Relation Between ESG Scores & Company Financial Performance

Project Work

Submitted to

PONDICHERRY UNIVERSITY

in partial fulfilment of the requirements

for the award of the degree of

Master of Science

in

Statistics

BY

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PONDICHERRY

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PONDICHERRY UNIVERSITY
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Certified that the project work entitled **Relation Between ESG Scores and Company Financial Performance** is a bonafide record of work carried out by the following student.

DNYANESHWAR DAREKAR 22375022

of M.Sc. Statistics submitted in partial fulfilment of the requirement for the award of degree of Master of Science in Statistics, during the academic year **2023-24.**

(Supervisor) Head of the Department

Submitted for M.Sc., Degree Examination held on _____

Examiners

1.

2.

newtral

May 03, 2024

To whomever it may concern

This is to certify that **Dnyaneshwar Narayan Darekar** of **Central University of Pondicherry** has successfully completed 4 months of his internship in the role of **DATA ANALYST INTERN** at Newtral Technologies Private Limited.

The internship start date was **15 Jan 2024** and end date will be **15 May 2024**.

During this period, he worked in various areas of Data Analysis, Market Research and Project Management Basics.

He shows a lot of skill in his work in his domain and he is extremely professional and hardworking. His association with us was beneficial and we wish him all the best for his future endeavors.

Best regards,

Avi Chudasama

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CERTIFICATE

This is to certify that **Dnyaneshwar Narayan Darekar (22375022)**, a student of M.Sc. Statistics from the Department of Statistics, Pondicherry University has completed her fourth semester project under our guidance at **Newtral Technologies Private Limited, Bangalore** from **January to May 2024.** The project work entitled **"Relation Between ESG Scores and Company Financial Performance"** embodies the novel work done by him.

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Dnyaneshwar Darekar

CONTENTS

ABSTRACT

This research investigates the intricate interplay between Environmental, Social, and Governance (ESG) performance metrics and company financial performance. In recent years, stakeholders have increasingly scrutinized companies' ESG practices, recognizing their potential impact on long-term financial viability and sustainability.

Drawing on a comprehensive dataset spanning multiple industries and geographies, this study employs robust statistical analysis techniques to examine the extent to which ESG scores correlate with various financial indicators, such as profitability, stock returns, and market valuation.

Moreover, the research delves into the nuanced dynamics between specific ESG factors and financial outcomes, shedding light on the mechanisms through which environmental stewardship, social responsibility, and governance practices influence corporate bottom lines.

CHAPTER 1

INTRODUCTION

1.1 Overview

The concept of Environmental, Social, and Governance (ESG) factors has emerged as a crucial area of study within the realm of responsible investment and corporate governance. Initially rooted in ethical considerations, ESG has evolved into a framework that guides risk assessment and operational practices for businesses (Wang and Sarkis, 2017). The increasing global focus on sustainability has propelled ESG to the forefront of economic and management discourse (Paradis and Schiehll, 2021; Finger and Rosenboim, 2022).

The Relationship between ESG and Financial Performance:

Statistical analysis plays a pivotal role in exploring the intricate relationship between ESG metrics and company financial performance. Stakeholders are increasingly recognizing the potential impact of ESG practices on long-term financial viability and sustainability. Robust statistical techniques are employed to examine the extent to which ESG scores correlate with key financial indicators such as profitability, stock returns, and market valuation. Through comprehensive datasets spanning multiple industries and geographies, statistical models aim to elucidate the nuanced dynamics between specific ESG factors and financial outcomes. This analysis sheds light on the mechanisms through which environmental stewardship, social responsibility, and governance practices influence corporate bottom lines.

Contributions of the Study:

This study contributes to the literature by providing empirical evidence on the relationship between ESG and financial performance using rigorous statistical methods. By analyzing data from Indian listed companies, the study expands the geographical scope of existing research and offers insights into the unique challenges and opportunities present in emerging markets. Furthermore, the incorporation of digital transformation as a moderating variable adds a novel dimension to statistical analysis, highlighting its potential to shape the ESG-financial performance nexus. These statistical findings offer valuable insights for policymakers and businesses seeking to promote sustainable economic development.

1.2 Tools for Analysing Observational Studies

In observational studies investigating the relationship between Environmental, Social, and Governance (ESG) factors and company financial performance, statistical tools play a crucial role in uncovering meaningful insights. Two commonly utilized tools in this context are correlation analysis and multiple regression analysis.

Correlation Analysis: Correlation analysis is a statistical technique used to measure the strength and direction of the relationship between two variables. In the context of our study, correlation analysis allows us to assess the degree of association between ESG performance metrics and various financial indicators such as profitability, stock returns, and market valuation. By calculating correlation coefficients, we can determine whether there exists a significant relationship between ESG scores and financial performance metrics. Positive correlations indicate that as ESG performance improves, financial performance also tends to improve, while negative correlations suggest an inverse relationship.

Multiple Regression Analysis: Multiple regression analysis extends correlation analysis by allowing us to examine the simultaneous influence of multiple independent variables on a dependent variable. In our study, multiple regression analysis enables us to assess the impact of ESG factors on company financial performance while controlling for other relevant variables. By specifying a regression model that includes ESG scores along with other potential determinants of financial performance, such as industry type or company size, we can quantify the unique contribution of ESG metrics to explaining variations in financial outcomes. Additionally, regression analysis provides insights into the strength and significance of these relationships, allowing for more robust conclusions to be drawn.

Correlation analysis and multiple regression analysis serve as indispensable tools for analyzing observational studies investigating the relationship between ESG performance and company financial performance. These statistical techniques provide valuable insights into the nature and magnitude of the associations between ESG factors and financial outcomes, facilitating informed decision-making for stakeholders in pursuit of sustainable business practices.

1.3 Project Objectives

Objectives in the project are:

1. To investigate the relationship between environmental, social, and governance metrics and companies' financial performance indicators.
2. To assess the impact of individual ESG factors on various aspects of financial performance using regression modelling.

CHAPTER 2

BACKGROUND

2.1 ESG definition and first notions

The acronym ESG is used in the economic and financial fields to describe all those activities that are related to responsible activities and investments (IR) that pursue the typical objectives of financial management by taking into consideration environmental, social and governance aspects. According to (Cambridge Dictionary, s.d.), this term can also be defined as a methodology of judging a company by factors that differ from mere financial performance. Therefore, these factors are central in measuring the sustainability and the environmental and social impact of a business or an investment in a company.

The first appearance of the ESG term can be found in a United Nations (UN) 2004 report, for which the former UN Secretary invited a joint initiative of financial institutions, that stated: "to develop guidelines and recommendations on how to better integrate environmental, social and corporate governance issues in asset management, securities brokerage services and associated research functions"(Eccles, Lee, & Stroehle, 2020).

The ESG expression consists of three words that describe three different universes of social sensitivity:

- E: Environmental
- S: Social
- G: Governance

The first aspect (**Environmental**), is connected with the Environment which includes risks such as climate change, air and water pollution, carbon dioxide emissions, waste and deforestation. These issues have become increasingly popular in the last 20 years and not only from a mere economic point of view, all the members of the United Nations have increased their focus on these crucial issues driving countries to embrace greener alternatives. An example of that is represented by the 2015 climate change conference that was held in Paris (COP21) that invited countries to formulate and submit by 2020 long-term low greenhouse gas emission development strategies (LT-LEDS) (UNFCCC, s.d.).

The second universe (**Social**), includes more the societal aspect so it concerns more topics such as human rights, labour standards, gender equality, and civil community relations.

Lastly, the third universe of social sensitivity (**Governance**) relates to corporate governance practices, including top management and corporate behaviour in terms of compliance with laws and ethics and which procedures should take place for stability and control (Silano, 2016).

2.2 ESG from the Corporate Perspective

In the realm of corporate governance, Environmental, Social, and Governance (ESG) factors have emerged as crucial considerations shaping business strategies and operations. Companies increasingly recognize that integrating ESG principles into their practices not only aligns with societal expectations but also yields tangible benefits in terms of risk mitigation, reputation enhancement, and long-term financial performance. From reducing carbon emissions and promoting sustainable resource management to fostering diverse and inclusive workplaces, corporations are adopting proactive measures to address environmental and social challenges while ensuring robust governance frameworks. Embracing ESG initiatives not only demonstrates a commitment to responsible business conduct but also positions companies favourably in attracting investors, accessing capital, and securing stakeholder trust. As such, ESG integration has become an integral aspect of corporate management strategies, reflecting a growing recognition of the interconnectedness between sustainable practices and business resilience (Reference: PwC, n.d.)

2.3 Sustainable Development Goals

In 2015, the United Nations introduced the Sustainable Development Goals (SDGs) as a universal agenda aimed at galvanizing global action to safeguard the planet, alleviate poverty, and foster a peaceful and prosperous world by 2030 (United Nations Development Programme, s.d.). Comprising 17 interlinked objectives, the SDGs are designed to operate synergistically, where progress in one area can catalyze advancements in others. Emphasizing the need for balanced social, economic, and environmental sustainability, the SDGs intersect closely with dimensions of Environmental, Social, and Governance (ESG) and Corporate Social Responsibility (CSR). This comprehensive framework is intended to be embraced by diverse stakeholders, ranging from individual enterprises to entire nations, with the understanding that collaborative efforts leveraging creativity, technology, and financial resources are essential for achieving the SDGs in all contexts (United Nations Development Programme, s.d.).

The commitment to the SDGs underscores a concerted effort to prioritize the advancement of marginalized communities. Notably, certain SDGs are tailored to eradicate poverty, hunger, AIDS,

and gender-based discrimination, as depicted in Figure 1.

Figure 1 The SDGs (United Nations Development Programme, s.d.)

2.4 ESG from the Investment Perspective

Environmental, social, and governance factors (ESG) are poised to exert a significant influence on the financial investment sector in the coming years (Bain & Company, 2022). With heightened support from consumers, employees, and communities for ESG initiatives, companies that effectively embrace and excel in these areas will increasingly differentiate themselves, potentially gaining a sustainable competitive edge.

2.5 The ESG Scoring (CRISIL)

CRISIL's (Credit Rating Information Services of India Limited) ESG scores are a comprehensive tool designed to assess and monitor Environmental, Social, and Governance risks across financial institutions and corporations. Here is a summary of the key points regarding CRISIL's ESG scoring methodology:

2.5.1 Methodology

CRISIL's ESG scores are based on a proprietary methodology that evaluates over 600 Key Performance Indicators (KPIs) to score 1,000 companies across approximately 65 sectors. The assessment relies on publicly available information from sources like company websites, exchange filings, annual reports, and sustainability reports. It also considers other material ESG information from reliable sources like industry associations and government agencies.

2.5.1 Scoring Framework

The ESG scores are assigned on a scale of 0-100, with different score categories indicating the level of ESG performance: 0-30 (Weak), 31-45 (Below average), 46-60 (Adequate), 61-70 (Strong), and 71-100 (Leadership). The scores are based on the relative importance of Environmental (35%), Social (25%), and Governance (40%) attributes. Governance is given the highest weightage, reflecting its crucial role in driving environmental and social agendas within companies.

CHAPTER 3

DATA INTRODUCTION

3.1 Data Source

The data for this project was sourced primarily from the Money Control website, a leading financial news and information portal in India. Utilizing web scraping techniques, we extracted a total of 5000 observations from various sections of the website, including company profiles, financial reports, and market analyses. It's essential to note that the data collection period for this project spanned the fiscal year 2021-22.

However, it is important to note that while we gathered a substantial amount of data, not all companies featured on CRISIL had available Environmental, Social, and Governance (ESG) scores. As a result, the final dataset includes only those companies for which ESG scores were accessible, resulting in a subset of observations for our analysis.

Money Control is a comprehensive online resource offering real-time market updates, financial news, stock analysis, and investment insights. With a vast repository of data covering a wide range of Indian companies and financial instruments, Money Control serves as a valuable platform for investors, researchers, and market enthusiasts seeking timely and accurate information to make informed decisions.

3.2 Sample Size

The study draws upon a sample size of 343 companies selected from the pool of 1000 stock market-listed companies in India. The selection criteria aim to ensure representation across various sectors and market capitalizations. ESG score data is sourced from the CRISIL platform, renowned for its comprehensive evaluation of corporate sustainability practices and governance standards. CRISIL's methodology provides a robust framework for assessing companies' performance across ESG dimensions, encompassing environmental stewardship, social responsibility, and corporate governance practices.

By leveraging this dataset, the study aims to analyze the relationship between companies' ESG scores and their financial performance metrics. Through statistical analysis and econometric modelling, the research endeavours to uncover insights into how ESG considerations impact key financial indicators such as profitability, risk management, and market valuation.

3.3 Software Used - R

The following packages have been used for the purpose of model building and further statistical analyses:

- plyr
- dplyr
- ggplot2
- car
- reshape2

3.4 Dependent Variables

3.4.1 Enterprise Value (in Crores)

Enterprise value (EV) measures a company's total value, often used as a more comprehensive alternative to market capitalization. EV includes in its calculation the market capitalization of a company but also short-term and long-term debt and any cash or cash equivalents on the company's balance sheet.

$$EV = MC + Total\ Debt - C$$

where:

MC=Market capitalization; equal to the current stock price multiplied by the number of outstanding stock shares

Total debt= Equal to the sum of short-term and long-term debt

C=Cash and cash equivalents; the liquid assets of a company, but may not include marketable securities

3.4.2 Dividend Payout Ratio

The dividend payout ratio is the total amount of dividends that a company pays to shareholders relative to its net income. Put simply, this ratio is the percentage of earnings paid to shareholders via dividends. The amount not paid to shareholders is retained by the company to pay off debt or to reinvest in its core operations. The dividend payout ratio is sometimes simply referred to as the payout ratio.

$$\text{Dividend Payout Ratio} = \frac{\text{Dividends Paid}}{\text{Net Income}}$$

3.4.3 Return on Capital Employed

The term return on capital employed (ROCE) refers to a financial ratio that can be used to assess a company's profitability and capital efficiency. In other words, this ratio can help to understand how well a company is generating profits from its capital as it is put to use. ROCE is

one of several profitability ratios financial managers, stakeholders, and potential investors may use when analyzing a company for investment.

$$\text{ROCE} = \frac{\text{EBIT}}{\text{Capital Employed}}$$

where:

EBIT=Earnings before interest and tax

Capital Employed=Total assets − Current liabilities

3.4.4 Asset Turnover Ratio

The asset turnover ratio, also known as the total asset turnover ratio, measures the efficiency with which a company uses its assets to produce sales. The asset turnover ratio formula is equal to net sales divided by the total or average assets of a company. A company with a high asset turnover ratio operates more efficiently as compared to competitors with a lower ratio.

$$ATR = Net\ Sales/Average\ Total\ asset$$

Where:

Net sales are the amount of revenue generated after deducting sales returns, sales discounts, and sales allowances.

Average total assets is the average of total assets at year-end of the current and preceding fiscal year. Note: an analyst may use either average or end-of-period assets.

3.4.5 Market Cap to Net Operating Revenue

Market capitalization (or "market cap") is a useful Figure to examine when trying to understand a company's structure and profitability, and therefore a stock's value. Market capitalization can be used to determine a variety of key performance metrics, including price-to-earnings and price-to-free-cash flow. Market capitalization refers to the total dollar market value of a company's outstanding shares. It is thus calculated by multiplying the total number of a company's shares by the current market price of one share. The investment community uses this Figure to determine a company's size, and basically how the stock market is valuing the company. Market cap is useful in categorizing stocks based on their absolute size (e.g., big-cap vs. small-cap stocks), and it is also used as an input in various financial ratios and other metrics. Read on to see how market cap is used to evaluate stocks.

3.4.6 Price to Book Value

A company's price-to-book ratio is the company's current stock price per share divided by its book value per share (BVPS). This shows the market valuation of a company compared to its book value. If your goal as an investor is to unearth high-growth companies selling at low-growth prices, the price-to-book ratio (P/B) offers an effective approach to finding undervalued companies.

The P/B ratio can also help investors identify and avoid overvalued companies. However, this ratio has its limitations and there are circumstances where it may not be the most effective metric for valuation.

3.5 Independent Variables

3.5.1 Environmental Score

The Environmental Score represents a quantitative assessment of a company's environmental performance and sustainability practices. It evaluates factors such as carbon emissions, energy efficiency, waste management, and adherence to environmental regulations. A higher Environmental Score indicates stronger environmental stewardship and a lower environmental impact.

3.5.2 Social Score

The Social Score quantifies a company's social responsibility and its impact on stakeholders, including employees, communities, and society at large. It encompasses aspects such as labor practices, diversity and inclusion initiatives, community engagement, and product safety. A higher Social Score reflects better social performance and positive contributions to society.

3.5.3 Governance Score

The Governance Score evaluates the quality of a company's corporate governance practices and structures. It assesses factors such as board independence, transparency, accountability, and adherence to ethical standards and regulatory requirements. A higher Governance Score indicates stronger governance mechanisms and better alignment with shareholder interests.

3.5.4 ESG Score

The ESG Score aggregates the Environmental, Social, and Governance Scores into a comprehensive metric that provides an overall assessment of a company's sustainability and responsible business practices. It serves as a holistic measure of a company's performance in managing environmental risks, fostering social well-being, and upholding sound governance principles. A higher ESG Score signifies superior ESG performance and a commitment to long-term value creation while considering environmental and social impacts alongside financial returns.

CHAPTER 4

DATA PREPARATION

4.1 Missing Values

In our dataset comprising 343 observations from 1000 stock market listed companies in India, we encountered a total of 188 missing values. Upon examination, it was determined that these missing values were predominantly associated with specific companies where data was not available. Consequently, to maintain the integrity and reliability of our analysis, we opted to remove these observations from the dataset.

4.2 Outliers Identification

During the initial data exploration phase, outliers were observed in all variables except for the Social Score and ESG Score. The presence of outliers can significantly impact the robustness of statistical analyses and may skew the results, particularly when comparing companies across different domains. Therefore, to ensure the integrity and reliability of our analysis, we made the decision to remove these outliers from the dataset.

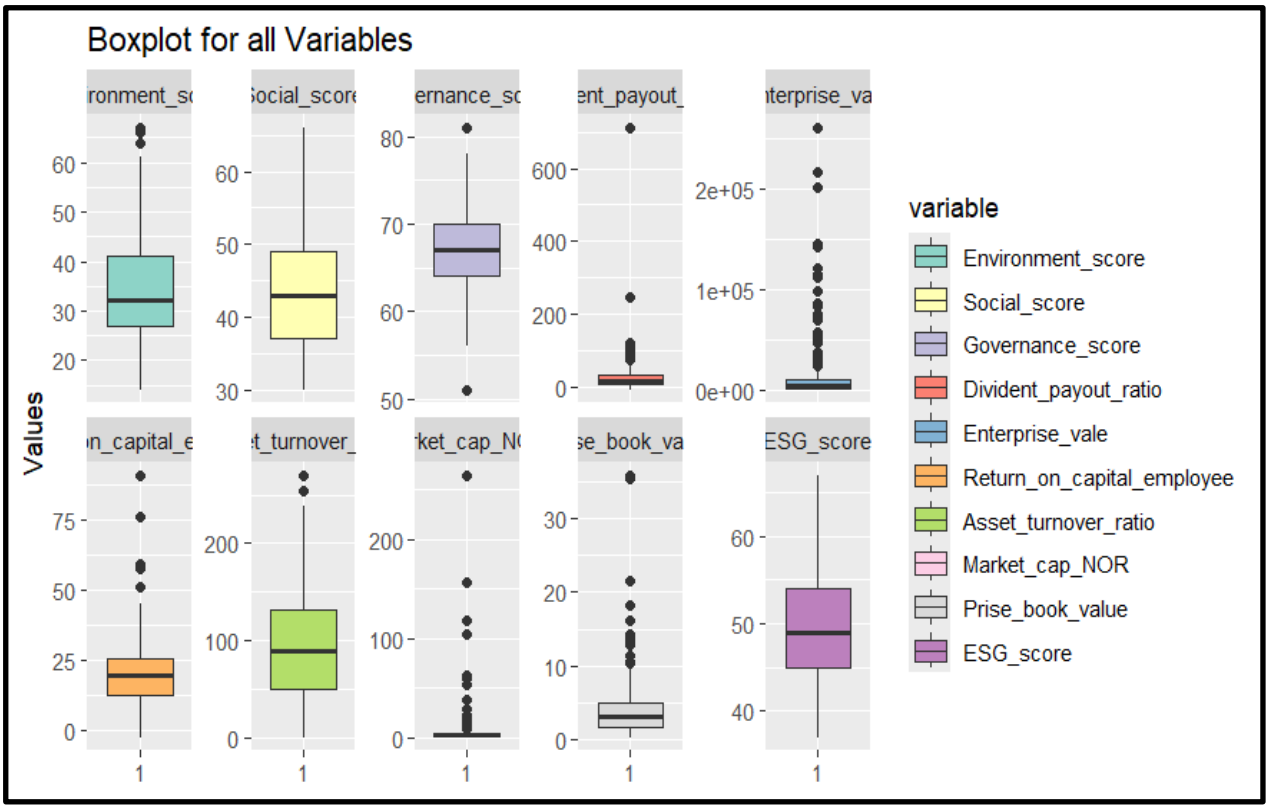


Figure 2 Outliers detection in the variables.

The presence of outliers often signifies that certain companies exhibit significantly larger values compared to others within the same domain. By removing these outliers, we aimed to mitigate the potential distortion they may introduce to our analysis and ensure a more representative sample for comparative evaluation.

Moving forward with a refined dataset free from outliers, we are better positioned to conduct a comprehensive analysis of the relationship between ESG scores and company financial performance, thereby yielding insights that are more indicative of the broader market landscape and conducive to informed decision-making.

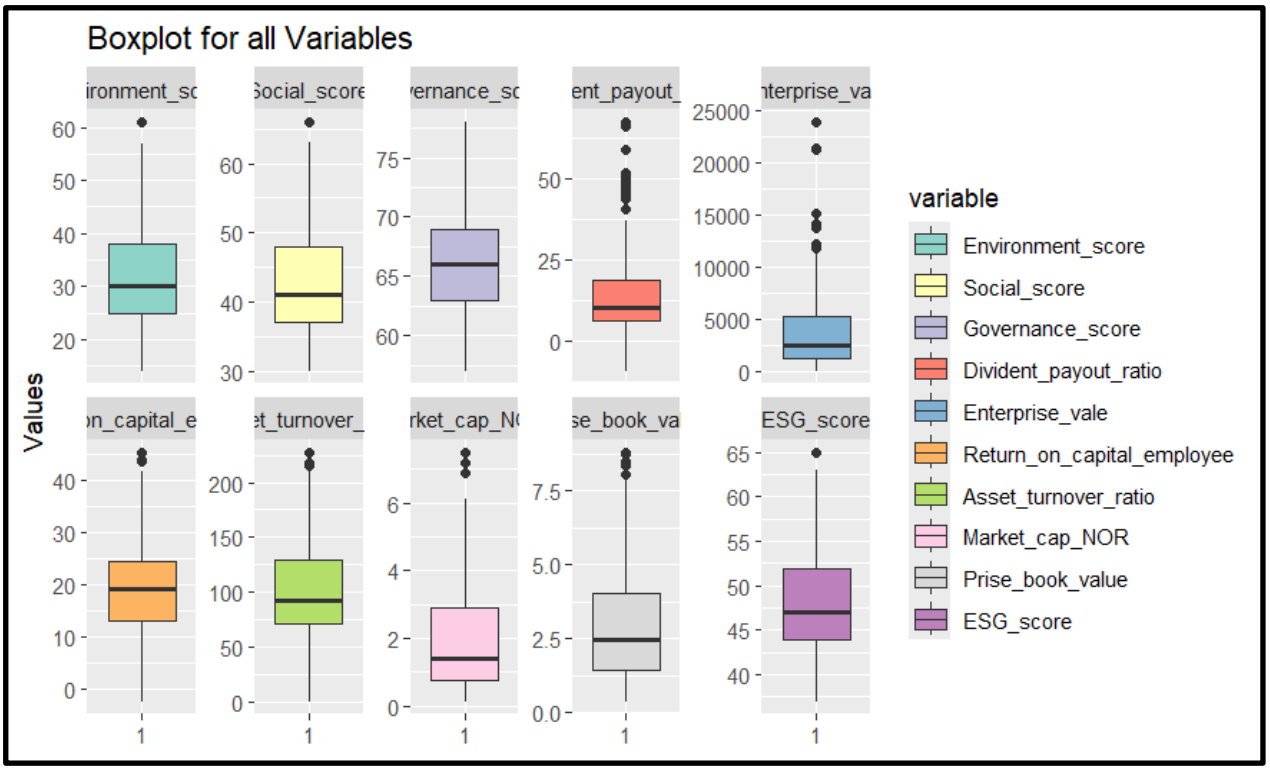


Figure 3 Variables after removing outliers

4.3 Descriptive Statistics

The descriptive statistics provide valuable insights into the distribution and central tendency of the variables in the dataset.

The following is the descriptive statistics table for the population before doing the statistical analysis.

```
> print(descriptive_stats)
                          vars   n    mean      sd  median trimmed     mad   min      max    range skew kurtosis     se
Environment_score            1 146   31.79    9.17   30.00   31.30    8.90 14.00    61.00    47.00 0.54    0.05   0.76
Social_score                 2 146   43.00    8.26   41.00   42.25    7.41 30.00    66.00    36.00 0.74   -0.13   0.68
Governance_score             3 146   66.10    4.61   66.00   65.95    4.45 57.00    78.00    21.00 0.32   -0.14   0.38
Divident_payout_ratio        4 146   15.57   14.64   10.16   13.20    8.51 -9.49    67.39    76.88 1.45    1.69   1.21
Enterprise_vale              5 146 4173.60 4350.78 2492.94 3381.96 2243.02 82.07 23875.20 23793.13 2.02    4.62 360.07
Return_on_capital_employee   6 146   19.29    8.97   19.23   18.90    8.17 -2.28    45.30    47.58 0.44    0.37   0.74
Asset_turnover_ratio         7 146   99.15   50.89   91.96   97.04   46.01  0.08   227.68   227.60 0.38    0.03   4.21
Market_cap_NOR               8 146    1.96    1.55    1.42    1.75    1.16  0.14     7.49     7.35 1.25    1.21   0.13
Prise_book_value             9 146    3.08    2.13    2.48    2.80    1.82  0.38     8.81     8.43 1.02    0.20   0.18
ESG_score                   10 146   48.34    5.56   47.00   48.03    5.93 37.00    65.00    28.00 0.50   -0.30   0.46
>
```

Table 1 Descriptive statistics for all variables

Here's a brief overview based on the provided statistics:

The Environment_score variable has a mean score of approximately 31.79, with a standard deviation of 9.17. The data is fairly symmetrically distributed, as indicated by a skewness of 0.54. The scores range from 14 to 61, with a median score of 30.

Similarly, the Social_score variable exhibits a mean score of around 43.00, with a standard deviation of 8.26. The distribution appears slightly positively skewed (skew = 0.74), with scores ranging from 30 to 66 and a median score of 41.

For Governance_score, the mean score is approximately 66.10, with a standard deviation of 4.61. The distribution is relatively symmetric (skew = 0.32), with scores ranging from 57 to 78 and a median score of 66.

The Divident_payout_ratio variable has a mean ratio of approximately 15.57%, with a considerable standard deviation of 14.64%. The data is positively skewed (skew = 1.45), with values ranging from -9.49% to 67.39%.

The Enterprise_vale variable exhibits a mean value of approximately 4173.60, with a large standard deviation of 4350.78. The distribution is positively skewed (skew = 2.02), with values ranging from 82.07 to 23875.20.

For Return_on_capital_employee, the mean return is around 19.29%, with a standard deviation of 8.97%. The data is fairly symmetric (skew = 0.44), with returns ranging from -2.28% to 45.30%.

The Asset_turnover_ratio variable has a mean ratio of approximately 99.15, with a standard deviation of 50.89. The distribution appears slightly positively skewed (skew = 0.38), with values ranging from 0.08 to 227.68.

For Market_cap_NOR, the mean market capitalization is approximately 1.96, with a standard deviation of 1.55. The data is positively skewed (skew = 1.25), with values ranging from 0.14 to 7.49.

The Prise_book_value variable exhibits a mean value of around 3.08, with a standard deviation of 2.13. The distribution is fairly symmetric (skew = 1.02), with values ranging from 0.38 to 8.81.

CHAPTER 5

STATISTICAL ANALYSIS

5.1 Data for Analysis

- **Variables**

Environment_score: Environment score of companies

Social_score: Social score for companies

Governance_score: Governance score of companies

Divident_payout_ratio: Dividend Payout Ration

Enterprise_vale: Enterprise value

Return_on_capital_employee: Return of Capital Employee

Asset_turnover_ratio: Asset Turnover Ration

Market_cap_NOR: Market Cap Net Operating Revenue

Prise_book_value: Prise Book Value

ESG_score: Environment, Social, Governance Score

5.2 Correlation Analysis

The heatmap visualizes the correlation between all variables in the dataset. Each cell represents the correlation coefficient between two variables, ranging from -1 to 1, where positive values indicate a positive correlation, negative values indicate a negative correlation,

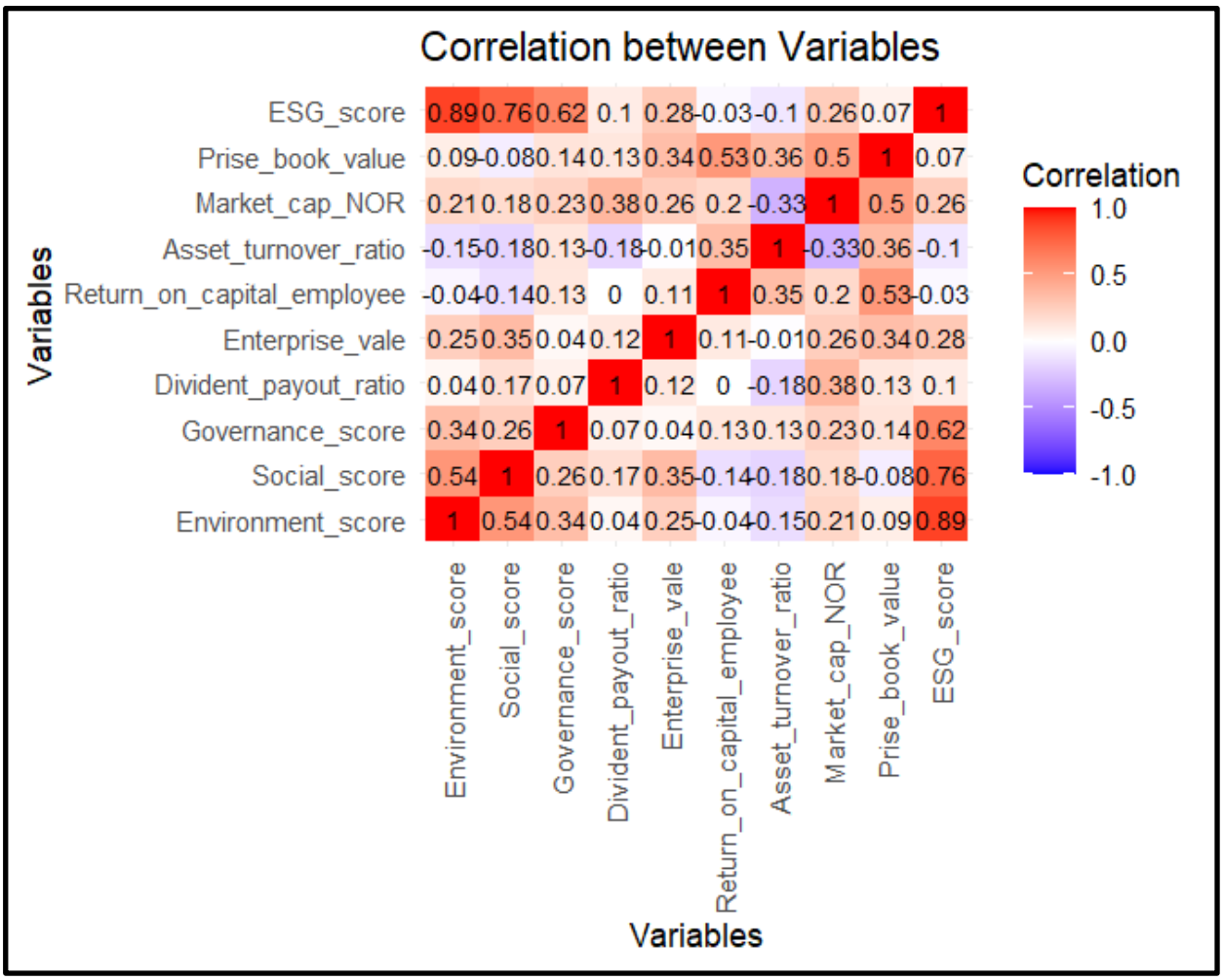


Figure 4 Correlation analysis between all the variables

and values closer to zero indicate a weaker correlation. Blue hues represent negative correlations, while red hues represent positive correlations. The intensity of color signifies the strength of correlation, with darker shades indicating stronger correlations. This visualization provides valuable insights into the relationships between variables, aiding in understanding patterns and dependencies within the dataset.

In the correlation analysis with the "Environment_score" variable (Figure5), we observe varying degrees of correlation with other variables in the dataset. The "Social_score" demonstrates a moderate positive correlation (0.54), indicating that as the environmental performance improves, so does the social performance. Similarly, there exists a mild positive correlation (0.34) with "Governance_score," suggesting a link between environmental sustainability and strong governance practices. Conversely, "Return_on_capital_employee" exhibits a slight negative correlation (-0.04), implying a minor inverse relationship between environmental performance and return on capital per

employee. Other variables such as "Divident_payout_ratio," "Enterprise_vale," "Asset_turnover_ratio," "Market_cap_NOR," and "Prise_book_value" display relatively weaker correlations, suggesting less direct influence on environmental performance. These findings provide initial insights into potential relationships between environmental sustainability and various

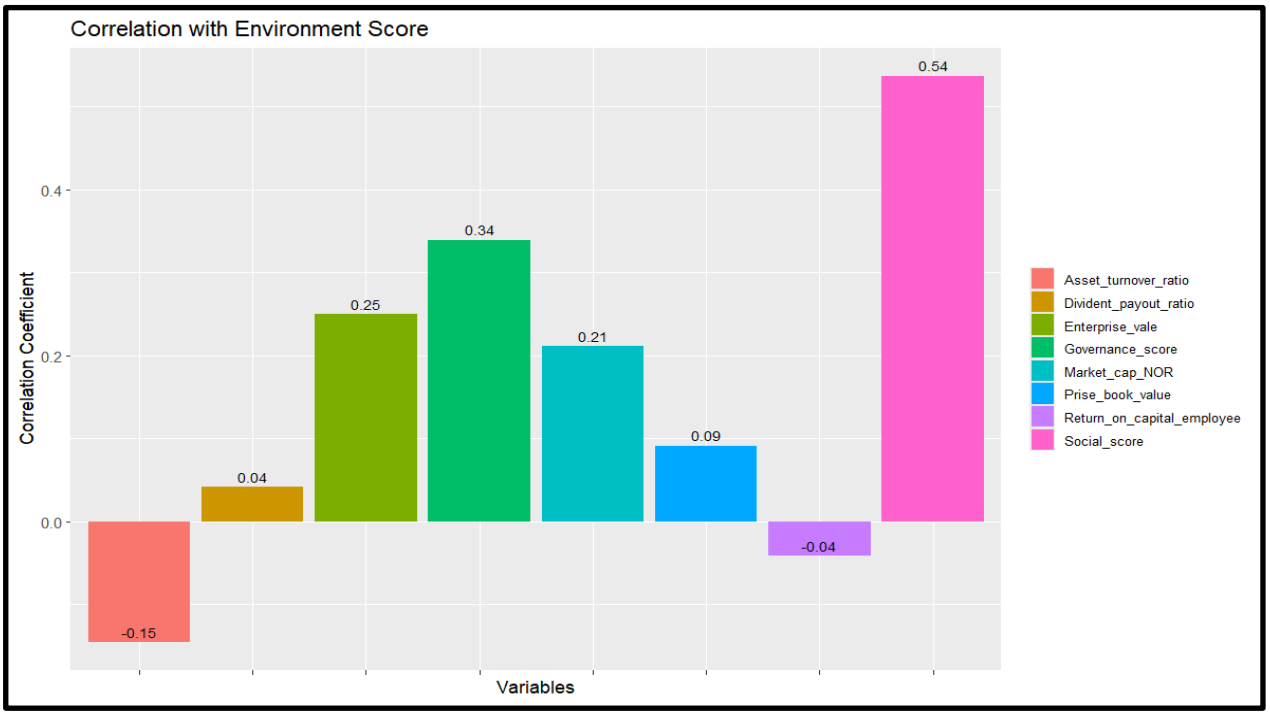


Figure 5 Correlation between environment score with all the other variables

financial and operational metrics within the dataset.

In the examination of correlations with the "Social_score" variable (Figure 6), noteworthy associations with other variables in the dataset emerge. Notably, a substantial positive correlation (0.54) is observed with the "Environment_score," indicating a strong link between social and environmental performance measures. Additionally, a moderate positive correlation (0.35) is evident with "Enterprise_vale," suggesting that companies with higher enterprise value tend to exhibit better social performance. Conversely, "Return_on_capital_employee" and "Asset_turnover_ratio" demonstrate slight negative correlations (-0.14 and -0.18, respectively), implying a potential trade-off between social performance and financial efficiency metrics. Other variables such as "Governance_score," "Divident_payout_ratio," "Market_cap_NOR," and "Prise_book_value" exhibit weaker correlations, suggesting less direct influence on social performance. These findings provide valuable insights into the interplay between social sustainability and various financial and operational factors within the

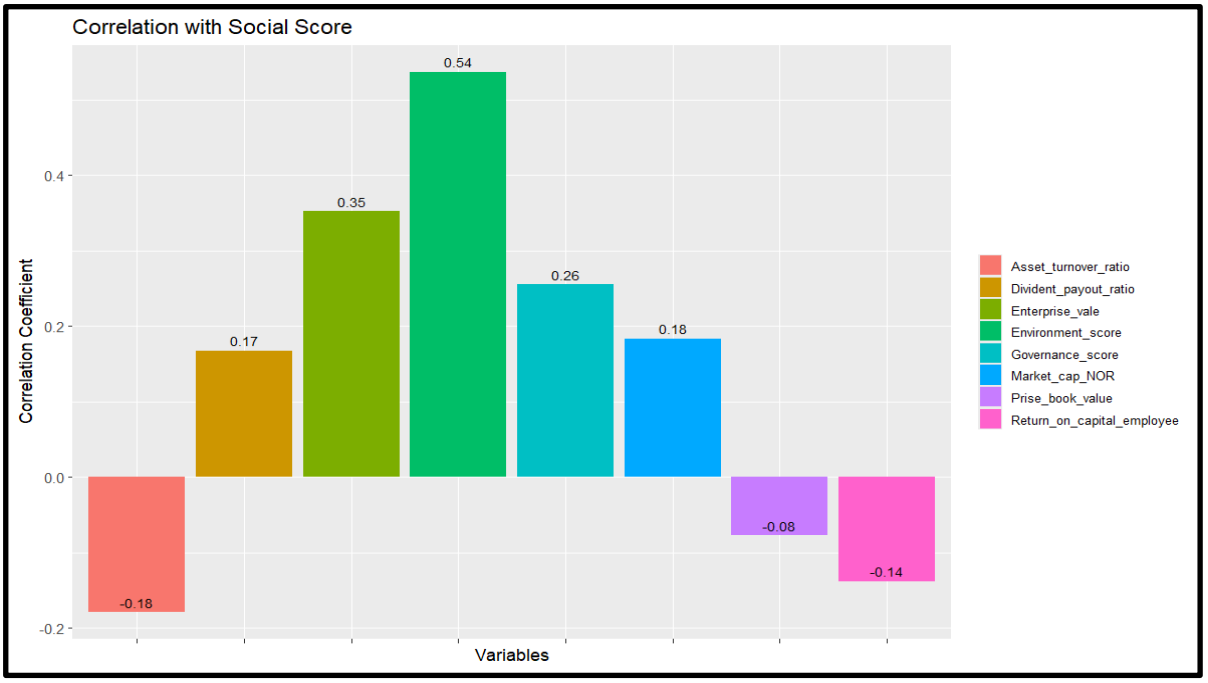


Figure 6 Correlation between social scorea & other variables.

dataset.

The analysis of correlations with the "Governance_score" (*Figure 7*) reveals insights into the relationships between governance measures and other variables in the dataset. Notably, a moderate positive correlation (0.34) is observed with the "Environment_score," suggesting a connection between effective governance practices and environmental sustainability. Additionally, a modest positive correlation (0.26) exists with the "Social_score," indicating that companies with stronger governance frameworks also tend to exhibit better social performance. However, variables such as "Divident_payout_ratio," "Enterprise_vale," "Return_on_capital_employee," and "Asset_turnover_ratio" demonstrate weaker correlations with governance scores, suggesting less direct influence on governance measures. Similarly, "Market_cap_NOR" and "Prise_book_value" exhibit relatively moderate correlations. These findings offer initial insights into the potential impact of governance practices on various financial and operational metrics within the dataset.

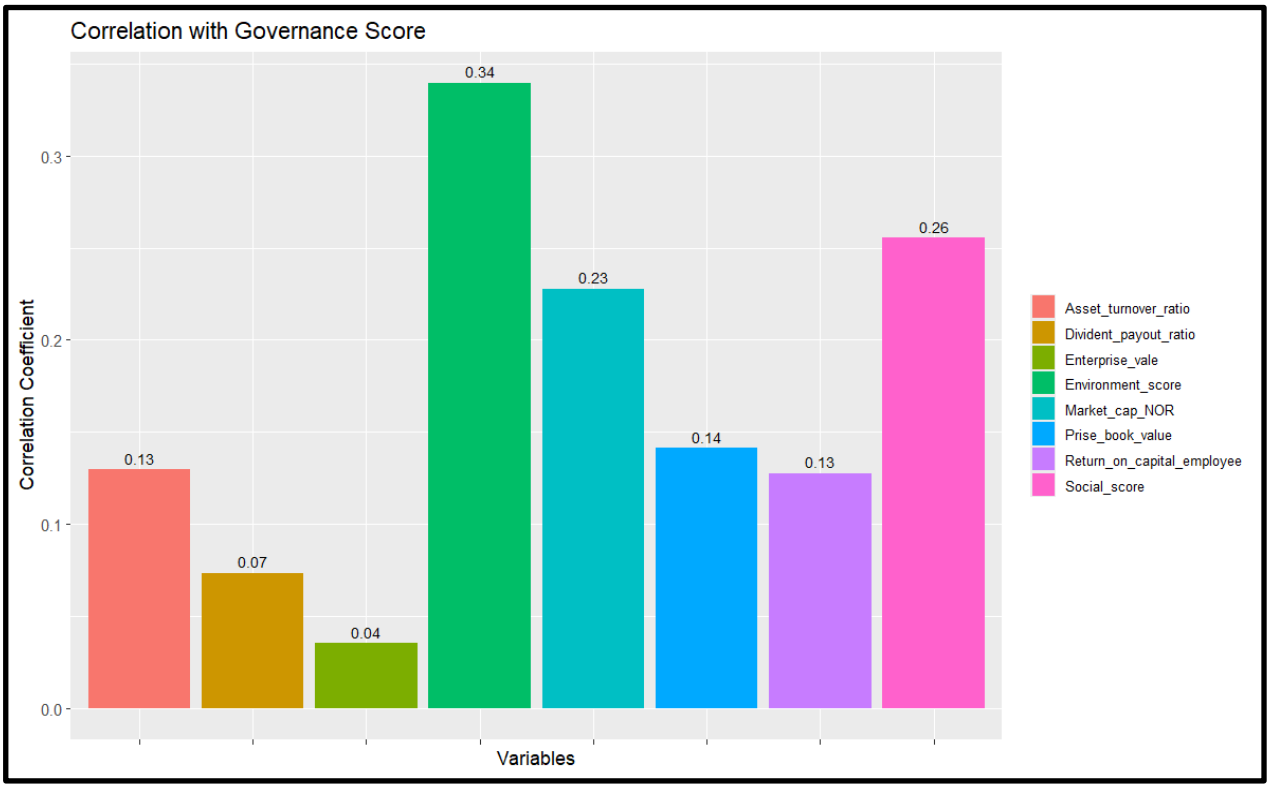


Figure 7 Correlation between governance score & all the other variables.

The examination of correlations with the ESG (Environmental, Social, and Governance) score *(Figure 8)* provides valuable insights into the factors influencing overall sustainability performance. Notably, strong positive correlations are observed between the ESG score and both the Environment score (0.89) and the Social score (0.76), indicating the

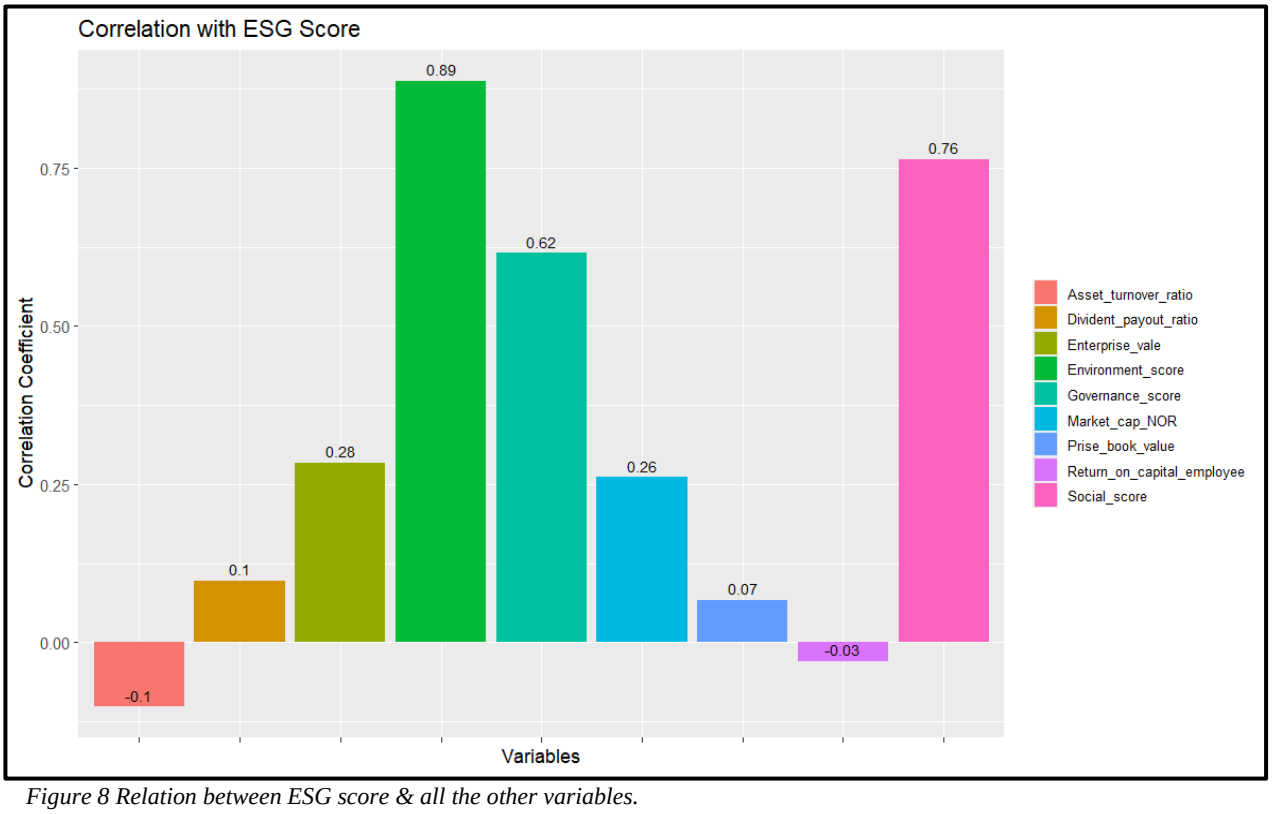
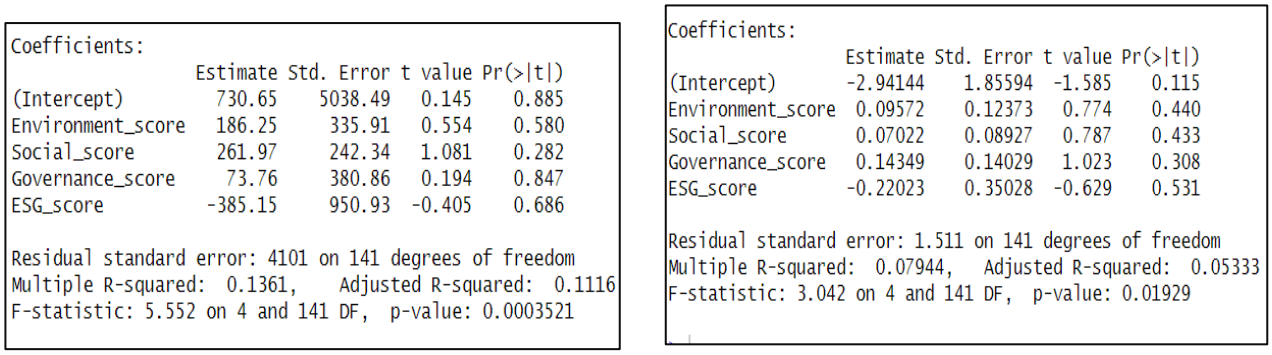


Figure 8 Relation between ESG score & all the other variables.

significant influence of environmental and social sustainability on overall ESG ratings. Additionally, a moderate positive correlation (0.62) exists with the Governance score, highlighting the importance of effective governance practices in comprehensive sustainability assessments. However, financial metrics such as Dividend Payout Ratio, Return on Capital Employee, Asset Turnover Ratio, Market Cap, and Price-to-Book Value exhibit weaker correlations with the ESG score, suggesting a less direct impact on overall sustainability performance. These findings underscore the multidimensional nature of ESG considerations and emphasize the importance of holistic approaches to sustainable business practices.

5.3 Regression Analysis

In this study, we aim to investigate the relationship between environmental, social, and governance (ESG) factors and key financial metrics, specifically enterprise value and return on capital employees. Utilizing linear regression analysis, we initially modelled the relationship between ESG scores and the aforementioned financial metrics. The summary outputs of the



```
Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)         730.65    5038.49   0.145    0.885
Environment_score   186.25     335.91   0.554    0.580
Social_score        261.97     242.34   1.081    0.282
Governance_score     73.76     380.86   0.194    0.847
ESG_score          -385.15     950.93  -0.405    0.686

Residual standard error: 4101 on 141 degrees of freedom
Multiple R-squared:  0.1361,    Adjusted R-squared:  0.1116
F-statistic: 5.552 on 4 and 141 DF,  p-value: 0.0003521
```

```
Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)       -2.94144    1.85594  -1.585    0.115
Environment_score  0.09572    0.12373   0.774    0.440
Social_score       0.07022    0.08927   0.787    0.433
Governance_score   0.14349    0.14029   1.023    0.308
ESG_score         -0.22023    0.35028  -0.629    0.531

Residual standard error: 1.511 on 141 degrees of freedom
Multiple R-squared:  0.07944,   Adjusted R-squared:  0.05333
F-statistic: 3.042 on 4 and 141 DF,  p-value: 0.01929
```

Figure 9 Model with Enterprise value(Model1) and Market cap per net operating revenue(model2) respectively.

regression models (m1 and m2) revealed insights into the coefficients, standard errors, t-values, and p-values of the predictor variables, including Environment_score, Social_score, Governance_score, and ESG_score, as well as the intercept. Interpretation of these coefficients provided valuable insights into the significance of each predictor variable in explaining variations in enterprise value and return on capital employee. Furthermore, key model fit metrics such as residual standard error, multiple R-squared, adjusted R-squared, F-statistic, and p-value were discussed to assess the overall performance of the models. Moving forward, our analysis will focus on investigating multicollinearity among predictor variables and implementing appropriate measures to address it, ensuring the robustness and accuracy of our findings. Ultimately, this study contributes to a deeper understanding of the impact of ESG factors on financial performance, highlighting their significance in sustainable investing and corporate governance practices.

5.3.1 Checking Multicollinearity

In the initial assessment of multicollinearity, variance inflation factor (VIF) values were

```
> library(car)
> vif(model1)
Environment_score      Social_score  Governance_score        ESG_score
         81.89516          34.52898          26.55342         240.82782
```

```
> vif(model2)
Environment_score      Social_score  Governance_score        ESG_score
         81.89516          34.52898          26.55342         240.82782
```

Figure 10 VIF values in model1 and model2.

calculated for each independent variable in the linear regression models (model1 and model2). The results indicated substantial multicollinearity, with VIF values exceeding commonly accepted thresholds. To address this issue, the variable with the highest VIF value, ESG score, was identified and removed from the models.

Subsequently, the VIF values were recalculated, revealing a significant reduction in multicollinearity, with all remaining variables exhibiting VIF values well below the threshold for concern. Specifically, the VIF values for Environment_score, Social_score, and Governance_score

```
> vif(m1)
Environment_score      Social_score  Governance_score
         1.497073          1.416975          1.139917
```

```
> vif(m2)
Environment_score      Social_score  Governance_score
         1.497073          1.416975          1.139917
```

Figure 11 VIF value after removing ESG score variable from model1 and model2.

decreased substantially, indicating a significant reduction in the intercorrelation among these variables. This adjustment ensures the reliability and validity of the regression models by mitigating the potential distortion of coefficient estimates due to multicollinearity. Moving forward, the refined models will provide a more accurate understanding of the individual contributions of environmental, social, and governance factors to enterprise value and return on capital employee. This process underscores the importance of addressing multicollinearity to enhance the integrity and interpretability of regression analyses in the study of financial metrics and ESG factors.

5.3.2 Final Models

```
Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)         504.99    4992.83   0.101  0.91958
Environment_score    51.45      45.28   1.136  0.25777
Social_score        165.86      48.95   3.388  0.00091 ***
Governance_score    -77.15      78.68  -0.981  0.32849
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 4089 on 142 degrees of freedom
Multiple R-squared:  0.1351,    Adjusted R-squared:  0.1168
F-statistic: 7.391 on 3 and 142 DF,  p-value: 0.0001229
```

```
Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)       -3.07047    1.84063  -1.668   0.0975 .
Environment_score  0.01863    0.01669   1.116   0.2662
Social_score       0.01526    0.01804   0.846   0.3991
Governance_score   0.05720    0.02901   1.972   0.0506 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.507 on 142 degrees of freedom
Multiple R-squared:  0.07686,    Adjusted R-squared:  0.05736
F-statistic: 3.941 on 3 and 142 DF,  p-value: 0.009766
```

Figure 12 Final regression model1& model2.

The initial linear regression models, denoted as m1 and m2, were constructed to examine the relationship between enterprise value and environmental, social, and governance (ESG) scores, as

well as the impact of these scores on market capitalization, respectively. For m1, the coefficients indicate that enterprise value is primarily influenced by social factors, with a notable positive association between social score and enterprise value. However, environmental and governance scores do not demonstrate significant effects on enterprise value. In contrast, m2 suggests that market capitalization experiences a slight increase with unit changes in environmental, social, and governance scores. Despite the relatively low R-squared values for both models, signifying that a limited proportion of the variance in the dependent variables is explained by the independent variables, these models remain valuable for understanding the nuanced relationships between ESG factors and financial metrics. This underscores the importance of considering multiple factors in financial analysis, as even modest associations can yield valuable insights for investors and stakeholders.

5.3.3 Homoscedasticity

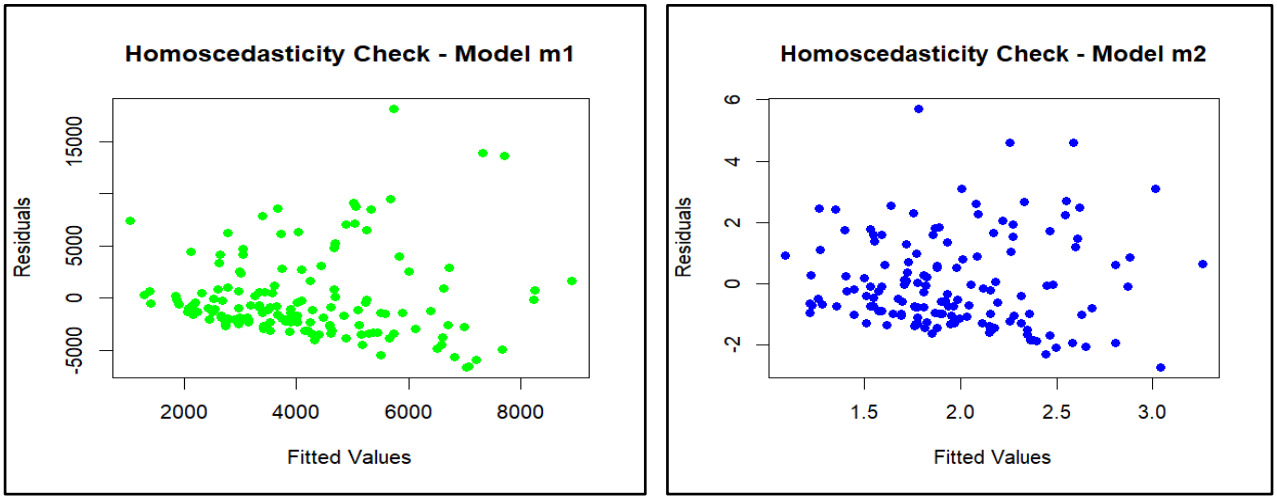


Figure 13 Homoscedasticity in both the models.

The examination of residuals against fitted values indicates that both models adhere to the assumption of homoscedasticity. This finding suggests that the variance of the residuals remains consistent across different levels of the predicted values, implying that the models exhibit uniform levels of variability in their errors. Consequently, there is no discernible pattern in the plot of residuals against fitted values, affirming the absence of heteroscedasticity. This alignment with the assumption of homoscedasticity enhances the reliability of the regression models, as it indicates that the error terms have a constant variance and do not exhibit systematic changes as the predicted values vary.

5.4 Regression Analysis after Variable Selection

In this section, we delve into the results obtained from regression analysis after variable selection, aiming to investigate the relationship between ESG (Environmental, Social, and Governance) scores and company financial performance. The analysis focuses on identifying which

ESG factors, if any, significantly influence financial metrics, such as enterprise value and market capitalization.

5.4.1 Enterprise Value Analysis

The regression analysis for enterprise value reveals that the selected features, namely Environment_score and Social_score, exhibit non-zero coefficients, indicating a potential relationship with enterprise value. However, the model's overall explanatory power, as indicated by the R-squared value (0.125), suggests that only a small portion of the variability in enterprise value can be explained by these ESG Scores.

The coefficients for Environment_score (45.1418) and Social_score (162.4366) indicate the magnitude of their impact on enterprise value. While Social_score demonstrates a statistically significant relationship (p-value < 0.05), Environment_score does not reach statistical significance (p-value > 0.05).

```
Results for Enterprise Value
Selected Features: Index(['Environment_score', 'Social_score'], dtype='object')
Coefficients: [ 45.14182378 162.4365652 ]
Intercept: -4087.57480451202

Regression Results:
                            OLS Regression Results
==============================================================================
Dep. Variable:       Enterprise_value   R-squared:                       0.125
Model:                            OLS   Adj. R-squared:                  0.113
Method:                 Least Squares   F-statistic:                     10.50
Date:                Tue, 30 Apr 2024   Prob (F-statistic):           5.46e-05
Time:                        12:22:39   Log-Likelihood:                -1463.5
No. Observations:                 150   AIC:                             2933.
Df Residuals:                     147   BIC:                             2942.
Df Model:                           2
Covariance Type:            nonrobust
==============================================================================
                     coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          -4087.5748   1874.323     -2.181      0.031   -7791.674    -383.476
Environment_score    45.1418     45.088      1.001      0.318     -43.962     134.246
Social_score        162.4366     50.186      3.237      0.001      63.258     261.615
==============================================================================
Omnibus:                       52.376   Durbin-Watson:                   2.319
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              111.707
Skew:                           1.547   Prob(JB):                     5.54e-25
Kurtosis:                       5.880   Cond. No.                         297.
==============================================================================
```

Figure 14 Regression Summary for Enterprise Value

5.4.2 Market Capitalization Analysis

In the analysis of market capitalization, the selected features include Environment_score, Social_score, Governance_score, and ESG_score. Despite including additional ESG factors, the

```
Selected Features:
Index(['Environment_score', 'Social_score', 'Governance_score', 'ESG_score'], dtype='object')

Coefficients:
[ 0.11829268  0.08678382  0.17522561 -0.28594689]

Intercept:
-3.266207060820224

Regression Results:
                            OLS Regression Results
==============================================================================
Dep. Variable:         Market_cap_NOR   R-squared:                       0.087
Model:                            OLS   Adj. R-squared:                  0.062
Method:                 Least Squares   F-statistic:                     3.450
Date:                Tue, 30 Apr 2024   Prob (F-statistic):             0.0100
Time:                        12:22:38   Log-Likelihood:                -273.31
No. Observations:                 150   AIC:                             556.6
Df Residuals:                     145   BIC:                             571.7
Df Model:                           4
Covariance Type:            nonrobust
===========================================================================================
                          coef    std err          t      P>|t|      [0.025      0.975]
-------------------------------------------------------------------------------------------
const                -3.2662      1.816     -1.799      0.074      -6.855       0.323
Environment_score     0.1183      0.124      0.956      0.341      -0.126       0.363
Social_score          0.0868      0.089      0.975      0.331      -0.089       0.263
Governance_score      0.1752      0.139      1.259      0.210      -0.100       0.450
ESG_score            -0.2859      0.350     -0.818      0.415      -0.977       0.405
==============================================================================
Omnibus:                       25.398   Durbin-Watson:                   2.086
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               32.566
Skew:                           1.019   Prob(JB):                     8.48e-08
Kurtosis:                       4.029   Cond. No.                     1.44e+03
==============================================================================
```

Figure 15 Regression summary for Market Capitalization.

model's explanatory power remains low with an R-squared value of 0.087. This suggests that these ESG scores collectively have limited predictive ability for explaining variations in market capitalization.

Among the selected features, only Governance_score demonstrates a marginally significant relationship with market capitalization (p-value < 0.10). Environment_score, Social_score, and ESG_score do not exhibit statistically significant associations with market capitalization.

CHAPTER 6

CONCLUSION

6.1 Merits

- This project contributes to existing knowledge by examining the correlation between ESG factors and financial performance metrics.
- The findings of this study hold practical implications for investors, businesses, and policymakers alike.
- Employing robust data-driven analysis techniques, we meticulously explore the relationships between variables.
- Addressing stakeholder concerns regarding sustainability and ethical investing is a key focus of this project.
- The insights gleaned from this research have the potential to shape corporate governance policies and sustainability initiatives.

6.2 Demerits

- Data availability and quality may impose limitations on the depth and breadth of our analysis.
- Linear regression models rely on assumptions that may not always be fully met.
- The exclusion of significant variables from our analysis may introduce confounding factors.
- The findings of this study may be context-specific, limiting their broader applicability.
- The interpretation of regression analysis results, particularly in complex scenarios, can present challenges.

6.3 Conclusion

In conclusion, the findings of this study underscore the significance of Environmental, Social, and Governance (ESG) considerations in shaping company performance and influencing investor decisions. The strong correlation observed between ESG scores and environmental performance emphasizes the pivotal role of environmental sustainability in driving overall ESG ratings. Companies prioritizing environmental stewardship not only demonstrate their commitment to sustainable business practices but also enhance their attractiveness to socially responsible investors. However, based on the regression analysis conducted, it is evident that solely relying on ESG scores may not provide a comprehensive understanding of companies' financial performance. Therefore, while ESG considerations remain essential in evaluating company sustainability, investors should exercise caution and consider a broader range of financial indicators for informed decision-making.

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APPENDIX - R code for analyses

Dataset containing all the variables and all observations.

```
fp<-read.csv("C:/Users/dnyan/Downloads/Cleaned Companies ESG & FP Data - Cleaned Data.csv",header = TRUE )
#Create a subset of the dataset with variables of interest
subset_data <- data.frame(
  Environment_score=fp$Environment.Score,
  Social_score=fp$Social.Score,
  Governance_score=fp$Governance.Score,
  Divident_payout_ratio=fp$Dividend.Payout.Ratio..CP.....,
  Enterprise_vale=fp$Enterprise.Value..Cr..,
  Return_on_capital_employee=fp$Return.on.Capital.Employed....,
  Asset_turnover_ratio=fp$Asset.Turnover.Ratio....,
  Market_cap_NOR=fp$MarketCap.Net.Operating.Revenue..X.,
  Prise_book_value=fp$Price.BV..X.,
  ESG_score=fp$ESG.Score
)
```

Code for checking NA values and remove it.

```
 #View(subset_data)
sum(is.na(subset_data))
# Remove rows with missing values
subset_data <- subset_data[complete.cases(subset_data), ]
```

We have utilized the ggplot2 and reshape2 libraries to create visually appealing graphical representations in our analysis.

```
library(ggplot2)
library(reshape2)
```

Code for checking outliers in the data and remove it

```
melt_data <- reshape2::melt(subset_data, id.vars = "row")

ggplot(melt_data, aes(x = factor(1), y = value, fill = variable)) +
  geom_boxplot() +
  facet_wrap(~ variable, scales = "free_y", nrow = 2) +
  scale_fill_brewer(palette = "Set3") +
  labs(x = NULL, y = "Values", title = "Boxplot for all Variables")

# Remove row column from subset_data
subset_data <- subset_data[, !names(subset_data) %in% c("row")]
```

```
## Function for outliers###

remove_outliers <- function(data, multiplier = 1.5) {
  # Loop through each column in the dataframe
  for (col in names(data)) {
    # Check if the column is numeric
    if (is.numeric(data[[col]])) {
      # Calculate the first and third quartiles
      Q1 <- quantile(data[[col]], 0.25)
      Q3 <- quantile(data[[col]], 0.75)

      # Calculate the interquartile range (IQR)
      IQR <- Q3 - Q1

      # Define the lower and upper bounds
      lower_bound <- Q1 - multiplier * IQR
      upper_bound <- Q3 + multiplier * IQR

      # Replace outliers with NA
      data[[col]][data[[col]] < lower_bound | data[[col]] > upper_bound] <- NA
    }
  }

  # Return the cleaned dataframe
  return(data)
}
subset_data<-remove_outliers(subset_data)
sum(is.na(subset_data))
subset_data<-na.omit(subset_data)
# Data melt for data reshape
# Add a new column named "ID" containing a sequence of numbers
subset_data$row <- seq_len(nrow(subset_data))
sum(is.na(subset_data))
nrow(subset_data)
melt_data <- reshape2::melt(subset_data, id.vars = "row")
ggplot(melt_data, aes(x = factor(1), y = value, fill = variable)) +
  geom_boxplot() +
  facet_wrap(~ variable, scales = "free_y", nrow = 2) +
  scale_fill_brewer(palette = "Set3") +
  labs(x = NULL, y = "Values", title = "Boxplot for all Variables")
# Remove row column from subset_data
subset_data <- subset_data[, !names(subset_data) %in% c("row")]

#### Descriptive of the data
statistics<-summary(subset_data)
# Load the psych package
library(psych)
```

```
# Get descriptive statistics
escriptive_stats <- describe(subset_data)
# Print the descriptive statistics
print(descriptive_stats)
```

```
# Load necessary libraries
library(ggplot2)
library(reshape2)

# Calculate correlation matrix
correlation_matrix <- cor(subset_data)
correlation_matrix

# Melt correlation matrix for heatmap
melted_correlation <- melt(correlation_matrix)

# Plot heatmap
ggplot(data = melted_correlation, aes(x = Var1, y = Var2, fill = value, label = round(value, 2))) +
  geom_tile() +
  geom_text(color = "black", size = 3) +  # Add correlation coefficient labels
  scale_fill_gradient2(low = "blue", mid = "white", high = "red",
                       midpoint = 0, limits = c(-1, 1),
                       name = "Correlation") +
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1)) +
  labs(title = "Correlation between Variables",
       x = "Variables", y = "Variables")
```

Code of correlation analysis

```
# Calculate correlation matrix
correlation_matrix <- cor(subset_data)
correlation_matrix

# Melt correlation matrix for heatmap
melted_correlation <- melt(correlation_matrix)

# Plot heatmap
ggplot(data = melted_correlation, aes(x = Var1, y = Var2, fill = value, label = round(value, 2))) +
  geom_tile() +
  geom_text(color = "black", size = 3) +  # Add correlation coefficient labels
  scale_fill_gradient2(low = "blue", mid = "white", high = "red",
                       midpoint = 0, limits = c(-1, 1),
                       name = "Correlation") +
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1)) +
  labs(title = "Correlation between Variables",
       x = "Variables", y = "Variables")
```

```
# Calculate correlation matrix
correlation_matrix <- cor(subset_data)
# Extract correlations of Environment Score with other variables
correlation_with_environment <- correlation_matrix[1, -c(1,10)]

# Extract correlations of Social Score with other variables
correlation_with_social <- correlation_matrix[2, -c(2,10)]

# Extract correlations of Governance Score with other variables
correlation_with_governance <- correlation_matrix[3, -c(3,10)]

# Extract correlations of ESG Score with other variables
correlation_with_esg <- correlation_matrix[10, -10]


# Plotting function
plot_correlation <- function(correlation_vector, score_name) {
  df <- data.frame(variable = names(correlation_vector), correlation = correlation_vector)
  ggplot(df, aes(x = variable, y = correlation, fill = variable)) +
    geom_bar(stat = "identity") +
    geom_text(aes(label = round(correlation, 2)), vjust = -0.5, size = 3, color = "black") +
    theme(axis.text.x = element_blank(),  # Remove x-axis labels
          legend.position = "right",       # Position legend on the right
          legend.title = element_blank(),  # Remove legend title
          legend.text = element_text(size = 8),  # Adjust legend text size
          legend.key.size = unit(0.5, "cm")) +  # Adjust legend key size
    labs(title = paste("Correlation with", score_name), x = "Variables", y = "Correlation Coefficient")
}


# Plot correlation graphs for each score
plot_environment <- plot_correlation(correlation_with_environment, "Environment Score")
plot_social <- plot_correlation(correlation_with_social, "Social Score")
plot_governance <- plot_correlation(correlation_with_governance, "Governance Score")
plot_esg <- plot_correlation(correlation_with_esg, "ESG Score")

# Display plots
print(plot_environment)
print(plot_social)
print(plot_governance)
print(plot_esg)
```

Code for Regression Analysis in the project.

```
m1<-lm(subset_data$Enterprise_vale~Environment_score +
          Social_score +
          Governance_score +
          ESG_score, data = subset_data)

m2<-lm(subset_data$Market_cap_NOR~Environment_score +
                Social_score +
                Governance_score +
                ESG_score, data = subset_data)
summary(m1)
summary(m2)
library(car)
vif(model1)
vif(model2)


m1<-lm(subset_data$Enterprise_vale~Environment_score +
          Social_score +
          Governance_score, data = subset_data)

m2<-lm(subset_data$Market_cap_NOR~Environment_score +
                Social_score +
                Governance_score, data = subset_data)

summary(m1)

summary(m2)
vif(m1)
vif(m2)
### model1### Regression Model Validation ######
# For Model m1
plot(predict(m1), resid(m1),
    ylab = "Residuals", xlab = "Fitted Values",
    main = "Homoscedasticity Check - Model m1",
    col = "green", pch = 16)

# For Model m2
plot(predict(m2), resid(m2),
    ylab = "Residuals", xlab = "Fitted Values",
    main = "Homoscedasticity Check - Model m2",
    col = "blue", pch = 16)
```

Code for Homoscredasticity

```
# For Model m1
plot(predict(m1), resid(m1),
    ylab = "Residuals", xlab = "Fitted Values",
    main = "Homoscedasticity Check - Model m1",
    col = "green", pch = 16)

# For Model m2
plot(predict(m2), resid(m2),
    ylab = "Residuals", xlab = "Fitted Values",
```

```
    main = "Homoscedasticity Check - Model m2",
    col = "blue", pch = 16)
```

Code of Variable selection:

```
import pandas as pd
import numpy as np
from sklearn.feature_selection import RFE
from sklearn.linear_model import LinearRegression
import statsmodels.api as sm
# Load your dataset
data = pd.read_csv('cleaned_data.csv')
from sklearn.linear_model import LassoCV
import statsmodels.api as sm

# Define independent and dependent variables
X = data[['Environment_score', 'Social_score',
'Governance_score', 'ESG_score']]
y = data['Enterprise_value']  # Dependent variable

# Initialize LassoCV for variable selection
lasso = LassoCV(cv=5)  # 5-fold cross-validation

# Fit LassoCV
lasso.fit(X, y)

# Get selected features (non-zero coefficients)
selected_features = X.columns[lasso.coef_ != 0]
print("Selected Features:")
print(selected_features)

# Perform regression analysis with selected features
# Fit the regression model with selected features
model = LinearRegression()
model.fit(X[selected_features], y)

# Print the coefficients
print("\nCoefficients:")
print(model.coef_)

# Print the intercept
print("\nIntercept:")
print(model.intercept_)

# Perform regression analysis using statsmodels for summary
X = sm.add_constant(X[selected_features])  # Add constant
term
model = sm.OLS(y, X).fit()

# Print the summary of the regression model
print("\nRegression Results:")
print(model.summary())

from sklearn.linear_model import LassoCV
import statsmodels.api as sm

# Define independent and dependent variables
```

```
X = data[['Environment_score', 'Social_score', 'Governance_score', 'ESG_score']]
y = data['Market_cap_NOR']  # Dependent variable

# Initialize LassoCV for variable selection
lasso = LassoCV(cv=5)  # 5-fold cross-validation

# Fit LassoCV
lasso.fit(X, y)

# Get selected features (non-zero coefficients)
selected_features = X.columns[lasso.coef_ != 0]
print("Selected Features:")
print(selected_features)

# Perform regression analysis with selected features
# Fit the regression model with selected features
model = LinearRegression()
model.fit(X[selected_features], y)

# Print the coefficients
print("\nCoefficients:")
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X = sm.add_constant(X[selected_features])  # Add constant term
model = sm.OLS(y, X).fit()

# Print the summary of the regression model
print("\nRegression Results:")
print(model.summary())
```