus, the firm's capital structure, which will be regulated with 100% debt financing, means that the market value of the firm will reach the highest point, thus laying the groundwork for the optimal capital structure (Chen et al., 2014). The increase in borrowing will reveal to lenders and investors the idea that the company is in danger and at risk of bankruptcy in real life. These two groups, which have a higher return expectation, will cause the total cost of capital to increase (Atrill, 2009).

M&M (1963) argued that firms are indifferent between using internal resources and external resources because of the perfect substitution between the financial resources of the companies. For this reason, they defended the view that firms' investment behavior is independent of the source of financing, consistent with the traditional economics approach (Modigliani & Miller, 1963). However, asymmetrical access to the details of the projects to the lender and the buyer causes the cost of the external resource to be obtained greater than the alternative cost of using the internal resources of the firm. In other words, external

resources are more costly than internal resources (Blanchard & Fischer, 1989). The cost of borrowing from outside of a firm that is adequate in terms of capital is lower than a firm that is insufficient in terms of capital. In this context, external effects that may cause the financial structures of firms to change negatively affect the real activities of firms and change the distribution of wealth in the economy. Accordingly, the existence of a financial system that allocates resources effectively can be expected to positively affect the growth of the economy (TÜSİAD, 2005: 77).

There are many criticisms in the literature against the M&M theory. According to Brigham and Ehrhardt (2013), this is due to the incompatibility of theory assumptions with reality. The biggest criticism of the theorem is made by Stiglitz. According to Stiglitz (1969), in fact, since firms operate under imperfect competition conditions, interest rates rise, and an rise in interest rates causes the theorem to lose its validity. Gottardi (1995), on the other hand, emphasizes that earnings from securities affect both the capital structure and real values of firms. Therefore, the resulting uncertainty renders the theory invalid. Lastly, Türko (1994) underlines the costs arising from both stock trading and other financial transactions.

1.2.2. Trade-off Theory

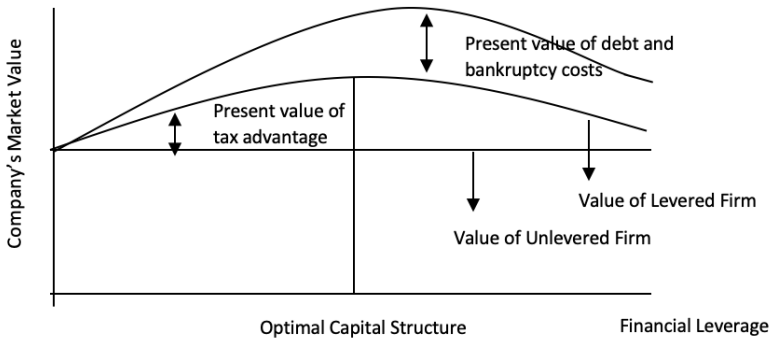
Alan Kraus and Robert Litzenberger, who discussed Modigliani and Miller's work and carried it to a further point in terms of bankruptcy costs, developed the Trade-off Theory (TOT) with their article "A State-Reference Model of Optimal Financial Leverage" published in 1973. Theorists, who state that the concepts of taxation and bankruptcy cost should be considered together, emphasize the importance of the tax advantage of borrowing and the risk of bankruptcy that will arise during the non-payment of debt, and the costs of bankruptcy. The present value of the tax savings effect of interest expenses arising from borrowing will increase the value of the firm. However, they argue that the increased risk of bankruptcy through borrowing will reduce the market value of firms due to increased bankruptcy costs *(*Kraus & Litzenberger, 1973).

Miller (1977) likens the balance between the tax benefit and the cost of bankruptcy to the recipe for horse and rabbit stew. In other words, bankruptcy costs are relatively small compared to the advantages of debt. However, DeAngelo and Masulis (1980) emphasize

that the balance to be established between the tax benefit of debt arising from the tax deduction of interest payments and the costs of financial distress that arise with increased debt will determine the optimum or target capital structure. At this point, they oppose Miller's analogy by stating that the optimal capital structure will be established.

Figure 5

Optimal Capital Structure and Change in Firm Value According to the Trade-off Theory



Note. From (Lakshmi & Stewart, 1999)

The fact that the optimum debt level of the firms is proportional to the tax savings benefit of borrowing and the cost of the increased risk of bankruptcy due to borrowing indicates the balance of the optimal capital structure. It is emphasized that the increase in debt use and the increase in firm value do not have a linear relationship and this situation will not continue indefinitely even if it is observed for a certain period of time (Ergün, 2020).

TOT is separated into two static and dynamic. Static trade-off theory argues that firms reach their target leverage ratio by taking into account the pros and cons of borrowing. However, the firm's assets and investments do not change. The firm uses debt instead of equity and equity instead of debt until its value is maximized (Myers, 1984). On the other hand, the dynamic capital structure takes into account adjustment costs in the process. However, the observed capital structure is not always the target capital structure (Dudley, 2007).

1.2.3. Pecking-Order Theory

The foundations of the Pecking-Order Theory (POT) were laid by Gordon Donaldson (1961); it was improved by Stewart C. Myers and Nicholas S. Majluf (1984). Donaldson (1961) clarify that managers choose retained earnings to debt and debt to equity to fund new investments. In other words, companies reduce their leverage ratio by keeping their profits in equity during profitable periods; in unprofitable periods, they tend to increase their leverage by using debt. In the same period, with the increase in studies on information asymmetry, the results of the study containing similar results with the hierarchy of finance inspired the development of the theory by Myers and Majluf (Yiğit, 2016).

According to the POT theory, firms have two resources, internal resources that they prioritize in investment processes and external resources that they will use if internal resources are not sufficient. The POT does not have a debt-to-equity ratio that the firm targets in opposition to the trade-off theory. According to the theory, firms act in accordance with a hierarchy in the financial preference stages, with their internal resources at the top (Bontempi, 2022).

Myers (1984) explains the functioning of the pecking order theory as follows;

1) The first choice of companies will be the financing of internal resources.
2) Dividend payments of companies -although it is known to be fixed- may vary according to investment opportunities.
3) Changes in payments, income or investments of companies may affect cash outflow. If the firm's cash inflow is lower than its investment expenditures, the firm uses its cash or securities.
4) When external financing is required, firms tend to choose the most risk-free option. Debt, stock and capital are among the options from risk-free to risky.

The POT is based on the asymmetric information between firms and investment markets. The concept of information asymmetry implies that executives have more internal data about the company's expectations, risks and value than investors. According to example one, the company's dividend payment amounts are a benchmark for investors. As the increase in the dividend paid is perceived in parallel with the expectation of increase in

future incomes, the stock price will also increase. According to example two, the expectation of a positive company future will direct the managers to debt financing, and the expectation of a negative company future will lead to equity financing. However, debt financing will rise the value of the company, while equity financing will decrease it. The way in which the steps taken and the methods applied by the managers are perceived from the outside causes some results as seen in the examples.

1.2.4. Market Timing Theory

Market timing theory was developed in 2002 by Malcolm Baker and Jeffrey Wurgler in their article “Market Timing and Capital Structure”. The theory is based on the idea that firms issue stocks when their market cap to book value ratios are high and borrow when their market cap to book value ratios are low. An ideal market timing is to sell stocks when prices are high and buy back when prices are low.

Although it was developed as a theory in 2022, it has a history in the literature as an idea. Moreover, previous studies provide the basis for market timing. In the financial hierarchy approach developed by Myers (1974), the general rule for investors was that undervalued firms borrowed the firm and overvalued firms offered stocks to the market. Taggart (1977) named the name of the variable expressed by dividing the average market value in the last two periods by the market value in the last 12 periods, as the capital market timing variable. Hovakimian, Opler, and Titman (2001) observed that companies with higher current share prices compared to past share prices prefer stocks instead of debt as a source of financing.

According to Baker and Wurgler (2002) capital structure is the cumulative result of activities related to timing the equity market in the past, and past market values have a lasting impact on the capital structure. An example of this can be said that the basis of the capital structure obtained for 2020 stems from a change in the market value in 2010. In other words, the change in market value was able to effectively change the capital ratio for 10 years.

For permanence, which is one of the main concepts of the theory, Alti (2006) has examined the public offering processes of companies that provide data that can also make observations in terms of timing. According to the findings of Alti's study, he brought a

criticism to the theory by claiming that the permanence effect is low since the rate of change in the amount of equity issuance of the firms is low, regardless of the market situation, whether it is hot or cold. Another criticism of the theory was made by DeAngelo, DeAngelo, and Stulz (2010). According to the results of DeAngelo et al.'s (2010) study, many companies with high market value and book value did not issue stocks contrary to what was expected according to the theory.

CHAPTER TWO

AN OVERVIEW OF THE ENERGY SECTOR

Lindsay's (1971:383) emphasis on the concept of energy gradually becoming a part of the "real wealth of nations" in the early 1970s has not lost its validity today. Russia's invasion of Ukraine and embargoes on Russia created the energy crisis and led to a change in energy balances. The five biggest oil companies such as BP, Chevron, Exxon Mobil, Shell, and TotalEnergies obtained combined profits of almost 200 billion dollars in 2022 (Meredith, 2023). It is clear that energy is closely related to economic development. According to British Business Energy's (n.d.) data, the top three share of the energy sector in the GDP belongs to the Netherlands (47%), Russia (29%), and Norway (20%).

With the recent developments, investments in renewable energy resources, where countries can benefit from their existing potential, have increased. According to the Renewable Energy Capacity Statistics 2023 Report, renewable energy worldwide increased by 9.6 in 2023 compared to 2022 and reached 3,372 gigawatts. While the share of renewable energy in total energy capacity increase was 78 percent in 2022, it increased to 83 percent in 2023 (IRENA, 2023).

2.1.The Concept of Energy and its Resources

Energy, which is the main source of production, is an essential factor for rising the welfare standard of societies and is used in every area of daily life. The concept of energy is actually derived from the Ancient Greek word "energia" which means "to do or be something"; It was defined by the first modern physicists as the capacity or ability to do work (Ghosh & Prelas, 2009; Übelacker, 2005). Today, the energy needs of the developed or developing countries' economies are increasing the importance of the limited energy resources in the world.

Table 4

Energy Resources Classification

	Primary Resources	Secondary Sources
Non-renewables	• Coal (hard, brown) • Peat • Oil • Natural Gas • Additives and oxygenates • (partially) Municipal waste Nuclear Heat from chemical processes	• Coal products • Peat products • Refinery feedstocks • Oil products
Renewables	• Biofuels (except charcoal) • (partially) Municipal waste Heat from renewable sources	• Charcoal

Note. From (United Nations, 2018)

The sources that produce energy in various ways are called energy sources. Energy is converted from one type to another by proper methods, and different classification examples can be found according to the forms of obtaining, place of use and purposes. It is divided into two as renewable and non-renewable energy sources in accordance with their usage types, and as primary and secondary energy sources in accordance with their convertible properties. Primary energy is the state of energy that has not undergone any modification or transformation. Primary energy sources are coal, oil, natural gas, nuclear, biomass, hydraulic, wave-tide, wind, solar, biofuels and partially municipal waste. The type of energy acquired as a result of the transformation of primary energy, which cannot be used directly as it is found in nature, is secondary energy. Secondary energy sources are refinery feedstocks, charcoal, coal, peat, and oil products.

The classification of energy resources based on their consumable or renewability properties at the point of use is another category that is extensively utilized. According to this classification, energy resources that can remain the same in a natural cycle process, do not decrease and do not run out despite being used are called renewable energy resources. Wind, solar, hydro, geothermal, wave tide, biomass, hydrogen are the renewable energy sources. Non-renewable energy sources are those that, once consumed, cannot replenish

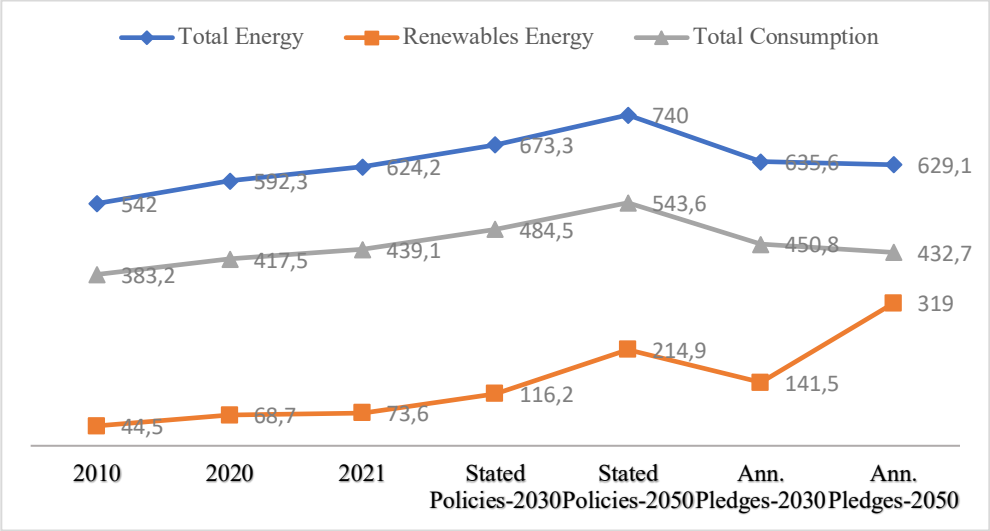
themselves. Coal, oil, natural gas, uranium and thorium are non-renewable energy sources. While the effects of non-renewable energy sources on global warming and environmental pollution cause major problems, renewable energy sources have little or no such effects. Therefore, although its use continues to increase today, its high cost is the biggest factor preventing its widespread use.

2.2.The General Review of Energy in the World

Energy has a global impact beyond its local and regional importance, in parallel with the increase in consumption with the world population and due to the unequal distribution of resources with its consumable feature. Moreover, although there have been various energy crises in the past, it has also emerged that energy can become a weapon with the Russia-Ukraine invasion that started in 2022. On the other hand, the close relationship between the concept of energy and the environment should not be overlooked. 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 its place at the top of the risk table every year. Therefore, duties and responsibilities related to the future state of energy gain importance.

Figure 6

Total & Renewables Energy Supply and Total Consumption in the World

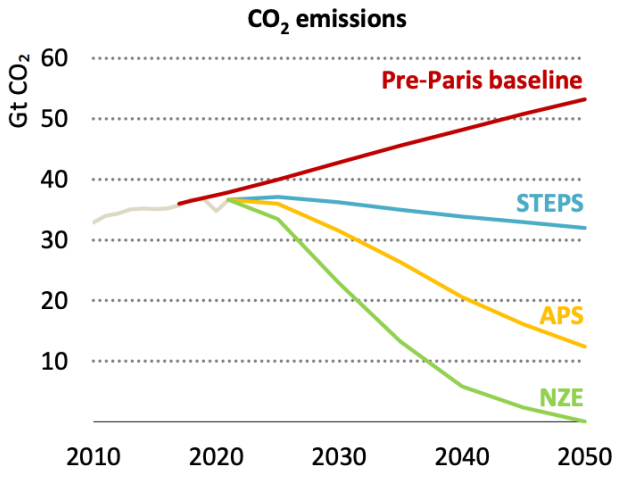


Note. From (IEA, 2022)

According to Figure 6 real values, the renewable energy supply which is included in the world energy supply and the total energy supply, has a general increase. On the other hand, although the world energy consumption has a similar increase, the energy supply is still at a level that can meet the consumption. Besides the actual values, the International Energy Agency also provides a supply and consumption forecast for responses to today's crisis, based on stated policies and announced commitments by countries. Accordingly, it is predicted that energy supply and consumption will increase linearly when the policies specified by the countries are implemented. Similarly, when the commitments announced in accordance with the Paris Climate Agreement are implemented, it is estimated that energy supply and consumption will not increase in 2030 compared to 2021, but will decrease in 2050. The interesting point in the graph is that when the commitments are followed, the share of renewable energy in the total energy supply is expected to double in 2030 and quadruple in 2050 compared to 2021 (IEA, 2022).

Figure 7

CO2 Emissions in the World according to Different Scenarios



Note. From (IEA, 2022)

A large part of the solid and gaseous residues, which are called carbon emissions, that occur with energy production are due to the use of fossil resources in the energy sector; the increase in carbon emission, which causes environmental pollution with its non-recyclable residues, is linear with the increase in energy consumption (Çoban & Şahnaz

Kılınç, 2015). CO2 emissions due to industrial and energy use increased by 1.9 Gt in 2021, making the largest annual increase ever, for a total of 36.6 Gt (IEA, 2022). If the Paris Agreement had not been put into effect or if the countries did not act in accordance with this policy, as seen in Figure 7, it is estimated that carbon emissions will increase gradually over the years and will exceed 50 Gt by 2050. On the other hand, it is predicted that carbon emissions will not increase and even decrease, if the policies specified by the countries, or the announced commitments, or net zero emission policy are implemented. It is expected that carbon emissions will decrease with the acceleration of the transition to clean energy sources such as solar, wind and hydroelectric energy instead of fossil fuels.

In the field of energy, global steps have been taken since the end of the 20th century to ensure unity and solidarity, moreover, to maintain this unity and to compare its outputs. The Energy Charter Agreement, which was signed in 1994 and entered into force in 1998, is one of the important agreements in the field, which has a unifying character between 53 parties from the West and East countries, influenced by the conditions of the period after the Cold War period. Contrary to determining an energy policy, it is aimed to protect foreign investments, to maintain equitable conditions in energy trade, to resolve conflicts between parties and to improve the level of energy efficiency (International Energy Charter, n.d.).

Studies on climate change, which is a concept related to energy, have concluded that greenhouse gas emissions are carried out by developed countries and that gas emissions per capita in developing countries are low. However, considering the finding that the greenhouse gas emissions will increase with the increase in the future social and economic developments of the developing countries, it has emerged that it is necessary to take measures at the global level to control and even reduce greenhouse gas emissions (Kennett, 2003). In 1994, 198 countries, which accepted the existence of a problem related to the environment and climate, adopted the United Nations Framework Convention on Climate Change (UNFCCC). The convention's principal goals are to reduce anthropogenic interference with the climate system and the buildup of greenhouse gases in the atmosphere.

The Kyoto Protocol, which was signed in 1997 as an additional international agreement to the UNFCCC and entered into force in 2005, requires countries, like its predecessor, to reduce the amount of carbon they emit to the atmosphere. According to the protocol, the number of greenhouse gases released into the atmosphere will be reduced by 5%, the legislation will be revised, alternative energy sources will be used to decrease the rate of methane and carbon dioxide in the atmosphere, clean energy sources will be used instead of fossil fuels, waste processes will be rearranged in high energy consuming enterprises, and moreover, countries that consume fuel and produce excess carbon will be taxed more (Dursun, 2011). However, the Kyoto Protocol has some controversial points. Some of the points emphasized by Kaya (2020) are that the initial membership number of the protocol is insufficient and that a limited number of party countries have greenhouse gas reduction necessity. Also, the Protocol left out the concerns of cost and adaptability to the negative effects of climate change. Finally, the fact that the sectors to be controlled are limited, the first obligation period has a short time span and the fact that the Protocol is ratified by the country's parliaments is very slow creates a cumulative effect on the achievement of the objectives of the protocol.

The Paris Climate Agreement, which was approved by 195 nations at the UNFCCC Conference of the Parties in December 2015, is the current agreement that significantly influences energy policies and is in effect. In short, the Paris Agreement is important as it is the first multinational agreement on climate change, including almost all world emissions. The agreement was opened for signature by UNFCCC party countries at a high-level ceremony held in New York on 22 April 2016. The agreement, to which Türkiye became a party by being signed in 2016, was approved by the Turkish Grand National Assembly on October 6, 2021; issued in the Official Gazette on October 7, 2021; and finally, it entered into force on 10 November 2021 (Anadolu Agency, 2021).

For the post-2050 period, it is aimed to reach “global net zero emissions”, where the amount of greenhouse gas emitted is equal to the amount emitted from the atmosphere, primarily in developed countries. This is also described as climate neutral or carbon neutral (Türkeş, 2021). The Paris Agreement is important because it has a level of influence that will force many countries to take decisions and implement them.

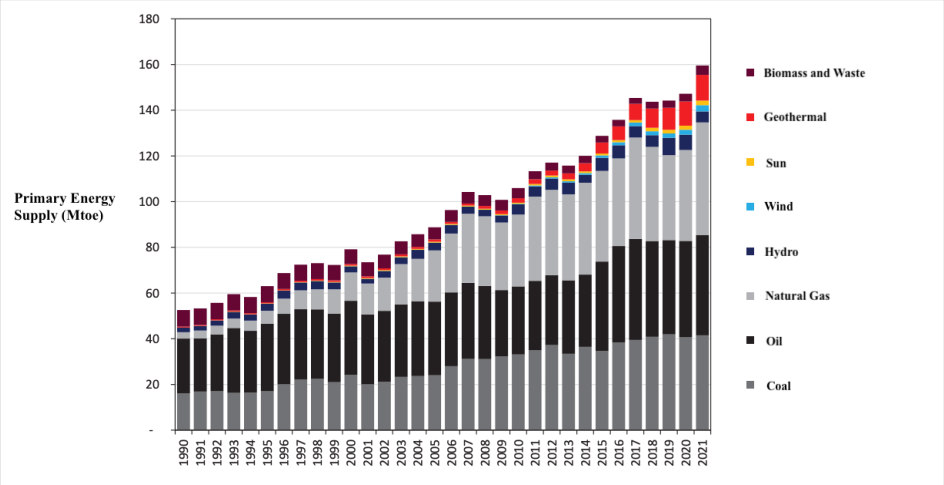
On this occasion, attention can be drawn to the energy policies followed by some countries with significant energy consumption in the world. First, by implementing two policies, The Inflation Reduction Act and the Bipartisan Infrastructure Act, the United States aims to increase renewable energy production and reduce coal consumption by three quarters by 2030 (IEA, 2022). Japan, on the other hand, foresees a one percent annual reduction in energy supply from October 2021 to 2030, according to its Strategic Energy Plan. The goal of China, which has one of the largest energy demands in the world, is to be carbon neutral by 2060. In India, which will have the world's largest population in 2025, it aims to strengthen itself in renewable energy until 2030, while targeting 2070 for net zero emissions.

2.3.The General Review of Energy in Türkiye

Türkiye is on its way to becoming a country that is gaining more and more importance in regional and global energy markets. At the same time, it is among the countries where energy supply and demand are increasing rapidly with the reality of its developing economy, increasing population and advancing technological infrastructure. In addition, it has strategic importance in terms of its proximity to global energy markets due to its location. On the other hand, Türkiye’s foreign dependency, especially in the supply of fossil fuels, is one of its important disadvantages in the field of energy. However, the oil and natural gas discoveries in the recent past have the potential to contribute to reducing Türkiye’s dependence on foreign sources, and studies on this subject continue.

Figure 8

Primary Energy Demand Development between 1990-2021 (Mtoe)

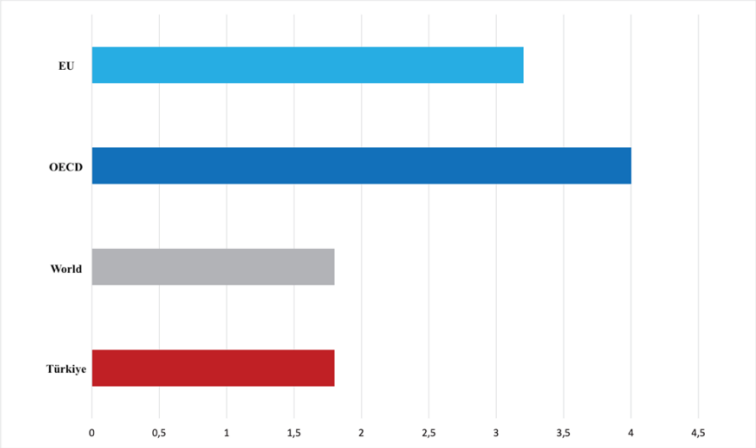


Note. From (Sabancı University, 2022)

Türkiye's energy sector, which is equivalent to almost 1% of both the world's population and the world's global economy, constitutes almost 1% of the world's total energy consumption with its primary energy supply of approximately 150 million tons of mtoe (Sabancı University, 2022). Between 1990 and 2021, demand for primary energy development increased linearly; the declines experienced in some years were not sudden and deep. The energy types with the highest demand are coal, oil and natural gas. Biomass and waste energy demand has decreased over the years. On the other hand, as of 2015, it is seen that there are serious increases in the supply of geothermal, solar and wind energies.

Figure 9

Primary Energy Consumption Per Capita in 2021 (Mtoe)

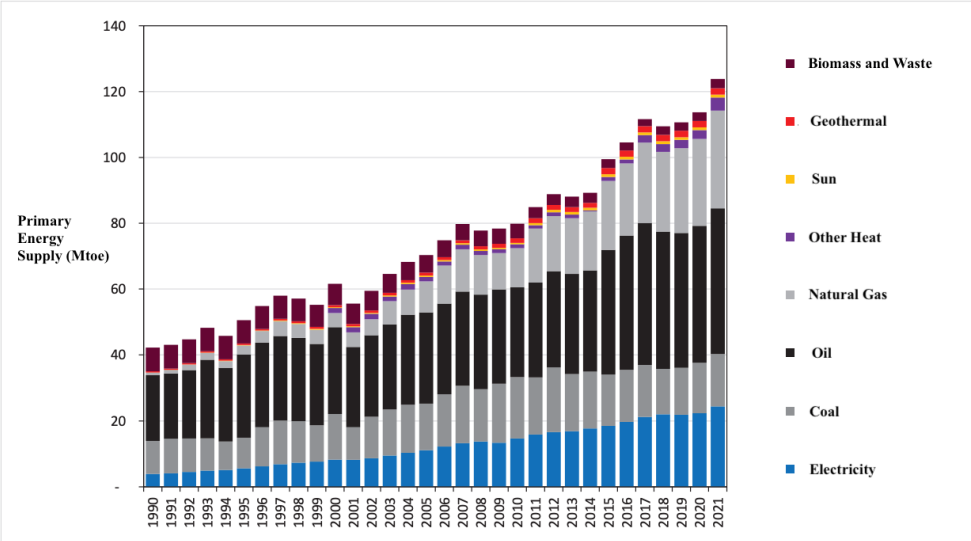


Note. From (Sabancı University, 2022)

The increase in energy demand is related to the increase in population, industrialization and distribution of sectoral structure, development of technology and urbanization factors. Türkiye's primary energy consumption in 2021 is close to the world average. On the other hand, it is below the average of European Union (EU) and Organization for Economic Co-operation and Development (OECD) countries. Similarly, when the data for 2021 are examined, the consumption of industry and its branches has an important place in energy consumption. The main metal industry consumes the most energy with a consumption of 26 percent in the industry. It is followed by the manufacturing branch of mineral products such as glass, ceramics and cement with a consumption share of 16 percent and the manufacturing of chemical products with a consumption share of 12 percent. An important part of energy consumption is related to daily consumption. About one-fifth of total final energy consumption is made by the trade and services sector, and about a quarter by housing (ETKB, 2022).

Figure 10

Distribution of Final Energy Demand by Resources between 1990-2021 (Mtoe)

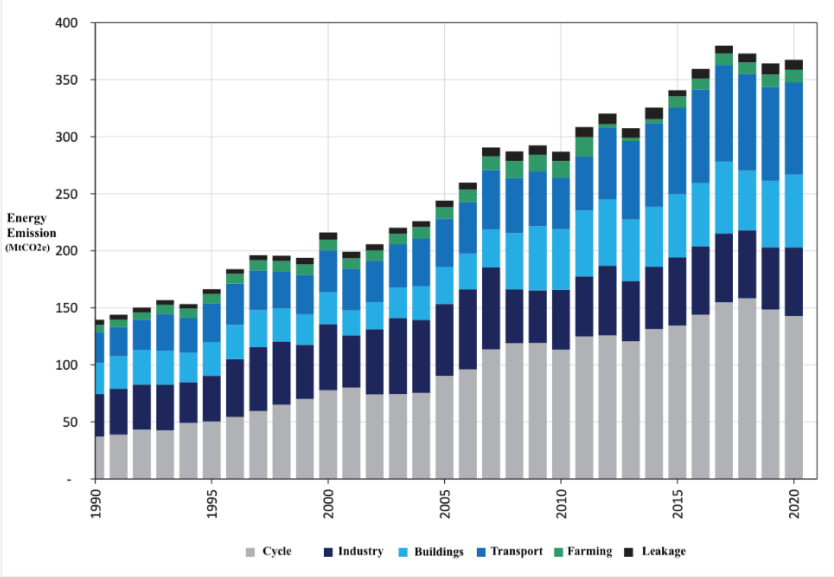


Note. From (Sabancı University, 2022)

The changes in Türkiye's final energy demand between 1990 and 2021 are shown in figure 10. The most important change is between coal and natural gas. Over the years, with the rising in the use of natural gas, especially in home heating, coal consumption in final consumption has decreased. Consumption of natural gas increased from 2 percent in 1990 to 23 percent; the consumption of coal decreased from 24 percent to 13 percent in 1990 (Sabancı University, 2022). Consumption of electricity and oil continued to increase linearly; It is observed that renewable energy consumption has increased in recent years.

Figure 11

Development of Greenhouse Gas Emission Inventory Originating from the Energy Sector between 1990-2020 (MtCO2e)



Note. From (Sabancı University, 2022)

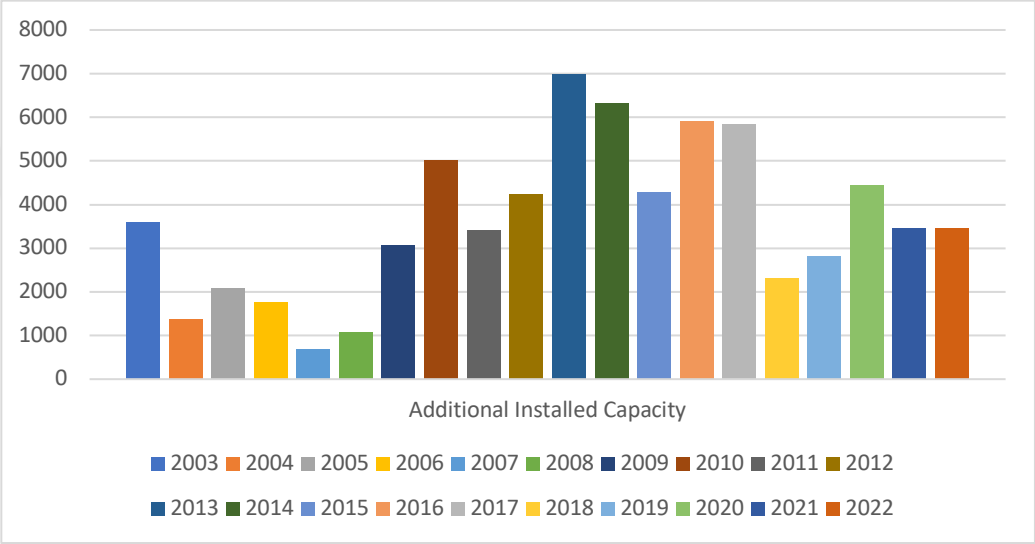
The ratio of domestic production to supply in primary energy is 40% in coal, 10% in oil and 1% in natural gas (Sabancı University, 2022). Although there is no equal distribution of energy resources in the world, the orientation to renewable resources is an alternative option both in terms of domestic production employment and environmental responsibility. When this alternative is preferred, foreign dependency will decrease and it will be easier to control the changes in the prices of imported fossil fuels, which are reflected on the consumer. While the change in energy prices in October 2022 for Türkiye compared to the same period of the previous year is 137 percent, it has the highest increase rate among OECD countries (IEA, 2022:10).

In addition to the economic consequences of the use of fossil resources, environmental effects are also observed. The increase in fossil-based energy consumption also causes an increase in emissions. In 1990, 139,6 million tons of CO2e emissions increased by 163 percent by 2020 and increased to 367.6 million tons of CO2e (Sabancı University, 2022). However, it is essential to take steps towards the net-zero emission

target of 2053, which Türkiye has set in accordance with the Paris Climate Agreement, of which it has become a part in 2021. While the conversion sector has the highest share in energy emissions, it is followed by the transportation sector, industry sector and buildings.

Figure 12

Energy Investments in terms of Additional Installed Capacity between 2003-2022 (MW)

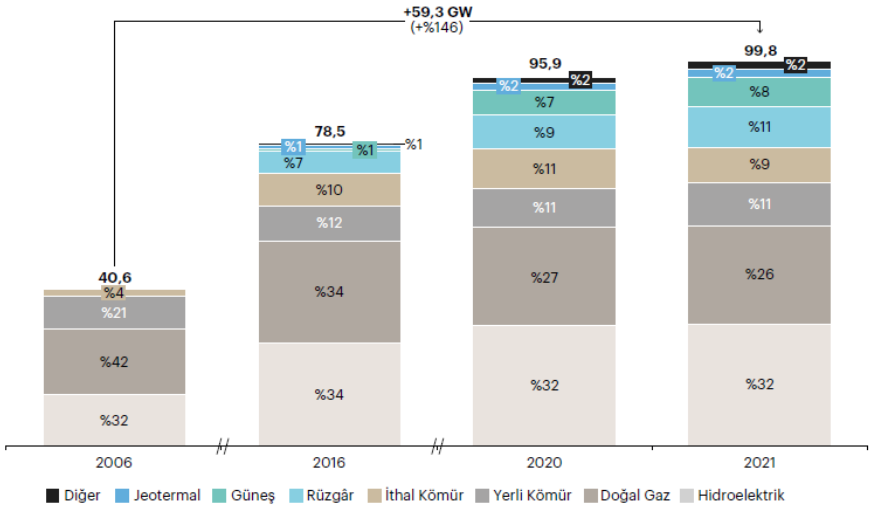


Note. From (ETKB, n.d.)

Energy investments are important for a country to be self-sufficient in terms of production and to reduce foreign dependency. According to figure 12, which shows the additional power capacities added to improve the existing power units, the evolution of power capacities is not linear but shows fluctuating variation. The years with the highest level of additional power investment are approximately between 2013 and 2017. On the other hand, it is seen that the years with the lowest investment are between 2004 and 2008. According to the 'Why invest in Türkiye?' booklet published by the Republic of Türkiye Investment Office in March 2022, there are ten different investment reasons presented to foreign investors. Strong economy, effective domestic market, strategic location due to proximity to important markets, suitable demographic structure, educated workforce, ongoing reform process, incentives and the existence of a favorable environment for research and development studies are shown among these reasons (Invest.gov.tr, 2022).

Figure 13

Comparative installed capacity development in Turkey in 2006, 2016, 2022-2021



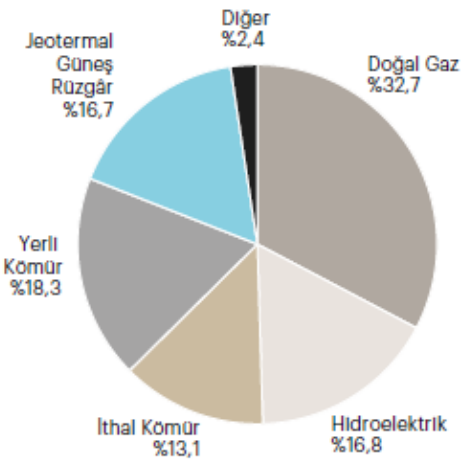
Note. From (Kearney, 2022:11)

Electric energy, one of Türkiye's important energy instruments, as of the end of 2021; it has the fifth largest area in Europe with an electrical installed power capacity of approximately 100 gjgawatt (Kearney, 2022:4). Total installed power capacity has increased by 27 percent in the last 5 years. At the same time, 54 percent of the installed power in the country is made up of renewable resources. While there was a 51 percent increase in hydraulic, solar, wind and geothermal capacity between 2016 and 2021, the highest average increase rate was realized in solar energy-based investments with 57 percent. At the same time, when compared to 2016, the share of coal decreased by 2 points and the share of natural gas by 8 points compared to 2016.

Figure 14

Gross Electricity Generation Distribution 2021 (MWh)

In terms of electricity generation, Türkiye is the third largest market in Europe with a production of 331 billion kilowatts (kWh) (Kearney, 2022:4). Electricity production has increased by 9 percent compared to 2020; While 33 percent of the gross electricity production is obtained from natural gas power plants, coal power plants take the second place with a share of 31 percent. 17 percent of the gross electricity production was obtained from hydraulic, 17 percent of geothermal, solar and wind, and the remaining 2 percent from various sources such as biomass, fuel oil and diesel oil. In other words, about 64 percent of electricity production consists of fossil fuels and about 33 percent is renewable energy.



Note. From (Kearney, 2022:14)

A concept as important as resource wealth, installed power development, production and consumption demand in energy is related to how energy is used. Energy efficiency is simply the reduction of energy consumption per unit of service or product (Doğan & Yılankırkan, 2015). However, while ensuring productivity increases the quality of life and service in buildings, it should not lead to a decrease in production quality and amount of production in industrial enterprises. Based on this, the Energy Efficiency Law numbered 5627 was issued in the Official Gazette on April 18, 2007, and entered into force on May 2, with reference to the effective use of energy, the prevention of energy waste, the reduction of the burden of energy costs on the economy and the protection of the environment (Official Gazette 5627, 2007).

Various regulations have been published since the law came into force. As of 2017, the National Energy Efficiency Action Plan was put into practice between the years 2017 and 2023. Within the scope of the plan to be applied between 2017 and 2023, it is aimed to decrease Türkiye's primary energy consumption by 14% in 2023 with 55 actions defined in 6 categories, including buildings and energy, services, industry and technology, transportation, agriculture and horizontal issues (ETKB, n.d.). According to the statement of Minister of Energy and Natural Resources Fatih Sönmez regarding the plan process in

action at the Eurasia Cogeneration Conference, 4.8 billion dollars was invested between 2017 and 2020, and accordingly, 1.2 billion dollars was saved with 3.19 million tons of oil equivalent energy (Anadolu Agency, 2021).

2.4.Energy Policy and International Organizations

Energy policy essentially consists of the institutional framework where decisions about technology, the economy, and energy are made; also, it comprises actions for managing supply and demand in short-term and long-term planning (Bayraç, 1999). According to the International Energy Agency, the key components of policy planning consist of identifying the key need, designing the process, implementing the policy, monitoring the process, and reviewing when necessary.

According to the policy of the Ministry of Foreign Affairs of the Republic of Türkiye, the fundamental elements constituting the international dimension of Türkiye's energy strategy are as follows.

- To provide route and resource diversification in the supply of oil and natural gas, based on the increase in demand and the reality of energy imports,
- Contributing to global and regional energy security,
- To be a regional trade center in energy,
- Taking into account the social and environmental effects at every stage of the energy chain and not ignoring the sustainability conditions,
- Rising the share of domestic and renewable energy in electricity generation,
- Utilizing nuclear energy

There are also plans that Türkiye follows in line with its existing energy strategy. Within the framework of harmonization with the EU, the first National Energy Efficiency Action Plan (NEEAP) covering the years 2017 and 2023 was published in the Official Gazette numbered 30289 on January 2, 2018 (OG, 02.01.2018-30289). Within the scope of the plan, it is aimed to reduce energy costs, ensure energy supply security, reduce the risks arising from foreign dependency, and protect the environment. Within the scope of NEEAP, it is aimed to decrease primary energy consumption by 14% in 2023 with 55 actions to be implemented between 2017 and 2023 on the topics of buildings and services,

transportation, energy, industry and technology, agriculture and horizontal. According to the 2017 and 2020 Year Development Report, a total investment of 4.783 million USD was made between 2017 and 2020; on the other hand, 3,190 mteo of energy savings were achieved, which corresponds to a monetary equivalent of 1,117 million USD (T.C. Enerji ve Tabii Kaynaklar Bakanlığı, 2021).

Another plan that is being implemented is the Green Reconciliation Action Plan published in the Official Gazette numbered 31543 on 16 July 2021 (OG, 16.07.2021-31543). The basis of this plan is based on the European Green Agreement announced by the EU on 11 December 2019. With this agreement, the EU aims to be the first climate-neutral continent in the world by 2050; at the same time, it foresees that It will implement a new growth plan that calls for changing its industry and reshaping all of its policies around climate change (T.C. Ticaret Bakanlığı, n.d.). Policies in other countries have also gained momentum in the field of combating climate change. In 2020, South Korea, Japan and China also announced their targets for the green transformation of their economies; In addition, countries such as Sweden, Norway, Canada, Chile, and South Africa are among the countries that have declared their net zero emission targets.

Since energy policies have a dynamic structure that is affected by both time and environmental conditions, as well as national and international environment, it is not always easy to achieve unity and solidarity. Parallel to this, a number of institutions and organizations such as the “International Energy Agency (IEA), the International Atomic Energy Agency (IAEA), and the International Renewable Energy Agency (IRENA) have been established in order to act in line with common goals and objectives. Türkiye has also agency and association memberships operating in this field.

Firstly, Türkiye is one of the founding members of the IEA. The idea of establishing the IEA emerged as a result of the 1973-1974 oil crisis. The majority of OECD members formed a framework agreement, called the International Energy Agency, in 1974, which brought binding provisions to the party countries, in order to reduce their dependence on oil and to be prepared for sudden interruptions in oil supply. In addition to its main objective of oil supply security, the agency also conducts studies in energy analysis and statistics, energy saving and technology and innovation. Within the scope of country

energy policy studies, which is one of the activities of the agency, it publishes a report approximately every 5 years. The latest version of this study, which has been conducted for Türkiye since 2001, has been published in 2021. The report contains information on energy policies and the overall energy security situation; moreover, it makes policy recommendations. However, it is a recommendation and not binding. Fatih Birol is the chief economist and Global Energy Economy Director of the agency, who served between 1995 and 2015, and the Executive Director since 2015.

The IAEA is an organization with 176 members, founded in 1957 on the basis of scientific and technical cooperation in the peaceful use of nuclear technology. In line with the nuclear energy policy in Türkiye, which became a part of the community in 1957, the Turkish Atomic Energy Agency was established on September 4, 1956 in the Official Gazette numbered 9398. As of 2020, the duties of the relevant institution have been taken over by the Turkish Energy, Nuclear and Mining Research Institute.

Finally, although the foundation of the IRENA dates back to the 1981 United Nations Conference, it was officially established on 26 January 2009 in Bonn, Germany. The institution, which has 168 members, is based on international cooperation. Moreover, it supports energy transition countries and provides data and analysis on many topics such as technology, finance and investment (IRENA; n.d.).

2.5.Energy Sector and Companies

Despite significant regional changes, energy consumption in the world has increased continuously since the 1950s in parallel with economic growth and population growth; however, with the oil crisis in the 1970s and especially the high energy prices in 1979, the increase in consumption started to slow down. In Türkiye, which is one of the countries affected by the crisis, investments have stopped to a large extent and difficulties have been experienced in foreign payments; and even the sectoral growth targets envisaged in the 4th Five-Year Development Plan implemented were far behind (Mutluer, 1990). For this reason, the Oil Crisis has revealed the importance of energy resources and foreign dependency both in the world and in Türkiye and has pushed countries to make significant changes in their energy models.

Countries rich in energy resources have primarily sought to increase their investments in production; and benefiting from renewable energy sources according to the conditions of the country has been prioritized. In Türkiye, in the energy sector, which was mostly owned by public enterprises until the 2000s, with the 2000s, encouraging private sector investments, increasing foreign capital inflows, starting to use renewable energy sources, increasing resource diversity in primary energy sources and giving importance to energy efficiency. Such steps have been taken (Özkan, 2010).

Table 5

Top 10 Global and Turkey's Energy Company Rankings

No.	Energy Companies in the World	2022 Profits * $	No.	Energy Companies in Türkiye	2021 Profits * TL
1	Saudi Arabian Oil Co	105.303.000.000	1	Enerji Piyasaları İşletme A.Ş.	167.126.287.343
2	Petróleo Brasileiro SA - Petrobras	20.148.000.000	2	Türkiye Petrol Rafineleri A.Ş.	150.971.584.000
3	PJSC LUKOIL	13.911.000.000	3	Petrol Ofisi A.Ş.	67.010.981.000
4	Exxon Mobil Corp	23.040.000.000	4	Opet Petrolcülük A.Ş.	56.007.463.000
5	Public JSC Gazprom	37.455.000.000	5	Star Rafineri A.Ş.	54.562.977.491
6	TotalEnergies SE	16.032.000.000	6	Socar Turkey Petrol Tic.A.Ş.	53.599.532.886
7	Equinor ASA	8.563.000.000	7	Enerjisa Enerji Üretim A.Ş.	30.547.681.000
8	Chevron Corp	15.625.000.000	8	Petkim Petrokimya Holding A.Ş.	28.715.657.000
9	Shell plc	20.101.000.000	9	EÜAŞ Elektrik Üretim A.Ş.	26.884.296.291
10	ConocoPhillips	8.079.000.000	10	Türkiye Elektrik İletim A.Ş.	17.829.803.654

Note. From (S&P Global, n.d. , Fortune Türkiye, n.d.)

Table 5 includes 10 current energy sector companies based on annual profitability, both in the world and in the Turkish sector. The country with the most profitable energy companies in the world is the United States of America with three companies, followed by Russia with two companies. The list also includes companies from Saudi Arabia, Brazil, France, Norway and the United Kingdom, which are also located on different continents.

All of the companies operate in oil and gas operations. Equinor ASA, a Norwegian energy company among them, also stands out with its investments in renewable energy.

On the Turkish side, eight of the ten companies on the list are private sector companies and only two are public enterprises. In this case, it can be said that the list of energy companies and the policy of encouraging private sector investments and increasing foreign capital inflows implemented in Türkiye are compatible. Public enterprise energy companies EÜAŞ Elektrik Üretim A.Ş. and Türkiye Electricity Transmission A.Ş. Energy companies in the private sector are also divided into two, either based in Türkiye or based abroad. Private Turkish energy companies are Enerji Piyasaları İşletme A.Ş., Türkiye Petrol Rafineleri A.Ş., and Opet Petrolcülük A.Ş. Foreign-based energy companies are Netherlands-based Petrol Ofisi A.Ş, Azerbaijan-based Star Rafineri A.Ş., Socar Turkey Petrol Tic. A.Ş and Petkim Petrokimya Holding A.Ş. In other words, Azerbaijan has an important place among the most profitable energy companies in Türkiye. Finally, the shareholding structure of Enerjisa Enerji Üretim A.Ş., which differs from other companies in the list, is half and half, based in Türkiye and Germany.

The energy sector is frequently affected by current developments in the world or in a country in terms of both investment and consumption. The Global Covid-19 Pandemic, which started in 2020 and was effective until 2022, caused a decrease in energy consumption in the field of transportation and industry, along with social distance and closure practices, and an increase in domestic consumption. Similarly, the decrease in demand in Türkiye, which was affected similarly to other countries during the pandemic period, led to a decline in electricity wholesale prices (Deloitte, 2020). Right after the pandemic, with the Russian invasion on Ukraine on February 24, 2022, the world markets - in the words of the IEA - were in the middle of the global energy crisis for the first time. This move by Russia, one of the world's largest importers of fossil fuels, caused the prices of natural gas, oil and coal to rise. Especially when European countries and many other countries' sanction practices were also a part of the process, this situation was reflected to consumers as high energy bills and supply shortages. According to IEA's World Energy Outlook 2022 report, it is predicted that households' access to electricity may decrease in the near future and firewood may be preferred for cooking (IEA, 2022).

Natural events such as earthquakes, landslides and floods are also closely related to the energy sector. It can be said that one of the natural disasters affecting the sector the most is the 2023 Kahramanmaraş earthquake. On February 6-7, 2023, two earthquakes with a magnitude greater than 7 occurred in Kahramanmaraş and 10 provinces were affected by this situation. According to the "2023 Kahramanmaraş and Hatay Earthquakes Report" (2023:73), the Presidency of the Republic of Türkiye Strategy and Budget Department, earthquakes caused approximately 11.2 billion Turkish Liras of damage in the sector. It has been determined that 20 percent of this damage belongs to the public sector and 80 percent to private sector energy companies. According to the report, it is aimed to guide investors with special incentives to be given in these 11 cities, where solar and wind energy potential is high; and thus, it is one of the long-term improvement policies that can encourage the development of the region.

The "Global Energy Perspective 2022" report published by the management consultancy firm McKinsey & Company makes predictions about the future of the industry. It is predicted that the global demand for oil will peak in the next ten years and then decline. This is due to the prediction that the transition to low-carbon energy systems will stand out as a strong and long-term trend. In the report, which emphasizes the goal of achieving net zero carbon emissions in the coming years, a total of 64 countries that lead the Climate Change Conference held by the United Nations in November 2021 and cause more than 89 percent of global emissions, draw attention to the need for the transformation to accelerate (Fortune Turkey, 2022).

CHAPTER THREE

LITERATURE REVIEW ON THE DETERMINANTS OF CAPITAL STRUCTURE

When the literature is examined, it is seen that the concept of capital structure is one of the most discussed concepts in the area of accounting and finance. Studies started with the article titled 'The Cost of Capital, Corporation Finance and the Theory of Investment' published by Modigliani and Miller in 1958. Studies on the concept of capital structure have led to the determination of the factors affecting the capital structure over time. In parallel, an attempt was made to reach an agreement on the variability of these factors; moreover, the conflicts have helped enrich the literature in the field of capital structure. The fact that a consensus could not be reached between the studies has led to the formation of different ideas and theories and to the continuation of various studies today.

Among the most studied topics in the literature are the determination of the variables that affect the choice of capital structure, the relationship between capital structure and firm value, and the compatibility of capital structures of enterprises with capital structure theories. In this part of the study, the practices that examine the determinants of capital structure in Türkiye and in the world have been tried to be summarized. The chapter will examine the studies on the energy sector and the studies on other sectors under two different headings.

3.1.Literature Review in Various Sectors by Country

Studies examining the determinants of capital structure in different sectors are summarized in this section. Amid the studies examining the concept, apart from the energy sector; there are studies in manufacturing, service, automotive, food, banking, insurance, tourism, airline, advanced technology, forestry, pharmaceutical industry, leather-textile, and production sector enterprises. In this part of the study, the capital structure studies carried out in different countries will be emphasized, and then the focus will be on sectoral studies.

Guha-Khasnobis (2002) analyzed the financial data of 697 Indian companies obtained from a data company between 1990 and 1998 with dynamic panel data method in

order to examine their basic capital structure preferences. Unlike other studies, it is aimed to reach the optimal capital structure in this study. Asset structure has progressed similarly to its predecessors as a company analysis method based on six different variables such as firm size, NDTS, dividend decision, profitability and short-term financial distress risk; and focused on the impact of each component. It has been concluded that companies prefer short-term borrowing or internal resources rather than long-term borrowing, and it is concluded that this situation is compatible with pecking order theory. On the other hand, there was no significant result on the effect of dividend and NDTS variables.

Chen (2004) focused on the impact of capital structure components of 88 Chinese public companies between 1995 and 2000. In the study, leverage and long-term leverage were used as two dependent variables, while size, profitability, growth, volatility, tangibility, and NDTS were analyzed as independent variables. Analysis result show that a positive relationship was determined between growth and tangibility and leverage. It was concluded that Chinese companies that appeared to prefer short-term borrowing were partly explained by the pecking-order theory.

Mazur (2007) analyzes the compatibility of capital structure variables with static trade-off and pecking-order theory of a total of 238 Polish companies from 13 different sectors traded on the Warsaw Stock Exchange between 2000 and 2004. The dependent variable of the study consists of dept ratio and its independent variables occur assets structure, profitability, liquidity, firm size, growth opportunities, product uniqueness, earnings volatility, NDTS, the effective tax rate, and dividend policy. The findings indicate that more successful companies and those with strong liquidity ratios prefer to finance their operations internally. The pecking order will be indicated by the negative relation between the size and assets structure variables and the positive coefficient for the uniqueness variable.

Bayrakdaroğlu, Ege and Yazıcı (2013) analyzes the effect of company and country-based components on capital structure and their connection with capital structure theories, based on the financial data of 242 companies in the Istanbul Stock Exchange between 2000-2009. According to the analysis findings, it has been determined that large companies have higher debt ratios and this situation is used to take advantage of the tax shield,

especially in periods when tax rates are high. On the other hand, it is one of the findings that companies turn to equity financing in the period of high inflation and growth. Finally, the study argues that Turkish firms are compatible with the ideas of Pecking order theory.

Çekrezi (2013) studies the factors affecting the capital structure components of 53 non-financial companies operating in Albania between 2008 and 2011. Dependent variable of the study is debt to equity ratio, and independent variables are tangibility, profitability, liquidity, size, NDTS, business risk, gross domestic products growth rate, interest rate and inflation rate. In addition to the factors consisting of the firm's financials, the effect of macroeconomic factors is also observed. According to analysis results, leverage is significantly influenced by tangibleness, liquidity, profitability, size, and risk.

In their study, Enakirerhi and Chijuka (2016) will determine the capital structure components of 100 British companies traded in the London Stock Exchange Index between 2003 and 2012, and in addition to this, the relation between the determined variables and the debt levels of the firms will make sense, and finally, will focus on capital structure theories. In addition to literature studies, which generally focus on pecking order and trade off theories, this study also deals with agency cost theory. According to the analysis findings, while the profitability variable and capital structure were negative, positive results were obtained with the size and tax shield variables. According to the results, it is stated that all three theories are supported, and in parallel with the positive result of the tax shield concept, which has emerged to explain the increase in expenses in the literature and the decrease in income in this direction, the study suggests that companies increase their financing intake.

In their study, Sayılgan, Karabacak and Küçükkocaoğlu (2006) analyze the capital structure components of 123 manufacturing companies included in the Istanbul Stock Exchange between 1993 and 2002. In the study, the dependent component is debt to equity and the independent variables are profitability, size, growth opportunities, tangibility, and NDTS. Analysis results show that leverage ratio variables show a positive correlation with size and growth opportunities of total assets; however, profitability, NDTS, and tangibility show a negative correlation with debt level.

Karadeniz, Kandir, Balcilar, and Onal (2008) analyzed the variables that affect the capital structure decisions of five companies traded on the Istanbul Stock Exchange and also involved in the Hotel Management industry between 1994 and 2006, using dynamic panel data analysis method. Tax rates, return on assets, tangibility of assets, free cash flow, growth opportunities, NDTS, firm size, and net commercial credit position are among the variables examined in the study. According to the results obtained from the study, it was discovered that the tangibility of assets, tax rates, and return on assets variables had a negative relation with the capital structure, while the other variables did not. In terms of theories, although the study reaches partial similarities with pecking-order theory, it has concluded that completely similar results cannot be achieved with any theory.

Öztürk and Şahin (2013) analyzed the capital structure determinants of Turkish sports firms between 2002 and 2011 in their study. The study, which has a limited sample of 4 companies, consists of Galatasaray, Beşiktaş, Fenerbahçe and Trabzonspor Incorporated Companies. The data set created as a quarterly contains debt to equity ratio as a dependent variable and return on assets, size, tangibility and growth as an independent variable. Analysis result show that the dependent variable of profitability and growth variables is positive; it has been determined that the size variable affects the dependent variable negatively.

In Acaravcı's study (2015), the capital structure components of 79 manufacturing companies traded in the stock exchange between 1993 and 2000, especially firm size and sectoral variables, are measured by panel data method. Although it was determined that there was a relationship between different variables such as growth opportunities, size, profitability, tangibility and leverage, and capital structure, no significant relationship was found only in the non-tax debt shield variable. According to the findings obtained in the study, which compared the financial hierarchy theory with the balancing theory and the effects of the variables, the growth opportunity variable supported the trade-off theory; size, profitability and tangibility support the ideas of pecking-order theory. In addition, the study analyzed the population as two different samples, small and large firms. As a result of this analysis, no significant difference was found between the two samples.

Alipour et al. (2015) tested the capital structure preferences of Iranian companies by making 1918 observations on Iranian non-financial companies ranging from 327 to 412 between 2003 and 2007. As a result of the findings, they found that the most important financial source of Iranian companies is short-term debt rather than long-term debt, and this tendency is more than the G7 and EU countries.

In their study, Gharaibeh and AL-Tahat (2020) analyze the capital structure components that affect 45 Jordanian service companies traded on the Amman stock exchange between 2014 and 2018. Debt ratio is used as the dependent variable and size, tangibility, growth, profitability, NDTS, business risk, and institutional ownership as independent variables. According to the analysis findings, two of the five components have a negative impact on profitability and business risk capital structure, and accordingly, Jordan service companies generally go for domestic borrowing or the probability of borrowing increases as their size increases.

Işık and Ersoy (2021) analyze the relation between seven different independent variables by determining the leverage ratio, which is the ratio of short-term and long-term debts to total assets, as the dependent variable, with the data obtained from 143 Turkish manufacturing companies traded in Borsa Istanbul between 2010 and 2019. The independent variables are profitability, firm size, liquidity, tangibility, NDTS, growth opportunities, and volatility. There was a positive relationship between the size, growth opportunities, and volatility variables and the dependent variables. It has been determined that debt and mostly short-term debt are used as a source of financing in the Turkish manufacturing sector, and this behavior is compatible with Pecking order theory, one of the capital structure theories. On the other hand, neither theory can explain the model of companies that follow long-term debt according to the leverage regression of companies.

Yang et al. (2022) presents a comparative study that analyzes the capital structure components between 2000 and 2017 by considering the Korean and Greek shipping industry. As the operating method follows the owner model of the Greek shipping industry and the operator model of the Korean shipping industry, it is a matter of curiosity what the consequences will be in terms of capital structure in the two countries that operate oppositely. In the sample of 60 Korean and 32 Greek companies, debt ratio is used as

dependent variable and growth, tangibility, size and profitability are used as independent variables. As the analysis shows, leverage has a positive correlation with tangibility and growth in Greek and Korean shipping firms. On the other hand, there is a negative correlation between leverage and scale, also profitability. Results are additionally compatible with the pecking order theory.

In their study, Stoiljkovi´c et al. (2023) aimed to define the firm-based components of capital structure on the manufacturing sector firms of the Republic of Serbia between 2006 and 2020. Panel data analysis was applied. Also, the dependent variable was determined to be short-term, long-term and total leverage. Independent variables are identified as profitability, size, tangibility, growth opportunities and risk. According to the study's findings, compared to short-term and overall leverage, profitability, size, and tangibility of assets have an adverse impact on long-term leverage. In other words, the conduct of businesses in the Republic of Serbia while using long-term leverage is consistent with the predictions of the trade-off theory, whereas when using short-term and total leverage, the pecking order theory can be used to explain business behavior.

Uzun (2023) analyzes capital structure components on 32 metal sector companies traded in Borsa Istanbul between 2011 and 2020. Within the scope of the study, total leverage ratio was used as the dependent variable, while size, profitability, asset structure, NDTS, gross domestic product growth rate and inflation rate were included as independent variables. It has been determined that there is a positive relationship between firm size, NDTS, inflation and leverage. Findings show that metal sector companies act in parallel the trade-off theory as the size and inflation rate variables, and also, in parallel the pecking order theory as the NDTS variable.

3.2.Literature Review in the Energy Sector

In the field of capital structure, publicly traded companies are mostly analyzed regardless of the sector. When sectoral studies are taken as a basis, studies are mostly carried out in the manufacturing and service sectors. The energy sector, which will be examined within the scope of this thesis, has few studies. Related studies in the literature are summarized below.

Table 6

Independent Variables Analyzed in Literature on the Energy Sector

	CVA	Size	Profit	Growth	NDTS	TANG	LIQ	Ass.Str.	Turn	Debt	Tax Rate	Age	Dserv	Own
Saeed (2007)	X	X	X	X	X									
Ghani & Bukhari (2010)		X	X	X		X								
Ayyıldız (2013)			X				X	X	X					
Zhang & others (2018)		X	X			X					X			
Chakrabarti & Chakrabarti (2018)		X	X	X	X	X	X		X			X	X	
Ahmed&Sabah (2020)		X	X	X		X								
Köse (2020)		X	X	X					X	X				
Nga&Long (2020)		X	X	X	X	X	X					X		X
Jaworski&Czerwonka (2021)		X	X	X	X	X	X							

Note. (*Variables related to financials have been taken into account; macroeconomic and sectoral variables are left out of the table.)

In master's thesis, Saeed (2007) analyzes whether 22 different energy companies traded on the Karachi stock exchange between 2001 and 2005 followed the ideas of three different capital structure theories - Static trade-off theory, Pecking-order theory and Agency cost theory. Leverage is used as dependent variable, collateralizable value of assets (CVA), size, growth, profit, and non-debt tax shields (NDTS) are used as independent variables. Analysis result show that only size, growth and NDTS independent variables had a positive relationship with financial leverage. In terms of debt financing, it is concluded that the only theory that supports the analysis is Pecking order theory. At the same time, leverage ratios increase as Pakistani energy companies increase in size; accordingly, the analysis is compatible with static trade-off theory and agency cost theory. Similarly, only pecking-order theory is similar to the result of increasing debt use as firms' growth rate increases. Another important finding is that Pakistani energy companies do not make their investments with debt; in this respect, while the pecking-order theory is supported, the opposite findings of the static trade-off theory have been produced. As a result, it has been found that they are partially acceptable.

In their study, Ghani and Bukhari (2010) tried to analyze the relationship between capital structure components and capital structure theories of 20 energy companies traded

in Karachi stock exchange in Pakistan between 2004 and 2008. Leverage was used as the dependent variable and growth, size, profitability, and tangibility as the independent variable in the study. Among the components analyzed according to the static trade-off and pecking-order theories, tangibility and size are compatible with the static trade-off theory, while the profitability and growth components are similar to the advocating ideas of the pecking-order theory. It is claimed that in Pakistan, where capital structure preferences are evenly distributed, larger firms find financing more easily, and similarly, larger firms have less risk of bankruptcy.

Ayyıldız (2013) presents a comparative analysis between the Turkish and European energy sectors, as well as determining the variables of the capital structure of the companies in the Turkish energy sector. The study, which was analyzed with the panel data method, focuses on the Turkish energy sector between 1996 and 2011, and the comparative analysis between Türkiye and Europe focuses on the years between 2009 and 2012. The study has a data set consisting of debt ratio as dependent variable and asset structure, profit, liquidity and turnover as independent variables. According to the results of the analysis, the only significant variable in explaining the capital structure in Turkish energy sector enterprises was determined as profitability. On the other hand, significant variables in European energy sector enterprises were determined as current ratio, asset structure and equity turnover variables used as liquidity variables. At the point of evaluating the findings with the theories, the decrease in the debt ratio as the profitability increases in the Turkish energy sector enterprises can be explained by the theory of financial hierarchy. In the European energy sector enterprises, the decrease in the debt ratio as the current ratio increases can be explained by the theory of financial hierarchy, and the increase in the debt ratio as the share of tangible fixed assets in total assets and equity turnover increases can be explained by the trade-off theory.

Tailab (2014) analyzed the capital structure components of American energy firms that affect firm performance between 2005 and 2014. While return on assets and equity are used as dependent variables, the ratio of short-term, long-term and total debt to assets, which are the fundamental variables of capital structure, are included as independent variables. As a result of the study, it was concluded that capital structure is an important

factor on firm profitability. In addition, it has been observed that total debt has a negative effect on profitability.

In the study of Zhang et al. (2018), the components influencing the capital structure of 16 Pakistani oil and energy companies between 2010 and 2015 were studied. 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 relation between the dependent variable and the tax rate is negative. The relation between other variables and leverage was discovered to be positive. In this direction, it can be said that the capital structure choices of the Pakistani oil and energy sector are compatible with the trade-off theory.

Chakrabarti and Chakrabarti (2019) tests the capital structure decisions of 141 Indian energy companies by using panel data analysis method by determining a large sample between 2006 and 2016. The study has a total debt ratio dependent variable and a data set of independent variables such as profitability, growth, size, tangibility, turnover, age, liquidity, NDTS. According to the results, there is a positive relation between the dependent and independent variables consisting of firms' age, turnover, liquidity and size. The study concludes that there is an inverse relationship between the variables related to the capital structure, combined with the result that the borrowing source is internalized as the age and size of the firms increase in Indian energy companies where profitability increases.

In their study, Ahmed and Sabah (2020) aimed to identify capital structure components, take into account the differences between company levels and find out which capital structure theory is compatible. Unlike other studies, the sample consists of Gulf Council Countries consisting of six different countries such as Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates. Additionally, the study focuses on 22 different oil and gas companies between 2010 and 2019. It has a data set consisting of debt to equity as dependent variable and profitability, growth, size, and tangibility as independent variables. According to the results obtained from the study, while the capital structure has a positive relation with the size and tangibility of the firm, on the other hand, 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, while 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 the trade-off and pecking-order theory.

In master's thesis, Köse (2020) tests 10 energy companies in BIST between 2012-2019 in terms of ratio analysis and profitability ratio analysis methods for six-month periods. Contrary to general usage, the dependent variable is not the debt to equity factor, but it determined as Return On Asset/Return On Equity, which is net income divided by total assets and total capital. As a result of the panel data analysis, it was concluded that the capital multiplier and the leverage ratio negatively affect the capital structure. In the study, which has not been evaluated in terms of theoretical compatibility, it has been suggested to create policies that will reduce the use of foreign resources for the future of the sector, increase their income and enable them to use their own resources effectively.

In the study, by Şahin (2020) the capital structure of energy companies, whose financial statements were reached between 2009 and 2019, was examined with the generalized moment methods model. In order 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 are taken as the basis for capital structure variables and micro variables are ignored. As a result of the study, it has been revealed that there is a positive and significant relation between capital structure and leverage ratio lagged value, exchange rate, interest rate, tangible assets, and industrial production index.

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

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 EU. In the study, in addition to the total debt ratio variable used as a dependent variable, a total of 17 different independent variables related to the financials of the company, the sector and the country were analyzed. Although there are no significant differences between energy enterprises and other enterprises in the EU, positive and negative judgments have been made on some factors. A positive relation between indebtedness and tangibility, size, and growth factors; On the other hand, it was concluded that there is a negative relationship with liquidity, profitability, and NDTS factors. As a result of the findings, the capital structure of energy enterprises is compatible with the pecking order theory.

Wieczorek-Kosmala et al. (2021) examines the relationship between leverage and profitability of energy companies in Central European countries between 2015 and 2019, including the Czech Republic, Hungary, Slovakia and Poland. According to the results of the study with a large sample of 2776, it has been revealed that the relationship between long-term and total liabilities is compatible with pecking-order theory, and the relationship between short-term liabilities is compatible with trade-off theory.

CHAPTER FOUR

ANALYSIS OF ENERGY SECTOR ENTERPRISES DETERMINANTS WITH PANEL DATA METHOD

In this part of the study, the variables that affect the capital structure of the enterprises in the energy sector and which type of structure is compatible with the capital structure theories are investigated. First of all, the purpose and importance of the research were mentioned and the scope and limitations of the research were determined. Then, the variables formed from the studies in the literature were determined and a model related to the research method was created. Finally, panel data analysis was applied to energy sector enterprises and the findings obtained as a result of the application were evaluated.

4.1.Purpose and Scope of the Research

Energy is becoming a sector whose importance is increasing day by day. Along with the developing technology, the level of dependence on energy has increased and continues to increase. The increase in the demand for energy both makes energy more important and shows that this sector will not lose its importance.

The aim of the research is to analyze the capital structure determinants of the enterprises based on the effect of the enterprises based on the energy sector in Borsa Istanbul on their capital structures. In line with these targets, the financial statements of all 8 enterprises operating in the BIST 100 energy sector between the years 2014-2021 were reached. Secondary data on the capital structure determinants variables were obtained from the annual financial reports published on the Public Disclosure Platform (KAP) (kap.gov.tr, n.d.). The obtained data were analyzed with the panel data analysis method in the Stata package program.

Table 7

Energy Sector in BIST Companies and Codes

Sıra	Kod	Şirket Unvanı
1	AKENR	AKENERJİ ELEKTRİK ÜRETİM A.Ş.
2	AKSEN	AKSA ENERJİ ÜRETİM A.Ş.
3	AKSUE	AKSU ENERJİ VE TİCARET A.Ş.
4	AYEN	AYEN ENERJİ A.Ş.
5	ODAS	ODAŞ ELEKTRİK ÜRETİM SANAYİ TİCARET A.Ş.
6	PAMEL	PAMEL YENİLENEBİLİR ELEKTRİK ÜRETİM A.Ş.
7	ZEDUR	ZEDUR ENERJİ ELEKTRİK ÜRETİM A.Ş.*
8	ZOREN	ZORLU ENERJİ ELEKTRİK ÜRETİM A.Ş.

The companies included in the research are shown in Table 7.[1]

4.2.Importance and Limitations of the Research

Capital structure decisions are a subject that is frequently examined on different sectors in the literature. Although the importance of the energy sector and the interest of researchers have increased recently, the amount of studies examining the determinants of capital structure variables of the sector is still limited. In addition, it can be said that the analysis will be one of the firsts for Türkiye as it includes sector variables and provides a different perspective. In this context, the study will conduce to the literature.

When evaluated in terms of limitations in the study, the limited number of companies whose financial data were accessed affected the number of observations of the study. Also, when the literature is examined, the number of studies examining the capital structure in the energy sector is not sufficient; In addition to the lack of relevant studies, it can be said that it is very difficult to access data on sector variables. It would be appropriate to evaluate the study under these constraints.

*Previously known as Utopya Turizm İnşaat İşletmecilik Ticaret A.Ş. changed its commercial title as Zedur Enerji Elektrik Üretim A.Ş. on 27.09.2022.

4.3.Research Method

Panel data analysis will be applied as a research method. The panel data combines time series and cross-section data taking into account periods, and gathers series of the same units in different time sections under a single roof (Baltagi, 2005). Since the 1950s, the need for panel data has attracted attention in terms of the lack of dimensions of the horizontal section and time series data used for analysis in econometric studies. It was tried in the studies of Hildert in 1950, Kuh in 1959, Balestra and Nervole in 1960, and Swamy in 1970; however, the beginning of applied analyzes corresponds to the 1990s (Tatoğlu, 2021).

In the analysis, the cross-section unit is shown as 'N' and the number of periods included in the analysis is shown as 'T'. The general estimation model of the panel data is presented in Equation (4.1) (Baltagi, 2005).

$$Yit = \alpha it + \beta itXit + uit \; i = 1,2, \dots ,N \; ; \; t = 1,2, \dots , T \quad (4.1)$$

In the above model; Y represents the dependent variable, X represents the independent variable. α is the constant coefficient, β is the slope coefficient and u is the error term. The coexistence of i (horizontal section) and t (time) in the sub-index shows that the model is suitable for panel data method. This analysis method includes more than one time section.

The panel data method has the following advantages over other time and cross-section models.

- Panel data analysis allows time and units to be analyzed together, allowing to work with a larger data set; in addition, it adds dimension to the analysis by increasing the data quality and quantity.
- It provides high reliability parameter estimates and high degrees of freedom in series with more than one unit and time.
- In the time series and cross section data analysis methods, many features of the units that cannot be observed by the independent variables are included in the error term. In this case, panel data analysis separates these features from the error term by defining a different constant for each unit.

- The units used in econometric analyzes are generally heterogeneous. While time series and cross-section data analysis alone cannot control this variable; panel data analysis method provides this heterogeneity.
- In this model, due to the excluded variable, there is a correlation between the error term and the explanatory variables, and the parameter estimates are biased. By using panel data, the effects of these variables can be kept under control, in which case the prediction bias is reduced or completely disappeared.

On the other hand, it also has the following disadvantages.

- One of the most obvious problems is the data collection process. Difficulties arise as a result of the data to be collected in accordance with the panel data method, limited observations and unanswered questions in the survey studies.
- Another problem is that although the time dimension is short, the unit dimension is excessive (Tatoğlu, 2021). This situation arises due to the fact that asymptotic properties depend on too many variables, and it causes econometric problems that are difficult to get out of in nonlinear panel data studies.

4.4.Data Set and Variables

The research data set consists of the data of the Electricity, Gas and Water sector financial statements operating in Borsa Istanbul in the period of 2014-2021, as well as sectoral and country-based data. As of 2021, the most observation is provided in 2014 and the number of companies that are publicly open to operate is 8. For this reason, the number of companies to be observed in the sector with 25 companies has been reduced to 8.

Türkiye BİST 100 index:

i=1,2,…..,8 N=8 number of enterprises

t=1,2,…..,8 T=8 (2014-2021) number of periods

NxT=8x8=64 number of observations

In the research, it is aimed to determine the capital structure determinants of the companies operating in the energy sector in the period of 2014 and 2021. In this context, the dependent and independent variables included in the study are shown in Table 8.

Table 8

Table of Variables

Code	Variables	Dependent Variables	Independent Variables
CS	Capital structure (total debt ratio)	X	
TANG	Assets structure (tangibility)		X
SIZE	Size of the enterprise		X
GROWTH	Growth opportunities		X
PROFIT	Profitability		X
LIQUIT	Liquidity		X
NDTS	Non-debt tax shield		X
DRIND	Debt ratio median in country/industry		X
ENENDKS	Industrial Production and Distribution Index		X
ANNGROW	Annual growth of GDP		X
INF	Inflation		X
TAXRV	Tax revenue		X

When the study is compared with its counterparts, it can be said that the independent variables differ in their categorization. The independent variables are divided into three groups as firm, sector and country based. At the same time, while determining the variables in the research, variables related to the capital structure and frequently used in the literature were selected. Table 9 summarizes both the grouping of independent variables and the studies in which the variables are used in the literature.

Table 9

Studies in which Variables were Analyzed

Variable	Definition	Adapted from
Dependent Variable		
Capital Structure /Leverage	total debt/total assets	Saeed (2007), Ayyıldız (2013), Bayrakdaroğlu, Ege, Yazıcı (2013), Çekrezi (2013), Enakirerhi&Chijuka (2016),

		Chakrabarti & Chakrabarti (2019), Şahin (2020), Nga (2021), Uzun (2023)
Firm-based Independent Variables		
Assets structure (tangibility)	fixed assets/total assets	Mazur (2007), Ghani (2010), Ayyıldız (2013), Bayrakdaroğlu, Ege, Yazıcı (2013), Zhang and oth. (2018), Chakrabarti & Chakrabarti (2019), Nga (2021),
Size of the enterprise	In(total assets) - Natural logarithm of total assets	Chen (2004), Saeed (2007), Chakrabarti & Chakrabarti (2019), Nga (2021), Uzun (2023)
Growth opportunities	(total assets n /total assets n-1) -1	Nga (2021)
Profitability	EBIT/total assets	Saeed (2007), Bayrakdaroğlu, Ege, Yazıcı (2013), Zhang and oth. (2018), Nga (2021), Chen (2004),
Liquidity	current assets/short-term liabilities	Mazur (2007), Ayyıldız (2013), Işık&Ersoy (2021)
Non-debt tax shield	Depreciation/total assets	Chen (2004), Mazur (2007), Nga (2021), Bayrakdaroğlu, Ege, Yazıcı (2013), Çekrezi (2013), Enakirerhi&Chijuka (2016)
Sector-based Independent Variables		
Debt ratio median in country/industry	Median of debt ratio in particular country	Jaworski&Czerwonka (2021)
Industrial Production and Distribution Index		(Şahin, 2020)
Country-based Independent Variables		
Annual growth of GDP	GDP growth (annual %)	Çekrezi (2013), Jaworski&Czerwonka (2021), Uzun (2023)
Inflation	Inflation, consumer prices (annual %)	Çekrezi (2013), Jaworski&Czerwonka (2021), Uzun (2023)

Tax revenue	Tax revenue (% of GDP)	Jaworski&Czerwonka (2021)

4.5.Basic Statistical Data of the Analysis

The information including all the variables and descriptive statistics about the variables are shown in Table 10.

Table 10

Summary Statistics of Variables

VARIABLE	OBS	MEAN	STD. DEV.	MIN	MAX
CS	64	0.7	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
LIQUIT	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

Table 11

The Level of Debting among the Companies

COMPANY	CS - MEAN
AKENR	0,83
AKSEN	0,67
AKSUE	0,57
AYEN	0,78
ODAS	0,71
PAMEL	0,5
UTPYA	0,63
ZOREN	0,9

When descriptive statistics were examined, it was determined that all variables included an equal number of observations. The completeness of the data for the variables indicates that the system has a balanced panel data set. The average financial leverage level of the companies examined in the study is around 70%. According to table 11, Zorlu Enerji uses debt financing the most with 90%, followed by Akenerji with 83% and Ayen Enerji with 78%. The energy company that carries out finance with the least borrowing is Pamel Renewable Energy with 50%. This indicates that the firms in the sample finance

more than half of their assets by borrowing. The low difference between the standard deviation, minimum and maximum values also indicates that an assessment can be made that the distributions of the variables are appropriate.

Before proceeding to the panel data analysis, it needs to be tested whether there is a multicollinearity between the independent variables. Multicollinearity is important because it may cause incorrect estimation of the regression coefficients, exaggeration of the standard errors of the regression coefficients, and accordingly, incorrect results. In testing multicollinearity, different methods are used to measure the correlation coefficient, variance inflation values, or the determinant of the correlation matrix (Topal et al, 2010). In the study, Variance Inflation Factor (VIF) measurement was preferred.

Table 12

Multiple Linear Connection Test I

	VIF	1/VIF
INF	42.547	.024
TAXRV	38.099	.026
LOGDRIND	35.897	.028
LOGENENDKS	20.785	.048
ANNGROW	2.253	.444
GROWTH	1.93	.518
LIQUIT	1.355	.738
SIZE	1.232	.812
PROFIT	1.175	.851
TANG	1.153	.867
NDTS	1.151	.869
MEAN VIF	13.416	.

By measuring the severity of multicollinearity between variables, VIF provides an estimate of the interaction or correlation between independent variables. While the VIF value between 0-5 is low and 5-10 is acceptable by giving a moderate result, if the value is more than 10, it causes multicollinearity problem with high correlation result (James et al., 2013). When Table 12 was examined, it was determined that the VIF values for the INF,

TAXRV, LOGDRIND and LOGGENENDKS variables were quite high. In such a case, performing the analysis will not yield consistent results.

Table 13

Multiple Linear Test II

	VIF	1/VIF
LOGDRIND	4.775	.209
LOGENENDKS	4.232	.236
ANNGROW	2.222	.45
INF	2.024	.494
GROWTH	1.923	.52
LIQUIT	1.316	.76
SIZE	1.231	.812
PROFIT	1.16	.862
NDTS	1.15	.87
TANG	1.15	.87
MEAN VIF	2.118	.

In order to overcome the multicollinearity problem, TAXRV variable was removed from Model 1 among the four variables with high VIF values. As a result, Table 13 shows the results of the VIF analysis that was applied again after the TAXRV variable was removed from Model 1. All VIF values are lower than 5 which is called the critical value in many studies as can be seen. Therefore, the multicollinearity problem has been overcome in Model 1.

Table 14

Results for Multiple Linear Connection Test for all Models

	MODEL 1		MODEL 2		MODEL 3		MODEL 4	
	VIF	1/VIF	VIF	1/VIF	VIF	1/VIF	VIF	1/VIF
LOGDRIND	4.775	0.209	-	-	-	-	-	-
LOGENENDKS	4.232	0.236	-	-	-	-	-	-
ANNGROW	2.222	0.45	-	-	-	-	1.39	0.718
GROWTH	1.923	0.52	1.231	0.813	-	-	-	-

INF	2.024	0.494	-	-	-	-	4.14	0.242
SIZE	1.231	0.812	1.223	0.818	-	-	-	-
NDTS	1.15	0.87	1.143	0.875	-	-	-	-
PROFIT	1.16	0.862	1.122	0.891	-	-	-	-
TANG	1.15	0.87	1.099	0.91	1.06	0.947	1.07	0.931
LIQUIT	1.316	0.76	1.094	0.914	1.14	0.874	1.32	0.76
LOGDRIND			-	-	2.63	0.379	-	-
LOGENENDKS			-	-	2.77	0.361	-	-
TAXRV			-	-	-	-	5.00	0.199
			-	-	-	-	-	-
MEAN VIF	2.118	-	1.152	-	1.9	-	2.59	-

Multicollinearity test was applied to all models and test results are given in Table 14. The results show that there is no multicollinearity problem in the models.

4.6.Determining the Research Models

In the literature, capital structure is usually tested by firm-based variables. Although there are studies that add macroeconomic variables to the data set or only consider them from a macroeconomic perspective, they are few in number. Studies examining the sectoral perspective are rare. For this reason, in addition to observing the effect of independent variables on the dependent variable one by one, group analysis is important in terms of providing a different perspective to the sector. In this framework, four different models will be estimated.

Before determining the model, Hausman test is applied to determine which fixed effects or random effects model should be preferred in panel data analysis. The significance level was taken as P = 0.05 in the interpretation of the Hausman test and also, in the study. Before the analysis, the following two hypotheses were established.

H_0 = There is a random effect.

H_1 = There is no random effect.

Table 15

Hausman Test Results

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 Hausman test results in Table 15, 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 base the random effects model. The models are constructed as follows.

Model 1:

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

Model 2:

$CS_{i,} = \beta_0 + \beta_1.TANG_{i,} + \beta_2.SIZE_{i,} + \beta_3.GROWTH_{i,} + \beta_4.PROFIT_{i,} + \beta_5.LIQUIT_{i,} + \beta_6.NDTS_{i,} + u$

Model 3:

$CS_{i,} = \beta_0 + \beta_1.DRIND_{i,} + \beta_2.ENENDKS_{i,} + \beta_3.LIQUIT_{i,} + \beta_4.TANG_{i,} + u$

* Liquidity and Tangibility independent variables are added to the models as control variables and are important in terms of contributing to the significance of the model.

Model 4:

$CS_{i,} = \beta_0 + \beta_1.ANNGROW_{i,} + \beta_2.INF_{i,} + \beta_3.TAXRV_{i,} + \beta_4.LIQUIT_{i,} + \beta_5.TANG_{i,} + u$

* Liquidity and Tangibility independent variables are added to the models as control variables and are important in terms of contributing to the significance of the model.

β: Fixed value

u: Error term

i; company and t; time shows.

4.7.Panel Data Analysis and Findings

In the study, 4 different models were constructed. As a result of the Hausman test, it was determined that the random effects should be applied for all models. In order to obtain accurate results, the diagnostic test results will be examined beforehand. These tests are basically cross-section dependency, autocorrelation and varying variance tests. Next, the analysis findings will be listed.

Cross-section dependence investigates whether all cross-section units in the panel data are affected by the shock in the same way when a certain shock hits the series. The Berusch Pagan test is used to determine whether cross-section dependence is present when the time dimension is greater than the cross-section dimension (T>N); the Pesaran test is used to determine whether it is present when the time dimension is equal to the cross-section dimension (T=N) and less than the cross-section dimension (T<N) (Göçer, 2013). In this study, since there are 8 companies (N=8) and 8 years (T=8) for all models, the Pesaran (2004) test will be applied.

Autocorrelation refers to situations where there is a relationship between error terms. In the case of autocorrelation where there is sequential dependence between the error terms, the estimates of the population parameters and their standard errors are negatively affected. In the case of sequential dependency, the regression coefficients lose their effectiveness even if they do not lose their unbiasedness and consistency.

The varying variance test analyzes the assumption that the variances of error terms between units in panel data models are the same, in other words, they are constant. Many panel data applications can have cross-section units of different structures. The difference between the units causes the parameters of the model to differ in this heterogeneity. Even though the regression coefficients continue to be consistent in case of facing the problem of varying variance and ignoring the estimations, these estimations lose their effectiveness. As a result, the standard errors found as a result of the estimation become biased.

Model 1

Table 16

Cross Section Dependency Test Results-Model 1

	Statistics Value	Probability Value
Pesaran Horizontal Section Test	-2.038	0.042
Friedman Horizontal Section Test	0.75	0.997

Cross-section dependency test results are presented in Table 16. When the results of the cross-section test are examined, it is seen that the basic hypothesis stating that there is no cross-sectional problem in the model as a result of the Pesaran cross-section test is rejected at the 5 percent level and the alternative hypothesis stating that there is a cross-section (0.042<0.05) is accepted. According to the results of the Friedman cross-section test, the basic hypothesis that there is no cross-section in the model is accepted.

Table 17

Wooldridge Autocorrelation Test Results-Model 1

F	23.262
Prob>chi2	0.002

Table 17 shows the Wooldridge autocorrelation test results. As a result of the autocorrelation test, the fundamental hypothesis, which states that there is no autocorrelation in the model, is rejected in favor of the alternative hypothesis, which states that there is autocorrelation in the model (0.002<0.005).

Table 18

Groupwise Heteroscedasticity Test Results-Model 1

	Statistics Value	Probability Value
W0	1.365	0.238
W50	1.268	0.282
W100	1.364	0.238

Due to the random effects being chosen as the estimator, Leveene Groupwise Heteroscedasticity test will be applied to the model. The results of this test are shown in

Table 18. As a result of the variable variance test applied for Model 1, the null hypothesis stating that there is no varying variance in the model cannot be rejected at all levels (probability>0.05). Therefore, it was determined that there was no problem of varying variance in Model 1.

As a result, it has been determined that there is autocorrelation problem and that there are no cross-sectional dependence and heteroscedasticity problems for the Random Effects estimator. In this case, it was evaluated that applying the Generalized Least Square (GLS) estimator, which is sensitive to first-order autocorrelation, to the model would yield consistent results (Hoechle, 2007). Analysis results are shown in Table 19.

Table 19

GLS Estimator Analysis Results-Model 1

CS	Coef.	St.Err.	t-value	p-value
TANG	-0.224	0.097	-2.32**	0.02
SIZE	-0.006	0.02	-0.32	0.745
GROWTH	-0.133	0.053	-2.49**	0.013
PROFIT	-0.534	0.135	-3.95***	0.000
LIQUIT	-0.002	0.001	-2.65***	0.008
NDTS	0.523	0.872	0.60	0.549
LOGDRIND	-0.004	0.019	-0.18	0.854
LOGENENDKS	-0.045	0.077	-0.59	0.557
ANNGROW	0.153	0.468	0.33	0.743
INF	-0.271	0.158	-1.72*	0.086
Constant	1.404	0.468	3.00	0.003

Mean dependent var	0.700	SD dependent var	0.182
Overall r-squared	0.342	Number of obs	64
Chi-square	87.773	Prob > chi2	0.000
R-squared within	0.612	R-squared between	0.053

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

According to Model 1 estimation results, probability values of SIZE, NDTS, LOGDRIND, LOGENENDKS and ANNGROW variables are above all critical values (0.1, 0.05, 0.01). Therefore, the coefficient values of these variables will not be interpreted. However, other variables gave statistically significant results at different critical levels.

Accordingly, it has been determined that a one-unit increase in the TANG variable will cause a 0.224-unit decrease on the CS. This coefficient, like the GROWTH coefficient, is statistically significant at the 5 percent level. A one-unit increase in the GROWTH and PROFIT variables will decrease the CS variable by 0.133 and 0.534 units, respectively. The coefficient value for the LIQUIT variable is again negative and 0.002. Lastly, a one-unit increase in the INF variable decreases the CS by 0.271 units.

Model 2

The estimation of Model 2 will be given in this part. All of the tests applied for Model 1 will also be applied for Model 2 and the results will be evaluated.

Table 20

Cross Section Dependency Test Results-Model 2

	Statistics Value	Probability Value
Pesaran Horizontal Section Test	-1.347	0.178
Friedman Horizontal Section Test	2.125	0.926

Cross-section dependency test results are presented in Table 20. When the results of the cross-section test are examined, the basic hypothesis that there is no cross-section in the model according to the results of the Pesaran and Friedman cross-section test is accepted because the probability value is higher than the critical value of 5 percent.

Table 21

Wooldridge Autocorrelation Test Results-Model 2

F	36.417
Prob>chi2	0.001

Table 21 shows the autocorrelation test results. As a result of the autocorrelation test, the fundamental hypothesis, which states that there is no autocorrelation in the model, is rejected in favor of the alternative hypothesis, which states that there is autocorrelation in the model. (0.001<0.05).

Table 22

Groupwise Heteroscedasticity Test Results-Model 2

	Statistics Value	Probability Value
W0	1.602	0.154
W50	1.25	0.291
W100	1.602	0.154

Due to the random effects being chosen as the estimator, Leveene Groupwise Heteroscedasticity test will be applied to the model. The results of this test are shown in Table 22. As a result of the variable variance test applied for Model 2, the null hypothesis stating that there is no varying variance in the model is accepted at all levels (probability>0.05). Therefore, it has been determined that there is no problem of varying variance in Model 2.

As a result, it has been determined that there is autocorrelation problem and that there are no cross-sectional dependence and heteroscedasticity problems for the Random Effects estimator. In this case, it was evaluated that applying the GLS estimator, which is sensitive to first-order autocorrelation, to the model would yield consistent results (Hoechle, 2007). Analysis results are shown in Table 23.

Table 23

GLS Estimator Analysis Results-Model 2

CS	Coef.	St.Err.	t-value	p-value
TANG	-0.212	0.09	-2.36**	0.018
SIZE	-0.003	0.018	-0.18	0.86
GROWTH	-0.112	0.041	-2.72***	0.006
PROFIT	-0.581	0.127	-4.58***	0.000
LIQUIT	-0.002	0.001	-2.72***	0.007
NDTS	0.626	0.859	0.73	0.466
Constant	0.956	0.371	2.58**	0.01

Mean dependent var	0.700	SD dependent var	0.182
Overall r-squared	0.342	Number of obs	64
Chi-square	87.773	Prob > chi2	0.000
R-squared within	0.612	R-squared between	0.053

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

According to Model 1 estimation results, probability values of SIZE and NDTS variables are above all critical values (0.1, 0.05, 0.01). Therefore, the coefficient values of these variables will not be interpreted. However, other variables gave statistically significant results at different critical levels. Accordingly, it has been determined that a one-unit increase in the TANG variable will cause a 0.212-unit decrease in the CS. This coefficient is statistically significant at the 5 percent level. A one-unit increase in the GROWTH, PROFIT and LIQUID variables will decrease the CS variable by 0.112, 0.581 and 0.002 units, respectively.

Model 3

The estimation of Model 3 will be given in this part.

Table 24

Cross Section Dependency Test Results-Model 3

	Statistics Value	Probability Value
Pesaran Horizontal Section Test	-0.608	0.543
Friedman Horizontal Section Test	3.458	0.839

Cross-section dependency test results are presented in Table 24. When the results are examined, the basic hypothesis that there is no cross section in the model is accepted because the probability value is higher than the critical value of 5 percent.

Table 25

Wooldridge Autocorrelation Test Results-Model 3

F	11.364
Prob>chi2	0.012

Table 25 shows the autocorrelation test results. As a result of the autocorrelation test, the fundamental hypothesis, which states that there is no autocorrelation in the model, is rejected in favor of the alternative hypothesis, which states that there is autocorrelation in the model (0.012<0.05).

Table 26

Groupwise Heteroscedasticity Test Results-Model 3

	Statistics Value	Probability Value
W0	3.326	0.005
W50	2.847	0.013
W100	3.326	0.005

Due to the random effects being chosen as the estimator, Leveene Groupwise Heteroscedasticity test will be applied to the model. The results of this test are shown in Table 26. According to the results, the null hypothesis stating that there is no varying variance in the model is rejected at all levels (probability>0.05). However, since the probability value at the W50 level is higher than 1 percent in model 3, it will be accepted that there is no varying variance.

As a result, it has been determined that there is autocorrelation problem and that there are no cross-sectional dependence and heteroscedasticity problems for the Random Effects estimator. In this case, it was evaluated that applying the GLS estimator, which is sensitive to first-order autocorrelation, to the model would yield consistent results (Hoechle, 2007). Analysis results are shown in Table 27.

Table 27

GLS Estimator Analysis Results-Model 3

CS	Coef.	St.Err.	t-value	p-value
LOGDRIND	0.031	0.016	1.94	0.052
LOGENENDKS	-0.211	0.068	-3.11	0.002
LIQUIT	-0.003	0.001	-3.56	0.000
TANG	-0.349	0.107	-3.25	0.001
Constant	1.666	0.34	4.90	0.000
Mean dependent var	0.700	SD dependent var		0.182
Overall r-squared	0.237	Number of obs		64
Chi-square	31.506	Prob > chi2		0.000
R-squared within	0.418	R-squared between		0.077

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

According to Model 3 estimation results, the probability values of all variables were below the critical values (0.1, 0.05, 0.01) and gave statistically significant results at different critical levels. Accordingly, it was determined that a one percent increase in the LOGDRIND variable would cause an increase of 0.03 units on the CS. This coefficient is statistically significant at the 5 percent level. An increase of one percent, which would be expected to occur in the LOGENENDKS variable, would decrease the CS variable by 0.211. A one-unit increase in the LIQUIT and TANG variables will decrease the CS variable by 0.003 and 0.349 units, respectively.

Model 4

The estimation of Model 4 will be given in this part.

Table 28

Cross Section Dependency Test Results-Model 4

	Statistics Value	Probability Value
Pesaran Horizontal Section Test	0.775	0.438
Friedman Horizontal Section Test	9	0.253

Cross-section dependency test results are presented in Table 28. When the results are examined, the basic hypothesis that there is no cross section in the model is accepted because the probability value is higher than the critical value of 5 percent.

Table 29

Wooldridge Autocorrelation Test Results-Model 4

F	6.927
Prob>chi2	0.034

Table 29 shows the autocorrelation test results. As a result of the autocorrelation test, the fundamental hypothesis, which states that there is no autocorrelation in the model, is rejected in favor of the alternative hypothesis, which states that there is autocorrelation in the model (0.012<0.05).

Table 30

Groupwise Heteroscedasticity Test Results-Model 4

	Statistics Value	Probability Value
W0	2.213	0.05
W50	2.15	0.053
W100	2.213	0.05

Due to the random effects being chosen as the estimator, Leveene Groupwise Heteroscedasticity test will be applied to the model. The results of this test are shown in Table 30. As a result of the variable variance test applied for Model 4, the null hypothesis stating that there is no varying variance in the model is accepted at all levels (probability>0.05). Therefore, it is clear that there is a variable variance problem in Model 4.

As a result, it has been determined that there is autocorrelation problem and that there are no cross-sectional dependence and heteroscedasticity problems for the Random Effects estimator. In this case, it was evaluated that applying the GLS estimator, which is sensitive to first-order autocorrelation, to the model would yield consistent results (Hoechle, 2007). Analysis results are shown in Table 31.

Table 31

GLS Estimator Analysis Results-Model 4

CS	Coef.	St.Err.	t-value	p-value
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
LIQUIT	-0.002	0.001	-2.44**	0.014
TANG	-0.289	0.112	-2.58**	0.01
Constant	1.206	0.254	4.75	0.000
Mean dependent var	0.7	SD dependent var		0.182
Overall r-squared	0.203	Number of obs		64
Chi-square	26.58	Prob > chi2		0.000
R-squared within	0.33	R-squared between		0.07

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

According to Model 4 estimation results, probability values of ANNGROW, LIQUIT and TANG variables were below the critical values (0.1, 0.05, 0.01) and gave statistically significant results at different critical levels. Accordingly, it has been determined that a one-unit increase in the ANNGROW variable will cause an increase of 1.031 units on the CS. This coefficient is statistically significant at the 5 percent level. A one-unit increase in the LIQUIT and TANG variables will decrease the CS variable by 0.002 and 0.289 units, respectively.

RESULTS

Capital structure provides for-profit enterprises with information about which variables can affect them and how they should be followed in order to establish optimum debt and equity balances. Energy, on the other hand, is becoming an increasingly important economic and political element. The energy sector requires a close examination because of the increase in renewable energy investments due to energy resources that are not equally available in the world and the fact that dependence on energy has become indispensable with technological developments. This study covers the capital structure of enterprises in the energy sector. The aim of the study is to examine the components that determine the capital structures of energy enterprises operating in BIST 100.

The concept of capital structure has been examined, and traditional and modern theories have been emphasized. After giving information about the concept of energy, the state of energy and current developments, a literature summary was created from important studies.

In addition to these theoretical studies, the study analyzed empirically. In the analysis made with the panel data study, the period of 2014-2021 was examined. It includes the effect of 11 independent variables on the leverage ratio of 8 energy companies. At the same time, while the separate effects of the components were observed, the study was created in company, sector and country-based models and had the chance to observe the effect in different categories. During the analysis of the data, firstly, the summary statistics of the variables were determined. It has been determined that the average financial leverage level of the examined companies is around 70%. Accordingly, it is seen that Turkish energy companies finance their resources mainly by debt. When the literature is examined, it is seen that Ayyıldız (2013) and Şahin (2020) reached similar conclusions. For Central European countries, Wieczorek-Kosmala et al. (2021) also have as the almost 60% debt ratio. Similarly, Mjøs (2008) found that one of the biggest liability ratios in the Norwegian sectors belongs to energy companies at 83%.

In addition to the model in which all variables are included in the models, three more models based on firm, sector and country were created; thus, analysis was applied for 4 models. For Model 1, in which the effects of all variables were analyzed, no significant

relationship was found between SIZE, NDTS, LOGDRIND, LOGENENDKS, and ANNGROW and the dependent variable. TANG, GROWTH, PROFIT, LIQUIT and INF negatively affect leverage. For Model 2, in which firm-based variables were analyzed, no significant relationship was found between SIZE and NDTS and the dependent variable. TANG, GROWTH, PROFIT and LIQUIT negatively affect leverage. Accordingly, it seems that the energy enterprises in Türkiye are in financial difficulties and the assets are insufficient to meet the resources. Accordingly, it seems that the energy enterprises in Türkiye are in financial difficulties and the assets are insufficient to meet the resources. It can be said that energy companies should pay attention to profitability and liquidity ratios while determining their borrowing levels.

There is no insignificant variable for Model 3, where sector-based variables are analyzed. While the LOGDRIND variable affects the leverage positively, LOGGENENDKS affects the leverage negatively. Accordingly, the increase in the country's debt ratio provides a parallel increase in the leverage ratio, while the increase in the sector's production and distribution index and the decrease in leverage provide important information to the sector. While determining the level of borrowing, it is necessary to pay attention to the sector averages and market conditions. For Model 4, in which country-based variables were analyzed, no significant relationship was found between INF and TAXRV and the dependent variable. The ANNGROW variable has a negative effect on leverage.

Table 32

Comparison of Analysis Results and Capital Structure Theories

Variables	Analysis Result	TOT	POT	Theory Consistent with Results
TANG	-	+	-	POT
SIZE		+	-	
GROWTH	-	-	+	TOT
PROFIT	-	+	-	POT
LIQUIT	-	+	-	POT

NDTS		-	-
DRIND	+		
ENENDKS	-		
ANNGROW	-		
INF	-		
TAXRV			

A comparison was made between the analysis results and the assumptions of trade-off and pecking-order theories, which are among the capital structure theories. The fields for the variables that could not be found to be related to the dependent variable and that the theories could not explain were left blank. It was concluded that the variables tangibility, profitability and liquidity were compatible with the pecking-order theory, and only the growth variable was compatible with the trade-off theory. Accordingly, it can be said that Turkish energy sector enterprises take their capital structure decisions by considering the pecking-order theory. These findings appropriate with prior studies provided by Ayyıldız (2013) for Türkiye's energy sector and Wieczorek-Kosmala et al. (2021) for central European countries' energy companies.

Although the theory of capital structure is a subject that has been studied for many years, there are few studies on the energy sector. Although it is known that it is difficult to reach various data related to the sector, it is important that the sector companies are willing to provide the data, because understanding this will benefit the future of the sector. Moreover, sector-based studies should be increased and applied to every sector.

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