Norwegian School of Economics
Bergen, Fall 2022

A Novel Rating Model Basing on ESG Disclosure

Wei Zhao

Supervisor: Evelina Gavrilova-Zoutman

NORWEGIAN SCHOOL OF ECONOMICS

Acknowledgements

This work has relied on many people, But I wish to thank my parents most, they are the exact reason I can have enough power to finish the project. Also, I need to thank Professor Evelina Gavrilova-Zoutman, it is she offers me guidance when I having confused about the thesis. Finally, I need to thank Lawrence, it is through his help, I can find the confidence and the strength to finish the thesis.

Abstract

This article has discussed a new way to explore the relationship between the company's disclosure and the company's ESG performance. during the exploration, this article has proved the feasibility to evaluate a company's ESG performance by analysing its public disclosure. Furthermore, this article creates a novel approach to rating the ESG performance of an unknown company. With the validation, the method is adequate to meet real-life requirements and can rate a listed company's ESG level with a minimum error. That offer a possible solution to evaluate the ESG performance of a company do not have mature ESG rating information.

This article also found the relation between a company's ESG performance to its financial performance in different industries within different periods. It found that the large-scale systematic crisis will undermine the ESG value. And the size of ESG value is well connected to the market prosperity and national economic situation.

Keywords: ESG, 10-k form, systematic crisis, machine learning, textual analysis, the U.S. stock market

Contents

Contents

1. Introduce

As a spate of unprecedented global events struck western society in the 1960s to 1970s, the entire society is becoming stunned and confused. They had to start to rethink those problems drawn forth from the old lifestyle and business protocols. Those reflections extracted from the Vietnam war, affirmative action and the oil crises, are eventually transmitted to the investment field and reshaping the investment principle and managing philosophy. Thus, ESG (environmental, social, and corporate governance), a new type of investment concept comes out to satisfy the moral and ethical needs of investors and the public. In this concept, labour rights, environmental protection and others business ethics issues began to be emphasized in investment choices. It reflects a new set of company valuation criteria, not just based on the profit maximization for shareholders of the corporation but also on learning the corporation's goals for social responsibility. Such an ESG strategy is soon being accepted by both corporates and investors. For example, Pax World Funds (1971) in the United States refused to invest in companies that profited from the Vietnam War and emphasized labour rights issues. Merlin Ecology Fund (1988), in the UK, invests only in environmentally conscious companies. And with the maturity of ESG rating system and ESG disclosure systems, such as Refintiv and UNPRI, the ESG investment is rapid growing according to the UN's report, as of March 2022, there are more than 4.800 signatories from over 80 countries representing approximately 100 trillion U.S. dollar have signed up to the principles and carry on ESG investments

Some ESG idea supporters are convinced that such a set of social and environmental goals will appreciate the value of corporations by actually cutting down the risk level of corporate and increasing the corporate potential towards current or future crises, i.e., global warming, energy shortage, and ethical scandal. The other ESG concept advocates point out that corporate that is guided by ESG idea will be favoured and supported by consumers or other stakeholders who have strong social responsibility or environmental consciousness (Michelon, Boesso, & Kumar, 2013).

However, there are still many disputed, about those benefits. One is some scholars believe that the benefit of implementing ESG strategy is more presented in the externality part rather than creating value for the corporate itself. It will mainly increase the positive externality and appreciate the total utility of society. Even though this altruistic action will eventually

reflect the corporation itself and enhance the firm's development, this value transmits chain still lacks effectiveness and exclusiveness. That will make ESG strategy only powerful when those who hold ESG ideas as their company tenet is the crowd in the same region and have the right mechanism to award this action. And other scholars find the level of customer favour, bought by a firm's ESG strategy, is highly correlated with the level of perception toward a company's ESG image (Costa & Menichini, 2013). That makes every ESG claim corporate will try their best to render the corporate's social response image in their firm disclosure, in some cases, there would hide or greenwash the business action that violet ESG tenets. For instance, Chevron had been fined 8.6 billion USD for environmental pollution by Ecuador authority in 2011(The New York Times, 2011), but such a major scandal did not present in its annual sustainability report (Chevron, 2011). This kind of inaccurate disclosure will make investors suspect the reference value of the company's ESG disclosure and doubt the true ESG situation of target companies. Those arguments also happened to coincide with the real situation. The ESG tenet is much more prevailing in the developed country market than the emerging market. According to the US SIF report, more than three-fourths of ESG-related investments have happened in developed markets. Some scholars implicate that it could cause by the investor in emerging markets only have company disclosure but an accurate ESG rating system to find ESG corporate and whether ESG tenet could offer firm's value in the field like risk imitate but the green and humanity image to trap the ethic customer.

Given this, this thesis is aimed at answering the following research questions:

Question 1. Will the disclosure of corporate with ESG idea reflect the company itself true daily ESG performance?

For this question, this thesis will choose corporates from different industries in the biggest ESG investment market, the U.S. market. Using their 10-k form (annual report) and 8-k form (event report) to implement textual analysis and quantitative measures target firms' ESG level and compared to ESG score from professional ESG rating agencies, Seeking the potential relationship between disclosure report to their ESG score.

Question 2. Will the company's ESG performance always correlate to the company's financial performance?

For this question, this thesis will choose two current major crises. Covid pandemic and the Energy crisis caused by Russo-Ukrainian War and examine whether ESG performance always correlated to a company's financial performance.

Through research, this article finds a new way to explore the relationship between the company's disclosure and the company's ESG performance. it discusses a new way to identify good ESG performance companies from bad ESG performance companies, that is apply the sentimental analysis to companies' public disclosure. Through the data analysis in our sample firms, we find this method is adequate to meet the real-life requirements and also has the potential to fit the ESG score of the company. That offers a possible solution to value the ESG performance of a company in a country that does not have a mature ESG rating system

This thesis is quantitative causal-comparative research. The primary data is compiled data from the target firm's annual and event reports and other character scarps from the internet. The secondary data is the target firm's share price in the U.S. stock market and the related ESG score in the rating agency. Data sources are free of subjective interference. Thus, this research has certain objectivity. This thesis is following the cross-sectional design and basing the former research. It aims to find the relationship between the firm's report and the firm's ESG situation and examine the anti-risk feature in the global crisis. The target firms are classified into three different industries and two types of firms to secure the reliability and validity of this thesis.

The article divides into six parts to elaborate on and answer the research questions. Following the introduction, the second part of this thesis is a background explanation and literature review. In this part, this thesis introduces the relevant background of ESG and related concepts, i.e., ESG idea, ESG market and ESG rating system. Also, review the previous literature and relevant theory in the field, present the current research outcome and related theoretical fundamentals of ESG usage, ESG risk feature and the methodology in machine learning and textual analysis. The third part of the thesis is introducing the data and research methodology the thesis has applied, in this part, this thesis will elaborate on the data definition and types, the method of data collection and preprocessing, and the specific methodology and related theory to analyse the data. The fourth part is the empirical analysis and corresponding results that are generated from descriptive statistics, correlation testing, cosine similarity analysis, sentimental analysis, and fitting analysis. The fifth part is the

discussion of this research, which discusses the limitations and the future potential of this article. And the final part is the research conclusions, which present the final answer to the research question and the related finding of the empirical analysis.

2. Background and literature review

2.1 Introducing ESG investment

2.1.1 Development

According to the McKinsey report.[1] The E in ESG stands for environmental criteria, including energy and resources consumption and waste emission, and the consequences for living creators from its business actions. the S in ESG stands for social criteria, addresses the social relationships your company owns and the social fame towards the people and the institutions in the region where you carry on business, which also includes relations, diversity and inclusion of labour the E in ESG stands for governance criteria, it represents the internal system health which includes practices, controls, and procedures section in your company, especially for effective decisions, law follow, and external stakeholders considering.

ESG is a current prevalent corporate business tenet, it is presenting significant influence on mordent society. And the investment that follows this criterion is the ESG investment. Although this concept was created in the 1970s, it still stays on the morality level. In 1992 the Earth Summit held by UNCED (The United Nations Conference on Environment and Development) sent an initiative to urge ESG should play a more important role in the financial institution decision process. From that, the ESG criterion is gradually transmitted to the strategy level and guides the investment and other business actions strategy of stokeholds or investors, especially for religious funds, Sovereign wealth funds other moral corporates. Their stakeholder will comprehensively consider both company's ESG performance and financial performance. Furthermore, the Global Reporting Initiative (GRI), co-sponsored by (CERES) and (UNEP) in 1997, issued four versions of Sustainability Reporting Guidelines in 2000, 2002, 2006 and 2013 Those guidelines offer the third parties and investors a window to evaluate the environmental and human right and others social responsibilities situation among target corporation's business activities. The standard and interpretable disclosure report system help GRI bring the ESG investment to a new stage in its GRI

[1] https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Strategy%20and%20Corporate%20Finance/Our%20Insights/Five%20ways%20that%20ESG%20creates%20value/Five-ways-that-ESG-creates-value.ashx

Indicator Protocol Set, there are six groups of performance indicators to standardize the corporate ESG disclosure, which are Economic (EC01 to EC09) Environmental (EN01 to EN30), Labor Practices and Decent Work (LA01 to LA15), Human Right (HR01 to HR11), Society (SO01 to SO10) and Product Responsibility (PR01 to PR09). Also, those criteria are adjusted from G1 to G4 due to climate change and various social campaigns. This article will further discuss the detail of the criteria in the data part. With the influence of GRI. In the new century, the Former UN Secretary-General Kofi Annan has launched a new set of ESG principles, the UNPRI (Principles for Responsible Investment). The six main principles bring a practical framework of a series of actions to integrate environmental, social, and corporate governance issues into investment practices across different industries. And it is created to offer the signatories a guideline for incorporating ESG goals into the traditional fiduciary framework, which will largely increase the accessibility of UNPRI. All those efforts make ESG tenet is becoming inextricably bound to the western economic system and play a vital role in every corner of modern society (Henisz et al., 2019).

2.1.2 Current situation

Owing to the maturity of ESG disclosure and rating systems, the ESG market and ESG investment are thriving nowadays. In 2020. There are more than 2300 institutions that have signed to become partner members of UNPRI. The ESG and ESG-related investment is reaching 80 trillion U.S. dollars. And just two years later, as of march of 2022, there are more than 4.800 signatories from over 80 countries representing approximately 100 trillion U.S. dollars have signed up to the principles and carry on ESG-related investments, which include the world's leading financial institutions and pension funds, such as BlackRock Inc., Allianz, Man Group plc, CalPERS, etc. the ESG tenet is also root in many investors thought. In 2018 the UNPRI has implemented field research towards more than 900 signatures entities across 48 countries on a different continents. That research presents that there are more than 90% of company runners and 93% of investment managers had generate practical ESG investment policies and regulations.

Although ESG ideas and ESG-related investment now are located at an unprecedented peak and dominate the tide of current investment strategies, it’s still almost only prevalent in developed countries. According to the USSIF, there is only twenty per cent of ESG investment is happened in emerging markets, the majority of ESG-related investment has happened in developed countries, and even in developed countries’ mature markets, there are

still significant unbalance distribution among those market. The U.S. market is the biggest ESG market in the world. 30 trillion U.S. dollars of ESG ETF and corporate bonds take one-third part of global ESG investment. Furthermore, the present ESG investment type is also highly unbalanced. The mainstream ESG investment instrument is ESG ETF, which is mainly based on a certain stock or related ESG index. At the end of 2020, this part accounts for approximately 90% of total ESG investments. The ESG-related bonds show up in the market in 2017 now only account for a few parts of total ESG investments. Thus, individual corporate ESG investment and other forms of ESG investment are still rich in potential.

Another interesting point is although there are many scholars have summary the ESG metric and ESG word list, there still a lack of an official agreement on the precise definition of every section of the ESG concept, which makes the involve company could add own understand into its ESG framework to carry on ESG tenet.

2.1.3 Dispute

The reason of ESG investment prevalent is owing to its strong value creation ability. some of scholars generate five main value adding part for the company following long term ESG criteria: the top-line growth, the cost reductions, the regulatory and legal interventions, the productivity uplift, and the investment and asset optimization

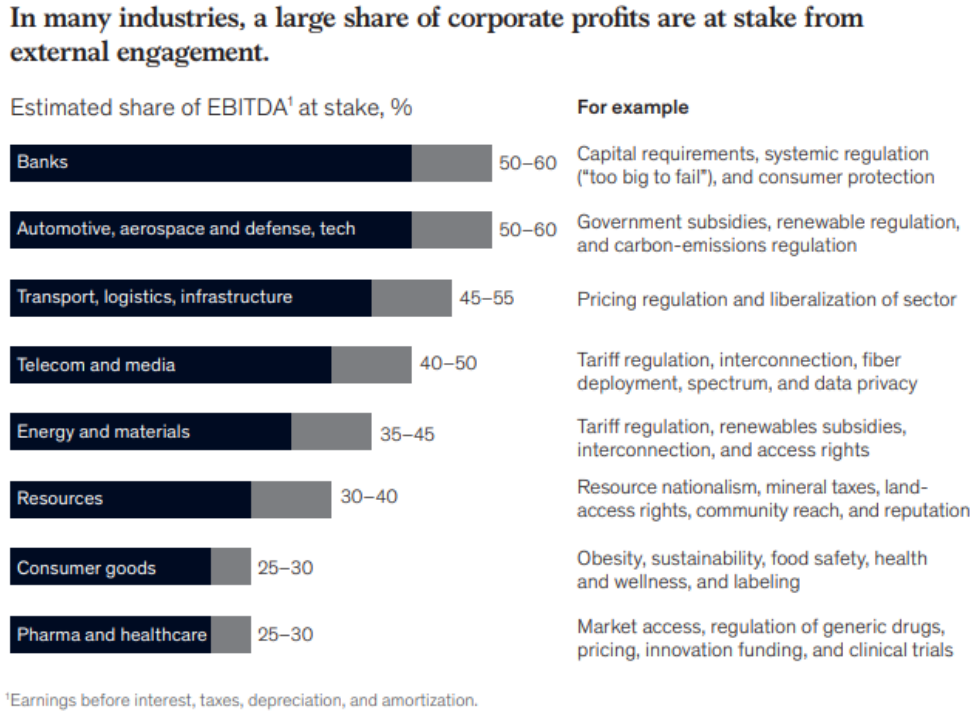
A firmer ESG standpoint assist companies exported new markets and gain expansion on an existing market. Company's ESG tenet will rendering a good image to local governing authorities make they are more likely to award the ESG firms the accessibility certain industry, approvals of production, and licenses for business actions, all those bonus will give company the opportunities for growth. Even in some field , the firms with well ESG reputations will receiving perks, such as the low rent and fees, to carry on business actions, and the scale of the perks is correlate with how far the firms is perceived to be beneficial by public and social stakeholders. That make these companies achieved demonstrably higher valuations than competitors with lower social capital(Sinziana Dorobantu2014). And such a phenomenon is also showing in the customer side, that almost 70 percent of consumers in the U.S. announced that willing pay more to purchase the same function and performance green product (5 percent more)

One others benefit for ESG is it can reduce costs in business actions. In the McKinsey research has found ESG strategies can affect operating profits by as much as 60 percent, and

the significant correlation between resource efficiency and financial performance. “For instance, FedEx, for its part, aims to convert its entire 35,000-vehicle fleet to electric or hybrid engines; to date, 20 percent have been converted, which has already reduced fuel consumption by more than 50 million gallons. And 3M, which has long understood that being proactive about environmental risk can be a source of competitive advantage. The company has saved $2.2 billion since introducing its pollution prevention pays” “(3Ps) program, in 1975, preventing pollution up front by reformulating products, improving manufacturing processes, redesigning equipment, and recycling and reusing waste from production” (Witold J. Henisz, 2016).

Also ESG corporate could also reduce regulatory and legal interventions and enable to achieve a bigger strategic freedom or a smaller legal risk. As many scholars have point out the ESG corporate will have lower risk in adverse government action and will have better chance to earn the government subside or tax support. According to McKensie report, although varies from industries, there are still on average thirty percentage of corporate profits are at risk from the threat of potential government intervention and regulation. The detail number and fraction is in the Figure 2.1

Figure 2.1 The external influence



There also have been reports showing ESG could make employee productivity uplift. They found ESG corporate are outperformance in firms' inner productivity, which may be owing to ESG companies being better in satisfied quality employees and building fare work environments. Employee satisfaction has been proven positively correlated with shareholder returns (Alex Edmans, 2011). "For example, the London Business School's Alex Edmans found that the companies that made Fortune's "100 Best Companies to Work For" list generated 2.3 per cent to 3.8 per cent higher stock returns per year than their peers over a greater than 25-year horizon" (Alex Edmans, 2012).

ESG proposition could optimize corporate's investment and assets. It will enhance investment profit by distributing capital and resource to sustainable opportunities to seize the first-mover advantage in the environmental field. For example, the subside of electric or hybrid engines vehicle in the Norwegian market. Also, it can help corporate to avoid or decrease losses in environmental or social issues.

However, ESG investment also has a disadvantaged part. ESG investment usually lacks diversity, and the majority of ESG companies that meet the UNPRI ESG requirement is the large-cap stock and crowded in a small number of industries. And most of these kinds of ESG companies or ESG funds are allocated in the U.S. and some western European

countries. And another disadvantage is that in some ESG mutual funds, such as ESG ETFs, the investment strategies are excluded from certain industries entirely – like alcohol and weapon. The elimination certainly fits the ESG tenet but this action is also cut down the sharp ratio investors, basing the capital asset pricing model, and it is harm fund diversification and increases the investor risk.

2.1.4 ESG rating system

Following the heat of ESG investment, the ESG rating system is also growing rapidly. The first version of the ESG evaluation standard in showed in the UNPRI official paper in 2006. It offers ESG investors a rough standard to compare two companies' ESG performance and separate points in environmental, social, and corporate governance sections. After that, there many domestic and international institutions established dozens of ESG rating systems and corresponding scoring methodologies. Although there some articles show the rating system has big deficits. It points out those ESG methodologies commonly lack standardization and exist several biases, i.e., "firm size bias, geography bias, and industry weight and business alignment bias." Doyle(2018)

The current mainstream ESG rating system is the MSCI ESG (Morgan Stanley Capital International), DJSI (Dow Jones Sustainability Indexes), CDP (Carbon Disclosure Project), Moody ESG, and Refinitiv (Thomson Reuters) and in this thesis we choose Refinitiv score to represent the companies ESG performance. The rating indicator is shown in Figure 2.2

Figure 2.2 The detail item for ESG rating

Pillars	Catagories	Themes	Data points	Weight method
Environmental	Emmission	Emissions	TR.AnalyticCO2	Quant industry median
		Waste	TR.AnalyticTotalWaste	Quant industry median
		Biodiversity *		
		Environmental management systems *		
	Innovation	Product innovation	TR.EnvProducts	Transparency weights
		Green revenues/R&D/capex	TR.AnalyticEnvRD	Quant industry median
	Resource use	Water	TR.AnalyticWaterUse	Quant industry median
		Energy	TR.AnalyticEnergyUse	Quant industry median
		Sustainable packaging *		
		Environmental supply chain *		
Governance	CSR strategy	CSR strategy	Data points in governance category/data points in governance pillar	Count of data points in each governance category/All data points in governance pillar
		ESG reporting and transparency		
	Management	Structure (independence, diversity, committees)	Data points in governance category/data points in governance pillar	Count of data points in each governance category/All data points in governance pillar
		Compensation		
	Shareholders	Shareholder rights	Data points in governance category/data points in governance pillar	Count of data points in each governance category/All data points in governance pillar
		Takeover defenses		
Social	Community	Equally important to all industry groups, hence a median weight of 5 is assigned to all industry groups		Equally important to all industry groups
	Human rights	Human rights	TR.PolicyHumanRights	Transparency weights
	Product responsibility	Responsible marketing	TR.PolicyResponsibleMarketing	Transparency weights
		Product quality	TR.ProductQualityMonitoring	Transparency weights
		Data privacy	TR.PolicyDataPrivacy	Transparency weights
	Workforce	Diversity and inclusion	TR.WomenEmployees	Quant industry median
		Career development and training	TR.AvgTrainingHours	Transparency weights
		Working conditions	TR.TradeUnionRep	Quant industry median
		Health and safety	TR.AnalyticLostDays	Transparency weights

* No data points available that may be used as a proxy for ESG magnitude/materiality

The Refinitiv score adopted a percentile rank scoring methodology to calculate the 10 category scores – being based on rank, these are not sensitive to outliers. The scoring methodology considers three key factors rank, the industry and the total values. Refinitiv also uses self-developed, automatically and dynamically adjusted ESG magnitude matrix as a proprietary model to issue an objective, impartial and trusted rating report.[2]

2.2 Introduce theoretical frameworks

[2] https://www.refinitiv.com/content/dam/marketing/en_us/documents/methodology/refinitiv-esg-scores-methodology.pdf

2.3 literature review

“There are many article in this field to research the relationship between ESG performance and financial performance”, Giese and Lee(2019) “suggest a significant positive correlation between corporate’s ESG performance and its financial performance.” And Friede et al. (2015) is also suggest that there is a non-negative correlation between ESG and corporate financial performance. Also in the Giese and Lee(2019), they find a minimum level of ESG investment for a ESG corporate to have significant improve in its financial performance. However, in the Kim & Lyon (2014), it has point out that Non-financial responsibility do not show a significant positive influence to corporate’s financial performance. The same outcome is also shows in the Nelling and Webb(2009) article find that owning the massive expenditure in corporate’s stuff, and other unprofitable expenditure the analysis result present there is “not a very significant correlation between ESG and financial success”. And Hong & Kacperczyk (2009) has indicated ESG is significantly negatively correlated with the following year’s performance. Meanwhile, Shane and Spicer(1983) shows the companies invest more in environmental pollution treatment will gain higher excess returns. And Fernandez-Kranz and Santalo(2010) indicate the investors in developed financial markets have better perceptions towards the negative environmental responsibility information, which will largely affect investors decision and opinion about target corporate. Also (Michelon, Boesso, & Kumar, 2013) find corporate that implement ESG idea will be favored and be supported by consumers or other stakeholders who has strong social responsibility or environmental consciousness. The other scholars find the level of the customer favor, bought by firm’s ESG strategy, is highly correlated with the level of percption toward company’s ESG image (Costa & Menichini, 2013). Furthermore, for the risk level of ESG corporate, Kumar et al. (2016) suggest that ESG corporates’ stocks or related funds are less risky to default than peers in the same area.

Philipp Baier & Marc Berninger （2020) is using 10-K form generate the top 50 most frequently occurring ESG words in 10-K report and proxy statements. And Barkemeyer, Comyns, Figge & Napolitano (2014) conduct sentiment analysis on CEO statements from corporate ESG disclosure and find that sustainability reporting cannot show adequate reliability the the CEO statements is not accountable.

3. Data and methodology

In this part, the thesis will discuss the data involved to explore our research questions and the methodologies and algorithms that are applied in this thesis. More specifically, in the first question, this thesis will use the textual data from target companies' 10-k forms and 8-k forms compared with their Bloomberg ESG score and the ESG-term word list. The methodologies and the algorithms behind the analysis are textual analysis, sentimental analysis, and the related machine learning model. And in the second question, this thesis applies the daily log return of target stock in some typical time interval to examine the relationship between ESG performance and financial performance.

3.1 Data

3.1.1 Data structure and range

The dataset for this thesis can be divided into three parts: the textual data from companies' reports, the ESG score and rating data from mainstream ESG rating agencies, the Bloomberg ESG, and the companies' financial performance data from the authority website, yahoo finance. For all those data, the textual data is the primary data in this article and other data is the second data to support the analysis.

For the reliability concerned, this thesis has chosen three different industries, which are the oil and gas industry, the food Beverage & Tobacco industry, and the automobile industry. Those industries are not only highly ESG involved industry, but also real-life highly related industries. These selections will approximately cover the main aspect of ESG criteria and will be adequate to meet the requirements on sample size. That will ensure the universality of the sample and also reduce the calculation workloads, achieving the re-presentation and effectiveness in both directions.

This thesis chooses six different listed U.S. corporates in each industry as the sample companies, which will enhance the representation of sample data and partly remit the influence of potential abnormal performance or outlier data points in some companies. The reason for this article using the data in U.S corporates is owing to the U.S. market is the most dynamic ESG market nowadays. It has been crowded with the largest scale of ESG investment, this kind of selection could increase the reliability of the article. The detail of the

sample companies is shown in Table 3.1. Those 18 corporates can be divided into two groups. One is the group that has the best comprehensive ESG performance in their industry, they usually have top 3 scores in their industry. Another one is the group that has the worst comprehensive ESG performance, normally, the bottom 3 in the score list. Those ranking and scores come from the reports of Just Capital. Just Capital is an American non-profit organization, which dedicate to "building an economy that works for all Americans by helping companies improve how they serve all their stakeholders – workers, customers, communities, the environment, and shareholders."[5] And their ESG ranking methodology is comprehensive considerate the size, the industry type, and the product about target company[6], which ensure the reliability of its ESG ranking and ESG score.

The time range for textual data and ESG score is from 2015 to 2020, the financial performance data are from 2017 to December 2022. Such an arrangement is due to the financial and ESG disclosure lagging behind the company's performance and the ESG score is based on a long-term corporate social responsibility level and hardly largely shifting (Ngoc Vuong & Yoshihisa Suzuki 2021). This article also chose this time zone to avoid an abnormal period from 2020 to 2022, which will help us to analysis the company's ESG level in a normal situation. And the time range for financial performance is designed to solve the research question, and examine the ESG effect towards financial performance in extreme periods, thus the financial data will include the extreme periods.

[5] https://justcapital.com/rankings/

[6] https://justcapital.com/our-methodology/

Table 3.1 The sample companies

Industry & score	Oil & Gas	Food, Beverage & Tobacco	Automobile
High ESG score	ExxonMobil Corporation (XOM) 34088	PepsiCo Inc (PEP) 77476	Ford Motor Company (F) 37996
	ConocoPhillips (COP) 1163165	Archer-Daniels-Midland Company (ADM) 0000007084	General Motors Company (GM) 1467858
	Chevron Corporation (CVX) 93410	General Mills Inc (GIS) 40704	Aptiv plc (APTV) 1521332
Low ESG score	New Fortress Energy Inc (NFE) 0001749723	Darling Ingredients Inc (DAR) 916540	Driven Brands Holdings Inc (DRVN) 1804745
	Continental Resources Inc (CLR) 732834	Monster Beverage Corporation (MNST) 865752	QuantumScape Corporation (QS) 1811414
	Coterra Energy Inc (CTRA) 858470	Pilgrims Pride Corporation (PPC) 802481	LKQ Corp (LKQ) 1065696

3.1.2 Textual data

The textual data in this thesis is the primary data, which is scarping from the 10-K forms and the 8-K forms that the sample companies have posted on the U.S. SEC website. It is used as the original ESG opinion of target companies.

A 10-K form is usually issued per year. It is a relatively standard form that companies filled to disclose their annual business situation[7], the risks they encountered, and the operating and financial results for their fiscal year. It will paint a comprehensive picture of the company's business in the past year. To standardize the report, the SEC rules require that 10-K forms follow a set order of topics. It has divided into four parts with fifteen items, which include the description of the company's business (item 1), the most significant risks in the company (item 1) and the "Management's Discussion and Analysis of Financial Condition and Results of Operations", also as known as MD&A (the item 7). In this thesis, we mainly apply the content of item 7 as the sample textual data. This is because this part of the form will give adequate details about the company's perspective on the business results of the past financial year. In this section companies commonly will describe their vision and story in their special ways, which makes it become the most succulent part for textual analysis. It can largely expose the corporate's potential ideological tendency, the opinion towards last year's operation and financial results, and the major business risks and the related corporate's responding. Thus, the sample textual data is mainly scarped from this part of the report This thesis has collected 105 10-k forms in total, the detailed description is shown in the appendix, due to list date and other reasons, some firms do not have 10-k forms in some years, in that case, we merge the 8-k from any other equivalent report to filling the gaps.

The 8-k from is belong to event report.[8] It allows the investors and other corporate's stakeholders to get in touch with the company's latest changes and events and enable them to make informed decisions. The 8-k form is usually full of corporate's significant events which include red flags, quarterly earnings, and the upcoming reform. And its strong timeliness will help reasonable investors make investment decisions in time. The 8-k form consists of 9 items. From material Impairments (item 2) to financial statements and exhibits

[7]https://www.investor.gov/introduction-investing/general-resources/news-alerts/alerts-bulletins/investor-bulletins/how-read

[8]https://www.investor.gov/introduction-investing/general-resources/news-alerts/alerts-bulletins/investor-bulletins/how-read-8

(Item 9), it almost presents every possible event of the corporate could occur, it is usually not every item will be filled, and most of the item will be blank or simply mentioned, thus in this part, this thesis mainly manually select the content in the key items in every 8-k reports, and combine all those items into a large corpus as a supplementary to the main textual data. This measure makes the 8-k form could more precisely reflect the real companies' situations or the potential opinion of corporate and reduce the calculation or other workloads, largely enhancing the effectiveness of data preprocessing and analysis. In this thesis, there are 50 different 8-k forms in total that have been selected or partly select into the main dataset. The detail of data from 8-k forms is shown in appendix

Although, there is not official word list to measure the ESG relevance of corporate reports. But in the article of Baier et al.(2018), they present the ESG lexicon from 10-k forms based on the frequency of each word, which perfectly fits this thesis' situation. Thus, after a little modification, this thesis applies this word list as a ruler to measure the relevance between the ESG concept and the company's reports. The detail of the word list is shown in Table 3.2

Table 3.2 The ESG lexicon

Environmental word list	clean, compensation, environment, climate, renewable, carbon, waste, earth, sustainable, bird, fish, ecosystem, biology , emission, water, natural, pollution, green, air ,reserves, exploration land, animal, protection,
Social word list	health, human, satisfy, labor, society, education, employment, access, social ,friend ,public, train, kindness, hire, independent, awards, gender, black, race, discrimination ,racism, discrimination
Governance word list	governance, leadership, approve, transparency, audit, control, evaluation, stakeholder, incentive, engagement, compliance, teamwork, responsible, structure, vote

3.1.3 ESG data

The ESG data is the ESG score and the ESG rating from different rating agencies. It is secondary data. It will support the thesis and examine the research question by comparing it with the ESG performance generated from textual data. The ESG data in this thesis is mainly from three parts: the comprehensive score from Refintiv and Bloomberg, the ESG risk level from Sustainalytics and the ESG ranking from Just Capital.

We apply the ranking and the risk level to divide sample corporates into two groups the high ESG performance group and the low ESG performance group. This separation is based on the ranking number published by Just Capital and the risk level from Sustainalytics[9]. In Sustainalytics their rating methodology has classified the corporate into 5 different types of risk levels[10]. This thesis marks those level from 1 to 5 and combines the ESG rank collect from Just Capital. Using the average method select the corresponding firm for both sample group.

The ESG score is mainly generate from Bloomberg's Bloomberg ESG score, which content three main pillars the environment score, the social score, and the governance score. Each represent different criteria. the calculation methodology is the environment sore is basing the Climate Exposure (25% weight), the GHG Emissions Management (25% weight), the Water Management (14% weight), the Energy Management (11% weight), the Ecological Impact (9% weight), the Air Quality (8% weight), and the Waste Management (8% weight)

The social sore is basing the Occupational Health & Safety Management (31% weight), the Labour & Employment Practices (22% weight), the Operational Risk Management (22% weight), the Community Rights & Relations (12% weight), the Ethics & Compliance (11% weight).

The governance sore is basing the Board Composition (11% weight), the Director Roles (6% weight), the Diversity (6% weight), the Independence (6% weight), the Refreshment (6% weight), the Compensation (7% weight), the Incentive Structure (8% weight), the Pay Governance (8% weight), the Pay for Performance (8% weight), the Shareholder Rights (7%

[9] https://www.sustainalytics.com/esg-data

[10] Negligible low medium high severe.

weight), the Director Voting (11% weight), the Shareholder Policies (11% weight), the Incentive Structure (11% weight).

Due to some of the data points being missing, also for generality reasons we introduce the ESG score from Refintiv and combine it with the ESG score from Bloomberg in the ratio of 1:2. The weighted average will remit the score biases mentioned in Doyle(2018) and increasing the score accuracy about the sample firms. Also, the scoring system from Refintiv is famous for the weight system, which balances the influence of company size and company industry. It makes the ESG score in this thesis can more precisely represent the real image of the firm's ESG situation.

The detailed score is shown in appendix 1. After we generate the firm's comprehensive ESG score we find serval interesting points. Then we find the difference between the high ESG performance group and the low-performance group in the Oil industry, the food industry and the automobile industry are 2.04 0.52 and 2.44 respectively. The food industry has the lowest difference, which may represent the business identity and consistency in the food industry. That perhaps owing to the technical difference being lower in the food industry. Meanwhile, other industries are relatively similar in difference, they stay around 2.

3.1.4 Financial data

In this part, this thesis is choosing the daily stock log return for all the sample corporates. The data is downloaded from the yahoo database, with the help of the "quantmod" package. To better measure the ESG influence in different industry and examine the risk defence effect from ESG strategies when a corporate is facing a global crisis, this thesis has set the time range between 2017 to 2022, which contain the 2020 COVID-19 epidemic and the 2022 Rosso-Ukraine conflict. One is paralyzing society and several cut down the retail industry income, another one is pushing the energy price of petrol and gas soaring and driving inflation and the price of material increasing. And the log return ensures the additive for the data, which will be good for further analysis.

3.2 Methodology

This section is elaborate with five steps. In the first step, we point out the research structure of this thesis, which includes the research design and research strategy, and two hypotheses are proposed to answer the research question. In the second step, this thesis conducts textual analysis by comparing the frequency matrix, cosine similarity and the sentimental score in two groups to examine the first hypothesis. In the third step, this thesis attempts to use textual data to replicate the ESG score. This thesis applies the machine learning model (Extreme Gradient Boosting) on textural data to fit the ESG score. In the fourth step, this thesis compares two group performance differences to examine the second hypothesis. In the final step, this thesis will discuss its validity and reliability issues.

3.2.1 Research structure

Research design is a blueprint or plans specifically created to answer the research question and to control the variance (Dulock et al, 1993). This thesis is a descriptive cross-sectional study using quantity data and the specific time interval to describe the relationship between the corporate's report an ESG score. Also, it analysis the relationship between ESG performance and financial performance in several situations. To achieve that, this thesis applies the frequency matrix, cosine similarity model, the sentimental score and a comparison of the two types of firms' performance situations to carries on the research and further make attempting to find a new method for scoring corporate's ESG situation. To examine the research questions this thesis has brought up two hypotheses.

Hypothesis 1. There is significant difference between high ESG score firms and low ESG score firms on the usage of ESG word or the other word in their disclosure reports.

Hypothesis 2. There is significant difference between high ESG score firms and low ESG score firms on the financial performance in the crisis periods.

3.2.2 Textual analysis

"Textual analysis is the study of documents and communication artifacts, which might be texts of various formats"[11]. Since the textural data in this thesis is directly scraped from the government's website it's content many noises. To achieve more precise research results. This thesis has conducts a preprocessing process before further analysis. In this part, the stop words and the numbers have been removed. This preprocessing process also gets rid of words with too many or too less characters, which is uncommon in the real life. Then this thesis is further stemming the corpus. Through lemmatization, the data in this thesis is more central and precise to search for the tendency.

The next step is to form an ESG-related lexicon, although there is not an official word list for the ESG field, but in Baier et al.(2018), the writer has analysis long term's10-k forms and generate a set of ESG-related word lists, which is adequate for this research. Thus, basing that word list this thesis has created an ESG lexicon to compare the target group. The detail of the ESG lexicon is shown in Table 3.2. and the original one can be found in appendix

After we convert the corpus to a document term matrix and calculate the frequency of both corpus then, we use the top 50 frequency word list to compare to the ESG lexicon and compare the difference of matching numbers.

Next, this thesis will conduct a cosine similarity test to examine the difference level between the high ESG score firms and the low ESG score firms. Cosine similarity is a popular method to measure the similarity between two sequences of numbers. "For defining it, the sequences are viewed as vectors in an inner product space, and the cosine similarity is defined as the cosine of the angle between them, that is, the dot product of the vectors divided by the product of their lengths."[12] The function can write as:

$$\text{cosine similarity} = \cos(\theta) = \frac{A \cdot B}{\|A\| \cdot \|B\|} = \frac{\sum_{i=1}^{n} A_i B_i}{\sqrt{\sum_{i=1}^{n} A_i^2} \sqrt{\sum_{i=1}^{n} B_i^2}}$$

[11] https://en.wikipedia.org/wiki/Content_analysis

[12] https://en.wikipedia.org/wiki/Cosine_similarity

Where the Ai and Bi are the compounds of vector A and B respectively. The result bigger the difference between two corpora is smaller.

Finally using the build-in function in R to calculate the ESG sentimental value for both groups and compere the score difference. And in this step, we choose GI as the key dictionary to determine the emotions in target sentences. The GI is referred to in the Harvard-IV dictionary (as used in General Inquirer) it represents the normal wording systems, which will increase the representative of our results.

3.2.3 Fitting

In this part, this thesis uses corporate's ESG score as the dependent variable and the sentimental score and the frequency of ESG related words as the independent variables and applies data to xgboost the machine learning model to solve the problem, the xgboost model and its parameters are shown in below and the detail is in the appendix :

```
mod1 = xgboost(data = data.matrix(esg.fitt.train[-15]), label = esg.fitt.train$esg_score,

                gamma = 0, subsample = 0.9,lambda = 1,

                max.depth = 2, eta = 0.01, set.seed(1), nfold = 3,

                nrounds = 1000)
```

during the fitting process we will choose one third of data as test data set to validate the model prediction ability. and calculate RMSE to examining the accuracy of our model.

3.2.4 comperesion

In this part, this article mainly works on the second hypothesis. It calculates the average return for a different group in each industry and compares the performance difference by implementing a t-test to find if there are significant differences between the two types of firms. Especially during the crisis periods.

3.2.5 Validity and reliability

Validity and reliability it the most vital part of a research study. This thesis has applied several methods in data selection, data prepossessing, and the model design part to ensure the validity and reliability of this article.

In the sample selection part. This article chooses the biggest and the fiercest ESG market, the U.S. market. The highly matured market and investment instrument, reduce the anomaly return, that commonly shows in an inefficient market. This will help the research to reach the true excess return of ESG investment. Furthermore, in the more micro part, this thesis has chosen three different industries, which almost cover every part of daily life, which enhances the universality and the validity of this thesis. Also, this article selects the numbers of the firm and uses the average value as independent variables significantly increase the reliability by reducing the influence of the outlier and the anomaly data points.

At the data prepossessing part, this article has removed the noise of the dataset and centralised and amplified the data feature. That makes this thesis, descriptive research, which could find the hiding tendency in the dataset. The lemmatization process is also reinforcing the data feature, increasing the validity of this article

In the model design part, this article divides the training set and the test set to reach a validate outcome for real life. And prefer the t-test to the model results. Such a process also ensures the validity and reliability of this article.

4. Results

This thesis presents the results from the previous model, we find some interesting results. We find for all the industries, at least with this dataset, the researchers and the investors can identify the difference between the company with good ESG performance and the company with bad ESG performance, and this difference can be found by the investor or other outsiders with a relatively easy and low-cost method, which is reviewing their report and account the frequency of specific ESG related word. And although, the ESG-related word list is not the official ESG reference from some trustable authorities, it still can offer a relatively accurate guide to support investors distinguish the target company's real ESG performance level.

4.1 Textual analysis

In this section we will elaborate on the usage of textual analysis in the field of identifying the real better performance ESG companies, in this case, we utilize the target corpus frequency about the ESG keywords, target corpus similarity in a different type of companies and target corpus sentimental score to ESG keywords. By all over approaches we are examining our new method to identify the real ESG-valued companies. And finally applied machine learning to use textual analysis outcome to fit an approximate ESG score.

4.1.1 Frequency

This thesis has applied frequency analysis to eighteen U.S. listed corporates, which belong to the oil & gas industry, the food & beverage and tobacco industry and the automobile industry. As we discussed above, this selection of sample companies is covering the majority part of U.S. daily life. And it both includes the high ESG performance companies and the low ESG performance companies; thus, this sample set is having a certain representation and a certain reliability too.

Based on the 10-k form and 8-k form, those companies had uploaded; we generate the two sets of word frequency lists about two types of companies in each target industry. Conducting the two-sample t-test to determine if those two types of companies are significantly different in their 10-k language.

Oil & gas

Table 4.1 The keywords frequency list for the oil and gas industry

word in the ESG lexicon					
high ESG performance group			low ESG performance group		
rank	item	frequency	rank	item	frequency
1	natural	708	1	natural	512
2	reserves	611	2	reserves	167
3	exploration	568	3	exploration	66
4	compliance	93	4	compensation	62
5	environment	82	5	compliance	24
6	climate	79	6	land	19
7	access	78	7	independent	17
8	control	75	8	environment	17
9	carbon	75	9	access	13
10	air	65	10	control	12
11	responsible	62	11	public	10
12	water	61	12	water	8
13	emission	40	13	structure	7
14	clean	40	14	audit	7
15	compensation	39	15	labor	3
16	health	35	16	train	2
17	evaluation	35	17	employment	2
18	renewable	21	18	satisfy	1
19	human	21	19	pollution	1
20	pollution	19	20	leadership	1
21	waste	18	21	carbon	1
22	audit	17	22	awards	1
23	independent	15	23	approve	1

After we created a word frequency table, the detail list in the appendix, Table 4.1, we find in the oil and gas industry, compared to the group of low ESG performance, the corpus from the group that consisted of high ESG score corporates, is more cline to using ESG relate words in there disclosure reports and the frequency of the ESG relate words is also significantly superior than the low source group. In Figure 4.1 via the two-sample t-test, we prove that in the report field the firms with higher ESG score are significantly in the report wording, the ESG-related words usage is significantly higher than the low ESG score firms, which also indicate that least in the oil & gas industry, it is possible to distinguish the well ESG performance firms to the bad ESG performance firms only via their public reports.

Figure 4.1 The two-sample t-test

```
> t.test(x,y,var.equal = T)

        Two Sample t-test

data:  x and y
t = -335.37, df = 118, p-value < 2.2e-16
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -5.154963 -5.094443
sample estimates:
 mean of x  mean of y
0.01460246 5.13930556
```

Food, Beverage & Tobacco

Table 4.2 The keywords frequency list for the food, beverage & tobacco industry

word in the ESG lexicon					
high ESG performance group			low ESG performance group		
rank	item	frequency	rank	item	frequency
1	compensation	269	1	animal	88
2	control	168	2	control	86
3	health	163	3	compensation	83
4	independent	129	4	natural	64
5	reserves	111	5	renewable	61
6	environment	98	6	labor	51
7	awards	81	7	reserves	47
8	green	70	8	green	46
9	audit	68	9	health	43
10	evaluation	65	10	evaluation	30
11	access	61	11	compliance	28
12	incentive	60	12	incentive	25
13	compliance	53	13	public	25
14	natural	39	14	structure	25
15	land	38	15	protection	19
16	public	34	16	access	17
17	transparency	29	17	bird	16
18	animal	27	18	independent	15
19	structure	26	19	carbon	15
20	water	24	20	employment	12
21	sustainable	20	21	satisfy	10
22	social	19	22	waste	9
23	responsible	18	23	environment	7
24	governance	16	24	climate	7
25	protection	13	25	human	7
26	education	8	26	black	6
27	labor	7	27	sustainable	6
28	employment	6	28	fish	5
29	leadership	6	29	land	5
30	society	6	30	transparency	5
31	waste	5	31	awards	4
32	engagement	4	32	education	4
33	human	4	33	water	3

After we create a word frequency table, the detail list in the appendix, Table 4.2, we find in the Food, Beverage & Tobacco industry, compared to the group of low ESG performance, the corpus from the group that consisted by high ESG score corporates, also has the tendency to using ESG related words in there disclosure reports and the frequency of the ESG relate

words is also significantly superior to the low source group. In Figure 4.2 via the two-sample t-test, we prove that in the report field the firms with higher ESG scores are significant in the report wording, but we also noticed that the ESG related word difference is not so big as the oil and gas industry. But still, it shows the ESG related words usage is significantly higher than the low ESG score firms, which also indicates that at least in the Food, Beverage & Tobacco industry, it is possible to distinguish the well ESG performance firms from the bad ESG performance firms only via their public report.

Figure 4.2 The two-sample t-test

```
> t.test(x,y,var.equal = T)

        Two Sample t-test

data:  x and y
t = 2.14, df = 56, p-value = 0.03673
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
  1.727646 52.341320
sample estimates:
mean of x mean of y
 55.58621  28.55172
```

Automoblie

Table 4.3 The keywords frequency list for the food, beverage & tobacco industry

word in the ESG lexicon					
high ESG performance group			low ESG performance group		
rank	item	frequency	rank	item	frequency
1	structure	130	1	compensation	27
2	incentive	98	2	labor	20
3	compensation	88	3	incentive	16
4	labor	88	4	control	10
5	public	60	5	responsible	10
6	environment	53	6	independent	7
7	control	42	7	structure	6
8	reserves	38	8	reserves	5
9	compliance	34	9	compliance	3
10	access	29	10	health	3
11	independent	28	11	human	3
12	health	27	12	public	3
13	awards	23	13	water	2
14	green	20	14	leadership	1
15	evaluation	19	15	land	1
16	air	18			
17	leadership	17			
18	emission	12			
19	audit	12			
20	protection	10			
21	responsible	9			
22	natural	9			
23	sustainable	9			
24	satisfy	7			
25	society	5			
26	waste	5			
27	water	5			
28	employment	5			
29	human	4			
30	land	4			
31	governance	4			
32	transparency	2			
33	climate	2			
34	pollution	1			
35	vote	1			
36	social	1			

As the Table 4.3 and the appendix showed the difference between two type of firms is wider in the automobile industry. Such a significant difference make investor can easily distinguish

two type of firm and make the reasonable investment decision, the companies that has better ESG performance will mention the ESG related words frequently. This kind of action may owe to the well ESG performance companies are eager to make its stakeholders or other potential investors perceive the ESG effort and the ESG cost the company has give out. And try to earn the ESG or moral premium to repay the cost from following the strict ESG tenet. Meanwhile, those companies that have bed ESG performance. may also do not think highly of ESG concept and that may cause them to do not or use lesser effort to present the ESG image to it stakeholders or potential investors.

Also, in the Figure 4.3 this thesis also points out that the two-sample t-test also show there are a significant difference about two sample's mean value, which also indicate that at least in the Automobile industry, it is possible to distinguish the well ESG performance firms to the bad ESG performance firms only via their public reports.

Figure 4.3 The two-sample t-test

```
> t.test(x,y,var.equal = T)

        Two Sample t-test

data:  x and y
t = 3.5655, df = 28, p-value = 0.001329
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 15.74295 58.25705
sample estimates:
mean of x mean of y
     44.8       7.8

>
```

4.1.2 Similarity

Table 4.4 The cosine similarity value

	Oil industry	Food industry	Automobile industry
Cosine	0.1618112	0.0836453	0.1171987

Table 4.4 present us the cosine similarity in disclosed corpus between well ESG performance companies and bad ESG performance companies. As we discussed in the previous chapter cosine similarity is designed for searching the similarity level between two different corpora. The bigger the cosine coefficient, the more similarity between the two corpora. Thus, Table 4.4 has pointed out that in the food industry those two types of companies share a relatively lesser common point in their public disclosure while in the oil industry, the two types of firms are not so different in disclosure area and the automobile industry is in the middle position and has a big gap between both oil and food industry. But all this showing no matter what industry the applied languages for a high ESG performance company's 10-k report are quite different to a low ESG performance company in the same industry.

Such a result may cause by their industry features. The oil industry's business action is relative and has many common points with other industries and the food industry is not. At least in this sample set, the well-ESG performance companies are all at the top of the U.S. food market or other retail markets and owing to the relatively low-profit level in this industry, these giant companies are more willing and have more chances to be involved other business fields while the bed ESG performance corporate is lack of capital to explore the new market or enter a new industry, which makes their business is more locally and more conservatively. And that is the reason that the food industry has the widest language gap between ESG orient companies and ESG ignored companies.

4.1.3 Sentimental

In this section, as we discussed in the last chapter, this thesis will apply sentimental analysis to generate a series of sentimental scores for two types of companies in a specific industry. This sentimental score is generated from the sentences that contained ESG-related words, which use the GI dictionary to form the sentimental score. GI is referred to the Harvard-IV dictionary (as used in General Inquirer) it represents the normal wording systems, which will increase the representative of our results.

Oil & Gas

Table 4.5 The sentimental score for the oil and gas industry

	Oil & Gas Sentimental Score					
	2015	2016	2017	2018	2019	2020
High ESG Score	0.0125	0.0097	0.0090	0.0105	0.0124	0.0170
Low ESG Score	0.0065	0.0039	0.0057	0.0013	0.0165	0.0262

from Table 4.5 we could easily find that in the oil & gas industry there is a huge sentimental difference between those two groups, the well ESG performance group has quite a positive attitude towards the ESG-related field, which may owe to their more focus on the ESG construction and using itself effect to improve the corporate ESG level. However, for those corporate, that have bad ESG performance, the outcomes are quite different. In their disclosure report, the ESG content is relatively connected with negative sentiments, which causes the sentimental score to remain at a low level. Just from the sentimental score, we can barely find the true reason behind this.

It could owe to the Matthew effects which are the term coined by sociologists Robert K. Merton and Harriet Zuckerman in 1968[13], it describes the phenomenon of "the rich get richer, and the poor get poorer". This theory could also give the reason for this result. Due to the more and more popular ESG strategy. Customers and the local government are more and more regard ESG and ESG-related things as a vital part of life. And make people no longer willing to tolerate action do not follow the ESG criteria, and that opinion is worsening the

[13] https://en.wikipedia.org/wiki/Matthew_effect

situation of the bed ESG performance company and causing the result that the ESG related sentences is linked with negative sentiment.

Food, Beverage & Tobacco

Table 4.6 The sentimental score for the food, beverage & tobacco industry

	Food, Beverage & Tobacco Sentimental Score					
	2015	2016	2017	2018	2019	2020
High ESG Score	0.0252	0.0245	0.0258	0.0224	0.0242	0.0207
Low ESG Score	0.0381	0.0121	0.0101	0.0067	0.0122	0.0105

There are ESG-related sentences about the sentimental situation in Food, Beverage & Tobacco industries. Just as it is present in this industry is not like the other two industries, there is not such a huge difference in their ESG related sentimental but it still has a noticeable difference in the emotions of ESG issues.

Since the food industry is the main battlefield for the ESG concept. Corporations in this industry are usually more sensitive to the ESG tenet. This is because this industry is the most common in people's life. customers in this industry are also more frightened when they related company has faced this moral issue, this situation is far worse for the current period when ESG has so popular in everyone's daily life. And force the corporate in this field, no matter what idea the managers have, they must have a relatively high ESG sense to deal with the harsh environment and the public stress about ESG life and criteria.

Automobile

Table 4.7 The sentimental score for the automobile industry

	Automobile Sentimental Score					
	2015	2016	2017	2018	2019	2020
High ESG Score	0.024883	0.03261	0.030621	0.028881	0.03532051	0.016765
Low ESG Score	0.021359	0.017094	0.010887	0.002258	0.00632197	-0.01626

In Table 4.7, we could notice the sentence's sentimental situation in the automobile industry. Similar to the food industry and the automobile industry there is not such a huge difference in their ESG-related sentimental score for both types of companies. But still, in some years the language emotion is widely spread.

This could owe to the automation system involved in their production process. The average automatic production rate is quite high in the U.S. that make the basic eco level and governance level will quite high in all the united states automobile companies, and generally speaking, the ESG production method will heavily cut down the environmental risk and legal risk for a manufactory industry, thus no matter the high ESG score companies or the low ESG score companies, it is a common sense that ESG is adding the value to company’s stakeholders.

4.1.4 Fitting model

In this section as we discuss in the last chapter, we applied Extreme Gradient Boosting (xgboost) method to fit the model, with the Bloomberg ESG score for each company in different industries as the dependent variable and the sentimental score in the different dictionaries as independent variables. With the parameters we discussed in the previous chapter and the one-third test dataset to cross-validating the model, we have generated the following outcomes.

Table 4.8 The accuracy situation for fitted model

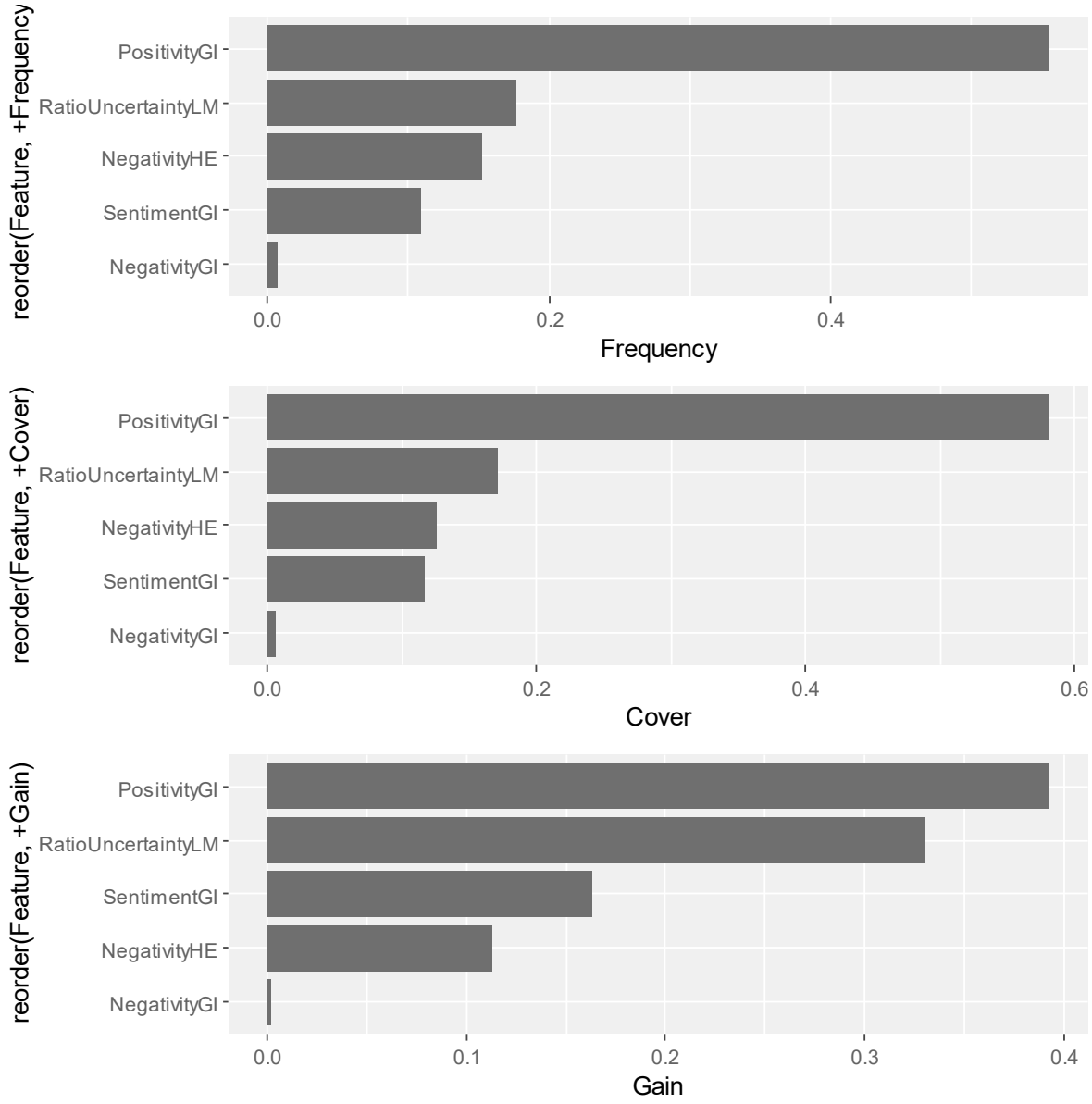
Name	ME	RMSE	MAE	MPE	MAPE
Oil	-0.00035	0.00059	0.00049	-0.00667	0.00961
Food	-0.00010	0.00055	0.00052	-0.00191	0.00989
Automobile	0.00033	0.00263	0.00186	-0.00424	0.03207171

As Table 4.8 shows above, this fitting method is adequate to meet the accuracy requirement about investor's needs, especially for the Oil and Gas industry and Food, Beverage & Tobacco industries the Root Mean Square Error is less than 0.0006, and even for the automobile industry which RMSE value is relatively larger, the value is still less than 0.002. such outcomes are completely adequate to use to periodic other companies' potential ESG scores as long as we can access this company's public report. This will give us a new approach to value a company's ESG performance, even if it does not in the Bloomberg ESG score list or has not been updated in the while.

The following figures below will present the most vital explanatory variables for different industries.

Oil & gas

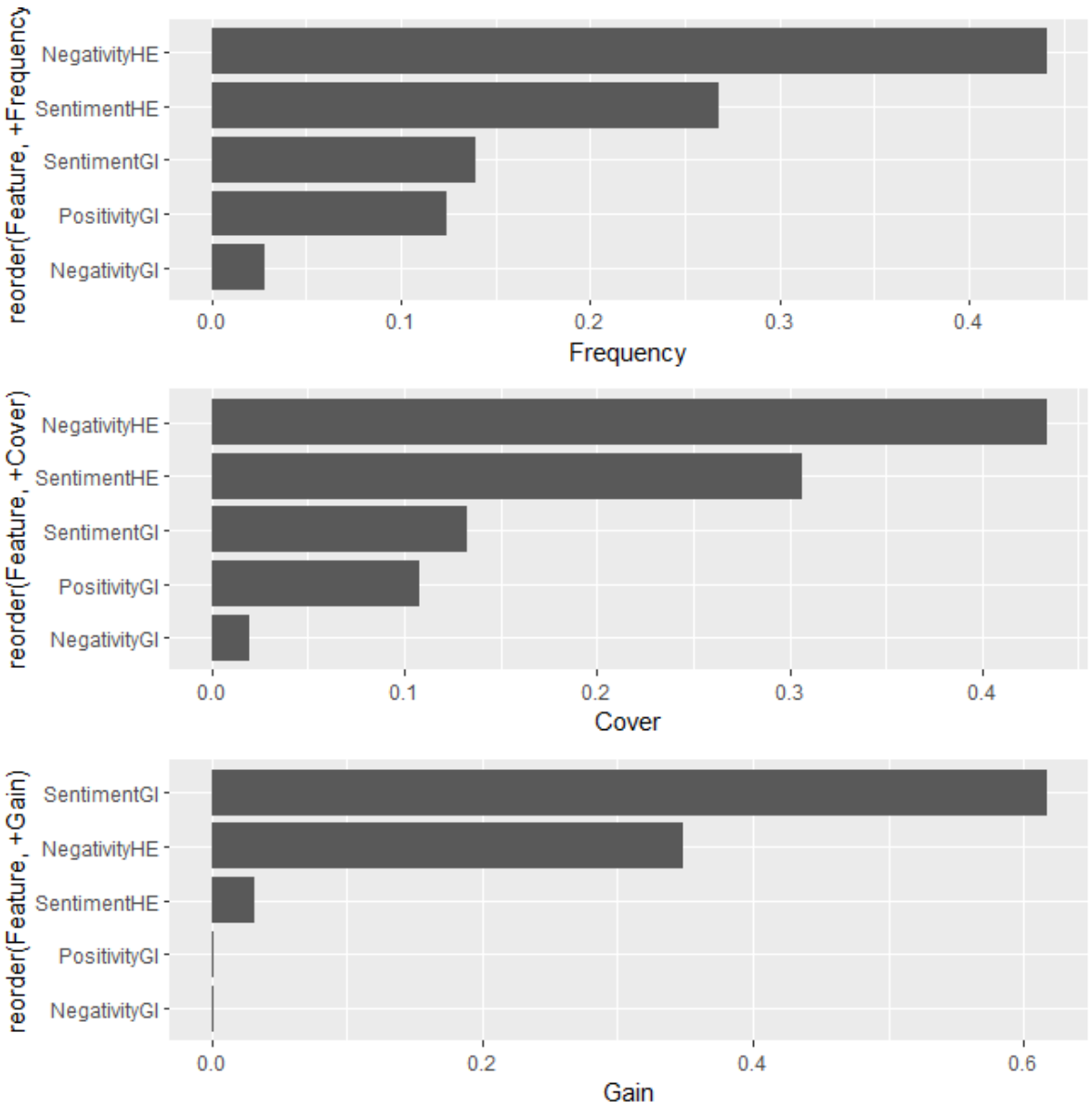
Figure 4.4 The variables importance



From Figure 4.4, it is obvious that the positivity GI is the most vital explanatory variable for the oil and gas industry and the negativity GI is the least vital explanatory variable for an oil and gas company's ESG score generation. This again demonstrates the fitness for involving GI as the mean diction to calculate the sentimental score. and for the oil and gas industry the positive words related to ESG keywords usually reflect this company's true ESG level.

Food, Beverage & Tobacco

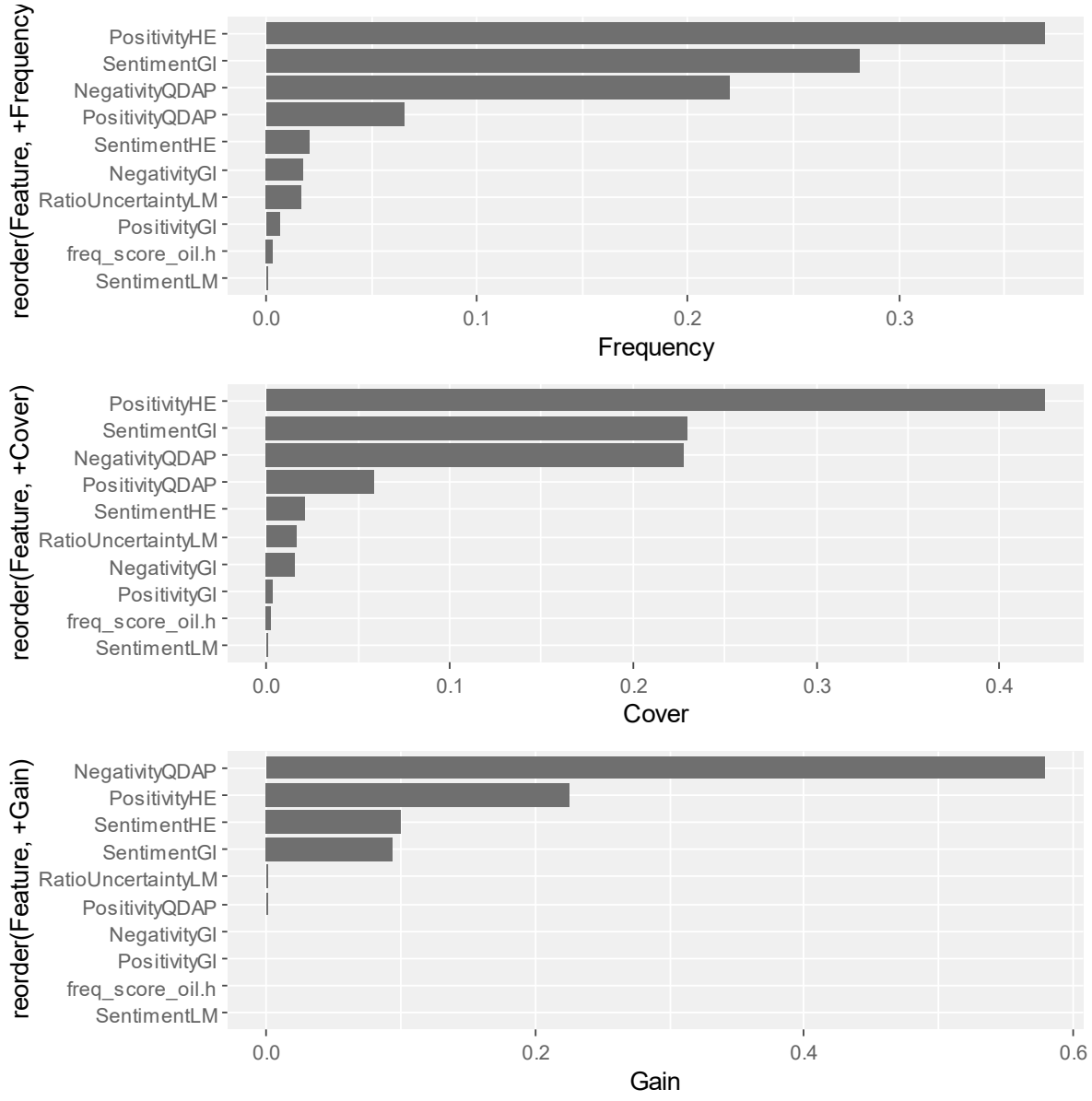
Figure 4.5 The variables importance



From Figure 4.5, it is obvious that the negativity HE is the most vital explanatory variable for the food, beverage and tobacco industry and the negativity GI is also the least vital explanatory variable for a food, beverage and tobacco company's ESG score formation. This demonstrates that for the food, beverage and tobacco industry the negative words related to ESG keywords usually reflect this company's true ESG level.

Automoblie

Figure 4.6 The variables importance



From Figure 4.6, it is obvious that the positivity HE is the most vital explanatory variable for the automobile industry and the sentimental score from the financial dictionary LM is the least vital explanatory variable for an automobile company's ESG score formation. This demonstrates that for the automobile industry the positive words relate to ESG keywords usually reflect this company's true ESG level.

4.2 Finacial analysis

In this section, this thesis will respectively reveal the result of the second question in three different industries, we have discussed the relation between ESG performance and financial performance for a brunch of listed U.S. corporates. Especially, compare their performance differences when the related market is facing some worldwide systematic crisis, and test the anti-risk capacity for a high ESG performance corporate.

4.2.1 Oil&gas

As we discussed in the previous chapter, we divide the timeline into 3 major parts. The time interval from 2017-12-01 to 2019-12-01 represents a normal period. The time interval from 2019-12-01 to 2022-12-01 will be separated from 2022-02-15 to represent covid epidemic and the Russo-Ukrainian War respectively.

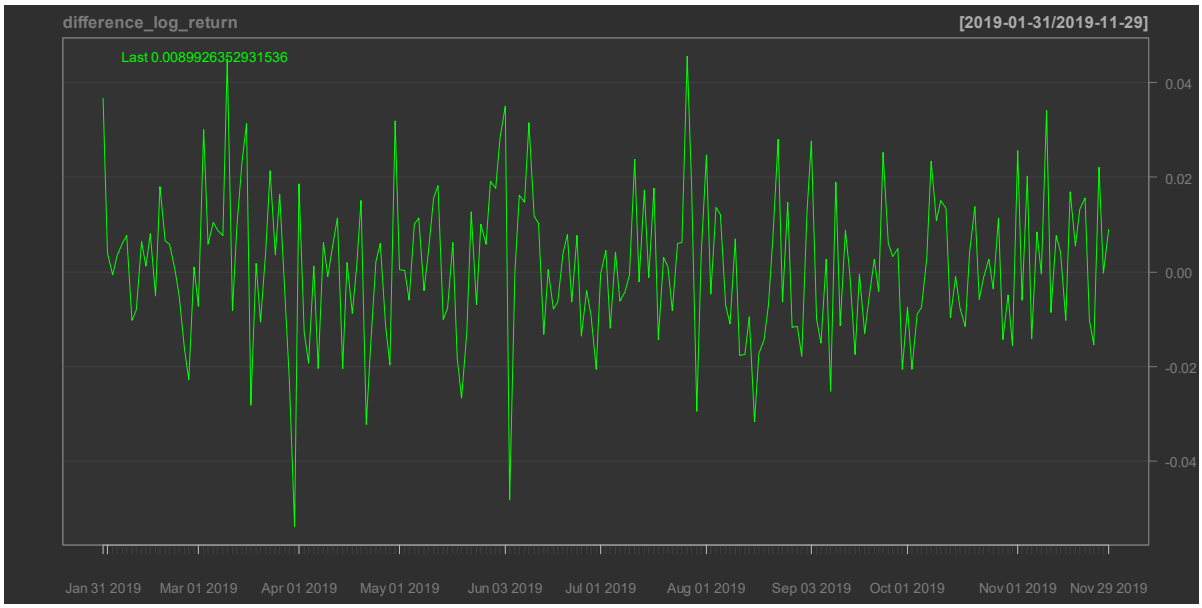
Table 4.9 normal period descriptive statistics

2017.12-2019.12	P-value	Mean	St. Dev.	Min	Max
High ESG score	0.585	-0.00037	0.013228	-0.03981	0.061310
Low ESG score		-0.00121	0.019582	-0.05277	0.058456

Table 4.9 shows clearly that in the oil and gas industry the high ESG performance corporates will have a better financial performance in a normal market, from 2017.12.01 to 2019.12.01, the average daily log return for high ESG score companies is 3 times more than the low ESG score companies group. Moreover, those high ESG performance corporates in ESG will also have relatively lower risk than the low ESG performance corporates, their risk is 32.45% lower than that compared group, this also can be found in their narrower range, the fluctuations for high ESG score are lesser than the low ESG score companies. It is understandable because the ESG criteria for the Bloomberg ESG score are taken concerned with the company size and social status in its social and governance scoring systems thus large and well-fame companies will naturally cherish by investors. Also, the high ESG score will indeed cut down the political and legal risks about the eco-life and humanity, which will also bring value to companies' ESG effort.

The P-value from the two-sample t-test is 0.585. It shows we have 58.5% to keep the null hypothesis and claim those two portfolios are not significantly different from each other. This also could be found in Figure 4.7 about the daily log return difference from the 2019 holy year. Although the fluctuation about the difference is quite large, overall, it has fluctuated up and down around the x-axis.

Figure 4.7 The difference between the log returns of the two ESG performance portfolios (high-low,113 points great than zero, 98 points are not)



Thus, we can conclude that, at least in this dataset, in the oil and gas industry the relationship between the company's ESG performance and the company's financial performance is not significant. And from these data, we cannot find statistical proof to show that ESG is good for companies' performance in the normal period.

Table 4.10 Covid-epidemic period descriptive statistics

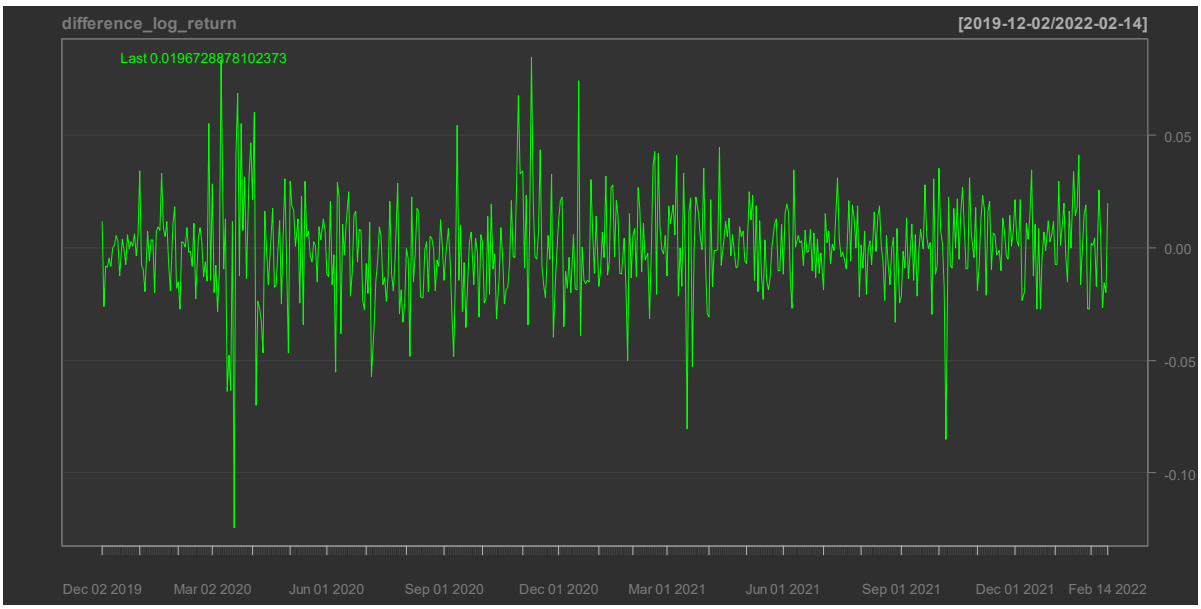
2019.12-2022.02	P-value	Mean	St. Dev.	Min	Max
High ESG score	0.8233	0.000424	0.028596	-0.19427	0.183066
Low ESG score		0.000828	0.031577	-0.27768	0.128097

And for the covid epidemic period, from 2019.12.01 to 2022.02.15, the dataset shape has some changes. In the table, the high ESG score companies now have worse financial

performance than those low ESG score companies. The average daily log return for low ESG score companies is 2 times more than the high ESG score companies group. Although the risk for high ESG score companies are still lower than the low ESG score companies but compared to the normal period above, the difference between the two value is relatively smaller, and so does the range difference. Such a phenomenon could owe to the social turmoil that start from the covid-19 outbreak, the terror and depress, undermine the willingness of keeping social responsibility, people become short-sight and deferred the call of the environment to deal with some more urgent needs, such as food and medic treatment. Thus, the value of ESG performance declined. Also, the more expensive ESG expenditure during the epidemic could be another reason for their bad performance in the stock market.

But the P-value from the two-sample t-test is 0.8233. It shows we have 82.33% to keep the null hypothesis and claim those two portfolios are not significantly different from each other. This also could be found in the figure about the daily log return difference from the end of 2019 to the beginning of 2022. Although the fluctuation in the difference is quite large, especially when the covid outbroke in the U.S. in the Mar. of 2020 but overall, it has fluctuated up and down around the x-axis. This is also could be explained by the previous reason that the outbreak of systematic crisis will downgrade their priority need to the basic need for life and health and less care about the other higher spiritual needs, and that will make the ESG score indifferent to investors and consumers.

Figure 4.8 The difference between the log returns of the two ESG performance portfolios (high-low,269 points great than zero, 287 points are not)



Thus, we can conclude that, at least in this dataset, in the oil and gas industry the relationship between the company's ESG performance and the company's financial performance is not significant. And from these data, we cannot find statistical proof to show that ESG is good for companies' performance in the COVID-epidemic period.

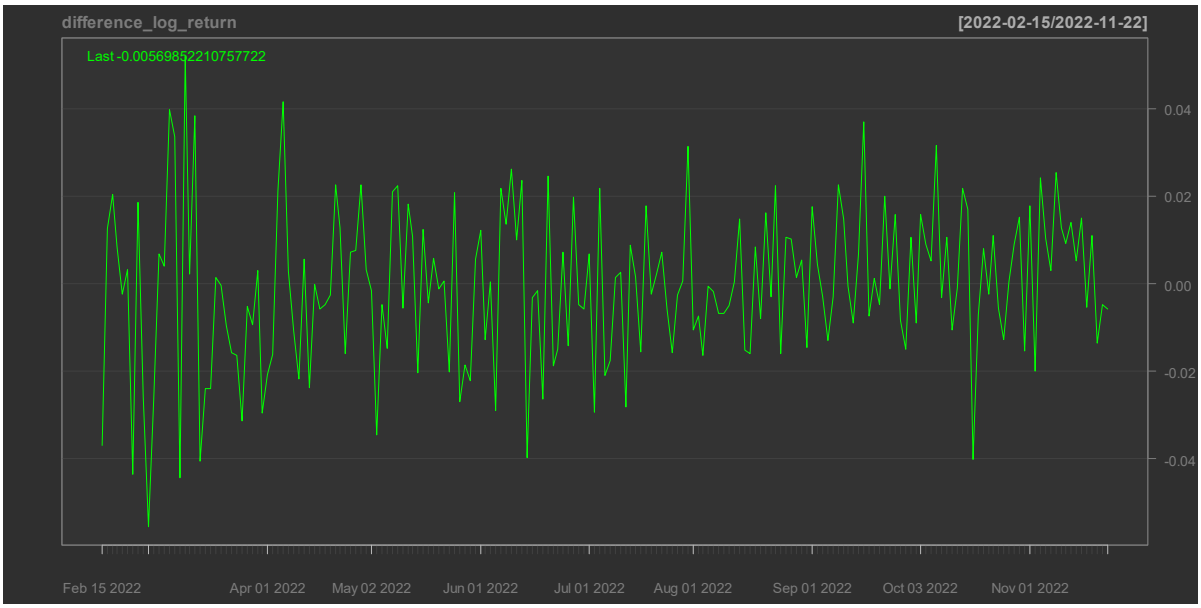
Table 4.11 Russo-Ukrainian War period descriptive statistics

2022.02-2022.12	P-value	Mean	St. Dev.	Min	Max
High ESG score	0.8066	0.001703	0.023299	-0.08467	0.059315
Low ESG score		0.002330	0.027436	-0.10712	0.078991

The outbreak of the Russo-Ukrainian War brings more chaos to the European market, and the continuous sanctions in the energy and financial fields of Russia bring a big opportunity towards U.S. oil and gas industry. That indicates, compare to another period, this period has the highest average daily log return for both high ESG score companies and low ESG score companies. From 2022.02.15 the rumours about the Russian invasion are out, and till now, the entire European is covered by the shadow of war, for the safety reason the hot money crowd to the U.S. market. It strongly boosts the U.S. stock market. In the meanwhile, sanctions towards Russian will also increase market competitiveness and increase sales and profit. And since oil and gas now is a seller's market, the difference in ESG level for the two companies becomes valueless. In our dataset, the companies with high ESG scores are performance worse than the companies with low ESG scores. Thus, in a seller's market, the ESG construction for a company will even cause a backfire on the company itself

the P-value from the two-sample t-test is 0.8066. It shows we have 80.66% to keep the null hypothesis and claim those two portfolios are not significantly different from each other. In the figure about the daily log return difference from 2022.02.15 to 2022.11.22. Except at the beginning of the war, the fluctuation in the difference is quite large. For the rest of the time, the difference between the two types of companies is not so great. The shortage of energy makes the gap in ESG level between the two types of companies becomes indifferent, and that causes the large P-value about the t-test.

Figure 4.9 The difference between the log returns of the two ESG performance portfolios (high-low,96 points great than zero, 99 points are not)



Thus, we can conclude that, at least in this dataset, in the oil and gas industry the relationship between the company's ESG performance and the company's financial performance is not significant. And from these data, we cannot find statistical proof to show that ESG is good for companies' performance in the wartime.

4.2.2 Food, Beverage & Tobacco

In this part, this thesis will continue to divide the timeline into three pieces, from 2017-12-01 to 2019-12-01, from 2019-12-01 to 2022-02-15 and from 2022-02-15 to 2022-12-01. To discuss the ESG effect on different occasion.

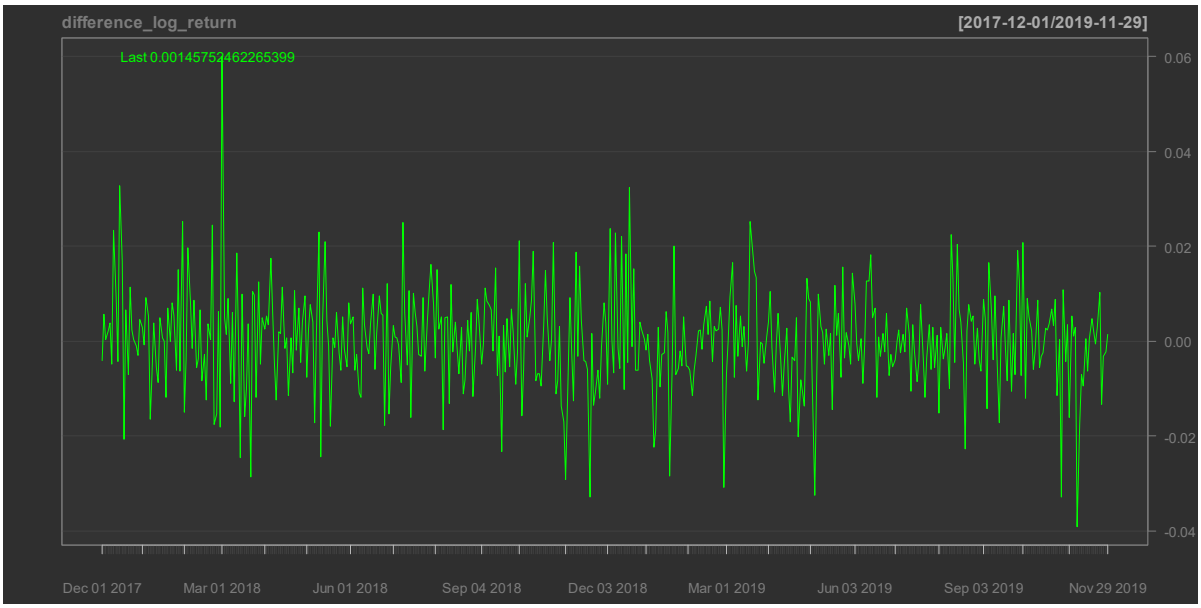
Table 4.12 normal period descriptive statistics

2017.12-2019.12	P-value	Mean	St. Dev.	Min	Max
High ESG score	0.9412	0.000111	0.009248	-0.03716	0.023152
Low ESG score		0.000058	0.012982	-0.06694	0.041422

Table 4.12 indicate that for the Food, Beverage & Tobacco industry the high ESG performance for a company will end up with a better performance in finance. According to the dataset, from 2017.12.01 to 2019.12.01, such a normal period, the average daily log return for high ESG score companies is 2 times more than the low ESG score companies group. Also, the risk for the high ESG score companies is 28.76% lesser than the low ESG score companies. Thus, the high ESG score companies will have a better return, and risk level and they have a narrower range.

However, the P-value from the two-sample t-test is 0.9412. It shows we have 94.12% to keep the null hypothesis and claim those two portfolios are not significantly different from each other. This also could be found in the figure about the daily log return difference from 2017 to 2019. Although in the March 2018 and in the December 2018, the differences between the high ESG score group and the low ESG score group is quite large, in general, the difference line has fluctuated up and down around the x-axis.

Figure 4.10 The difference between the log returns of the two ESG performance portfolios (high-low,259 points great than zero, 243 points are not)



Thus, we can conclude that at least in this dataset, in the food, beverage & tobacco industry the relationship between the company's ESG performance and the company's financial performance is not significant. And from these data, we cannot find statistical proof to show that ESG is good for companies' performance in the normal period.

Table 4.13 Covid-epidemic period descriptive statistics

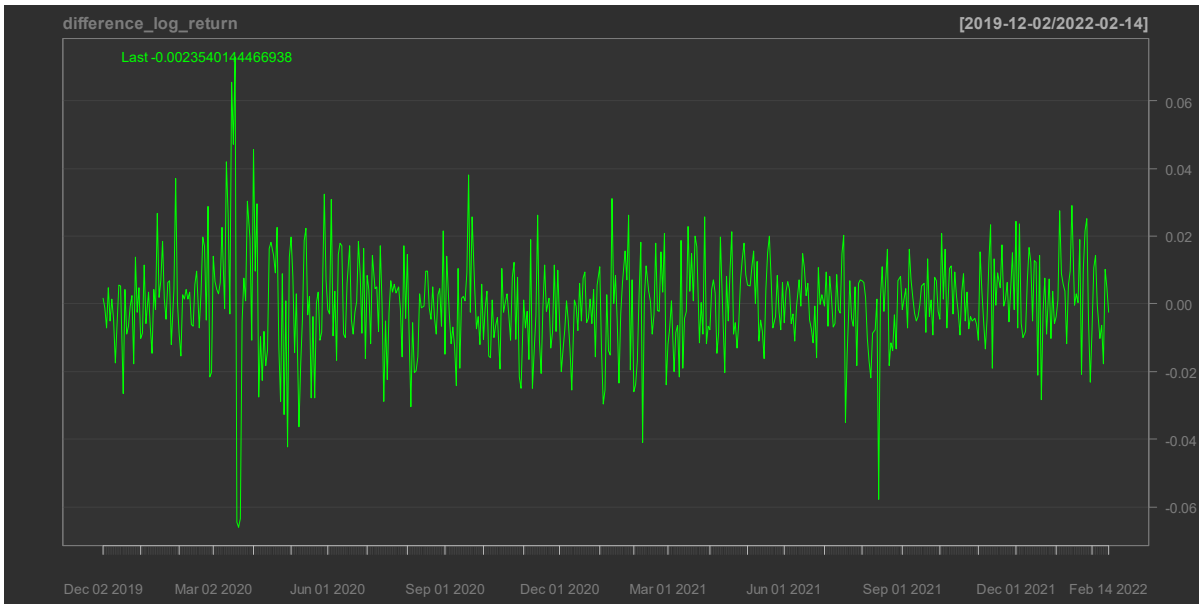
2019.12-2022.02	P-value	Mean	St. Dev.	Min	Max
High ESG score	0.908	0.0006073	0.014431	-0.09321	0.103012
Low ESG score		0.0007282	0.019998	-0.12540	0.089941

And for the covid epidemic period, the return difference between high ESG score companies to low ESG score companies is shortened. Moreover, the high ESG score companies now have worse financial performance than those low ESG score companies. Although the difference is quite small, it still shows the same fact as the oil and gas industry the server social crisis will drive people to focus on some more fundamental needs to preserve their health and life. The ESG value will largely deprecate in the tough period and will make the cost of maintenance company's ESG level could not be covered. But we also noticed that

compared to the oil and gas industry, the overtake from the low ESG score companies in the food industry is not so obvious, this could owing to the relatively easy to sense the low ESG product in this industry, and consumer can relatively distinguish the difference about two ESG level. That may add to the value of the company's ESG performance.

However, the P-value from the two-sample t-test is 0.908. It shows we have 90.08% to keep the null hypothesis and claim those two portfolios are not significantly different from each other. That indicates ESG score has little influence on a company's financial performance in the covid epidermic period. According to the figure about the daily log return difference from the end of 2019 to the beginning of 2022, only in March 2020, the return gap between the two type company is largely widened. Follow by the time the difference between those two types of companies is small and smaller. It is also due to the need downgrading in a crisis period.

Figure 4.11 The difference between the log returns of the two ESG performance portfolios (high-low,280 points great than zero, 276 points are not)



Thus, we can conclude that at least in this dataset, in the food, beverage & tobacco industry the relationship between the company's ESG performance and the company's financial performance is not significant. And from these data, we cannot find statistical proof to show that ESG is good for companies' performance in the covid period.

Table 4.14 Russo-Ukrainian War period descriptive statistics

2022.02-2022.12	P-value	Mean	St. Dev.	Min	Max
High ESG score	0.731	0.0009703	0.012624	-0.06242	0.034486
Low ESG score		0.0003534	0.019071	-0.06689	0.048012

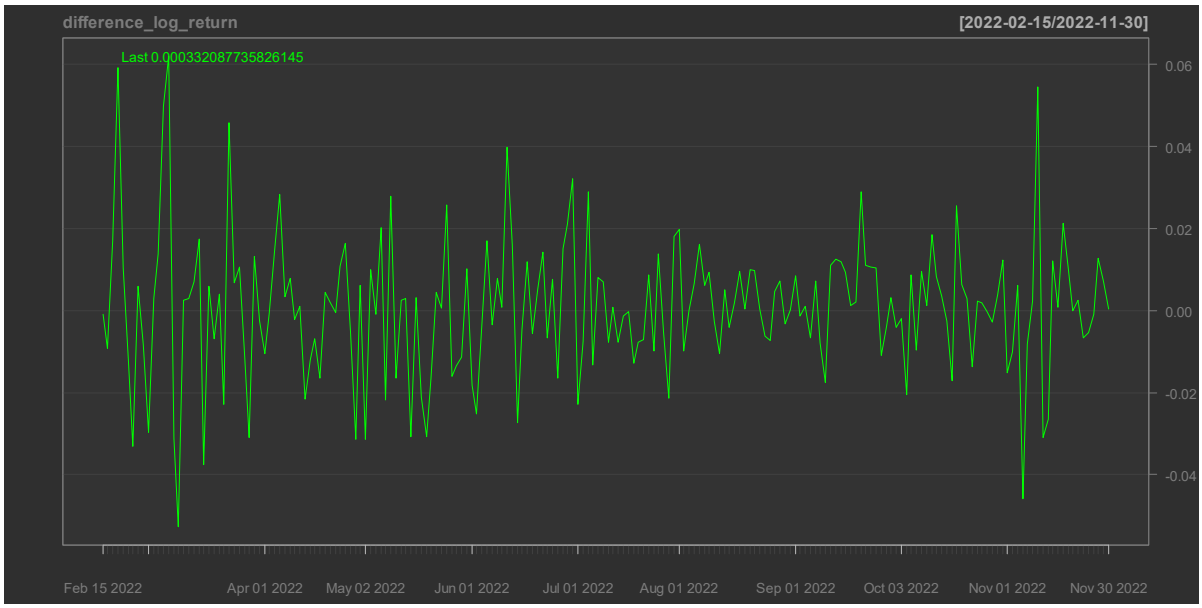
The overtake phenomenon disappeared in Russo-Ukrainian War, in the food industry the average daily log return for high ESG score companies is more than 2.5 times higher than the low ESG score companies. This is an obvious improvement in the ESG value in this industry compared to the last period. The reason for ESG score back to important could be the outbreak of the Russo-Ukrainian War has greatly boosted the U.S. economy, which at the cost of European economic vitality. The market recovery will arouse the investor's and consumers' new spiritual or moral needs. That will lead them to be more interested in high ESG level companies, and make those companies have a better financial performance. Thus, such a wide average return gap between the two types of companies could be a sign of a recovered society.

the P-value from the two-sample t-test is 0.731. It shows we have 73.10% to keep the null hypothesis and claim those two portfolios are not significantly different from each other. the figure about the daily log return difference from 2022.02.15 to 2022.11.30 shows the return difference is quite obvious at beginning of February and the beginning of November. Compare to the last period the return gap is widened and the fluctuations are increased.

Thus, we can conclude that at least in this dataset, in the food, beverage & tobacco industry the relationship between the company’s ESG performance and the company’s financial performance is not significant. But it is more significant than the covid period and normal period. From these data, we could claim that the ESG effort is good for U.S. companies’ financial performance in the Russo-Ukrainian War period.

.

Figure 4.12 The difference between the log returns of the two ESG performance portfolios (high-low,110 points great than zero, 90 points are not)



4.2.3 Automobile

In this part, this thesis will also divide the timeline into three pieces, from 2017-12-01 to 2019-12-01, from 2019-12-01 to 2022-02-15 and from 2022-02-15 to 2022-12-01. To discuss the ESG effect for different occasions.

Table 4.15 normal period descriptive statistics

2017.12-2019.12	P-value	Mean	St. Dev.	Min	Max
High ESG score	0.9511	-0.000293	0.015404	-0.04832	0.05249
Low ESG score		-0.000227	0.018673	-0.21164	0.112727

Table 4.15 shows that in the automobile industry the high ESG performance corporates will have worse financial performance in a normal market, from 2017.12.01 to 2019.12.01. The average daily log return for high ESG score companies is slightly less than the low ESG score companies group. However, those high ESG performance corporates in ESG will still have relatively lower risk than the low ESG performance corporates, their risk is 17.50% lower than compare group. The range of high ESG score companies also has a smaller range than the low ESG score companies, which shows the high ESG score companies are relatively stable in the stock market. However, this lesser risk level is trading from a worse daily return rate. Due to the cost to upkeep the high ESG score in every year's ESG reviewing, their profitability is facing a sort of challenge.

The P-value from the two-sample t-test is 0.9511. It shows we have 95.11% to keep the null hypothesis and claim those two portfolios are not significantly different from each other. This means statistically, in the daily log return field, those two types of companies are indifferent. This also can be witnessed in the figure. Except for the May of 2018, those two types of companies are largely spread, for the rest of the period. The difference between high ESG score companies to low ESG score companies is close to zero.

Thus, we can conclude that, at least in this dataset, the automobile industry the relationship between the company’s ESG performance and the company’s financial performance is not significant. And from these data, we cannot find statistical proof to show that ESG is good for companies’ performance in the normal period.

Figure 4.13 The difference between the log returns of the two ESG performance portfolios (high-low,261 points great than zero, 241 points are not)

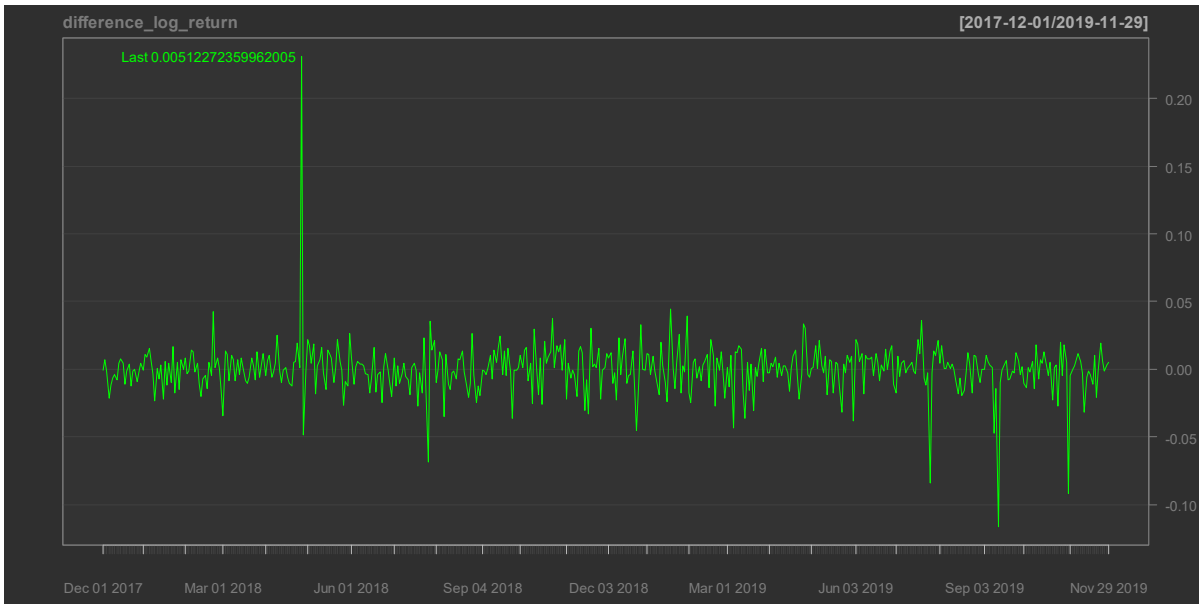


Table 4.16 Covid-epidemic period descriptive statistics

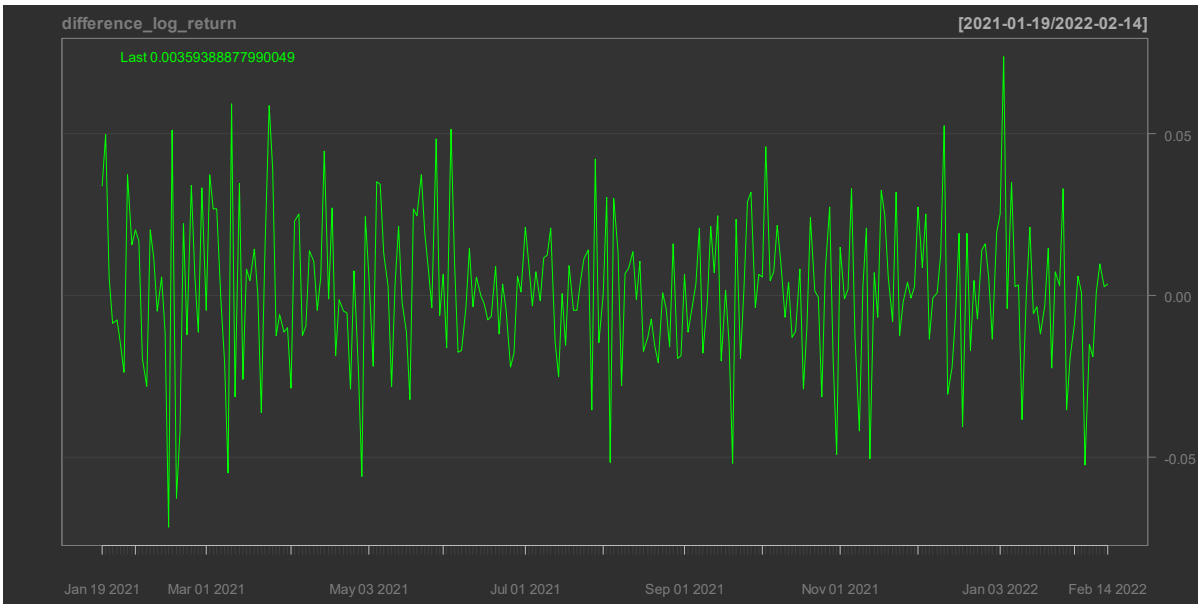
2019.12-2022.02	P-value	Mean	St. Dev.	Min	Max
High ESG score	0.3889	0.000789	0.028943	-0.22073	0.15179
Low ESG score		-0.000958	0.023853	-0.06183	0.077197

According to Table 4.16, we found the ESG value for an automobile company has great change. From 2019.12.01 to 2022.02.15, the covid epidemic period, the high ESG score companies now have a better financial performance than those low ESG score companies. The average daily log return for high ESG score companies is 2.5 times more than the low ESG score companies group. However, the risk for high ESG score companies is significantly higher than the low ESG score companies, and so does the range. This could cause by the income depression that makes the eco-automobile popular. And the higher ESG level factory usually with a higher automation level, which will offset the rising labour costs in the covid period. Both reasons could help companies obtain more value from a high-level ESG performance.

The P-value from the two-sample t-test is 0.3889. It shows we have 38.89% to keep the null hypothesis and claim those two portfolios are not significantly different from each other. This means in statistically our dataset shows there is a significant difference between high ESG score companies' daily returns to low ESG score companies' daily returns in the covid period

Also, the figure also presents the same information, the fluctuations in the difference are quite large and significant in all time.

Figure 4.14 The difference between the log returns of the two ESG performance portfolios (high-low,147 points great than zero, 125 points are not)



Thus, we can conclude that, at least in this dataset, the automobile industry the relationship between the company's ESG performance and the company's financial performance is significant. And from these data, we can find statistical proof to show that ESG is good for companies' performance in the covid epidemic period.

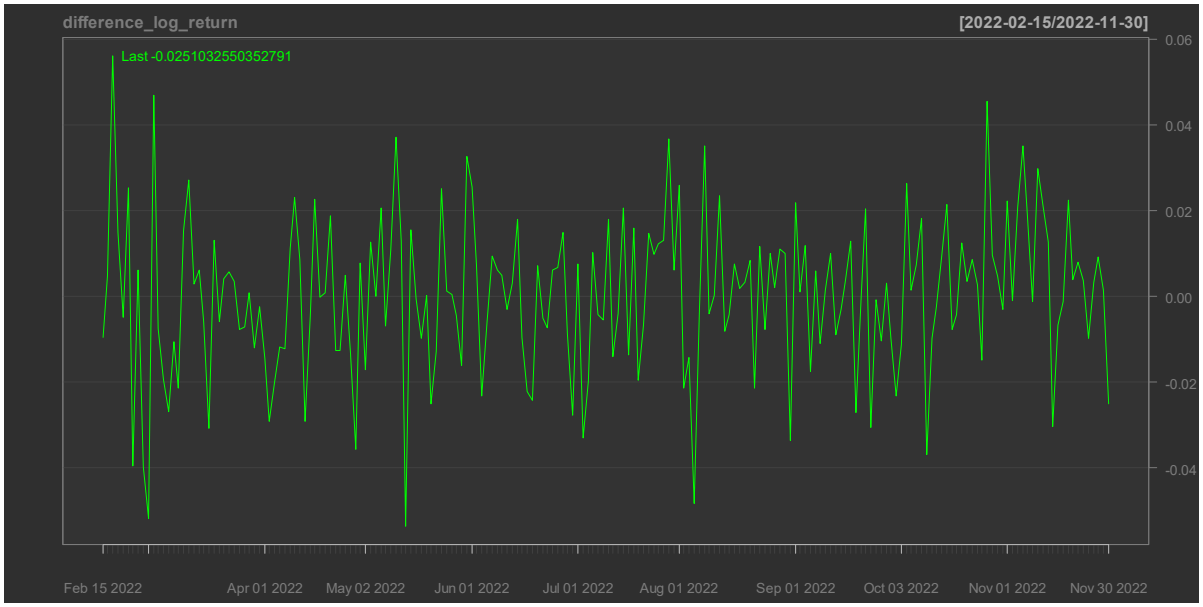
Table 4.17 Russo-Ukrainian War period descriptive statistics

2022.02-2022.12	P-value	Mean	St. Dev.	Min	Max
High ESG score	0.9735	-0.001186	0.029244	-0.09116	0.074571
Low ESG score		-0.001283	0.029091	-0.08288	0.059698

For the final period, the Russo-Ukrainian War period, the value of the company's ESG performance quickly fade away. According to the table. The high ESG score companies only have a slight advantage over low ESG score companies, their daily log return are quite close. Also, their risk level during wartime is quite close too. This could also be explained by the revival of the U.S. economy. The lesser confusion by the European energy crisis, make US consumers need not purchase eco-automobile to save money, which undermines the value of the company's ESG performance.

the P-value from the two-sample t-test is 0.9735. It shows we have 97.35% to keep the null hypothesis and claim those two portfolios are not significantly different from each other. In the figure about the daily log return difference from 2022.02.15 to 2022.11.22. we found the difference between the two types of companies is quite even. It makes t-test result does not significant.

Figure 4.15 The difference between the log returns of the two ESG performance portfolios (high-low,106 points great than zero, 94 points are not)



Thus, we can conclude that, at least in this dataset, the automobile industry the relationship between the company's ESG performance and the company's financial performance is not significant. And from these data, we cannot find statistical proof to show that ESG is good for companies' performance during the covid epidemic period. In our dataset the ESG feature does not make the company distinguished.

5. Disscusstions

5.1 Disscusstion of textual analysis

Since one of the purposes of this thesis is to find a new way to score a company's ESG performance, we use the 10-K form, the most common public report for U.S. listed companies, to represent the company's ESG attitude, then using this attitude to fit our model to generate the potential ESG score for the target company. However, before we dig out the target company's ESG attitude, we need proof that by just relying on the 10-k form we can distinguish a different ESG performance company and that the company's ESG attitude is a good connection with its ESG performance.

In this part, this thesis applied three approaches to achieve the goal, which are term frequency, cosine similarity and sentiment score. this thesis refers to the keyword list for ESG that has been generated by Baier in 2018 and streamlines some words to batter fit our situation. Then we are using this corpus to implement in-term frequency analysis and using the two-sample t-test to verify there is a significant language difference between companies with different ESG performances. Then, we applied cosine similarity to examine the context difference between companies with different ESG performances. Finally, the sentiment score we generated converted the textual data to digital data, which is suitable for xgboost fitting.

5.2 Disscusstion of financial analysis

Another research question is about examining the relationship between ESG performance and financial performance, especially in some tough periods.

This thesis has chosen 2017.12.01-2022.12.01 as the target time interval. In this time interval, we can observe the target company's financial performance in a normal period, the covid-epidemic period and the Russia-Ukraine war period. Using both two major systematic crises to examine their financial performance and compare it to their ESG performance. Via this method to explore the relationship between a company's ESG performance and its financial performance.

5.3 Implications

This thesis studied two questions: ESG scoring system replication and the correlation between ESG performance and financial performance.

In the first question, this article has created a novel approach to simulating the present ESG rating system, which is based on textual analysis and 10-k report, as the discussion in chapter 3, this rating approach has great potential and can be applied in other company's ESG valuation especially suit for the industry that lack of other ESG rating agencies or lack the timely update ESG reports.

In the second question, this article has chosen a series of time sets to observe the correlation between ESG performance and financial performance. With the descriptive statistics analysis and the two-sample t-test, we draw a series of conclusions about the correlation in different industries at different time intervals. Such explore studies have enrich the study of the ESG value creation.

5.4 Limitation

Although this article has selected three types of industries, it still many other industries have been left out, and are not involved in our research, some industries could be irrelevant to our selected industry or even to some similar industries, and they could also generate a different outcome. This deficit also exit in the corporate selection part, although the company set formed with three typical companies is quite adequate to meet the quantity requirement of the dataset. It still could add more corporates into the dataset to drive a more genialized outcome. But due to the workloads, this thesis has chosen a relatively small dataset, which may lead to results having some level of deviation from real life.

Another one is this article does not choose any firm in the emerging market. And the corporates all come from one country. That could undermine the universality of the results, there is the possibility that it will be a totally contrary outcome if we are using emerging markets or other markets' firms.

The 10-k form and the 8-k form may not be enough to reveal the corporate's ESG attitudes, and they also may not so precisely mark the corporate ESG level and the efforts that the corporate had made. This research may perform better if it is using the official ESG

disclosure reports as the primary dataset. Thankfully, this year February, the U.S. government announced that the ESG report or disclosure will become the obligation for all the listed corporates in the U.S. I believe such an official and standardized ESG report definitely will give the later researcher a better view of analysis the ESG performance or ESG disclosure in the listed corporates

Also, in the data prepossessing part. Many other additional prepossessing methods can be implemented to further improve the representation and the reliability of the dataset, those prepossessing methods include but are not limited to the skip-gram and the pop methods, which will be adding the analysis about the compound of sentences, remove the unwanted part of sentences.

Finally, the ESG lexicon this thesis has applied is not comprehensive enough, there many other ESG-related words are not selected in the lexicon list. That could weaken the reliability of the outcomes. And if we overwrite it with such methods that barely use frequency to judge the ESG perception is still a little bit lack reliability.

6. Conclusions

6.1 Summary of fundings

This article has found a novel technical to rate a company's ESG performance, in the oil and gas industry and the food, beverage & tobacco industry the rating error is less than 0.0006, and in the automobile industry, the predict error is also less than 0.002. this new way to evaluate a company's ESG performance is based on the serval requirement, 1) the company's 10-k form can reflect the ESG attitude of the company management department. 2) ESG attitude from the company management department determines this company's ESG performance 3) this ESG performance can be converted to a sentimental score based on a specific dictionary. After we meet those requirements, our model can generate a quite accurate ESG score to evaluate the target company.

This article also found the relationship between a company's ESG performance to its financial performance. this article finds: 1) In most of the time there is not a significant relationship between a company's ESG performance and its financial performance. 2) The world-wise systematic crisis will undermine the ESG value. 3) The size of ESG value is well connected to the market prosperity and national economic situation. 4) Compared to other industries we discussed the food industry has more ESG valuation.

6.2 Further research

This research is intended to find a new way to rate the unknown stock or company's ESG situation. But as the limitation has referred, this article has not studied emerging market cases. This field is exactly the most urgent for the ESG rating system introduction. Hope other researchers could find a better underlying and base it to create a new rating system target for the emerging market. Or applied other machine learning methods to fit the rating model.

Also, the other researcher can choose different industries to conduct analysis or enlarge the dataset this article has used. It obviously will have other interesting outcomes.

7. Appendixes

7.1 Frequency list about oil industry

oil&gas industry top 50 popurlar word list											
high ESG performance group						low ESG performance group					
rank	item	frequency	rank	item	frequency	rank	item	frequency	rank	item	frequency
1	production	1609	26	billion	433	1	oil	585	26	expenses	219
2	million	1239	27	barrel	426	2	crude	552	27	per	212
3	gas	1230	28	average	425	3	million	539	28	total	205
4	oil	1204	29	proved	424	4	gas	524	29	properties	197
5	percent	783	30	including	410	5	natural	512	30	may	186
6	per	763	31	tax	394	6	december	478	31	credit	184
7	total	731	32	capital	387	7	production	407	32	flows	182
8	net	721	33	interest	382	8	prices	393	33	operations	179
9	costs	711	34	operating	381	9	year	374	34	activities	177
10	natural	708	35	company	381	10	cash	353	35	debt	175
11	operations	669	36	assets	373	11	increase	342	36	income	175
12	lower	657	37	well	351	12	costs	273	37	billion	174
13	prices	645	38	president	348	13	sales	270	38	decrease	171
14	exxonmobil	622	39	equity	347	14	ended	254	39	fourth	170
15	reserves	611	40	period	342	15	facility	248	40	interest	168
16	development	605	41	united	340	16	compared	246	41	reserves	167
17	years	580	42	additional	336	17	due	244	42	revenues	165
18	exploration	568	43	earnings	334	18	quarter	244	43	primarily	159
19	due	555	44	wells	333	19	future	239	44	company	152
20	financial	506	45	corporation	332	20	tax	239	45	drilling	151
21	may	500	46	increased	328	21	net	236	46	additional	143
22	crude	490	47	statements	322	22	capital	235	47	proved	143
23	consolidated	456	48	business	318	23	increased	227	48	commodity	141
24	activities	443	49	primarily	312	24	operating	221	49	approximately	137
25	information	442	50	year	311	25	financial	220	50	notes	137

7.2 Frequency list about food industry

Food, Beverage & Tobacco industry top 50 popurlar word list											
high ESG performance group						low ESG performance group					
rank	item	frequency	rank	item	frequency	rank	item	frequency	rank	item	frequency
1	net	2955	26	costs	894	1	million	3675	26	certain	566
2	million	2848	27	cost	862	2	sales	1990	27	related	563
3	fiscal	2108	28	charges	853	3	year	1733	28	companys	561
4	operating	1712	29	table	843	4	december	1662	29	decrease	547
5	tax	1554	30	see	834	5	net	1473	30	compared	542
6	financial	1551	31	consolidated	827	6	company	1343	31	credit	536
7	cash	1469	32	due	819	7	fiscal	1287	32	foreign	534
8	assets	1288	33	expense	817	8	ended	1175	33	andor	519
9	company	1230	34	earnings	788	9	income	1109	34	expenses	515
10	sales	1226	35	benefit	776	10	increase	1106	35	assets	506
11	results	1198	36	primarily	757	11	cash	876	36	value	504
12	billion	1193	37	exchange	753	12	tax	836	37	monster	484
13	income	1165	38	statements	738	13	operating	777	38	expense	470
14	growth	1163	39	note	720	14	costs	719	39	increased	469
15	profit	1112	40	plan	713	15	approximate	644	40	amount	460
16	related	1076	41	impairment	709	16	segment	644	41	including	453
17	year	1049	42	rates	684	17	due	631	42	statements	433
18	total	1014	43	including	682	18	operations	631	43	impact	431
19	december	1002	44	items	675	19	primarily	625	44	facility	415
20	impact	976	45	based	669	20	energy	623	45	notes	407
21	value	954	46	debt	667	21	gross	612	46	years	406
22	interest	938	47	pension	662	22	ingredients	603	47	prices	384
23	rate	923	48	operations	660	23	products	592	48	rate	371
24	certain	910	49	segment	659	24	cost	576	49	may	369
25	foreign	895	50	percent	650	25	financial	572	50	business	368

7.3 Frequency list about automoblie industry

Automoblie industry top 50 popurlar word list											
high ESG performance group						low ESG performance group					
rank	item	frequency	rank	item	frequency	rank	item	frequency	rank	item	frequency
1	december	1713	26	vehicles	670	1	year	543	26	ebitda	136
2	net	1531	27	company	649	2	million	514	27	percentage	133
3	credit	1509	28	business	635	3	revenue	513	28	vehicle	130
4	year	1406	29	vehicle	626	4	december	349	29	result	125
5	million	1372	30	total	599	5	ended	271	30	increased	124
6	income	1333	31	market	587	6	operations	264	31	distribution	123
7	financial	1329	32	debt	582	7	segment	264	32	inventory	121
8	cash	1236	33	expense	580	8	related	263	33	including	119
9	billion	1229	34	increased	576	9	expenses	259	34	interest	119
10	ended	1175	35	assets	575	10	acquisition	251	35	credit	118
11	automotive	1024	36	management	557	11	prior	209	36	may	117
12	operations	1014	37	including	540	12	compared	195	37	change	116
13	sales	939	38	rates	529	13	products	187	38	growth	116
14	primarily	921	39	value	518	14	specialty	186	39	sales	112
15	tax	917	40	pension	508	15	costs	177	40	vehicles	112
16	interest	874	41	approximatel	479	16	acquisition	162	41	aftermarket	111
17	due	844	42	table	466	17	total	157	42	cost	110
18	costs	838	43	capital	459	18	due	154	43	america	106
19	ford	826	44	based	458	19	primarily	151	44	debt	104
20	results	776	45	favorable	454	20	increase	150	45	impact	100
21	operating	765	46	statements	454	21	cash	148	46	table	100
22	changes	751	47	notes	451	22	north	148	47	business	98
23	cost	740	48	may	446	23	net	147	48	expense	93
24	related	683	49	future	444	24	parts	143	49	sold	93
25	rate	681	50	certain	437	25	operating	139	50	income	91

7.4 T-test result for oil and gas industry

```
> t.test(average_lowesg_return,average_highesg_return,var.equal = T)

        Two Sample t-test

data:  average_lowesg_return and average_highesg_return
t = -0.54654, df = 459, p-value = 0.585
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.003860784  0.002180583
sample estimates:
    mean of x     mean of y
-0.0012107321 -0.0003706314
```

```
> t.test(average_lowesg_return,average_highesg_return,var.equal = T)

        Two Sample t-test

data:  average_lowesg_return and average_highesg_return
t = 0.22332, df = 1110, p-value = 0.8233
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.003141429  0.003948374
sample estimates:
   mean of x    mean of y
0.0008279113 0.0004244387
```

```
> t.test(average_lowesg_return,average_highesg_return,var.equal = T)

        Two Sample t-test

data:  average_lowesg_return and average_highesg_return
t = 0.24503, df = 393, p-value = 0.8066
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.004403704  0.005657673
sample estimates:
  mean of x   mean of y
0.002329649 0.001702664
```

7.5 T-test result for Food, Beverage & Tobaccos industry

```
> t.test(average_lowesg_return,average_highesg_return,var.equal = T)

        Two Sample t-test

data:  average_lowesg_return and average_highesg_return
t = -0.073768, df = 1002, p-value = 0.9412
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.001448527  0.001343567
sample estimates:
    mean of x     mean of y
0.00005847545 0.00011095532
```

```
> t.test(average_lowesg_return,average_highesg_return,var.equal = T)

        Two Sample t-test

data:  average_lowesg_return and average_highesg_return
t = 0.11559, df = 1110, p-value = 0.908
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.001931214  0.002172992
sample estimates:
   mean of x    mean of y
0.0007281567 0.0006072674
```

```
> t.test(average_lowesg_return,average_highesg_return,var.equal = T)

        Two Sample t-test

data:  average_lowesg_return and average_highesg_return
t = -0.38144, df = 398, p-value = 0.7031
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.003796225  0.002562479
sample estimates:
   mean of x    mean of y
0.0003534300 0.0009703029
```

7.6 T-test result for automobile industry

```
> t.test(average_lowesg_return,average_highesg_return,var.equal = T)

        Two Sample t-test

data:  average_lowesg_return and average_highesg_return
t = 0.061342, df = 1002, p-value = 0.9511
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.002053833  0.002186381
sample estimates:
    mean of x     mean of y
-0.0002265810 -0.0002928549
```

```
> t.test(average_lowesg_return,average_highesg_return,var.equal = T)

        Two Sample t-test

data:  average_lowesg_return and average_highesg_return
t = -0.86212, df = 826, p-value = 0.3889
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.005722693  0.002229790
sample estimates:
    mean of x     mean of y
-0.0009576786  0.0007887730
```

```
> t.test(average_lowesg_return,average_highesg_return,var.equal = T)

        Two Sample t-test

data:  average_lowesg_return and average_highesg_return
t = -0.033274, df = 398, p-value = 0.9735
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.005831259  0.005637156
sample estimates:
   mean of x    mean of y
-0.001283108 -0.001186056
```

7.7 The coding

Please check the attachment

References

Sinziana Dorobantu, Witold J. Henisz, and Lite J. Nartey, “Spinning gold: The financial returns to stakeholder engagement,” Strategic Management Journal, December 2014, Volume 35, Number 12, pp. 1727–48, onlinelibrary.wiley.com

Giovanna Michelon, Giacomo Boesso, Kamalesh Kumar, Examining the Link between Strategic Corporate Social Responsibility and Company Performance: An Analysis of the Best Corporate Citizens

R. Costa, T. Menichini, A multidimensional approach for CSR assessment: The importance of the stakeholder perceptionJanuary 2013Expert Systems with Applications 40(1):150–161

https://chevroncorp.gcs-web.com/static-files/808472c3-0ec8-42a4-8f86-721d0c480506

Witold Henisz, Tim Koller, and Robin Nuttall. (2019). Five ways that ESG creates value

Witold J. Henisz, “The costs and benefits of calculating the net present value of corporate diplomacy,” Field Actions Science Reports, 2016, Special Issue 14.

Spinning gold: The financial returns to stakeholder engagement, Spinning gold: The financial returns to stakeholder engagement, https://doi.org/10.1002/smj.2180

Alex Edmans, “Does the stock market fully value intangibles? Employee satisfaction and equity prices,” Journal of Financial Economics, September 2011, Volume 101, Number 3, pp. 621–40, sciencedirect.com.

Alex Edmans, “The link between job satisfaction and firm value, with implications for corporate social responsibility,” Academy of Management Perspectives, November 2012, Volume 26, Number 4, pp. 1–9, journals.aom.org.

Research Design: Descriptive Research, Helen L. Dulock et al, 1993

Giovanna Michelon, Giacomo Boesso, Kamalesh Kumar, Examining the Link between Strategic Corporate Social Responsibility and Company Performance: An Analysis of the Best Corporate Citizens

Hertzel, Michael and Richard L. Smith. (1993). Market Discounts and shareholder Gains for placing Equity Privately. Journal of Finance, 48, 459-485.

Doyle, T. M. (2018). Ratings that don’t rate: The subjective world of ESG rating agencies. American Council for Capital Formation. Available at: https://accfcorpgov.org/wpcontent/uploads/2018/07/ACCF_RatingsESGReport.pdf

AMOS TVERSKY AND DANIEL KAHNEMAN,Judgment under Uncertainty: Heuristics and Biases: DOI: 10.1126/science.185.4157.1124

Hong, Harrison Kacperczyk, Marcin. (2009). The price of sin: The effects of social norms on markets. Journal of Financial Economics, Elsevier, 93(1), 15-36.

Elsa Allman, Joonsung Won, The Effect of ESG Disclosure on Corporate Investment Efficiency

Ngoc Vuong & Yoshihisa Suzuki 2021, The Motivating Role of Sentiment in ESG Performance: Evidence from Japanese Companies

Giese G, Lee L E, Melas D, et al. (2019). Foundations of ESG investing: How ESG affects equity valuation, risk, and performance. The Journal of Portfolio Management, 45(5), 69-83

Friede, G., Busch, T., Bassen, A. (2015). ESG and financial performance: aggregated evidence from more than 2000 empirical studies. Journal of Sustainable Finance Investment, 5, 210-233. Friedman, M. (1970). The Social Responsibility of Business Is to Increase Its Profits. New York Times Magazine, 13 September 1970, 122-126.

Kim & Lyon (2014), Greenwash vs. Brownwash: Exaggeration and Undue Modesty in Corporate Sustainability Disclosure

Nelling and Webb(2009), Corporate social responsibility and financial performance: the "virtuous circle" revisited

Hong, Harrison Kacperczyk, Marcin. (2009). The price of sin: The effects of social norms on markets. Journal of Financial Economics, Elsevier, 93(1), 15-36.

Shane, P. B., Spicer, B. H. (1983). Market Response to Environmental Information Produced outside the Firm. The Accounting Review, 58(3), 521-538.

Fernandez-Kranz D, Santalo J. (2010). When necessity becomes a virtue: The effect of product market competition on corporate social responsibility. Journal of Economics Management Strategy, 19(2), 453-487.

Costa & Menichini, 2013, A multidimensional approach for CSR assessment: The importance of the stakeholder perception

Philipp Baier & Marc Berninger （2020), Environmental, social and governance reporting in annual reports: A textual analysis

Barkemeyer, Comyns, Figge & Napolitano (2014), CEO statements in sustainability reports: Substantive information or background noise?

Baier et al.(2018), Intron-containing algal transgenes mediate efficient recombinant gene expression in the green microalga Chlamydomonas reinhardtii

Dulock et al, 1993, Research design: Descriptive research