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Master's Thesis

HOW ESG AFFECTS A FIRM'S STOCK PERFORMANCE

by

SOULTANA M. MOUSTAKA

Supervisor: Prof. Ioannis A. Tampakoudis

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Abstract

In recent years, companies and investors emphasize more and more in the importance of sustainability and particularly in ESG investments. Therefore, the aim of this thesis is to bring additional evidence to determine if ESG ratings have a significant impact on a firm's stock-financial performance. The research focuses on European companies listed in STOXX 600 index. The sample used contained 539 companies in four years period, 2019-2022 which translates in 2156 firm-year observations. To test this hypothesis the research is conducted using multiple linear regression analysis with independent variables being the rates of the decomposed pillars of ESG and YEAR while dependent variables being ROA, ROE, P/E and TSR financial ratios as stock performance indicators. Data extracted from Refinitiv and the relevant financial statements of each firm. Results rejected this hypothesis as they claimed that the is not a significant relationship between ESG and stock performance. However, this study still contributes to a better understanding of this area as it is supported by existing literature and provides valuable insights for future research. Finally, this thesis is a quantitative research study with a focus on objectivity that contributes to broadening the scope of the literature review by exploring the existence of a correlation between ESG and stock returns in Europe, while on influence of Covid-19 pandemic, a period of high market volatility, and also by using a combination of dependent variables/performance indicators that have not been used before all together.

Keywords

Sustainable Finance, ESG, SRI, CSR, Stock Performance, ROE, ROA, P/E Ratio, TSR, Covid-19.

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List of Abbreviations

a = alpha level

ANOVA = Analysis of Variance

ASEAN = Association of Southeast Asian Nations

BSE100 = Bombay Stock Exchange 100

Cap. = Capitalization

CFI = Corporate Finance Institute

CFP = Corporate Financial Performance

Covid-19 = Corona Virus Disease 2019

CS = corporate sustainability

CSR = Corporate Social Responsibility

D/E = Debt-to-equity Ratio

DF = Degrees of Freedom

D-W = Durbin-Watson

E = Environmental

EBIT = Earnings Before Interest and Taxes

EPS = Earnings per Share

ESG = Environmental, Social and Governance

ESGC = Environmental Social Governance Combination

ETF = Exchange-Traded Fund

FTSE350 = Financial Times Stock Exchange 350

G = Governance

IPO = Initial Public Offering

ISO International Standard Organisation

K-S Kolmogorov-Smirnov

LSEG = London Stock Exchange Group

MSCI = Morgan Stanley Capital International

n.d. = no date (used both in the in-text citation and the reference list)

NIAT = Net Income After Tax

OLS = Ordinary Least Squares

P/E , PE = Price per Earnings Ratio

R&D = Research and development

ROA = Return on Assets

ROE = Return on Equity

S = Social

S&P 500 = Standard and Poor’s 500

SD = Standard Deviation

Sig. = Significance

SPSS = Statistical Package for the Social Sciences

SRI = Socially Responsible Investing

Std. = Standard

TQ, Q = Tobin's Q

TSR = Total Shareholder Return

UK = United Kingdom

UN = United Nations

UNGC = United Nations Global Compact

US = United States

VIF = Variance Inflation Factor

ZPRED = The Standardized Predicted Values of the Dependent Variable

ZRESID = The Standardized Residuals, or Errors

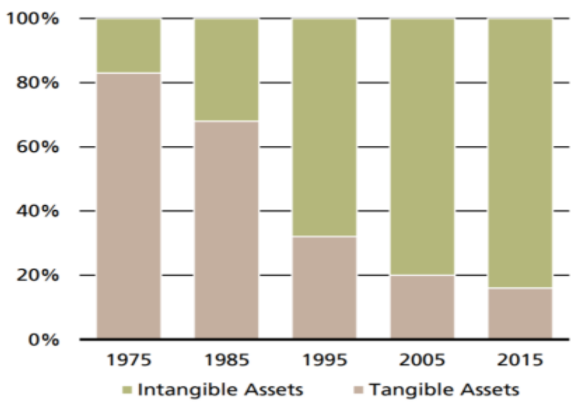
1. Introduction

Over the past two decades, and specifically since 2004 when "ESG" was first ever used as a term by UNGC, the idea that businesses need to focus on sustainability themed investing and swerve from the sole objective of shareholders wealth maximization has become increasingly popular. This is a shift towards an approach generally known as "Triple Bottom Line" or 3 Ps (People, Planet and Profit) (United National Global Compact, 2004). During the first quarter of 2021, sustainable ETFs attracted a record amount of capital in Europe, surpassing the fund flow to the "non sustainable" ETFs for the first time in history (Financial Times, 2021). As time changes, so does corporations and in the 21st century, companies with great power have even greater responsibilities. This is the reason why environmental decisions, societal considerations, and ethical guidelines interwoven with stock-financial performance are more interesting than ever for research. All these statements are presented thouroughtly in the following.

Figure 1. Triple-bottom line formulation.

Source: Arslan and Kisacik (2017)

Figure 2. Growth in market value of Intangible vs Tangible assets.



Source: Ocean Tomo (2015)

1.1 Sustainable Finance

Finance's primary role is to allocate financial resources by directing individuals' savings towards companies in need of capital and possessing investment opportunities. For m decades, this allocation was primarily based on companies' profitability and risk. However, the environmental crisis and new social issues, such as inclusion and diversity, have led to the emergence of sustainable finance.

The Banque de France (2022) defines sustainable finance as “financial practices aimed at promoting the long-term interests of the community”. In other words, sustainable finance aims to channel financial flows towards companies that have a positive impact on society. Sustainable finance comprises three pillars: The first pillar is solidarity finance, allowing investment in projects with high social utility. The second pillar is green finance, facilitating the funding of projects in energy transition and combating climate change. The third pillar is responsible finance, also known as SRI. SRI involves investing in companies in a "socially responsible" manner, considering profitability as well as certain ESG criteria.

1.2 Corporate Social Responsibility

While Milton Friedman, Nobel laureate in Economics in 1976, asserted in 1970 in “A Friedman doctrine - The Social Responsibility Of Business Is To Increase Its Profits, Milton Friedman” that the primary goal of companies should be to maximize profit to satisfy shareholders, and therefore, the company has no responsibility to society but only to its shareholders (Friedman, 2007), this view has been questioned in recent decades. With the popularization of CSR, companies are assigned other objectives, which are not solely financial, relying on stakeholder theories by R. Freeman (2005).

CSR is defined by the European Commission (2011) as: “a concept that refers to the voluntary integration by companies of social and environmental concerns into their commercial activities and their relations with their stakeholders”. The ISO 26000 (2010), representing the international standard for CSR, defines it as: “The responsibility of an organization regarding the impacts of its decisions and activities on society and the environment, resulting in ethical and transparent behavior that - contributes to sustainable development, including the health and well-being of society; -

takes into account the expectations of stakeholders; – respects applicable laws and is in accordance with international standards of behavior; and is integrated throughout the organization and implemented in its relations”.

But CSR does not only concern the companies and/or organizations themselves, consumers also tend to want to consume more responsibly, whether for environmental or social reasons. This has the effect of attracting the attention of investors who are now looking for companies to invest in. Whether they are individuals or institutions, they will now not only select a company using purely financial criteria but also other criteria that can indicate the level of the company's involvement in sustainable development and long-term considerations. These criteria are called ESG criteria.

Table 1. The spectrum of social and financial investing.

	Philanthropy		Social Impact Investing		Sustainable and Responsible Investing[8]	Conventional financial investing
	Traditional Philanthropy	Venture Philanthropy	Social Investing	Impact investment	ESG investing	Fully commercial investment
Focus	Address societal challenges through the provision of grants	Address societal challenges with venture investment approaches	Investment with a focus on social and/or environmental outcome and some expected financial return	Investment with an intent to have a measurable environmental and/or social return	Enhance long-term value by using ESG factors to mitigate risks and identify growth opportunities.	Limited or no regard for environmental, social or governance practices
			Use of ESG metrics and methodologies			
Return Expectation	Social return only	Social return focused	Social return and sub-market financial return	Social return and adequate financial market rate	Financial market return focused on long-term value	Financial market return only
	Social impact	←→	Social and financial		←→	Financial returns

Source: OECD (2019)

1.3 Environmental, Social and Governance

From the above, sustainable finance and CSR tend to result in the same direction: ESG criteria. ESG criteria, specifically, are data-driven aspects of sustainability that emphasize a company’s performance in the areas of the environment, society, and governance, all of which are measurable (Ognen et al., 2017). Of the three pillars of ESG, the environmental pillar addresses major environmental concerns, including carbon footprint, resource use, waste management, and toxic emissions (Jasch, 2006). In contrast, the social pillar focuses on major societal aspects such as community issues, workforce management, human rights, and product responsibility and the governance pillar mainly addresses policy planning, employee management, business ethics, and corporate social responsibility (Ognen et al., 2017).

Figure 3. Examples of ESG criteria.

Source: US SIF (n.d.)

1.3.1 Importance of ESG

There are several reasons why it is important for a company to have a high ESG score:

1. Attracting investors: Investors are increasingly looking for companies that prioritize ESG factors, as they believe that such companies are better positioned for long-term success. Having a high ESG score can attract more investors, including those who specialize in ESG investing.

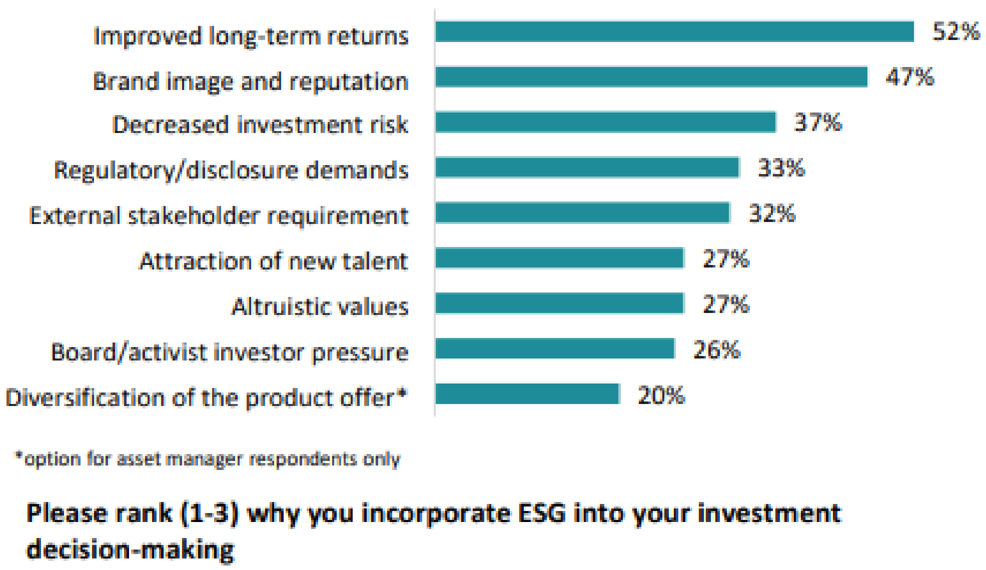
2. Managing risk: Companies that prioritize ESG considerations are better able to manage risks related to environmental and social issues, such as climate change, resource scarcity, and social unrest. This can help to protect the company's reputation, avoid costly legal battles, and maintain the support of key stakeholders.

3. Enhancing brand reputation: A strong ESG performance can enhance a company's brand reputation, leading to increased customer loyalty, stronger employee engagement, and greater public trust.

4. Improving operational efficiency: Companies that prioritize ESG considerations often have better operational efficiency, as they are more likely to adopt sustainable practices and reduce waste. This can lead to cost savings and increased profitability.
5. Meeting regulatory requirements: Companies that prioritize ESG factors are more likely to comply with regulatory requirements related to environmental and social issues, reducing the risk of fines, penalties, and legal disputes.

In summary, having a high ESG score is important for companies as it can attract investors, manage risk, enhance brand reputation, improve operational efficiency, and meet regulatory requirements.

Figure 4. Drivers of ESG integration.



Source: BNP

2. Literature Review

2.1 Overview of ESG and its relevance to firms and investors

2.1.1 Incentives for Environmental and Social Policies of Companies

There are several factors that explain the reason why some companies develop their environmental and social policies more than others. Bénabou and Tirole (2010) were among the first to elaborate on those factors, identifying three main reasons. The first reason for developing environmental and social policies is the long-term interest of the company. The second reason is that such policies are implemented at the request of stakeholders, whether they are shareholders (Hart and Zingales, 2017), consumers (Servaes and Tamayo, 2013) or employees (Brekke and Nyborg, 2008). Finally, the last reason is that executives have stronger preferences in this direction. While the first two reasons may align with the idea that the role of the company is to maximize shareholder value, the last reason brings potential agency costs. The article by Ferrell et al. (2016) demonstrates that companies with the most developed CSR also suffer the least from agency costs.

2.1.2 Impact of ESG on Company Performance and Risk

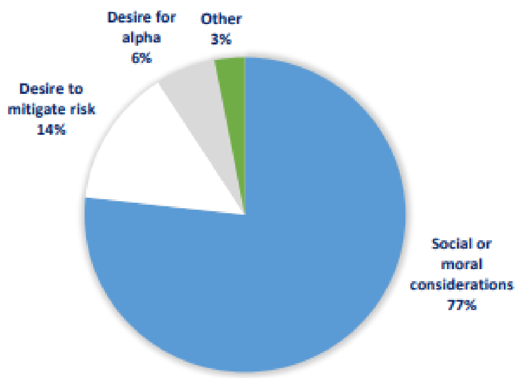
One reason for companies to invest in environmental or social protection would be the long-term performance of the company. This trade-off between short-term profit and consideration of societal and environmental issues is supported by numerous studies showing the negative impact of management or investor blind spots on ESG performance (Akey and Appel, 2020; Kim and Xu, 2021). However, the link between ESG investments and performance is still debated in empirical literature. Many articles exist on the subject, contrasting different approaches (Orlitzky et al., 2003; Margolis et al., 2009). It appears that differences in results could stem from the heterogeneous nature of sustainable investments. If they are adapted to the company's activities and enable it to outperform competitors, they create value (Albuquerque et al., 2019; Cao et al., 2019). Conversely, if they result from a manager overstepping their role, the impact on the company's value will be neutral or negative.

The awareness of the new role of the company in society through its social and environmental impact poses new risks, as seen with the Orpea and Volkswagen scandals (Hoepner et al., 2018). Interestingly, CSR policies reduce systematic risk (Albuquerque et al., 2019), while social irresponsibility increases idiosyncratic risk (Oikonomou et al., 2012).

Due to climate change urgency and the increasing demand for more socially responsible companies, government institutions are increasingly implementing laws related to ESG issues. This regulatory pressure poses a significant risk to companies that may suddenly find themselves obliged to implement costly investments to avoid fines or reputation-damaging scandals (Shapiro and Walker, 2018). This regulatory risk is now perceived as the most significant by investors. Regarding the environmental aspect, regulations can take the form of laws limiting emissions, setting up a carbon quota market following the Coase theorem logic (Bartram et al., 2022; Coase, 1960), implementing a carbon tax inspired by the Pigovian tax (Acemoglu et al., 2012; Golosov et al., 2014), or a mix of both (Fischer and Newell, 2008).

In addition, companies are exposed to environmental risks. The climate crisis reduces overall revenue (Addoum et al., 2020; Custódio et al., 2022) and production for companies, especially in the industrial and agricultural sectors ((Mendelsohn and Nordhaus, 1999); Deschênes and Greenstone, 2012; Dell et al., 2012; Peng et al., 2018). Real estate assets exposed to sea level rise are depreciated (Baldauf et al., 2020; Bakkensen and Barrage, 2017), reducing access to debt if used as collateral. Finally, the workforce is also affected by a decrease in productivity due to increased occurrences of extreme temperatures (Zivin and Neidell, 2014). To counterbalance these additional operational risks they are exposed to, companies reduce their leverage (Chang et al., 2018; Ginglinger and Moreau, 2019).

Figure 5. Drivers of ESG investing.



Source: Merrill Lynch Wealth Management

2.1.3 The Role of Investors

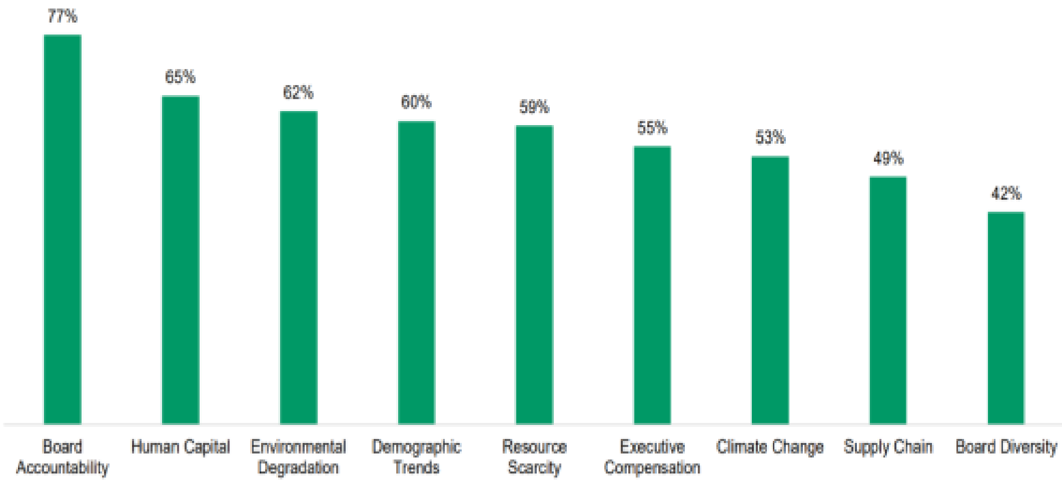
Since shareholders are the primary stakeholders affected by ESG risks, the ownership structure and its composition play a crucial role in shaping companies' ESG policies. Before delving into the impact of ownership, it is essential to understand how shareholders can influence companies' environmental and social policies. Firstly, shareholders can "vote with their feet," meaning they can simply divest from the company if they believe the company's activities do not meet their environmental and social criteria (Hong and Kacperczyk, 2009). Secondly, they can directly engage with the company by voting on environmental and social proposals (Dimson et al., 2015; Edmans et al., 2022; He et al., 2019). Finally, shareholders can appoint ESG-oriented directors who can contribute their expertise to the board and aid in the development of environmental and social policies.

The results of Dyck et al. (2019) and Azar et al. (2021) suggest that institutional investors favor ESG performance mainly because they want to hedge against regulatory risks (De Haas and Popov, 2019; Dyck et al., 2019; Krueger et al., 2020).

Beyond shareholders, it seems that creditors also influence the implementation of CSR policies. Indeed, interest rates applied to less responsible companies are higher, encouraging companies to become more sustainable to benefit from lower debt costs (Seltzer et al., 2020; Bellon, 2021). Moreover, the market has seen two major financial innovations emerge: green bonds, which are bonds backed by environmental projects

(Flammer, 2021; Zerbib, 2022; Tang and Zhang, 2020), and sustainability-linked bonds, which are bonds with interest rates indexed to environmental and social criteria (Berrada et al., 2022; Kölbel and Lambillon, 2022). These two new financial products facilitate the financing of sustainable projects through debt. Investors' culture or country of origin (Liang and Renneboog, 2017), their political preferences (Baldauf et al., 2020; Di Giuli and Kostovetsky, 2014), and their experiences (Choi et al., 2020) may explain why some investors are involved in companies' CSR policies. Despite a shift in investor preferences for ethical reasons or risk perception, sustainable finance can only adequately fund the transition to a more sustainable mode if accurate information is communicated to them.

Figure 6. ESG metrics investors consider.



Source: CFA (2017)

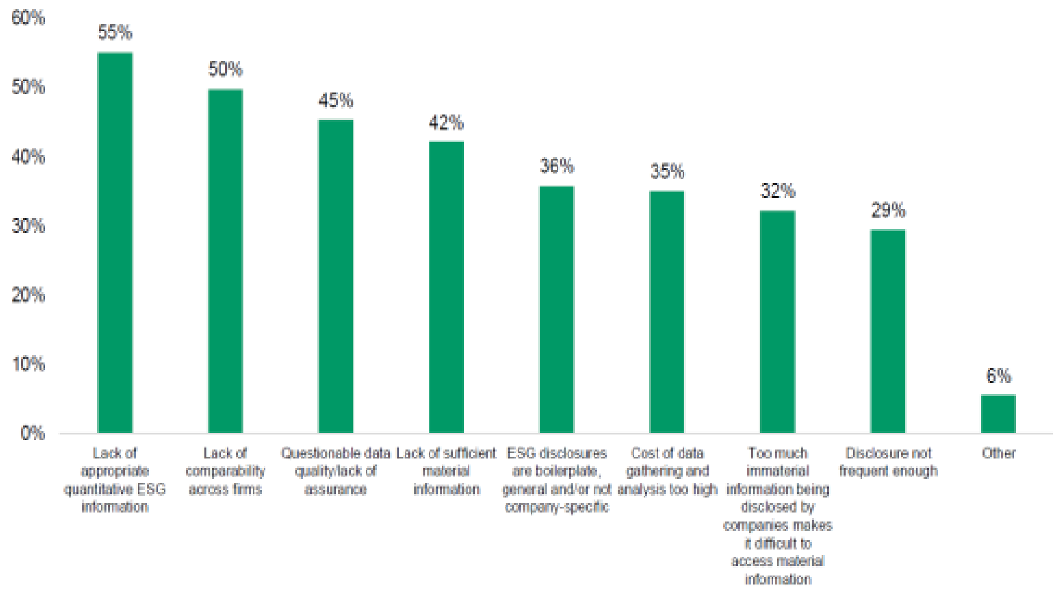
2.1.4 Measuring the Environmental and Social Impact of Companies

Finance is a discipline dominated by quantitative analysis, which proves problematic when discussing environmental and social impact. In order to provide a framework for sustainable development, the UN have defined 17 Sustainable Development Goals.

With the help of these Sustainable Development Goals, generalist non-financial rating agencies such as MSCI, LSEG, RobecoSAM or Sustainalytics have developed scores and ratings based on the three pillars of ESG. However, each agency decides what it includes in each of these pillars, and each has its approach to sustainability and what should be assessed in these scores. Some agencies have an ideological vision based on moral values, while others have a pragmatic approach based on the materiality of ESG risk and therefore on the evaluated company's value (Eccles et al., 2014). These differences in vision lead to significant heterogeneity in scores. Bartram et al. (2022) demonstrate that the correlation between them is incredibly low, unlike credit scores.

This uncertainty is problematic because it could lead to a decrease in demand for shares of responsible companies (Avramov et al., 2022) and an increase in pollution (Brandon et al., 2019). It is, therefore, urgent to better understand the construction of these scores and how to ensure that investors obtain the best possible information.

Figure 7. Challenges affecting investor's ability to integrate non-financial information.



Source: CFA (2017)

2.2 Theoretical Frameworks for Understanding ESG and Stock-Financial Performance

2.2.1 Financial Performance

For any company to maintain its long-term sustainability, the investigation of financial performance is essential.

Financial performance is the primary performance metric. It informs about whether or not the company succeeded in reaping revenue during the accounting period. So, conclusions can also be drawn for the financial health of the organization and the effectiveness of manages and controls of its resources. The higher the financial performance, the more effectively the resources are used (Almajali et al., 2012).

According to the following studies: Şamiloğlu et al., 2017; Dadepo and Afolabi, 2020; Madushanka and Jathurika, 2018; Dahiyat et al., 2021; Ayoush et al., 2021; Lestari et al., 2021; Putri et al., 2020; Ajanthan, 2013; Noor and Lodhi, 2015; Manullang et al., 2020; Manyo and Ugwu, 2013; Lismana et al., 2021; Efendi et al., 2019, ROA and ROE are represented as the outcome of financial performance.

2.2.2. Financial Analysis

Financial analysis is an assessment of a company's past financial performance and a tool to prospect the future performance. It involves the calculation of various ratios which are crucial for finding out favorable or unfavorable operational and financial characteristics of a firm.

Weston et al. (1996) support that financial statement analysis is actually a comparison between a firm's performance and all the other firms in the same business line. The main function of it is to identify and suggest actions that might enable the firm to take advantage of the strengths and correct its weaknesses. Also, it is very helpful to financial managers for planning future financial requirements by means of forecasting and budgeting procedures.

As a result, financial statement analysis depicts a relationship between items and groups of items in a way by which financial stability and health of a firm can be judged.

2.2.2.A Significance of financial analysis

The importance of analysis depends on the reason why it is been executed by the company. So, different groups of people associated with the company, are interested in and concerned by different results that came from the analysis. The various facts about managerial performance, corporate efficiency, financial strengths and weaknesses and credit worthiness are examined based on the objectives of each company has. This type of analysis leads management to take important decisions such as operative policies, investment value of the firm inter-financial control system and bargaining strategy for funds from external sources with more caution.

The parties that are benefited more by the results from the financial performance analysis can be listed as:

I. Top management: The main responsibility of top management is to evaluate whether the resources of the firm are used in the most effective and efficient way and make sure that the financial position of the firm is good enough. As it has already stated, based on the past performance of a firm, there is some knowledge about what to expect for the future. Top management has therefore the ability to measure how well different departments and processes are working, evaluate how individual employees are doing, and check the company's internal auditing system.

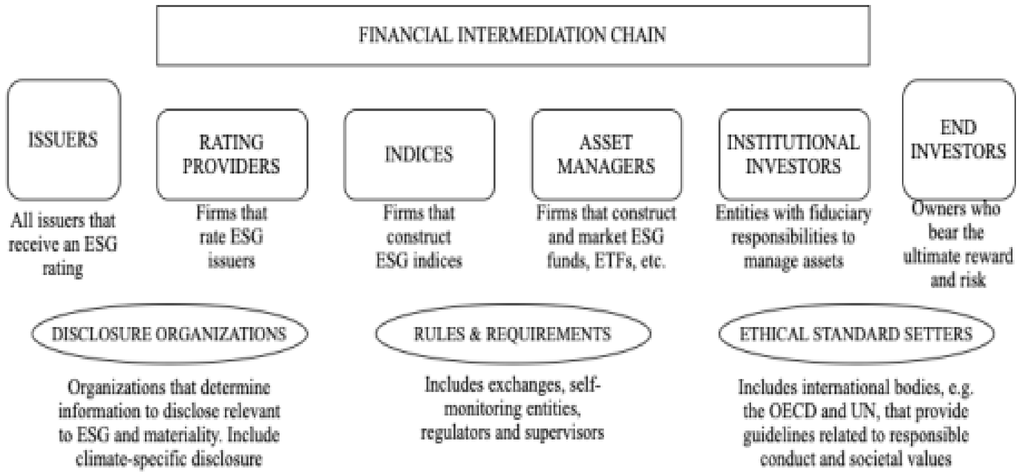
II. Creditors: The creditors want to know the financial strength, capacity, and independency of the borrower. Trade creditors are interested in their claims to meet with the company's ability to pay back over a short span of time, while the suppliers are concerned with the long-term financial health and survival of the company. Banks that lend money to a company can use financial statements to decide if the company will be able to pay back the loan and the interest on time.

III. Shareholders: The shareholders, who have invested in the firm's shares, are most concerned about the firm's earnings. They evaluate the efficiency of the management and consider if any changes need to be made. In larger companies, shareholders decide whether to buy, sell, or hold their shares, depending on the financial performance of the company. In case of a good performance, they wish to buy or hold the shares, while in case of a poor performance they tend to sell their shares.

IV. Economists: Economists study the overall business and economic conditions. They analyze the financial statements of companies to understand what is happening in the economy. Government agencies also look at financial statements to help make decisions about regulations such as setting prices or rates for certain things.

V. Labor unions: Labor unions represent the rights and benefits of workers. They want to make sure whether the rights and the benefits of labour are applied and if workers are motivated and happy. For this to happen, they might ask for things like higher wages or better benefits. But, whether or not a company can provide these things depends on its financial condition. So, labor unions assess a company's financial statements to make sure if the company can afford to give workers these benefits.

Figure 8. ESG financial ecosystem.



Source: Boffo and Patalano (2020)

2.2.2.B Techniques of Financial Analysis

The aim of the analytical technique is to simplify or reduce the data that have to be reviewed in order to understand the terms. There are various tools and techniques of financial statement analysis, each of which is applied in accordance with the goal of the analysis.

The widely techniques used are:
• Ratio analysis.
• Statement of changes in financial position.
• Cash flow statement.

2.2.3 Ratio Analysis

Ratio analysis is the most effective and commonly used analytical technique.

The link between two accounting statistics, represented quantitatively, is known as a financial ratio. Alternatively, the term "ratio" describes the numerical or quantitative relationship between two variables. Numbers can be stated as a percentage, fraction, or proportion in this kind of connection (Weston et al., 1996).

Financial ratios assist us in identifying problem symptoms. Finding the symptoms of any issue is the first step towards figuring out its source. By looking at these ratios' behavior, one can determine a company's operational and financial issues. So, the ratios are thought to be the most accurate indicators of their performance (Goyal, 1988).

The financial ratio is of two types, namely normative and positive. The normative approach involves comparing the organization ratios with the standard values. In a positive approach the financial ratios can be used for forecasting purposes (Mohammadi and Malek 2012).

"Ratio analysis is a part of the whole process of analysis of financial statements of any business or industrial concern especially to take output and credit decision" (Kothari, 2013). Ratio analysis is therefore used to evaluate a company's long-term financial performance and status comparing to other companies. In other words, it can be used to make a qualitative assessment of a company's financial performance, providing a comprehensive view.

Ratio analysis is the methodical use of ratios to the interpretation of financial statements in order to identify the firm's strengths and weaknesses, past performance, and present financial situation. With its guidance, a comparison between various statistics relating to various facts of a business unit may be made. Ratio analysis of a company's financial performance (Kothari, 1990).

Financial ratios are categorized into the following groups:

• Liquidity ratios
• Activity ratios
• Profitability ratios
• Leverage ratios

2.2.3.A ROA

Return on assets (ROA) is a financial ratio that is used to evaluate a company's profitability during a specific period.

It is used to measure the company's ability to generate net income based on the assets it possesses and to present how effectively those assets are utilized to generate profit. So, the higher the ROA, the higher the efficient management of organization earnings as this ratio measures the effectiveness of the organization.

ROA is calculated by comparing NIAT to total assets, which are averaged between the beginning and end of the year. Profit is an indicator of the company's ability to fulfill obligations to creditors and investors and is a part of the company's value creation process related to the company's prospects in the future.

According to Fraser and Ormiston (2008), ROA depicts the amount of profits generated in a period according to the amount of investments in total assets. The higher the ROA, the higher the efficiency of the company to generate net income, and the greater the company's financial performance as for the rate of stock returns. This is the reason why potential investors are appealed to higher ROAs.

Also, it is useful when comparing a firm's performance between different time periods, or when comparing two different firms of similar size in the same industry.

Finally, ROA can be used to determine asset-intensive / asset-light companies; The lower the ROA, the more asset-intensive a company is (e.g. airline company) and the higher the ROA, the less asset-intensive a company is (e.g. software company). As a general rule, when ROA is under 5% is considered an asset-intensive business, while when ROA is above 20% is considered an asset-light business.

The formula for ROA is:

ROA = Net Income / Average Assets

or

ROA = Net Income / End of Period Assets

Where:

Net Income** is equal to net earnings or net income in the year (annual period)

Average Assets is equal to ending assets minus beginning assets divided by 2

**Net income is the total amount of money that a company makes after deducting all the operating costs in a given period. It includes all interest paid on debt, government income taxes owned, and all operational and non-operational expenses.

(Investopedia, 2024,c; Corporate Finance Institute, n.d.,k)

2.2.3.B ROE

Return on equity (ROE) is a financial ratio that is used to measure the firm's ability to turn equity investments into profits.

ROE expresses a company's annual return income divided by the value of its total shareholders' equity, showing the profits made for each dollar from shareholders' equity. So, the higher the ROE, the higher profits are generated.

That is the reason why ROE is a two-part ratio in its derivation, because it assembles the income statement with the balance sheet.

ROE represents returns to shareholders of common stocks and is generally considered an important financial indicator for investors. In order to satisfy investors, a company should be able to generate a higher ROE than the return available from a lower risk investment.

The amount of profit an owner is entitled to with their capital is calculated via ROE. The higher the ROE, the higher the share price increase that the company will have, so the greater the profitability that shareholders will benefit from. In other words, ROE ratio helps shareholders to calculate the level of return of the investments they made for each dollar they spend.

From another point of view, ROE growth indicates that the company's opportunities are well utilized because it knows how to reinvest its earnings wisely, and as a result it boosts the total profit. So, it demonstrates how effective or not is the usage of the own capital.

Some researchers have proved that ROE variables have a partially significant effect on firm's while others support that there is no significant relationship between ROE and the company's value. (Rosikah et al., 2018)

A misleadingly high ROE can occur either from inconsistent profits or from excess debt.

In the first case, the firm has been unprofitable for several years so shareholders equity is reduced. If the same company has had a windfall in the most recent year and returned to profitability, when calculating ROE it would be mistakenly high.

In the second case, the firm has been borrowing money in an aggressive way, and because equity is equal to assets minus debt, ROE would increase. The more debt a company has, the lower equity can fall.

A common scenario is when a company borrows large amounts of debt in order to repurchase its own stock. This can increase EPS, but it does not have an actual effect on performance or growth rates.

The formula for ROE is:

ROE = Net Income / Shareholders' Equity

Or

ROE = Net Income / Average Shareholders' Equity

<u>DuPont</u>

The DuPont is a tool that is used in a company's financial performance analysis which occurs by decomposing ROE in its component parts.

DuPont allows investors to determine what financial activities contribute the most to the changes in ROE. Also, it can help in comparison of the operational efficiency of similar firms. From the other side, managers can use DuPont analysis to identify strengths or weaknesses that should be addressed.

The DuPont analysis implies that a company can increase its ROE via the following:

- Generates Higher Net Profit Margin
- Efficiently Utilizes Assets to Generate More Revenue
- Increases its Financial Leverage

The formula for DuPont is:

DuPont Analysis = NPM × AT × EM

where:

NPM = Net Profit Margin = Net Income / Revenue

AT = Asset Turnover = Sales / Average Total Assets

EM = Equity Multiplier = Average Total Assets / Average Shareholders' Equity

$$\text{ROE} = \frac{\text{Net income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Total Assets}} \times \frac{\text{Total Assets}}{\text{Shareholder Equity}}$$

(Investopedia, 2024,d; Wikipedia, 2024,b; Wall Street Prep., 2024; Corporate Finance Institute, n.d.,l)

2.2.3.C P/E Ratio

Price-to-earnings ratio (P/E Ratio) is a financial ratio that is used to express the relationship between a company's current stock price and its EPS.

The P/E ratio shows the expectations of the market and gives investors a better sense of the value of the company. Since investors require information on how profitable a company is and will be in the future, earnings play a significant role in determining the value of a firm's shares, so knowing the P/E is crucial. Furthermore, the P/E can be understood as the number of years it will take the company to recuperate the amount paid for each share if it fails to grow and its current level of earnings remains constant.

If a stock's P/E is not compared to the firm's historical P/E or the rivals' P/E in the same industry, it does not reveal sufficient information about the stock. Without making any comparisons, it can be difficult to determine if a stock with a P/E of 10x is inexpensive or one with a P/E of 50x is expensive.

When considering about whether is better to own a share with a higher or lower P/E, sometimes is wise to buy shares in companies with a lower P/E because this means you are paying less for every dollar of earnings that you receive. However, a company can have a low P/E because its business model is fundamentally in decline and so the apparent bargain might be an illusion.

There are two types of P/E: Trailing and Forward.

The trailing P/E relies on past performance by dividing the current share price by the total EPS earnings over the past 12 months.

Trailing P/E Ratio = Current Per Share Price of a Stock / EPS from Previous Year

The forward (or leading) P/E uses future earnings guidance rather than trailing figures.

Forward P/E Ratio = Current Share Price / Estimated Future Earnings per Share

The trailing P/E ratio will change as the price of a company's stock moves because earnings are only released each quarter, while stocks trade day in and day out. As a result, some investors prefer the forward P/E. If the forward P/E ratio is lower than the trailing P/E ratio, it means analysts are expecting earnings to increase; if the forward P/E is higher than the current P/E ratio, analysts expect them to decrease.

The price-to-earnings ratio is also sometimes known as the price multiple or the earnings multiple.

The formula for P/E Ratio is:

P/E = Market value per share / Earnings per share

or

P/E = Stock Price Per Share / Earnings Per Share

or

P/E = Market Capitalization / Total Net Earnings

or

Justified P/E = Dividend Payout Ratio / R – G

Where:

R = Required Rate of Return

G = Sustainable Growth Rate

(Investopedia, 2024,b; Corporate Finance Institute, n.d.,j; Corporate Finance Institute, n.d.,m; Corporate Finance Institute, n.d.,e; Wu, 2013; Ghaeli, 2017; Liem and Basana, 2012; Supriyadi, 2021)

2.2.3.D TSR

Total shareholder return (TSR) is a financial ratio that is used to evaluate an investment's performance.

TSR factors in appreciation in a stock's shares and dividends so as it can measure the overall return an investor will have from a stock. It is a metric to evaluate how much an investment is successful or not, in the means of how much additional money the investors capital has earned in a specific time period.

For understanding TSR over a period, one must think of it like the change in the stock price. It is essentially the difference between the starting price and the ending price of a stock, adjusted for changes in expectations, plus any cash payments the company gave to equity holders, over a given period of time.

TSR is the capital accumulation rate. Only investors who reinvest all their dividends into the stock with no taxes or transaction costs can earn the TSR.

Since TSR is externally focused and portrays the market's impression of performance, it could be impacted in a very negative way by the decline of a strong financially company's share price in the immediate future, causing negative publicity or peculiar stock market behavior since it is very sensitive to market volatility.

Total size or return of an investment is not taken into account by TSR, so it may mistakenly favor investments with greater rates of return when the real amount of return is really small.

In addition, TSR does not take into consideration the cost of capital and cannot compare investments over different time periods.

There are two cases when TSR cannot be used. The first one is when the investment has one or more cash inflows after purchase. The second one is when the investment generates cash flows.

The formula for TSR is:

TSR = price appreciation + [(1 + price appreciation) × dividend yield]

or

TSR = (Pfinal – Pinitial) / Pinitial + Div. / Pinitial

Where:

Pinitial = Initial Stock Price

Pfinal = Final Stock Price

Div. = Dividend

(Morgan Stanley, 2023; Investopedia, 2021; Burgman and Van Clieaf, 2022; Lafont et al., 2021)

2.3 Empirical studies on the relationship between ESG and stock performance

Numerous studies have been conducted on the subject, dating back to the 1970s. Friede et al. (2015) wrote about this in 2015, documenting more than 2,200 studies on the links between ESG factors and stock-financial performance. In the present day, a vast number of studies are still being conducted with varied conclusions.

When observing the link between corporate sustainability and corporate financial performance, researchers have focused on two things: the identification of the type of the relationship and of the direction of causation (Waddock and Graves, 1997). Soana (2011) portrays all the possible types of relationships between CS and CFP. Those are the positive one, the negative one, the no-relationship/neutral one and the mixed one. Waddock and Graves (1997) describe the two possible causal directions: the first one, knowing as good management theory, that changes in sustainability of a corporation have a significant impact on its financial performance and the second one, knowing as slack resource theory, that changes in CFP have a significant impact on its sustainability.

2.3.1 Positive relationship

There are a lot of studies indicating that there is a positive and significant relationship between ESG and stock-financial performance.

Gillan et al. (2010) found a positive relationship between a company's operational performance and its scores in governance and environmental factors. Companies with stronger environmental and governance policies tend to have better financial performance. They also found a positive relationship between a company's ESG score and its market value through the Tobin's Q.

Yu and Zhao (2015) discovered a positive relationship between a company's value and its sustainability performance.

Velte (2017) made a research whose sample was taken from German listed companies for the years 2010-2014 and the findings were clear about the positive correlation between ESG factors and ROA, but there was no correlation between ESG and Tobin's Q. Additionally, indicators related to the governance aspect of ESG have a greater positive impact than those related to environmental or social aspects.

Back to 1997, Cohen et al. (1997) made it clear that the firms which have adopted greener techniques are doing as well or better financially than their more polluting counterparts.

Gao et al. (2023) based on firm life cycle perspective and using data from 2010 to 2020 only for Chinese listed companies they aimed to check the dynamic relationship between ESG, corporate financial risk and corporate performance in all life cycle stages. The results were that investing in ESG activities/practices at the decline stage of life cycle can benefit by take up internal resources and financial increase.

Khan (2019) in his study with title "Corporate Governance, ESG, and Stock Returns around the World" which was published in 2019 aimed to check about whether companies' ESG performance - which includes corporate governance strength - predicts stock returns. As a result, it was found that the ESG materiality framework looks for investment value in ESG performance by focusing on ESG issues that are important to shareholders and other stakeholders, so that stock returns can be predicted.

Al Amosh (2022) conducted an analysis with subject "Environmental, social and governance impact on financial performance: evidence from the Levant countries" in 2022 which purpose was to investigate if the ESG disclosure has an impact on the financial performance represented by Tobin's Q, ROA and ROE indices in the Levant countries from 2012 to 2019, which was a period of turmoil and political repercussions that affected the countries of the region. The finding shows that environmental, social and total ESG scores helps in maximization of financial performance whereas governance score can only influence ROA. This suggests that companies should focus on external stakeholders mainly because that way they will achieve their financial performance goals. Meanwhile, it is also important to improve their non-financial performance by enhancing their disclosure levels.

Pu (2023) made a survey in which the goal was to identify the relationship between ESG and financial performance as non-linear. The findings of Chinese listed firm show a positive relationship between ESG and the firm performance. However, the relationship is nonlinear. The meaning of this is that the relationship between those two is inverted U-shaped, which indicates the relationship is positive up to a certain threshold and once the ESG activities cross that threshold it starts to have negative effect on the financial performance of the firm.

The results of Bettin's thesis (2021) showed that the integration of ESG factors in investments does not penalize returns, instead decreases the investment's volatility by increasing the probability of avoiding or reducing losses.

Kong et al. (2023) made a study which sample was made by top global tech leaders of 2018 for the period of 2010 to 2017. For the determination of corporate's current and future values were two proxies: EPS and P/E. Findings showed that ESG scores had a positive and statistically significant relationship with firm's value, not so much to the current value when compared to how promising the impact was for future value. But most importantly, despite the increased risk of ESG investments in the hi-tech sector, firms with higher ESG scores not only report higher earnings performance, but investors also are optimistic about future financial prospects of such firms (Kong et al., 2023).

Ray and Goel's (2022) research contained 48 Indian firms from BSE100 index in the period of 2011-2019. The analysis suggests a positive correlation between ESG score and a firm's financial performance (Ray and Goel, 2022).

Ahmad et al. (2021) published a study that re-examines the impact of total and individual dimensions of ESG on CFP with a sample of firms from FTSE350 for the period 2002-2018. The results of total ESG indicate that it has a positive and significant impact on market value and EPS. However, the results are mixed when considering the individual dimensions of ESG and their impact on financial performance of firm, but overall high ESG firms perform better as compared to low ESG firms. Also, firm size plays an important role in the correlation of these two.

Khan (2019b) tried to find new governance and ESG metrics to predict stock returns worldwide. The results were that indeed those metrics were found to predict stock returns in a global investable universe over the tested period. In the cross-section, forward stock returns increased monotonically across governance and ESG quartiles, suggesting potential investment value in curated ESG signals.

Liu et al. (2023) published a study that compiled with Japanese listed companies from January 2016 to December 2021. The results showed a positive association between ESG and stock returns during the Covid-19 period. Most importantly, it was demonstrated that strong ESG performance contributed to enhanced stock market stability and increased market liquidity in Japan.

Wu (2023) in his thesis presents the results that companies with higher ESG tend to have lower volatility and lower Tobin's Q than companies with lower ESG. Also, companies with higher ESG are more likely to cope better with an increase in volatility and a decrease in Tobin's Q associated with the financial crisis than companies with lower ESG. Lastly, there is no correlation between ESG performance and net margin so before as after the financial crisis.

Agnese's (2020) results show that a greater commitment to ESG factors would lead companies to higher, or at least more stable, financial outcomes. The analysis proves the presence of a negative risk premium for the ESG factor, which means that a company is safer when it has a greater commitment to ESG.

In XU's (2022) thesis the dataset was made from A-share listed companies from 2018 to 2020. The results show that ESG rating has a positive impact on the company's financial performance, which is greater when the company is state-owned than when it is not state owned. Thus, with the increase of the company's R&D expenditure, the impact of ESG rating on the company's financial performance is gradually increasing.

Henri and Klomsiyah's (2023) sample consisted only of companies listed on the Indonesia Stock Exchange and are based in ASEAN-5 in the period 2008-2020. The findings implicate that ESG disclosure has a positive impact on the company's market performance. Also, there is a causal relationship between economic growth and stock market development. As far as it concerns the sustainability, political stability has a significant positive impact on stock market movements both in the short and long term .

Koundouri et al. (2021) published a paper with a study from the companies of STOXX Europe ESG Leaders 50 index. Results were clear about the existence of positive correlation between ESG performance and financial results and implying a comparatively lower equity risk, except for companies in automotive sector. As far as it concerns the D/E ratio, ESG had no impact on it, whereas both ROA and ROE had a good relationship with ESG performance in all sectors.

Serafeim and Yoon's (2023) thesis had the aim to investigate whether ESG rates can predict future ESG news and the associated market reactions. The results show that indeed ratings can predict future news, but its ability weakens for firms that there is a great disagreement between raters for their ratings. In the presence of high disagreement between raters, the relation between news and market reactions diminishes while the rating with most predictive power predicts future stock returns.

Khan's (2022) study attempted to synthesize literature on ESG performance and its impact on financial performance through bibliometric analysis and meta-analysis of more than two hundred studies. The results showed that most of the studies revealed a positive and significant correlation between ESG scores and CFP. Also, it was highlighted that firms with greater ESG practices tended to have reduced risks, lower costs of capital, and improved long-term value.

Kotsantonis et al.'s (2016) results showed that companies with stronger ESG performance experienced higher stock returns, which in fact led to creation of intangible value, attraction of socially responsible investors and migration of risks, leading to improvement in corporate value.

Zhou and Zhou's (2021) article presents that companies with excellent ESG performance tend to reduce stock price volatility on a crisis like Covid-19 and are more capable of stabilization of the stock price. In comparison with companies which had poor ESG performance, they had significantly lower volatility over the same period of time.

2.3.2 Negative relationship

On the contrary, there are also numerous studies that point out the existence of a negative relationship between ESG and stock-financial performance.

Brammer et al. (2006) found a negative relationship between CSR and financial performance in their sample of UK companies. The striking result was that companies with the highest CSR scores performed worse than the market, while those with the lowest CSR scores performed better than the market.

Filbeck and Gorman (2004) also found a negative relationship, this time between environmental performance and financial performance

Lavorini (2020) used data from 573 companies including listed companies to S&P 500 index for the period of January 2008 to December 2019. The results indicated that the ESG scores have a significant impact and are negatively correlated with the average yields of stocks, which means that companies with lower ESG scores have better stock performance than those with higher ESG scores.

Vuorimaa (2022) made a thesis about "Analysis of the relationship between ESG performance and financial performance of the Scandinavian companies" in 2022. The results of the research are mixed but indicate the existence of a statistically significant negative relationship between environmental and social performance and explained variables, especially when additional financial explanatory variables are taken into consideration. Furthermore, social pillar score has a more significant impact for stock price volatility in comparison with environmental. At the same time, no evidence found on relationship between ESG and stock returns.

The analysis of Lismoen and Moum (2020) is using equal weights and data from 2010-2018, implies that companies with low ESG scores have performed better than those with high ESG scores in terms of cumulative returns. As far as it concerns the quality factor of ESG performance, stock market does not value companies with high ESG scores, meaning there is not a relationship between them.

2.3.3 Neutral relationship

There are also some studies that show no actual evidence about the existence of a correlation between ESG and stock-financial performance at all.

Brammer and Millington (2008) found no linear link between companies' social performance and their financial performance.

Serkan and Emin (2020) used as variables all four ESG scores, ROA, ROE, and Tobin's Q in ther survey. It has been determined that the ESG scores do not have a statistically significant effect on the financial performance of airline companies, while there is only a statistically significant relationship between the ESG overall score and ROA. This drives to the conclusion that airline sector investors do not take their ESG scores into consideration and vice versa.

Dreyer et al. (2023) conducted a study with the title "Do environmental, social and governance practices affect portfolio returns? Evidence from the US stock market from 2002 to 2020." As far as it concerns the risk-adjusted returns, the results are highly dependent on the rating provider used, and neither support underperformance nor indicate a tendency over time, which implements that that ESG is not a determinant of portfolio performance.

Ismaili and Kjøsnes (2021) aimed to analyze the difference between the impact of lower and higher rated ESG in stock performance of Scandinavian companies from 2011 to 2020. Findings indicate that there is a neutral relationship between ESG and stock performance. Furthermore, companies with higher ESG scores tend to be less exposed to systematic risk than companies with lower ESG scores. Finally, there is no correlation between stock market performance and ESG performance when using ESG scores, ESGC scores, environmental and social scores individually. A positive relationship only occurs between stock and governance performances.

Junius et al. (2020) used a sample of 271 listed companies of four ASEAN countries (Indonesia, Malaysia, Singapore, and Thailand) for five years period (2013- 2017). Firm Performance is examined by dividing it into three measurements: Operational Performance (ROA), Financial Performance (ROE) and Market Performance (TQ) and Market Value (P/E). The findings indicate that there is not significant impact from ESG score to firm performance and its three components also.

2.3.4 Mixed relationship

The mixed relationship theory defines the link between ESG and stock-financial performance to be as inconsistent overtime.

Kuykendal (2019) figures out that ESG ratings has a negative and a positive correlation with company's stock performance. Sectors like utilities, healthcare, and basic materials see a distinct positive relationship between high ratings and high market performance. On the contrary, companies from sectors like technology, real estate, industrials, energy, and consumer outperformed defensive ESG ratings indicated negative performance indicating that the negatively trending sectors either face financial loss when pursuing ESG initiatives or simply are incapable of correctly balancing ESG with overall company performance.

De Lucia et al.'s (2020) goal of study was to explore whether ESG practices would lead to better performances for European public enterprises. The main results suggested that the financial metrics ROE and ROA that were used did not had a clear relationship with ESG and that there is the need for focus on policy implications on the following ESG issues- Environmental innovation, employment productivity and diversity and equal opportunity.

Liu et al. (2022) made a qualitative comparative study with the topic being the examination of how different configurations of ESG pillars affect corporate finance performance from the perspective of configuration. The data were from 2016 to 2020 and refer to Chinese energy listed companies. There is no consensus on the impact of total ESG on CFP. The results show that different configurations of ESG pillars may generate high CFP and low CFP outcomes. Also, the S pillar score had a much more important impact on CFP than scores on the E and G pillars.

Lin et al.'s (2015) purpose of the study was to explain how CSR affects financial performance with the mediating role of intellectual capital and the moderating role of industry type. The results indicate that CSR can indeed enhance intellectual capital, which can increase financial performance. However, the direct effect of CSR on financial performance may be different for each industry type. This effect is significantly positive in environmentally sensitive industries, but significantly negative in environmentally non-sensitive industries.

McPheeters (2022) used a sample consisted of 377 of S&P 500 firms between January 2010 and September 2019. The findings were that total ESG, environment, and social scores had no significant relationship with excess returns whereas governance score had a positive and statistically significant relationship with excess returns.

Triantafyllidou's (2021) dataset was created from the large-cap companies listed in the S&P500 for the years 2017 to 2020 and financial performance is measured by the year-over-year change in revenues. The results represent a positive significant relationship between governance and financial performance whereas a negative correlation exists between both ESG total and environmental with financial performance. Also, there is no relationship between financial performance and the social pillar.

Peltonen (2022) wrote a thesis with data from 192 firms during the years 1999-2021. The results show that ESG does not have a strong impact on stock returns but there is a positive relationship between ESG and TQ in some of the Nordic countries. As far as it concerns the firm performance, the results are neutral and varying so it is difficult to say if high ESG scores have a positive or a negative impact on it.

Erdenetugs' (2022) thesis database consists of 269 publicly listed extractive firms in 2018. The results suggest that there is a weak but positive correlation between total ESG score, and CFP which is measured by TQ and ROE. When analyzing ESG factors individually for association with ROE, it is revealed that the social and governance scores are not associated with ROE, whereas the water score and environmental score is positively associated with ROE.

Breuer and Nau (2014) used a sample consisted of 100 listed US technology companies over the period from 2009 to 2012. The findings show that there is a positive relationship between the overall ESG performance and CFP, from both an accounting and a market perspective but it is not clear if greater CFP is achieved through higher ESG performance or if better performing companies have more resources to invest more in ESG. Moreover, not all three ESG pillars have a significant relationship with CFP. This study outlines that firms with high ESG scores have higher market values because they seem as less risky. ESG investment is not value destroying, and rather value creating, both from a market and an accounting perspective. Control variables such as ROA or sales are not significant in conducting a market-based analysis for the technology industry.

Fatemi et al. (2018) made a research about “ESG performance and firm value: The moderating role of disclosure” in 2017. The results indicate that environmental strengths increase the firm’s valuation and that weaknesses decrease it. As far for social and governance factors, while weaknesses in both areas again tend to decrease valuation, neither social nor governance strengths increase it.

Kulsrud and Storvik’s (2022) sample data for ESG was collected from three different rating providers for the years 2018-2021, constructing two portfolios. The first consisted of high and low ESG rated firms and the second of the high and low difference. The results defined a statistically and economically significant relationship for the first portfolio but for the second portfolio there were no correlation, suggesting that there is no clear answer about if investors in emerging markets would pay a premium for holding high ESG-rated firms over low ESG-rated firms.

Pulino et al. (2022) made a report in 2022 with the title “Does ESG Disclosure Influence Firm Performance?” In this study they tried to analyze the impact of ESG disclosure on the performance of a firm, used data from 10 years duration (2011 to 2020) of only Italian listed companies with the help of EBIT and ROA. The results showed that the environmental and the social pillars have a positive impact on firm performance. However, no significant impact has been found in relation to the governance pillar. Also, the E score has a strong negative impact on ROA.

Kim and Li (2021) tried to find a relationship between ESG factors and CFP which led to the following findings: The total ESG score has a positive impact on corporate profitability. As far as it concerns the relationship between governance and corporate profitability, it was only observed positive in firms with weak governance. While social, governance and total ESG scores have positives correlations with credit rating, E score has a surprisingly negative one.

Alareeni and Hamdan (2020) showed that ESG disclosure positively affects a firms’ performance measures. Their findings were the following: Measuring ESG sub-components separately showed that environmental (EVN) and corporate social responsibility (CSR) disclosure is negatively associated with ROA and ROE. EVN and CSR disclosure is positively related to Tobin’s Q. Further, corporate governance (CG) disclosure is positively related to ROA and Tobin’s Q, and negatively related to ROE. More importantly, ESG, CSR, EVN and CG tend to be higher with firms that have high assets and high financial leverage. Furthermore, the higher level of ESG, EVN, CSR and CG disclosure, the higher the ROA and ROE.

Papenburg (2022) investigated the topic “ESG performance and company financial performance moderated by board gender diversity and sensitive industries.”
The sample contained 85 listed west European companies from 2013 to 2020. The moderating effect of sensitive industries is found on relation of ESG performance and company financial performance with ROA as performance indicator. The effect of ESG on CPF is weaker for sensitive industries and the effect of board gender diversity is not significant.

“Are high ESG-rating companies performing better?” is a thesis written by Kruszelnicki (2022). The database was referred to a time-period of 1st January 2017 to 1st January 2022 and was constructed by three portfolios. The first one is a high and low ESG rating portfolio, the second one is a high and low sector-based portfolio, and the third one is a value and growth portfolio based on the median P/E ratio of the sectors. The findings regarding the first portfolio show that low ESG rating portfolios tend to outperform high ESG rating portfolios when comparing about excess return, Sharpe ratio, and Sortino ratio. Also, both ESG rating portfolios have not a statistically significant impact on returns. Lastly, about the third portfolio, growth outperformed value.

Yoon et al.’s (2018) main goal of research was to examine whether there is an impact of ESG on CSR in an emerging market as Korea. Results indicated that the valuation effect of corporate governance practice is strongly positive for chaebols, whereas it is negative or insignificant for ordinary Korean firms.

“Exploring the relationship of ESG score and firm value using cross-lagged panel analyses: case of the Indian energy sector” is an article written by Behl et al. (2021). The aim of the study was to evaluate the bidirectional causality and autoregression effects between ESG scores and the firm value of Indian energy sector companies. The results show that both total and individual ESG scores do not have a clear relationship with firm value, but it varies in each case. Overall, the impact of the ESG scores in CFP varies across economies, industries, and institutional frameworks due to varying legal, social structures and expectations from stakeholders.

2.3.5 Complexity of the relationship

Now that we have stated some studies and their important findings for each category, it is quite obvious that the majority of them depict a positive relationship, then some depict a mixed one, a few a neutral one and a little a negative one. This outcome has been also ascertained by research analysis. In the following, there are two such examples:

Whelan et al. (2021) made a research on the topic "ESG AND FINANCIAL PERFORMANCE: Uncovering the Relationship by Aggregating Evidence from 1,000 Plus Studies Published between 2015 - 2020", in which they found evidence that support a positive relationship between ESG and financial performance for 58% of the "corporate" studies focused on operational metrics such as ROE, ROA, or stock price with 13% showing neutral impact, 21% mixed results (the same study finding a positive, neutral or negative results) and only 8% showing a negative relationship.

Another research that can confirm the variation of the results is "Misery Loves Companies: Rethinking Social Initiatives by Business" written by Margolis and Walsh (2003) counting 109 different studies that explore the relationship between CSP and CFP. Findings suggested that out of these 109 studies, 54 find a positive correlation, 7 a negative correlation, 28 find a non-significant impact, and 20 mixed results. This inconsistency in results further supports the divergent beliefs and views concerning the CSP and CFP relationship.

From the above facts, the complex nature of this relationship is apparent.

2.3.6 Critiques of the relationship

The mentioned articles constitute a non-exhaustive list. It is important to note that most of the studies conducted on the subject tend to conclude that the relationship between corporate sustainability and stock-financial performance is non-negative.

However, the disparity in results can be attributed to several possible explanations:

I. Temporal Variations: Data collected in each article comes from different time periods. Is it logical to compare CSR policies in the 1980s or even the early 2000s with those implemented today or during the 2010s?

II. Geographic Differences: Data from different articles often come from various geographical areas. While some attempt to provide an overall view, many analyze companies in specific countries. CSR may be perceived differently in each region of the world. Can results obtained in European countries, which are among the global leaders in implementing CSR policies, be generalized to other countries?

III. Diverse Indicators: Different articles often use non-identical indicators. For ESG, various types of indices are available, ranging from general ESG scores calculated by major groups like Bloomberg to extremely specific indicators on particular aspects of ESG, such as the number of women in the board of directors or the amount of recycled waste. Similarly, there are numerous possible indicators to evaluate a company's financial performance, such as ROE, ROA, EBIT, TQ, etc., all of which can be calculated differently depending on the data source.

IV. Inconsistent Terminology: Research occurring ESG and financial performance often has to deal with various and different terminology and codification. Meuer et al. (2019) found that there are 33 definitions of corporate sustainability in usage.

V. Material and Immaterial ESG: Research often struggles to differentiate between material and immaterial ESG issues as well as ESG leaders versus improvers. For example, Khan et al. (2016) establishes the alpha potential of companies incorporating material ESG issues, in the matter of stock performance, outperforming those who focus on immaterial ESG issues or no ESG issues at all.

VI. Overcomplicating Results: Usage of ESG data with such a lack of standardization makes it impossible for the results to be clear. Studies use different ESG scores for different companies by different data providers. Eccles et al. (2017) reviewed a global survey of institutional investors and concluded that “the biggest barrier is the lack of high-quality data about the performance of companies on their material ESG factors.” Furthermore, ESG disclosure is not easy to find for several companies or there is not at all, that happens because ESG legislations about mandatory disclosure is not the same worldwide. Also, there are plenty of evidence about the shortcomings of accounting metrics and ESG data (Berg et al., 2022). Finally, corporate sustainability on its own cannot give us a clear view about its effect on CFP because nowadays companies appear

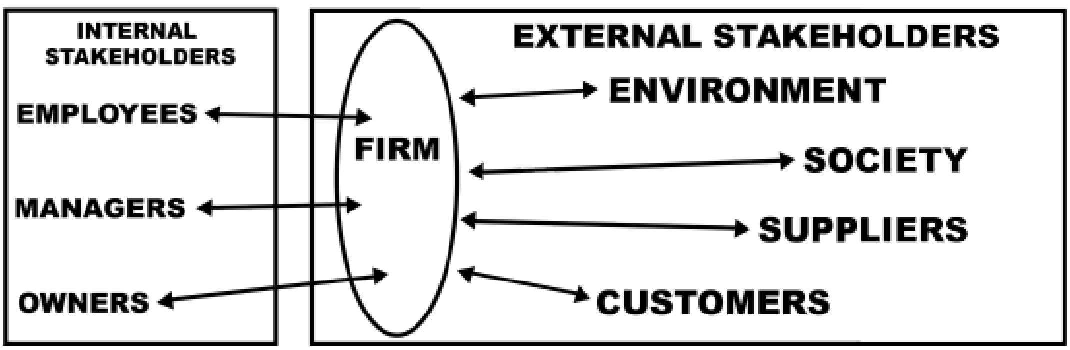
to have adopted a more sustainable character, but it is only mediating factors such as improved risk management and more innovation.
The sometimes-contradictory links between ESG and financial performance are characterized by the opposition of two ideological positions:

Neo-Classical Position / Shareholder Theory: Led by M. Friedman (2007), who defined the responsibility of a business in 1970 as maximizing profits for its shareholders within the rules of fair competition. Any activity with a goal other than profit maximization would incur higher costs for the company, create conflicts of interest with shareholders, and ultimately decrease overall performance.

Figure 9. Shareholder Theory - Illustration of Freidman's description.

Stakeholder Theory: Developed by R.E. Freeman (2005) in 1984 in "Strategic Management: A Stakeholder Approach" and the concept of "Shared Value" introduced by M. Porter and M. Kramer (2011) in "Creating Shared Value" in 2011. They reinvent the primary purpose of a business not as maximizing shareholder value but as maximizing the overall well-being of all stakeholders, including shareholders, customers, employees, suppliers, and the environment.

Figure 10. Stakeholder Theory - Illustration of Freeman's description.



3. Methodological Framework: Design, Sampling, And Variable Measurement

3.1 Research Design and Originality of the Research.

3.1.1 Research Design

This study is a quantitative research in which are collecting and analyzing numerical data with experimental research design. As far as it concerns the data collection method is secondary research which uses secondary data sources to review existing research in order to examine if and how they can contribute to understanding a new issue that is in question. Finally, data analysis procedure is going to involve statistical and econometrical techniques.

3.1.2 Originality of the Research.

This thesis contributes on broadening the existing literature by exploring the existence of a correlation between ESG rates and stock performance in Europe, in the times of Covid-19 pandemic, a high market volatility period, while also using a combination of dependent variables/performance indicators (ROE, ROA, P/E, TSR) that have not been used before all together.

3.2 Sample Selection and Data Sources

3.2.1 Sample Selection

For the creation of the sample, there were basically two requirements that all companies should fulfill.

The first one was for the company to be public traded for at least before 2017. That serve the purpose that in the research there should be only companies that have stocks so we can measure their stock performance. Also, the data that have been used refer to the years from 2019 to 2022. Companies that made their first time IPO in 2018 were excluded because their first year would have been probationary and accordingly not accurate for this kind of research.

The second one was the nationality of the company as there were only used European companies in the research. Something worth mentioning is that it was a challenge to choose to work with companies in Europe and not in USA or worldwide as up to now there are still some countries in Europe that have not make mandatory for companies to publicly announce their ESG rates.

Consequently, keeping those requirements in mind, the sample has been made by companies which constitute the STOXX Europe 600, also known as STOXX 600 or SXXP. "STOXX Europe 600 is a stock index of European stocks designed by STOXX Ltd. This index has a fixed number of 600 components representing large, medium, and small cap. companies among 17 European countries, covering approximately 90% of the free-float market cap. of the European stock market (not limited to the Eurozone). The countries that make up the index are the United Kingdom (composing around 22.3% of the index), France (composing around 16.6% of the index), Switzerland (composing around 14.9% of the index) and Germany (composing around 14.1% of the index), as well as Austria, Belgium, Denmark, Finland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Spain, and Sweden" (Wikipedia, 2024,c).

From those 600 companies, 539 were used in the analysis as some of the data needed could not be gathered for the other 61.

3.2.2 Data Sources

To address the research questions and objectives, the proper way of collecting information is one of the most crucial parts.

In this study, all measurements used were collected from established data sources. More specifically, data were collected from LSEG Financial Data - Refinitiv, and the financial statements for the years 2019 to 2022 of each firm.

The majority of the data that has been used were pre-existing so that makes them secondary, while there is one type of data that is primary.

3.3 Variables and Measurement Techniques

3.3.1 Variables

In order to understand each variable that has been used, firstly it is important to understand the topic of this study. The question is if the ESG rate of a company is important enough to influence its stock performance on the market.
So, the first set of variables that have been used to check this assumption is clearly the ESG ones. That leaves us with three variables: ESG_Environmental Rate, ESG_Social Rate and ESG_Governance Rate.

For the second part of the assumption, there is the need to clarify the constituent elements of the stock performance, which can differ for every researcher. In this research those are Return on Equity (ROE), Return on Assets (ROA), Price-to-Earnings Ratio (P/E Ratio) and Total Shareholders Return (TSR).

Also, a thing worth mentioned is the timeline that has been used. There are chosen four years for the study: 2019, 2020, 2021 and 2022. So, another variable is Year.

Into the more technical part, classification of the variables as quantitative and qualitative: All variables are quantitatives.

3.3.2 Measurement Techniques

As it was earlier mentioned, the prices of all ESG Rates, ROE, ROA, and P/E for the years mattered (2019-2022) were collected from data bases. In contrary, TSR prices for the i-th company in the j-th year were calculated one by one from the financial statements of theirs for the favor of this research.

In this point is crucial to be stated the meaning of every price behind the variables. ESG_E Rate, ESG_S Rate and ESG_G Rate are provided annually by organizations that rate companies upon ESG factors. So, every year we have a price which is corresponding to each ESG Rate.

That was the easiest part, the hardest part includes ROE, ROA, P/E and much more TSR.

That happens because every company has each own regulations on how and when they are releasing their financial statements. Some prefer to publicly release them every quarter of the year, some every six months, and some annually. So there had to be a way to compare all those: We did it by fix on the numbers that came out annually at the end of the year.
For example, when we were looking for a company's ROA for the year of 2022, we had to go through their financial statements that were released at the end of 2022 (31 December 2022). That was the only way that all those data could be comparable and legitimate.

As for TSR, "When calculating TSR, an investor can only consider the dividends they actually received or were eligible to receive. For example, they may be in possession of the stock on the day the dividend is payable, yet they receive the dividend only if they owned the stock on or before the ex-dividend date. Therefore, an investor needs to know the stock's ex-dividend date rather than the dividend payment date when calculating TSR" (Investopedia, 2021).

4. Theoretical Foundations of Regression Analysis: Assumption, Diagnostics, and Interpretation

4.1 Introduction to Regression Analysis

In this chapter are presented in theoretical terms and are thoroughly analyzed all the important information about regression analysis. Specifically, in the beginning there is an explanation of the multiple linear regression model and the assumptions that govern it. Then there is every aspect, in the correct order that must be taken into consideration and checked when performing a regression analysis; descriptive statistics, correlation analysis, linearity and inferential statistics, analysis of variance, independence and normality of errors, homoscedasticity and heteroscedasticity, multicollinearity diagnostics and last but not least, investigation of unusual and influential observations.

"Multiple linear regression refers to a statistical technique that is used to predict the outcome of a variable based on the value of two or more variables. It is sometimes known simply as multiple regression, and it is an extension of linear regression. The variable that we want to predict is known as the dependent variable, while the variables we use to predict the value of the dependent variable are known as independent or explanatory variables.

Multiple Linear Regression Formula: $Yi = β0 + β1Xi1 + β2Xi2 + … + βpXip + ε$

Where:

Yi is the dependent or predicted variable

β0 is the Y-intercept, i.e., the value of Y when both X1 and X2 are 0.

β1 and β2 are the regression coefficients representing the change in Yi relative to a one-unit change in Xi1 and Xi2, respectively.

βp is the slope coefficient for each independent variable.

ϵ is the model's random error (residual) term.

Multiple regression is a type of regression where the dependent variable shows a linear relationship with two or more independent variables.

Multiple linear regression is based on the following assumptions:

1. A linear relationship between the dependent and independent variables: The first assumption of multiple linear regression is that there is a linear relationship between the dependent variable and each of the independent variables.

2. The independent variables are not highly correlated with each other: The data should not show multicollinearity, which occurs when the independent variables (explanatory variables) are highly correlated. When independent variables show multicollinearity, there will be problems figuring out the specific variable that contributes to the variance in the dependent variable.

3. The variance of the residuals is constant: Multiple linear regression assumes that the amount of error in the residuals is similar at each point of the linear model. This scenario is known as homoscedasticity. When analyzing the data, the analyst should plot the standardized residuals against the predicted values to determine if the points are distributed fairly across all the values of independent variables.

4. Independence of observation: The model assumes that the observations should be independent of one another. Simply put, the model assumes that the values of residuals are independent.

5. Multivariate normality: Multivariate normality occurs when residuals are normally distributed." (Corporate Finance Institute, n.d.,i)

Now that we have set up and explained the model, we should explain thoroughly every statistical method and econometrical technique that we are going to use.

4.2 Descriptive statistics

"Descriptive statistics are brief informational coefficients that summarize a given data set, which can be either a representation of the entire population or a sample of a population. Descriptive statistics are broken down into measures of central tendency and measures of variability (spread), and frequency distribution. Measures of central tendency include the mean, median, and mode, while measures of variability include standard deviation, variance, minimum and maximum variables, kurtosis, and skewness. Measures of frequency distribution describe the occurrence of data within the data set (count)” (Investopedia, 2023,c)

In the output of descriptive statistics, we should pay more attention to skewness and kurtosis because they are used as a metric to examine fast if data is normally distributed.

"Skewness assesses the extent to which a variable’s distribution is symmetrical. If the distribution of responses for a variable stretches toward the right or left tail of the distribution, then the distribution is characterized as skewed. A negative skewness indicates a greater number of larger values, whereas a positive skewness indicates a greater number of smaller values.
As a general guideline, a skewness value between -1 and +1 is considered excellent, but a value between -2 and +2 is generally considered acceptable. Values beyond -2 and +2 are considered indicative of substantial nonnormality." (Hair et al., 2022).

“Kurtosis is a measure of whether the distribution is too peaked (a very narrow distribution with most of the responses in the center). A positive value for the kurtosis indicates a distribution more peaked than normal. In contrast, a negative kurtosis indicates a shape flatter than normal.
Analogous to the skewness, the general guideline is that if the kurtosis is greater than +2, the distribution is too peaked. Likewise, a kurtosis of less than −2 indicates a distribution that is too flat.
When both skewness and kurtosis are close to zero, the pattern of responses is considered a normal distribution” (George & Mallery, 2019; Hair et al., 2022).

“Descriptive statistics allow for the ease of data visualization. It allows for data to be presented in a meaningful and understandable way, which, in turn, allows for a simplified interpretation of the data set in question” (Corporate Finance Institute, n.d.,c)

4.3 Correlation Analysis

The study of how variables are correlated is called correlation analysis.
Correlation is used to test relationships between quantitative variables or categorical

variables. Correlation is a statistical term describing the degree to which two variables move in coordination with one another. If the two variables move in the same direction, then those variables are said to have a positive correlation. If they move in opposite directions, then they have a negative correlation.

"The Pearson correlation produces a sample correlation coefficient, r, which measures the strength and direction of linear relationships between variables. The coefficient can take any values from -1 to +1.
The interpretations of the values are:

- -1: Perfect negative correlation. The variables tend to move in opposite directions (i.e., when one variable increases, the other variable decreases).
- 0: No correlation. The variables do not have a relationship with each other.
- +1: Perfect positive correlation. The variables tend to move in the same direction (i.e., when one variable increases, the other variable also increases)." (Corporate Finance Institute. (n.d.,b)

"The correlation coefficient can be found using the following formula:

$$r_{xy} = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \sum(y_i - \bar{y})^2}}$$

Where:

rxy are the correlation coefficient of the linear relationship between the variables x and y

xi are the values of the x-variable in a sample

$\bar{x}$ is the mean of the values of the x-variable

yi are the values of the y-variable in a sample

$\bar{y}$ is the mean of the values of the y-variable" (Corporate Finance Institute, n.d.,b)

Correlation and p-value

"In statistics, a p-value is used to indicate whether the findings are statistically significant. It is possible to determine that two variables are correlated, but there may not be enough supporting evidence to state this as a strong claim. A high p-value indicates there is enough evidence to meaningfully conclude that the population correlation coefficient is different from zero.

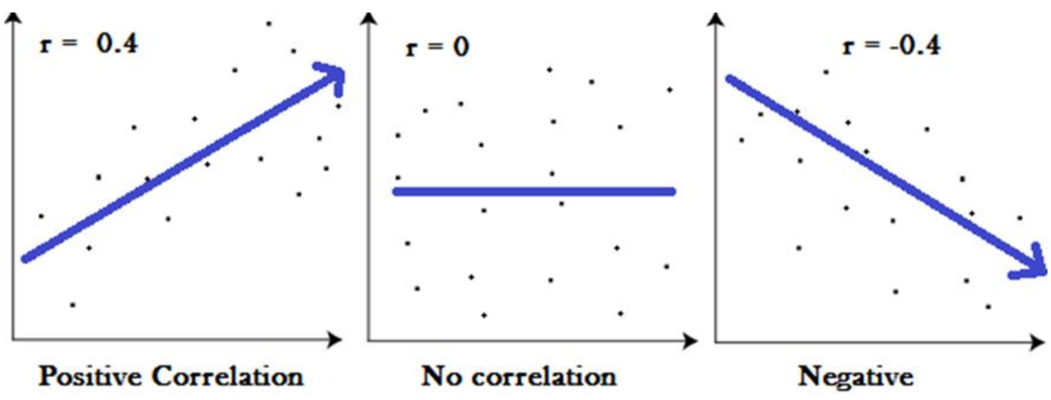
Scatterplots

The easiest way to visualize whether two variables are correlated is to graphically depict them using a scatterplot. Each point on a scatterplot represents one sample item. The x-axis of the scatterplot represents one of the variables being tested, while the y-axis of the scatter plot represents the other.

The correlation coefficient of the two variables is depicted graphically often as a linear line mapped to show the relationship of the two variables. If the two variables are positively correlated, an increasing linear line may be drawn on the scatterplot. If two variables are negatively correlated, a decreasing linear line may be draw. The stronger the relationship of the data points, the closer each data point will be to this line.

Scatterplots may be more useful when analyzing more complex data that might have changing relationships. For example, two variables may be positively correlated to a certain point, then their relationship becomes negatively correlated. This non-linear relationship may be more difficult to identify using formulas but can be easier to spot when graphed on a scatterplot." (Investopedia, 2023,b)

Figure 11. Scatterplots showing a correlation of +0.4, 0 and -0.4.



4.4 Linearity

Linearity describes the relationship between two (or more) variables when they tend to change at the same rate. A linear model is a type of theory in which one variable (the dependent variable) is postulated to be related to one or more other variables (the independent variables) in a simple direct proportion - a straight line relationship.
A straight line relationship refers to a direct correlation between a dependent variable and one or more independent variables. (Social Research Glossary, 2019)

"Linearity is important for:

1. Regression Analysis

One of the most common uses of linearity is in regression analysis.
We need to make sure that the relationship between the variables is linear before we assume that it is.
If there is not a straight-up relationship, we might need to transform the data or use a different model to capture the behavior of the variables accurately.

By testing for linearity in regression, we can be confident that our linear regression results accurately reflect the relationship between the variables we are interested in.

2. Correlation

Another reason to care about linearity is that it is crucial for understanding correlation. When the relationship between variables is linear, the correlation coefficient can give us valuable insights into the strength and direction of the relationship.

A correlation coefficient of +1 indicates a perfect positive linear relationship, while a correlation coefficient of -1 signifies a perfect negative linear relationship. A 0 would mean no linear relationship.

3. Analysis of Variance

When we use ANOVA, we need to make sure that the effect of the independent variable(s) on the dependent variable is the same across all levels of the independent variable(s).

By making sure there is linearity, we can be confident that our ANOVA results accurately reflect the differences between groups and let us draw real conclusions about the populations we are studying.

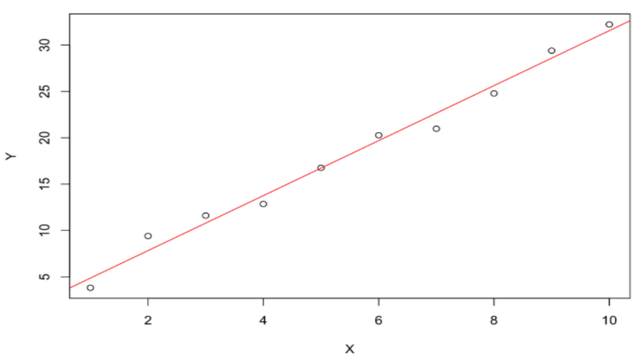
4. Hypothesis Testing

If we assume that there is a linear relationship between the variables, but there is not, we might end up rejecting the null hypothesis when we should not have. That is where linearity comes in. We need to make sure that there is actually a straight-up relationship between the variables we are testing before we start doing hypothesis testing.

How to test linearity in statistics:

- Scatterplots: A scatterplot is a graph that shows how two things are related to each other. If there is a linear relationship, the points on the scatterplot will form a straight line.

Figure 12. Example of a Scatterplot.

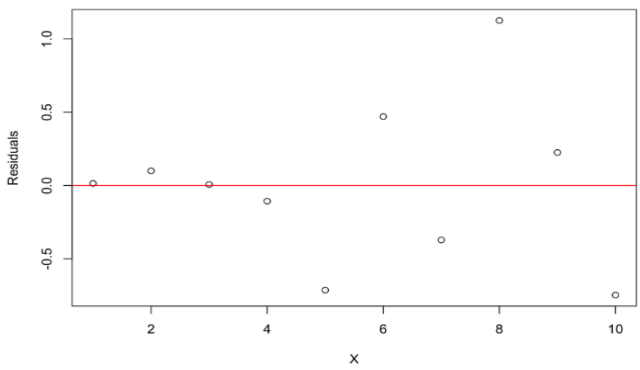


Source: Uedufy (2023)

- Correlation coefficient: The correlation coefficient measures the strength of the relationship between two things. If there is a linear relationship, the correlation coefficient will be close to 1 (or -1 if it's a negative relationship). For example, the correlation coefficient of 0.9975461 indicates a strong positive linear relationship between variables.

- Residual plots: A residual plot shows how far off our predictions are from the actual values. If there is a pattern in the residual plot, our linear model might not be accurate." (Uedufy, 2023)

Figure 13. Example of a Residual plot.



Source: Uedufy (2023)

4.5 Inferential Statistics

"Inferential statistics is mainly used to derive estimates about a large group (or population) and draw conclusions on the data based on hypothesis testing methods and confidence intervals" (Corporate Finance Institute, n.d.,h).

<u>Hypothesis Testing</u>

"Hypothesis Testing is a method of statistical inference. It is used to test if a statement regarding a population parameter is statistically significant.

Here are the steps for hypothesis testing:

1. State the null hypothesis (H_0) and the alternative hypothesis (H_a).
2. Consider the statistical assumptions being made. Evaluate if these assumptions are coherent with the underlying population being evaluated. For example, is assuming the underlying distribution as a normal distribution sensible?
3. Determine the appropriate probability distribution and select the appropriate test statistic.
4. Select the significance level commonly denoted by the Greek letter alpha (α). This is the probability threshold for which the null hypothesis will be rejected.
5. Based on the significance level and on the appropriate test, state the decision rule.
6. Collect the observed sample data and use it to calculate the test statistic.

7. Based on your results, you should either reject the null hypothesis or fail to reject the null hypothesis. This is known as the statistical decision.
8. Consider any other economic issues that are applied to the problem. These are non-statistical considerations that need to be considered for a decision. For example, sometimes, societal cultural shifts lead to changes in consumer behavior. This must be taken into consideration in addition to the statistical decision for a final decision.

Stating the Null Hypothesis and Alternative Hypothesis:

The null hypothesis is usually set as what we do not want to be true. It is the hypothesis to be tested. Therefore, the null hypothesis is considered to be true until we have sufficient evidence to reject it. If we reject the null hypothesis, we are led to the alternative hypothesis.

Type I and Type II Errors:

The binary nature of our decision, to reject or fail to reject the null hypothesis, gives rise to two possible errors. The table below illustrates all the possible outcomes. A Type I Error arises when a true null hypothesis is rejected. The probability of making a Type I Error is also known as the level of significance of the test, which is commonly referred to as alpha (α). So, for example, if a test that has its alpha set as 0.01, there is a 1% probability of rejecting a true null hypothesis or a 1% probability of making a Type I Error.

A Type II Error arises when you fail to reject a false null hypothesis. The probability of making a Type II Error is commonly denoted by the Greek letter beta (β). β is used to define the power of a Test, which is the probability of correctly rejecting a false null hypothesis. The power of a test is defined as $1-\beta$. A test with more power is more desirable, as there is a lower probability of making a Type II Error" Corporate Finance Institute, n.d.,g).

Table 2. Type I and Type II Errors.

	True Case	
Decision	H_0 True	H_0 False
Do not reject H_0	Correct Decision	Wrong Decision **TYPE II ERROR**
Reject H_0	Wrong Decision **TYPE I ERROR**	Correct Decision

Source: CFI (n.d.)

Confidence Intervals

"A confidence interval is an estimate of an interval in statistics that may contain a population parameter. The unknown population parameter is found through a sample parameter calculated from the sampled data.

The interval is generally defined by its lower and upper bounds. The confidence interval is expressed as a percentage (the most frequently quoted percentages are 90%, 95%, and 99%). The percentage reflects the confidence level.

The concept of the confidence interval is very important in statistics (hypothesis testing) since it is used as a measure of uncertainty.

After the statistical interval is calculated, the interval can only either contain the population parameter or not.

The interval is calculated using the following steps:

1. Gather the sample data.
2. Calculate the sample mean $\bar{x}$.
3. Determine whether a population's standard deviation is known or unknown.
4. If a population's standard deviation is known, we can use a z-score for the corresponding confidence level.
5. If a population's standard deviation is unknown, we can use a t-statistic for the corresponding confidence level.

6. Find the lower and upper bounds of the confidence interval using the following formulas:

    a. Known population standard deviation.

$$\text{Lower bound} = \bar{x} - z \times \frac{\sigma}{\sqrt{n}}$$

$$\text{Upper bound} = \bar{x} + z \times \frac{\sigma}{\sqrt{n}}$$

    b. Unknown population standard deviation.

$$\text{Lower bound} = \bar{x} - t \times \frac{s}{\sqrt{n}}$$

$$\text{Upper bound} = \bar{x} + t \times \frac{s}{\sqrt{n}}$$ ”

(Corporate Finance Institute, n.d.,a).

4.6 Analysis of Variance

“Analysis of variance (ANOVA) is a collection of statistical models and their associated estimation procedures (such as the "variation" among and between groups) used to analyze the differences among means. ANOVA is based on the law of total variance, where the observed variance in a particular variable is partitioned into components attributable to different sources of variation. In its simplest form, ANOVA provides a statistical test of whether two or more population means are equal, and therefore generalizes the t-test beyond two means. In other words, the ANOVA is used to test the difference between two or more means” (Wikipedia, 2024,a).

The Formula for ANOVA is:

F = MST / MSE

where:

F = ANOVA coefficient

MST = Mean sum of squares due to treatment

MSE = Mean sum of squares due to error

The result of the ANOVA formula, the F statistic (also called the F-ratio), allows for the analysis of multiple groups of data to determine the variability between samples and within samples.

If no real difference exists between the tested groups, which is called the null hypothesis, the result of the ANOVA's F-ratio statistic will be close to 1. The distribution of all possible values of the F statistic is the F-distribution. This is actually a group of distribution functions, with two characteristic numbers, called the numerator degrees of freedom and the denominator degrees of freedom.

ANOVA tests assume that the data is normally distributed and that the levels of variance in each group is roughly equal. Finally, it assumes that all observations are made independently. If these assumptions are not accurate, ANOVA may not be useful for comparing groups" (Investopedia, 2023,a).

The Kolmogorov-Smirnov Goodness of Fit Test (K-S test) compares data with a known distribution and informs if they have the same distribution. Although the test is nonparametric, which means that it does not assume any particular underlying distribution, it is commonly used as a test for normality to see if your data is normally distributed. It is also used to check the assumption of normality in analysis of Variance. Lilliefors test, a corrected version of the K-S test for normality, generally gives a more accurate approximation of the test statistic's distribution. In fact, many statistical packages (like SPSS) combine the two tests as a "Lilliefors corrected" K-S test.

4.7 Independence of Errors

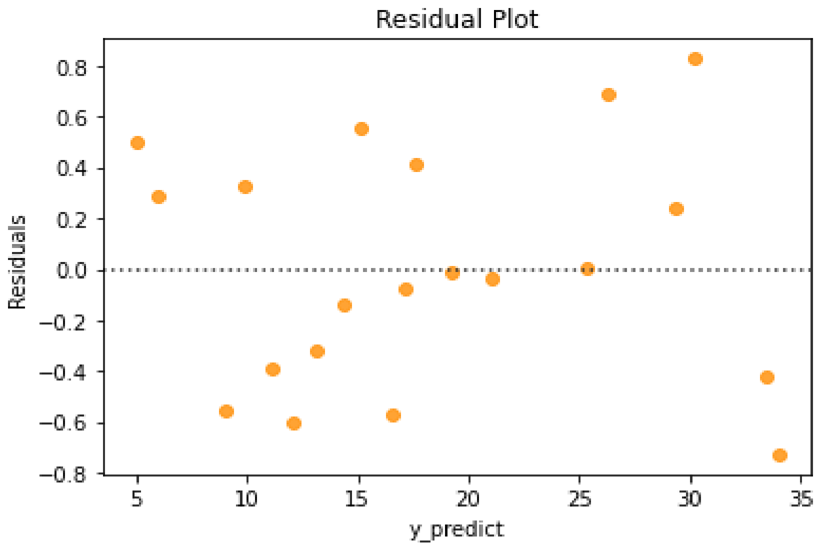
"One of the first assumptions of linear regression is the independence of errors. Independence assumption specifies that the error terms in the model should not be related to each other. In other words, the covariance between the error terms should be 0 and can be represented as:

$$Cov(\varepsilon i, \varepsilon j) = 0 \; for \; all \; i \neq j$$

It is critical to satisfying independence assumption, as violating it would mean that confidence intervals and significance tests will be invalid for the analysis. In the case of time series data where we often have scenarios with data being temporally correlated, violating the independence assumption may lead to bias in parameter estimation for regression and provide invalid statistical inferences.” (Dataversity, 2023)

“To test for non-time-series violations of independence, you can look at plots of the residuals versus independent variables. The residuals should be randomly and symmetrically distributed around zero under all conditions, and in particular there should be no correlation between consecutive errors no matter how the rows are sorted, as long as it is on some criterion that does not involve the dependent variable. If this is not true, it could be due to a violation of the linearity assumption or due to bias that is explainable by omitted variables (say, interaction terms or dummies for identifiable conditions).” Duke University, 2020

Figure 14. Residual plot of residuals and independent variables.



Source: Google Images

Otherwise, you can run a Durbin-Watson Test to detect the presence of autocorrelation in the residuals of a regression analysis.

One of the assumptions of regression is that the observations are independent. If observations are made over time, it is likely that successive observations are related. If there is no autocorrelation (where subsequent observations are related), the Durbin-Watson statistic should be between 1,5 and 2,5.

“The Durbin Watson statistic will always assume a value between 0 and 4. A value of DW = 2 indicates that there is no autocorrelation. When the value is below 2, it indicates a positive autocorrelation, and a value higher than 2 indicates a negative serial correlation.

To test for positive autocorrelation at significance level α (alpha), the test statistic DW is compared to lower and upper critical values:

- If DW < Lower critical value: There is statistical evidence that the data is positively autocorrelated.
- If DW > Upper critical value: There is no statistical evidence that the data is positively correlated.
- If DW is in between the lower and upper critical values: The test is inconclusive.

To test for negative autocorrelation at significance level α (alpha), the test statistic 4-DW is compared to lower and upper critical values:

- If 4-DW < Lower critical value: There is statistical evidence that the data is negatively autocorrelated.
- If 4-DW > Upper critical value: There is no statistical evidence that the data is negatively correlated.
- If 4-DW is in between the lower and upper critical values: The test is inconclusive."

(Corporate Finance Institute, n.d.,d)

4.8 Normality of Errors

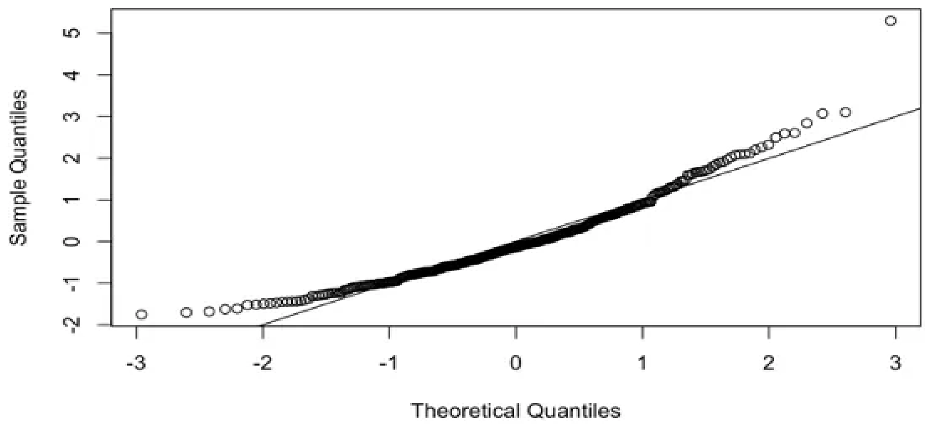
"Extending the linearity assumption, we lead to the normality assumption in linear regression which states that the error term or the residual (ε) in the model follows a normal distribution. We can express that mathematically as follows where ε is the error term, N is the normal distribution with 0 being the mean and σ^2 being the variance.

$$\varepsilon \sim N(0, \sigma^2),$$

Satisfying the normality assumption is critical for performing a valid hypothesis testing and accurate estimation of the coefficients. In case the normality test is violated then it might lead to bias in parameter estimation along with inaccurate predictions. In case the error or residual has a skewed distribution then it won't be able to provide accurate confidence intervals.

In order to validate the normality assumption, we can utilize the above Q-Q norm plot as in Figure 15. Additionally, we can also utilize histograms of standardized errors to validate the normality assumption as in Figure 16.

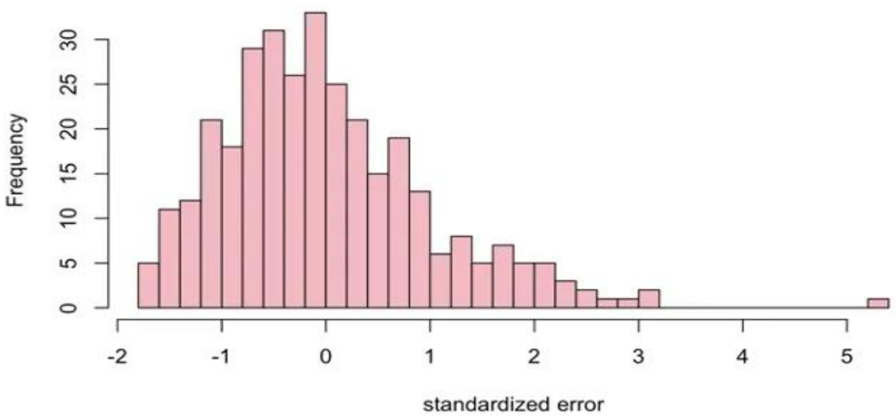
Figure 15. Q-Q norm plot for standardized residuals.



Source: Dataversity (2023)

In Figure 16 we observe how the standardized errors are distributed around 0. Because we are attempting to forecast the outcome of a random variable, errors should be randomly distributed (i.e., a large number of small values centered on zero). In order to have a comparable scale for all the residuals we standardize the errors resulting in a standard normal distribution. Each dot in the plot represents how a standardized residual is plotted against the theoretical residual for the area of the standardized distribution. We also observe how most of the residual data points are centered around 0 and lie between -2 and 2 as we expect for a standardized normal distribution, thus helping us validate the linearity assumption.

Figure 16. Histogram of standardized errors.



Source: Dataversity (2023)

In Figure 16, we observe that the distribution is centered around zero, with most of the data distributed between -2 and 2 which satisfies a standard normal distribution thereby validating the normality assumption." (Dataversity, 2023)

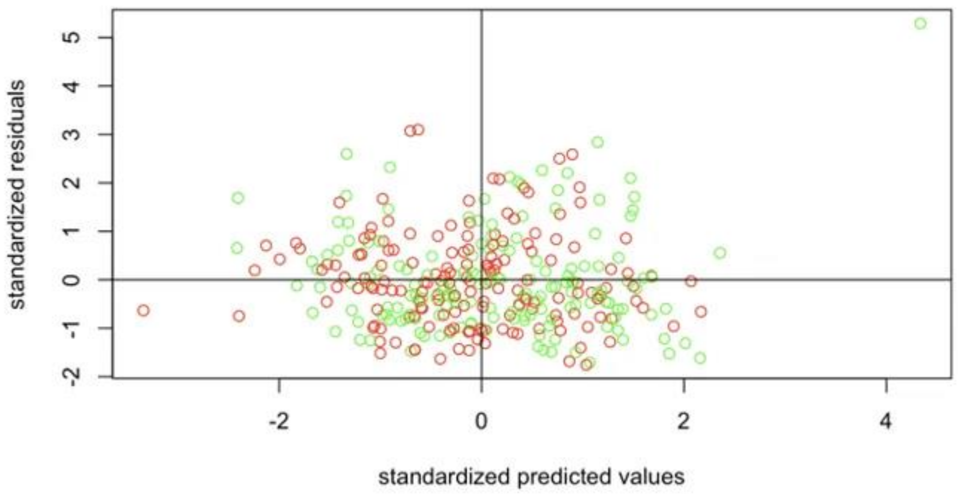
4.9 Homoscedasticity

Homoscedasticity: The variance of the errors is constant across all levels of the independent variables.

"The homogeneity assumption states that the variances of the variables are roughly equal. Meanwhile, the homoscedasticity assumption states that the error term or residual is the same across all values of the independent variables. This assumption is critical, as it makes sure that the errors or residuals do not change with changing values of the predictor variables (i.e., the error term has a consistent distribution).

Violating the homoscedasticity assumption, also known as heteroscedasticity, can lead to inaccurate hypothesis testing as well as inaccurate parameter estimation for predictor variables. In order to validate both these assumptions you can create a scatterplot where X-axis values represent standardized predicted values by your regression model and Y-axis values represent standardized residuals or the error terms of your regression model. We need to standardize both these sets of values for an easier scale to interpret.

Figure 17. Scatterplot of standardized residuals and predicted values.



Dataversity (2023)

In Figure 17, we observe a scatterplot of standardized predicted values along the x-axis in green and standardized residuals along the y-axis in red.

We can claim that the homogeneity assumption is satisfied if the spread above the (0,0) line is similar to that below the (0, 0) line in both the x and y directions. In case there is a very large spread on one side and a smaller spread on the other side then we can say that the homogeneity assumption is violated. In the figure, we observe an even distribution across both the lines, and we can claim that the homogeneity assumption is valid for this case.

For homoscedasticity validation, we wish to check if the spread is equal all the way across the x-axis. It should look like an even random distribution of dots. In case the distribution somewhat resembles megaphones, triangles, or big groupings of data then we say that heteroscedasticity is observed. In the figure, we can observe an even random distribution of dots thereby validating the homoscedasticity assumption." (Dataversity, 2023)

4.10 Heteroskedasticity Tests

The concept of heteroscedasticity, the opposite being homoscedasticity, is used in statistics, especially in the context of linear regression or for time series analysis, to describe the case where the variance of errors of the model is not the same for all observations, while often one of the basic assumption in modeling is that the variances are homogeneous and that the errors of the model are identically distributed.

Why is heteroscedasticity a problem? In linear regression analysis, the fact that the errors of the model are not homoskedastic has the consequence that the model coefficients estimated using OLS are neither unbiased nor those with minimum variance. The estimation of their variance is not reliable.

"When heteroskedasticity exists in a regression, it can be categorized into two types, pure and impure heteroskedasticity.

Pure heteroskedasticity refers to situations where the correct number of independent variables are used (known as a model specification), but the residual plots demonstrate unequal variance.

Impure heteroskedasticity refers to situations where an incorrect number of independent variables are used (known as model misspecification). In this case, the regression may include too few variables (underspecified) or too many variables (over specified). Either way, it results in a model with unequal variance." (Corporate Finance Institute, n.d.,f)

"Heteroskedasticity in a model can be present due to any of the below reasons:

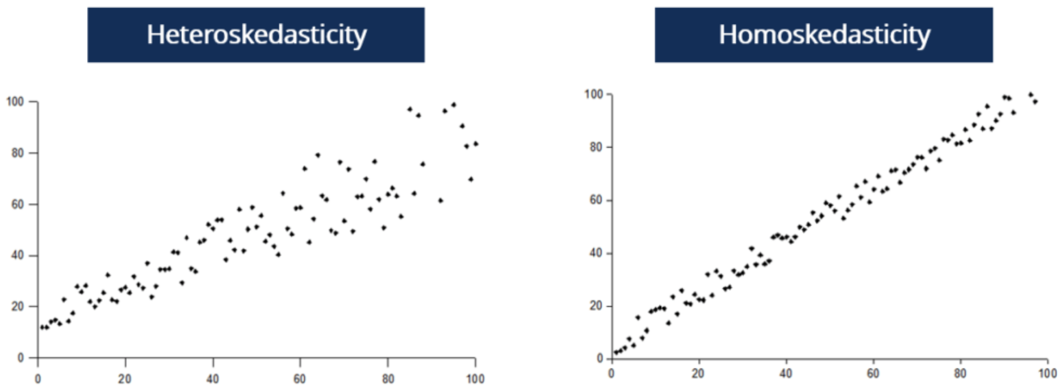
- Existence of outliers in the dataset.
- Collection of data from different scales.
- Not specification of the model correctly.
- Usage of an incorrect transformation method to represent the model."
  (Project Guru, 2020)

How to detect heteroscedasticity:

<u>Scatterplot of residuals test</u>
"When performing simple models, those with only a single predictor, or time-series data, to look for heteroskedasticity, it is necessary to first run a regression and analyze the residuals. One of the most common ways of checking for heteroskedasticity is by plotting a graph of the residuals.

Visually, if there appears to be a fan or cone shape in the residual plot, it indicates the presence of heteroskedasticity. Also, regressions with heteroskedasticity show a pattern where the variance of the residuals increases along with the fitted values." (Corporate Finance Institute, n.d.,f)

Figure 18. Difference in scatterplots presenting heteroskedasticity vs homoscedasticity.



Source: CFI (n.d)

“Benefits: Helps in detecting the presence of heteroskedasticity.

Limitations: Vague information about heteroskedasticity presence.

Heteroskedasticity condition: Rough cone shape spread of the dataset.” (Project Guru, 2020)

Breusch-Pagan test

However, with more complicated models you can typically only diagnose it using heteroskedasticity tests. The most widely used test for heteroscedasticity is the Breusch-Pagan test. This test uses multiple linear regression, where the outcome variable is the squared residuals. The predictors are the same predictor variable as used in the original model.

“The test uses the following null and alternative hypotheses:

Null Hypothesis (H0): Homoscedasticity is present (the residuals are distributed with equal variance)

Alternative Hypothesis (Ha): Heteroscedasticity is present (the residuals are not distributed with equal variance)

If the p-value of the test is less than some significance level (i.e. $\alpha = 0.05$) then we reject the null hypothesis and conclude that heteroscedasticity is present in the regression model.

Steps to perform a Breusch-Pagan test:

1. Fit the regression model.

2. Calculate the squared residuals of the model.

3. Fit a new regression model, using the squared residuals as the response values.

4. Calculate the Chi-Square test statistic X^2 as nR^2_{new} **
   where, n: The total number of observations
   R^2_{new}: The R-squared of the new regression model that used the squared residuals as the response values.

5. If the p-value that corresponds to this Chi-Square test statistic with p (the number of predictors) degrees of freedom is less than some significance level (i.e. $\alpha = 0.05$) then reject the null hypothesis and conclude that heteroscedasticity is present. Otherwise, fail to reject the null hypothesis. In this case, it is assumed that homoscedasticity is present." (Statology, 2020)

** The statistic used for the test, proposed by Koenker (1981) is: $LM = nR^2$, where LM stands for Lagrange multiplier. This statistic has the advantage of asymptotically following a Chi-square distribution with p degrees of freedom, where p is the number of explanatory variables.

Data Assumption: Independent variables could have a linear relationship. Datasets should be normally distributed.

Benefits: Derives accurate results. Suitable for large sample sizes.

Limitations: Not applicable in case of a non-linear relationship. Heteroskedasticity in non-normal distribution could not be analyzed.

Heteroskedasticity condition: Chi-square Test statistic value is greater than the significance value." (Project Guru, 2020)

4.11 Multicollinearity Diagnostics

"Multicollinearity is the occurrence of high intercorrelations among two or more independent variables in a multiple regression model.

Multicollinearity can lead to skewed or misleading results when a researcher or analyst attempts to determine how well each independent variable can be used most effectively to predict or understand the dependent variable in a statistical model. Thus, it can be hard to determine how the independent variables influence the dependent variable individually. This inflates the standard errors of some or all of the regression coefficients.

In general, multicollinearity can lead to wider confidence intervals that produce less reliable probabilities in terms of the effect of independent variables in a model. Multicollinearity in a multiple regression model indicates that collinear independent variables are not truly independent.

Types of Multicollinearity:

- ❖ Perfect Multicollinearity

Perfect multicollinearity demonstrates a linear relationship that is exact between multiple independent variables. This is usually seen on a chart where the data points fall along the regression line.
Perfect collinearity exists when there is an exact 1:1 correspondence between two independent variables in a model. This can be either a correlation of +1.0 or -1.0.

- ❖ High Multicollinearity

High multicollinearity demonstrates a correlation between multiple independent variables, but it is not as tight as in perfect multicollinearity. Not all data points fall on the regression line, but it still signifies that data is too tightly correlated to be used.

- ❖ Structural Multicollinearity

Structural multicollinearity occurs when you use data to create new features. For instance, if you collected data and then used it to perform other calculations and ran a regression on the results, the outcomes will be correlated because they are derived from each other.

- ❖ Data Based Multicollinearity

A poorly designed experiment or data collection process, such as using observational data, generally results in data-based multicollinearity, where data is correlated due to the nature of the way it was collected. Some or all of the variables are correlated."
(Investopedia, 2023,d)

How to detect multicollinearity:

An econometrical technique called the VIF can detect and measure the amount of collinearity in a multiple regression model. VIF measures how much the variance of the estimated regression coefficients is inflated as compared to when the predictor variables are not linearly related.

"The formula for VIF is:

$$VIF_i = \frac{1}{1 - R_i^2} = \frac{1}{Tolerance}$$

where, R_i^2 represents the unadjusted coefficient of determination for regressing the i^{th} independent variable on the remaining ones. The reciprocal of VIF is known as tolerance.

If R_i^2 is equal to 0, the variance of the remaining independent variables cannot be predicted from the i^{th} independent variable. Therefore, when VIF or tolerance is equal to 1, the i^{th} independent variable is not correlated to the remaining ones, which means multicollinearity does not exist in this regression model. In this case, the variance of the i^{th} regression coefficient is not inflated.

- VIF equal to 1 will mean that the variables are not correlated.
- VIF between 1 and 5 shows that variables are moderately correlated.
- VIF between 5 and 10 will mean that variables are highly correlated.

Generally, a VIF above 4 or tolerance below 0.25 indicates that multicollinearity might exist, and further investigation is required. When VIF is higher than 10 or tolerance is lower than 0.1, there is significant multicollinearity that needs to be corrected.

However, there are also situations where high VIFs can be safely ignored without suffering from multicollinearity. The following are three such situations:

1. High VIFs only exist in control variables but not in variables of interest. In this case, the variables of interest are not collinear to each other or the control variables. The regression coefficients are not impacted.

2. When high VIFs are caused as a result of the inclusion of the products or powers of other variables, multicollinearity does not cause negative impacts. For example, a regression model includes both x and x^2 as its independent variables.

3. When a dummy variable that represents more than two categories has a high VIF, multicollinearity does not necessarily exist. The variables will always have high VIFs if there is a small portion of cases in the category, regardless of whether the categorical variables are correlated to other variables." Corporate Finance Institute, n.d.,n)

4.12 Investigation of Unusual and Influential Observations

An assumption of regression is that there are no influential observations. These are extreme values which pull the regression line towards them therefore having a significant impact on the coefficients of the model.

Outliers: Outliers are observations where the observed dependent value does not follow the general trend given the independent value (unusual y given x). In this situation, the residual for that observation is likely to be large unless it is also influential and has pulled the line towards it. A residual is the difference between observed and predicted values and standardized residuals (with a mean of 0 and SD of 1) can be requested in SPSS. Approximately 5% of standardized residuals will be outside ±1.96 and 0.3% of values are classified as extreme outliers which are outside ±3. Large samples are more likely to contain extreme outliers just by chance.

Deleted residuals are the residuals obtained if the regression was repeated without the individual observation.

Leverage: Leverage relates to subjects with unusual values of the independent variable which have the potential to influence the slope greatly. An observation with high leverage will pull the regression line towards it. Calculations compare the independent values with their mean. The average leverage score is calculated as (k + 1)/ n where k is the number of independent variables in the model and n is the number of observations. Observations with high leverage will have leverage scores 2 or 3 times this value.

Influence: An influential observation is one which is an outlier with leverage and affects the intercept and slope of a model significantly. Calculations are based on how the predictions would differ if the observation was not included.

Cooks distance: This is calculated for each individual and is based on the squared differences between the predicted values from regression with and without an individual observation. A large Cook's Distance indicates an influential observation. Compare the Cooks value for each observation with 4/n where n is the number of observations. Values above this indicate observations which could be a problem. (UCLA, n.d.,a)

5. Regression Diagnostics and Assumption Testing: Unveiling the Statistical Health of the Models

In this chapter, the focus will shift from the theoretical background to the practical application of regression diagnostics.

The main object of regression diagnostics is to provide us with information about the health and accuracy of the regression model. That information refer mostly to validity of inferences, reliability of predictions, interpretability of results and model generalization.

5.1 Data Preparation for Regression Diagnostics

To model the relationship between two or more independent variables and a dependent variable you have to use a multiple linear regression model as an econometrical tool.

In this case, the independent variables are all the ESG Rates: ESG_E, ESG_S, ESG_G, and because the idea is to understand how changes in the ESG Rates may be associated with changes in the ROA, ROE, P/E and TSR, that makes them the dependent variables.

Now, let's form the four multiple linear regression models, one for every dependent variable:

$ROEij = \beta0 + \beta1(ESG\_Eij) + \beta2(ESG\_Sij) + \beta3(ESG\_Gij) + \varepsilon ij$

$ROAij = \beta0 + \beta1(ESG\_Eij) + \beta2(ESG\_Sij) + \beta3(ESG\_Gij) + \varepsilon ij$

$PEij = \beta0 + \beta1(ESG\_Eij) + \beta2(ESG\_Sij) + \beta3(ESG\_Gij) + \varepsilon ij$

$TSRij = \beta0 + \beta1(ESG\_Eij) + \beta2(ESG\_Sij) + \beta3(ESG\_Gij) + \varepsilon ij$

Where:

i indexes the company and it can take prices from 1 to 539 and j indexes the year and it can take the prices of 2019, 2020, 2021 and 2022, so that we can have a unique observation for a specific company on a specific year.

ROEij is the ROE for the i-th company in the j-th year.

ROAij is the ROA for the i-th company in the j-th year.

PEij is the P/E for the i-th company in the j-th year.

TSR_{ij} is the TSR for the i-th company in the j-th year.

$\beta0$ is the intercept.

$\beta1$, $\beta2$ and $\beta3$ are the coefficients for the respective ESG rates, representing the change in the mean of ROE / ROA / PE / TSR for a one-unit change in the corresponding ESG variable.

ESG_E_{ij} is the ESG_Environmental Rate for the i-th company in the j-th year.

ESG_S_{ij} is the ESG_Social Rate for the i-th company in the j-th year.

ESG_G_{ij} is the ESG_Governance Rate for the i-th company in the j-th year.

ε_{ij} is the error term for the i-th company in the j-th year.|

Even if it was already mentioned in the beginning of the previous chapter, a crucial part of data preparation is the specification of the data type of each variable and examination of the dataset for any missing values.

In the matter of data types, all variables are numeric and in the matter of missing values, there are none.

As we are not required to handle cases where we must handle categorical variables with dummy coding or/and missing values with imputation or data removal, we should start with setting the hypotheses.

The null hypothesis (H0) states that all coefficients in the model are equal to zero. In other words, none of the predictor variables have a statistically significant relationship with the response variable.

H0: $\beta1 = \beta2 = \beta3 = 0$

The alternative hypothesis states that not every coefficient is simultaneously equal to zero. In our case that means there is a significant relationship between a company's ESG Rates and ROE.

H1: $\beta1 = \beta2 = \beta3 \neq 0$

After finishing with the hypothesis, we should start to run tests.
The regression analysis is going to be executed on SPSS, as it is the statistical software we chose.

Something important that also has to be mentioned is that because we have four dependent variables, we must examine each one individually. Therefore, we would run the test four times, one time for each dependent variable so that we can draw the right conclusions.

5.2 Examination of the relationship between ESG Rates - ROE in SPSS

The first dependent variable we will examine would be ROE.

Multiple linear regression model:

$ROEij = β0 + β1(ESG\_Eij) + β2(ESG\_Sij) + β3(ESG\_Gij) + εij$

Hypothesis:

H0: $β1 = β2 = β3 = 0$
In this case that means there is not a significant relationship between a company's ESG Rates and ROE.

H1: $β1 = β2 = β3 \neq 0$
In this case that means there is a significant relationship between a company's ESG Rates and ROE.

First things first we are going to examine the output of descriptive statistics for anything remarkable.

Table 3. Descriptive Statistics for ROE.

	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
ROE	2156	6205,11	-2362,00	3843,11	12,5062	2,32342	107,88275	11638,688	15,288	,053	855,302	,105
YEAR	2156	3	2019	2022	2020,50	,024	1,118	1,251	,000	,053	-1,360	,105
ESG_E	2156	99	0	99	68,36	,455	21,144	447,050	-,964	,053	,483	,105
ESG_S	2156	95	3	98	74,16	,360	16,728	279,813	-1,047	,053	,941	,105
ESG_G	2156	86	13	99	71,25	,370	17,162	294,540	-,828	,053	,184	,105
Valid N (listwise)	2156											

Source: SPSS

As we can see, skewness and kurtosis prices for ROE are 15,288 and 855,302 which are > +2 implying that ROE data are not normally distributed.

Therefore, we should run a Kolmogorov-Smirnov test** for normality to be sure.
We are not going to use SPSS's Lilliefors Significance Correction because we need to reduce the power of the K-S to detect departures from normality, so we are going to customize the test.

There are some who may criticize this approach; however, we do have confidence that the slight departure of normality for ROE will not negatively impact prediction equation's performance. Also, we must keep in mind that the sample size is a large one: N = 2156 which affects too.

Table 4. Hypothesis Test Summary for ROE.

	Null Hypothesis	Test	Sig.[a]	Decision
1	The distribution of ROE is normal with mean 12,51 and standard deviation 107,88275.	One-Sample Kolmogorov-Smirnov Test	,396	Retain the null hypothesis.

a. The significance level is ,050.
b. Asymptotic significance is displayed.

Source: SPSS

From the above findings, ROE variable passes the normality test, and we can proceed with the regression analysis.

(Roberts and Roberts, 2020)

Next step is the correlation analysis:

We are checking all the variables (ROE, Year, ESG_E, ESG_S, ESG_G) together with Pearson Correlation Coefficient.

Table 5. Correlations for ROE.

		ROE	YEAR	ESG_E	ESG_S	ESG_G
ROE	Pearson Correlation	1	,022	-,017	-,011	,000
	Sig. (2-tailed)		,298	,417	,624	,989
	N	2156	2156	2156	2156	2156
YEAR	Pearson Correlation	,022	1	,086**	,067**	,171**
	Sig. (2-tailed)	,298		<,001	,002	<,001
	N	2156	2156	2156	2156	2156
ESG_E	Pearson Correlation	-,017	,086**	1	,654**	,192**
	Sig. (2-tailed)	,417	<,001		<,001	<,001
	N	2156	2156	2156	2156	2156
ESG_S	Pearson Correlation	-,011	,067**	,654**	1	,279**
	Sig. (2-tailed)	,624	,002	<,001		<,001
	N	2156	2156	2156	2156	2156
ESG_G	Pearson Correlation	,000	,171**	,192**	,279**	1
	Sig. (2-tailed)	,989	<,001	<,001	<,001	
	N	2156	2156	2156	2156	2156

**. Correlation is significant at the 0.01 level (2-tailed).

Source: SPSS

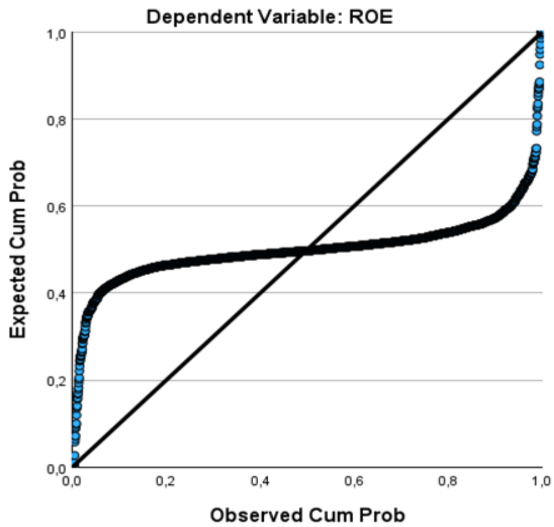
From the above table we can figure that:

ROE has not a statistically significant linear relationship with the independent variables.

YEAR, ESG_E, ESG_S and ESG_G have a statistically significant linear relationship with each other.

Next step is Homoscedasticity and Normality of Errors:

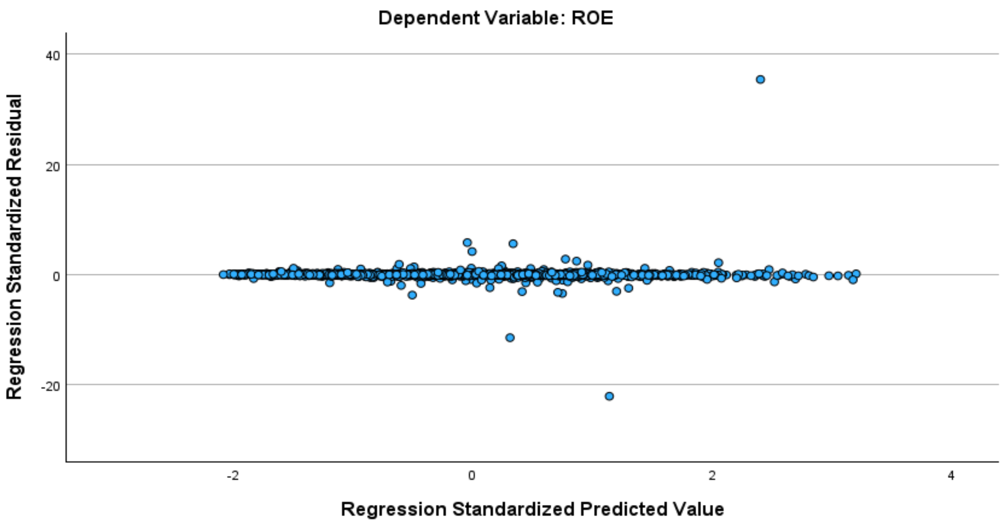
Figure 19. Normal P-P Plot of Regression Standardizes Residual for ROE.



Source: SPSS

The above figure represents the normal P-P plot of regression studentized residual and dependent variable which tell us that the error terms follow normal distribution.

Figure 20. Scatterplot of ZRESID and ZPRED for ROE.



Source: SPSS

The above figure represents the data which look like they do not have an obvious pattern, there are points equally distributed above and below zero on the X axis, and to the left and right of zero on the Y axis. Homoscedasticity implies homogeneous spread.

Next step is to examine the output of linear regression analysis:

Table 6. Model Summary for ROE.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,030[a]	,001	-,001	107,93539	1,980

a. Predictors: (Constant), ESG_G, YEAR, ESG_E, ESG_S

b. Dependent Variable: ROE

Source: SPSS

This table provides the R and R-square values.
The R value represents the correlation between the observed and predicted values of dependent variable. (R is also called the multiple correlation coefficient.) R = +0,030 indicates a weak positive level of prediction.

R-Square is the proportion of variance in the dependent variable which can be predicted from the independent variables. (R-Square is also called the coefficient of determination.) R-squared = +0,001 or 0,1% indicates 0,1% of the variability in the outcome data cannot be explained by the model.

Adjusted R-square attempts to yield a more honest value to estimate the R-squared for the population. Adjusted R-squared = -0,001 indicates a model that has no predictive value.

Std. Error of the Estimate also called the root mean square error, is the standard deviation of the error term, and is the square root of the Mean Square Residual (or Error). Std. Error of the Estimate = 108 which is far from zero indicates that the estimated value is far from the true value.

Durbin-Watson statistic is a test statistic to detect autocorrelation in the residuals from a regression analysis. DW = 1,980, which is between 1,5 and 2,5 and therefore the data is not autocorrelated.

Table 7. ANOVA for ROE.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	22119,744	4	5529,936	,475	,754[b]
	Residual	25059253,228	2151	11650,048		
	Total	25081372,972	2155			

a. Dependent Variable: ROE

b. Predictors: (Constant), ESG_G, YEAR, ESG_E, ESG_S

Source: SPSS

The Total variance is partitioned into the variance which can be explained by the independent variables (Regression) and the variance which is not explained by the independent variables (Residual, sometimes called Error).

Sum of Squares are associated with the three sources of variance: Total, Model and Residual. Conceptually, these formulas can be expressed as:
SSTotal; The total variability around the mean: $S(Y – Ybar)^2$.
SSResidual; The sum of squared errors in prediction: $S(Y – Ypredicted)^2$.
SSRegression; The improvement in prediction by using the predicted value of Y over just using the mean of Y. Hence, this would be the squared differences between the predicted value of Y and the mean of Y, $S(Ypredicted – Ybar)^2$.
(Note that the SSTotal = SSRegression + SSResidual.)

Df are the degrees of freedom associated with the sources of variance. The total variance has N-1 degrees of freedom.
The model's degrees of freedom correspond to the number of predictors minus 1 (K-1). The intercept is automatically included in the model (unless you explicitly omit the intercept).

Mean Square are the Sum of Squares divided by their respective DF. These are computed so you can compute the F ratio, dividing the Mean Square Regression by the Mean Square Residual to test the significance of the predictors in the model.

F and Sig: The F-value is the Mean Square Regression divided by the Mean Square Residual, yielding the F-value. The p-value (Sig.) is associated with this F-value. These values are used to answer the question “Do the independent variables reliably predict

the dependent variable?”. The p-value is compared to the alpha level (a = 0.05) and, if smaller, you can conclude “Yes, the independent variables reliably predict the dependent variable”. If the p-value is greater than 0.05, you would say that the group of independent variables does not show a statistically significant relationship with the dependent variable, or that the group of independent variables does not reliably predict the dependent variable.
(Note that this is an overall significance test assessing whether the group of independent variables when used together reliably predict the dependent variable, and does not address the ability of any of the particular independent variables to predict the dependent variable.)
The ability of each individual independent variable to predict the dependent variable is addressed in the table below where each of the individual variables are listed.
In our test, F-value = 5529,936 / 11650,048 = 0,475.
The p-value (Sig.) associated with the F-value is 0,754.
P-value = 0,754 > a = 0,05 so the group of independent variables does not show a statistically significant relationship with the dependent variable.

Table 8. Coefficients for ROE.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	-4681,059	4269,054		-1,097	,273	-13052,961	3690,843		
	YEAR	2,326	2,114	,024	1,101	,271	-1,819	6,472	,967	1,034
	ESG_E	-,103	,146	-,020	-,709	,479	-,389	,182	,571	1,753
	ESG_S	,007	,188	,001	,038	,970	-,361	,376	,548	1,826
	ESG_G	-,002	,143	,000	-,011	,991	-,282	,279	,899	1,113

a. Dependent Variable: ROE

Source: SPSS

B are the values for the regression equation for predicting the dependent variable from the independent variable. These are called unstandardized coefficients because they are measured in their natural units. The regression equation can be presented in many different ways, for example:

Ypredicted = b0 + b1x1 + b2x2 + b3x3 + b4x4

The column of estimates (coefficients or parameter estimates, from here on labeled coefficients) provides the values for b0, b1, b2, b3 and b4 for this equation.
Expressed in terms of the variables used in our test, the regression equation is

ROE Predicted = - 4681,059 + 2,326YEAR - 0,103ESG_E + 0,007ESG_S – 0,002ESG_G.

These estimates tell you about the relationship between the independent variables and the dependent variable. These estimates tell the amount of increase in ROE that would be predicted by a 1 unit increase in the predictor.
(Note: For the independent variables which are not significant, the coefficients are not significantly different from 0, which should be taken into account when interpreting the coefficients.)
The coefficient (parameter estimate) for YEAR is +2,326. So, for every unit increase in YEAR, a 2,326 unit increase in ROE is predicted, holding all other variables constant.
The coefficient (parameter estimate) for ESG_E is -0,103. So, for every unit increase in ESG_E, a 0,103 unit decrease in ROE is predicted, holding all other variables constant.
The coefficient (parameter estimate) for ESG_S is +0,007. So, for every unit increase in ESG_S, a 0,007 unit increase in ROE is predicted, holding all other variables constant.
The coefficient (parameter estimate) for ESG_G is -0,002. So, for every unit increase in ESG_G, a 0,002 unit decrease in ROE is predicted, holding all other variables constant.
(Note: It does not matter at what value you hold the other variables constant, because it is a linear model.)
(See the columns with the t-value and p-value about testing whether the coefficients are significant).

Std. Error are the standard errors associated with the coefficients. The standard error is used for testing whether the parameter is significantly different from 0 by dividing the parameter estimate by the standard error to obtain a t-value (see the column with t-values and p-values (Sig.)). The standard errors can also be used to form a confidence interval for the parameter, as shown in the last two columns of this table.

Beta are the standardized coefficients. These are the coefficients that you would obtain if you standardized all the variables in the regression, including the dependent and all the independent variables, and ran the regression. By standardizing the variables before

running the regression, you have put all the variables on the same scale, and you can compare the magnitude of the coefficients to see which one has more of an effect. You will also notice that larger betas are associated with larger t-values.

T and Sig. columns provide the t-value and two-tailed p-value used in testing the null hypothesis that the coefficient/parameter is 0. If you use a two-tailed test, then you would compare each p-value to your preselected value of alpha. Coefficients having p-values less than alpha are statistically significant. For example, if you chose alpha to be 0,05, coefficients having a p-value of 0,05 or less would be statistically significant (i.e., you can reject the null hypothesis and say that the coefficient is significantly different from 0). If you use a one-tailed test (i.e., you predict that the parameter will go in a particular direction), then you can divide the p-value by 2 before comparing it to your preselected alpha level.

In our test, with a two-tailed test and a = 0,05, we should not reject the null hypothesis that the coefficient for YEAR is equal to 0, because p-value for YEAR coefficient = 0,271 > a = 0,05.

The p-value for ESG_E coefficient = 0,479 > a = 0,05 which makes it not statistically significantly different from 0, we should retain the null hypothesis.

The p-value for ESG_S coefficient = 0,970 > a = 0,05 which makes it not statistically significant different from 0, we should retain the null hypothesis.

The p-value for ESG_E coefficient = 0,991 > a = 0,05 which makes it not statistically significant different from 0, we should retain the null hypothesis.

95% Confidence Interval for B are the 95% confidence intervals for the coefficients. The confidence intervals are related to the p-values such that the coefficient will not be statistically significant at alpha = 0,05 (5%) if the 95% confidence interval includes zero.

A 95% confidence interval for the slope for ROE takes values between -13052,843 and +3690,843. Here we see that the confidence interval does contain 0 which corresponds to the fact we should not reject the null hypothesis that the slope was 0.

A 95% confidence interval for the slope for YEAR takes values between -1,819 and +6,472; we should retain the null hypothesis.

A 95% confidence interval for the slope for ESG_E takes values between -0,389 and +0,182; we should retain the null hypothesis.

A 95% confidence interval for the slope for ESG_S takes values between -0,361 and

+0,376; we should retain the null hypothesis.
A 95% confidence interval for the slope for ESG_G takes values between -0,282 and +0,279; we should retain the null hypothesis.

VIF measures how much the variance of the estimated regression coefficients is inflated as compared to when the predictor variables are not linearly related. The reciprocal of VIF is known as tolerance. VIF values between 1 and 2 mean that the variables are not correlated. If there is at least one variable that has VIF > 10, Collinearity Diagnostics table on the output must be checked.
VIF value for YEAR = 1,034 < 10; the variables are not correlated
VIF value for ESG_E = 1,753 < 10; the variables are not correlated
VIF value for ESG_S = 1,826 < 10; the variables are not correlated
VIF value for ESG_G = 1,113 < 10; the variables are not correlated
And since all variables have VIF < 10 we do not have to check further on the Collinearity Diagnostics table.

(Statistics For Dummies, 2023; Kanda Data, 2022; REGORZ STATISTIK, 2020; University of Bristol, n.d.; UCLA, n.d.,b)

Table 9. Residuals Statistics for ROE.

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	5,8423	22,7641	12,5062	3,20381	2156
Std. Predicted Value	-2,080	3,202	,000	1,000	2156
Standard Error of Predicted Value	2,587	10,846	5,012	1,379	2156
Adjusted Predicted Value	2,7001	29,0930	12,5034	3,23735	2156
Residual	-2378,16553	3822,90356	,00000	107,83517	2156
Std. Residual	-22,033	35,418	,000	,999	2156
Stud. Residual	-22,093	35,499	,000	1,001	2156
Deleted Residual	-2391,09302	3840,40991	,00287	108,30066	2156
Stud. Deleted Residual	-25,121	55,151	,008	1,378	2156
Mahal. Distance	,239	20,759	3,998	2,977	2156
Cook's Distance	,000	1,154	,001	,027	2156
Centered Leverage Value	,000	,010	,002	,001	2156

a. Dependent Variable: ROE

Source: SPSS

(Note that the unstandardized residuals have a mean of zero, and so do standardized predicted values and standardized residuals.)

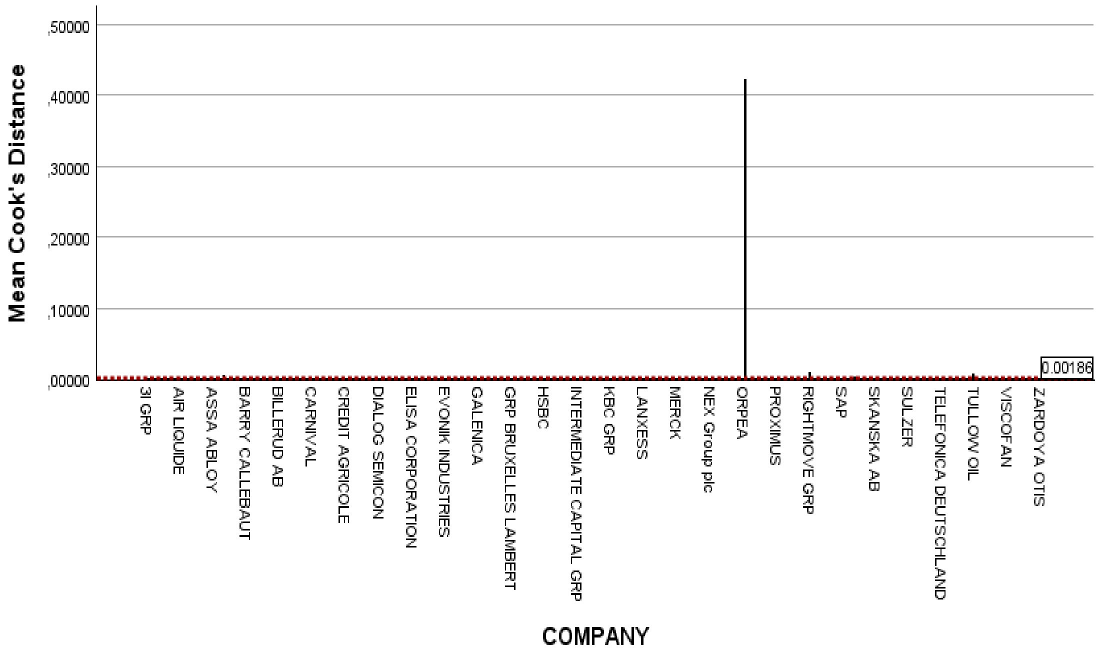
Regression analysis is sensitive to outliers, so we want to ensure that there are no extreme outliers in our data set. We can do this by reviewing the Minimum and Maximum columns of the Std. Residual row in the Residuals Statistics table. A data point with a standardized residual that is more extreme than +/-3 is usually considered to be an outlier. In other words, if the value in the Minimum column of the Std. Residual row is less than -3, we should investigate it. Similarly, if the value in the Maximum column of the Std. Residual row is greater than 3, we should investigate it.

In this case, the minimum value of std. residual is -22,093 and the maximum value of std. residual is +35,418, indicating that our dataset includes extreme outliers.

(EZ SPSS TUTORIALS, n.d.)

Last step is to investigate for Unusual and Influential Observations:

Figure 21. Cook's Distance for ROE.

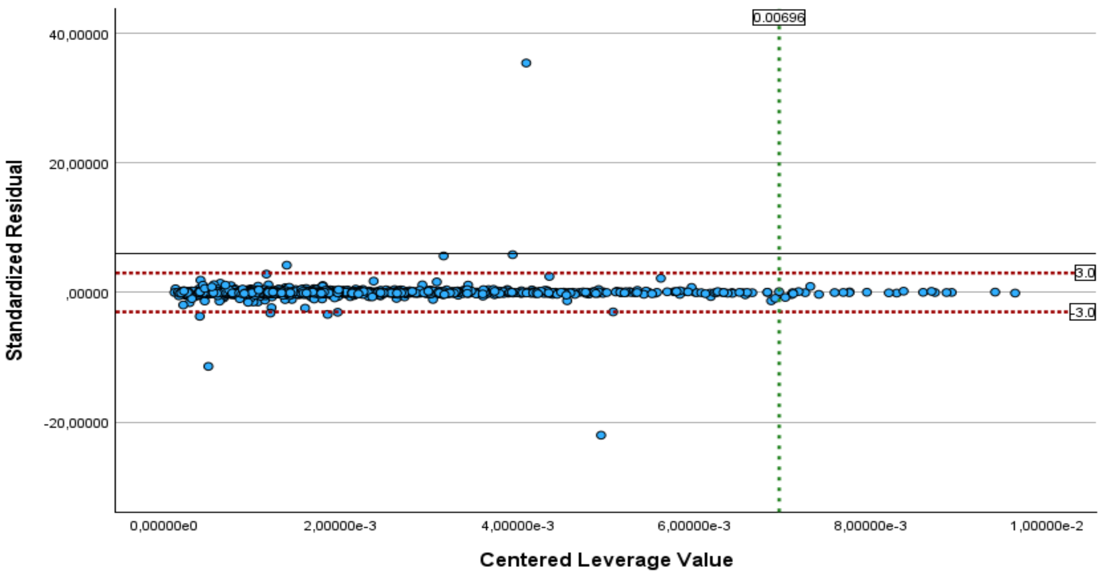


Source: SPSS

The above figure shows the Cook's Distance for ROE of all the 539 companies that used in the sample.

The cut off for Cook's Distance is 4/n so here it is 4/2156 = 0,00186 which is added to the chart as a reference red line to make it easier to see.
All the Cook's Distances are below this line besides 3 of them. This may indicate that those companies' observations could be a problem for the regression analysis.

Figure 22. Scatterplot of the Centered Leverage Values and the Standardized Residuals for ROE.



Source: SPSS

The above figure shows a scatterplot of the Centered Leverage Values and the Standardized Residuals for ROE.

The cut off for Leverage is 3*(k + 1) / n, where k = the number of independent variables. The cut off here is 3*(4+1) / 2156 = 0,00696 which is added to the chart as a reference green line to make it easier to see.

There are some observations with standardized residuals outside ±3 but there are only 2 extreme outliers with standardized residuals outside ±20 that would be worthy of further investigation.

(UCLA, n.d.,a)

5.3 Examination of the relationship between ESG Rates - ROA in SPSS

The second dependent variable we will examine would be ROA.

Multiple linear regression model:

ROAij = β0 + β1(ESG_Eij) + β2(ESG_Sij) + β3(ESG_Gij) + εij

Hypothesis:

H0: β1 = β2 = β3 = 0
In this case that means there is not a significant relationship between a company's ESG Rates and ROA.

H1: β1 = β2 = β3 ≠ 0
In this case that means there is a significant relationship between a company's ESG Rates and ROA.
First things first we are going to examine the output of descriptive statistics for anything remarkable.

Table 10. Descriptive Statistics for ROA.

	N	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
ROA	2156	-109,76	213,87	4,5121	10,93597	119,595	5,932	,053	117,335	,105
YEAR	2156	2019	2022	2020,50	1,118	1,251	,000	,053	-1,360	,105
ESG_E	2156	0	99	68,36	21,144	447,050	-,964	,053	,483	,105
ESG_S	2156	3	98	74,16	16,728	279,813	-1,047	,053	,941	,105
ESG_G	2156	13	99	71,25	17,162	294,540	-,828	,053	,184	,105
Valid N (listwise)	2156									

Source: SPSS

As we can see, skewness and kurtosis prices for ROA are 5,932 and 117,335 which are > +2 implying that ROA data are not normally distributed.

Therefore, we should run a Kolmogorov-Smirnov test** for normality to be sure.
We are not going to use SPSS's Lilliefors Significance Correction because we need to reduce the power of the K-S to detect departures from normality, so we are going to customize the test.

There are some who may criticize this approach; however, we do have confidence that the slight departure of normality for ROA will not negatively impact prediction equation's performance. Also, we must keep in mind that the sample size is a large one: N = 2156 which affects too.

Table 11. Hypothesis Test Summary for ROA.

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of ROA is normal with mean 4,51 and standard deviation 10,93600.	One-Sample Kolmogorov-Smirnov Test	,184	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

Source: SPSS

From the above findings, ROA variable passes the normality test, and we can proceed with the regression analysis.

(Roberts and Roberts, 2020)

Next step is Correlation Analysis:

We are checking all the variables (ROA, Year, ESG_E, ESG_S, ESG_G) together with Pearson Correlation Coefficient.

Table 12. Correlations for ROA.

		ROA	YEAR	ESG_E	ESG_S	ESG_G
ROA	Pearson Correlation	1	,005	-,017	-,032	,022
	Sig. (2-tailed)		,802	,425	,135	,312
	N	2156	2156	2156	2156	2156
YEAR	Pearson Correlation	,005	1	,086**	,067**	,171**
	Sig. (2-tailed)	,802		<,001	,002	<,001
	N	2156	2156	2156	2156	2156
ESG_E	Pearson Correlation	-,017	,086**	1	,654**	,192**
	Sig. (2-tailed)	,425	<,001		<,001	<,001
	N	2156	2156	2156	2156	2156
ESG_S	Pearson Correlation	-,032	,067**	,654**	1	,279**
	Sig. (2-tailed)	,135	,002	<,001		<,001
	N	2156	2156	2156	2156	2156
ESG_G	Pearson Correlation	,022	,171**	,192**	,279**	1
	Sig. (2-tailed)	,312	<,001	<,001	<,001	
	N	2156	2156	2156	2156	2156

**. Correlation is significant at the 0.01 level (2-tailed).

Source: SPSS

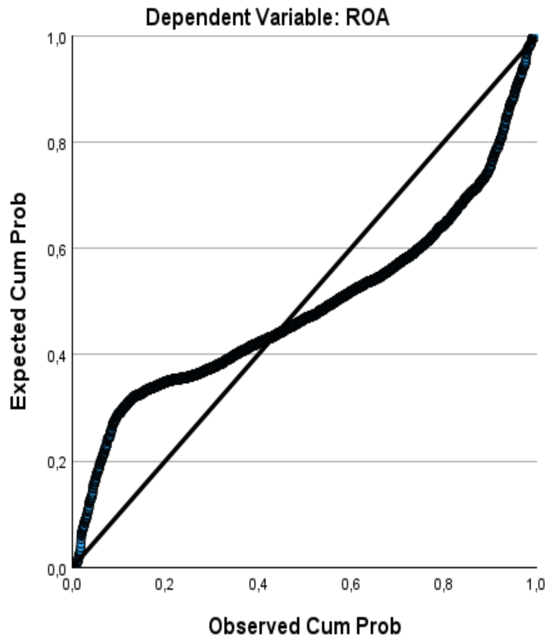
From the above table we can figure that:

ROA has not a statistically significant linear relationship with the independent variables.

YEAR, ESG_E, ESG_S and ESG_G have a statistically significant linear relationship with each other.

Next step is Homoscedasticity and Normality of Errors:

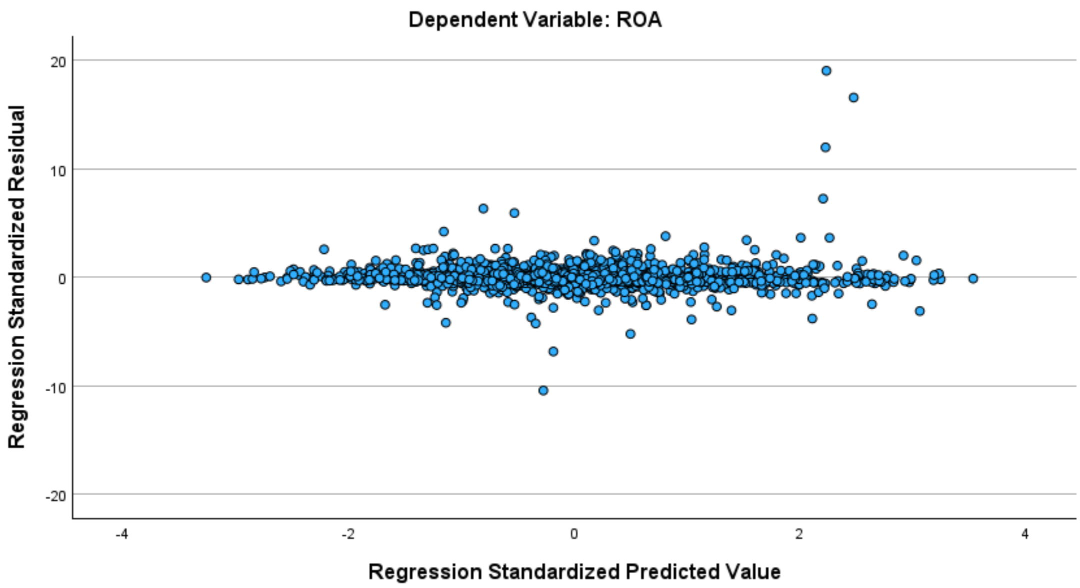
Figure 23. Normal P-P Plot of Regression Standardizes Residual for ROA.



Source: SPSS

The above figure represents the normal P-P plot of regression studentized residual and dependent variable which tell us that the error terms follow normal distribution.

Figure 24. Scatterplot of ZRESID and ZPRED for ROA.



Source: SPSS

The above figure represents the data which look like they do not have an obvious pattern, there are points equally distributed above and below zero on the X axis, and to the left and right of zero on the Y axis. Homoscedasticity implies homogeneous spread.

Next step is to examine the output of linear regression analysis:

Table 13. Model Summary for ROA.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,046[a]	,002	,000	10,93469	1,984

a. Predictors: (Constant), ESG_G, YEAR, ESG_E, ESG_S

b. Dependent Variable: ROA

Source: SPSS

This table provides the R and R-square values.
The R value represents the correlation between the observed and predicted values of dependent variable. (R is also called the multiple correlation coefficient.) R = +0,046 indicates a median positive level of prediction.

R-Square is the proportion of variance in the dependent variable which can be predicted from the independent variables. (R-Square is also called the coefficient of determination.) R-squared = +0,002 or 0,2% indicates 0,2% of the variability in the outcome data cannot be explained by the model.

Adjusted R-square attempts to yield a more honest value to estimate the R-squared for the population. Adjusted R-squared = 0 indicates a model that has no predictive value.

Std. Error of the Estimate also called the root mean square error, is the standard deviation of the error term, and is the square root of the Mean Square Residual (or Error). Std. Error of the Estimate = 10,935 which is not far from zero indicates that the estimated value is not far from the true value.

Durbin-Watson statistic is a test statistic to detect autocorrelation in the residuals from a regression analysis. DW = 1,984, which is between 1,5 and 2,5 and therefore the data is not autocorrelated.

Table 14. ANOVA for ROA.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	538,559	4	134,640	1,126	,342[b]
	Residual	257189,649	2151	119,567		
	Total	257728,208	2155			

a. Dependent Variable: ROA

b. Predictors: (Constant), ESG_G, YEAR, ESG_E, ESG_S

Source: SPSS

The Total variance is partitioned into the variance which can be explained by the independent variables (Regression) and the variance which is not explained by the independent variables (Residual, sometimes called Error).

Sum of Squares are associated with the three sources of variance: Total, Model and Residual. Conceptually, these formulas can be expressed as:
SSTotal; The total variability around the mean: $S(Y – Ybar)^2$.
SSResidual; The sum of squared errors in prediction: $S(Y – Ypredicted)^2$.
SSRegression; The improvement in prediction by using the predicted value of Y over just using the mean of Y. Hence, this would be the squared differences between the predicted value of Y and the mean of Y, $S(Ypredicted – Ybar)^2$.
(Note that the SSTotal = SSRegression + SSResidual.)

Df are the degrees of freedom associated with the sources of variance. The total variance has N-1 degrees of freedom.
The model's degrees of freedom correspond to the number of predictors minus 1 (K-1). The intercept is automatically included in the model (unless you explicitly omit the intercept).

Mean Square are the Sum of Squares divided by their respective DF. These are computed so you can compute the F ratio, dividing the Mean Square Regression by the Mean Square Residual to test the significance of the predictors in the model.

F and Sig: The F-value is the Mean Square Regression divided by the Mean Square Residual, yielding the F-value. The p-value (Sig.) is associated with this F-value. These values are used to answer the question "Do the independent variables reliably predict the dependent variable?". The p-value is compared to the alpha level (a = 0.05) and, if smaller, you can conclude "Yes, the independent variables reliably predict the dependent variable". If the p-value is greater than 0.05, you would say that the group of independent variables does not show a statistically significant relationship with the dependent variable, or that the group of independent variables does not reliably predict the dependent variable.

(Note that this is an overall significance test assessing whether the group of independent variables when used together reliably predict the dependent variable, and does not address the ability of any of the particular independent variables to predict the dependent variable.)

The ability of each individual independent variable to predict the dependent variable is addressed in the table below where each of the individual variables are listed.

In our test, F-value = 134,640 / 119,567 = 1,126.

The p-value (Sig.) associated with the F-value is 0,342.

P-value = 0,342 > a = 0,05 so the group of independent variables does not show a statistically significant relationship with the dependent variable.

Table 15. Coefficients for ROA.

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95,0% Confidence Interval for B Lower Bound	95,0% Confidence Interval for B Upper Bound	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	-40,584	432,488		-,094	,925	-888,722	807,555		
	YEAR	,023	,214	,002	,105	,916	-,397	,443	,967	1,034
	ESG_E	,003	,015	,006	,211	,833	-,026	,032	,571	1,753
	ESG_S	-,030	,019	-,045	-1,562	,118	-,067	,008	,548	1,826
	ESG_G	,021	,014	,033	1,450	,147	-,007	,049	,899	1,113

a. Dependent Variable: ROA

Source: SPSS

B are the values for the regression equation for predicting the dependent variable from the independent variable. These are called unstandardized coefficients because they are measured in their natural units. The regression equation can be presented in many different ways, for example:

Ypredicted = b0 + b1x1 + b2x2 + b3x3 + b4x4

The column of estimates (coefficients or parameter estimates, from here on labeled coefficients) provides the values for b0, b1, b2, b3 and b4 for this equation.
Expressed in terms of the variables used in our test, the regression equation is

ROA Predicted = - 40,584 + 0,023YEAR + 0,003ESG_E - 0,030ESG_S + 0,021ESG_G.

These estimates tell you about the relationship between the independent variables and the dependent variable. These estimates tell the amount of increase in ROA that would be predicted by a 1 unit increase in the predictor.
(Note: For the independent variables which are not significant, the coefficients are not significantly different from 0, which should be taken into account when interpreting the coefficients.)
The coefficient (parameter estimate) for YEAR is +2,326. So, for every unit increase in YEAR, a 2,326 unit increase in ROA is predicted, holding all other variables constant.
The coefficient (parameter estimate) for ESG_E is +0,003. So, for every unit increase in ESG_E, a 0,003 unit increase in ROA is predicted, holding all other variables constant.
The coefficient (parameter estimate) for ESG_S is -0,030. So, for every unit increase in ESG_S, a 0,030 unit decrease in ROA is predicted, holding all other variables constant.
The coefficient (parameter estimate) for ESG_G is +0,021. So, for every unit increase in ESG_G, a 0,021 unit increase in ROA is predicted, holding all other variables constant.
(Note: It does not matter at what value you hold the other variables constant, because it is a linear model.)
(See the columns with the t-value and p-value about testing whether the coefficients are significant).

Std. Error are the standard errors associated with the coefficients. The standard error is used for testing whether the parameter is significantly different from 0 by dividing the parameter estimate by the standard error to obtain a t-value (see the column with t-values and p-values (Sig.)). The standard errors can also be used to form a confidence interval for the parameter, as shown in the last two columns of this table.

Beta are the standardized coefficients. These are the coefficients that you would obtain if you standardized all the variables in the regression, including the dependent and all the independent variables, and ran the regression. By standardizing the variables before

running the regression, you have put all the variables on the same scale, and you can compare the magnitude of the coefficients to see which one has more of an effect. You will also notice that larger betas are associated with larger
t-values.

T and Sig. columns provide the t-value and two-tailed p-value used in testing the null hypothesis that the coefficient/parameter is 0. If you use a two-tailed test, then you would compare each p-value to your preselected value of alpha. Coefficients having p-values less than alpha are statistically significant. For example, if you chose alpha to be 0,05, coefficients having a p-value of 0,05 or less would be statistically significant (i.e., you can reject the null hypothesis and say that the coefficient is significantly different from 0). If you use a one-tailed test (i.e., you predict that the parameter will go in a particular direction), then you can divide the p-value by 2 before comparing it to your preselected alpha level.
In our test, with a two-tailed test and a = 0,05, we should not reject the null hypothesis that the coefficient for YEAR is equal to 0, because p-value for YEAR coefficient = 0,916 > a = 0,05.
The p-value for ESG_E coefficient = 0,833 > a = 0,05 which makes it not statistically significantly different from 0, we should retain the null hypothesis.
The p-value for ESG_S coefficient = 0,118 > a = 0,05 which makes it not statistically significant different from 0, we should retain the null hypothesis.
The p-value for ESG_E coefficient = 0,147 > a = 0,05 which makes it not statistically significant different from 0, we should retain the null hypothesis.

95% Confidence Interval for B are the 95% confidence intervals for the coefficients. The confidence intervals are related to the p-values such that the coefficient will not be statistically significant at alpha = 0,05 (5%) if the 95% confidence interval includes zero.
A 95% confidence interval for the slope for ROA takes values between -888,722 and +807,555. Here we see that the confidence interval does contain 0 which corresponds to the fact we should not reject the null hypothesis that the slope was 0.
A 95% confidence interval for the slope for YEAR takes values between -0,397 and +0,443; we should retain the null hypothesis.
A 95% confidence interval for the slope for ESG_E takes values between -0,026 and +0,032; we should retain the null hypothesis.

A 95% confidence interval for the slope for ESG_S takes values between -0,067 and +0,008; we should retain the null hypothesis.
A 95% confidence interval for the slope for ESG_G takes values between -0,007 and +0,049; we should retain the null hypothesis.

VIF measures how much the variance of the estimated regression coefficients is inflated as compared to when the predictor variables are not linearly related. The reciprocal of VIF is known as tolerance. VIF values between 1 and 2 mean that the variables are not correlated. If there is at least one variable that has VIF > 10, Collinearity Diagnostics table on the output must be checked.
VIF value for YEAR = 1,034 < 10; the variables are not correlated
VIF value for ESG_E = 1,753 < 10; the variables are not correlated
VIF value for ESG_S = 1,826 < 10; the variables are not correlated
VIF value for ESG_G = 1,113 < 10; the variables are not correlated
And since all variables have VIF < 10 we do not have to check further on the Collinearity Diagnostics table.

(Statistics For Dummies, 2023; Kanda Data, 2022; REGORZ STATISTIK, 2020; University of Bristol, n.d.; UCLA, n.d.,b; Investopedia, 2024,a)

Table 16. Residual Statistics for ROA.

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2,8804	6,2791	4,5121	,49991	2156
Std. Predicted Value	-3,264	3,535	,000	1,000	2156
Standard Error of Predicted Value	,262	1,099	,508	,140	2156
Adjusted Predicted Value	2,8822	6,2923	4,5119	,50100	2156
Residual	-114,13432	208,24130	,00000	10,92454	2156
Std. Residual	-10,438	19,044	,000	,999	2156
Stud. Residual	-10,470	19,086	,000	1,001	2156
Deleted Residual	-114,83293	209,16263	,00019	10,96235	2156
Stud. Deleted Residual	-10,745	20,937	,002	1,032	2156
Mahal. Distance	,239	20,759	3,998	2,977	2156
Cook's Distance	,000	,322	,001	,010	2156
Centered Leverage Value	,000	,010	,002	,001	2156

a. Dependent Variable: ROA

Source: SPSS

(Note that the unstandardized residuals have a mean of zero, and so do standardized predicted values and standardized residuals.)

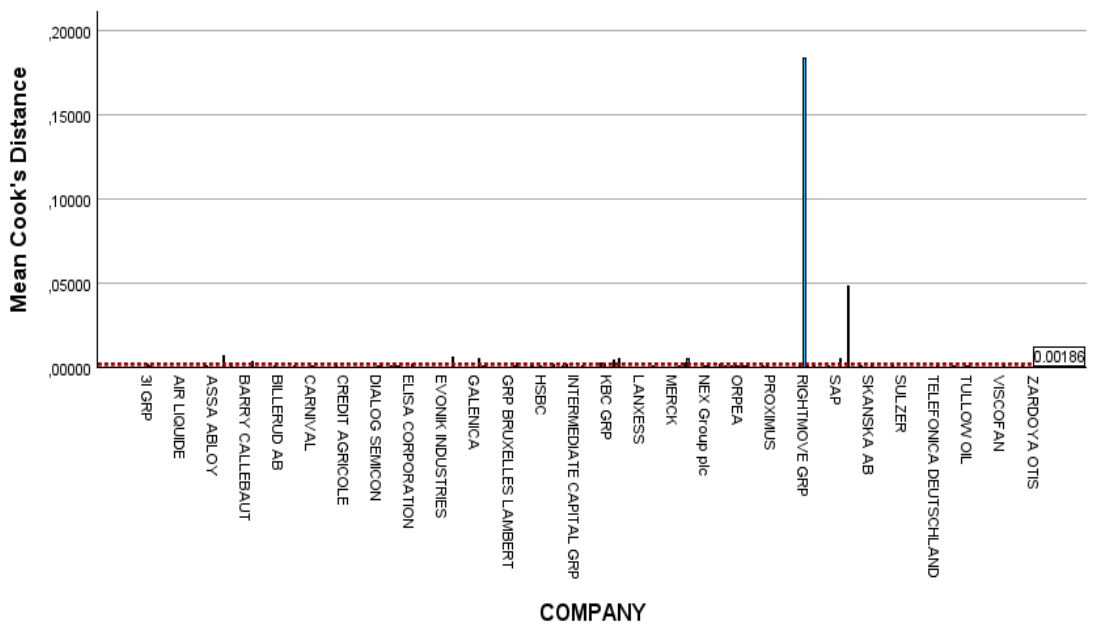
Regression analysis is sensitive to outliers, so we want to ensure that there are no extreme outliers in our data set.We can do this by reviewing the Minimum and Maximum columns of the Std. Residual row in the Residuals Statistics table. A data point with a standardized residual that is more extreme than +/-3 is usually considered to be an outlier. In other words, if the value in the Minimum column of the Std. Residual row is less than -3, we should investigate it. Similarly, if the value in the Maximum column of the Std. Residual row is greater than 3, we should investigate it.

In this case, the minimum value of std. residual is -10,438 and the maximum value of std. residual is +19,044 , indicating that our dataset includes extreme outliers.

(EZ SPSS TUTORIALS, n.d.)

Last step is to investigate for Unusual and Influential Observations:

Figure 25. Cook's Distance for ROA.

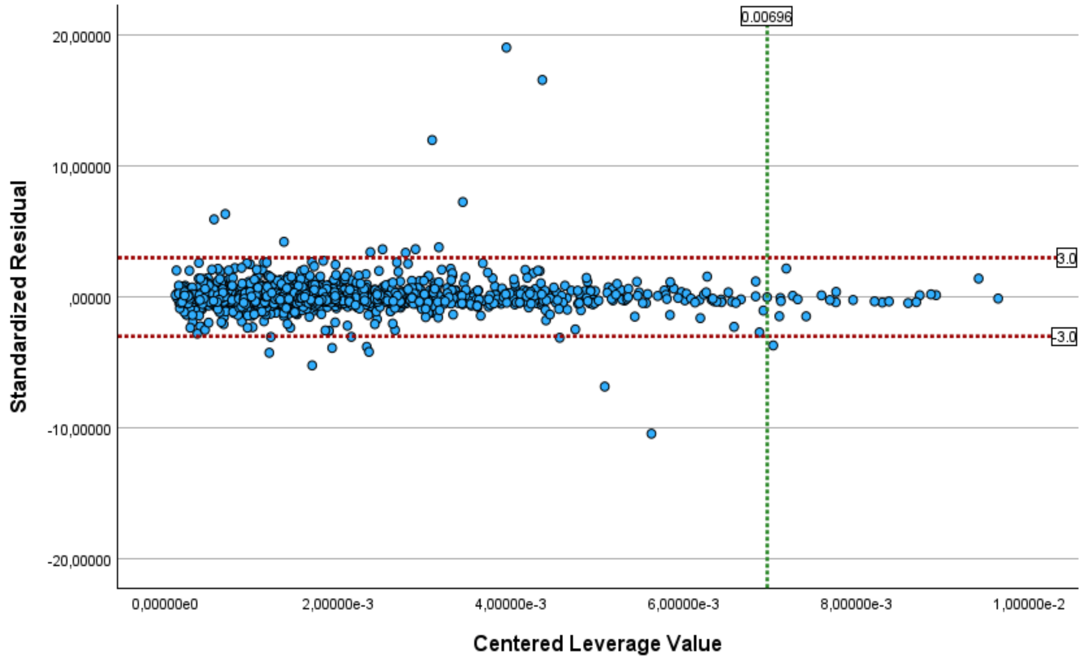


Source: SPSS

The above figure shows the Cook's Distance for ROA of all the 539 companies that used in the sample.

The cut off for Cook's Distance is 4/n so here it is 4/2156 = 0,00186 which is added to the chart as a reference red line to make it easier to see.
There are a lot Cook's Distances above this line, and 2 of them are extremely far from it. This may indicate that those companies' observations could be a problem for the regression analysis.

Figure 26. Scatterplot of the Centered Leverage Values and the Standardized Residuals for ROA.



Source: SPSS

The above figure shows a scatterplot of the Centred Leverage Values and the Standardised Residuals for ROA.

The cut off for Leverage is 3*(k + 1) / n, where k = the number of independent variables. The cut off here is 3*(4+1) / 2156 = 0,00696 which is added to the chart as a reference green line to make it easier to see.

There are many observations with standardized residuals outside ±3 but there are only 4 extreme outliers with standardized residuals outside ±10 that would be worthy of further investigation.

(UCLA, n.d.,a)

5.4 Examination of the relationship between ESG Rates – P/E Ratio in SPSS

The third dependent variable we will examine would be P/E Ratio.

Multiple linear regression model:

$PE_{ij} = \beta 0 + \beta 1(ESG\_E_{ij}) + \beta 2(ESG\_S_{ij}) + \beta 3(ESG\_G_{ij}) + \varepsilon_{ij}$

Hypothesis:

$H0: \beta 1 = \beta 2 = \beta 3 = 0$

In this case that means there is not a significant relationship between a company's ESG Rates and P/E Ratio. $H1: \beta 1 = \beta 2 = \beta 3 \neq 0$

In this case that means there is a significant relationship between a company's ESG Rates and P/E Ratio.

First things first we are going to examine the output of descriptive statistics for anything remarkable.

Table 17. Descriptive Statistics for P/E.

	N	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
P/E	2156	-15032,90	1874,90	14,9513	341,77342	116809,068	-39,396	,053	1747,040	,105
YEAR	2156	2019	2022	2020,50	1,118	1,251	,000	,053	-1,360	,105
ESG_E	2156	0	99	68,36	21,144	447,050	-,964	,053	,483	,105
ESG_S	2156	3	98	74,16	16,728	279,813	-1,047	,053	,941	,105
ESG_G	2156	13	99	71,25	17,162	294,540	-,828	,053	,184	,105
Valid N (listwise)	2156									

Source: SPSS

As we can see, skewness and kurtosis prices for P/E Ratio are -39,369 and 1747,040 which are > +2 implying that P/E Ratio data are not normally distributed.

Therefore, we should run a Kolmogorov-Smirnov test** for normality to be sure.
We are not going to use SPSS's Lilliefors Significance Correction because we need to reduce the power of the K-S to detect departures from normality, so we are going to customize the test.
There are some who may criticize this approach; however, we do have confidence that the slight departure of normality for P/E Ratio will not negatively impact prediction equation's performance. Also, we must keep in mind that the sample size is a large one: N = 2156 which affects too.

Table 18. Hypothesis Test Summary for P/E.

	Null Hypothesis	Test	Sig.[a,b]	Decision
1	The distribution of P/E is normal with mean 14,95 and standard deviation 314,77300.	One-Sample Kolmogorov-Smirnov Test	,095	Retain the null hypothesis.

a. The significance level is ,050.
b. Asymptotic significance is displayed.

Source: SPSS

From the above findings, P/E Ratio variable passes the normality test, and we can proceed with the regression analysis.

(Roberts and Roberts, 2020)

Next step is Correlation Analysis:

We are checking all the variables (P/E Ratio, Year, ESG_E, ESG_S, ESG_G) together with Pearson Correlation Coefficient.

Table 19. Correlations for P/E.

		P/E	YEAR	ESG_E	ESG_S	ESG_G
P/E	Pearson Correlation	1	,024	,032	,035	-,005
	Sig. (2-tailed)		,273	,142	,106	,813
	N	2156	2156	2156	2156	2156
YEAR	Pearson Correlation	,024	1	,086**	,067**	,171**
	Sig. (2-tailed)	,273		<,001	,002	<,001
	N	2156	2156	2156	2156	2156
ESG_E	Pearson Correlation	,032	,086**	1	,654**	,192**
	Sig. (2-tailed)	,142	<,001		<,001	<,001
	N	2156	2156	2156	2156	2156
ESG_S	Pearson Correlation	,035	,067**	,654**	1	,279**
	Sig. (2-tailed)	,106	,002	<,001		<,001
	N	2156	2156	2156	2156	2156
ESG_G	Pearson Correlation	-,005	,171**	,192**	,279**	1
	Sig. (2-tailed)	,813	<,001	<,001	<,001	
	N	2156	2156	2156	2156	2156

**. Correlation is significant at the 0.01 level (2-tailed).

Source: SPSS

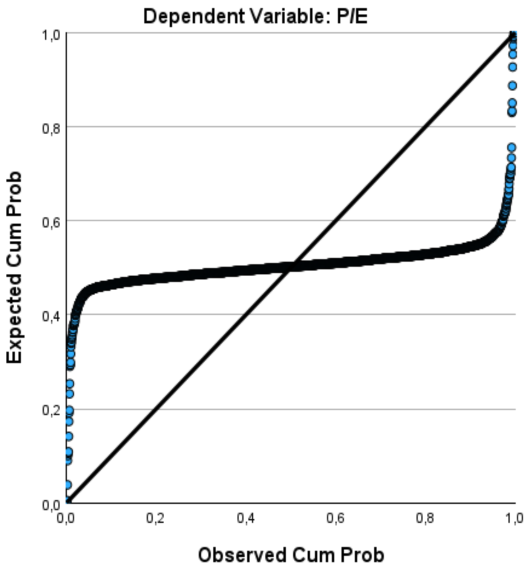
From the above table we can figure that:

P/E Ratio has not a statistically significant linear relationship with the independent variables.

YEAR, ESG_E, ESG_S and ESG_G have a statistically significant linear relationship with each other.

Next step is Homoscedasticity and Normality of Errors:

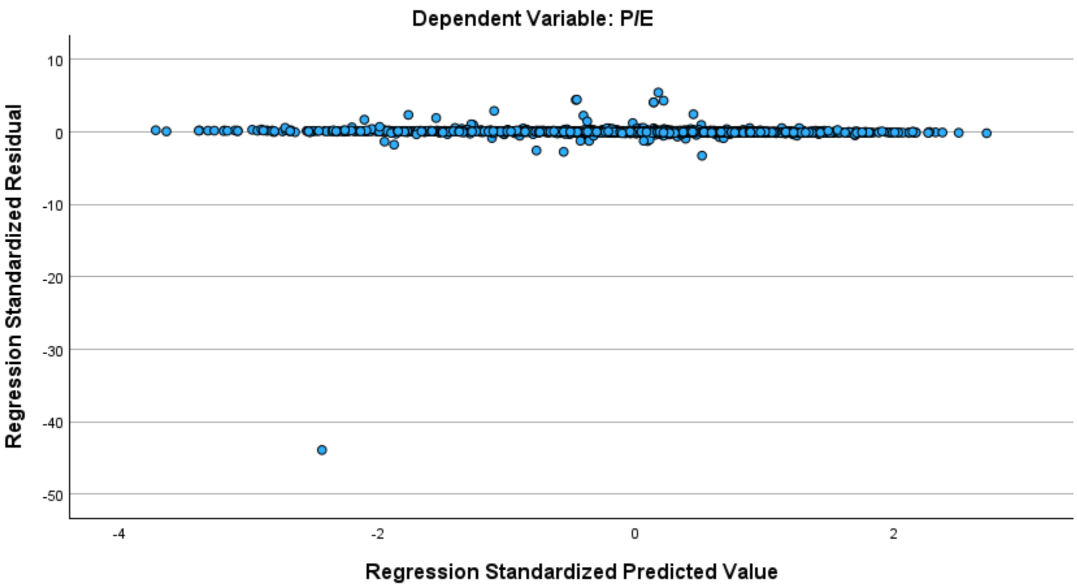
Figure 27. Normal P-P Plot of Regression Standardizes Residual for P/E.



Source: SPSS

The above figure represents the normal P-P plot of regression studentized residual and dependent variable which tell us that the error terms follow normal distribution.

Figure 28. Scatterplot of ZRESID and ZPRED for P/E.



Source: SPSS

The above figure represents the data which look like they do not have an obvious pattern, there are points equally distributed above and below zero on the X axis, and to the left and right of zero on the Y axis. Homoscedasticity implies homogeneous spread.

Next step is to examine the output of linear regression analysis:

Table 20. Model Summary for P/E.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,046[a]	,002	,000	341,72400	1,993

a. Predictors: (Constant), ESG_G, YEAR, ESG_E, ESG_S

b. Dependent Variable: P/E

Source: SPSS

This table provides the R and R-square values.
The R value represents the correlation between the observed and predicted values of dependent variable. (R is also called the multiple correlation coefficient.) R = +0,046 indicates a median positive level of prediction.

R-Square is the proportion of variance in the dependent variable which can be predicted from the independent variables. (R-Square is also called the coefficient of determination.) R-squared = +0,002 or 0,2% indicates 0,2% of the variability in the outcome data cannot be explained by the model.

Adjusted R-square attempts to yield a more honest value to estimate the R-squared for the population. Adjusted R-squared = 0 indicates a model that has no predictive value.

Std. Error of the Estimate also called the root mean square error, is the standard deviation of the error term, and is the square root of the Mean Square Residual (or Error). Std. Error of the Estimate = 341,724 which is very far from zero indicates that the estimated value is very far from the true value.

Durbin-Watson statistic is a test statistic to detect autocorrelation in the residuals from a regression analysis. DW = 1,993 , which is between 1,5 and 2,5 and therefore the data is not autocorrelated.

Table 21. ANOVA for P/E.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	539893,333	4	134973,333	1,156	,328[b]
	Residual	251183647,59	2151	116775,289		
	Total	251723540,93	2155			

a. Dependent Variable: P/E

b. Predictors: (Constant), ESG_G, YEAR, ESG_E, ESG_S

Source: SPSS

The Total variance is partitioned into the variance which can be explained by the independent variables (Regression) and the variance which is not explained by the independent variables (Residual, sometimes called Error).

Sum of Squares are associated with the three sources of variance: Total, Model and Residual. Conceptually, these formulas can be expressed as:
SSTotal; The total variability around the mean: $S(Y – Ybar)^2$.
SSResidual; The sum of squared errors in prediction: $S(Y – Ypredicted)^2$.
SSRegression; The improvement in prediction by using the predicted value of Y over just using the mean of Y. Hence, this would be the squared differences between the predicted value of Y and the mean of Y, $S(Ypredicted – Ybar)^2$.
(Note that the SSTotal = SSRegression + SSResidual.)

Df are the degrees of freedom associated with the sources of variance. The total variance has N-1 degrees of freedom.
The model's degrees of freedom correspond to the number of predictors minus 1 (K-1). The intercept is automatically included in the model (unless you explicitly omit the intercept).

Mean Square are the Sum of Squares divided by their respective DF. These are computed so you can compute the F ratio, dividing the Mean Square Regression by the Mean Square Residual to test the significance of the predictors in the model.

F and Sig: The F-value is the Mean Square Regression divided by the Mean Square Residual, yielding the F-value. The p-value (Sig.) is associated with this F-value. These values are used to answer the question "Do the independent variables reliably predict the dependent variable?". The p-value is compared to the alpha level (a = 0.05) and, if smaller, you can conclude “Yes, the independent variables reliably predict the dependent variable”. If the p-value is greater than 0.05, you would say that the group of independent variables does not show a statistically significant relationship with the dependent variable, or that the group of independent variables does not reliably predict the dependent variable.

(Note that this is an overall significance test assessing whether the group of independent variables when used together reliably predict the dependent variable, and does not address the ability of any of the particular independent variables to predict the dependent variable.)

The ability of each individual independent variable to predict the dependent variable is addressed in the table below where each of the individual variables are listed.

In our test, F-value = 134.973,333 / 116.775,289 = 1,156.

The p-value (Sig.) associated with the F-value is 0,328.

P-value = 0,328 > a = 0,05 so the group of independent variables does not show a statistically significant relationship with the dependent variable.

Table 22. Coefficients for P/E.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	-14771,894	13515,846		-1,093	,275	-41277,379	11733,592		
	YEAR	7,303	6,692	,024	1,091	,275	-5,821	20,427	,967	1,034
	ESG_E	,228	,461	,014	,494	,621	-,676	1,132	,571	1,753
	ESG_S	,605	,595	,030	1,018	,309	-,561	1,772	,548	1,826
	ESG_G	-,401	,452	-,020	-,887	,375	-1,289	,486	,899	1,113

a. Dependent Variable: P/E

Source: SPSS

B are the values for the regression equation for predicting the dependent variable from the independent variable. These are called unstandardized coefficients because they are measured in their natural units. The regression equation can be presented in many different ways, for example:

Ypredicted = b0 + b1x1 + b2x2 + b3x3 + b4x4

The column of estimates (coefficients or parameter estimates, from here on labeled coefficients) provides the values for b0, b1, b2, b3 and b4 for this equation. Expressed in terms of the variables used in our test, the regression equation is

P/E Ratio Predicted = - 14.771,894 + 7,303YEAR + 0,228ESG_E + 0,605ESG_S - 0,401ESG_G.

These estimates tell you about the relationship between the independent variables and the dependent variable. These estimates tell the amount of increase in P/E Ratio that would be predicted by a 1 unit increase/decrease in the predictor.
(Note: For the independent variables which are not significant, the coefficients are not significantly different from 0, which should be taken into account when interpreting the coefficients.)
The coefficient (parameter estimate) for YEAR is +7,303. So, for every unit increase in YEAR, a 7,303 unit increase in P/E Ratio is predicted, holding all other variables constant.
The coefficient (parameter estimate) for ESG_E is +0,228. So, for every unit increase in ESG_E, a 0,228 unit increase in P/E Ratio is predicted, holding all other variables constant.
The coefficient (parameter estimate) for ESG_S is +0,605. So, for every unit increase in ESG_S, a 0,605 unit increase in P/E Ratio is predicted, holding all other variables constant.
The coefficient (parameter estimate) for ESG_G is +0,021. So, for every unit increase in ESG_G, a 0,021 unit increase in P/E Ratio is predicted, holding all other variables constant.
(Note: It does not matter at what value you hold the other variables constant, because it is a linear model.)
(See the columns with the t-value and p-value about testing whether the coefficients are significant).

Std. Error are the standard errors associated with the coefficients. The standard error is used for testing whether the parameter is significantly different from 0 by dividing the parameter estimate by the standard error to obtain a t-value (see the column with t-values and p-values (Sig.)). The standard errors can also be used to form a confidence interval for the parameter, as shown in the last two columns of this table.

Beta are the standardized coefficients. These are the coefficients that you would obtain if you standardized all the variables in the regression, including the dependent and all the independent variables, and ran the regression. By standardizing the variables before running the regression, you have put all the variables on the same scale, and you can compare the magnitude of the coefficients to see which one has more of an effect. You will also notice that larger betas are associated with larger
t-values.

T and Sig. columns provide the t-value and two-tailed p-value used in testing the null hypothesis that the coefficient/parameter is 0. If you use a two-tailed test, then you would compare each p-value to your preselected value of alpha. Coefficients having p-values less than alpha are statistically significant. For example, if you chose alpha to be 0,05, coefficients having a p-value of 0,05 or less would be statistically significant (i.e., you can reject the null hypothesis and say that the coefficient is significantly different from 0). If you use a one-tailed test (i.e., you predict that the parameter will go in a particular direction), then you can divide the p-value by 2 before comparing it to your preselected alpha level.

In our test, with a two-tailed test and a = 0,05, we should not reject the null hypothesis that the coefficient for YEAR is equal to 0, because p-value for YEAR coefficient = 0,275 > a = 0,05.

The p-value for ESG_E coefficient = 0,621 > a = 0,05 which makes it not statistically significantly different from 0, we should retain the null hypothesis.

The p-value for ESG_S coefficient = 0,309 > a = 0,05 which makes it not statistically significant different from 0, we should retain the null hypothesis.

The p-value for ESG_E coefficient = 0,375 > a = 0,05 which makes it not statistically significant different from 0, we should retain the null hypothesis.

95% Confidence Interval for B are the 95% confidence intervals for the coefficients. The confidence intervals are related to the p-values such that the coefficient will not be statistically significant at alpha = 0,05 (5%) if the 95% confidence interval includes zero.

A 95% confidence interval for the slope for P/E Ratio takes values between
-41.277,379 and +11.733,592. Here we see that the confidence interval does contain 0 which corresponds to the fact we should not reject the null hypothesis that the slope was 0.

A 95% confidence interval for the slope for YEAR takes values between -5,821 and +20,427; we should retain the null hypothesis.
A 95% confidence interval for the slope for ESG_E takes values between -0,676 and +1,132; we should retain the null hypothesis.
A 95% confidence interval for the slope for ESG_S takes values between -0,561 and +1,772; we should retain the null hypothesis.
A 95% confidence interval for the slope for ESG_G takes values between -1,289 and +0,486; we should retain the null hypothesis.

VIF measures how much the variance of the estimated regression coefficients is inflated as compared to when the predictor variables are not linearly related. The reciprocal of VIF is known as tolerance. VIF values between 1 and 2 mean that the variables are not correlated. If there is at least one variable that has VIF > 10, Collinearity Diagnostics table on the output must be checked.
VIF value for YEAR = 1,034 < 10; the variables are not correlated
VIF value for ESG_E = 1,753 < 10; the variables are not correlated
VIF value for ESG_S = 1,826 < 10; the variables are not correlated
VIF value for ESG_G = 1,113 < 10; the variables are not correlated
And since all variables have VIF < 10 we do not have to check further on the Collinearity Diagnostics table.

(Investopedia, 2024,a; Statistics For Dummies, 2023; Kanda Data, 2022; REGORZ STATISTIK, 2020; University of Bristol, n.d.; UCLA, n.d.,b)

Table 23. Residuals Statistics for P/E.

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-44,0028	58,0078	14,9513	15,82816	2156
Std. Predicted Value	-3,725	2,720	,000	1,000	2156
Standard Error of Predicted Value	8,191	34,337	15,867	4,365	2156
Adjusted Predicted Value	-44,5457	58,4338	14,9539	15,86929	2156
Residual	-15009,31152	1857,19849	,00000	341,40670	2156
Std. Residual	-43,922	5,435	,000	,999	2156
Stud. Residual	-43,994	5,442	,000	1,001	2156
Deleted Residual	-15058,06934	1861,86975	-,00261	342,48509	2156
Stud. Deleted Residual	-138,938	5,478	-,044	3,010	2156
Mahal. Distance	,239	20,759	3,998	2,977	2156
Cook's Distance	,000	1,257	,001	,027	2156
Centered Leverage Value	,000	,010	,002	,001	2156

a. Dependent Variable: P/E

Source: SPSS

(Note that the unstandardized residuals have a mean of zero, and so do standardized predicted values and standardized residuals.)

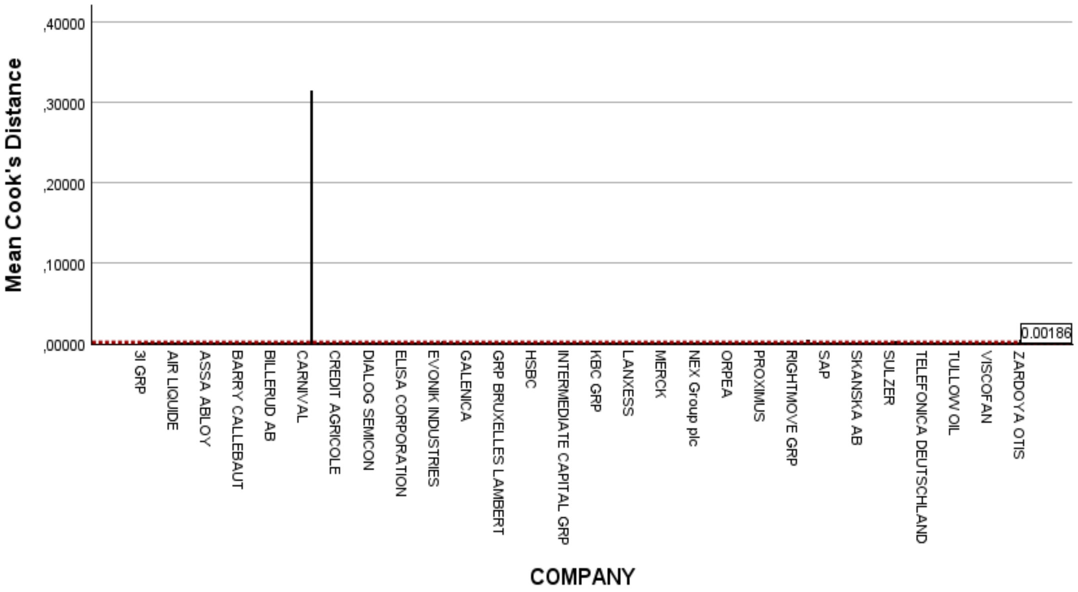
Regression analysis is sensitive to outliers, so we want to ensure that there are no extreme outliers in our data set.We can do this by reviewing the Minimum and Maximum columns of the Std. Residual row in the Residuals Statistics table. A data point with a standardized residual that is more extreme than +/-3 is usually considered to be an outlier. In other words, if the value in the Minimum column of the Std. Residual row is less than -3, we should investigate it. Similarly, if the value in the Maximum column of the Std. Residual row is greater than 3, we should investigate it.

In this case, the minimum value of std. residual is -43,922 and the maximum value of std. residual is +5,435 , indicating that our dataset includes extreme outliers.

(EZ SPSS TUTORIALS, n.d.)

Last step is to investigate for Unusual and Influential Observations:

Figure 29. Cook's Distance for P/E.

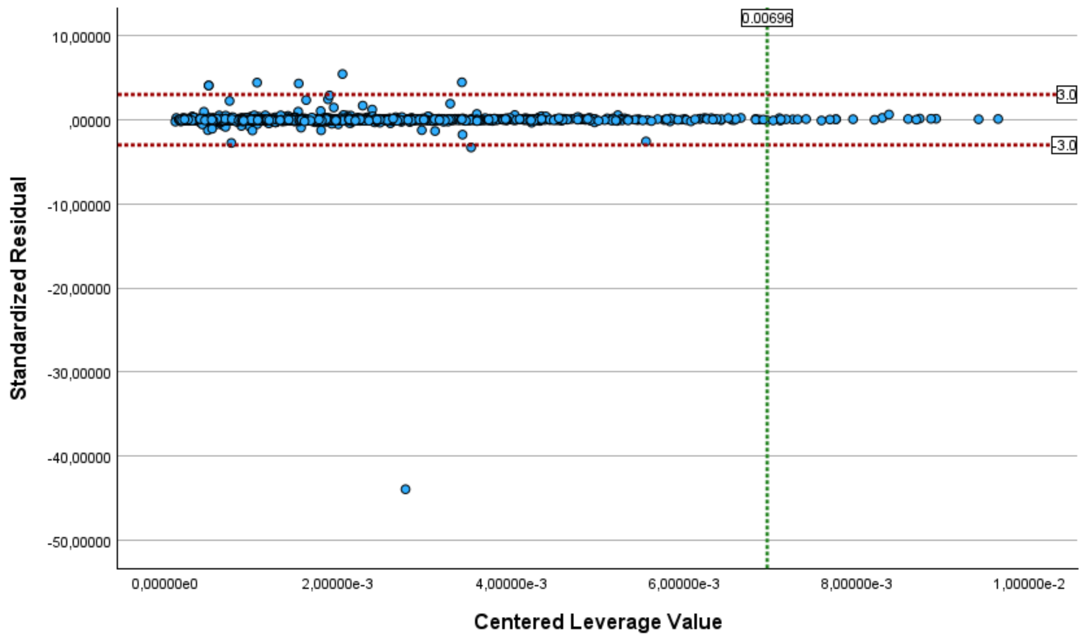


Source: SPSS

The above figure shows the Cook's Distance for P/E Ratio of all the 539 companies that used in the sample.

The cut off for Cook's Distance is 4/n so here it is 4/2156 = 0,00186 which is added to the chart as a reference red line to make it easier to see.
There is only one of Cook's Distances above this line, which is extremely far from it. This may indicate that this company's observations could be a problem for the regression analysis.

Figure 30. Scatterplot of the Centered Leverage Values and the Standardized Residuals for ROE.



Source: SPSS

The above figure shows a scatterplot of the Centred Leverage Values and the Standardised Residuals for P/E Ratio.

The cut off for Leverage is 3*(k + 1) / n, where k = the number of independent variables. The cut off here is 3*(4+1) / 2156 = 0,00696 which is added to the chart as a reference green line to make it easier to see.

There are six observations with standardized residuals outside ±3 but there are none extreme outliers with standardized residuals outside ±10 that would be worthy of further investigation.

(UCLA, n.d.,a)

5.5 Examination of the relationship between ESG Rates – TSR in SPSS

The fourth dependent variable we will examine would be TSR.

Multiple linear regression model:

TSRij = β0 + β1(ESG_Eij) + β2(ESG_Sij) + β3(ESG_Gij) + εij

Hypothesis:

H0: β1 = β2 = β3 = 0
In this case that means there is not a significant relationship between a company's ESG Rates and TSR.

H1: β1 = β2 = β3 ≠ 0
In this case that means there is a significant relationship between a company's ESG Rates and TSR.
First things first we are going to examine the output of descriptive statistics for anything remarkable.

Table 24. Descriptive Statistics for TSR.

	N	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
TSR	2156	-93,0	364,3	9,166	32,9655	1086,724	1,024	,053	7,020	,105
YEAR	2156	2019	2022	2020,50	1,118	1,251	,000	,053	-1,360	,105
ESG_E	2156	0	99	68,36	21,144	447,050	-,964	,053	,483	,105
ESG_S	2156	3	98	74,16	16,728	279,813	-1,047	,053	,941	,105
ESG_G	2156	13	99	71,25	17,162	294,540	-,828	,053	,184	,105
Valid N (listwise)	2156									

Source: SPSS

As we can see, skewness and kurtosis prices for TSR are 1,024 and 7,020 of which are skewness is < +2 and kurtosis is > +2 implying that TSR data maybe are not normally distributed.

Therefore, we should run a Kolmogorov-Smirnov test** for normality to be sure.
We are not going to use SPSS's Lilliefors Significance Correction because we need to reduce the power of the K-S to detect departures from normality, so we are going to

customize the test.

There are some who may criticize this approach; however, we do have confidence that the slight departure of normality for P/E Ratio will not negatively impact prediction equation's performance. Also, we must keep in mind that the sample size is a large one: N = 2156 which affects too.

Table 25. Hypothesis Test Summary for TSR.

	Null Hypothesis	Test	Sig.^{a,b}	Decision
1	The distribution of TSR is normal with mean 9,2 and standard deviation 32,9655.	One-Sample Kolmogorov-Smirnov Test	,162	Retain the null hypothesis.

a. The significance level is ,050.

b. Asymptotic significance is displayed.

Source: SPSS

From the above findings, TSR variable passes the normality test, and we can proceed with the regression analysis.

(Roberts and Roberts, 2020)

Next step is Correlation Analysis:

We are checking all the variables (TSR, Year, ESG_E, ESG_S, ESG_G) together with Pearson Correlation Coefficient.

Table 26. Correlations for TSR.

		TSR	YEAR	ESG_E	ESG_S	ESG_G
TSR	Pearson Correlation	1	-,292**	-,009	,007	-,054*
	Sig. (2-tailed)		<,001	,662	,742	,011
	N	2156	2156	2156	2156	2156
YEAR	Pearson Correlation	-,292**	1	,086**	,067**	,171**
	Sig. (2-tailed)	<,001		<,001	,002	<,001
	N	2156	2156	2156	2156	2156
ESG_E	Pearson Correlation	-,009	,086**	1	,654**	,192**
	Sig. (2-tailed)	,662	<,001		<,001	<,001
	N	2156	2156	2156	2156	2156
ESG_S	Pearson Correlation	,007	,067**	,654**	1	,279**
	Sig. (2-tailed)	,742	,002	<,001		<,001
	N	2156	2156	2156	2156	2156
ESG_G	Pearson Correlation	-,054*	,171**	,192**	,279**	1
	Sig. (2-tailed)	,011	<,001	<,001	<,001	
	N	2156	2156	2156	2156	2156

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Source: SPSS

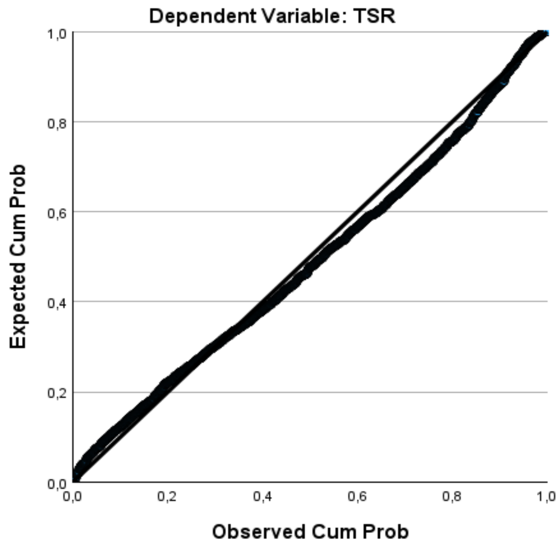
From the above table we can figure that:

TSR has a statistically significant linear relationship only with YEAR from all the independent variables.

YEAR, ESG_E, ESG_S and ESG_G have a statistically significant linear relationship with each other.

Next step is Homoscedasticity and Normality of Errors:

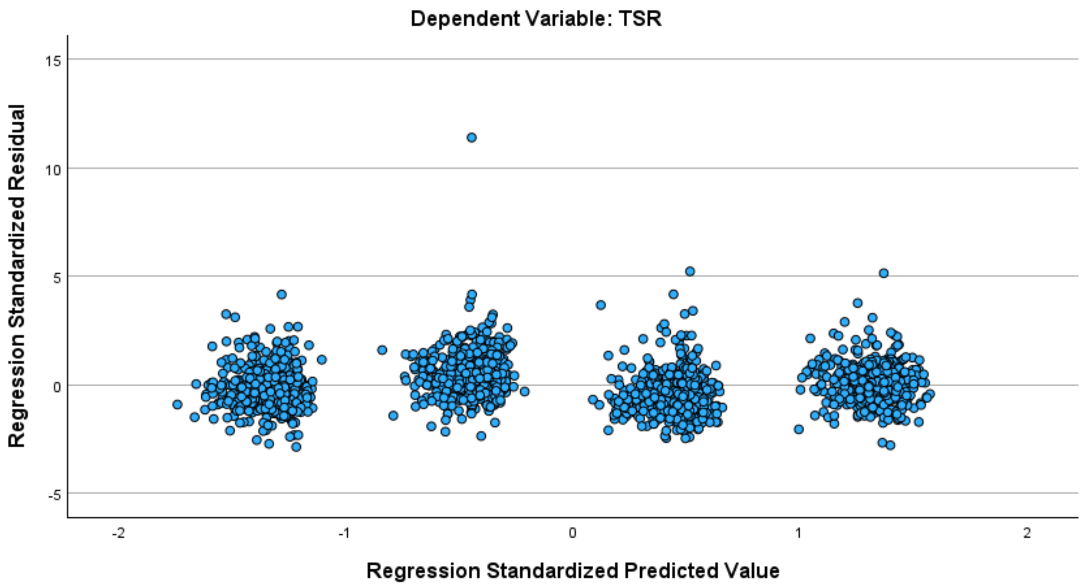
Figure 31. Normal P-P Plot of Regression Standardizes Residual for TSR.



Source: SPSS

The above figure represents the normal P-P plot of regression studentized residual and dependent variable which tell us that the error terms follow normal distribution.

Figure 32. *Scatterplot of ZRESID and ZPRED for TSR.*



Source: SPSS

The above figure represents the data which look like they do not have an obvious pattern, there are points equally distributed above and below zero on the X axis, and to the left and right of zero on the Y axis. Homoscedasticity implies homogeneous spread.

Next step is to examine the output of linear regression analysis:

Table 27. *Model Summary for TSR.*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,294[a]	,086	,085	31,5393	1,687

a. Predictors: (Constant), ESG_G, YEAR, ESG_E, ESG_S

b. Dependent Variable: TSR

Source: SPSS

This table provides the R and R-square values.
The R value represents the correlation between the observed and predicted values of dependent variable. (R is also called the multiple correlation coefficient.) R = +0,294 indicates a median positive level of prediction.

R-Square is the proportion of variance in the dependent variable which can be predicted from the independent variables. (R-Square is also called the coefficient of determination.) R-squared = +0,086 or 8,6% indicates 8,6% of the variability in the outcome data cannot be explained by the model.

Adjusted R-square attempts to yield a more honest value to estimate the R-squared for the population. Adjusted R-squared = 0,083 indicates a model that has almost no predictive value.

Std. Error of the Estimate also called the root mean square error, is the standard deviation of the error term, and is the square root of the Mean Square Residual (or Error). Std. Error of the Estimate = 31,539 which is not far from zero indicates that the estimated value is not far from the true value.

Durbin-Watson statistic is a test statistic to detect autocorrelation in the residuals from a regression analysis. DW = 1,687 , which is between 1,5 and 2,5 and therefore the data is not autocorrelated.

Table 28. *ANOVA for TSR.*

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	202223,900	4	50555,975	50,824	<,001[b]
	Residual	2139665,471	2151	994,731		
	Total	2341889,372	2155			

a. Dependent Variable: TSR

b. Predictors: (Constant), ESG_G, YEAR, ESG_E, ESG_S

Source: SPSS

The Total variance is partitioned into the variance which can be explained by the independent variables (Regression) and the variance which is not explained by the independent variables (Residual, sometimes called Error).

Sum of Squares are associated with the three sources of variance: Total, Model and Residual. Conceptually, these formulas can be expressed as:
SSTotal; The total variability around the mean: $S(Y – Ybar)^2$.
SSResidual; The sum of squared errors in prediction: $S(Y – Ypredicted)^2$.
SSRegression; The improvement in prediction by using the predicted value of Y over just using the mean of Y. Hence, this would be the squared differences between the predicted value of Y and the mean of Y, $S(Ypredicted – Ybar)^2$.
(Note that the SSTotal = SSRegression + SSResidual.)

Df are the degrees of freedom associated with the sources of variance. The total variance has N-1 degrees of freedom.
The model’s degrees of freedom correspond to the number of predictors minus 1 (K-1). The intercept is automatically included in the model (unless you explicitly omit the intercept).

Mean Square are the Sum of Squares divided by their respective DF. These are computed so you can compute the F ratio, dividing the Mean Square Regression by the Mean Square Residual to test the significance of the predictors in the model.

F and Sig: The F-value is the Mean Square Regression divided by the Mean Square Residual, yielding the F-value. The p-value (Sig.) is associated with this F-value. These values are used to answer the question “Do the independent variables reliably predict the dependent variable?”. The p-value is compared to the alpha level (a = 0.05) and, if smaller, you can conclude “Yes, the independent variables reliably predict the dependent variable”. If the p-value is greater than 0.05, you would say that the group of independent variables does not show a statistically significant relationship with the dependent variable, or that the group of independent variables does not reliably predict the dependent variable.

(Note that this is an overall significance test assessing whether the group of independent variables when used together reliably predict the dependent variable, and does not address the ability of any of the particular independent variables to predict the dependent variable.)

The ability of each individual independent variable to predict the dependent variable is addressed in the table below where each of the individual variables are listed.

In our test, F-value =50.555,975 / 994,731 =50,824.

The p-value (Sig.) associated with the F-value is < 0,001.

P-value = 0,001 < a = 0,05 so the group of independent variables does show a statistically significant relationship with the dependent variable.

Table 29. *Coefficients for TSR.*

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	17401,576	1247,442		13,950	<,001	14955,258	19847,895		
	YEAR	-8,609	,618	-,292	-13,938	<,001	-9,821	-7,398	,967	1,034
	ESG_E	-,005	,043	-,003	-,107	,915	-,088	,079	,571	1,753
	ESG_S	,063	,055	,032	1,157	,248	-,044	,171	,548	1,826
	ESG_G	-,025	,042	-,013	-,597	,550	-,107	,057	,899	1,113

a. Dependent Variable: TSR

Source: SPSS

B are the values for the regression equation for predicting the dependent variable from the independent variable. These are called unstandardized coefficients because they are measured in their natural units. The regression equation can be presented in many different ways, for example:

Ypredicted = b0 + b1x1 + b2x2 + b3x3 + b4x4

The column of estimates (coefficients or parameter estimates, from here on labeled coefficients) provides the values for b0, b1, b2, b3 and b4 for this equation.

Expressed in terms of the variables used in our test, the regression equation is

TSR Predicted = - 17.401,576 - 8,609YEAR - 0,005ESG_E + 0,063ESG_S - 0,025ESG_G.

These estimates tell you about the relationship between the independent variables and the dependent variable. These estimates tell the amount of increase in TSR that would be predicted by a 1 unit increase/decrease in the predictor.
(Note: For the independent variables which are not significant, the coefficients are not significantly different from 0, which should be taken into account when interpreting the coefficients.)
The coefficient (parameter estimate) for YEAR is -8,609. So, for every unit increase in YEAR, a 8,609 unit decrease in P/E Ratio is predicted, holding all other variables constant.
The coefficient (parameter estimate) for ESG_E is -0,005. So, for every unit increase in ESG_E, a 0,005 unit increase in P/E Ratio is predicted, holding all other variables constant.
The coefficient (parameter estimate) for ESG_S is +0,063. So, for every unit increase in ESG_S, a 0,063 unit decrease in P/E Ratio is predicted, holding all other variables constant.
The coefficient (parameter estimate) for ESG_G is +0,025. So, for every unit increase in ESG_G, a 0,025 unit increase in P/E Ratio is predicted, holding all other variables constant.
(Note: It does not matter at what value you hold the other variables constant, because it is a linear model.)
(See the columns with the t-value and p-value about testing whether the coefficients are significant).

Std. Error are the standard errors associated with the coefficients. The standard error is used for testing whether the parameter is significantly different from 0 by dividing the parameter estimate by the standard error to obtain a t-value (see the column with t-values and p-values (Sig.)). The standard errors can also be used to form a confidence interval for the parameter, as shown in the last two columns of this table.

Beta are the standardized coefficients. These are the coefficients that you would obtain if you standardized all the variables in the regression, including the dependent and all the independent variables, and ran the regression. By standardizing the variables before

running the regression, you have put all the variables on the same scale, and you can compare the magnitude of the coefficients to see which one has more of an effect. You will also notice that larger betas are associated with larger
t-values.

T and Sig. columns provide the t-value and two-tailed p-value used in testing the null hypothesis that the coefficient/parameter is 0. If you use a two-tailed test, then you would compare each p-value to your preselected value of alpha. Coefficients having p-values less than alpha are statistically significant. For example, if you chose alpha to be 0,05, coefficients having a p-value of 0,05 or less would be statistically significant (i.e., you can reject the null hypothesis and say that the coefficient is significantly different from 0). If you use a one-tailed test (i.e., you predict that the parameter will go in a particular direction), then you can divide the p-value by 2 before comparing it to your preselected alpha level.
In our test, with a two-tailed test and a = 0,05, we should reject the null hypothesis that the coefficient for YEAR is equal to 0, because p-value for YEAR coefficient = 0,001 < a = 0,05.
The p-value for ESG_E coefficient = 0,915 > a = 0,05 which makes it not statistically significantly different from 0, we should retain the null hypothesis.
The p-value for ESG_S coefficient = 0,248 > a = 0,05 which makes it not statistically significant different from 0, we should retain the null hypothesis.
The p-value for ESG_E coefficient = 0,550 > a = 0,05 which makes it not statistically significant different from 0, we should retain the null hypothesis.

95% Confidence Interval for B are the 95% confidence intervals for the coefficients. The confidence intervals are related to the p-values such that the coefficient will not be statistically significant at alpha = 0,05 (5%) if the 95% confidence interval includes zero.
A 95% confidence interval for the slope for TSR takes values between
-14.955,258 and +19.847,895. Here we see that the confidence interval does contain 0 which corresponds to the fact we should not reject the null hypothesis that the slope was 0.
A 95% confidence interval for the slope for YEAR takes values between -9,821 and
-7,398; we reject retain the null hypothesis.
A 95% confidence interval for the slope for ESG_E takes values between -0,088 and

+0,079; we should retain the null hypothesis.
A 95% confidence interval for the slope for ESG_S takes values between -0,044 and +0,171; we should retain the null hypothesis.
A 95% confidence interval for the slope for ESG_G takes values between -0,107 and +0,057; we should retain the null hypothesis.

VIF measures how much the variance of the estimated regression coefficients is inflated as compared to when the predictor variables are not linearly related. The reciprocal of VIF is known as tolerance. VIF values between 1 and 2 mean that the variables are not correlated. If there is at least one variable that has VIF > 10, Collinearity Diagnostics table on the output must be checked.
VIF value for YEAR = 1,034 < 10; the variables are not correlated
VIF value for ESG_E = 1,753 < 10; the variables are not correlated
VIF value for ESG_S = 1,826 < 10; the variables are not correlated
VIF value for ESG_G = 1,113 < 10; the variables are not correlated
And since all variables have VIF < 10 we do not have to check further on the Collinearity Diagnostics table.

(Statistics For Dummies, 2023; Kanda Data, 2022; REGORZ STATISTIK, 2020; University of Bristol, n.d.; (UCLA, n.d.,b; Investopedia, 2024,a)

Table 30. *Residuals Statistics for TSR.*

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-7,697	24,390	9,166	9,6871	2156
Std. Predicted Value	-1,741	1,572	,000	1,000	2156
Standard Error of Predicted Value	,756	3,169	1,464	,403	2156
Adjusted Predicted Value	-7,403	24,490	9,167	9,6849	2156
Residual	-90,3695	359,4492	,0000	31,5101	2156
Std. Residual	-2,865	11,397	,000	,999	2156
Stud. Residual	-2,869	11,421	,000	1,000	2156
Deleted Residual	-90,5786	361,0029	-,0014	31,5885	2156
Stud. Deleted Residual	-2,873	11,782	,000	1,003	2156
Mahal. Distance	,239	20,759	3,998	2,977	2156
Cook's Distance	,000	,113	,000	,003	2156
Centered Leverage Value	,000	,010	,002	,001	2156

a. Dependent Variable: TSR

Source: SPSS

(Note that the unstandardized residuals have a mean of zero, and so do standardized predicted values and standardized residuals.)

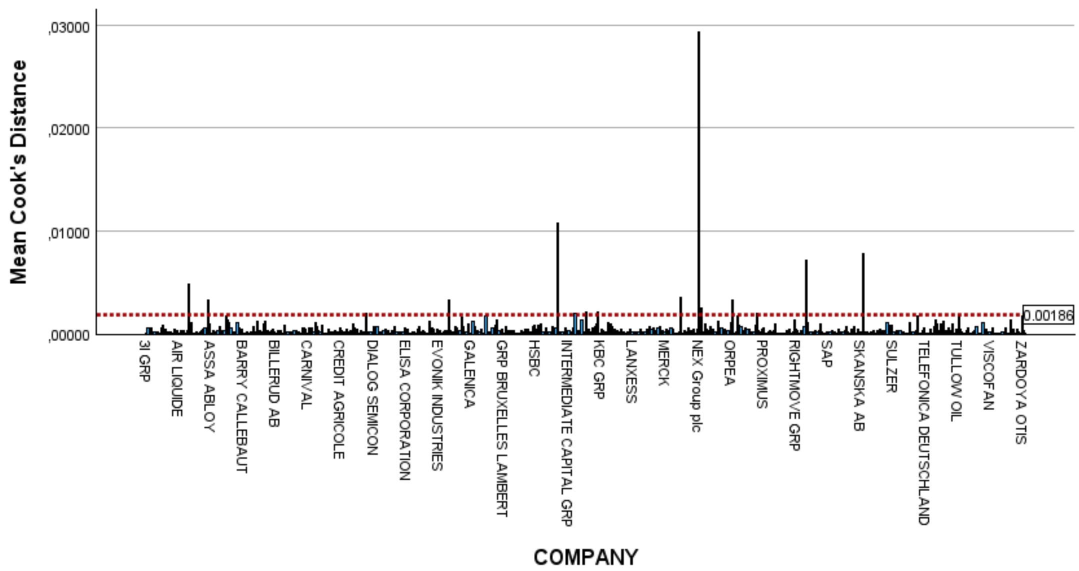
Regression analysis is sensitive to outliers, so we want to ensure that there are no extreme outliers in our data set.We can do this by reviewing the Minimum and Maximum columns of the Std. Residual row in the Residuals Statistics table. A data point with a standardized residual that is more extreme than +/-3 is usually considered to be an outlier. In other words, if the value in the Minimum column of the Std. Residual row is less than -3, we should investigate it. Similarly, if the value in the Maximum column of the Std. Residual row is greater than 3, we should investigate it.

In this case, the minimum value of std. residual is -2,865 > -3 and the maximum value of std. residual is +11,397 > +3 , indicating that our dataset might includes extreme outliers.

(EZ SPSS TUTORIALS, n.d.)

Last step is to investigate for Unusual and Influential Observations:

Figure 33. Cook's Distance for TSR.

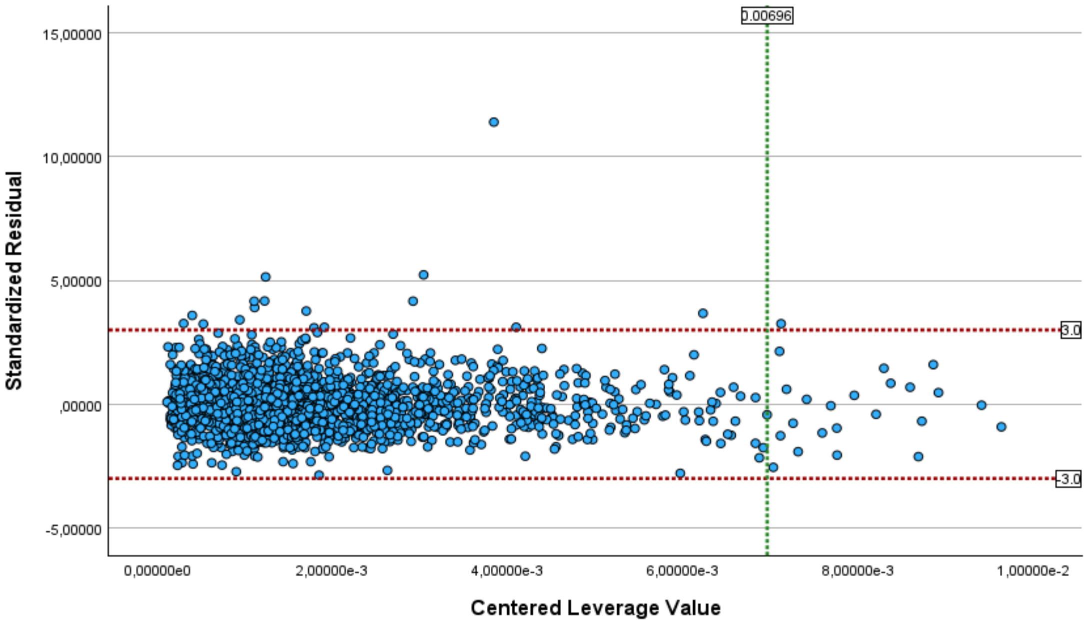


Source: SPSS

The above figure shows the Cook's Distance for TSR of all the 539 companies that used in the sample.

The cut off for Cook's Distance is 4/n so here it is 4/2156 = 0,00186 which is added to the chart as a reference red line to make it easier to see.
There are a lot of Cook's Distances above this line, which is extremely far from it. This may indicate that these companies' observations could be a problem for the regression analysis.

Figure 34. Scatterplot of the Centered Leverage Values and the Standardized Residuals for TSR.



Source: SPSS

The above figure shows a scatterplot of the Centred Leverage Values and the Standardised Residuals for TSR.

The cut off for Leverage is 3*(k + 1) / n, where k = the number of independent variables. The cut off here is 3*(4+1) / 2156 = 0,00696 which is added to the chart as a reference green line to make it easier to see.

There are several observations with standardized residuals outside ±3 but there is only one extreme outliers with standardized residuals outside ±10 that would be worthy of further investigation.

(UCLA, n.d.,a)

6. Insights and Empirical Revelations

This chapter presents the results of the examination for the relationship between each financial ratio separately with the ESG scores.

6.1 Results of ESG - ROE analysis

The first dependent variable that was examined for its relationship with ESG Rates was ROE.

In the beginning we had to check if ROE data were following a normal distribution.

From the Descriptive Statistics table we observed that both skewness and kurtosis values were greater than 2, which was an alert for abnormal distribution, so we executed a customized K-S test to assure that allegation. The findings were clear about the normality of ROE.

We continued with correlation analysis, homoscedasticity, and normality of errors.

From the Correlations table it was easy to understand that ROE had not a statistically significant linear relationship with the independent variables (YEAR, ESG_E, ESG_S and ESG_G), whereas the independent variables had one with each other.

A scatterplot of regression standardized residual and regression standardized predicted values and a normal P-P plot of regression studentized residual insured the existence of a homogeneous spread and the errors' normal distribution.

Next step was to examine the output of linear regression analysis; Model Summary, ANOVA, Coefficients and Residuals Statistics tables.

Model Summary: R value indicated a weak positive level of prediction and R-squared indicated a 0,1% of the variability in the outcome data cannot be explained by the model. Adjusted R-squared indicated a model that has no predictive value and Std. Error of the Estimate indicated that the estimated value is far from the true value.
D-W clarified that the data is not autocorrelated.

ANOVA: From F-value we could draw the conclusion that the group of independent variables (YEAR, ESG_E, ESG_S, ESG_G) does not reliably predict ROE.

Coefficients: Expressed in terms of the estimates given, the regression equation is ROE Predicted = - 4681,059 + 2,326YEAR - 0,103ESG_E + 0,007ESG_S – 0,002ESG_G. From t-value and two-tailed p-value, used in testing the null hypothesis that the coefficient/parameter is 0, we infer that for all independent variables we should retain the null hypothesis. The same conclusion comes from examining the Confidence Intervals either. As far as it concerns VIF values, all dependent variables are not correlated.

Residuals Statistics: The minimum and maximum value of std. residuals indicate that the dataset includes extreme outliers.

Last but not least, we had to investigate for Unusual and Influential Observations.

Cook's Distance and Leverage figures assume that there are companies' observations which may be a problem for regression analysis and for that reason they require further investigation.

Inferentially, the analysis for ROE demonstated that we have to accept the null hypothesis (H0: $\beta1 = \beta2 = \beta3 = 0$) which means that there is not a significant relationship between a company's ESG Rates and ROE.

6.2 Results of ESG - ROA analysis

The second dependent variable that was examined for its relationship with ESG Rates was ROA.

In the beginning we had to check if ROA data were following a normal distribution.

From the Descriptive Statistics table we observed that both skewness and kurtosis values were greater than 2, which was an alert for abnormal distribution, so we executed a customized K-S test to assure that allegation. The findings were clear about the normality of ROA.

We continued with correlation analysis, homoscedasticity, and normality of errors.

From the Correlations table it was easy to understand that ROA had not a statistically significant linear relationship with the independent variables (YEAR, ESG_E, ESG_S and ESG_G), whereas the independent variables had one with each other.

A scatterplot of regression standardized residual and regression standardized predicted values and a normal P-P plot of regression studentized residual insured the existence of a homogeneous spread and the errors' normal distribution.

Next step was to examine the output of linear regression analysis; Model Summary, ANOVA, Coefficients and Residuals Statistics tables.

Model Summary: R value indicated a median positive level of prediction and R-squared indicated a 0,2% of the variability in the outcome data cannot be explained by the model. Adjusted R-squared indicated a model that has no predictive value and Std. Error of the Estimate indicated that the estimated value is not far from the true value.
D-W clarified that the data is not autocorrelated.

ANOVA: From F-value we could draw the conclusion that the group of independent variables (YEAR, ESG_E, ESG_S, ESG_G) does not reliably predict ROA.

Coefficients: Expressed in terms of the estimates given, the regression equation is ROA Predicted = - 40,584 + 0,023YEAR + 0,003ESG_E - 0,030ESG_S + 0,021ESG_G. From t-value and two-tailed p-value, used in testing the null hypothesis that the coefficient/parameter is 0, we infer that for all independent variables we should retain the null hypothesis. The same conclusion comes from examining the Confidence Intervals either. As far as it concerns VIF values, all dependent variables are not correlated.

Residuals Statistics: The minimum and maximum value of std. residuals indicate that the dataset includes extreme outliers.

Last but not least, we had to investigate for Unusual and Influential Observations.

Cook's Distance and Leverage figures assume that there are companies' observations which may cause a problem for regression analysis and for that reason they require further investigation.

Inferentially, the analysis for ROA demonstated that we have to accept the null hypothesis (H0: $\beta1 = \beta2 = \beta3 = 0$) which means that there is not a significant relationship between a company's ESG Rates and ROA.

6.3 Results of ESG - P/E analysis

The third dependent variable that was examined for its relationship with ESG Rates was P/E Ratio.

In the beginning we had to check if P/E Ratio data were following a normal distribution.

From the Descriptive Statistics table we observed that both skewness and kurtosis values were greater than 2, which was an alert for abnormal distribution, so we executed a customized K-S test to assure that allegation. The findings were clear about the normality of P/E Ratio.

We continued with correlation analysis, homoscedasticity, and normality of errors.

From the Correlations table it was easy to understand that P/E Ratio had not a statistically significant linear relationship with the independent variables (YEAR, ESG_E, ESG_S and ESG_G), whereas the independent variables had one with each other.

A scatterplot of regression standardized residual and regression standardized predicted values and a normal P-P plot of regression studentized residual insured the existence of a homogeneous spread and the errors' normal distribution.

Next step was to examine the output of linear regression analysis; Model Summary, ANOVA, Coefficients and Residuals Statistics tables.

Model Summary: R value indicated a median positive level of prediction and R-squared indicated a 0,2% of the variability in the outcome data cannot be explained by the model. Adjusted R-squared indicated a model that has no predictive value and Std. Error of the Estimate indicated that the estimated value is very far from the true value.
D-W clarified that the data is not autocorrelated.

ANOVA: From F-value we could draw the conclusion that the group of independent variables (YEAR, ESG_E, ESG_S, ESG_G) does not reliably predict P/E Ratio.

Coefficients: Expressed in terms of the estimates given, the regression equation is
P/E Ratio Predicted = - 14.771,894 + 7,303YEAR + 0,228ESG_E + 0,605ESG_S -

0,401ESG_G. From t-value and two-tailed p-value, used in testing the null hypothesis that the coefficient/parameter is 0, we infer that for all independent variables we should retain the null hypothesis. The same conclusion comes from examining the Confidence Intervals either. As far as it concerns VIF values, all dependent variables are not correlated.

Residuals Statistics: The minimum and maximum value of std. residuals indicate that the dataset includes extreme outliers.

Last but not least, we had to investigate for Unusual and Influential Observations.

Cook's Distance and Leverage figures assume that there are companies' observations which may cause a problem for regression analysis and for that reason they require further investigation.

Inferentially, the analysis for P/E Ratio demonstated that we have to accept the null hypothesis (H0: β1 = β2 = β3 = 0) which means that there is not a significant relationship between a company's ESG Rates and P/E Ratio.

6.4 Results of ESG - TSR analysis

The fourth dependent variable that was examined for its relationship with ESG Rates was TSR.

In the beginning we had to check if TSR data were following a normal distribution.

From the Descriptive Statistics table we observed that both kurtosis value was greater than 2 whereas skewness value was lower than 2, which was maybe an alert for abnormal distribution, so we executed a customized K-S test to assure that allegation. The findings were clear about the normality of TSR.

We continued with correlation analysis, homoscedasticity, and normality of errors.

From the Correlations table it was easy to understand that TSR had a statistically significant linear relationship only with YEAR from all the independent variables (YEAR, ESG_E, ESG_S and ESG_G), whereas the independent variables had one with each other, except YEAR which had also one with TSR.

A scatterplot of regression standardized residual and regression standardized predicted values and a normal P-P plot of regression studentized residual insured the existence of a homogeneous spread and the errors' normal distribution.

Next step was to examine the output of linear regression analysis; Model Summary, ANOVA, Coefficients and Residuals Statistics tables.

Model Summary: R value indicated a median positive level of prediction and R-squared indicated a 8,6% of the variability in the outcome data cannot be explained by the model. Adjusted R-squared indicated a model that has almost no predictive value and Std. Error of the Estimate indicated that the estimated value is not far from the true value.
D-W clarified that the data is not autocorrelated.

ANOVA: From F-value we could draw the conclusion that the group of independent variables (YEAR, ESG_E, ESG_S, ESG_G) does reliably predict TSR.

Coefficients: Expressed in terms of the estimates given, the regression equation is TSR Predicted = - 17.401,576 - 8,609YEAR - 0,005ESG_E + 0,063ESG_S - 0,025ESG_G. From t-value and two-tailed p-value, used in testing the null hypothesis that the coefficient/parameter is 0, we infer that for all independent variables except YEAR we should retain the null hypothesis. The same conclusion comes from examining the Confidence Intervals either. As far as it concerns VIF values, all dependent variables are not correlated.

Residuals Statistics: The maximum value of std. residuals indicate that the dataset includes extreme outliers whereas minimum value of std. residuals is greater than -3.

Last but not least, we had to investigate for Unusual and Influential Observations.

Cook's Distance and Leverage figures assume that there are companies' observations which may cause a problem for regression analysis and for that reason they require further investigation.

Inferentially, the analysis for TSR demonstated that we have to accept the null hypothesis. ($H0$: $\beta1 = \beta2 = \beta3 = 0$) which means that there is not a significant relationship between a company's ESG Rates and TSR.

7. Synthesis and Discourse: Interrogating Findings, Literature, and Future Trajectories

This chapter synthesizes the research findings so as to create a versatile approach of the subject, engages in discourse by opposing them with the ones from the existing literature, and suggests potential directions for future research.

7.1 Summary of the findings and their meaning

In this section will be compared the main points from each relationship examined and evaluated overall in order to draw a more comprehensive meaning of the findings in the research.

To begin with, all four financial ratios that were used in the research, were checked to see if they met all the prerequisites for to be examined by regression analysis: normal distribution of data, correlation analysis, homoscedasticity, normality of errors.

ROE, ROA and P/E had skewness and kurtosis values greater than +2, whereas TSR had kurtosis value greater than +2 but skewness value lower than +2. A customized K-S test had to be executed to assure the normality of them, which all of them passed it.

ROE, ROA, P/E had not a statistically significant linear relationship with the independent variables (YEAR, ESG_E, ESG_S and ESG_G), whereas the independent variables had one with each other. While TSR had a statistically significant linear relationship only with YEAR from all the independent variables (YEAR, ESG_E, ESG_S and ESG_G), whereas the independent variables had one with each other, except YEAR which had also one with TSR.

ROE had a weak positive level of prediction, whereas ROA, P/E and TSR had a median positive level of prediction. The percentage of variability in the outcome data that cannot be explained by the models were almost the same for ROE, ROA and P/E, 0,1% and 0,2% respectively, while TSR had 8,6%.

ROE, ROA, P/E and TSR were not reliably predicted by the group of independent variables (YEAR, ESG_E, ESG_S, ESG_G).

ROE, ROA and P/E when tested in the null hypothesis that the coefficient/parameter is 0, inferred that for all independent variables the null hypothesis should be retained. While TSR when tested in the null hypothesis that the coefficient/parameter is 0, inferred that for all independent variables, except YEAR, the null hypothesis should be retained.

ROE, ROA and P/E dataset included extreme outliers with the concern being so in the maximum as in the minimum value of std. residuals. Whereas TSR dataset included extreme outliers with the concern being only in the minimum value of std. residuals.

ROE, ROA, P/E and TSR models when Cook's Distance and Leverage figures examined, assumed that there are companies' observations which may cause a problem for regression analysis and for that reason they require further investigation.

The conclusion of the analysis of the dependent variables demonstated that we have to accept the null hypothesis (H0: $\beta1 = \beta2 = \beta3 = 0$) which means that there is not a significant relationship between a company's ESG Rates and those financial ratios.

From the comparison above, it is clear that ROE, ROA and P/E ratio have roughly the same analysis process, and so almost the same results. Obviously there are differences since we are handling completely different sets of data, but in the final analysis these differences do not affect the results to such a great extent. But, this is not happening in the case of TSR. In several key points of the research there are differences in its results compared to the other financial ratios. In this point it must be mentioned that a significant relationship between the YEAR - independent variable and a dependent variable only exists with TSR, as all the other dependent variables (ROE, ROA, R/E) do not have a statistically significant relationship with YEAR.

The conclusion of course remains the same for all four of them, but there are some reservations when it comes to TSR and the exact kind of relationship that it has with ESG Rates.

7.2 Comparison of the results with the literature and prior research

This study examined if there is a positive, negative, mixed or no relationship between the stock - financial performance of a firm and the ESG criteria as environmental, social, and governance factors separately.

The main results of the study supported that the environmental, social and governance factors alongside with ROE, ROA, P/E and TSR financial ratios of the selected companies had not correlate in a significant way.

Literature in the subject of the relationship between ESG and financial performance, and more specifically stock returns is vast. This can mistakenly be interpreted as a huge list with clear information in this subject. The reality of it is that from the one hand, indeed there is some knowledge on the issue, but that knowledge is so subjective in the context and limitations of each investigation that gives all kinds of conclusions.

Sustainable finance includes environmental, social and governance considerations in investment decisions and is a new perspective in the area of investments and finance in general. It is quite logical that a variety of researchers are intrigued by it and want to examine every side of its pluralistic content. However, this is the result, because each researcher sets a different context, data, method of approach, point of intersection, time horizon etc. that there is no clear picture of the relationship between financial factors and sustainability.

As far as it concerns this research, with all its specifics in its structure and implementation, it came to the result that the relationship between ESG and stock - financial performance is a neutral one. In comparison with prior research claiming that the majority of studies depict a positive relationship, then some depict a mixed one, a few a neutral one and a little a negative one.

7.3 Limitations of the study and suggestions for future research

7.3.1 Limitations of the study

Like most academic studies, this study has several limitations in methodology and results which should be clearly communicated.

First of all, the time period of the research is only four years, between 2019 to 2022, which included the first years of the Covid-19 pandemic. This could influence the results in a significant way, as it has affected the whole finance in general.

Also, this time span is thought to be a quite small one in order to get significant results in any research.

The second limitation is the sample size which contains only 539 firms. The company data that were used concerned only European companies that operate in STOXX Europe 600. The final selection made under the circumstances of the company to be public traded for at least before 2017. Companies that made their IPO in 2018 were excluded because their first year would have been probationary and accordingly not accurate for this kind of research.

Additionally, the selection of the firms made without taking into account the particular cap. and the particular sector of each company when that information would have been truly useful for the categorization of the effect of ESG on each different case.

Also, the sample only included companies that do not present missing values for any of the selected variables.

Another significant limitation is the constituent elements of the stock - financial performance that were chosen for this study, which can differ for every researcher. In this research those are ROE, ROA, P/E and TSR financial ratios, while for sustainability were used the three pillars of ESG, without also using the overall ESG score.

An also important topic is the time chosen in record keeping of the financial statements of the companies. Every company has each own regulations on how and when they are releasing their financial statements. So, it was chosen to be the ones that came out annually, at the end of the year.

As far as it concerns the ESG scores that were used, were extracted from LSEG Financial Data – Refinitiv, without being compared with respective scores from other databases. Because each provider uses a different method in this field, comparison would be necessary in order to test their accuracy. Also, a common hindrance to the use of ESG ratings is that ratings that come from different rating agencies are often not directly comparable or does not give the same kind of information. The Sustainalytics ESG score is a risk score, whereas the Refinitiv ESG score measures a good performance.

Last but not least, TSR prices for the i-th company in the j-th year were calculated one by one from the financial statements of their respective companies for the favor of this study. That makes these prices not accurate because each researcher may use another formula to calculate TSR.

All those limitations could cause the results to be flawed and that is the reason why every single study is unique, because investors' points of view always differ even if only slightly.

7.3.2 Suggestions for future research

It is a fact that higher ESG firms have also higher financial performance compared to their peers. This study does not show if better stock returns are achieved through high ESG performance, so we do not draw any conclusion regarding the direction of the causality of this relationship as this study found no correlation between them.

The regression models that were used, showed a quite low overall fit which designates or a problematic approach or a problematic implementation or both of them.

So, it is recommended for future research to add more control variables which would increase the explanatory power of the regression models. These variables could be ownership structure, R&D expenditure, growth rates, board characteristics, sector, size and cap.. This serves the idea of presenting the relationship between ESG and stock - financial performance personalized for every category of the above with the usage of dummies for each one in order to track possible differences in the categories.

Furthermore, this analysis' data refer to four years. It would be interesting to carry out a similar study over a longer period and without the effect of Covid-19 included. That way results of the study would be more accurate, especially ESG which is considered to be important for value creation and sustainability on the long-term.

Also, using and finding a way to compare the ESG ratings from different rating providers could increase the robustness and precision of the results.

Usage of ROA, ROE, P/E and TSR financial ratios as proxy variables to measure stock - financial performance, which to some extent do not fully capture the level of it, would be wise if in future are replaced by some more related multidimensional indicators.

Multiple linear regression analysis maybe was not a good idea after all for examining this kind of relationship and it would have been more ideal to use panel data analysis which signifies the dependent variable with two subscripts that allows them to track the i-th of N companies in the t-th of T periods.

Moreover, there is a little part of literature that refers to the relationship between ESG activities and the firm performance as a non-linear one. In other words, the findings support that the ESG activities are rewarding only up to a point and start to affect the performance negatively after that, claiming the relationship is actually inverse U-shaped. For future research it would be interesting to deal with this allegation more.

Finally, this paper focused on decomposing ESG and deal with only the three ESG pillars. In future research, it would be interesting to include the overall ESG score to also explore its impact.

7.4 Practical implications for investors and firms

As it was earlier mentioned, literature suggests a positive effect for all three pillars of ESG on financial performance and specifically stock returns, but the results of the hereto research primarily indicate a neutral effect, failing to support the hypothesis of a positive correlation existence.

This obviously does not mean that we accept that only one case is correct. The cases are not mutually exclusive, it is just that this specific study could not show the same results mainly due to its composition and application.

The accredited claim that stock - financial performance and ESG factors have a positive relationship, most of the times, is very useful for investors, managers, stakeholders, employees of listed companies.

First, those empirical findings give reasons to managers to focus on the improvement of ESG performance, since it seems to benefit CFP in general. Second, the market does value ESG performance, as it eases transparency. In addition, we have seen that not all the three different pillars have the same significance. Moreover, managers should not be misled by the findings that show that bad ESG performance does not affect operating performance as it is in fact penalized by the market, reflecting in lower firm values.

As far as it concerns the investors, firms with higher ESG scores tend to be less risky options for investments as higher sustainability companies can show lower volatility in the stock market as well as reduced credit and business risk. This enables in valuing the company more highly because of the trade-off between risk and return. So, an investment like this is not value destroying but rather value creating, both from a market's and an accounting's perspective.

Another important empirical finding is that firms who exhibit healthier ESG performances, may have better reputation and public image which will potentially lead to easier attraction and retention of employees and higher customer loyalty.

Last but not least, higher ESG companies are found to be more successful in making strategic decisions which consequently lead to having higher growth prospects.

8. Conclusion

Both theoretical and empirical researchers in sustainable finance have hypothesized and documented numerous links between ESG activities and stock - financial performance. When reviewing the literature, it is highlighted that some results are quite robust. However, other results are mixed which suggest that there is a role for research seeking to reconcile the differences and add to the understanding of the issues.

The primary objective of this study was to draw conclusions regarding the existence or non-existence of any type of correlation between corporate sustainability and the company's financial performance. More specifically, in order to achieve this analysis, we delved into the examination of the relationship between the ESG criteria, which reflect the viability of a company, and the stock performance, which is a major factor affecting its general financial performance as well as its external image and its reputation among prospective investors and partners.

Regarding the examination of the ESG criteria, we used the three pillars into which the ESG score is decomposed: Environmental, Social, and Governance. On the other hand, in order to examine the stock returns, the analysis of four financial ratios was chosen: ROE, ROA, P/E and TSR, because each of them provides different important information that, as a whole, compose a report on both the stock returns and the financial returns of the company in general, which obviously are interrelated and mutually influencing.

The sample that was used consisted of 539 companies for the period from 2019 to 2022. Those companies are listed in the STOXX Europe 600 and all of them reported ESG ratings and financial statements for the period under investigation. All the relevant information was extracted from Refinitiv and financial reports.

The main results of the research indicated that ESG criteria does not affect stock returns in any way. More specifically, environmental, social and governance factors have a neutral relationship with stock performance of a company in a not significant way.

Those results come into conflict with the results from literature. In particular, the majority of the previous research support that there is a positive correlation between ESG and stock - financial performance. There is only a small number of researchers that have found similar results.

A possible reason for our results to contradict those in the literature is the design and the implementation of the research. There were several significant limitations that could have altered the results. But a more important role played the non-linearities between the ESG activities and firm performance in case of the stock market.

Be that as it may, this thesis contributes to the field of the existing research as it supports some of the existing results which claim the absence of a correlation between ESG and stock performance and gives great insight for future approaches on this subject.

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Appendices

Appendix A: ESG Rating Methodologies by Refinitiv.

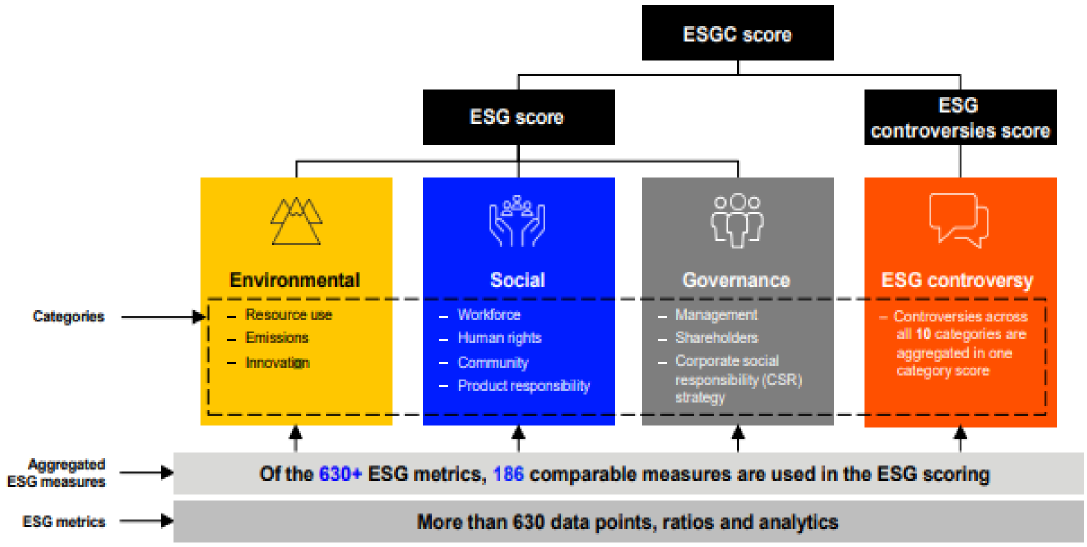
LSEG Financial Data - Refinitiv offers one of the most comprehensive databases, consisting of more than 15,500+ public and private companies globally, translated as over 90% of the global market cap. coverage. Refinitiv's 700+ analysts collect data from every accessible source to provide up-to-date information for each company.

The analysis of ESG score, which measures the ESG performance of companies relative to the sector (for the environmental and social pillars) and to the country of incorporation (for the governance pillar), and also a combination of all ESG scores (ESGC), which is calculated by a score related to any controversies referring to the company examined, goes back to 2002.

More specifically, Refinitiv collects and calculates 630+ company-level ESG measures, of which the 186 are the most comparable metrics per industry to determine the entire firm assessment. Those are separated into 10 categories that reconstruct firstly the three pillar ESG score and then the total ESG score. The ESG pillar score is a relative sum of the category weights that are used for every industry, which differ for every industry as far as it concerns the environmental and social categories. While for governance, remain the same. The pillar weights are standardized to percentages ranging between 0 and 100.

The ESGC store is calculated as the weighted average of the ESG scores and ESG controversies score per fiscal period, when companies are involved in ESG controversies with recent controversies reflected in the latest completed period. Otherwise, when companies are not involved in ESG controversies, the ESGC score is equal to the ESG score.

Figure 35. Refinitiv's ESG scoring methodology.



Source: LSEG (2023)

Refinitiv's ESG Scores calculation methodology is as follows:

<u>Step 1: Calculation of ESG category scores</u>

Boolean data are assigned to the system as questions being answered with only three possible answers: Yes, No or Null. Boolean data are converted to numeric numbers with the correlation that Null entries as 0 while for Yes and No, each measure has a specific polarity indicating whether a higher value is positive or negative.

Table 31. Boolean data converted to numeric variables.

Default values		
Positive	Yes = 1	No/Null = 0
Negative	Yes/Null = 0	No = 1

Source: LSEG (2023)

Numeric data is information expressed in numbers that help with the comparison between companies of the same industry group. Some numeric data only make sense for certain types of companies. If a number doesn't apply to a company's industry, it is not included in comparisons.

Figure 36. Category score calculation.

$$score = \frac{no.of\ companies\ with\ a\ worse\ value + \frac{no.of\ companies\ with\ the\ same\ value\ included\ in\ the\ current\ one}{2}}{no.of\ companies\ with\ a\ value}$$

Source: LSEG (2023)

<u>Step 2: Calculation of category weights</u>

The weights for each of the 10 categories, that are used only for environmental and social topics, are determined using the magnitude matrix. The way the matrix is derived is explained in the following:

At first, a relative median is calculated by obtaining each industry medians for every data point within every industry group.

The median value of an industry group is divided by the sum of all industry groups average, represents the relative median.
Deciles are classified via their relative median values, and weights ranging from 0 to 10 are assigned accordingly.

When a category has more than one data points, the magnitude weight of this category is the median of the decile weight.

As far as it concerns the corporate governance magnitude weights, they are calculated by a measure of data points in each governance category derived by total data points in the governance pillar and multiplied by the default category weights of 15.

Then, category weights are generated from the magnitude weights of all the categories for an industry group.

Figure 37. Category weight calculation.

$$Category\ weight\ of\ an\ industry\ group = \frac{Magnitude\ weight\ of\ a\ category}{Sum\ of\ magnitudes\ of\ all\ categories}$$

Source: LSEG (2023)

Step 3. Calculation of overall and pillar ESG score

The scores for the environmental, social and governance pillars are calculated from the relative sum of the category weights.

While the overall ESG score is calculated from the aggregation of the three pillars with each one based on its category weight.

Step 4. Calculation of Controversies scores

The controversy score is measured based on the 23 ESG metrics. The default value for controversy topics is 0, but it becomes 1 if the company is involved in severe ESG controversies.

The number of controversies is multiplied by the severity weight and the final score is aggregated from the percentile formula only when using it from firms with controversies. Otherwise, firms with no controversies will automatically get a score of 100%.

Note that the benchmark for controversies scores is the industry group.

Table 32. Calculation of controversy scores based on the market cap. grouping.

Global benchmark	Cap class	Severity rate*
>=10 billion	Large	0.33
>=2 billion	Mid	0.67
<2 billion	Small	1

*Logic to derive weights: large = 1/3 or 0.33, mid = 0.67, small = 0.33+0.67 = 1.

Source: LSEG (2023)

Step 5. Calculation of ESGC score

In the event that the controversies score is lower than the ESG score, the ESGC score is given by the average of the controversies and the ESG score.

On the contrary, if the controversies score is higher than the ESG score, the ESGC score is equal to the ESG score.

Last but not least, ESG scores are expressed in percentiles, that are converted to letter grades, ranging from A+ (excellent ESG performance) to D- (poor ESG performance).

Table 33. Refinitiv's conversion from ESG percentile scores to letter grades.

Score range	Grade	Description
0.0 <= score <= 0.083333	D -	'D' score indicates poor relative ESG performance and insufficient degree of transparency in reporting material ESG data publicly.
0.083333 < score <= 0.166666	D	
0.166666 < score <= 0.250000	D +	
0.250000 < score <= 0.333333	C -	'C' score indicates satisfactory relative ESG performance and moderate degree of transparency in reporting material ESG data publicly.
0.333333 < score <= 0.416666	C	
0.416666 < score <= 0.500000	C +	
0.500000 < score <= 0.583333	B -	'B' score indicates good relative ESG performance and above- average degree of transparency in reporting material ESG data publicly.
0.583333 < score <= 0.666666	B	
0.666666 < score <= 0.750000	B +	
0.750000 < score <= 0.833333	A -	'A' score indicates excellent relative ESG performance and high degree of transparency in reporting material ESG data publicly.
0.833333 < score <= 0.916666	A	
0.916666 < score <= 1	A +	

ESG laggards

ESG leaders

Source: LSEG (2023)

Appendix B: Country Weight of the Sample

Table 34. Sample's weight per country.

Country	Symbol	No. of Firms	Weight
Austria	AT	6	1,11%
Belgium	BE	14	2,60%
Czech Republic	CZ	2	0,37%
Denmark	DK	20	3,71%
Finland	FI	14	2,60%
France	FR	75	13,91%
Germany	DE	61	11,32%
Great Britain	GB	154	28,57%
Greece	GR	3	0,56%
Ireland	IE	8	1,48%
Italy	IT	30	5,57%
Luxembourg	LU	3	0,56%
Netherlands	NL	24	4,45%
Norway	NO	12	2,23%
Portugal	PT	4	0,74%
Spain	ES	25	4,64%
Sweden	SE	38	7,05%
Switzerland	CH	46	8,53%
Total		539	100,00%

Appendix C: Industry Weight of the Sample

Table 35. Sample's weight per industry.

Industry	No. of Firms	Weight
Automobiles & Parts	14	2,60%
Banks	42	7,79%
Basic Resources	16	2,97%
Chemicals	25	4,64%
Construction & Materials	18	3,34%
Financial Services	29	5,38%
Food & Beverage	21	3,90%
Health Care	36	6,68%
Industrial Goods & Services	97	18,00%
Insurance	33	6,12%
Media	23	4,27%
Oil & Gas	21	3,90%
Personal & Household Goods	31	5,75%
Real Estate	25	4,64%
Retail	27	5,01%
Technology	18	3,34%
Telecommunications	19	3,53%
Travel & Leisure	20	3,71%
Utilities	24	4,45%
Total	539	100,00%