UNIVERSITÀ DEGLI STUDI DI PADOVA

DIPARTIMENTO DI SCIENZE ECONOMICHE ED AZIENDALI

"M. FANNO"

CORSO DI LAUREA MAGISTRALE IN

BUSINESS ADMINISTRATION

(ACCOUNTING & FINANCE)

TESI DI LAUREA

What effect does board diversity (experience and education) have on the environmental, social, and governance (ESG) performance of the technology sector (23 big companies) in the United States of America (USA)?

RELATORE LAUREANDO:	GAURAV GAURAV
MATRICOLA NO:	2046903
CH.MO. PROF.:	MARCO GHITTI

ANNO ACCADEMICO – 2023 – 2024

Dichiarazione di Originalità

Il candidato dichiara che il presente lavoro è originale e non è già stato sottoposto, in tutto o in parte, per il conseguimento di un titolo accademico in altre Università italiane o straniere.
Il candidato dichiara altresì che tutti i materiali utilizzati durante la preparazione dell'elaborato sono stati indicati nel testo e nella sezione "Riferimenti bibliografici" e che le eventuali citazioni testuali sono individuabili attraverso l'esplicito richiamo alla pubblicazione originale.

Declaration of Originality

The candidate declares that the present work is original and has not already been submitted, totally or in part, for the purposes of attaining an academic degree in other Italian or foreign universities. The candidate also declares that all the materials used during the preparation of the thesis have been explicitly indicated in the text and in the section "Bibliographical references" and that any textual citations can be identified through an explicit reference to the original publication.

Firma dello Studente ……

Preface

This thesis, entitled "What Effect Does Board Diversity (Experience and Education) Have on the Environmental, Social, and Governance (ESG) Performance of the Technology Sector in the United States," aims to explore a critical area of corporate governance that has garnered significant attention in recent years. As the global business environment becomes increasingly complex and stakeholder expectations rise, understanding the impact of board diversity on ESG performance has never been more pertinent.

The motivation for this research stems from my keen interest in corporate governance and sustainability, coupled with the recognition of the growing importance of ESG factors in shaping corporate strategies and outcomes. The technology sector, characterized by rapid innovation and significant societal impact, serves as an ideal context to investigate these dynamics. This study focuses on 23 prominent technology companies in the United States, aiming to provide insights that are both academically rigorous and practically relevant.

Board diversity, in terms of both experience and education, is hypothesized to influence a company's ESG performance in various ways. Directors with diverse professional backgrounds and educational qualifications bring a wealth of perspectives and skills, potentially leading to more robust decision-making processes and improved organizational outcomes. This thesis seeks to empirically examine these relationships, contributing to the broader discourse on how board composition can drive corporate sustainability efforts.

The research process involved several stages, beginning with a comprehensive review of existing literature on board diversity and ESG performance. This review highlighted gaps in current knowledge and informed the development of the research hypotheses. Subsequently, data collection was undertaken, focusing on board composition and ESG performance metrics of the selected technology companies. This process required meticulous attention to detail and a thorough understanding of the nuances involved in measuring both board diversity and ESG outcomes.

One of the primary challenges encountered during this research was the collection and analysis of data. Given the proprietary nature of some corporate information, accessing detailed and accurate data on board members' backgrounds and companies' ESG performance required significant effort. Leveraging multiple sources, including company reports, public disclosures, and specialized databases, was essential to ensure the reliability and validity of the data used in this study.

The analysis involved both quantitative and qualitative methods. Statistical techniques were employed to test and identify significant relationships between board diversity and ESG performance. Additionally, qualitative case studies of selected companies provided deeper

insights into the mechanisms through which diverse boards influence ESG outcomes. This mixed-methods approach allowed for a more comprehensive understanding of the research question and added depth to the findings.

The findings of this research reveal nuanced relationships between board diversity and ESG performance.

This thesis also discusses the practical implications of the findings for corporate governance practices. For technology companies aiming to improve their ESG performance, strategic efforts to enhance board diversity could be beneficial. However, it is crucial for companies to consider the specific context and needs of their organizations when designing their board composition strategies. The insights from this research can inform policymakers, regulators, and corporate leaders in their efforts to promote more diverse and effective boards.

Reflecting on the broader implications of this study, it is evident that board diversity is a multifaceted concept that encompasses more than just gender or ethnic diversity. The diversity of thought, skills, and experiences that board members bring to the table can significantly influence a company's ability to navigate complex challenges and seize opportunities in the rapidly evolving business landscape. As such, fostering a diverse and inclusive boardroom is not only a matter of social equity but also a strategic imperative for sustainable business success.

This thesis represents a significant step in understanding the impact of board diversity on ESG performance in the technology sector. While the findings offer valuable insights, they also highlight the need for further research to explore the complex interplay of factors influencing board effectiveness and corporate sustainability. I hope that this study will contribute to the ongoing efforts to create more diverse, inclusive, and effective corporate boards, ultimately fostering better ESG outcomes and sustainable business practices.

Acknowledgements

Completing this master's thesis has been an arduous yet immensely rewarding journey. I am deeply grateful to the many individuals and institutions whose support and guidance have been crucial to the successful completion of this research on the effect of board diversity (experience and education) on the environmental, social, and governance (ESG) performance of the technology sector in the United States.

First and foremost, I wish to express my sincere gratitude to my thesis advisor, Professor Marco Ghitti. Your profound knowledge, invaluable insights, and unwavering support have been instrumental in navigating through the complexities of this research. Your patience and encouragement have been a constant source of motivation, and your constructive criticism has significantly enhanced the quality of this work.

Special thanks are due to the 23 technology companies whose participation made this research possible. Your willingness to share data and insights was critical to the success of this study. I am grateful for your transparency and your commitment to advancing ESG performance in the industry.

To my fellow graduate students and colleagues at University of Padova, thank you for your camaraderie and intellectual exchange. The collaborative environment and shared experiences have been invaluable. I am particularly grateful to Faraz, Saifi, Jalal, Aamir, and Masood (University of Ca'Foscari Venice) for their support, feedback, and encouragement during the most challenging times.

In addition to the insightful discussions on ESG contributed by my friends, I received invaluable technical assistance and advice from Saad and Madhusudhan. Their expertise greatly facilitated the assembly of this thesis, ensuring its comprehensive and meticulous completion. Their support was indispensable and deeply appreciated.

I owe a debt of gratitude to my family and friends for their unwavering support. To my parents, Devender Singh and Sunita, your belief in me has been my anchor. Your love, encouragement, and sacrifices have made this achievement possible. To my siblings, Nitish, and Nidhi, thank you for your constant support and understanding.

Finally, I wish to acknowledge the inspiration and dedication of all the researchers and practitioners in the field of ESG performance and corporate governance. Your pioneering work has laid the groundwork for studies like mine, and I hope this thesis contributes meaningfully to the ongoing discourse on the importance of board diversity in enhancing ESG outcomes in the technology sector.

This thesis is the culmination of the collective efforts and support of many individuals and institutions. Each contribution, no matter how small, has played a significant role in the successful completion of this research. I am deeply grateful to everyone who has been a part of this journey.

Table of Contents

Chapter 1: Introduction

Recently, the relation between corporate governance and sustainability (ESG) and financial performance has been considered seriously by the researchers, scholars, policy experts and corporate masters. As concerns are going on over changes in climate, social inequality, and ethical business practices, it is very important to think and consider the sustainable practices and responsibilities by the corporate board. Specifically, the configuration of the board with respect to the distinctiveness of experience and education background has been shown as crucial for shaping corporate sustainable (ESG) performance.

The information technology sector or I would say technology sector simply, is growing day by day and hence, rapid innovation can be seen with sustainable economic influence standing at the forefront of this discourse. Where tech companies play a significant role forming the social, environmental and governance norms and undoubtedly, the global economy, thus, correlation between ESG performance and board diversity holds great implications for business and society. Plus, in the case of the United States of America, home of some of the best tech companies globally will be playing an important role.

This thesis work will look into the effect of board diversity specifically with reference to the experience of board and education background with some other variables like the size of the firm and Research and Development expenses, with ESG performance of 23 big tech companies of the United States of America. Hence, this study will find out the deep insights within this industry in context of board composition and sustainability.

The main reason to select this thesis topic is to check how the different perspectives of the board which comes from distinct experiences base and education specialty can be impacted (positive or negative) to take major decision-making procedures, innovative processes and risks and/or returns associated with ESG performance. Furthermore, stakeholders demand accountability, transparency and ethical behavior from companies to understand how the diversity of the board impacts (positively and negatively) the long-term growth, competitiveness, market share and many more.

Our study to achieve its objectives will be using quantitative analysis (Regression Model) on the data collected from different sources for example Refinitiv, LinkedIn, Bloomberg, secondary literature, company reports, etcetera. Where data in the sense of ESG Ratings of firms, board composition (experience in years, and education background), and other two control variables (Research and development expenses and size of the firm) for the year of 2013 to 2022 i.e., 10 years. Therefore, this whole study will be offering an extensive understanding of the complex interplay of board composition and sustainability (ESG).

Eventually, our study will help in the decision-making processes in corporate governance and to academic scholars, thus, this research is going to provide deep insights to policy makers, economists, investors, government and other stakeholders seeking to foster more inclusive and resilient business practices in the tech sector.

The following sections will go through the relevant literature, outlined research methodology employed, present findings and discussions of implications and finally, conclusion of the USA technology sector.

Chapter 2: Literature Review

2.1 Introduction

First of all, in simple terms ESG means using Environmental, Social and Governance factors to assess the sustainability of companies and countries. These three factors are seen as best embodying the three major challenges facing corporations and wider society, now encompassing climate change, human rights and adherence to laws. From last two-three decades, it has been seen that the value of environment, social and governance (ESG) or there are similar terminologies are used instead of these like sustainability or the word green sometimes or eco-friendly, is escalating day by day in every stream whether science, technology, management, corporations or corporates, economics, medical and many more. Businesses are confronting more and more environmental difficulties, and the "business-as-usual" paradigm has to be drastically rethought. It draws attention to how issues with the economy, society, and environment are intertwined, especially in metropolitan settings. The notion of "sustainable development" and the transition from centralized to decentralized environmental self-regulation are introduced in the text. (ULHOI et al., 1996, 243-254) Therefore, the concerns of this topic can be investigated in so many different fields, meaning that in the tech field, environment related, geography, political, stock etc. The strength of corporate governance and other aspects of ESG performance are predictive of future stock return success. (Khan, 2019, 103-133) However, here in this research thesis we are concentrating only on the corporates, more specifically in the context of board experience and education with two other variables i.e. Research and Development expenses (R&D) and size of the firm in the US tech sector. Amy Edmondson, a professor at Harvard Business School, Edmondson focuses on leadership, teaming, and organizational learning. She emphasizes the importance of governance within ESG, highlighting how effective governance structures can foster transparency, accountability, and ethical decision-making within an organization. Moreover, under this section of literature review we will be highlighting different aspects (in the context of diversified industries and all) of ESG in relation to size of board, Gender, board independence and many more including our main title and some of the cases of different countries for example, China, USA Kenya etc. as per separate sections.

2.2 Different Board Diversity Variables

Beyond experience and educational background, there are a number of other factors that overlap with corporate governance and ESG (Environmental, Social, and Governance). Crucial roles are played by elements including executive remuneration structures, stakeholder engagement, transparency in reporting, diversity on boards, and ethical supply chain management. There is a positive correlation between board diversity (including gender diversity) and ESG performance. Companies with diverse boards tend to perform better on ESG metrics, which can have a positive impact on financial performance. Overall, the evidence points to the potential benefits for both ESG performance and financial performance of companies from diverse boards, good governance practices, and the incorporation of ESG considerations into board decision-making processes. (Friede et al., 2015, 210-233) Besides that if we explain about the director interlocking and for especially environmental performance, like under certain circumstances, such as when the company is affiliated with a larger parent company and in instances of both low and high interlock diversity, director interlocks have a favorable effect on a firm's environmental performance. Under these circumstances, director interlocks improve environmental performance by influencing the strategic choices made by the organizations they are associated with. Finding novel and creative ways to improve environmental performance also benefits greatly from the varied knowledge provision and numerous networks that stakeholders enjoy as a result of director interlocks. (Mandojana & Aragon-Correa, 2015, 499-517) Additionally, decision-making processes are influenced by the gender and racial diversity of the board. Sustainable targets linked to executive compensation encourage ethical business behavior. And even throughout operations, social and environmental responsibility is guaranteed via ethical supply chain management. By adding these factors, corporate governance frameworks are strengthened and companies are better positioned to succeed long-term and have a positive social impact. According to the meta-analysis conducted, the moderating influence of a nation's commitment to sustainable objectives, CEO duality, board independence, board size, and women's participation on the board are among the important variables that are looked at. Furthermore, it was shown that whereas board independence, board size, and women's representation had favorable relationships with sustainability, CEO duality had negative relationships. Furthermore, in nations with lower levels of commitment to sustainable goals, these connections were more important. (Villegas et al., 2018, 1-22) In order to monitor ESG performance, match financial objectives with social responsibility programs, provide reporting transparency, involve stakeholders, manage risks, and

direct strategic decision-making processes, corporate governance and the board of directors are essential.

The responsibility of BOD in promoting moral and ethical behavior, adherence to rules and regulations, and environmental awareness. It also looks at the idea of a "green" board and how sustainable activities are related to it. By using ideas from the stakeholder paradigm, the review seeks to demonstrate the relationship between BOD features and sustainable performance. Additionally, it is possible to link ESG to aspects such as equity, stock performance, and investment. (Chams & Blandon, 2019, 1067-1081) The growing interest in ESG investing globally and the potential predictive power of corporate governance and ESG factors on stock returns. By considering these factors and incorporating cross-country variations, investors and analysts can make more informed decisions regarding their investment strategies. The study discovered a statistically significant and favorable relationship between the sustainability team, average attendance at board meetings, and board independence and ESG Score. Additionally, the ESG score revealed a low negative link with CEO dualism and a minor negative correlation with board size. (Shahbaz et al., 2020, 1-14) The results indicate a positive correlation between corporate sustainability performance and both gender and nationality diversity, albeit this correlation is not statistically significant. In influencing corporate sustainability outcomes, the study highlights the significance of board diversity, especially with regard to gender and nationality. Based on the results, which highlight the potential advantages of diverse board compositions, it is believed that diversity in organizations can improve corporate sustainability performance. (A. Zaid et al., 2020) Furthermore, board gender diversity also plays a crucial role for sustainability performance and even some studies reveal that businesses with diverse boards typically exhibit higher levels of innovation, improved risk management, and refined decision-making procedures, which in turn result in improved financial performance and a favorable effect on the environment and society. A balanced representation of male and female directors on a company's board of directors has a substantial impact on sustainability performance, as evidenced by the positive effects of gender diversity on ESG scores. The association between gender diversity and ESG performance was also found to be negatively moderated by CEO duality, suggesting that the existence of CEO duality restricts the beneficial influence of female directors on ESG score. Plus, CEO duality negatively moderates the relationship between sustainability performance and a more balanced gender composition of the board of directors. The study also

confirmed the negative influence of CEO power on the relationship between gender diversity and ESG performance, aligning with agency theory. (Romano et al., 2020, 1-16)

According to a study (reviewed 67 scholarly articles published between 1992 and 2020), the relationship between corporate governance and sustainability was found to be crucial, with CSR being viewed as a development of good governance. It was also examined how different director characteristic attributes, including gender, race, expertise, and network, can affect a company's performance in terms of sustainability or CSR. (Bolourian et al., 2021, 1-21) In case we talk about only the technological sector here about the United States of America, the commercial strategy and resource allocation decisions made by technology businesses have a significant impact on national security, the environment, and society at large. These companies are therefore under increased pressure to uphold social responsibility, the environment, and sustainable development. Plus, the fourth industrial revolution has brought about significant changes, and as technology both enriches people and damages the environment, there is now more pressure on digital businesses to uphold higher standards of social responsibility and accountability, and consequently, ESG in general. Additionally, among the social demands made on IT companies are respect for human rights, environmental sustainability, the abolition of employment discrimination, and limiting the environmental impact of their activities. (Okafor et al., 2021, 1-11)

The general and sustainability-related performance raises the ESG performance of the business. Furthermore, the impact of generic governance on the business sustainability performance is more pronounced and consistent. Furthermore, the incorporation of quantitative sustainability into the policies or remuneration plans of executive committee members has a favorable impact on the firm's sustainability performance. Additionally, incorporating quantitative sustainability targets into CEO remuneration plans and the role of independent directors both improve business ESG performance. This study was created using an OLS linear regression model with data from 185 listed companies in the European markets (mixed, non-industry specific). However, this study was not without its limitations: 1) panel data collection was limited to a single year; 2) research was limited to European enterprises; other nations were not included. As a result, this topic can be covered in greater detail in later research. (Minciullo et al., 2022, 1-11)

The many forms of internal corporate governance, such as board independence, diversity, and size as well as the CEO's position and disclosure and transparency procedures, are crucial in determining a company's path toward integrating ESG principles. The purpose of this study was to determine the importance of corporate governance to sustainability practices using 56 sample articles. Furthermore, it is proposed that ESG laws and openness can increase stakeholders' trust in the context of social implications. (Ludwig & Sassen, 2022, 1-11) Increased diversity on the board gives decision-makers the human capital they need to better handle obstacles in the business environment and enhance overall firm performance, including ESG performance and related sub-dimensions. (Shatnawi et al., 2022, 3431-3448)

2.3 Different Countries and Industries

In all sectors and nations, ESG (Environmental, Social, and Governance) and board diversity are essential. Maintaining diversity on the board encourages creativity and adaptability to the market in the tech industry. For instance, in order to improve corporate responsibility and flexibility, US tech behemoths are placing a growing emphasis on diverse board memberships and ESG initiatives. European automakers are setting the standard for incorporating gender diversity and environmental principles into their boards and adhering to local ESG laws. Adopting diverse boards and ESG principles promotes resilience, moral decision-making, and long-term wealth generation across industries and geographies while tackling particular socioeconomic and environmental issues that arise globally. The significance of board composition in driving ESG performance in the banking sector and argues that a firm's sustainability practices and results are significantly influenced by elements such as gender diversity, the number of independent directors on the board, board size, and the existence of a CSR sustainability committee. Additionally, in line with Kanter's critical mass theory, the research indicates that a minimum of three female board members are required to have a favorable effect on banks' ESG performance. (Birindelli et al., 2018,1-20)

The study emphasizes how important ESG elements are in influencing CSR performance and how board composition, CSR efforts, and financial results interact in the hospitality and tourism sector. Additionally, in hospitality and tourism companies, the number of non-executive board members is favorably correlated with environmental, social, governance, and ESG performance.

This demonstrates how important board composition is in guiding ESG programs inside businesses. (Uyar et al., 2022, 1-13) The correlation between board diversity and business success in the lodging industry assumes greater relevance when considered in the context of Environmental, Social, and Governance (ESG) concerns. As stakeholders and investors assess a company's ethical and sustainable business practices, environmental, social, and governance (ESG) factors are becoming more and more significant. Diversity on boards, especially that of gender and age, can help to improve decision-making procedures that consider sustainability programs and environmental issues. A varied board could contribute a range of viewpoints on environmental matters, resulting in more all-encompassing approaches to lessen the lodging industry's negative environmental effects. Furthermore, diversity on the board is a crucial component of sound governance procedures. Businesses in the lodging sector can improve openness, responsibility, and moral decision-making by including a variety of voices and viewpoints at the board level. Better governance frameworks that adhere to ESG principles may result from this. (Song et al., 2020, 1-10)

Plus, we discuss the different institutions in the context of corporate governance with sustainability so that findings could be quite different like Microfinance institutions, Islamic Financial Institutions and many more. Corporate Governance's Impact on Microfinance Organizations Financial Sustainability in Kenya found strong correlations between microfinance institutions' financial sustainability and their corporate governance policies. The benefits of having a diverse board membership, the necessity of having a female CEO, the significance of keeping the CEO and chairman functions separate, and the favorable effects of a moderate board size were among the main conclusions. The suggestions included separating the duties of chairman and CEO, keeping the size of the board moderate, and making sure that the board is diverse. They also included encouraging more women to hold leadership roles. Microfinance institutions in Kenya can improve their financial performance and sustainability by putting these suggestions into practice, which will ultimately help the microfinance industry grow and succeed in the nation. (Chenuos et al., 2014,) On the top of that, sustainability practices have a positive relationship with Islamic Financial Institutions (IFIs), corporate governance mechanisms like the size of the Board of Directors and the Shariah Supervisory Board (SSB), the presence of independent directors, and the incorporation of environmental, social, and profit aspects into the company's mission and vision. In particular, better disclosure of sustainability practices results

from the involvement of more SSB experts and individuals on the Board of Directors, as well as independent directors serving as shareholder representatives. Furthermore, IFIs that incorporate social and environmental elements into their goal and vision typically concentrate more on sustainable practices. But it was also discovered that there is little correlation between the magnitude of SSB and IFIs' sustainability efforts. IFIs from Gulf Council Cooperation (GCC) countries showed a positive relationship with sustainability practices in terms of the size of the Board, the presence of independent directors, and the inclusion of environmental, social, and profit aspects in the company's mission and vision. This suggests that a higher level of Islamic value and culture in these countries leads to better sustainability practices. The cultural setting and the nation of origin have an impact on the relationship between corporate governance and sustainability practices in IFIs, and the governance processes inside IFIs are a major factor in promoting sustainability practices. (Hashima et al., 2015, 36-43)

Furthermore, if we examine the studies or research in the context of countries like Malaysia, China, India and many more, the results would have been different somehow. How sustainability issues are handled within a company can be influenced by the affiliation of board members, including their professional backgrounds and industry experience. Directors with a variety of affiliations outside of the conventional business world can offer new perspectives and methods to address sustainability issues. Directors with backgrounds outside of business might provide the company with fresh insights that encourage creativity and long-term thinking. (Oosthuizen & Lahner, 2016) ESG practices are greatly influenced by the makeup of the board, which includes diversity in terms of gender, age, nationality, ethnicity, and educational background. (Cucari et al., 2018, 250-266) A company's risk management procedures may be improved with the diversity of its board. Boards are better able to recognize and manage possible risks, including ESG risks that may affect the company's long-term viability, when they have a diverse range of perspectives and experiences on their board. (Rafindaa et al., 2018, 793-806) The research study conducted on 38 Malaysian listed firms, explores how characteristics such as gender, age, composition, capabilities, and reputation of board members influence the firms' sustainability practices. Research revealed a positive correlation between firm sustainability practices and board diversity attributes, including age, capabilities, and reputation. However, the sustainability practices of the firm are adversely impacted by the presence of independent and female directors. In shaping and guiding companies toward fulfilling shareholders' goals of profit maximization

while looking out for the interests of other stakeholders, the research also emphasized the significance of board diversity. With board diversity accounting for 97.1 percent of the variation in firm sustainability disclosure, it was determined that board diversity is one of the major factors influencing firm sustainability disclosure. (Ismail & Latiff, 2019, 31-50) Recent improvements in board diversity and ESG in China point to a progressive turn. Businesses are incorporating sustainability into their operations by adopting ESG (environment, social, governance) principles. Boardrooms now emphasize inclusive decision-making, gender equality, and a diversity of viewpoints, which encourages creativity and adaptability in the business world. However, board diversity and company performance are related, but only when ESG practices are followed. The negative interaction effect between board diversity and ESG activity suggests that a higher level of ESG involvement reduces the benefits of board diversity for company performance. (Dong, et al., 2023, 1592-1609) Hence, it has been discovered that board diversity and ESG activities are equivalent in terms of influencing company performance, suggesting that participation in ESG initiatives can make up for a board that is less varied in China.

2.4 Latest Research Concepts

Here in this section, we are going to discuss some recent concepts:

Sustainability Reporting: Companies use sustainability reporting to communicate with stakeholders and enhance reputation. In order to comply with environmental, social, and governance (ESG) standards, companies now have to report on sustainability. It also sheds light on a company's social and environmental impact, going beyond financial metrics. These reports describe initiatives aimed at lowering carbon emissions, supporting diversity, ensuring moral supply chains, and interacting with nearby communities. Businesses that communicate openly about their sustainability efforts build trust with stakeholders, draw in socially conscious capital, and effect positive change. To ensure consistency and comparability in sustainability reporting across industries and to support informed decision-making for a more sustainable future, standardized frameworks such as the Task Force on Climate-related Financial Disclosures (TCFD) and the Global Reporting Initiative (GRI) are helpful. If we take any board features like independence or any other diversity criteria, so board size, gender diversity both influence the reporting levels where board size does not significantly affect sustainability reporting and gender

diversity on boards has minimal impact on sustainability reporting. (Adeniyi & Fadipe, 2018, 43-50) Moreover, the significance of materiality disclosure in sustainability reporting to satisfy accountability and transparency demands from stakeholders. It draws attention to the suggested framework as a tool for comprehending how board diversity affects materiality disclosure, which is based on resource-based view theory and stakeholder theory. The framework intends to support efficient sustainability reporting procedures and improve corporate social responsibility communication. (Ngu & Amran, 2018, 96-109)

Impact Investing: Finance is allocated to companies, groups, and initiatives through impact investing with the goal of producing both financial returns and beneficial social or environmental effects. Impact investing assesses businesses according to their dedication to sustainability, social responsibility, and ethical practices, in contrast to traditional investment methods that are mostly focused on profit. It includes a range of industries, including healthcare, education, and affordable and renewable energy. As they align profit with purpose to bring about significant change, impact investors aim to address urgent global challenges in addition to achieving competitive financial results. The significance of novel investment strategies, such as impact investing, in promoting socio economic development. Impact investing seeks to lower poverty, improve quality of life, address social and environmental issues, encourage corporate responsibility, and ease social tensions. Hence, it is recommended that impact investing give priority to addressing gender inequality in the workplace, maintaining employment, and healthcare. (Dvoryadkina et al., 2023)

Supply Chain Transparency: The act of freely disclosing details regarding the manufacture, sourcing, and delivery of goods is referred to as supply chain transparency. It entails sharing information about manufacturers, labor laws, suppliers, and environmental effects. Through increased transparency, companies can improve consumer confidence and decision-making by strengthening trust, accountability, and sustainability across their supply chains. There is a substantial moderating effect of supply chain transparency on the influence of social capital on supply chain performance. A corporation can clearly grasp the farmers' inputs, production materials, and compliance with the company's requirements when there is high supply chain transparency between the two parties. This openness fosters the growth of shared values between the business and the farmer by revealing information about the production practices of farmers. It

also makes reciprocity's effect on income growth stronger. Greater income gains result from a stronger emphasis on reciprocity in supply chains as they become more transparent. Improved information sharing also fosters mutual trust and increases the effectiveness of communication, both of which have an impact on financial results. However, depending on the viewpoint, the moderating impact of supply chain transparency may vary, having different effects on reciprocity and communication from the perspective of the firm and the farmers. (Liu et al., 2023) Prerequisites for improving supply chain transparency include supplier leadership, engagement, and commitment. Moreover, in order to maintain credibility and safeguard their reputation, brands first began sharing details about their supply chain operations. Nevertheless, they changed to a proactive, ethically motivated strategy that resulted in more information about their supply chains being disclosed. On the road to transparency, issues pertaining to supply chain complexity must be resolved through stronger supply chain visibility and collaborations. Furthermore, building cooperative relationships with suppliers is a good starting point for obtaining supply chain transparency. Through knowledge sharing and raising awareness, NGOs are essential to improving transparency. (Brun et al., 2020)

ESG Integration in Investment Strategies: When making investment decisions, environmental, social, and governance factors are taken into account in addition to financial metrics as part of ESG integration in investment strategies. Investors seek to find opportunities that support corporate responsibility, reduce risks related to social and environmental issues, and align with sustainability goals by integrating ESG criteria. This strategy aims to create long-term value while promoting a more just and sustainable global community. The performance of investors is closely associated with Environmental, Social, and Governance (ESG) factors. This is because investors are increasingly taking ESG factors into account when making investment decisions. The relationship between ESG and investor performance is as follows, along with the empirical data demonstrating its beneficial effects on risk management and financial performance: a) ESG Integration and Financial Performance: Strong ESG performance is positively correlated with financial performance, according to a number of studies. Over time, financial performance of companies with strong ESG practices typically exceeds that of their peers. Plus, owing to investors' perceptions that they are less risky and more sustainable, companies with high ESG ratings frequently enjoy lower cost of capital. Lower financing costs and increased profitability may result from this. Additionally, Companies may generate long-term

value for stakeholders and shareholders by incorporating ESG factors into their business plans. Responsibly managed governance and sustainable practices support resilient and sustainable growth. b) Risk Management and ESG: Supply chain, operational, regulatory, reputational, and other risks are just a few of the hazards that ESG factors are essential in identifying and reducing. Businesses with a strong emphasis on environmental, social, and governance (ESG) issues are more adept at-risk management. In addition to this, strong environmental, social, and governance (ESG) practices make a company more resilient to external shocks and crises. Proactive risk management and environmentally friendly company procedures are the sources of this adaptation. Companies can maintain compliance with changing regulatory requirements by adhering to ESG standards and regulations. Companies can steer clear of possible fines, legal problems, and reputational harm by proactively addressing ESG risks. (Ni, 2023, 210-214)

Circular Economy: Utilizing resources for as long as possible is the goal of the circular economy, an economic system designed to reduce waste and promote sustainability. Ensuring product durability, reuse, and recycling are key components of this process. Additionally, closed-loop production systems that involve continuous material regeneration are produced. A circular approach can help businesses reduce their environmental impact and stimulate economic growth in place of the linear "take-make-dispose" model. The perceived benefits of implementing circular economy principles in organizations include:

1. Cost savings
2. Resource conservation
3. Increased stakeholder participation
4. Improved brand reputation
5. Regulatory compliance

These benefits align with the overarching objectives of circular economy procedures and can contribute to the sustainability and efficiency of organizations.

Supply chain constraints, lack of knowledge, and lack of comprehension of circular economy concepts are the main obstacles to implementing circular economy principles in organizations. In order to efficiently transition to a circular economy, these obstacles must be removed as they

impede the adoption and integration of circular economy practices within organizations. (Toni, 2023, 81-89)

The main origins of Circular Economy include the following:

a) Nature's Processes: The idea of "narrowing the loop" in the circular economy is inspired by nature's processes, which primarily employ a limited chemical palette made up of six elements: carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulfur. This idea is based on the effectiveness of natural processes and calls for using fewer resources per product.
b) Current Circular Economy Models: The paper addresses the numerous models of the principles of the Circular Economy that have been created in diverse industries. These models serve as a foundation for comprehending the advantages and restrictions of circular economy tactics in the built environment.
c) UNEP Model: Assigned to value retention loops such as "user to user," "user to business," and "business to business," the UNEP (United Nations Environment Programmed) model maps circular processes or strategies, such as reuse, refurbish, or recycle. ". (Haase et al., 2024, 461-470)

Climate Risk Disclosure: Companies that want to take advantage of climate-related opportunities and dangers must disclose those risks publicly. In particular, the financial effects of things like extreme weather, policy changes, and changes in consumer preferences brought on by climate change will be explained. Businesses can increase openness, help make educated decisions, and show their dedication to solving environmental issues by revealing climate risks. Following environmental shareholder activism, the stock market responds favorably to companies' disclosure of their climate risk, demonstrating that investors value openness regarding a company's exposure to hazards related to climate change. Moreover, clearly and completely disclose climate risk to investors in order to effectively inform them of their vulnerability to climate change. Set precise guidelines for the disclosure of various business risks, including risks associated with climate change, in order to give investors, the information they need. With the assistance of legislators, create uniform reporting guidelines that will allow businesses to effectively convey the risks associated with climate change and their mitigation plans. Furthermore, keep an eye out for instances of climate risk disclosure, such as 10-K and 10-Q filings, and take into account the degree of focus that the company is placing on the issue through

transcripts of its earnings conference calls. Plus, determine which companies are most vulnerable to climate change and offer incentives for disclosure, particularly in situations when companies would not be motivated to divulge information about the hazards associated with climate change. (Vestrelli et al., 2024)

2.5 Conclusion

Firstly, due to the topic's specialized nature, finding previous research work or studies on how board diversity affects ESG performance in the US technology industry was difficult. The limited number of studies available is due to the peculiarity of analyzing board diversity in terms of experience and education among just 23 organizations. Furthermore, direct comparisons are made more difficult by the disparate definitions and criteria of ESG performance. In addition to this, current research can easily become out of date due to the tech sector's continuous evolution and the ESG standards.

However, under this literature review part or chapter we tried to examine and discuss various topics and angles of how diversification in corporate boards impacts the ESG or sustainability performance. Therefore, this study demonstrates a complex and ever-changing relationship between the success of Environmental, Social, and Governance (ESG) initiatives and the makeup of corporate boards. Research continuously emphasizes the value of diverse boards in improving ESG performance, citing a number of reasons such as increased decision-making sensitivity, a wider range of viewpoints, and better sensitivity to stakeholders' interests. Gender diversity, in particular, has been prominently linked to stronger ESG outcomes, with women directors often championing sustainability and ethical governance.

But the effects of having a diverse board go beyond gender. In addition, variety in ethnicity and culture is important because it promotes creativity and makes sure the board reflects the demographics of a globalized market. Plus, in order to achieve sustainable and ethical corporate practices and, eventually, generate long-term value for stakeholders, it is still imperative that board diversity be prioritized as the tech sector continues to change. Companies may implement more extensive and successful ESG policies as a result of this diversification, addressing a greater range of social and environmental challenges. Furthermore, case studies and scholarly research

indicate that boards with a varied range of backgrounds and abilities are better able to handle the intricacies of ESG programs, such as social justice and climate change mitigation.

The literature also points out drawbacks, such as tokenism and the difficulty of incorporating different viewpoints into coherent strategy, in spite of these advantages. Furthermore, there is a need for context-specific initiatives because the influence of board diversity on ESG varies among businesses and geographical areas. Future studies should carry out more in-depth analysis of these subtleties to offer a better understanding of how diverse boards may continuously promote strong ESG performance. For firms, stakeholders, and governments looking to use board diversity as a spark for ethical and sustainable business practices, this knowledge is essential.

Chapter 3: Data and Methodology

3.1 Introduction

This study's data and methodology chapter seeks to establish a solid framework for examining the complex relationship between board diversity and ESG performance in the context of the ever-changing US technology industry. This section explores the methodical technique used to examine the many facets of board diversity and its influence on environmental, social, and governance indicators, acknowledging the crucial interaction between corporate governance frameworks and sustainable practices.

A key component of our investigation is the careful compilation of information from many sources, such as annual reports, financial disclosures, and specialist databases, to create an extensive dataset that includes 23 well-known technological companies (details are given in Appendix 6). This study uses a mixed-methods approach in its methodology, combining qualitative evaluations to explore the subtle factors influencing ESG performance with quantitative studies to measure board diversity in terms of experience and education.

Along with discussing potential confounding variables and methodological limitations, this chapter also clarifies the analytical frameworks, statistical methods, and econometric models used to clarify the causal connections between board diversity and ESG results. This chapter establishes the groundwork for a thorough investigation of the research hypotheses by clarifying the nuances of data collection and analytical techniques. It also advances knowledge among academics regarding corporate governance and sustainable development in the technology industry.

3.2 Data (Analysis and Collection)

Firstly, the data analysis portion conducts a thorough investigation of the connection between board diversity and Environmental, Social, and Governance (ESG) performance in the US technology industry. The study makes use of a dataset that includes 23 well-known American technological companies (details are given in Appendix 6) throughout the course of 2013-2022. Secondly, the main source of data for this research is publicly accessible data, such as annual

reports, corporate governance documents, and sustainability reports of the chosen businesses. To guarantee the authenticity and comprehensiveness of the information, secondary data from reliable databases like Bloomberg, refinitiv Reuters, and MSCI ESG Research LLC is also used. Thirdly, a number of important factors are being looked into, including ESG performance metrics and board diversity as assessed by experience and education of the board members, and other control variables like Research and Development expenses and Size of the firm (in terms of total assets) has been taken. Hence, a variety of metrics, including experience in terms of years, and educational background in terms of degree in tech fields of board members, are used to operationalize board diversity. Carbon emissions, energy efficiency, diversity and inclusion programs, community involvement, and corporate governance standards are some of the established indicators used to evaluate ESG performance. However, we have taken the ESG scores directly from the selected companies.

3.2.1 Data Collection Methods

- ESG performance metrics: Environmental, Social, and Governance (ESG) performance metrics gauge a company's sustainability and ethical impact. Environmental standards evaluate the ecological impact of a company, including resource consumption and carbon emissions. Social metrics, which address diversity, labor practices, and human rights, examine interactions with stakeholders, communities, and employees. Governance metrics assess compliance, ethics, and transparency in leadership. The carbon footprint, staff turnover rates, diversity ratios, diversity on the board, and executive compensation in relation to ESG objectives are important indicators. A company's commitment to ethical business practices and long-term sustainability is communicated to investors, stakeholders, and legislators through these measures, which build trust and promote positive social effect in addition to financial gains. However, we have used the overall ESG ratings out of 100 defined by some prestigious organizations which computes all these matrices like refinitiv database, LSEG data and analytics, and Bloomberg.
- Board diversity metrics: Board diversity measures assess the age, gender, ethnicity, and level of experience of business boards. Quantitative metrics evaluate the proportion of age groups, women, and minorities to total membership on boards. Qualitative metrics examine the individual member's skill sets, experiences, and viewpoints. Expertise

matrices, gender parity indices, and ethnic diversity scores are a few examples of potential metrics. Monitoring succession planning and attrition rates also demonstrate a dedication to diversity. It's also critical to assess how inclusive board meetings and decision-making procedures are. In the end, thorough diversity metrics promote innovative thinking, inclusive governance, and improved decision-making that takes into account the interests of various stakeholders. Here in our study, we use qualitative metrics where we have experience of the board in years and education background in technical streams. And, to get data we have used company reports, some social media platforms like LinkedIn, public reports, documents and many more.

- Company selection criteria: We have selected the best 23 American tech companies in terms of their value in the industry. It includes all the diversified firms whether IT firm, software developing, and even multinational automotive and clean energy companies (like Tesla). Thus, we have not selected any specific subsector in the tech industry in the USA.

3.2.2 Data Preprocessing

The process of preparing raw data for analysis through cleansing, transformation, and organization is known as data preparation. It covers operations such as encoding categorical variables, scaling features, addressing missing values, and eliminating outliers. Proper preprocessing guarantees the quality of the data, minimizes noise, and improves machine learning models' performance by making the data easier to understand and more dependable.

For checking out the accurate and reliable ESG Ratings, it poses several challenges. Thus, the lack of defined techniques, inconsistent data between sources, and restricted coverage for specific businesses or locations can all contribute to the obscuring of trustworthiness. The procedure is further complicated by the dynamic nature of ESG elements and rating agencies' subjective interpretation of the criteria. In our study, we have used the databases of the agencies for example refinitiv, Bloomberg and other sources, which provides the data of ESG ratings and other details so that we also faced many challenges, most specifically the access problem then we got to know that through our university credentials we can access theses databases for the limited time like 24 hours in case of Refinitiv. Moreover, sometimes the ESG ratings were not defined in these

databases too where we have taken 0 (zero) for these particular years as a result some discrepancies can be created in the analysis.

Finding the educational backgrounds and work experiences of board members for a thesis may be difficult due to a lack of publicly available information, different industry disclosure requirements, and the difficulty of credential verification. Comprehensive analysis may be impeded by a lack of transparency or inconsistent reporting processes. Moreover, efforts to gather comparable and reliable information may be made more difficult by different board structures and foreign rules. Same when we were collecting data in the context of variables for our study, sometimes details of board experience (in years) and education was not available so I used to check out the social media platforms, specifically LinkedIn and even confusion was there because profiles were not updated by the board of directors. Plus, for education backgrounds at times, boards have different types of degrees, so discrepancies and complexities can be found there too. But in the case of two control variables (Research and development expenses R&D, and size of the firm in terms of total assets) which we used in our analysis, it was not that difficult because it could be easily obtained by annual reports of the firms and a few websites providing the direct details of these variables.

Therefore, to avoid all the challenges, outliers and complexities at the time of collection of data, we have checked out the different sources and databases and even different reports so that everything can be authenticated and systemized, and get transparency in the analysis.

3.3 Research Design

Using secondary data from company websites, annual reports, and reliable financial databases, a quantitative research design was employed for this study. The educational backgrounds and work experiences of board members will be examined in order to gauge the diversity of the board. Rating systems will be used to evaluate ESG performance. Regression modeling is one statistical technique that will be used to examine the connection between board diversity with Research and Development expenses (R&D), and size of the firms (total assets) and ESG performance in the USA technology companies that have been chosen.

For a number of reasons, regression modeling is the best method for examining the connection between board diversity and ESG performance in the technology industry. First off, regression analysis makes it possible to compare several independent variables—like the diversity of the board's experience and education—against a single dependent variable, which is ESG performance. This makes it possible to comprehend how various facets of board diversity affect ESG results in a more nuanced way. Regression modeling, secondarily, makes it easier to control variables that could cause confounding, such industry-specific factors or firm size. This guarantees that the association between board diversity and ESG performance is real and unaffected by outside factors. Regression analysis additionally offers quantitative insights into the strength and direction of the association between board diversity and ESG performance, enabling the discovery of important variables and evaluation of their applicability. Regression models are also suitable for handling big datasets, which is why they are a good choice for examining the performance of 23 prominent US technology businesses (details are given in Appendix 6) over time. Regression modeling, in conclusion, provides a strong analytical framework for examining the intricate relationship between board diversity and ESG performance in the technology industry, offering insightful information to investors, corporate executives, and politicians alike.

However, there can be a few limitations of regression modeling or analysis under our study. First of all, a thorough understanding of the intricacy of board dynamics and their influence on ESG results may be difficult. Second, it can be difficult to account for all pertinent variables, including market circumstances and company-specific elements. Regression analysis also overlooks nonlinear or interacting effects since it presumes the linearity and independence of the variables. Finally, the accuracy of the model may be impacted by the availability and quality of the data for factors such as board diversity metrics.

3.4 Variables and Measures

Table given below illustrates about the details of variables (dependent and independent), their notation and measurement:

Variable	Notation	Measure

Environmental, Social & Governance	ESG	Ratings defined by the Refinitiv as per the years
Experience of Board	EXP	Average experience of board members in years
Technical Background of Board	TECH	Average technical background of board members where 0 is non tech and 1 is tech background
Research & Development Expenses	RD	Research & Development expenses in billions of USD
Size of the firm	SIZE	Log value with base 10 of Total Assets in billions of USD

- **ESG Ratings as a Dependent Variable:**

  The dependent variable, which represents the overall sustainability performance of 23 significant technological businesses in the USA (details are given in Appendix 6), is the Environmental, Social, and Governance (ESG) grade. Environmental effect, social responsibility, and governance standards are all measured and combined into an ESG rating. It measures the companies' dedication to environmentally friendly practices and acts as a standard by which to compare how board diversity affects their ESG performance. As we have already mentioned in the data collection part that we have collected the data in relation to the ESG ratings from certain platforms like Refinitiv (these organizations have special criteria to do the in-depth analysis and compute the ratings with base 100), specifically for all the 23 companies and for the 10 (ten) years from 2013 to 2022 where for some time periods we have not the details so we took 0 (zero) in these types of cases. Therefore, no special measurement has been used for ESG ratings.

- **Board experience in years as an independent variable:**

  The variable board experience in a year will calculate the total number of years that directors in the technology sector have served in there, starting from the day of professional career and ending at the present. In order to evaluate its effect on environmental, social, and governance (ESG) performance among 23 well-known technological corporations in the USA (details are given in Appendix 6), this quantitative

indicator will be used as an independent variable. And, here in our research study we have calculated or measured the average experience of board in years.

- **Board Education background as an independent variable:**

  Board members' educational backgrounds and technological domain competence are included in the independent variable, board technical education background. Their technical expertise's effect on the environmental, social, and governance (ESG) performance of twenty-three significant US technology corporations (details are given in Appendix 6) is assessed. Examining the impact of technical expertise on strategic direction and decision-making while tackling ESG issues in the industry is the goal of this variable. And, in our study we have taken as a 1 (one) if the board member is from tech background otherwise 0 (zero) and then computed or measured by the average.

- **Research and Development (R&D) Expenses of the firm as a control variable:**

  An important control variable in this study is research and development (R&D) expenses, which show how much money technology companies are willing to spend on innovation and new product development. The study aims to eliminate any confounding variables and identify the precise impact of board diversity on environmental, social, and governance (ESG) performance by combining R&D expenditure data. A more sophisticated analysis of how board diversity interacts with organizational initiatives to encourage sustainable practices within the US technology industry is made possible by an understanding of the relationship between R&D investment and ESG results, which goes beyond the financial implications. We have taken the R&D expenses as it is in our study into billions, so there is no specific or particular technique that has been used, just took the expenses and converted them into billions.

- **Size of the firm as a control variable:**

  The size of the company, as measured by its total assets, is a key control variable in our research study. Total assets give insight into the company's operating scope and resources, as well as its scale and financial enormity. In order to maintain the validity and accuracy

of the observed impacts of board diversity on ESG performance, the study intends to control for potential confounding influences by including this variable. Taking firm size into consideration aids in separating the impact of board composition from the influence of organizational scale, improving the accuracy and validity of the results in the context of the changing US technology industry. As a measure in our study, we have taken the values of total assets and then change into the log values with base 100 to showcase the size of the firm.

3.5 Statistical Analysis

The statistical foundation of our study is regression analysis, which provides a methodical way to evaluate the connection between board diversity and ESG performance in the US technology industry. Regression models allow for the quantitative analysis of variables like board composition (diversity in education and experience) and ESG measures, revealing the strength and direction of their relationships. Regression analysis makes it possible to isolate the distinct influence of board diversity on ESG results by adjusting for potential confounders like business size and Research and Development expenses (R&D).

Researchers are able to make strong inferences on how board diversity affects environmental, social, and governance aspects of the technology sector because of this methodological technique. In our study, we have used both the regression models i.e. Ordinary Least Squares (OLS) and Multiple regression analysis as per the data and analysis and even for the specific requirements like to check with a particular variable. Where the degree of linear correlations between board diversity measures (experience, education with other control variables i.e. R&D expenses and size of the firm) and ESG scores can be ascertained by Ordinary Least Squares (OLS) regression.

In order to quantify the strength and direction of these links among the 23 large U.S. IT businesses that were chosen, OLS produces coefficient estimates. This gives insightful information about how board composition affects ESG outcomes and using multiple regression, one can simultaneously look at the impact of different diversity criteria (education, experience with other control variables i.e. R&D expenditure and size of the firm) on ESG scores. This

model (multiple regression), which takes into account a number of variables, offers a thorough examination of the ways in which various aspects of board diversity affect ESG outcomes as a whole, improving comprehension in the context of the research.

There can be certain assumptions while using the regression models in our study:

- Linearity: Assumes a linear relationship between variables.
- Independence: Assumes independence of observations.
- Homoscedasticity: Assumes constant variance of errors.
- Normality: Assumes normal distribution of errors.
- No multicollinearity: Assumes no high correlation among predictors.
- No autocorrelation: Assumes no correlation between error terms.
- Adequate sample size: Assumes a sufficiently large sample for reliable estimates.

3.6 Conclusion

To sum up, this chapter has provided a thorough description of the data gathering procedure and methodology used to look into how board diversity affects ESG performance in the US technology industry. The research, which uses a sample of 23 well-known businesses, quantitative analysis to provide light on the complex relationship between board membership and corporate sustainability outcomes.

Chapter 4: Results

4.1 Introduction

An essential starting point for comprehending the empirical results and their consequences is the introduction of the Results chapter in our study, which examines the effect of board diversity on the ESG performance of the technology sector in the USA. This chapter explores the results of a great deal of data collection, analysis, and interpretation from 23 well-known technological businesses. Fundamentally, the chapter aims to clarify the complex relationship that exists between the ESG performance measures and board diversity, taking into account both experience and educational dimensions with other control variables.

The technology industry has a growing impact on the socio-economic landscapes of the world; hence it is more important than ever to examine its corporate governance standards. As a result, the Results chapter becomes crucial for identifying the concrete effects of different board memberships on ESG results and for clarifying subtle patterns and trends within the chosen sample of businesses.

This chapter aims to determine whether there are any relationships, if any, between board diversity profiles and the social responsibility, environmental stewardship, and governance policies of the technology behemoths that are the subject of the research through careful inspection and statistical analysis. Through negotiating the empirical landscape, it seeks to offer perspectives that add to the continuing conversation on corporate governance, sustainability, and inclusive leadership in the modern business environment.

4.2 Statistical Analysis

As we already discussed in chapter 3 of our study, we are hereby using the regression modeling to showcase the relationship between variables where ESG Rating is the dependent one and others are independent which also includes the control variables. So, in our research study, we have analyzed and interpreted the relationship on the basis of four (4) main models and three (3)

sub models, and with other supporting statistical details like correlation, mean, standard error, variance and many more to make them more reliable and authentic.

4.2.1 Descriptive Statistics

Table 1 illustrates the descriptive statistics for both the dependent and independent variables. The descriptive statistics table includes the minimum, maximum, mean, median, mode, standard deviation, standard error, sample variance, kurtosis, skewness, range, sum, count and confidence level. However, here we will be discussing the prominent ones, which means the most crucial and explanatory to our study. Firstly, the mean (average) results are more satisfactory in case of all variables except R&D, where mean value for ESG rating is 49.032 with maximum 93.4, 29.267 is for average experience with maximum 36.889, 0.388 for average tech background with maximum 0.857, 1.642 for R&D with maximum 24.51 (not satisfactory) and 0.769 for size with maximum 2.562. Therefore, the average ESG or sustainability performance is more satisfactory for the period of 2013 -2022 by the standards of score definition. Similarly, for independent variables i.e. average experience, average tech background, the results are satisfactory, with two (2) control variables i.e. R&D and size, result is not satisfactory and satisfactory respectively. Plus, results are changed somehow in case of other average tools like median and mode. Secondly, if we examine the standard error for all the variables, the results are quite good because as our sample size is large like 230 observations so the values are 1.846, 0.325, 0.01, 0.228 and 0.052 for ESG scores, average experience, average tech background, R&D, and size respectively. Moreover, results do not look satisfactory for all the variables (28 for ESG rating, 4.93 for experience, 0.152 for tech, 3.46 for R&D) except in case of size i.e. 0.785. Thirdly, we check the skewness, it is positive in the case of average tech and R&D variables and for all other variables it shows the negative.

Table 1: Summary statistics of ESG Score and explanatory variables.

	ESG Rating	**EXP**	**TECH**	**RD**	**SIZE (Total Assets)**
Mean	49.032	29.267	0.388	1.642	0.769
Standard Error	1.846	0.325	0.01	0.228	0.052
Median	50.455	30.611	0.38	0.521	0.765

Mode	0	30	0.333	0	0.202
Standard Deviation	28	4.93	0.152	3.46	0.785
Sample Variance	783.999	24.304	0.023	11.969	0.617
Kurtosis	-0.814	2.865	0.148	19.075	-0.004
Skewness	-0.369	-1.576	0.366	4.088	-0.041
Range	93.4	27.333	0.79	24.51	3.855
Minimum	0	9.556	0.067	0	-1.292
Maximum	93.4	36.889	0.857	24.51	2.562
Sum	11277.29	6731.409	89.289	377.555	176.952
Count	230	230	230	230	230

This table shows the summary statistics of ESG SCORE and explanatory variables. The number of observations is 230 for all the variables.

4.2.2 Correlation Results

A correlation matrix would examine how the environmental, social, and governance (ESG) performance of 23 significant US technology businesses compares to the diversity of the board with regard to experience and education. If a substantial association is found between a diverse board composition and improved ESG measures, this would provide valuable information about how diversity affects business sustainability practices. Hence, in short, the correlation matrix highlights the pivotal relationships between the main variables of the study.

Table 2 illustrates that there is a positive relationship between ESG ratings/scores and average experience (EXP), Research & Development expenses (RD) and size of the firm (SIZE) but a negative relationship with average tech education (TECH). It means that there is a positive impact of the board's experience, research and development expenses and size of the firm (in terms of assets) on the sustainability performance in the technology sector of the USA. However, it is not (negative relationship with ESG performance) the same in case of tech education background of the board, thus, it implies that ESG performance tends to decline with an increase in tech education on the board. ESG performance often becomes better when the tech backdrop gets smaller.

Table 2: Correlation Matrix

	Y (ESG)	X1 (EXP)	X2 (TECH)	X3 (RD)	X4 (SIZE)
Y (ESG)	1.0000	0.6682	-0.1071	0.4863	0.6697
X1 (EXP)	0.6682	1.0000	0.0550	0.2911	0.5336
X2 (TECH)	-0.0107	0.0550	1.0000	-0.0554	-0.1043
X3 (RD)	0.4863	0.2911	-0.0554	1.0000	0.6447
X4 (SIZE)	0.6697	0.5336	-0.1043	0.6447	1.0000

4.2.3 Regression Analysis with Fixed Effects

Our research uses regression analysis to look at the relationship between board diversity as determined by experience and education and environmental, social, and governance (ESG) performance in the US technology industry. It offers significant insights into how diversity affects ESG activities by attempting to ascertain, via statistical methods, the extent to which variations in the composition of the board impact corporate sustainability outcomes. Additionally, by including fixed effects of time and company into regression analysis, a more nuanced understanding of the relationship between board diversity (experience and education) and environmental, social, and governance (ESG) performance can be obtained. Company-specific and time-invariant characteristics can thus be controlled. By eliminating the possibility of bias, this method increases the accuracy of determining how board membership affects business sustainability outcomes.

- **Regression Model/Equation in Econometrics form:**

$ESG = b_0 + b_1 EXP + b_2 TECH + b_3 RD + b_4 SIZE + U$

where, ESG = Economic, Social and Governance performance of the company.

EXP = Experience of board members (measured in years).

TECH = Technology knowledge of board members.

RD = Research and development expense (control variable) which is measured as expenses incurred on research and development.

SIZE = Firm size (control variable) which is measured as the firm's total assets).

U = Error Term (stochastic error term variables).

b_0 is the intercept term and b_1, b_2, b_3, and b_4 are the coefficients of the respective independent variables.

- **Regression Model/Equation with year and company fixed effects in Econometrics form:**

$ESG = b_0 + b_1 EXP + b_2 TECH + b_3 RD + b_4 SIZE + \alpha + \gamma + U$

where, ESG = Economic, Social and Governance performance of the company.

EXP = Experience of board members (measured in years).

TECH = Technology knowledge of board members.

RD = Research and development expense (control variable) which is measured as expenses incurred on research and development.

SIZE = Firm size (control variable) which is measured as the firm's total assets).

b_0 is the intercept term b_1, b_2, b_3, and b_4 are the coefficients of the respective independent variables.

α = represents the company fixed effects capturing the unobserved company specific characteristics that may affect the ESG performance.

γ = represents the year fixed effects, capturing the time specific factors that may affect the ESG performance.

U = Error Term (stochastic error term variables).

Table 3: Regression Models

	Model 1	Model 2	Model 3	Model 4
Variables	**Coefficients**	**Coefficients (Year FE)**	**Coefficients (Company FE)**	**Coefficients (Combined FE)**
Intercept	-37.159	-27.2296	-41.8501	-4.108
EXP	2.622	2.3908	2.436	1.263
TECH	-5.707	-5.3875	5.0405	4.683
RD	1.106	1.1702	-0.5099	-1.146
SIZE	11.672	10.8623	26.8859	22.458

Multiple R	0.775			
R Square	0.602	0.625	0.851	0.864
Adjusted R Square	0.595	0.62	0.832	0.84
Observations	229	230	230	230
Year Fixed Effect	No	Yes	No	No
Company Fixed Effect	No	No	Yes	No
Combined Fixed Effect	No	No	No	Yes
F	85.04	27.68	44.54	35.35
	P-value	**P-value**	**P-value**	**P-value**
Intercept	0	0	0.003	0.791
EXP	0	0	0	0.05
TECH	0.035	0.046	0.113	0.139
RD	0.014	0.009	0.478	0.122
SIZE	0	0	0	0

Table 3 displays the regression modeling with fixed effects where Model 1 shows the pooled OLS regression analysis, Model 2 shows regression analysis with year fixed effect, Model 3 displays the regression analysis with company fixed effect and Model 4 illustrates the combined fixed effect (time and company) regression analysis.

Regression Model 1 (in Table 3):

Equation: ESG = − 37.159 + 2.622EXP − 5.707TECH + 1.106RD + 11.672SIZE

The intercept of -37.159 indicates that the dependent variable is expected to be -37.159 when all independent variables are zero. The dependent variable increases by 2.622 for every unit increase in experience (EXP). With a negative coefficient of -5.707, technological knowledge (TECH) indicates that the dependent variable declines as TECH grows. The coefficient for research and development (RD) is positive (1.106), suggesting a positive correlation between increased RD investment and an increase in the dependent variable. With the biggest coefficient (11.672), company size (SIZE) appears to have a strong positive influence on the dependent variable. Moreover, every variable is a statistically significant predictor of the dependent variable because all of the p-values connected to the coefficients are extremely low (below 0.05).

A high positive correlation between the independent and dependent variables is indicated by the multiple R (0.775). Approximately 60.2% of the variability in the dependent variable can be explained by the independent variables in the model, according to the R-squared value of 0.602. A somewhat more cautious measure of the model's quality of fit is given by the adjusted R-squared value (0.595), which accounts for the number of predictors in the model. Using 229 observations, there is a sizable dataset available for study using this model. Plus, this model excludes year, company, and combined fixed effects. Overall, the model's high F-value (85.04) suggests that it is statistically significant.

Confidence level of variables, t stat of variables, standard error of variables, sum of squares of regression and residuals, mean squares of residuals and regression and degree of freedom (df), are discussed in Appendix 1.

In result, the association between experience of board, technology background of board, R&D spending, company size, and the dependent variable (ESG) is clarified by using this regression model. Strong statistical significance and sufficient explanatory power are displayed by the model, indicating that it may be used to predict the dependent variable from the given independent factors.

Regression Model 2 (in Table 3):

Equation: ESG = − 27.2296 + 2.3908EXP − 5.3875TECH + 1.17026RD + 10.8623SIZE + α (year fixed effect) + U (error term)

Under the year fixed effect and with all independent variables set to zero, the intercept of -27.2296 represents the estimated value of the dependent variable. A rise in the dependent variable of 2.3908 is associated with every unit increase in experience (EXP). The dependent variable decreases as technological knowledge (TECH) increases, assuming other variables remain constant. This is indicated by TECH's negative coefficient of -5.3875. The dependent variable increases with increasing research and development (RD) investment, as indicated by the positive coefficient (1.1702) when the year fixed effect is taken into account. When the year fixed effect is taken into consideration, the coefficient for company size (SIZE) is 10.8623, which indicates a positive impact on the dependent variable (ESG).

With the year fixed effect included, the R-squared value (0.625) indicates that the independent variables in the model account for around 62.5% of the variability in the dependent variable. The modified R-squared value (0.62) offers a somewhat more cautious estimate of the model's goodness of fit while taking the number of predictors into consideration. And, the model offers a strong dataset for study with 230 observations and year fixed effects included. With the exception of TECH, all coefficients have p-values of 0, signifying their statistical significance at the 0.05 level of significance. With a p-value of 0.046, the coefficient TECH indicates that it is marginally significant but should be regarded cautiously.

When taking into account the year fixed effect, the F-value (27.68) shows that the model is statistically significant, indicating that the independent variables together have a significant impact on the dependent variable.

Confidence level of variables, t stat of variables, standard error of variables, sum of squares of regression and residuals, mean squares of residuals and regression, degree of freedom (df), skewness, Kurtosis, Durbin-Watson, Omnibus, Jarque-Bera tests are discussed in Appendix 2.

It is concluded that understanding the relationship between experience, technical knowledge, R&D expenditure, firm size, and the ESG rating is made easier with the help of this regression model that includes year fixed effects. The technological investment coefficient has a marginally significant p-value, therefore careful interpretation is advised, even if the most of the coefficients are statistically significant. Overall, the model shows a respectable level of explanatory power and has the potential to be helpful in forecasting the dependent variable across various time periods.

Regression Model 3 (in Table 3):

Equation: ESG = − 41.8501 + 2.436EXP + 5.0405TECH - 0.5099RD + 26.8859SIZE + γ (company fixed effect) + U (error term)

With the inclusion of fixed effects for companies, this regression model attempts to predict a dependent variable (ESG) using a number of independent variables (EXP, TECH, RD, and SIZE). The link between each independent variable and the dependent variable, taking into account company-specific effects, is shown by the model's coefficients.

When all independent variables are zero, the intercept of -41.8501 indicates the dependent variable's (ESG) predicted value. It is anticipated that the dependent variable will increase by 2.436 units for each unit increase in EXP. In a similar vein, the dependent variable for TECH is projected to increase by 5.0405 units for each unit increase. The coefficient for Research and Development (RD) is -0.5099. This indicates that a rise in RD is linked to a fall in the dependent variable. As per the SIZE coefficient, an increase of one unit in SIZE is projected to result in a 26.8859 unit increase in the dependent variable.

R Squared at 0.851, it means that the independent variables (EXP, TECH, RD, SIZE) account for about 85.1% of the variance in the dependent variable (ESG). The robustness of the model in capturing the correlations between variables is confirmed by the Adjusted R Square, which is high at 0.832 even after taking into consideration the number of predictors. 230 observations provide the basis of the regression analysis. Companies are included in fixed effects, but not years. The total regression model is statistically significant, as indicated by the F-statistic of 44.54. All of the coefficients, with the exception of RD and TECH, have p-values less than 0.05 when the p-values are examined, indicating that they are statistically significant in explaining the variation in the

dependent variable. This suggests that while RD is not statistically significant at the traditional significance level of 0.05, EXP, and SIZE are significant predictors of the ESG performance.

Confidence level of variables, t stat of variables, standard error of variables, sum of squares of regression and residuals, mean squares of residuals and regression, degree of freedom (df), skewness, Kurtosis, Durbin-Watson, Omnibus, Jarque-Bera tests are discussed in Appendix 3.

Regression Model 4 (in Table 3):

Equation: ESG = − 4.108 + 1.263EXP + 4.683TECH - 1.146RD + 22.458SIZE + α (year fixed effect) + γ (company fixed effect) + U (error term)

This regression model incorporates both companies and year fixed effects (combined) and it uses independent variables i.e. EXP, TECH, RD & SIZE to predict a dependent variable i.e. ESG. The model's coefficients illustrate the relationship between each independent variable and the dependent variable, taking into account the combined fixed effect of company and time.

When there are no independent variables (EXP, SIZE, TECH and RD), the intercept of -4.108 indicates the predicted value of the dependent variable (ESG performance). This means that the dependent variable should rise by 1.263 units for every unit increase in EXP. In the same way, for every unit rise in TECH, there is a predicted increase of 4.683 units in the ESG. On the other hand, the coefficient for Research and Development (RD) is negative (-1.146), indicating that a rise in RD is linked to a fall in the dependent variable. According to the SIZE coefficient, there will be a 22.458-unit rise in the dependent variable for every unit increase in SIZE.

With a R Square value of 0.864, the regression model shows a high degree of explanatory power; almost 86.4% of the variance in the dependent variable is explained by the independent factors. Taking into account the complexity of the model, the Adjusted R Square, which stands at 0.840, supports this and confirms that the model is dependable in capturing the underlying relationships between the variables. There are 230 observations included in this regression analysis. Both companies and year fixed effects are covered. The total statistical significance of the regression model is indicated by the F-statistic of 35.35. Moreover, with the exception of the intercept (0.791),

TECH (0.139), and RD (0.122), all other coefficients have p-values less than 0.05 when examining the p-values. This indicates that, at the traditional significance threshold of 0.05, TECH and RD are not statistically significant, while EXP (0.05), and SIZE (0) are statistically significant predictors of the dependent variable.

Confidence level of variables, t stat of variables, standard error of variables, sum of squares of regression and residuals, mean squares of residuals and regression, degree of freedom (df), skewness, Kurtosis, Durbin-Watson, Omnibus, Jarque-Bera tests are discussed in Appendix 4.

4.2.4 Regression Analysis for the variables separately

Under this part of regression analysis, we are going to analyze the relationship of independent variables with ESG ratings or performance separately, hence EXP and ESG, TECH and ESG, RD and ESG, and SIZE and ESG. So, there are four regression analysis we have made and table given below examines the following:

Table 4: Regression Analysis for EXP/TECH/RD/SIZE with ESG separately.

	EXP	TECH	RD	SIZE
Multiple R	0.666685876	0.0114	0.478	0.67
R square	0.444470058	0.0001	0.229	0.448
Adjusted r square	0.442033523	-0.0043	0.225	0.446
Observations	230	229	229	230
Correlation	0.6682	-0.107	0.486	0.67
Standard error	20.91519106	27.974	24.568	20.84

F	182.418922	0.029	67.342	185.392
	P-value	**P-value**	**P-value**	**P-value**
Intercept	0	0	0	0
Exp/tech/RD/size	0	0.864	0	0
	Coefficients	**Coefficients**	**Coefficients**	**Coefficients**
Intercept	-61.78824262	49.651	42.58	30.662
Exp/tech/RD/size	3.786515492	-2.08	3.906	23.877

- **EXP (independent variable) and ESG (dependent variable):**

Equation: ESG = - 61.788 + 3.786EXP

With a multiple R value of 0.6667, the regression analysis findings show a reasonably strong association between the independent variable (EXP) and the dependent variable (ESG). With an R-squared of 0.4445, the independent variable can account for around 44.45% of the variance in the dependent variable. 0.4420 is the adjusted R-squared value, which takes the number of predictors in the model into consideration. This suggests that even when the number of predictors is taken into account, the model's explanatory power remains strong. The analysis has a relatively large sample size (230 observations), which improves the dependability of the results. The degree of correlation between the EXP and ESG is supported by the correlation coefficient of 0.6682. It suggests that the two variables have a positive linear connection. The average deviation of the data points from the regression line is indicated by the standard error of 20.915. A regression line that better fits the data has a reduced standard error. The total regression model is statistically significant at a high confidence level, according to the F-statistic of 182.42, which is correlated with a significant p-value.

The predicted value of the dependent variable (ESG) when the independent variable (EXP) is zero is represented by the intercept, which is -61.79. It indicates a negative intercept in this case, which

might need more research. The dependent variable (ESG) is predicted to rise by roughly 3.79 units for every unit increase in the independent variable (EXP), assuming that all other variables remain constant. This is indicated by the coefficient for EXP, which is 3.79. With p-values of 0, the intercept and coefficient for EXP are both statistically significant predictors of the dependent variable. Confidence level of variables, t stat of variables, standard error of variables, sum of squares of regression and residuals, mean squares of residuals and regression and degree of freedom (df), are discussed in Appendix 5 (1).

Overall, the results of the regression analysis point to a positive correlation between the two variables and the significant predictor status of EXP of the dependent variable (ESG). To properly comprehend the relationship between EXP and the dependent variable, more research could be required, hence care should be taken while interpreting the results.

- **TECH (independent variable) and ESG (dependent variable):**

Equation: ESG = 45.651 - 2.08TECH

With a multiple R value of 0.0114, the findings of the regression analysis show a weak association between the independent variable (TECH) and the dependent variable (ESG). Just 0.01% of the variance in the dependent variable can be accounted for by changes in the independent variable, according to the R-squared value of 0.0001. The corrected R-squared value is surprisingly negative (-0.0043), indicating that the addition of the independent variable (TECH) may have reduced the explanatory power of the model.

This situation suggests that either the independent variable is not significantly contributing to the explanation of the variance in the dependent variable (ESG), or the model may be overfitting the data. The correlation value is -0.107, suggesting a weak negative linear association between TECH and ESG, even with a comparatively high sample size of 229 observations. The comparatively high standard error of 27.974 indicates a significant degree of variability around the regression line.

With a non-significant p-value and an F-statistic of 0.029, the regression model as a whole is not statistically significant. This shows that the dependent variable is not significantly predicted by the independent variable (TECH). When the independent variable (TECH) is zero, the estimated value of the dependent variable is represented by the intercept, which stands at 49.651. However, TECH

is binary (0,1), therefore it might not be meaningful to evaluate the intercept in this particular situation.

The coefficient for TECH is -2.08, meaning that, assuming TECH is a binary variable, an increase of one unit will cause the dependent variable to fall by 2.08 units while keeping all other variables constant. Confidence level of variables, t stat of variables, standard error of variables, sum of squares of regression and residuals, mean squares of residuals and regression and degree of freedom (df), are discussed in Appendix 5(2). Given their p-values of 0, the TECH intercept and coefficient are both statistically significant. The modest effect size and lack of general model significance, however, make it unclear how useful these results are in real-world scenarios.

In result, the regression analysis raises the possibility that TECH negatively affects the ESG/sustainability performance in a way that is practically insignificant but statistically significant. To comprehend the relationship between TECH and the ESG better, more research into the model's fit and variable selection is necessary.

- **RD (independent variable) and ESG (dependent variable):**

Equation: ESG = 42.58 + 3.906RD

A multiple R value of 0.478 indicates a moderate association between the independent variable (RD) and the dependent variable (ESG), according to the results of the regression analysis. Approximately 22.9% of the variance in the dependent variable (ESG) can be explained by changes in the independent variable, RD, according to the R-squared value of 0.229. The corrected R-squared value, which takes the model's predictor count into account, is 0.225. According to this, even after accounting for the number of predictors, the model's explanatory power is still strong. The analysis has a relatively large sample size (229 observations), which improves the dependability of the results. The somewhat favorable linear link between the independent (RD) and dependent variables (ESG) is further supported by the correlation coefficient of 0.486. Data point divergence from the regression line on average is represented by the standard error of 24.568. A regression line that fits the data more closely is shown by a reduced standard error.

With a substantial p-value of 67.342, the F-statistic suggests that the regression model as a whole is statistically significant with a high degree of confidence.

When the independent variable RD is zero, the estimated value of the dependent variable ESG is represented by the intercept of 42.58. It indicates a positive intercept in this situation, which can call for more investigation. With all other variables held constant, the dependent variable is predicted to rise by roughly 3.906 units for every unit increase in the independent variable (RD), according to the coefficient of 3.906. Confidence level of variables, t stat of variables, standard error of variables, sum of squares of regression and residuals, mean squares of residuals and regression and degree of freedom (df), are discussed in Appendix 5(3). With p-values of 0, the RD intercept and coefficient are both statistically significant predictors of the dependent variable (ESG).

Overall, the results of the regression analysis point to a positive correlation between the two variables and the significant predictor status of RD for ESG. To completely comprehend the relationship between RD and sustainability performance, more research could be required, hence care should be taken while interpreting the results.

- **SIZE (independent variable) and ESG (dependent variable):**

Equation: ESG = 30.662 + 23.877SIZE

The multiple R value of 0.67 indicates a strong correlation between the independent variable (SIZE) and the dependent variable (ESG), as per the results of the regression study. With an R-squared of 0.448, it can be inferred that variations in the independent variable, SIZE, account for around 44.8% of the variance in the dependent variable, ESG. Adjusted R-squared, which takes the number of predictors in the model into consideration, comes out at 0.446. This implies that even after accounting for the number of predictors, the model's explanatory power is still strong. The analysis has a relatively large sample size (230 observations), which improves the dependability of the results. The significant positive linear link between SIZE of the firm and ESG is further supported by the correlation coefficient of 0.67. The average divergence of the data points from the regression line is shown by the standard error of 20.84. A regression line that fits the data better is shown by a reduced standard error. The whole regression model is statistically significant at a high confidence level, as indicated by the F-statistic of 185.392 that is correlated with a significant p-value.

The estimated value of the dependent variable i.e. ESG when the independent variable SIZE is zero is represented by the intercept, which is 30.662. This indicates a positive intercept in this situation, which would be worth investigating further. According to the coefficient for the independent variable (SIZE), which is 23.877, the dependent variable should rise by roughly 23.877 units for every unit increase in SIZE, assuming that all other variables remain constant. With p-values of 0, the intercept and coefficient for SIZE are both statistically significant predictors of the dependent variable (ESG). Confidence level of variables, t stat of variables, standard error of variables, sum of squares of regression and residuals, mean squares of residuals and regression and degree of freedom (df), are discussed in Appendix 5(4).

Regression analysis as a whole indicates that SIZE has a strong positive association with ESG and is a substantial predictor of the latter. But care should be taken when interpreting the data, and more research might be required to completely comprehend how SIZE and the ESG (dependent variable) are related.

Chapter 5: Conclusion

In summary, the complex relationship between board diversity—which encompasses education and experience—and the sustainability or environmental, social, and governance (ESG) performance of major US technology businesses was thoroughly investigated in this research study. A more nuanced understanding of how board diversity (years of experience and tech education background) affects ESG outcomes in the rapidly evolving American technology sector was attempted to be provided by including two significant control variables, the company's size in terms of total assets and its expenditure on research and development (RandD), along with time and company fixed effects.

Numerous significant concepts are clarified by the study's findings. Initially, the study demonstrated a robust positive association between board diversity (experience and technical education) and ESG performance, implying that companies with more diverse boards generally exhibit higher ESG metrics. The significance of fostering diversity in corporate leadership structures for enhancing sustainability practices is underscored by this. The inclusion of control variables like firm size and RandD expenditure also allowed for a more thorough analysis of the relationship between board diversity and ESG performance by accounting for any confounding variables that might have an impact on the results discovered. According to the research, while having a diverse board is important, other organizational characteristics and operational factors seem to have a bigger impact on ESG outcomes in the US IT sector.

Furthermore, by introducing time and company fixed effects, the analysis was able to capture longitudinal trends and variations specific to each company. This made it possible to have a complete grasp of the ways that board diversity influences ESG performance over time and in various organizations. As this dynamic viewpoint highlights, corporate sustainability initiatives must be constantly reviewed and modified in order to effectively handle new opportunities and challenges.

Both industry and academia at large will be greatly impacted by the study's conclusions. The study's empirical evidence supports the idea that diverse boards are essential to achieving favorable ESG outcomes and adds to the expanding corpus of scholarly research on corporate

governance, diversity, and sustainability. Furthermore, by using regression modeling, control variables, and fixed effects, this study's methodology offers a strong platform for future investigations into related relationships in various settings or sectors of the economy.
From an operational standpoint, the results provide insightful information to business executives, legislators, and other interested parties who are engaged in board composition and sustainability strategy decision-making processes. Organizations may encourage greater inclusivity, innovation, and resilience in the face of global challenges by giving diversity initiatives top priority within their governance structures once they acknowledge the beneficial effects of board diversity on ESG performance.

The importance of board diversity as a driver for encouraging positive ESG outcomes in the US technology sector is highlighted in our study's conclusion. Incorporating diversity acceptance and sustainable practices into corporate governance frameworks allows businesses to enhance not only their financial performance but also contribute to the development of a more equitable and resilient society.

Appendix 1

Regression Analysis without any Fixed Effect

SUMMARY OUTPUT

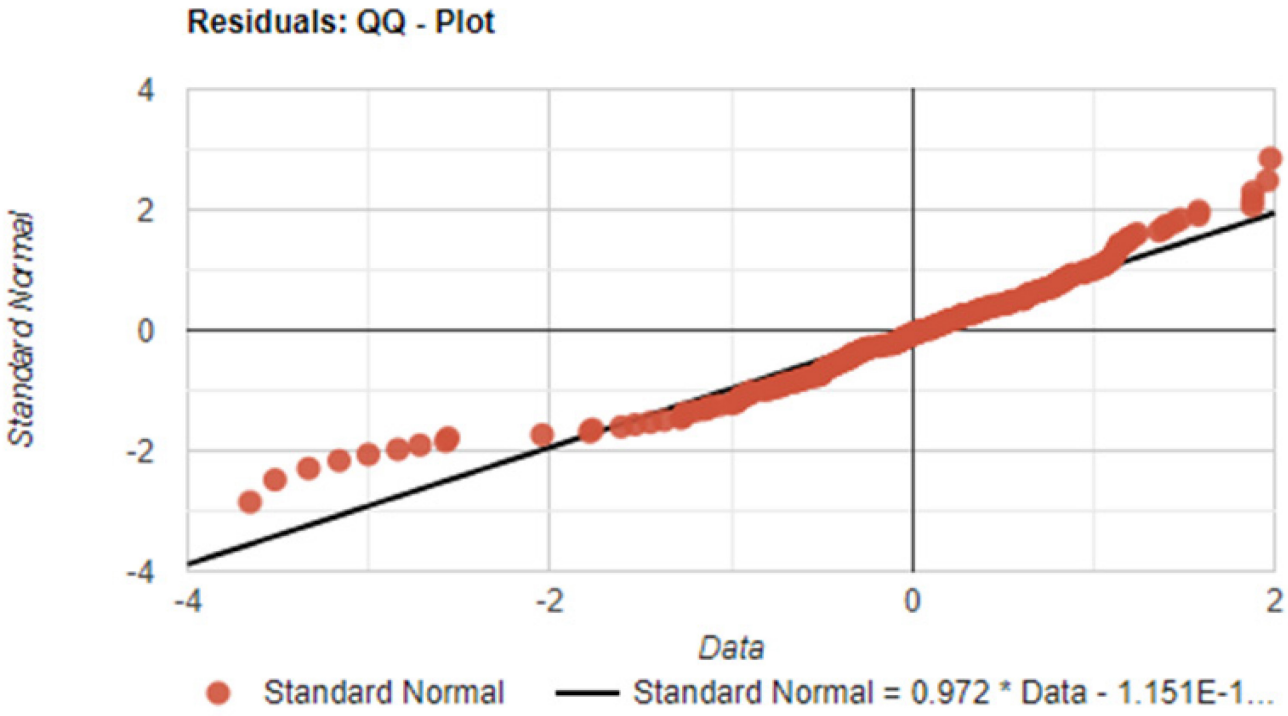
Regression Statistics

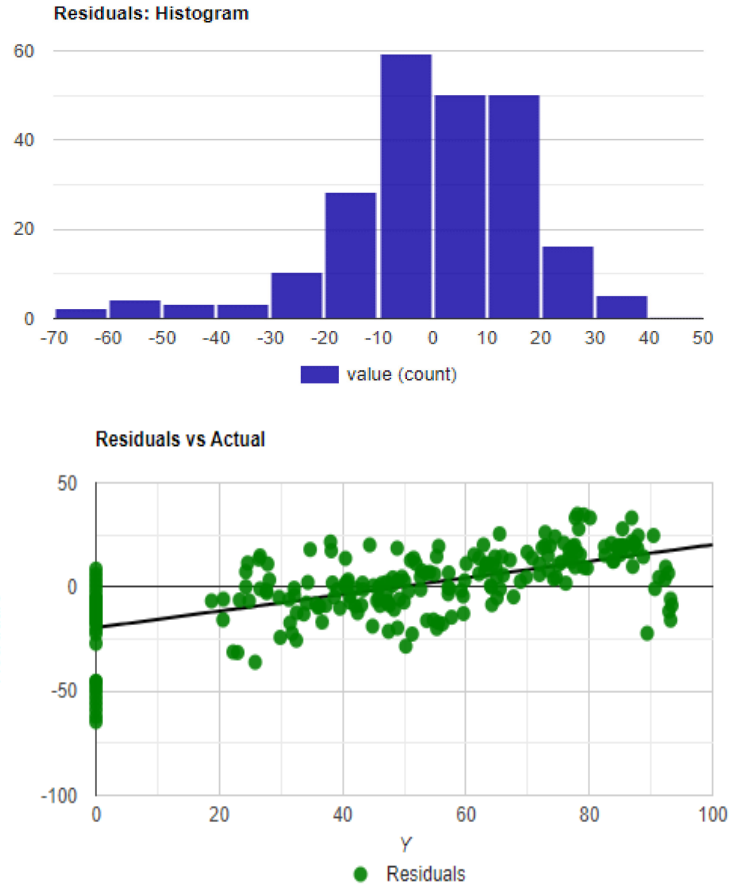
Multiple R	0.775
R Square	0.602
Adjusted R Square	0.595
Observations	229

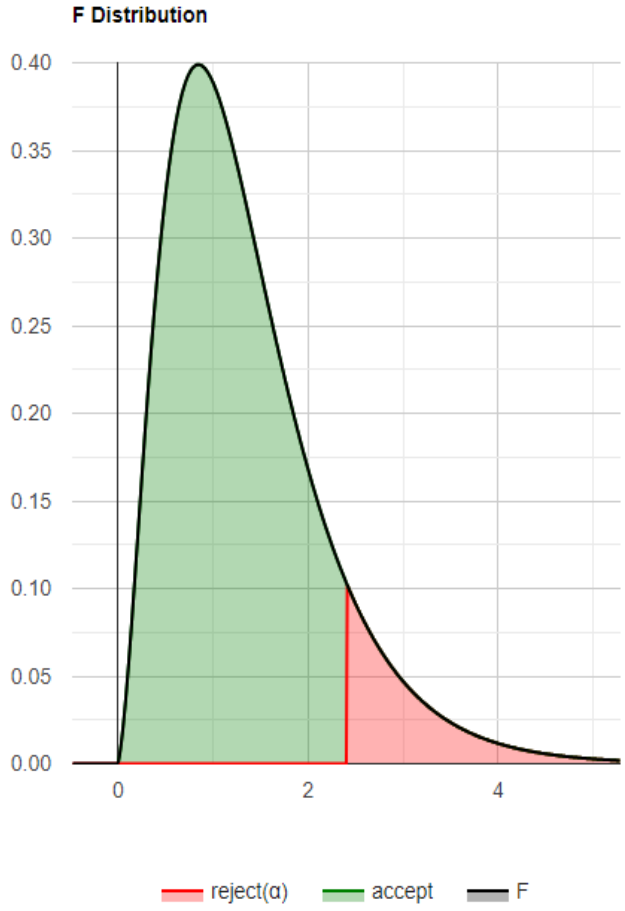
ANOVA

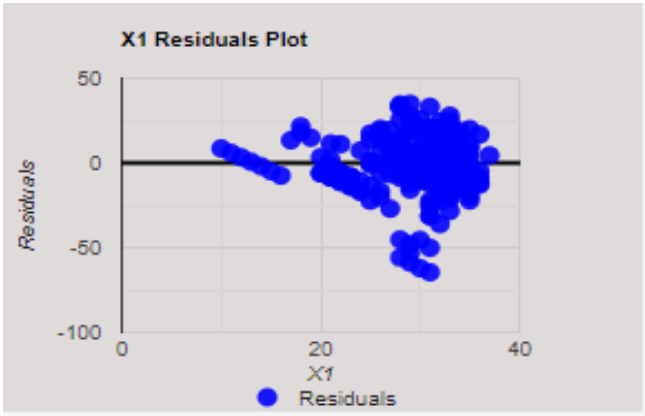
	Df	**SS**	**MS**	**F**	**Significance F**
Regression	4	108059.286	27014.821	85.04	0
Residual	225	71476.509	317.673		
Total	229	179535.794	783.999		

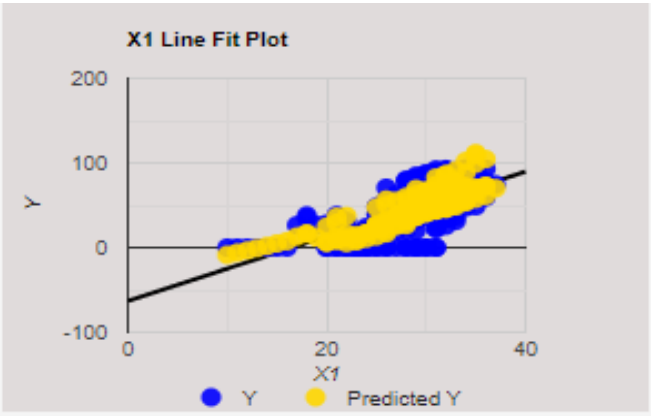
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-37.159	7.802	-4.763	0	-52.532495	-21.784741
EXP	2.622	0.288	9.11	0	2.054531	3.188729
TECH	-5.707	2.687	-2.124	0.035	-11.002207	-0.411019
RD	1.106	0.447	2.475	0.014	0.225164	1.985855
SIZE	11.672	2.25	5.188	0	7.238281	16.104821

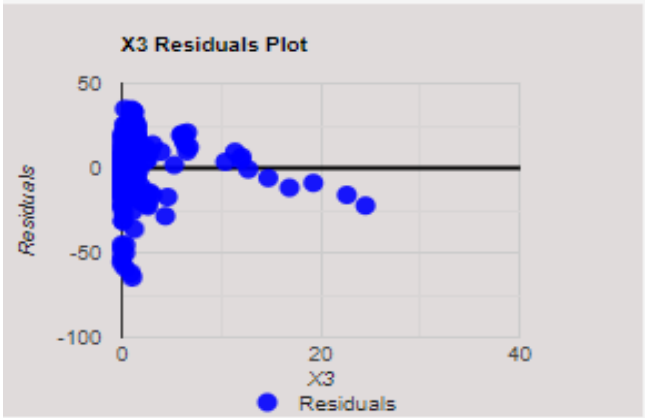

Residuals: QQ - Plot
Standard Normal
4
2
0
-2
-4
-4
-2
0
2
Data
Standard Normal
Standard Normal = 0.972 * Data - 1.151E-1...

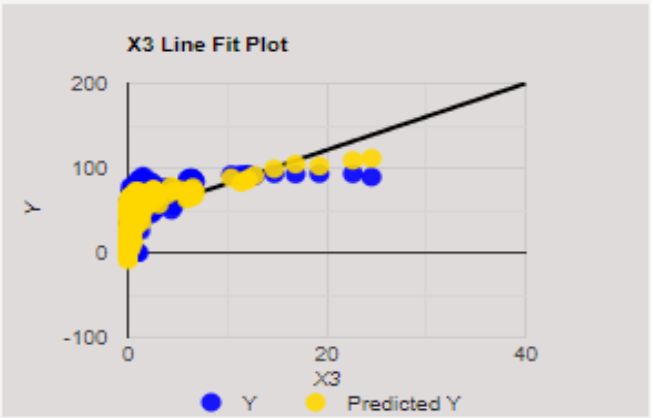

Residuals: Histogram
60
40
20
0
-70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50
value (count)
Residuals vs Actual
50
0
-50
-100
Residuals
0 20 40 60 80 100
Y
Residuals

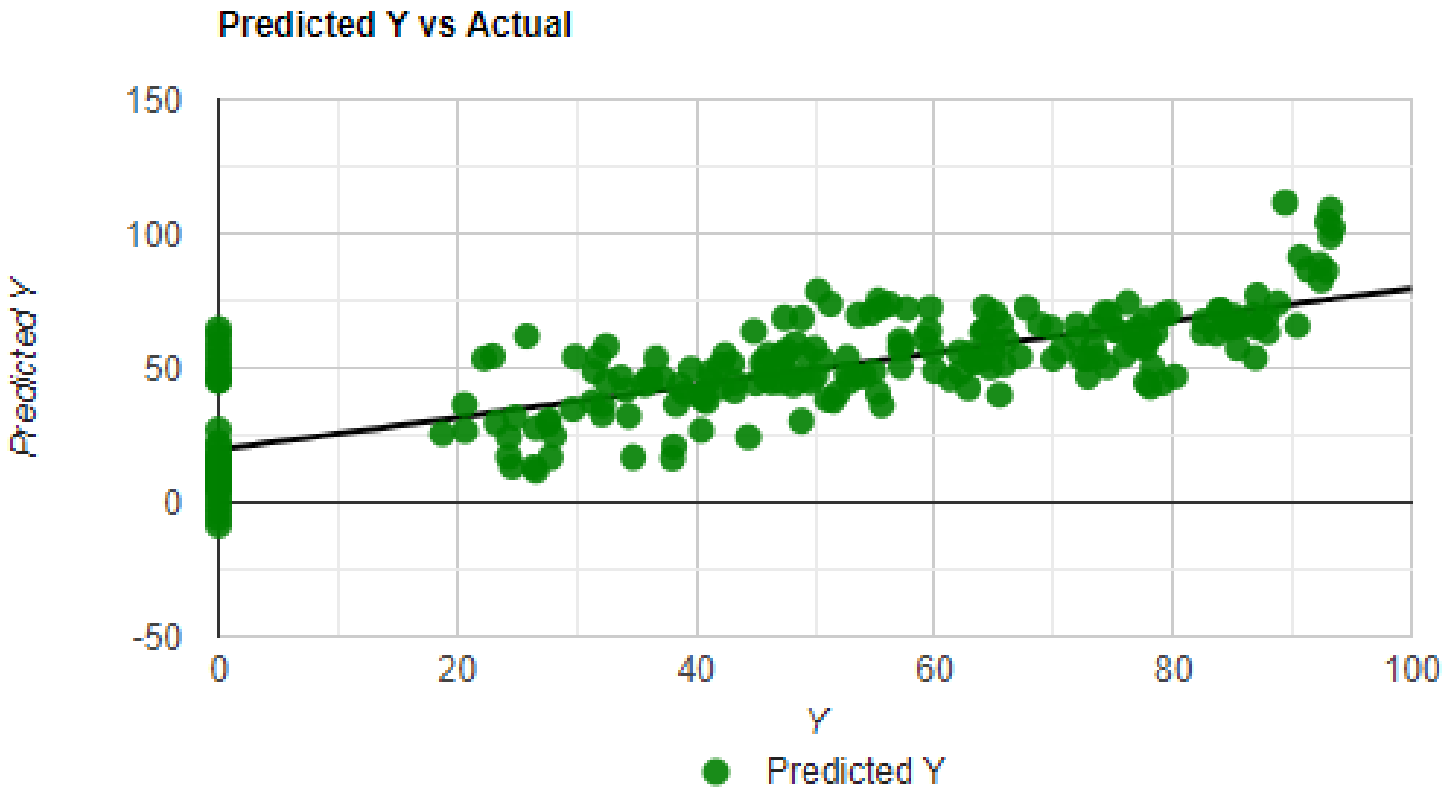

F Distribution
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0 2 4
reject(α)
accept
F


X1 Residuals Plot
50
0
-50
-100
Residuals
0 20 40
X1
Residuals


X1 Line Fit Plot
200
100
0
-100
Y
0 20 40
X1
Y
Predicted Y


X3 Residuals Plot
50
0
-50
-100
Residuals
0 20 40
X3
Residuals


X3 Line Fit Plot
200
100
0
-100
Y
0 20 40
X3
Y
Predicted Y


Predicted Y vs Actual
150
100
50
0
-50
0
20
40
60
80
100
Predicted Y
Y
Predicted Y

Appendix 2

Regression Analysis with Year Fixed Effect

SUMMARY OUTPUT						
Regression Statistics						
R Square	0.625					
Adjusted R Square	0.62					
Observations	230					
ANOVA						
	Df	**SS**	**MS**	**F**	**Significance F**	
Regression	216	67341.4645	8630.333	27.68	0	
Residual	13	179535.7944	311.766			
Total	229	246877.2589	8942.099			
	Coefficients	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**
Intercept	-27.2296	7.316	-3.722	0	-41.65	-12.809
EXP	2.3908	0.294	8.172	0	1.811	2.971

TECH	-5.3875	2.681	-2.01	0.046	-10.671	-0.104
RD	1.1702	0.443	2.641	0.009	0.297	2.044
SIZE	10.8623	2.247	4.833	0	6.433	15.292

Other Tests	**Values**
Omnibus	21.639
Prob. (Omnibus)	0
Skew	-0.646
Kurtosis	4.127
Durbin - Watson	0.566
Jarque-Bera (JB)	28.152
Prob. (JB)	0

Appendix 3

Regression Analysis with Company Fixed Effect

SUMMARY OUTPUT

Regression Statistics

R Square	0.851
Adjusted R Square	0.832
Observations	230

ANOVA

	df	**SS**	**MS**	**F**	**Significance F**
Regression	26	26777.5425	5875.3173	44.54	0
Residual	203	179535.7944	131.909		
Total	229	206313.3369	6007.2263		

	Coefficients	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**
Intercept	-41.8501	13.773	-3.039	0.003	-69.006	-14.694
EXP	2.436	0.566	4.307	0	1.321	3.551

TECH	5.0405	3.169	1.591	0.113	-1.208	11.289
RD	-0.5099	0.717	-0.711	0.478	-1.924	0.905
SIZE	26.8859	4.148	6.481	0	18.707	35.065

Other Tests	**Values**
Omnibus	48.087
Prob. (Omnibus)	0
Skew	-1
Kurtosis	5.6
Durbin – Watson	1.159
Jarque-Bera (JB)	103.062
Prob. (JB)	0

Appendix 4

Regression Analysis with Combined Fixed Effect

(Year and Company)

SUMMARY OUTPUT	
Regression Statistics	
R Square	0.864
Adjusted R Square	0.84
Observations	230

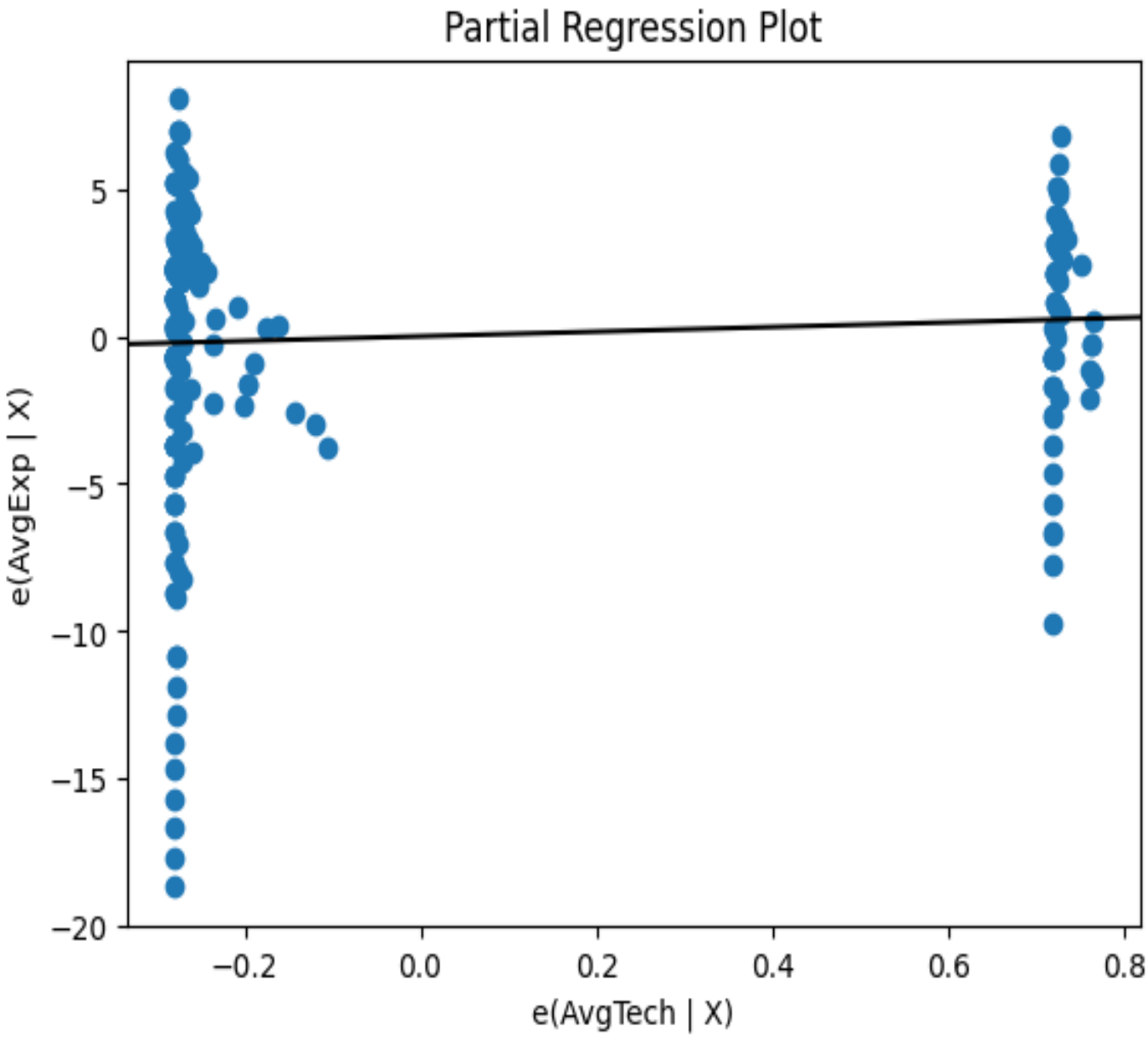
ANOVA

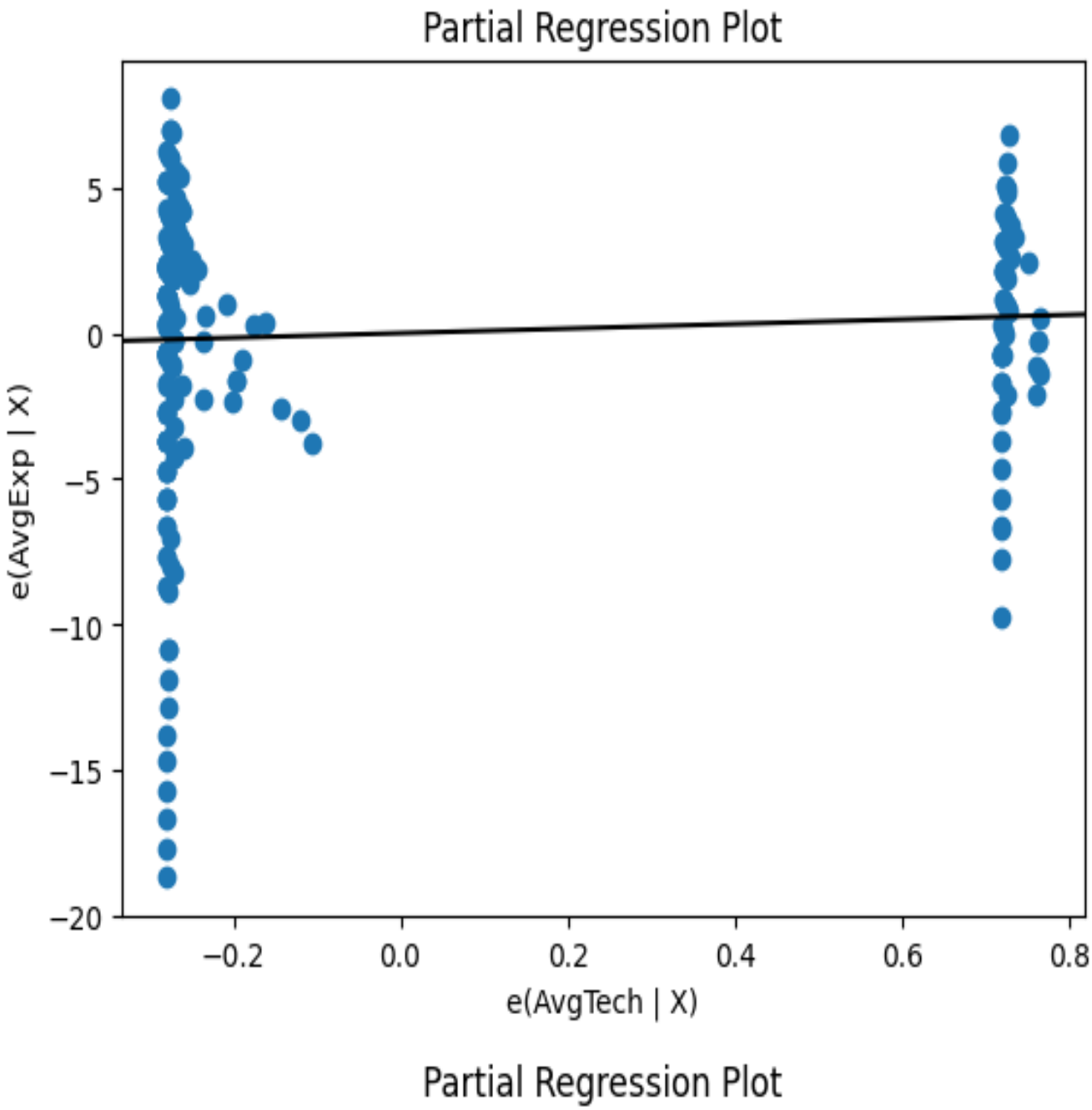
	Df	**SS**	**MS**	**F**	**Significance F**
Regression	194	26777.542	5875.317	35.35	0
Residual	35	179535.794	131.909		
Total	229	206313.336	6007.226		

	Coefficients	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**
Intercept	-4.108	15.517	-0.265	0.791	-34.712	26.496

EXP	1.263	0.641	1.972	0.05	0	2.526
TECH	4.683	3.153	1.485	0.139	-1.536	10.902
RD	-1.146	0.738	-1.552	0.122	-2.603	0.31
SIZE	22.458	4.47	5.024	0	13.642	31.274

Other Tests	**Values**
Omnibus	36.722
Prob (Omnibus)	0
Skew	-0.847
Kurtosis	4.977
Durbin – Watson	1.169
Jarque-Bera (JB)	64.973
Prob (JB)	0


Partial Regression Plot
e(AvgExp | X)
e(AvgTech | X)
5
0
−5
−10
−15
−20
−0.2
0.0
0.2
0.4
0.6
0.8



Partial Regression Plot

Appendix 5

1. Regression Analysis for Experience (EXP) and ESG

SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.667
R Square	0.444
Adjusted R Square	0.442
Observations	230
Correlation	0.6682
Standard Error	20.915

ANOVA

	Df	**SS**	**MS**	**F**	**Significance F**
Regression	1	79798.285	79798.2850	182.419	0
Residual	228	99737.509	437.445		
Total	229	179535.794			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-61.788	8.320	-7.426	0	-78.183	-45.394
EXP	3.787	0.280	13.506	0	3.234	4.339

2. Regression Analysis for TECH and ESG

SUMMARY OUTPUT

Regression Statistics

Multiple R	0.0114
R Square	0.0001
Adjusted R Square	-0.0043
Observations	229
Correlation	-0.107
Standard Error	27.974

ANOVA

	df	SS	MS	F	Significance F
Regression	1	23.006	23.006	0.029	0.864

Residual	227	177634.204	782.530
Total	228	177657.211	

	Coefficients	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**
Intercept	49.651	5.062	9.809	0.000	39.677	59.625
TECH	-2.080	12.131	-0.171	0.864	-25.983	21.823

3. Regression Analysis for RD and ESG

SUMMARY OUTPUT

Regression Statistics

Multiple R	0.478
R Square	0.229
Adjusted R Square	0.225
Observations	229
Correlation	0.486
Standard Error	24.568

ANOVA

	df	SS	MS	F	Significance F
Regression	1	40645.918	40645.918	67.342	0
Residual	227	137011.293	603.574		
Total	228	177657.211			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	42.580	1.794	23.736	0	39.045	46.115
RD	3.906	0.476	8.206	0	2.968	4.844

4. Regression Analysis for SIZE and ESG

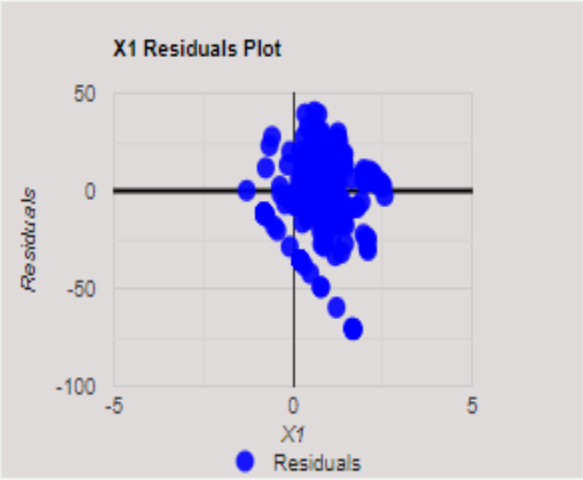
SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.670
R Square	0.448
Adjusted R Square	0.446
Observations	230
Correlation	0.670

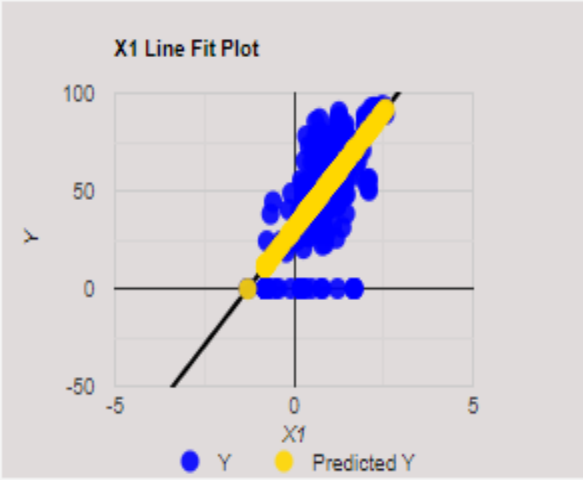
Standard Error	20.840

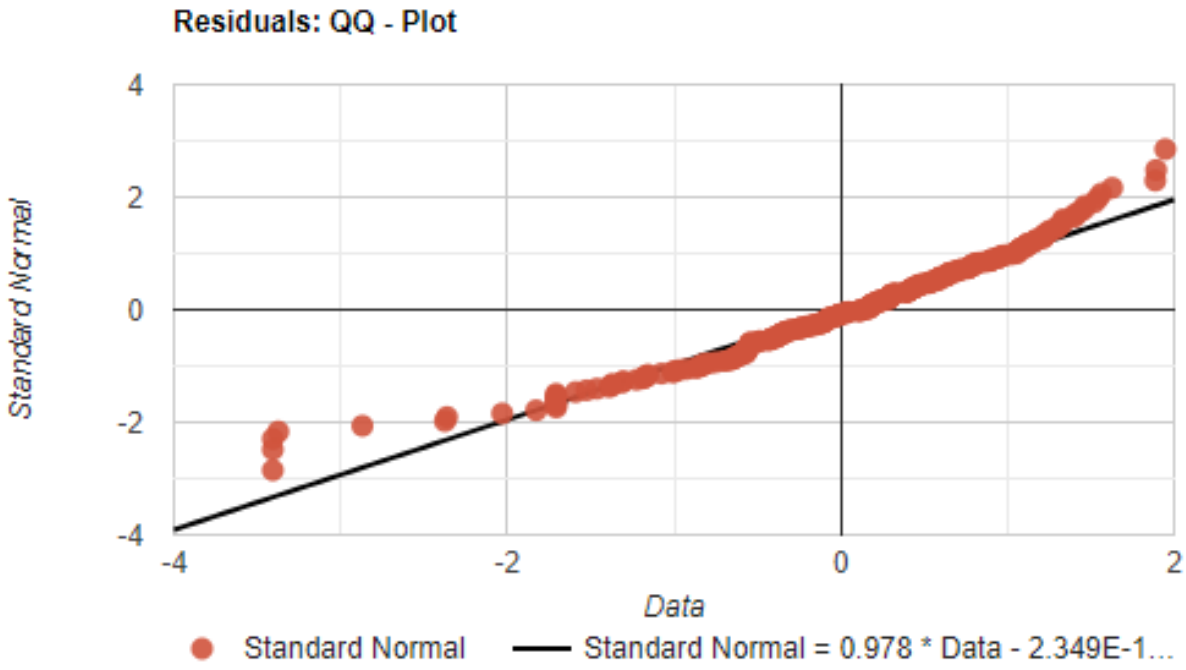
ANOVA

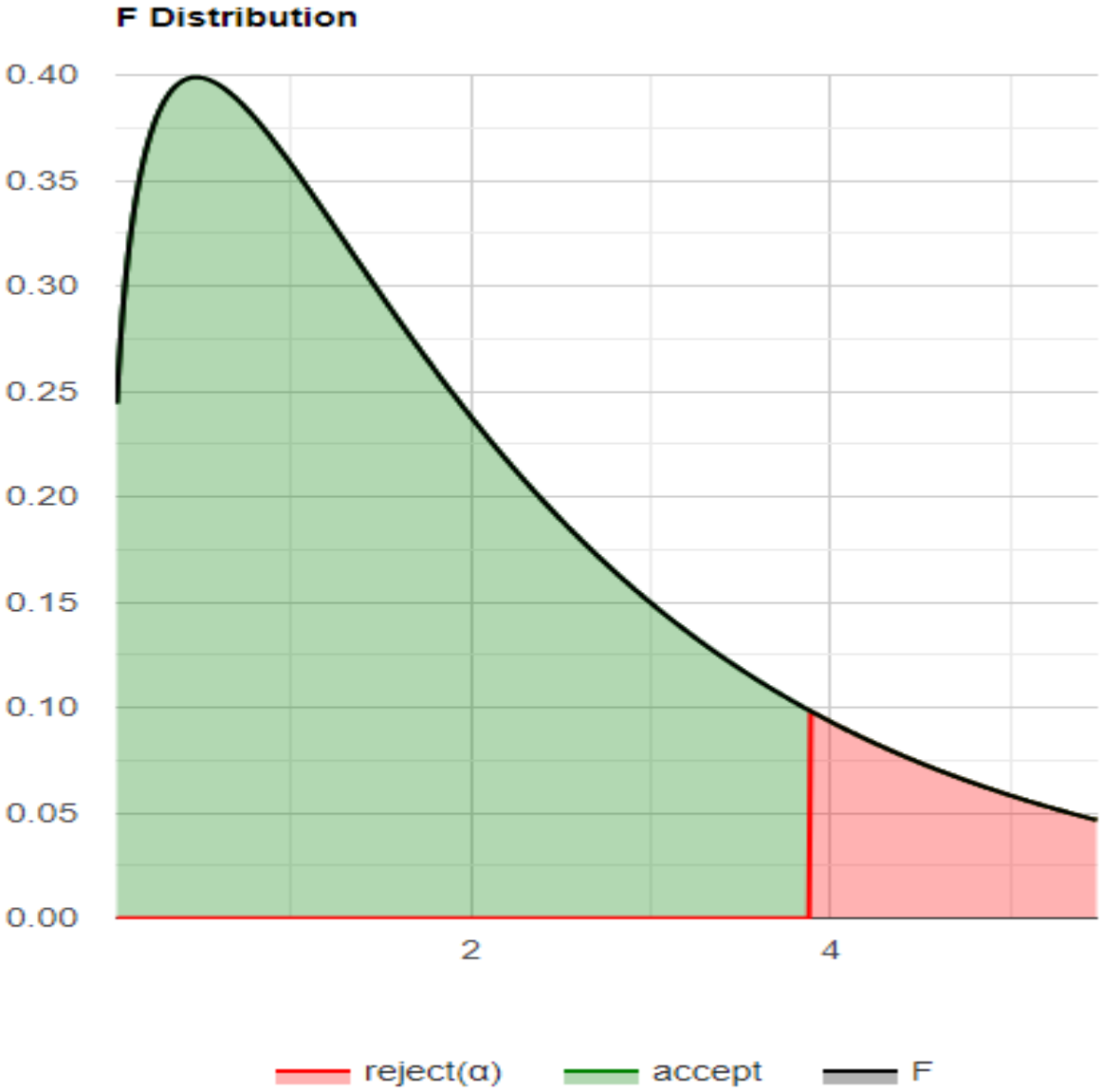
	df	**SS**	**MS**	**F**	**Significance F**
Regression	1	80515.640	80515.640	185.392	0
Residual	228	99020.154	434.299		
Total	229	179535.794			

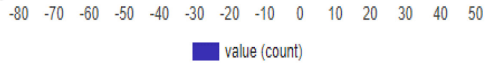
	Coefficients	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**
Intercept	30.662	1.926	15.922	0.000	26.867	34.456
SIZE	23.877	1.754	13.616	0.000	20.422	27.332

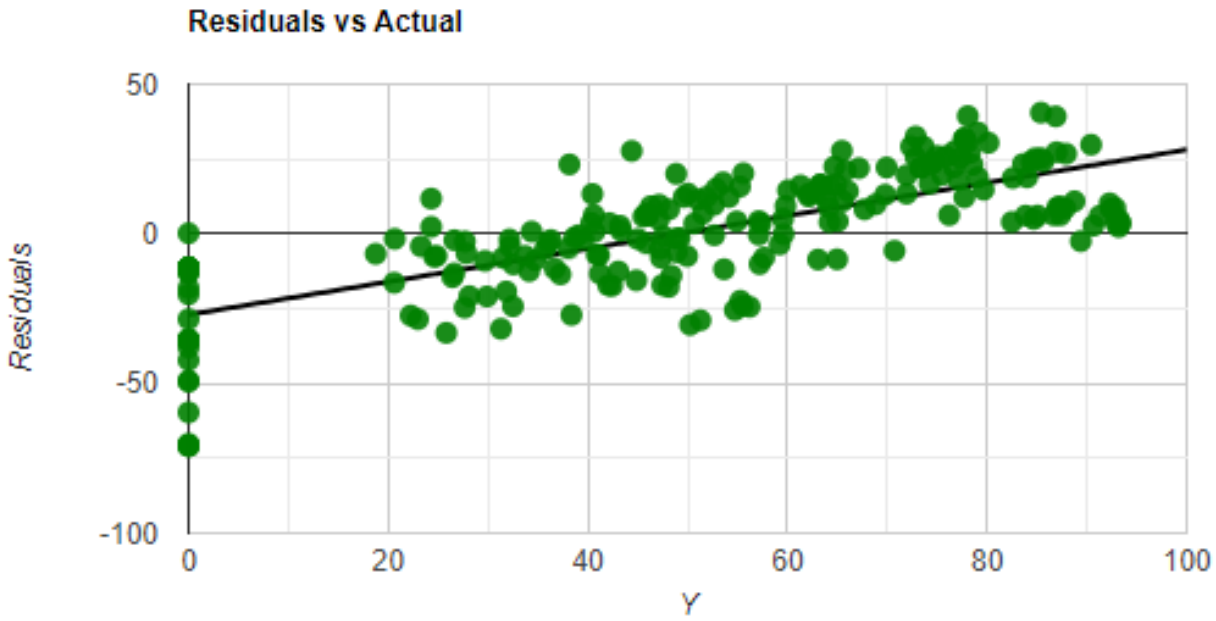

X1 Residuals Plot
50
0
-50
-100
Residuals
-5
0
5
X1
Residuals

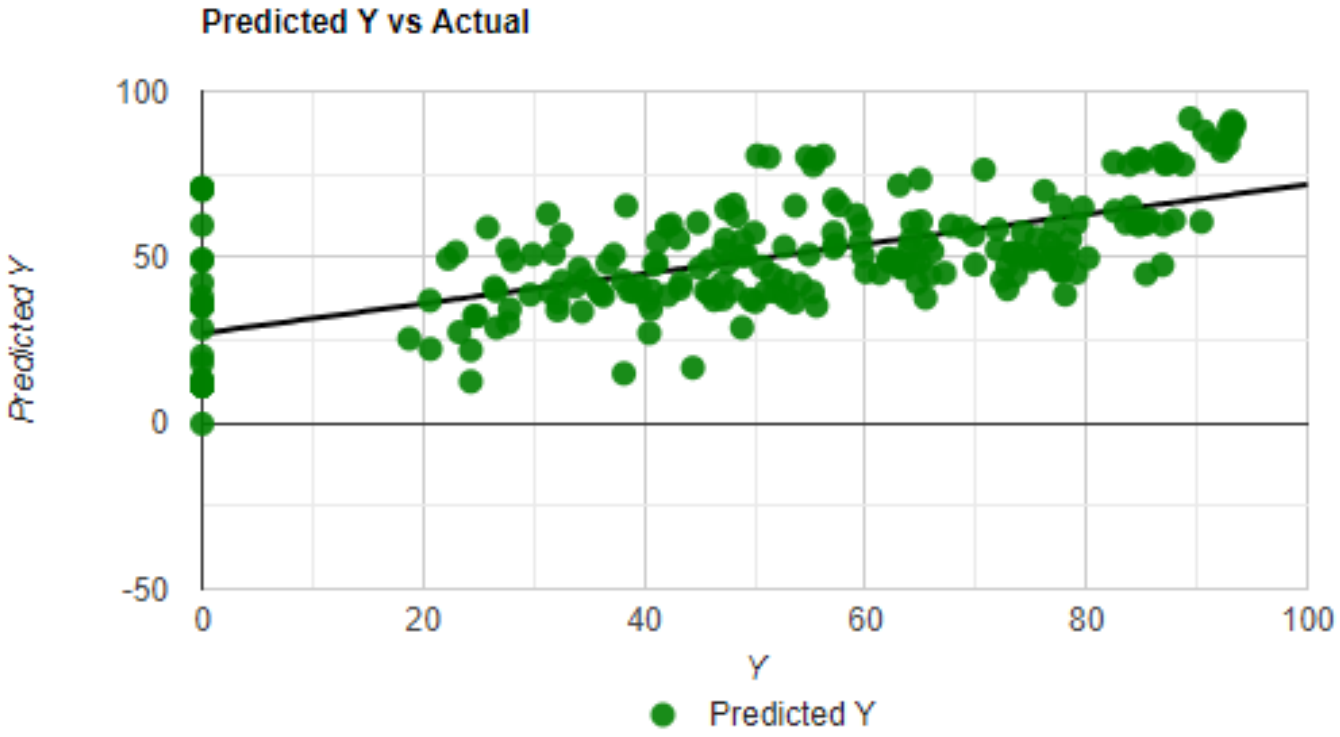

X1 Line Fit Plot
100
50
0
-50
Y
-5
0
5
X1
Y
Predicted Y


Residuals: QQ - Plot
Standard Normal
4
2
0
-2
-4
-4
-2
0
2
Data
Standard Normal
Standard Normal = 0.978 * Data - 2.349E-1...


F Distribution
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
2
4
reject(α)
accept
F


-80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50
value (count)


Residuals vs Actual
50
0
-50
-100
Residuals
0
20
40
60
80
100
Y


Predicted Y vs Actual
100
50
0
-50
Predicted Y
0
20
40
60
80
100
Y
Predicted Y

Appendix 6

Total number of companies selected from tech industry of USA

S. No.	Company Name
1	Microsoft
2	Dell
3	Cisco
4	Tesla
5	NVIDIA Corp
6	VMware Inc
7	Texas Instruments Inc
8	Intuit Inc
9	Cadence Design Systems Inc
10	Fortinet Inc
11	Workday Inc
12	Marvell Technology Group Ltd
13	Arista Networks Inc
14	Amphenol Corp
15	Microchip Technology Inc
16	Palantir Technologies Inc
17	Keysight Technologies Inc
18	MongoDB Inc
19	HubSpot Inc
20	CDW Corp
21	Cloudflare Inc
22	Verisign Inc
23	Zscaler Inc

Appendix 7 - Data

Co. No.	Company Name	Year	ESG Rating	Avg Exp	Avg Tech	R&D (blns USD)	Size (TA)	Log Values (base 10)
1	Microsoft	2013	92.28	34	0	10.41	142.431	2.1536
1	Microsoft	2014	92.39	31	0	11.38	172.384	2.2365
1	Microsoft	2015	92.84	32	0	12.05	174.472	2.2417
1	Microsoft	2016	91.29	32	0	11.99	193.468	2.2866
1	Microsoft	2017	90.65	33	0	12.72	250.312	2.3985
1	Microsoft	2018	93.19	35	0	14.73	258.848	2.4130
1	Microsoft	2019	92.92	36	0	16.87	286.556	2.4572
1	Microsoft	2020	93.4	34	0	19.27	301.311	2.4790
1	Microsoft	2021	93.19	35	0	22.64	333.779	2.5235
1	Microsoft	2022	89.39	35	0	24.51	364.84	2.5621
2	Dell	2013	0	28	0	0.00	48.192	1.6830
2	Dell	2014	0	29	0	0.33	48.192	1.6830
2	Dell	2015	0	30	0	0.92	48.192	1.6830
2	Dell	2016	0	31	0	1.05	45.122	1.6544
2	Dell	2017	51.28	32	0	2.64	118.206	2.0726
2	Dell	2018	50.25	33	0	4.38	124.193	2.0941
2	Dell	2019	55.53	33	1	4.60	111.82	2.0485
2	Dell	2020	54.73	33	1	2.45	118.861	2.0750
2	Dell	2021	56.21	32	0	2.46	123.415	2.0914
2	Dell	2022	55.28	33	0	2.58	92.735	1.9672
3	Cisco Systems	2013	82.48	29	1	5.94	101.191	2.0051
3	Cisco Systems	2014	85.06	29	0	6.29	105.07	2.0215
3	Cisco Systems	2015	84.67	30	1	6.21	113.373	2.0545
3	Cisco Systems	2016	86.67	31	1	6.30	121.652	2.0851
3	Cisco Systems	2017	87.34	30	1	6.06	129.818	2.1133
3	Cisco Systems	2018	87.83	31	1	6.33	108.784	2.0366
3	Cisco Systems	2019	87.32	30	1	6.58	97.793	1.9903
3	Cisco Systems	2020	88.76	31	0	6.35	94.853	1.9771
3	Cisco Systems	2021	87.05	32	0	6.55	97.497	1.9890
3	Cisco Systems	2022	83.86	32	1	6.77	94.002	1.9731
4	Tesla	2013	26.61	19	1	0.23	2.417	0.3833
4	Tesla	2014	28.13	20	0	0.47	5.831	0.7657
4	Tesla	2015	27.66	21	0	0.72	8.068	0.9068
4	Tesla	2016	31.3	22	0	0.83	22.664	1.3553

4	Tesla	2017	38.36	21	0	1.38	28.655	1.4572
4	Tesla	2018	48.11	25	0	1.46	29.74	1.4733
4	Tesla	2019	57.21	26	0	1.34	34.309	1.5354
4	Tesla	2020	63.07	27	0	1.49	52.148	1.7172
4	Tesla	2021	64.97	28	0	2.6	62.131	1.7933
4	Tesla	2022	70.73	26	0	3.1	82.338	1.9156
5	NVIDIA Corp	2013	75.88	31	0	1.15	6.412	0.8070
5	NVIDIA Corp	2014	78.29	29	0	1.34	7.251	0.8604
5	NVIDIA Corp	2015	74.46	29	0	1.36	7.201	0.8574
5	NVIDIA Corp	2016	73.31	32	0	1.33	7.37	0.8675
5	NVIDIA Corp	2017	76.67	33	0	1.46	9.841	0.9930
5	NVIDIA Corp	2018	75.49	33	0	1.80	11.241	1.0508
5	NVIDIA Corp	2019	74.24	35	0	2.38	13.292	1.1236
5	NVIDIA Corp	2020	79.07	34	0	2.83	17.315	1.2384
5	NVIDIA Corp	2021	77.72	32	0	3.92	28.791	1.4593
5	NVIDIA Corp	2022	76.2	33	0	5.27	44.187	1.6453
6	VMware Inc	2013	32.5	31	0	1.08	12.327	1.0909
6	VMware Inc	2014	25.82	32	0	1.24	15.216	1.1823
6	VMware Inc	2015	42.05	30	1	1.30	15.746	1.1972
6	VMware Inc	2016	42.44	29	0	1.50	16.643	1.2212
6	VMware Inc	2017	0	29	0	0.00	16.397	1.2148
6	VMware Inc	2018	48.37	30	0	1.92	21.206	1.3265
6	VMware Inc	2019	44.86	32	0	2.17	17.593	1.2453
6	VMware Inc	2020	47.45	33	0	2.52	26.294	1.4199
6	VMware Inc	2021	57.67	34	0	2.82	29.016	1.4626
6	VMware Inc	2022	53.65	33	0	3.06	28.676	1.4575
7	Texas Instruments Inc	2013	87.92	32	0	1.52	18.938	1.2773
7	Texas Instruments Inc	2014	83.6	32	0	1.36	17.372	1.2398
7	Texas Instruments Inc	2015	84.79	33	0	1.27	16.23	1.2103
7	Texas Instruments Inc	2016	86.97	33	0	1.36	16.431	1.2157
7	Texas Instruments Inc	2017	84.46	33	0	1.51	17.642	1.2465
7	Texas Instruments Inc	2018	85.42	33	0	1.56	17.137	1.2339
7	Texas Instruments Inc	2019	90.42	33	0	1.54	18.018	1.2557
7	Texas Instruments Inc	2020	85.64	33	0	1.53	19.351	1.2867
7	Texas Instruments Inc	2021	82.57	33	0	1.55	24.676	1.3923
7	Texas Instruments Inc	2022	79.66	34	0	1.67	27.207	1.4347
8	Intuit Inc	2013	64.31	31	0	0.65	5.486	0.7393
8	Intuit Inc	2014	69.93	31	0	0.71	5.201	0.7161
8	Intuit Inc	2015	72.84	31	0	0.80	4.968	0.6962

8	Intuit Inc	2016	77.75	28	0	0.88	4.25	0.6284
8	Intuit Inc	2017	79.08	28	0	1.00	4.068	0.6094
8	Intuit Inc	2018	86.88	31	0	1.19	5.134	0.7105
8	Intuit Inc	2019	80.14	28	0	1.23	6.283	0.7982
8	Intuit Inc	2020	78.54	33	0	1.39	10.931	1.0387
8	Intuit Inc	2021	77.12	33	0	1.68	15.516	1.1908
8	Intuit Inc	2022	84.01	34	0	2.35	27.734	1.4430
9	Cadence Design Systems Inc	2013	38.65	31	1	0.53	2.429	0.3854
9	Cadence Design Systems Inc	2014	32.54	31	1	0.60	3.21	0.5065
9	Cadence Design Systems Inc	2015	31.48	33	1	0.64	2.346	0.3703
9	Cadence Design Systems Inc	2016	36.29	32	1	0.74	2.097	0.3216
9	Cadence Design Systems Inc	2017	45.56	32	0	0.80	2.419	0.3836
9	Cadence Design Systems Inc	2018	46.06	33	0	0.89	2.469	0.3925
9	Cadence Design Systems Inc	2019	72.38	34	1	0.94	3.357	0.5260
9	Cadence Design Systems Inc	2020	85.4	33	0	1.03	3.951	0.5967
9	Cadence Design Systems Inc	2021	77.64	35	1	1.13	4.386	0.6421
9	Cadence Design Systems Inc	2022	78	36	1	1.25	5.137	0.7107
10	Fortinet Inc	2013	24.6	21	1	0.10	1.168	0.0674
10	Fortinet Inc	2014	27.84	22	1	0.12	1.425	0.1538
10	Fortinet Inc	2015	40.34	28	0	0.16	1.791	0.2531
10	Fortinet Inc	2016	42.15	29	0	0.18	2.14	0.3304
10	Fortinet Inc	2017	45.86	30	0	0.21	2.258	0.3537
10	Fortinet Inc	2018	47.12	31	0	0.25	3.078	0.4883
10	Fortinet Inc	2019	51.52	28	1	0.28	3.879	0.5887
10	Fortinet Inc	2020	61.32	31	1	0.34	4.045	0.6069
10	Fortinet Inc	2021	62.84	29	1	0.42	5.919	0.7722
10	Fortinet Inc	2022	62.12	31	1	0.51	6.228	0.7943
11	Workday Inc	2013	27.69	28	1	0.10	0.959	-0.0182
11	Workday Inc	2014	29.69	28	1	0.18	2.176	0.3377

11	Workday Inc	2015	39.1	30	1	0.32	2.35	0.3711
11	Workday Inc	2016	33.71	32	1	0.47	2.73	0.4362
11	Workday Inc	2017	52.63	32	1	0.68	3.268	0.5143
11	Workday Inc	2018	50.66	33	1	0.91	4.947	0.6943
11	Workday Inc	2019	47.57	34	1	1.21	5.521	0.7420
11	Workday Inc	2020	49.21	33	1	1.55	6.816	0.8335
11	Workday Inc	2021	52.67	32	1	1.72	8.718	0.9404
11	Workday Inc	2022	48.9	35	0	1.88	10.499	1.0211
12	Marvell Technology Group Ltd	2013	40.9	27	1	1.06	5.262	0.7212
12	Marvell Technology Group Ltd	2014	36.68	33	1	1.15	5.451	0.7365
12	Marvell Technology Group Ltd	2015	45.87	32	1	1.09	5.884	0.7697
12	Marvell Technology Group Ltd	2016	41.13	30	1	0.96	5.442	0.7358
12	Marvell Technology Group Ltd	2017	34.13	29	1	0.81	4.649	0.6674
12	Marvell Technology Group Ltd	2018	45.01	30	1	0.71	4.708	0.6728
12	Marvell Technology Group Ltd	2019	41.21	30	1	0.91	10.017	1.0007
12	Marvell Technology Group Ltd	2020	43.06	31	1	1.08	11.133	1.0466
12	Marvell Technology Group Ltd	2021	47.33	32	1	1.07	10.765	1.0320
12	Marvell Technology Group Ltd	2022	59.22	33	1	1.42	22.109	1.3446
13	Arista Networks Inc	2013	0	26	1	0.10	0.365	-0.4377
13	Arista Networks Inc	2014	0	27	1	0.15	0.811	-0.0910
13	Arista Networks Inc	2015	24.85	28	1	0.21	1.16	0.0645
13	Arista Networks Inc	2016	32.18	29	1	0.27	1.729	0.2378
13	Arista Networks Inc	2017	40.66	30	1	0.35	2.461	0.3911
13	Arista Networks Inc	2018	43.33	31	1	0.44	3.082	0.4888
13	Arista Networks Inc	2019	60.05	32	1	0.46	4.185	0.6217
13	Arista Networks Inc	2020	63.35	33	1	0.49	4.739	0.6757
13	Arista Networks Inc	2021	62.12	34	1	0.59	5.734	0.7585
13	Arista Networks Inc	2022	59.8	34	1	0.73	6.775	0.8309
14	Amphenol Corp	2013	22.25	31	0	0.10	6.168	0.7901

14	Amphenol Corp	2014	29.89	31	0	0.11	6.986	0.8442
14	Amphenol Corp	2015	22.98	31	0	0.12	7.458	0.8726
14	Amphenol Corp	2016	57.13	33	0	0.17	8.499	0.9294
14	Amphenol Corp	2017	59.55	34	0	0.19	10.004	1.0002
14	Amphenol Corp	2018	65.55	35	0	0.22	10.045	1.0019
14	Amphenol Corp	2019	64.13	34	0	0.23	10.816	1.0341
14	Amphenol Corp	2020	69.79	34	0	0.26	12.327	1.0909
14	Amphenol Corp	2021	71.93	34	0	0.32	14.678	1.1667
14	Amphenol Corp	2022	68.83	34	0	0.32	15.326	1.1854
15	Microchip Technology Inc	2013	65.84	31	0	0.26	3.851	0.5856
15	Microchip Technology Inc	2014	67.16	32	0	0.31	4.068	0.6094
15	Microchip Technology Inc	2015	63.25	31	0	0.35	4.781	0.6795
15	Microchip Technology Inc	2016	64.89	32	0	0.37	5.538	0.7434
15	Microchip Technology Inc	2017	66.06	33	0	0.55	7.687	0.8858
15	Microchip Technology Inc	2018	63.97	34	0	0.53	8.257	0.9168
15	Microchip Technology Inc	2019	65.04	35	0	0.83	18.35	1.2636
15	Microchip Technology Inc	2020	64.21	36	0	0.88	17.426	1.2412
15	Microchip Technology Inc	2021	59.61	36	0	0.84	16.479	1.2169
15	Microchip Technology Inc	2022	67.72	36	0	0.99	16.2	1.2095
16	Palantir Technologies Inc	2013	0	10	0	0	1.594	0.2025
16	Palantir Technologies Inc	2014	0	11	0	0	1.594	0.2025
16	Palantir Technologies Inc	2015	0	12	0	0	1.594	0.2025
16	Palantir Technologies Inc	2016	0	13	0	0	1.594	0.2025
16	Palantir Technologies Inc	2017	0	14	0	0	1.594	0.2025

16	Palantir Technologies Inc	2018	0	15	0	0.29	1.594	0.2025
16	Palantir Technologies Inc	2019	0	16	0	0.31	1.594	0.2025
16	Palantir Technologies Inc	2020	26.43	17	0	0.56	2.691	0.4299
16	Palantir Technologies Inc	2021	38.04	18	0	0.39	3.247	0.5115
16	Palantir Technologies Inc	2022	34.74	18	0	0.36	3.461	0.5392
17	Keysight Technologies Inc	2013	0	30	0	0.38	2.028	0.3071
17	Keysight Technologies Inc	2014	0	31	0	0.36	3.05	0.4843
17	Keysight Technologies Inc	2015	64.7	31	0	0.39	3.058	0.4854
17	Keysight Technologies Inc	2016	73.64	32	0	0.43	3.796	0.5793
17	Keysight Technologies Inc	2017	76.77	33	0	0.51	5.933	0.7733
17	Keysight Technologies Inc	2018	74.98	35	0	0.62	5.824	0.7652
17	Keysight Technologies Inc	2019	74.66	37	0	0.69	6.623	0.8211
17	Keysight Technologies Inc	2020	73.36	35	0	0.72	7.218	0.8584
17	Keysight Technologies Inc	2021	77.3	32	0	0.81	7.781	0.8910
17	Keysight Technologies Inc	2022	71.92	33	0	0.84	8.098	0.9084
18	MongoDB Inc	2013	0	20	0	0	0.157	-0.8041
18	MongoDB Inc	2014	0	21	0	0	0.157	-0.8041
18	MongoDB Inc	2015	0	22	0	0	0.157	-0.8041
18	MongoDB Inc	2016	0	23	0	0.04	0.157	-0.8041
18	MongoDB Inc	2017	24.31	24	0	0.05	0.174	-0.7595
18	MongoDB Inc	2018	24.31	25	0	0.06	0.433	-0.3635
18	MongoDB Inc	2019	23.28	26	0	0.09	0.733	-0.1349
18	MongoDB Inc	2020	34.37	28	1	0.15	1.329	0.1235
18	MongoDB Inc	2021	40.61	28	0	0.21	1.429	0.1550

18	MongoDB Inc	2022	48.14	29	0	0.31	2.45	0.3892
19	HubSpot Inc	2013	0	23	0	0.02	0.051	-1.2924
19	HubSpot Inc	2014	0	24	0	0.03	0.175	-0.7570
19	HubSpot Inc	2015	38.16	25	0	0.03	0.22	-0.6576
19	HubSpot Inc	2016	44.4	26	0	0.05	0.26	-0.5850
19	HubSpot Inc	2017	40.46	25	0	0.07	0.712	-0.1475
19	HubSpot Inc	2018	48.85	26	0	0.12	0.834	-0.0788
19	HubSpot Inc	2019	55.58	27	0	0.16	1.569	0.1956
19	HubSpot Inc	2020	65.45	28	0	0.21	1.973	0.2951
19	HubSpot Inc	2021	78.07	29	0	0.30	2.175	0.3375
19	HubSpot Inc	2022	72.85	30	0	0.44	2.545	0.4057
20	CDW Corp	2013	0	28	0	0	5.925	0.7727
20	CDW Corp	2014	0	29	0	0	6.076	0.7836
20	CDW Corp	2015	48.86	28	0	0	6.755	0.8296
20	CDW Corp	2016	54.91	29	0	0	6.948	0.8419
20	CDW Corp	2017	37.26	28	0	0	6.967	0.8430
20	CDW Corp	2018	31.82	31	0	0	7.168	0.8554
20	CDW Corp	2019	47.19	31	0	0	7.999	0.9030
20	CDW Corp	2020	57.32	32	0	0	9.345	0.9706
20	CDW Corp	2021	57.12	31	0	0	13.199	1.1205
20	CDW Corp	2022	49.95	31	0	0	13.132	1.1183
21	Cloudflare Inc	2013	0	20	0	0	0.163	-0.7878
21	Cloudflare Inc	2014	0	21	0	0	0.163	-0.7878
21	Cloudflare Inc	2015	0	22	0	0	0.163	-0.7878
21	Cloudflare Inc	2016	0	23	0	0.024	0.163	-0.7878
21	Cloudflare Inc	2017	0	24	0	0.034	0.163	-0.7878
21	Cloudflare Inc	2018	0	25	0	0.054	0.298	-0.5258
21	Cloudflare Inc	2019	26.63	25	0	0.091	0.831	-0.0804
21	Cloudflare Inc	2020	32.15	26	0	0.127	1.381	0.1402
21	Cloudflare Inc	2021	51.02	27	0	0.189	2.372	0.3751
21	Cloudflare Inc	2022	43.23	28	0	0.298	2.588	0.4130
22	Verisign Inc	2013	35.7	29	0	0.07	2.661	0.4250
22	Verisign Inc	2014	49.61	30	0	0.068	1.901	0.2790
22	Verisign Inc	2015	51.89	28	0	0.064	2.358	0.3725
22	Verisign Inc	2016	55.25	28	0	0.059	2.335	0.3683
22	Verisign Inc	2017	54.13	30	0	0.052	2.941	0.4685
22	Verisign Inc	2018	47.14	30	0	0.058	1.915	0.2822
22	Verisign Inc	2019	46.32	30	0	0.061	1.854	0.2681
22	Verisign Inc	2020	50.02	31	0	0.075	1.767	0.2472

22	Verisign Inc	2021	52.84	30	0	0.081	1.984	0.2975
22	Verisign Inc	2022	53.56	31	0	0.086	1.733	0.2388
23	Zscaler Inc	2013	0	22	1	0	0.154	-0.8125
23	Zscaler Inc	2014	0	23	1	0	0.154	-0.8125
23	Zscaler Inc	2015	0	24	1	0.015	0.154	-0.8125
23	Zscaler Inc	2016	0	25	1	0.021	0.154	-0.8125
23	Zscaler Inc	2017	0	26	1	0.034	0.183	-0.7375
23	Zscaler Inc	2018	20.66	28	1	0.039	0.448	-0.3487
23	Zscaler Inc	2019	18.75	27	1	0.062	0.604	-0.2190
23	Zscaler Inc	2020	20.61	29	1	0.098	1.833	0.2632
23	Zscaler Inc	2021	36.01	30	0	0.175	2.258	0.3537
23	Zscaler Inc	2022	39.56	31	0	0.289	2.833	0.4522

Appendix 8

Research and Development Expenses (R&D)

Company Name	Links
Microsoft	https://www.macrotrends.net/stocks/charts/MSFT/microsoft/research-development-expenses
Dell	https://www.macrotrends.net/stocks/charts/DELL/dell/research-development-expenses
Cisco Systems	https://www.macrotrends.net/stocks/charts/CSCO/cisco/research-development-expenses
Tesla	https://www.macrotrends.net/stocks/charts/TSLA/tesla/research-development-expenses
NVIDIA Corp	https://www.macrotrends.net/stocks/charts/NVDA/nvidia/research-development-expenses
VMware	https://www.macrotrends.net/stocks/delisted/VMW/VMware/research-development-expenses
Texas Instruments Inc	https://www.macrotrends.net/stocks/charts/TXN/texas-instruments/research-development-expenses
Intuit Inc	https://www.macrotrends.net/stocks/charts/INTU/intuit/research-development-expenses
Cadence Design Systems Inc	https://www.macrotrends.net/stocks/charts/CDNS/cadence-design-systems/research-development-expenses
Fortinet Inc	https://www.macrotrends.net/stocks/charts/FTNT/fortinet/research-development-expenses
Workday Inc	https://www.macrotrends.net/stocks/charts/WDAY/workday/research-development-expenses
Marvell Technology Group Ltd	https://www.macrotrends.net/stocks/charts/MRVL/marvell-technology/research-development-expenses
Arista Networks Inc	https://www.macrotrends.net/stocks/charts/ANET/arista-networks/research-development-expenses
Amphenol Corp	https://www.statista.com/statistics/746546/amphenol-research-and-development-expenditure/

Microchip Technology Inc	https://www.macrotrends.net/stocks/charts/MCHP/microchip-technology/research-development-expenses
Palantir Technologies Inc	https://www.macrotrends.net/stocks/charts/PLTR/palantir-technologies/research-development-expenses
Keysight Technologies Inc	https://www.macrotrends.net/stocks/charts/KEYS/keysight-technologies/research-development-expenses
MongoDB Inc	https://www.macrotrends.net/stocks/charts/MDB/mongodb/research-development-expenses
HubSpot Inc	https://www.macrotrends.net/stocks/charts/HUBS/hubspot/research-development-expenses
CDW Corp	https://www.macrotrends.net/stocks/charts/CDW/cdw/financial-statements
Cloudflare Inc	https://www.macrotrends.net/stocks/charts/NET/cloudflare/research-development-expenses
Verisign Inc	https://www.macrotrends.net/stocks/charts/VRSN/verisign/research-development-expenses
Zscaler Inc	https://www.macrotrends.net/stocks/charts/ZS/zscaler/research-development-expenses

Appendix 9

Total Assets of Companies

Company Name	Links
Microsoft	https://www.macrotrends.net/stocks/charts/MSFT/microsoft/total-assets
Dell	https://www.macrotrends.net/stocks/charts/DELL/dell/total-assets
Cisco Systems	https://www.macrotrends.net/stocks/charts/CSCO/cisco/total-assets
Tesla	https://www.macrotrends.net/stocks/charts/TSLA/tesla/total-assets
NVIDIA Corp	https://www.macrotrends.net/stocks/charts/NVDA/nvidia/total-assets
VMware Inc	https://www.macrotrends.net/stocks/delisted/VMW/VMware/total-assets
Texas Instruments Inc	https://www.macrotrends.net/stocks/charts/TXN/texas-instruments/total-assets
Intuit Inc	https://www.macrotrends.net/stocks/charts/INTU/intuit/total-assets
Cadence Design Systems Inc	https://www.macrotrends.net/stocks/charts/CDNS/cadence-design-systems/total-assets
Fortinet Inc	https://www.macrotrends.net/stocks/charts/FTNT/fortinet/total-assets
Workday Inc	https://www.macrotrends.net/stocks/charts/WDAY/workday/total-assets#:~:text=Workday%20total%20assets%20from%202011,a%2028.46%25%20increase%20from%202022.
Marvell Technology Group Ltd	https://www.macrotrends.net/stocks/charts/MRVL/marvell-technology/total-assets
Arista Networks Inc	https://www.macrotrends.net/stocks/charts/ANET/arista-networks/total-assets
Amphenol Corp	https://www.macrotrends.net/stocks/charts/APH/amphenol/total-assets
Microchip Technology Inc	https://www.macrotrends.net/stocks/charts/MCHP/microchip-technology/total-assets#:~:text=Microchip%20Technology%20total%20assets%20for%202023%20were%20%2416.37B%2C%20a,a%205.44%25%20decline%20from%202020.
Palantir Technologies Inc	https://www.macrotrends.net/stocks/charts/PLTR/palantir-technologies/total-assets
Keysight Technologies Inc	https://www.macrotrends.net/stocks/charts/KEYS/keysight-technologies/total-assets

MongoDB Inc	https://www.macrotrends.net/stocks/charts/MDB/mongodb/total-assets
HubSpot Inc	https://www.macrotrends.net/stocks/charts/HUBS/hubspot/total-assets
CDW Corp	https://www.macrotrends.net/stocks/charts/CDW/cdw/total-assets#:~:text=CDW%20Total%20Assets%202011%2D2023%20%7C%20CDW,-Prices&text=CDW%20total%20assets%20for%20the,a%2041.25%25%20increase%20from%202020.
Cloudflare Inc	https://www.macrotrends.net/stocks/charts/NET/cloudflare/total-assets
Verisign Inc	https://www.macrotrends.net/stocks/charts/VRSN/verisign/total-assets
Zscaler Inc	https://www.macrotrends.net/stocks/charts/ZS/zscaler/total-assets

Appendix 10

Python Code

```
import statsmodels.api as sm
import pandas
from patsy import dmatrices
df = data = pd.read_csv("c_data.csv")
vars = ['Company Name', 'Year','AvgExp','AvgTech','RD', 'Size',
'ESGRating']
df = df.dropna()
formula = 'ESGRating ~ AvgExp + DT2013 + DT2014 + DT2015 + DT2016 + DT2017
+ DT2018 +DT2019 + DT2020 + DT2021 + DT2022 + AvgTech + RD + Size + DC1 +
DC2 + DC3 + DC4 + DC5 + DC6 + DC7 + DC8 + DC9 + DC10 + DC11 + DC12 + DC13
+ DC14 + DC15 + DC16 + DC17 + DC18 + DC19 + DC20 + DC21 + DC22 + DC23'
y, X = dmatrices(formula, data=df, return_type='dataframe')
mod = sm.OLS(y, X)
res = mod.fit()
print(res.summary())

mse_regression = res.mse_model

# Get the mean squared error of the residuals (MSE) and sum of squared
errors of the residuals (SSE)
mse_residual = res.mse_resid

# Print the results
print("Mean Squared Error of Regression (MSE):", mse_regression)
print("Mean Squared Error of Residuals (MSE):", mse_residual)

# Get the sum of squared errors of the regression (SSR)
ssr_regression = res.ssr

# Get the sum of squared errors of the residuals (SSE)
sse_residual = res.ssr + res.ess

# Print the results
print("Sum of Squared Errors of Regression (SSR):", ssr_regression)
print("Sum of Squared Errors of Residuals (SSE):", sse_residual)
```

Bibliography

1) A. Zaid, M. A. et al., 2020. Boardroom nationality and gender diversity: Implications for corporate sustainability performance. *Journal of Cleaner Production,* Volume 251.

2) Adeniyi, S. I. & Fadipe, A. O., 2018. Effect of Board Diversity on Sustainability Reporting in Nigeria: A Study of Beverage Manufacturing Firms. *Indonesian Journal of Corporate Social Responsibility and Environmental Management,* 1(1), pp. 43-50.

3) Birindelli, G., Dell'Atti, S., Iannuzzi, A. P. & Savioli, M., 2018. Composition and activity of the board of directors: Impact on ESG performance in the banking system. *Sustainability (Switzerland),* 10(12), pp. 1-20.

4) Bolourian, S., Angus, A. & Alinaghian, L., 2021. The impact of corporate governance on corporate social responsibility at the board-level: A critical assessment. *Journal of Cleaner Production,* pp. 1-21.

5) Brun, A., Karaosman, H. & Barresi, T., 2020. Supply chain collaboration for transparency. *Sustainability (Switzerland),* 12(11).

6) Chams, N. & Blandon, J. G., 2019. Sustainable or not sustainable? The role of the board of directors. *Journal of Cleaner Production,* Volume 226, pp. 1067-1081.

7) Chenuos, N. K., Mohamed, A. & Bitok, S. K., 2014. Effects of Corporate Governance on Micro Finance Institutions Financial Sustainability in Kenya. *European Journal of Business and Management,* 6(30).

8) Cucari, N., De Falco, S. E. & Orlando, B., 2018. Diversity of Board of Directors and Environmental Social Governance: Evidence from Italian Listed Companies. *Corporate Social Responsibility and Environmental Management,* 25(3), pp. 250-266.

9) Dong,, Y., Liang, C. & Wanyin, Z., 2023. Board diversity and firm performance: impact of ESG activities in China. *Economic Research-Ekonomska Istrazivanja,* 36(1), pp. 1592-1609.

10) Dvoryadkina, E., Kvon, G. & Pozdeeva, O., 2023. Impact investing as a tool for achieving the targets for sustainable development of the region. *E3S Web of Conferences.*

11) Friede, G., Busch, T. & Bassen, A., 2015. ESG and financial performance: aggregated evidence from more than 2000 empirical studies. *Journal of Sustainable Finance and Investment,* 5(4), pp. 210-233.

12) Haase, M., Bernegger, H. & Meslec, M., 2024. Models of Circular Economy Principles. pp. 461-470.

13) Hashima, F., Mahadia, N. D. & Amrana, A., 2015. Corporate Governance and Sustainability Practices in Islamic Financial Institutions: The Role of Country of Origin. *Procedia Economics and Finance,* Volume 31, pp. 36-43.

14) Ismail, A. M. & Latiff, I. H. M., 2019. Board diversity and corporate sustainability practices: Evidence on environmental, social and governance (ESG) reporting. *International Journal of Financial Research,* 10(3), pp. 31-50.

15) Khan, M., 2019. Corporate Governance, ESG, and Stock Returns around the World. *Financial Analysts Journal,* 75(4), pp. 103-133.

16) Liu, H., He, G., Ma, R. & Fu, S., 2023. The Impact of Social Capital on Socially Responsible Supply Chain Performance: The Moderating Role of Supply Chain Transparency. *Foods,* 12(19).

17) Ludwig, P. & Sassen, R., 2022. Which internal corporate governance mechanisms drive corporate sustainability?. *Journal of Environmental Management,* 301(113780), pp. 1-11.

18) Mandojana, N. O. d. & Aragon-Correa, J. A., 2015. Boards and Sustainability: The Contingent Influence of Director Interlocks on Corporate Environmental Performance. *Business Strategy and the Environment,* 24(6), pp. 499-517.

19) Minciullo, M., Zaccone, M. C. & Pedrini, M., 2022. The Antecedents of Corporate Sustainability Performance: A Study on Generic and Sustainability-Related Corporate Governance Mechanisms. *Sustainability,* 14(9761), pp. 1-19.

20) Ngu, S. B. & Amran, A., 2018. Board Diversity and Materiality Disclosure in Sustainability Reporting: A Proposed Conceptual Framework. *nternational Academic Journal of Accounting and Financial Management,* 5(2), pp. 96-109.

21) Ni, Z., 2023. Corporate ESG Investment: Factors Affecting the Economic Sustainability. *Advances in Economics, Management and Political Sciences,* 39(1), pp. 210-214.

22) Okafor, A., Adeleye, B. N. & Adusei, M., 2021. Corporate social responsibility and financial performance: Evidence from U.S tech firms. *Journal of Cleaner Production,* pp. 1-11.

23) Oosthuizen, A. & Lahner, S., 2016. Board diversity and sustainability performance. Volume 20.

24) Pislaru, M., Herghiligiu, I. V. & Robu, I. B., 2019. Corporate sustainable performance assessment based on fuzzy logic. *Journal of Cleaner Production,* Volume 223, pp. 998 - 1013.

25) Rafindaa, A. et al., 2018. Board diversity, risk and sustainability of Bank Performance: Evidence from India. *Journal of Security and Sustainability Issues,* 7(4), pp. 793-806.

26) Romano, M., Cirillo, A., Favino, C. & Netti, A., 2020. ESG (Environmental, social and governance) performance and board gender diversity: The moderating role of CEO duality. *Sustainability (Switzerland),* 12(21), pp. 1-16.

27) Shahbaz, M., Karaman, A. S., Kilic, M. & Uyar, A., 2020. Board attributes, CSR engagement, and corporate performance: What is the nexus in the energy sector?. *Energy Policy,* 143(111582), pp. 1-14.

28) Shatnawi, A. et al., 2022. The Impact OF Board Diversity ON Esg: The Moderating Effect OF Legal Origins. *Journal of Positive School Psychology,* 6(6), pp. 3431-3448.

29) Song, H. J., Yoon, Y. N. & Kang, K. H., 2020. The relationship between board diversity and firm performance in the lodging industry: The moderating role of internationalization. *International Journal of Hospitality Management,* Volume 86, pp. 1-10.

30) Toni, M., 2023. Conceptualization Of Circular Economy And Sustainability At The Business Level. Circular Economy And Sustainable Development. *International Journal of Empirical Research Methods,* 1(2), pp. 81-89.

31) ULHOI, J. P., MADSENt, H. & HILDEBRANDT, S., 1996. GREEN NEW WORLD: A CORPORATE ENVIRONMENTAL BUSINESS PERSPECTIVE. *Scandinavian Journal of Management,* 12(3), pp. 243-254.

32) Uyar, A. et al., 2022. The link among board characteristics, corporate social responsibility performance, and financial performance: Evidence from the hospitality and tourism industry. *Tourism Management Perspectives,* 2022(35), pp. 1-13.

33) Vestrelli, R., Colladon, A. F. & Pisello, A. L., 2024. When attention to climate change matters: The impact of climate risk disclosure on firm market value. *Energy Policy,* Volume 185.

34) Villegas, J. G., Calero, L. P., González, J. M. H. & Puig, P. G., 2018. Board attributes and corporate social responsibility disclosure: A meta-analysis. *Sustainability (Switzerland),* December, 10(2018), pp. 1-22.