A Work Project, presented as part of the requirements for the Award of a Master's degree in Management from the Nova School of Business and Economics.

ESG Performance Impact on Firm's Investment Attractiveness: An Empirical Study for the Electric Vehicle Industry

Gonçalo Oliva – 51131

Work project carried out under the supervision of:

Professor António Nogueira Leite

17/05/2023

Abstract

This thesis highlights the ESG impact on firm's performance. It is based on a sample of dataset for the Energy and Technology Sectors in Europe and the Electrical Vehicle Industry on a global scope. A specific industry analysis is based on two parts. Firstly, a Multiple Linear Regression analysis model is developed, where a significant positive correlation between ESG and Tobin's q is observed for the energy and technology sector, while the EV industry shows a significant negative relation. Secondly, portfolio analysis was conducted through the analysis of the risk-return relationship, where the CAPM model is deployed to assess excess return compared to the market.

Keywords: ESG Investing, Tobin's Q, Stock Returns, Sustainable Investing, Valuation

I. Table of Contents

1. Introduction

ESG investing is becoming an increasingly important topic worldwide. Companies are showing increased awareness and concern towards improving their sustainability practices, as risks associated with the absence of these practices could have a material impact on their long-term success. Not only companies are increasing the sustainability aspects of their businesses, but also investors are integrating ESG concerns in their investment plans. This trend has been gaining increased relevance through the years, where global efforts are being made to raise awareness and promote sustainability across the corporate world. The testimonies of Principle for Responsible Investment (PRI) are higher by 28% (2020) and ESG investing is expected to grow by 84% to reach $33.9T in 2026 (Forbes 2022). ESG Assets Under Management (AUM) CAGR is 12.9% with an expected increase by 53% in Europe and reach $10.5T in the United States by 2026 (PWC 2022).

Numerous regulations are set by the formal institutions in which companies operate such as governments that impose taxes and penalties to contribute to the social welfare of nations and the planet, rating agencies that classify companies according to their ESG scores with low ratings that could convey a negative message to the market and investors about the erratic nature of firms and limit the attractiveness of investing in such sectors and industries. Annual flows to sustainable funds from investment management firms such as Vanguard, American Century, Brown Advisory and BlackRock, Global Sustainable Funds being dominated by Europe with 83% then followed by the US with 11% then the rest of the world with 2% which shows the investor’s high interest and demand for the ESG products (Morningstar 2022).

Additionally, various initiatives are being undertaken to foster sustainable development, with significant contributions from intergovernmental organizations, policy changes, financial institutions, and global standards bodies. The United Nations has established the Sustainable Development Goals (SDGs), a blueprint for achieving a more sustainable future. On the policy front, the EU has advanced initiatives such as the European Green Deal and the Eighth Environment Action Programme (8EAP), aiming to make Europe the world's first climate-neutral continent by 2050. In the realm of finance, the introduction of the Sustainable Finance Disclosure Regulation (SFDR) has brought about significant changes by necessitating greater transparency in how financial market participants integrate ESG risks into their investment decisions and advisory processes. To further investigate the ESG relationship with a firm's investment attractiveness, this thesis focus on the Energy and Technology sectors in Europe, and Electrical Vehicle industry worldwide. This relationship is analyzed through two approaches: a Multiple Linear Regression and the comparison of portfolios built based on ESG scores, where their performance is assessed through a risk-return relationship and the Capital Asset Pricing Model.

2. Background

2.1. The Concept of Sustainable Development

John Elkington, an expert, and pioneer of the corporate sustainability movement, highlighted the diverse range of interpretations and meanings associated with the concept of *sustainability*, describing it as a *2+2 = 5, or even 50, game* (1997). The term sustainable development was globally recognized at the United Nations Conference on The Environment (1972), marking the first major attempt to align economic growth and environmental sustainability, two terms that were often perceived as conflicting. (Caldwell 1984, cited by Purvis et al. 2019, 3). This conference led to the publication of the Report of The World Commission on Environment and Development: Our Common Future. This report described sustainable development as the development that meets the current necessities, without compromising the development of future generations (WCED 1987, 8). This (broad) concept of sustainability addresses the environmental consequences of economic activities (Erlich and Erlich 1991, cited by Carter et.

al. 2008), preserving non-renewable resources, also ensuring that fundamental human necessities are met (Carter et. al. 2008). The WCED set Economic and Social goals that shall be defined accordingly in all nations in a coherent manner, with a comprehensive strategic framework to achieve it (WCED 1987, 41). The institutionalization of sustainable development gained momentum through the ‘Rio Process,’ with the issuance of the ‘Rio Declaration,’ “comprising twenty-seven principles intended to serve as a guide for future *sustainable development.* The plan to implement these principles is described in “Agenda 21”. (Purvis et al. 2019). Sustainable development was rigorously discussed by Daly (1996), alongside other authors, who questioned the concept on its capability to offer a clear direction for organizations on how to recognize present and upcoming needs and how to choose suitable technologies and resources to meet them (Gimenez et al. 2012).

2.1.1. Classical and Neoclassical Economics Contributions

The concept of the *stationary state* was first introduced by classical economists during the 18th and 19th centuries. In this stationary state, the economy would produce just enough to meet the basic necessities of the people, with any surplus going to the landowners as rent. With wages set at the subsistence level, there would be no profits left over for the capitalists, who would have no incentive to invest in further growth, constraining economic expansion (Daly and Farley 2011).

Classical economists recognized this as the (natural) limit of human progress and well-being, whereas Mill “welcomed” it, believing that it could provide a higher quality of life for people, if there was continued progress in the “Art of living,” rather than just in the “Art of getting on” (Mill 1848). Mill argued that the surplus generated by the economy could be allocated in a manner that prioritizes social and environmental considerations, challenging the idea that the laws of governing production rigidly determine distribution, suggesting alternative models as being possible and desirable, and emphasized the importance of institutional arrangements to sustainable development, through the regulation of land use and the promotion of public goods (O'Connor and Spash 1999).

The primary contrast between Mill's approach and neoclassical economics about sustainable development is the underlying assumptions about economic growth and the environment.

Neoclassical economic theory starts with "non-physical parameters taken as givens – technology, preferences and the distribution of income," where the physical magnitudes must adjust (Daly 1996). The neoclassical economics theory assumes that markets are efficient mechanisms in allocating resources and argues that as economies grow, the adoption of cleaner technologies and more efficient resource use will enable improved environmental conditions. Thus, sustainable development can be achieved through economic growth, fueled by technological advances (Pearce, Markandya and Barbier 1989).

Daly contends that while the neoclassic theory contributes to the understanding of prices and markets through its theory of value, it may neglect the significance of physical factors, pushing the physical reality "too far into the background" (furthered addressed in 2.1.2.2.).

2.1.2. The Triple Bottom Line: Elkington's Contribution

Elkington (1997) proposed and developed a framework that seeks to address and balance three interconnected 'components' (Du Pisani 2006) that are fundamental to *sustainable development*. This framework, differing from traditional reporting ones (Slaper and Hall 2011), operates from a microeconomic perspective. To achieve sustainable development, Elkington argues that a firm must address social equity, environmental justice, and business ethics, and suggests that business leaders and executives conduct a sustainability audit, a 'necessary, yet challenging,' way to measure progress against sustainability's TBL (1997, 72).

2.1.2.1. The Economic Bottom Line and Eco-efficiency

Elkington starts by acknowledging the traditional bottom-line approach in accounting, which focuses on a company's profit. Traditionally comprised of Physical and Financial Capital, the concept of Economic Capital also accounts for Human Capital, and Intellectual Capital (Edvinsson and Malone 1997, Stewart 1997). The first Shear Zone of the model, between the economic and environmental agendas introduces the concept of eco-efficiency, and the need to achieve *Factor 4* (75%) and *Factor 10* (90%) reductions, sustainability concepts aimed at enhancing economic growth while minimizing environmental impacts.

2.1.2.2. The Environmental Bottom Line and the Concept of Natural Capital

According to Elkington (1997), during the 70's, there has been a shift towards a greater focus on the environmental agenda. The author argues that the first step for a corporation to achieve environmental sustainability is the understanding of the concept of *natural capital*, the 'complex and evolving' notion of the natural wealth supporting ecosystems. Daly and Farley (2011) describe it as the "Earth's natural resources and ecosystems that yield valuable goods and services to people." Costanza et al. (1997), developed a framework to estimate the economic value of seventeen different ecosystem services across sixteen biomes, ranging from climate regulation and water supply to pollination and recreation. The total value of these ecosystems is estimated between $16 and $54 trillion per year (in 1994 $USD). This figure is significantly larger than the world GNP (~$25 trillion) (United Nations, 1995), which highlights the 'immense' value of natural capital and the importance of preserving ecosystems for future generations. Furthermore, Elkington suggests a combination of financial indicators, as well as non-financial, to quantify the environmental bottom line. Financial metrics encompass patterns in adherence to law, allocations for penalties, legal expenditures, and costs related to landscaping, restoration, and abandonment. Non-financial metrics consider public complaints, energy, materials and water usage at manufacturing locations, polluting emissions, environmental threats, and waste production.

2.1.2.3. The Social Bottom Line and the Concept of Social Capital

According to Fukuyama (1995), Social Capital represents the ability for people to collaborate towards shared objectives within groups and organizations. Elkington argues that the degree of trust established between a corporation or industry and their external stakeholders significantly influences long-term sustainability. Therefore, societies with high social capital may be the most innovative (Elkington 1997, Fukuyama 1995). Elkington identifies the main concerns for which performance indicators have been developed, such as minority employment, irresponsible marketing and wages, and working conditions.

Contrary to this perspective, Friedman (1970), Nobel laureate in economics, argues that regardless of a manager's objective – be it profit maximization or establishing an institution for an "eleemosynary purpose", his foremost obligation is to the owners of the organization, rather than addressing (in the capacity of a businessperson, instead of as a principal) external social issues. Having "a social responsibility" as a corporate executive, implies acting in ways that may not align with the employer's best interests, as refraining from increasing prices to mitigate inflation or investing in pollution reduction beyond what is financially advantageous. Friedman (1970) asserts that, in each instance, the corporate executive is spending stakeholders' money. Should the corporate executive allocate these resources in a different manner from the stakeholders' best interests, he is essentially undertaking governmental functions.

Analogously, Friedman shares the skepticism of Adam Smith (1776) regarding the expected benefits that arise from businesses who claim to act for the public good, within the framework of a free market economy.

Despite Elkington's divergent perspective, the author acknowledges the challenges faced by companies, a *complex and political* process, in addressing the social reporting aspect of sustainability. These challenges arise from the absence of a unified framework to comprehend and implement social reporting. The author proposes that the key lies in building upon exemplary models, such as Skandia's "Power of Innovation" report, with "an innovative approach to valuing intellectual and organizational capital," that considers social capital's contributions to value creation and long-term sustainability (Elkington 1997).

2.1.3. Creating Shared Value: Porter and Kramer's Contribution

Porter and Kramer (2011) evidence that business have been adopting an outdated value creation approach, without the acknowledgement of the possible social consequences. The principle of shared value diverts from the traditional CSR redistribution approach, aligning a company's competitiveness with the improvement of its socio-economic responsibilities. Creating shared value is possible through three distinct approaches, reconceptualizing products and markets, revaluating productivity within the value chain, and supporting industry clusters at their locations. The authors argue that creating shared value, discussed in the context of businesses, is equally applicable to governments and non-governmental organizations. Flammer's (2015) study (with the typical literature regress measure of CFP approach (Tobin's Q, ROA, among others, measuring CSR) establishes a causal link CSR and financial performance, supporting Porter and Kramer's CSV framework. Corporate Social Responsibility activities are not only beneficial for society, but also lead to superior financial performance for firms. Flammer's findings suggest that CSR activities significantly impact firm value, increasing its market capitalization and leading to a better long-term financial performance. Critics posit that the strengths of CSV lie in its capacity to elevate social objectives to a strategic level, as a holist framework that debates about "conscious capitalism."

However, CSV's attempt to solve a system-level problem is pointed to be "fundamentally flawed," largely because it remains tethered to the perspective that a company's sole legitimate objective is to generate profits for its shareholders. In effect, the CSV's solution aligns with economic goals, and therefore, can only be upheld by overlooking significant portions of social reality (Crane et al. 2014).

2.1.4. Environmental, Social, and Governance: Financially Quantifying Sustainability

ESG is first coined as a framework for sustainable investing in the "Who Cares Wins: Connecting Financial Markets To A Changing World" Report. ESG investing has transitioned from its early stage to mainstream finance in various OECD reports, with investments reaching $USD 40 trillion (Bloomberg 2021). Sustainable investing assets, from 2016 to 2018, have increased 34%, amounting to $30.7 trillion in developed countries (GSIA 2018). Additionally, by 2019, these assets reached $1.87 trillion in China (China SIF 2019, cited by Boffo 2020). Steinbarth

(2018) argues that ESG practices, when "fit for purpose", can assist financial investors, aiding in risk management while transitioning to more sustainable strategies that focus on the long-term.

Although a relative "consensus" exists regarding the fundamental criteria within the Environmental, Social, and Governance domains, the metrics, methodologies, and weightings used by different rating providers exhibit substantial divergence, resulting in different ESG ratings (OECD 2020, fig. 1 *S&P 500 ratings correlation for different providers*). Such disagreement makes difficult the evaluation of ESG performance and may reduce the incentive to pursue more sustainable practices.

Chatterji et al. (2016) identifies two reasons for the divergence – what providers measure and the consistency of the measurements, termed "theorization" and "commensurability". Berg et al. (2022) findings show that measurement divergence, which authors describe as a circumstance in which rating agencies evaluate the same attribute with different indicators, is the main driver of ESG rating heterogeneity, indicating that disagreements are not solely due to different definitions, but also fundamental differences in underlying data. Furthermore, there is an absence of comparable ESG disclosures by firms, translating into an obstacle to accurately assessing a company's ESG performance on financial returns and societal impacts. Between 2007 and 2015, companies provided only approximately 18% of the recommended SASB disclosure items, according to Christensen et al. 2021 and Grewal et al. 2021. Research conducted by Clarkson, Li, Richardson, and Vasvari (2008) shows that companies with higher environmental performance disclose more information regarding their environmental practices, compared to the companies that have a lower environmental score.

2.1.4.1. An Introduction to ESG Pillars

2.1.4.1.1. Environment

The Environmental pillar represents a critical component in the assessment of an organization's sustainability and ethical performance, referring to its impact on the natural environment. Environmental factors encompass a wide range of issues that pertain to a firm's ecological footprint, resource efficiency, and compliance with environmental regulations. Key metrics within the "E" pillar include GHG Emissions (IPCC 2006), energy consumption (IEA 2022), water utilization, generation of waste (US EPA 2020), biodiversity impact (GRI 2022), environmental compliance, and environmental management systems. The growing importance of the "E" pillar reflects the increasing awareness of environmental challenges and their implications for long-term financial stability and economic growth (Clark, Finer, and Viehs 2015).

2.1.4.1.2. Social

The “S” pillar represents a company’s strategy in managing its relationships with its employees, customers, suppliers, and the community (Goss and Roberts 2011). Social metrics include equitable labor practices, health and safety measures for the employees, principles concerning human rights and diversity and inclusion efforts (Ionannou and Serafeim 2012), supplier social and environmental assessments, responsible sourcing practices and policies addressing force labor and child labor issues, customer satisfaction scores and community investment programs. According to Servaes and Tamayo (2013), it can significantly influence a company’s reputation, stakeholders’ relations, and financial performance. According to Jo and Horjoto (2011), firms with higher CSR performance have increased firm value, attributed to a better corporate governance. Moreover, they also have more access to investment, as it builds stakeholder trust (Cheng, Ionannou and Serafeim 2014).

2.1.4.1.3. Governance

The extensive and comprehensive study of corporate governance has demonstrated the significance of good practices in increasing shareholder value (Shleifer and Vishny 1997, Dimson, Karakas, and Li 2015). Governance metrics include board composition, audit and internal controls, executive compensation, shareholder rights, ethical practices and compliance, and risk management (Bloomberg Terminal ESG Data, CFA Institute, GRI, MSCI).

2.2. Sustainability and Investing

2.2.1. Sustainable Investing Drivers

Sustainable finance is the integration of ESG concerns in the investment process. There is an ongoing debate whether sustainable investing compromises short term returns for the sake of long-term sustainability, or whether companies and investors who are aware of ESG concerns can generate superior returns over the long term. However, under such pressure for change, dictated by climate change and social improvement, investors alongside policymakers are responsive to the risks imposed by this emergent threat (Silvola and Landau 2021). Investments in sustainable assets are increasing yearly across all regions of the globe, having achieved a value of 35,3 trillion dollars in 2020, which represents a growth of 15%, compared to 2018, and 55%, compared to 2016. The regions who contributed the most to this value are Europe and the US (GSIA 2020).

The 2007-2008 crisis has shown how financial markets are vulnerable to weak corporate governance and poor risk management practices (Escrig-Olmedo et al. 2019). In addition, increased evidence has shown that climate change presents a significant risk to economic activity and the well-functioning of financial markets. These two factors combined have led private and public organizations to be more aware of sustainable investing and has increased demand for socially responsible investments (Martini 2021). Furthermore, the covid-19 epidemic has further boosted the demand for SRI driven by two forces: investors preferences, there is a shift from investors to take into consideration companies who are aware and committed to tackle ESG threats, as opposed to only focusing on financial performance; Regulation, many governments are pushing regulatory incentives to increase investment on ESG driven companies, for instance the European Green Deal. (Taylor and Collins 2022).

Regarding performance, literature presents divergent conclusions on the relationship between the implementation of sustainable practices within a firm and its financial performance, stemming from the use of different methodologies used when assessing this relationship (Boffo and Patalano 2020; Nirino et al. 2022). However, according to Silvola and Landau (2021), firms with strong ESG disclosure and practices have several advantages when compared to the competition. Namely: a more loyal customer base, even in recession periods; easier access to funding, with lower costs associated; higher valuations in public listings and, over the long term, sustainable companies can generate good returns with a lower level of risk. In addition, effective risk management can only be achieved with the integration of ESG factor, since the materialization of a risk associated with one of the pillars could have a significant impact on profitability.

Albeit mixed evidence on the performance of ESG related investments, policy makers are pushing regulations to promote sustainable investing in the world of finance (Taylor and Collins 2022). One of the earliest international initiatives to promote sustainability was the creation of the Principles for Responsible Investment in 2006, which established six principles for sustainable investing and incorporating ESG analysis in investment decisions (PRI 2023). In 2019, more than three thousand institutional investors had signed this agreement, along with an increase of eighty trillion dollars of assets under management since its beginning (Nirino et al. 2022). More recently, with the Paris Agreement on Climate Change in 2015, the 17 Sustainable Development Goals (SDGs) were introduced. The aim of this initiative is to raise awareness and call to action companies and governments, in a global alliance, to improve aspects addressed in seventeen specific goals, for instance, end poverty, promote quality education or improving gender equality (UN 2022). Even though not very material for the delineation of investment strategies for investors, it signaled a global effort on addressing and tackling sustainability concerns.

Linked to SDGs and to further consolidate the 2030 Agenda for Sustainable Investment, the EU Taxonomy was developed in 2020. It consists of promoting a framework that standardizes assessment of sustainability factors in companies to improve sustainable investment through the increase reliability of information as well as ease of comparison between companies (Radley-Gardner, Beale, and Zimmermann 2016). In this way, ESG information is standardized, being more accurate, which improves investors' confidence on the subject and prevents investors to fall into the pitfall of greenwashing.

With the proliferation of sustainable investing, different strategies were developed to approach ESG factors when making investment decisions.

2.2.2. Investment Strategies

The approach to be followed differs for each type of investor, Silvola and Landau (2022) define two types of investors when addressing sustainable investment: quality investor and growth investor. The main difference between these two is their risk appetite. On the one hand, a quality investor prefers to invest in companies with superior ESG performance, thus exposed to less risk, being able to achieve good and stable returns. On the other hand, a growth investor undertakes a riskier strategy that relies on ESG arbitrage, assessing companies who are undervalued in terms of ESG and through active participation in the company seek an improvement in the value of the company, thus achieving superior returns at a greater risk.

There are many different strategies each investor can take, literature defines seven approaches that are most used in sustainable investing: positive and negative screening, tilting, ESG integration, active engagement and shareholder action, screening based on norms, impact investing and sustainability themed investing. (Boffo and Patalano 2022; GSIA 2020; EUROSIF 2023).

Screening and Tilting

Negative screening consists of avoiding certain companies or sectors related with significant ESG risk. It was one of the earliest strategies to be developed and it consisted primarily in the exclusion of securities from the sin industry, companies from the alcohol, tobacco, gambling, and weapon sectors were excluded from the investor's portfolio (Boffo and Patalano 2022). Nowadays, negative screening was extended to the exclusion of firms which present low ESG scores (Bernow, Klempner and Magnim 2017). Hence, with the increased availability and transparency of ESG scores, it remains an incredibly significant strategy, being the second most used strategy in the last years (GSIA 2020).

Positive screening, as opposed to negative screening, is defined by the preference and integration of firms with superior ESG scores compared to industry peers. Best in class is a specific strategy that consists of choosing the leading companies in terms of sustainability in an industry. (Bernow, Klempner and Magnim 2017, Nakajima et al. 2021).

Portfolio tilting derives from the screening strategy, but instead of excluding companies from investment portfolios, investors attribute portfolio's weights based on ESG performance (Boffo and Patalano 2020). Higher rated companies are overweighted in the portfolio, while lower rated companies are underweighted.

According to Boffo and Patalano (2020**)**, these methods could sometimes prove inefficient. By excluding stocks from bad sectors, one could exclude companies that have great sustainability aspects. For instance, in the energy sector and tobacco sector, the top 20% of firms in terms of sustainable practices score higher than the average MSCI World Index, based on ESG scores. Another factor to have in mind is that scores are developed according to the peer industry. In this sense, a company from a green sector might have a lower score compared to a company from a bad sector, nonetheless, this does not imply that the company from the green sector is less sustainable.

ESG Integration

This strategy is defined as "systematic and explicit inclusion of ESG risks and opportunities in all key aspects of an institutional investors' investment process" (Boffo and Patalano 2022). It consists in assessing quantitively and qualitatively the risk firms are exposed in each dimension of ESG, in this way a more precise risk management practice is achieved. ESG integration is the leading strategy, also presenting the fastest growth, with 25.2 trillion USD assets under management globally (GSIA 2020).

Shareholder Action

A proximity strategy between the investor and the investee that consists of assessing companies who are undervalued in terms of ESG with the opportunity to improve its sustainability aspects. Institutional investors usually acquire a stake in the company that enables them to integrate its board and influence management towards a more sustainable agenda (Bernow, Klempner and Magnim 2017, Silvola Landau 2021). It requires more effort and consistent communication, furthermore, it is a riskier practice but enables great value creation, thus generating superior returns for investors.

Norms-Based Screening

Categorized as a strategy of investing in companies who comply with standards and rules established by international organizations, like UNICEF, UN, and OECD. (Nakajima et al. 2021). It is the fourth most used strategy globally, with Europe leading this type of investment (GSIA 2020)

Impact and Sustainability Themed Investing

Theme investing refers to investments targeted at specific ESG risks, it is focused on the development of sustainability (Eurosif 2023, Nakajima 2021). An example of this strategy is the investment in green bonds, which mobilize debt capital to finance exclusively “green” projects, which has increased significantly since 2013 (OECD 2015).

Impact investing is the investment in companies or funds with the goal of promoting a positive impact in the environment and society aligned with the generation of financial profit (Eurosif 2023). This strategy presents the lowest engagement overall. It differs from philanthropy as investors have a stake within the company, hence expecting a financial return on their investment. This strategy presents the lowest amount invested of all (GSIA 2020), since the returns are expected to be below-to-market.

2.2.3. ESG Analysis Tools

In the past decade, ESG data collection and reporting have been expanding exponentially (Amel-Zadeh and Serafeim, 2017). Most companies release sustainability reports, where environmental, social and governance information is disclosed. In these reports, one could find metrics specific to each letter. For instance, carbon emission and water consumption address environmental issues, while employee compensation and turnover address social issues.

Corporate social responsibility (CSR) ratings are autonomous agencies that evaluate the sustainability of companies. This assessment is made through the collection of information related to each of the ESG pillars (Escrig-Olmedo 2019). This sector has grown rapidly over the last decade, where major players have gained increased relevance: examples of such agencies are Sustainalytics, Bloomberg, MSCI. However, there are differences in the way each agency computes ESG scores, due to: “scope divergence,” using categories to assess a dimension of ESG, “measurement divergence,” measuring the same categories differently, “weight divergence,” attributing different weights to categories (Brandon, Krueger, and Schmidt 2021). Thus, ESG scores frequently differ amongst CSR ratings. Escrig-Olmedo (2019) argues that rating agencies methodologies lack transparency, since these do not specify the criterion used on computing scores, and commensurability, as rating agencies might attribute different weights to the same aspect analyzed when developing the score.

In addition to this, Brandon, Krueger, and Schmidt (2021) demonstrate that differences in scores between rating agencies have a positive impact on a firm’s cost of capital. This could be interpreted as differences among rating agencies’ scores are viewed by investors as a signal of uncertainty, hence increasing the risk perceived, forcing investors to only hold the stock for an increased return. Due to this positive shock in the rate of return, the company's valuation is driven downwards.

On a final note, there is a relatively low coverage of ESG scores within the market. Twenty-five percent of listed firms in the US have ESG information available on rating agencies, while in EU it is little over 10%. However, when considering the aggregate value of market capitalization, the same companies with ESG information represent 95% and 89% of the total market capitalization, in the US and EU, respectively (Boffo and Patalano 2020). Despite the rapid development of CSR rating industry in the last decade, there are still steps to be taken to make ESG information more accurate and comparable.

2.2.4. Vehicles for Sustainable Investing

Following the strategies used in sustainable investment, it is relevant to understand who the main players are in the universe of sustainable investing. According to GSIA (2020), in 2020, 75% of sustainable investments were executed by institutional investors, while the remaining 25% were attributed to retail investors. Institutional investors consist of asset managers and pension funds. They are characterized for investing on behalf of other investors, whereas retail investors are individuals, hence, liquidity available to institutional investors is far greater. According to a survey conducted by Amel-Zadeh (2019), investors are drawn to sustainable investing for financial reasons, rather than societal. Furthermore, investors believe ESG metrics are better used to assess risk, instead of returns. The financial market is rapidly changing, with this investment vehicles also expand on the concept of sustainability. The four main asset classes available to institutional investors are: stocks, bonds, options, and derivatives, where stocks are the main vehicle of investment.

The focus of this thesis relies on the performance evaluation of stocks based on stock prices, with special focus on returns and risk. To do that, one must understand the underlying assumptions about return, risk and excess return compared to the market, when having an ESG integration approach.

As stated previously, a consensus has not been reached on the relationship between sustainability practices and returns. Following the insights provided by Bernow, Klemoner and Magnin (2017), a correlation between returns and ESG scores is hard to be established, however, through extensive research, it is possible to infer that sustainable investing is uncorrelated with poor returns. A more agreed upon notion is that sustainable investment is closely related to superior risk management. Sassen, Hinze and Hardeck (2016) state that firms with a stronger CSP tend to have inferior total and idiosyncratic risk, while systematic risk, where β is used as a proxy for this metric, is more related with the industry. Furthermore, social scores seem to demonstrate the strongest relation with each of the three types of risk, this implies that a company's reputation with the community is the most significant factor in risk. Environmental issues are a relevant factor in all types of risk for environmentally sensitive sectors, in other sectors this factor only has an impact on idiosyncratic risk.

In terms of abnormal return compared to the market, measured by Jensen's Alpha, there is evidence that lower scored ESG companies tend to have higher positive alphas, whereas higher scored companies tend to have negative alphas. (Boffo and Patalano 2020; Pástor, Stambaugh and Taylor 2021). This is explained by the preference of green securities by investors, which drives up the willingness to pay, reducing the cost of capital.

Bonds are fixed income instruments, it signals an agreement between the borrower and the debtholder, where the borrower pays a fixed interest rate to the debtholder. The appearance of green bonds was a great factor for the development of sustainable investing, since it improves liquidity for impact driven investments. Its popularity has been increasing, and institutional investors have made pledges to increase their holdings in such instruments (OECD 2015).

Lastly, options and derivatives are financial contracts used to hedge risk to stocks portfolio, serving as complementary investment vehicle.

2.3.Theoretical Foundation of ESG in Investing

2.3.1. Shareholder Theory

The shareholder theory or the Friedman doctrine was posted in the New York Times by Milton Friedman (1970), it represents a normative theory that aims towards maximizing shareholder's value without imposing the CSR of the firm towards the external environment. He believes that the sole social obligation of the firm is to improve the shareholder's return while complying with the regulatory standards of ethics and law. He also states that it is the duty of the government to ensure the wellbeing of society as they have the expertise and tools to do so and that it is not the company's task as it will have to pay taxes and support different social causes, and this will decrease its profit which is not for the benefit of the owners.

This is a controversial matter when it comes to ESG, as investors and scholars believe that improving social and environmental factors will maximize the shareholder's value in the long term and not doing so is not in their interest as it will be harmful for their reputation and growth. On the other hand, criticism towards this theory highlights that companies prioritize more shareholder value and short-term profit maximization instead of dealing with ESG problems and trying to improve sustainability. Their focus on profiting leads businesses to engage in immoral practices and adopt unsustainable behavior by neglecting the social causes. Some critics towards the theory is that the business needs to take into consideration stakeholder's interest that will benefit the shareholders. This will be further discussed in the next section.

2.3.2. Stakeholder Theory

Considering what is mentioned above and the criticism towards the shareholder theory, good ESG quality can be achieved through not only the shareholder theory but also with the stakeholder theory.

First, stakeholders are classified in two categories, the major or internal stakeholders that are impacted by the firm's actions directly, such as suppliers, clients, shareholders, investors, and employees and the secondary or external stakeholders who are indirectly impacted and are interested in how a company conducts in social business such as the government, local communities, and activist groups. We base our literature on this theory following a chronological order of definitions throughout the years.

First, according to a note on internal business at the Standford Research Institute (1963), a stakeholder is a person essential for the functioning of an organization. Stakeholders were then defined by R. Edward Freeman in 1980s as necessary to the company's survival. It was also defined by Cornell and Shapiro in 1987 and Hill and Jones in 1992 as an exchange relationship between parties. It was then narrowly defined by Clarkson in 1995 as individuals who are voluntary or unvoluntary affected by the firm's risk either through directly investing in the business or as consequences of the firm's activities. This states that no matter the relationship and power the stakeholders exercise over the firm, they have legitimate claims.

Based on the previous definitions, the stakeholder theory highlights that both shareholders' along with stakeholder's interests and values during the decision-making process should be considered as they contribute to businesses' long-term performance.

According to Achaltegger & Burritt in 2005, sustainability management requires the company to engage in the development of the society and economy. This states that sustainability management supports the stakeholder theory through the societal and environmental factors that are interlinked with the company's core activities to satisfy different interests and mutual benefits of each stakeholder to help them create value and profit sharing.

There are several models classifying the stakeholders and relating the ESG factors to them. First, the Salience Model originated by Mitchell, Agle, and Wood that is based on three elements which are the urgency related to time sensitivity and concerns, the legitimacy related to the firm's activities and procedures and the power. The higher the elements are the more prioritized the stakeholders. The stakeholders in ESG face a high level of urgency regarding the negative effects arising from environmental pollution and social injustice.

In addition to that, environmental organizations and social justice activists face high legitimacy when it comes to society standards concerning climate change, human rights, and social fairness. For the third element, the level of power differs among stakeholders, investors and customers have higher power and can influence the company's execution regarding ESG actions through law and investment decisions while other stakeholders such as employees have less power but play a role in influencing the social functioning.

2.3.3. Agency Theory

In addition to the previous theories, this thesis defines and emphasizes the importance of the agency theory and its relationship with ESG.

The agency theory is applied in many fields such as accounting, economics, and Finance. The delegation of authority and decision making can lead to the creation of the principal-agent problem. It is the conflict of interest in corporate governance between the principal who represents the shareholder or investor and the agent who represents the corporate manager or board of directors. This arises from the asymmetry of information where one party referred to as the agent is more informed and has more power than the other, the agent can also have different risk tolerance and incentives from the principal's objective of maximizing the shareholder profit and welfare. To guarantee the agent acts in his best behavior, the principal endures some agency costs such as the monitoring costs to control the agent's activities and enhance compensation through stock options, the bonding costs of expanding the resources and building trust by gaining more transparency and power over the agent and the residual costs arising from this conflict of interest between the two parties.

Investing in ESG can have positive impact on mitigating the agency problem. It reduces the asymmetry of information with shareholders as the more the management of the firm is engaged in disclosing the ESG the more it increases transparency between the two parties. It solves the conflict of interests between the two parties by encouraging the firms to enhance corporate social responsibility by investing in ESG methods that make the performance of the management transparent to the shareholders. On the other hand, investing in ESG could destroy shareholder's value (Friedman 1970).

It is true that it is beneficial for the managers to invest in ESG practices, but this increases the agency costs as there is competition in the market that makes the stakeholders benefit from the environmental and social factors and increase their profit (Jensen 2010).

2.3.4. Signaling Theory

To further develop and support what was referred to in the earlier theory about the asymmetry of information, this thesis defines the signaling theory and its ESG impact. This theory was developed by Michael Spence in 1973 and aims toward decreasing information asymmetry from having confidential information that can influence how investors and the market react. There are two types of signaling in the Finance field, the positive signaling through issuing equity reveals to the market and investors that the company will be financially stable and less risky in the future and the negative signaling through issuing debt reveals to the market that the company is risk-averse and more conservative to keep away from the dilution of their equity shares. Positive signaling is also implemented in corporate governance as the more diversified and independent the boards are the more, they signal that they are committed to social values of numerous stakeholders (Miller and Triana 2009).

This theory states that ESG disclosures signal to the market and stakeholders that the company is committed toward sustainability management which helps them better assess the company based on its good reputation (Fombrun and Shanley 1990). In addition to that, the greater the company's ESG performance the higher it discloses its information in a transparent manner to positively signal its engagement to the investors which allows it to better access funds (Spicer 1978), this could be achieved through delivering high quality sustainability reports and collaborating with third parties to obtain ESG certifications.

2.3.5. Institutional Theory

The way the institutional environment perceives the organizations makes them pressured to adopt structured, formal rules and norms to show that they act in an adequate manner even if it is not efficient and effective to their performance (Meyer and Rowan 1975). To eliminate the risk of being negatively judged about their conduct by the institutional environment, the companies act in their best behavior for their long-term survival and protection which is referred to as being legitimate (Scott and Layman 1968). This theory was also developed by Powell and DiMaggio in 1991 and described as the new institutionalism which is driven by institutional isomorphism of having different organizations adopting similar structures and procedures to comply with the institutional environment even if it is not suitable for them. It is based on three attributes, being coercive through complying to the rules imposed by powerful institutions such as the government, being normative by changing their behavior to comply with the social values and norms and being mimetic by imitating other comparable successful practices.

Applying this theory to the context of ESG shows that firms are pressured to implement ESG practices to preserve their legitimacy and comply with the institutional environment's standards towards sustainability. This arises from different regulatory requirements and stakeholder activism that pushes the firms to act in their best behavior to meet the expectations of society through being more environmentally responsible. According to this theory, the institutional environment in which the company operates can influence its culture and the way it implements ESG practices, for some companies which are market oriented they may find financial performance more important than ESG while for other companies which are community oriented, they may prioritize ESG over returns as high performance businesses strategically participate in CSR initiatives to build strong bonds with their stakeholders.

2.4. Hypothesis Development

The literature research reveals that earlier studies have demonstrated the effect of the ESG on financial success. The theories mentioned above show that firms are influenced by their external environment to act in their best behavior and engage in sustainable development practices to maximize their long-term profitability. To better understand this impact from an investor's perspective and knowing that the ESG industry in Europe is growing at a fast rate, this paper focuses on the Energy and Technology sectors and the Electrical Vehicles industry.

First, this paper studies the relationship between the Tobin's Q which is a measure of over-or undervaluation of portfolio stocks and ESG through using the regression analysis method that we will further discuss in the next section. If there is a correlation between both this shows that when ESG goes up Tobin's Q goes up and if not, this means that there is no relationship.

We develop the following hypothesis to evaluate this relationship:

H0[1]: There is no significant correlation between a firm's ESG performance and Tobin's Q

H1: There is significant correlation between a firm's ESG performance and Tobin's Q

H1a: There is significant correlation between a firm's Environmental performance and Tobin's Q

H1b: There is significant correlation between a firm's Social performance and Tobin's Q

H1c: There is significant correlation between a firm's corporate Governance performance and Tobin's Q

Second, to support the conclusions reached through the MLR, this paper also studies the relationship between superior ESG performing stocks and its performance on the stock market. To do so, the risk adjusted return, measured by the Sharpe ratio, and the excess return compared to the market, measured through Jensen's α, are analyzed, using the Capital Asset Pricing Model. There is an initial assumption that stocks that excel on sustainability aspects are able to achieve higher risk-adjusted return and outperform the average market return, making them more attractive to invest.

3. Methodology

3.1. Methodology: Part I

In part I of the Methodology Chapter, the Data Collection Procedure section (3.1) details the sources and criteria used to collect the dataset, as well as the rationale behind the selection of the Energy, Technology and Electric Vehicle industries. The multiple linear regression analysis is delineated in detail in section 3.2., wherein the motivations for the employment of a MLR are explained (3.2.1.), covering an overview of Tobin's q as the criterion variable (3.2.2.), as well as its transformation and implementation within the model (3.2.3.). The explanatory

[1] Analogous to H0, the same applies to H1a, H1b, and H1c, being the correspondent null hypothesis:
H0a: There is no significant correlation between environmental performance and Tobin's Q
H0b: There is no significant correlation between social performance and Tobin's Q
H0c: There is no significant correlation between corporate governance performance and Tobin's Q

variables rationale is discussed in section 3.2.4., supported with theoretical framework for each variable. The model is presented in section 3.2.5., considering industry-specific adjustments (3.2.6.). In section 3.2.7., the model assumptions are outlined to establish a solid basis for the empirical findings and interpretation (further addressed in Chapter 4). Finally, in section 3.2.8., the rationale on identifying and handling outliers in the data set is discussed.

3.1.1. Data Collection Procedure and Sample Selection Rationale

ESG Scores

ESG performance data was extracted from Bloomberg, which comprises reported data from 15,000 companies across one hundred countries since 2006 for all sectors (Bloomberg 2023). This thesis focuses on the Energy, Technology and Electrical Vehicle (EV) industries. The Bloomberg disclosure of ESG score is based on collecting data, regularly updating it, and then analyzing it to make sure that it is accurate. Bloomberg collects this data from sustainability reports of companies, regulatory filings, and news articles. Bloomberg scoring system is based on rating the corporate rules, disclosure procedures and performance measures implemented by the companies. In case of unavailability of the data, the platform uses machine-learning: smart or industry-implied models to provide an estimation.

First, the environmental scoring is based on factors such as the company's commitment to lower greenhouse gas emissions which is based on 3 scopes reported from 100,000 private and public firms, boost energy efficiency and employ more renewable energy sources, the procedures implemented pertaining to biodiversity preservation, waste minimization and water management, the company's ability to mitigate chemicals and air pollution where it scores climate risk in 50 scenarios , R&D investment and supply chain and product impact. Second, the governance scoring system is based on factors such as board composition and independence, the transparency of executive compensation, shareholder rights, voting and engagement, quality of audit and financial reports, whether the internal controls are properly implemented and CSR practices. Third, the social scoring system is based on factors such as labor practices, human rights, community relations with satisfying stakeholders and product quality and safety. An industry-specific study is conducted with 400 ESG criterion, it takes into consideration the materiality for each industry where several issues are prioritized and classified under each pillar with a sub-issue collecting the associated quantitative and qualitative ES data. Bloomberg's scoring system is standardized to a 0-100 range where each of these parameters are weighted according to their importance in contributing to the company's ESG performance. We proceeded as the following for the preparation of the data: we extracted the data from Bloomberg by collecting the individual ESG scores according to the member ticker of each company where scores are assigned respectively to each of the individual E, S, G pillars then we proceeded with data cleaning by taking out the missing ESG data. We would like to highlight that the ESG scores range from 0 to 10 with ten being the maximum score. Then, we took the average of Environmental, Social, Governance scores to obtain the independent variable 'ESG.'

3.2. Multiple Linear Regression Analysis

3.2.1. Motivations for Employing MLR Analysis

The primary motivation for employing MLR analysis in this study lies in its capacity to perform *ceteris paribus* analysis. Including multiple independent variables allows to control for additional factors that simultaneously affect the criterion variable (Wooldridge 2012). As more factors are incorporated into the model, a greater proportion of the variation in the criterion variable is explained, resulting in a more robust and accurate model (Chatterjee and Hadi 2015). The second motivation (further addressed in section 3.2.3.) lies in its capability to test for different functional form relationships between the criterion and independent variables. MLR models can incorporate transformations such as *logarithmic*, *exponential*, or *inverse* transformations, allowing for more flexibility (Wooldridge 2012), enhancing the robustness and explanatory power of the model. The present study utilizes IBM SPSS Statistics software to implement MLR analysis.

3.2.2. Tobin's q

To measure the correlation between ESG performance and a firm's investment attractiveness, this study employees Tobin's q as the criterion variable. Introduced by Nicholas Kaldor and further addressed and presented by James Tobin as an alternative to traditional financial measures, q_i serves as an instrumental variable to examine the causal relationship between investment and the ratio of a firm's Market Value of Assets to its Replacement Cost of Assets (Tobin 1968, 1969). This approach is more accurate than accounting for Assets Book Value, particularly in instances where inflation increases the replacement costs (Damodaran 2012).

The Tobin's q ratio is represented as follows:

$$\boldsymbol{q_i} = \frac{Market\ Value\ of\ Assets_i}{Replacement\ Cost\ of\ Assets_i} \quad (1)$$

Tobin's fundamental premise is that if $q_i > 1$, companies would be motivated to invest. The value of a new investment would be greater than its associated cost, and therefore, the market perceives the firm as having higher growth potential. Lindenberg and Ross (1981) argue that q_i may exceed unity due to Ricardian[2] rents, not represented in its replacement costs. On the contrary, a $q_i < 1$ indicates that the market perceives the company as having constrained growth potential, and thus, less attractive to investors.

---

[2] Excess profits that a firm earns due to the presence of unique or scarce resources and characteristics that provide a competitive advantage over competitors, such as access to scarce or unique natural resources, specialized knowledge or expertise, patents or intellectual property, and geographical location (Ricardo 1817)

Despite its potential to influence various aspects of corporate, Cheng and Pruitt (1994) argue that obtaining q data is significantly challenging, due to the complexity to accurately measure the replacement cost of assets. While q as a measure has advantages in theory, Damodaran (2012) corroborates Cheng and Pruitt arguments concerning q's practical applications. The variation, q'_i, of Tobin's q ratio, using the sum of Market Value of Equity and Market Value of Debt, and the Book Value of Assets, is represented as follows:

$$\boldsymbol{q'_i} = \frac{(Market\ Value\ of\ Equity + Market\ Value\ of\ Debt)_i}{Book\ Value\ of\ Assets_{\ i}} \qquad (2)$$

3.2.3. Transformation of the Criterion Variable: q(t)

In the present study, the criterion variable, q_i, undergoes a natural logarithm (ln) transformation. Applying a type of *log* transformation can mitigate, if not eliminate, heteroskedasticity and issues related to skewedness (Wooldridge 2012). Moreover, models with log(y) as the dependent variable are more likely to exhibit normality. This transformation is made possible due to the nature of the variable. Although q_i can theoretically range from zero to infinity, a value of 0 remains highly improbable in practical scenarios. A q_i value of 0 would denote that the company's market value is non-existent, as $Replacement\ cost\ of\ assets = 0$. (Tobin 1969). Even in cases of bankruptcy, the company retains residual value within their assets.

The transformed q_i, denoted as $q(t)_i$, is obtained by applying the natural logarithm to the original criterion variable values:

$$\boldsymbol{ln}(\boldsymbol{q_i}) = q(t)_i \qquad (3)$$

3.2.4. Explanatory Variables Rationale

The measurement of ESG performance is still flawed and remains inconsistent amongst rating agencies. As stated previously, rating agencies do not have standardized criteria to evaluate ESG performance. Additionally, there are many companies who are still improving their disclosure on ESG, which could result in a sudden change in ESG score from one year to the other (Hoang, Segbotangni, and Lahiani 2020). Hence, the information available is ambiguous and that could signal uncertainty to investors. Furthermore, the change in scores for a company is expected to influence a company's financial performance after a time lag is considered. An improvement in the sustainability aspects of a company in one year is very unlikely to improve the economic performance in that same year, as it takes time for the information to be validated and accepted by investors and other stakeholders. To understand the correlation between ESG performance and firm's value, the ESG variable is lagged by one year, whilst all the other variables correspond to the following year. For instance, the ESG scores from 2020 are compared to the other explanatory variables of 2021.

This section presents the explanatory variables employed in the MLR model and discusses the rationale behind its inclusion in analyzing the correlation between ESG performance and $q(t)_i$. In the present study, a total of eight[3] explanatory variables have been selected, namely (a) *ESG* performance; (b) Leverage, denoted by the Debt-To-Equity Ratio; (c) Liquidity, represented by the current ratio; (d) Research and Development Expenditure (adj.); (e) Market Capitalization; (f) Sales Growth; (g) Total Revenues[4]; and (h) Firm Size, computed as the ln(Total Assets). Subsequent sections will offer an elaboration of the explanatory variables concerning their pertinence to our research and the rationale for their inclusion.

[3] Concerning the weighted average ESG performance model. Concerning the individual performance analysis, this study considers ten explanatory variables (see section 3.2.5.)

[4] Exclusively applied to the Energy industry econometric specification, substituting *Sales Growth* (see section 3.2.6.)

3.2.4.1. Leverage

Leverage, employed in the MLR analysis as the *Debt-to-equity* ratio, accounts for firms' capital structure and financial risk, which may affect its investment decisions and market valuation. The Debt-To-Equity Ratio is particularly valuable to compare the financial leverage of a firm in relation to its industry counterparts (Brigham and Ehrhardt 2016). Moreover, the Debt-To-Equity Ratio may also capture agency costs[5] associated with debt financing, influencing a firm's q.

3.2.4.2. Liquidity

Liquidity pertains to the overall financial position of a company in terms of its solvency. Expressed in the present analysis as the Current Ratio, $\frac{Current\ Assets}{Current\ Liabilities}$, it assesses a company's capacity to fulfil its immediate financial commitments. As originally proposed by Keynes (1936), a benefit of maintaining a liquid balance sheet lies in the capacity it bestows upon firms to capitalize on valuable opportunities as they emerge (Almeida, Capello, and Weisbach 2005). In circumstances where a firm experiences financial constraint, its capacity to access external financing is limited, becoming reliant on internal liquidity (cash and cash equivalents) to underwrite operations and investment opportunities. Almeida, Capello, and Weisbach's study posits that financially constrained firms manifest a positive cash flow sensitivity of cash, meaning holding more liquid assets when cash flows are higher. In the context of q, maintaining adequate liquidity empowers financially constrained firms to pursue growth opportunities, which increases a firm's value.

[5] Costs that result from conflicts of interest between different stakeholders within a firm (Jensen and Heckling 1976)

3.2.4.3. Research and Development Expenditure

Studies show that investing in R&D effects the short and long future returns of the firm which results in higher Tobin's q (Hirschey 1985), another evidence to this is the increase in R&D spending to market value ratio that results in higher excess returns (Chan et al. 2001). Increasing R&D spending has a positive signaling effect that increases the prices of shares and their market value (Chauvin and Hirschey 1993).

R&D represents an intangible asset such as patents that their book value is difficult to measure and not included in the company's capital (Hall 1993), including R&D variable helps explaining how the market perceives the effect it has on the firm by the increase of productivity and added value, it also helps mitigate the signaling effect it has on Tobin's q. "Firm's Tobin's q is a function of its intangible assets" (Bharadwaj et al. 1999). Investing in R&D differentiates companies from competitors as it contributes to the creation of innovative goods, better customer service, quality and technologies which attracts the investor's attention to higher profit and growth in the future (Brynjolfsson et al. 2002). Griliches (1981) investigated the intricate connection between the company's market value, as captured by Tobin's q, and R&D investments and patent activity. The author derived a first expression, represented as following:

$$V = q(A + K), \tag{4}$$

Wherein,

V = current market value of the firm

A = current value of the firm's conventional assets[6]

K = Intangible assets of the firm

q = Tobin's q

[6] Referring to plant, equipment, inventories, and financial assets (Griliches 1981)

Griliches findings suggest that unanticipated R&D expenditures[7] and patent activities positively contribute to changes in market valuation. While anticipated R&D investments are already factored into a firm's market valuation, it is the unanticipated components of R&D and patent activities that drive changes in a firm's market value.

3.2.4.4. Market Capitalization

Market capitalization is a gauge of how worth the company stock shares are valued in the market; it can be overvalued or undervalued. It is determined as the following: current share price * total number of shares outstanding (CFI 2022). It is a measure of the size and financial stability of a firm. We use Market Capitalization as an explanatory variable in our model as it is significant in explaining the output variation in the criterion variable, Tobin's q, it measures the firm's market value of equity which represents the component of Tobin's q numerator of total market value as referred to in section 3.2.2. second equation q'_i. This means that when the market capitalization increases it signals to the market that the firm has future growth and financial stability which increases Tobin's q.

3.2.4.5. Sales Growth

Sales growth is defined as higher sales from one year to another (Kennedy et al, 2013). It measures how much the business revenues are growing over time and gives insights to investors about the profitability and market share of the company in the future. It is also defined as the variation in current and historical sales alongside historical sales (Horne and Wachowicz 2012, 223). This is described as the following formula: (Current sales - prior sales period) / prior sales

[7] Unanticipated R&D expenditures refer to investments in R&D activities that were not expected or predicted based on firm's historical trends, industry norms, or market conditions, resulting from factors such as breakthroughs, regulatory shifts, or emerging market opportunities.

period *100. The more the company’s sales are growing the more it impacts the Market Value of the company and its attraction to investors (Kusumajaya 2011).

3.2.4.6. Total Revenues

Total revenues refer to the total amount of money a firm earns through the selling of its goods and services during a specific period. Revenues may exhibit a correlation with q, as higher revenues indicate that a company is effectively utilizing its assets for income generation, potentially resulting in an increase in the perceived company value. As observed upon conducting initial analysis to examine the performance of the model (section 3.2.6.), *Total Revenues* captures and explains the dynamics and characteristics of the Energy industry in a better way.

3.2.4.7. Firm Size

According to Fama and French 1992, and Lang and Stulz 1994, Firm Size has been acknowledged as a determinant of corporate performance and valuation. As firms can vary widely in size, applying the ln transformation serves to attenuate this disparity, compressing the variable to a comparable scale. Larger firms may have distinctive characteristics that affect their value, such as economies of scale, greater market power, or increased diversification, leading to a higher q (Lang and Stulz 1994). Smaller firms may benefit from greater flexibility and adaptability, which also may contribute positively to firm value. Using this transformation as an approximation to a size of a firm aligns with the findings of previous research and increases the overall MLR model performance.

3.2.5. Model

This study adopts a nuanced approach by examining not only ESG overall performance, but also ESG individual performance. Therefore, the multiple linear regression analysis consists of two econometric specifications. The first econometric specification, $q(t)_i$, with the ESG overall performance as the key explanatory variable, is represented as follows:

$$\boldsymbol{q}(\boldsymbol{t})_{\boldsymbol{i}} = \alpha + \beta_1 ESG_i + \beta_2 LEV_i + \beta_3 SIZE_i + \beta_4 MKTCap_i + \beta_5 RD(adj.)_i + \beta_6 LIQ_i + \beta_7 SG_i + \varepsilon_i \quad (5)$$

The second econometric specification, $q'(t)_i$, with the individual contribution of each ESG pillar as separate independent variables, is represented as follows:

$$\boldsymbol{q}'(\boldsymbol{t})_{\boldsymbol{i}} = \alpha + \beta_1 E_i + \beta_2 S_i + \beta_3 G_i + \beta_4 LEV_i + \beta_5 SIZE_i + \beta_6 MKTCap_i + \beta_7 RD(adj.)_i + \beta_8 LIQ_i + \beta_9 SG_i + \varepsilon_i \quad (6)$$

Wherein,

Concerning the ESG overall performance econometric specification (5),

ESG_i = Weighted average of each ESG factor of firm i

Concerning the ESG individual performance econometric specification (6),

E_i = Environmental Performance of Firm i

S_i = Social Performance of Firm i

G_i = Corporate Governance performance of Firm i

Analogously to both econometric specifications (5) and (6),

$q(t)_i = ln(q_i)$

$LEV_i = (\frac{Debt}{Equity})_i$

$SIZE_i = ln(Total\ Assets_i)$

$MKTCap_i = \ number\ of\ outstanding\ shares_i * share\ price_i$

$$RD(adj.)_i = Reported\ R\&D\ exp._i + \ Amortization\ of\ capitalized\ R\&D_i E - Capitalized\ R\&D\ exp._i$$

$LIQ_i = (\frac{Current\ Assets}{Current\ Liabilities})_i$

$SG_i = \left(\frac{Total\ Revenue_{i,t} - Total\ Revenue_{i,t-1}}{Total\ Revenue_{i,t-1}}\right) * 100$

3.2.6. Industry-specific Model Adjustments

Upon conducting preliminary analysis examining model performance, it was observed that the independent variables ‘sales growth (SG)’ and ‘revenues (REV)’ demonstrated distinct levels of effectiveness in explaining the criterion variable ‘q(t)’ across the three industries. In the Technology and Electric Vehicle (EV) industries, sales growth was found to be a better fit for the model, while in the Energy industry, revenues emerged as a more suitable choice. The disparity in the explanatory significance of SG and REV for the Technology and EV Sectors vs. the Energy Industry may stem from its distinct industry characteristics (further addressed and developed in 4.1). Thus, and driven by preliminary model performance observation, a variation, $q(vt)_i$, of the econometric specification for the model was formulated for the Energy industry, both for the overall and individual ESG performance:

$$\boldsymbol{q(vt)_i} = \ \alpha + \ \beta_1 ESG_i + \ \beta_2 LEV_i + \beta_3 SIZE_i + \ \beta_4 MKTCap_i + \ \beta_5 RD(adj.)_i + \ \beta_6 LIQ_i + \ \beta_7 REV_i + \ \varepsilon_i \qquad (7)$$

$$\boldsymbol{q'(vt)_i} = \alpha + \beta_1 E_i + \beta_2 S_i + \beta_3 G_i + \beta_4 LEV_i + \beta_5 SIZE_i + \beta_6 MKTCap_i + \beta_7 RD(adj.)_i + \beta_8 LIQ_i + \beta_9 REV_i + \varepsilon_i \quad (8)$$

Wherein,

REV_i = Total Revenues of firm i

3.2.7. Model Assumptions

3.2.7.1. No Autocorrelation

Autocorrelation refers to the presence of correlation between the error terms of the model. To assess the no autocorrelation assumption, the Durbin-Watson test is employed. This test serves as a diagnostic tool to identify the existence of first-order autocorrelation in the model residuals. The Durbin-Watson test ranges between 0 and 4, with a value of 2 indicating the absence of autocorrelation in the residuals. In the absence of autocorrelation, the differences between successive residuals are expected to be random and collectively sum to ≈ 0, due to, under the null hypothesis of no autocorrelation, each residual is statistically independent of its predecessors and successors. Consequently, the ratio of the sum of squared differences to the sum of squared residuals should hover around the unity. The DW statistic is defined as twice this ratio, i.e., 2. If DW is significantly less than 2, this indicates the presence of positive autocorrelation. Also known as serial correlation, it occurs when errors terms in a time series transfer from one period to another is a systematic manner. Therefore, it indicates that the error term in one period is positively related to the error term in the preceding period, resulting in the underestimation of standard errors. If DW exhibits a value significantly greater than 2, this indicates the existence of negative autocorrelation. A positive error term is likely to be followed by a negative error term, and vice versa, leading to an overestimation of standard errors.

3.2.7.2. Normality

The normality assumption is assessed through visual inspection of the Histogram of the Residuals and the Normal P-P Plot of Regression Standardized Residuals of the criterion variable. The Histogram of the Residuals should ideally display a Gaussian curvature, with the majority of residuals congregating around the mean, symmetrically extending into both tails. Simultaneously, the Normal P-P Plot of Regression Standardized Residuals offers a more rigorous method for affirming normality, comparing the observed cumulative probabilities of residuals, x-axis, against their expected cumulative probabilities under a normal distribution, y-axis. If residuals follow a normal distribution, the points should closely align along the diagonal line in the Normal P-P Plot, and thus, the assumption of normality of the residuals is satisfied.

3.2.7.3. No Multicollinearity

To evaluate the presence of multicollinearity, the Variance Inflation Factor (VIF) Statistics, as well as the Collinearity Diagnostics Table are observed. The VIF for an explanatory variable is calculated as the reciprocal of the proportion of the variable variance that is not explained by the other explanatory variables. A VIF value of 1 implies that there is no correlation between the given explanatory variable and the remaining predictors, meaning that there is no multicollinearity. In this study, we adopt two levels of stringency, first evaluating against the standard threshold of 10, and a more conservative approach, with a threshold of 3. The second element of our approach involves the examination of the Collinearity Diagnostics Table. We evaluate the Condition Index, CI, against a threshold of 30. The CI is computed for each dimension of the model and identifies the extent to which explanatory variables are linearly dependent. A $CI > 30$ alone does not confirm the presence of multicollinearity. However, it indicates that the data structure allows for its potential existence. To further examine the potential presence of multicollinearity flagged by a high CI value, Variance Proportions are investigated against a threshold of 0.5. Two or more explanatory variables within the same dimension exceeding a VP of 0.5 may indicate substantial multicollinearity.

3.2.7.4. Linearity and Homoscedasticity

The evaluation of Linearity and Homoscedasticity is undertaken through visual inspection of the ZRESID vs ZPRED scatterplot. To further reinforce the visual assessment, each explanatory variable is also plotted against the criterion variable, to see if there is a clear linear relationship between each explanatory variable and the criterion variable. In a model adhering to the assumptions of Linearity and Homoscedasticity, the Residuals vs. Fitted values scatterplot would display an evenly dispersed, random pattern, between the range of -3 to 3, for both x and y axis. A discernible pattern, such as a funnel shape, or a clear curve, would suggest that the assumptions of Homoscedasticity or Linearity, respectively, are not met.

3.2.8. Outlier Detection and Treatment

This section discusses the methodology used to identify and handle outliers (further addressed in Chapter 4, concerning industry-specific analysis). Outliers and influential observations ought not to be indiscriminately eliminated or systematically down weighted, as they are not necessarily errors in the observations. On the contrary, they may be the most informative points in the data (Chatterjee and Hadi 2015). Initially, the interquartile range (IQR) method was applied to identify potential outliers in our dataset, with observations falling below $\boldsymbol{Q1 - 1.5.IQR}$ or above $\boldsymbol{Q3 + 1.5.IQR}$ being flagged as outliers. When applying the IQR method, a considerable number of outliers were identified for the criterion variable across all industries, primarily concerning the upper bound. Removing these values would lead to a loss of valuable information, crucial to understanding the underlying relationships being studied. An alternative approach based on the 1st and 99th percentiles of the data distribution was adopted, trimming the extreme values from both ends of the distribution. The application of this method effectively mitigated the influence of extreme values, while simultaneously preserving valuable information contained in the observations.

3.3. Methodology: Part II

In part II of the Methodology chapter, for each of the industries portfolios of stocks will be developed based on ESG performance, the scope and data collection procedures are explained in section 3.3.1.

A brief explanation of Portfolio theory (3.3.2) based on Markowitz's theory is presented, while laying out the steps for calculating portfolio's expected return and volatility.

CAPM's assumptions are presented and a proxy for systematic risk is established, the market β, a metric that is used to compute the portfolio's equilibrium expected return given through CAPM (3.3.3). Finally, three main metrics are defined to assess portfolios' performance: Jensen's Alpha, Sharpe ratio and Treynor ratio (3.3.4), while the steps for optimizing the weights of the portfolio are also defined.

3.3.1. Portfolio Selection and Stock Return

For each industry, 4 pairs of portfolios are built based on ESG performance: one pair addressing the aggregate ESG score and three pairs each addressing an individual dimension of ESG. Each pair of portfolios consists of two separate portfolios, where one is composed of the best stocks in the sustainability aspect analyzed of the data set, while the other portfolios is composed of the worst stocks for the same aspect analyzed. The average of scores of the last three years, retrieved from Bloomberg, were used to define the top and worst stocks of each category.

Having defined the stocks for each portfolio, the monthly adjusted share prices were also retrieved from Bloomberg, from January 2015 to December 2022. Companies that lack data on share price for one year or more were excluded from the portfolio creation and replaced by the following stock matching the criteria stipulated.

Upon gathering the monthly adjusted share price for each stock, the monthly return is computed, using the arithmetic returns approach, which has the following formula:

$$r_t = \frac{P_t - P_{t-1}}{P_{t-1}} \tag{9}$$

Wherein:

r_t= Total stock return realized at t month

P_t= Adjusted closing stock price at t month

Share prices for the energy and technology sectors are expressed in euros, since the regional focus of these sectors is the European market. As for the electric vehicle industry, stock prices are presented in USD. Nonetheless, since return is a ratio, this would not be impacted by using different currencies.

3.3.2. Portfolio theory

Markowitz (1952) introduced the concept that exists an interconnection between risk and return, meaning between two portfolios with similar levels of risk, the investor should opt for the one with the highest expected return. In the same line of thought, if two stocks present the same level of expected return, investors will prefer the stock with the lowest risk. Thus, Markowitz's model is defined as "mean-variance model" (Markowitz 1991) and it relies on several assumptions, namely: no transactions costs, no taxes, a single-period, investors are price takers, information is available to all, and investors behave similarly aside from their risk appetite and their initial investment (Elbannan 2014; Singh and Yadav 2021).

Bearing this risk-return relationship in mind, an efficient frontier can be defined, as investors will maximize return for a certain level of risk. This frontier represents the line of efficient portfolio, while portfolios below or to the right of this line are feasible portfolios. Since it is a "mean-variance model," investors will not hold a riskier portfolio for a specific level of risk, hence they will hold portfolios in the efficient frontier, as other feasible portfolios do not provide the optimal combination of risk and return (Markowitz 1991).

Portfolios are a combination of stocks with specific weights for each of the stocks. Important to notice that the sum of weights in any given portfolio is always one. Having attributed the weights, it is then possible to compute the portfolios expected return and volatility, bearing in mind that the volatility of the portfolio is influenced by each stock's individual volatility and the correlation between themselves. This correlation is useful to be analyzed, since bundling portfolios with low correlation between stocks can lead to lower overall volatility, which is defined as the diversification effect (Markowitz 1991; Sharpe 1964; Elbannan 2014)

A portfolio with n securities expected return is computed through the following equation (Singh and Yadav 2021):

$$R_p = \sum_{i=1}^{n} w_i R_i \tag{10}$$

Wherein,

R_p= Portfolio's return

w_i= Weight of security i in the portfolio

R_i= Return of security i

To compute the portfolio's variance the following equation is used (Singh and Yadav 2021):

$$\sigma_p^2 = \sum_{i=1}^{n} w_i^2 \sigma_i^2 + \sum_{i=1}^{n} \sum_{j=1}^{n} \sigma_i \, \sigma_j \rho_{ji} \; (i \neq j) \tag{11}$$

Wherein,

σ_p^2 = Portfolio's variance

w_i = Proportion of investment in security i relative to the portfolio's total investment

w_j = Proportion of investment in security j relative to the portfolio's total investment

σ_i = Standard Deviation of security i

σ_j = Standard Deviation of security j

ρ_{ij} = Correlation Coefficient between security i and j

In this thesis, portfolios' risk is analyzed through its average annual standard deviation, hence the square root is applied to the portfolio's variance to derive the appropriate risk measure.

3.3.3. CAPM

The capital asset pricing model (CAPM) was developed by Sharpe (1964) and Lintner (1965) and further developed the model created by Markowitz with the introduction of two new assumptions. Investors have the possibility to borrow and lend without restrictions at the Risk-Free rate and there is "homogeneity" in investors' expectations, this means, investors share the same distribution of returns for a given period and take similar decisions.

The risk-free asset represents a minimum level of return for no risk. Generalizing, every investor will have a combination between their risky portfolio and the risk-free rate, as lending and borrowing is allowed, they can choose the preferred combination between the two of them, so that they match their desired level of return. They can lend at the risk-free rate, holding a position of lower risk and expected return, or borrow at the risk-free rate, so they can reach a position with higher expected return, at the expense of extra risk.

The market portfolio is also introduced in the model to compare the performance of a specific portfolio in relation to the overall market. The market portfolio is defined as a well-diversified efficient portfolio with all the stocks in the market. In practical terms, such market portfolio is unfeasible to get accurate information, hence a benchmark index is a representation for the market portfolio. In this thesis, the benchmark index used for the energy and technology sector is the STOXX 600 Europe, while the index used for the electric vehicle industry is the STOXX 1800.

The volatility of a portfolio, or the total risk, can be split into two types of risk: systematic risk, which signals the exposure a portfolio is subject to the overall economic cycle, and idiosyncratic risk, which represents firm specific risks. A well-diversified portfolio mitigates specific risk, whereas systematic risk is undiversifiable, meaning portfolios will always be affected by this risk (Sharpe 1964; Elbannan 2021)

A proxy for measurement of systematic risk is the market beta (Elbannan 2021), this illustrates the magnitude in variability on a stock's return compared to the variability occurred in the overall market. In other words, a market beta lower than one signals a low correlation with the market, meaning it is anti-cyclical, when the market has an increase of 1%, the stock is expected to increase by less than 1%. Whereas a market beta above 1, signals a pro-cyclical stock, where a shock in the market will create a shock of higher magnitude on the stock's return.

$$\beta_i = \frac{cov(R_i, R_m)}{\sigma^2(R_m)} \tag{12}$$

Wherein,

β_i = Market Beta of stock i

$cov(R_i, R_m)$ = Covariance between stock i's return and market return

$\sigma^2(R_m)$ = Variance of the market portfolio

By extension, the β of a portfolio is the weighted average of each individual stock's β (Singh and Yadav 2021), the proportion of amount invested in each stock relative to the total investment in the portfolio is defined as the weights for each stock in the portfolio.

Having the risk-free and the β, the expected return according to CAPM is computed using the following formula, for both stocks and portfolios (Elbannan 2014):

$$E(R_i) = R_f + \beta\left(R_M - R_f\right) \qquad (13)$$

Wherein,

$E(R_i)$ = Expected return through CAPM

R_f = Risk-free asset return

β = Market beta of the stock or portfolio

R_M = Return of the market portfolio

3.3.4. Portfolio Performance Analysis

Jensen's Alpha is a key metric when analyzing the performance of a stock or a portfolio, it is given by the following formula:

$$\alpha = \mathrm{R_p} - \mathrm{E}\left(\mathrm{R_p}\right) \qquad (14)$$

Wherein,

α = Jensen's Alpha

R_p = Realized Return of portfolio

$E\left(R_p\right)$ = Expected Return of portfolio according to the CAPM

A non-zero alpha implies abnormal performance of the portfolio compared to the market index. A positive alpha signal an outperformance, meaning the portfolio is underpriced. While a negative alpha means the opposite, thus overpriced. Alpha compares not only the outperformance compared to the market, but also the investors preference. A negative alpha, on one hand, might signal underperformance, on the other hand, it could translate in a more attractive portfolio, as many investors are holding this portfolio, thus creating overvaluation (Nguyen et al. 2022).

Another important metric to assess performance is the Sharpe ratio (SR), which can be computed through the following equation:

$$SR = \frac{\left(R_p - R_f\right)}{\sigma_p} \tag{15}$$

Wherein, σ_p = Standard deviation of the portfolio.

This ratio measures the risk adjusted excess return of the portfolio (Sharpe 1964). Since the risk-free rate acts as an opportunity cost, to analyze portfolios it is necessary to deduct this rate to the realized return of the portfolio. It is one of the most important metrics to analyze the performance of a portfolio since it expresses the direct relationship between risk and return (Scholz and Wiikens 2005; Vidal-Garcia and Vidal 2021). It can be interpreted as the slope of the line that is drawn between the risk-free rate and the portfolio, in the graph with risk represented in the x-axis and return in the y-axis. Investors will prefer portfolios with a higher Sharpe ratio, in addition, investors usually set a target Sharpe ratio, where portfolios that have a ratio above the target are invested, while portfolios below the target are avoided. Furthermore, by maximizing this ratio one could achieve the optimal combinations in the weights for the portfolio: the tangency portfolio. By doing such, it would turn the portfolio into an efficient portfolio which lays in the efficient frontier (Lintner 1965; Zakamulin 2011). Investors would then hedge this efficient portfolio with the risk-free rate, and depending on their risk appetite and utility function, they choose a point along the efficient frontier that best suits them.

The Treynor's ratio (TR) is also commonly used to evaluate the performance of a portfolio (Vidal-Garcia and Vidal 2021). It differs from the Sharpe ratio in the denominator, where the ratio demonstrates the expected excess return per unit of systematic risk.

Thus, the formula for Treynor's ratio is the following:

$$Treynor's\ Ratio = \frac{(R_p - R_f)}{\beta_p} \tag{16}$$

Relevant to notice that Treynor's ratio is best suited for diversified portfolios since it accounts for the extra excess return relative to risk inherent to the market (Scholz, and Wiikens 2005). If a portfolio is not well diversified this ratio could be biased, since there is a lot of specific risk in the portfolio that is not accounted for in this ratio.

In this thesis, upon building portfolios composed of stocks that are extreme in terms of ESG performance, the return, risk, Jensen's Alpha, and Sharpe ratio are computed and analyzed, assuming an equally distributed portfolio. Furthermore, on the two ESG portfolios, the optimization of the portfolio will be done through the maximization of the Sharpe ratio, where two scenarios are proposed: one where short selling is allowed and one where investors are only allowed to hold long positions on their portfolios' stocks. After finding the optimal combinations of weights, the ratios mentioned above are recalculated for these optimal portfolios.

4.1. ESG Performance Impact on Firm's Investment Attraction for the Electric Vehicle Industry

4.1.1. Introduction

This chapter starts with an in-depth analysis of the Electric Vehicle Industry. First, the current overview of the EV Industry is provided in section 4.2.2, with the exploration of industry-specific dynamics, current trends, policy developments, key players and financial data. In section 4.2.3, we address the continuous incorporation of ESG practices in this industry, discussing sustainability initiatives, future developments and firms' sustainability objectives. Lithium-Ion batteries concerns and consequences from irresponsible supply chain management are discussed in section 4.2.4. After a comprehensive background discussion, the subsequent sections concern exclusively to the objective of the study and the research questions. Sections 4.2.5. and 4.2.5.1. present the data used to analyze the Electric Vehicle Industry. Section 4.2.6 delves into the study's first analysis. The Multiple Linear Regression analysis dataset is presented in section 4.2.6.1., followed by the ESG Overall Performance Model analysis (section 4.2.7), addressing the correlation between the ESG overall performance of firms within the EV industry and a firm's value. The section 4.2.8. is intended to further refine this analysis, examining each ESG component. Concluding remarks and additional reflections concerning the Multiple Linear Regression analysis and recommendations for future empirical research are elaborated upon in section 4.2.9. Section 4.2.10. delves into the study's second analysis. The CAPM portfolio dataset is presented in section 4.2.11., and each ESG individual and overall performance portfolio are analyzed from sections 4.2.11.1 to 4.2.11.4. The ESG optimization portfolio is discussed in section 4.2.12, the final section concerning the Electric Vehicle Industry analysis.

4.1.2. Electric Vehicle Industry Overview

The Electric Vehicle industry is experiencing a transformative change due to rapid technological advancements and innovative business models, redefining the automotive ecosystem (McKerracher 2023). Global expenditure on electric vehicles has experienced increased growth ($388 billion in 2022), an increase by fifty-three percent from 2022. Including 2022 data, the total value of EVs sold in the passenger vehicle segment exceeds one trillion (McKerracher 2023). However, the multifaceted implications of the recent war on the adoption of electric vehicles present a complex scenario (McKerracher 2022). On one hand, elevated oil prices may catalyze a shift towards EVs, as consumers seek refuge from high fuel costs. On the other hand, the surge in nickel and other battery metal prices may adversely affect the adoption of electric vehicles by increasing battery costs, consequently delaying price parity between EVs and Internal Combustion Engine (ICE)[8] vehicles. The uncertain economic ramifications of the war are expected to have a mixed impact on EV adoption (McKerracher 2022). The author argues that while the EV market share in percentage terms may benefit, the net effect on global unit sales remains indeterminate. According to the Global EV Outlook Report (2023), in 2022, global EV sales, constituted by BEVs[9] and PHEVs[10], reached a record 10 million units, exhibiting a fifty-five percent increase when compared to 2021. The share of EVs in total sales increased from nine percent in 2021 to fourteen percent in 2022 (IEA 2023), and the global stock of electric cars reached twenty-six million units, a sixty percent increase from 2021, with BEVs constituting approximately seventy percent of the total (IEA 2023). The expansion in the EV market led to China accounting for more than fifty percent of all the electric vehicles, with BEV sales increasing by sixty percent compared to 2021, reaching 4.4 million units, and PHEV

[8] Refers to a vehicle that uses an internal combustion engine for propulsion. The most common fuels for internal combustion engines are gasoline (petrol) and diesel.
[9] Fully electric vehicles that rely exclusively on electric energy stored in a battery pack to power the vehicle's electric motor(s).

sales nearly tripling to 1.5 million units (IEA 2023). Brian Gu, Co-President, and Honorary Vice Chairman of XPENG Motors, stated that EVs see great opportunity for international markets, with a lot of new-entry players. However, as the market starts to consolidate in the next years, many players will not possess the capability, the resources, and the reach to be successful (Bloomberg 2023).

The European EV market exhibited a 15% growth in sales in 2022, amounting to 2.7 million units. BEV sales grew by thirty percent, while PHEV sales experienced a three percent decline. Europe is the second-largest global market for EVs, constituting twenty-five percent of total electric car sales and thirty percent of the global stock (IEA 2023). The General Manager Ford Model e Europe aspires to achieve a complete transition to Battery Electric Vehicles for all passenger vehicles by 2030. Furthermore, by 2035, the German subsidiary envisions its entire product portfolio in Europe to consist exclusively of BEVs. This strategy includes the transformation of the company's industrial footprint to attain carbon neutrality by 2035 (Bloomberg 2023). In the US, EV sales exhibited a fifty-five percent growth in 2022 compared to 2021, primarily driven by BEVs, due to factors such as a more diverse range of models, greater public awareness and improved charging infrastructure, supported by the Bipartisan Infrastructure Law[11] (IEA 2023). As of December 2022, fully electric vehicles constituted seven percent of North American car production, with Tesla as the dominant manufacturer, producing 52,300 vehicles in December. Despite the constraints due to the Inflation Reduction Act, tightening eligibility requirements for purchase incentives, EV sales in the US increased by 60% in the first three months of 2023, compared to 2022. The three major markets for the EV

[11] Passed by the US Congress, and as enacted in the Infrastructure Investment and Jobs Act, it allocates approximately $1.2 trillion over eight years to fund various infrastructure projects and improvements across the country (United States Congress 2021).

industry – China, Europe, and the US – accounted for approximately ninety-five percent of global sales (IEA 2023).

4.1.3. ESG Practices in the Electric Vehicle Industry

There has been a rapid rise in international initiatives and pledges targeting electromobility, reflecting global governmental determination to hasten the transition towards zero-emission transportation (IEA 2023). Established during the Conference of the Parties (COP 27), the Accelerating to Zero (A2Z) Coalition objective is to achieve a global transition to zero-emission vehicles by 2040. The coalition underscores the need for strong policies, bold commitments, and increased investment in research, manufacturing, supply chains, infrastructure, and development assistance to enable a global transition to ZEVs. In the context of the growing commitment to electric vehicles and zero-emission transportation, automotive manufacturers have set ambitious targets for the expansion of BEV production and sales. Volkswagen has already advanced its goal for fully electric production to 2033 in Europe and Ford aims to establish a large commercial vehicle battery production site in Europe (Ford Motor Company 2022).

4.1.4. Lithium-Ion batteries, Cobalt Mining, and its Implications to ESG

The production of Lithium-Ion batteries, essential for the operation of EVs, requires the mining and processing of critical mineral resources, such as cobalt manganese, graphite and lithium. Given their expected durability, Lithium-Ion batteries are anticipated to reach the end of their functional lives in approximately a decade (Gaines 2014). Doshi (2020) presents a critical analysis of the widely held perception that electric vehicles are unequivocally environmentally sustainable, underscoring the propensity to overstate the extent to which EVs mitigate carbon dioxide emissions. The adoption of EVs in regions where electricity generation relies heavily on high-carbon sources may be counterproductive. In such cases, EVs only move emissions away from the road, rather than reducing them globally (Hawking, Singh, Majeau-Bettez, and Strømman 2012). Hawking et. al., argue that the emission shifts instigated by the adoption of EVs may represent both opportunities and challenges for policymakers and stakeholders. While EVs can aggregate emissions at a few point sources[12], the indirect nature of these emissions raises questions about life cycle thinking and the extent of control and oversight that should be exerted across production chain. Doshi (2020) also highlights the often-overlooked social consequences associated with the production of EVs. The Democratic Republic of the Congo (DRC) has witnessed a surge in small-scale or "artisanal" cobalt mining, often characterized by hazardous working conditions and child labor exploitation. In an investigation conducted by Amnesty International and Afrewatch in 2015, it was revealed that cobalt miners, including children, were exposed to cobalt-containing dust, leading to the development of many respiratory diseases (Amnesty International 2016). According to Tesla's Annual Environmental Impact Report, the company adopts a "Zero Tolerance" policy towards child labor and has dispatched a delegation to scrutinize the mining conditions in the DRC (Tesla 2020). Since the publication of the 2016 report on cobalt sourcing, there has been significant progress in addressing these issues, with the formation of the Responsible Cobalt Initiative. However, Baumann-Pauly (2023) study posits that stakeholders in the automotive, battery, and electronics sectors have not sufficiently implemented measures that ensure that the cobalt supply chain management is free from poor working conditions and child labor.

[12] Refer to power plants and mines.

4.1.5. Data Description

The present study incorporates two distinct data sets, one for the Multiple Linear Regression analysis, further detailed in section 4.2.6.1, and one for the Capital Asset Pricing Model analysis, as elaborated in section 4.3.1.

4.1.5.1. ESG Data Set

The ESG data set for the Electric Vehicle Industry follows the rationale outlined previously in section 3.1, and encompasses a five-year period, from 2017 to 2021. To ensure a comprehensive and representative ESG data set within this specific industry, data was collected on a global scope, with a market capitalization threshold of $1 billion USD.

Applying these criteria, a total of 42 tickers were initially identified. However, after assessing the availability of complete data, the final sample size comprised 29 tickers. The ESG individual and overall scores were collected as of February 15th, 2023. Individual ESG scores were collected according to the ticker of each company, and the ESG overall scores were calculated as the weighted average of each ESG component for the respective year.

4.1.6. Multiple Linear Regression Analysis

4.1.6.1. MLR Data Set

The data is comprised of 116 observations. The range for the criterion variable, $q(t)_i$, and the explanatory variables spans from 2018 to 2022. Both ESG individual and overall scores span from 2018 to 2022, as explained in sections 3.2.4 and 4.1.4.1. The explanatory variables are expressed in absolute values, $MKTCap_i$ and $RD(adj.)_i$, are in millions of $USD. The explanatory variables LEV_i and SG_i are expressed in percentage.

4.1.7. ESG Overall Performance Model Analysis

4.1.7.1. Model Assumptions Validation

Autocorrelation

The Durbin-Watson statistic (appendix Table 3.3.) is 2.023, $DW \approx 2$, indicative of no autocorrelation in the residuals. Thus, the residuals are independent, and we fail to reject the Durbin-Watson test null hypothesis. Hence, the model satisfies the assumption of independent errors, and the estimates of the regression coefficients are likely to be unbiased and efficient.

Normality

This section focusses on the evaluation of the normality assumption of residuals in the ESG Overall Performance Model. Observing the histogram of $q(t)_i$, (appendix Chart 3.1.), it exhibits a normal distribution (bell-shaped curve), possible due to the natural logarithm transformation applied to the original q_i values, exhibiting no significant deviations from normality. Analyzing the Normal P-P Plot of Regression Standardized Residuals (appendix Chart 3.2.), it is observed that the close alignment of the data points with the diagonal line provides strong evidence that the standardized residuals exhibit a normal distribution. Based on the histogram of the residuals and the Normal P-P Plot of Regression Standardized Residuals, we conclude that the residuals follow a normal distribution, and the normality assumption is satisfied.

Multicollinearity

The analysis of multicollinearity within the model is conducted in two parts. First, an examination of the Variance Inflation Factor Statistics (VIF) (appendix Table 3.5.) and the Collinearity Tolerance is performed, followed by an assessment of the Collinearity Diagnostics Table (appendix Table 3.6.), previously delineated in section 3.2.7. Analyzing the VIF

Statistics, it is observed that no variable surpasses the threshold value of 10[13] (Bowerman and O'Connel 1990), with values ranging from approximately 1.25 to approximately 3.34. Adopting a more conservative perspective and applying a threshold of 3, it is observed that the sole variable exceeding this value is $SIZE_i$, with a VIF of 3.339. Given that it remains the only variable exhibiting a VIF above the conservative threshold, and the value does not surpass the standard threshold of 10, there is no significant collinearity, and it is not necessary to remove this variable from the model. Analyzing the Collinearity Tolerance, no value falls below the critical threshold of 0.25, further reinforcing the absence of significant collinearity within the explanatory variables. Assessing the Collinearity Diagnostics Table, specifically the Condition Index (CI), it is observed that Dimension 8 exhibits a $CI > 30$. Upon further examination of the Variance Proportions (VP) of the explanatory variables within this dimension, only $SIZE_i$ demonstrates a $VP > 0.5$. Given that there are no two explanatory variables in this dimension that simultaneously exhibit a $VP > 0.5$, there is no significant collinearity within the explanatory variables of the model.

Linearity and Homoscedasticity

In this section, we examine the assumptions of Linearity and Homoscedasticity. The scatterplot of residuals (appendix Chart 3.3.), computed by $y = ZRESID$ and $x = ZPRED$, demonstrates that the Standardized Residuals and the Standardized Predicted Values of $q(t)_i$ lie within the acceptable range, exhibiting values between -2.0 and 3.0, for the *y*-axis, and between -1.0 and 1.0, for the *x*-axis. Visually examining the scatterplot of residuals leads to the conclusion that Heteroscedasticity is present, as the points distribute similarly to a funnel-shaped form. This is further substantiated by the Modified Breusch-Pagan test (appendix Table 3.8.) and the Cook-Weisberg test (appendix Table 3.9.), both of which test the null hypothesis that the Variance of

---

[13] The inverse of Collinearity Tolerance, i. e., $\frac{1}{0.1}$

the Errors does not depend on the values of the explanatory variables. Given both extremely low p-values (< 0.001) in both tests, the null hypothesis is rejected, $\forall\ \alpha$. Examining Linearity, the presence of a discernible pattern in the scatterplot of residuals suggests that this assumption is not satisfied. Upon analyzing the scatterplot of each explanatory variable individually, Linearity is observed for some of the explanatory variables, suggesting that the model manifests partial linearity between the explanatory variables and $q(t)_i$. Consequently, it is reasonable to conclude that the current model still offers valuable insights on examining the correlation between a firm's ESG overall performance and the criterion variable, q_i. To address the presence of Heteroscedasticity, parameter estimates with robust standard errors were employed with the heteroskedasticity-consistent standard error estimator (HC3)[14] method (appendix Table 3.11.). This method presents a more accurate and reliable interpretation of the correlation between ESG_i and $q(t)_i$ in the presence of Heteroskedasticity and thus, in the next section, the interpretation of the significance of the individual coefficients is examined accordingly to the application of this method.

4.1.7.2. Descriptive Statistics

The criterion variable, $q(t)_i$, undergoes a natural logarithm transformation. Therefore, the reported mean of 0.129 (appendix Table 3.1.), as well as the standard deviation of 0.455 correspond to the transformed dataset. To derive insights regarding the original data, an inverse transformation is applied. Consequently, by employing the exponential functional, an estimated

---

[14] $HC3 = (X'X)^{-1}X'diag\left[\frac{e_i^2}{(1-h_{ii})^2}\right]X(X'X)^{-1}$, whereas:
X is the matrix of explanatory variables in the regression model.
X' is the transpose of the matrix of explanatory variables.
$diag$ refers to diagonal matrix, a square matrix where all elements outside the main diagonal are equal to zero.
e_i^2 represents the squared residuals.
h_{ii} is the leverage of the i-th, the i-th diagonal element of the hat matrix.

geometric mean[15] of approximately 1.137 is obtained, which suggests that the EV firms encompassed within the sample exhibit, on average, a $q_i > 1$, implying that, on average, are perceived by the market as having high growth potential, manifesting a marginally elevated Market Value of Assets relative to their Replacement Cost of Assets, translating into an incentive to invest, as previously explained in section 3.2.2. The geometric standard deviation[16], approximating 1.576, indicates a moderate degree of variability among the sampled firms. The mean ESG_i for the firms within the EV sample is 3.6121, implying that, on average, the firms within the EV sample have ≈ 3.6 as the ESG overall score, with a standard deviation of 0.9687, indicating a moderate degree of variability in the ESG performance scores. The mean LIQ_i for the firms in the EV sample is 1.2809, with a standard deviation of 0.3372. This suggests that, on average, firms exhibit a liquid balance sheet, with more current assets than current liabilities. The $MKTCap_i$ mean is 40,707.57 thousand $USD, with a standard deviation of 43,387.67 thousand $USD. The elevated standard deviation indicates that there is a wide dispersion of the data around the mean, which translates into a diversified sample, with firms exhibiting a Market Capitalization that far surpass the average, while others demonstrate lower values. The LEV_i mean is ≈ 1.0843, with a standard deviation of ≈ 0.9487, indicating that, on average, the sampled firms possess more debt than equity, relying on debt financing to a greater extent than equity financing for their operations and growth initiatives. Observing Research and Development Expenditure (adj.), it exhibits a mean of ≈ 2,864.83 thousand of $USD, with a standard deviation of ≈ 3,660.56 thousand $USD, representing a significant degree of dispersion in R&D expenditure among the sampled firms. This indicates that there is a great level of disparity in investment by the firms in this industry, as the standard deviation is higher than μ. The mean sales growth is ≈ 6.354%, with a standard deviation of ≈ 18.058%, suggesting

[15] $Geometric\ Mean = e^{0.1285} \approx 1.137$
[16] $Geometric\ Std.Deviation = e^{0.4551} \approx 1.576$

that, on average, firms exhibit a positive sales growth throughout the range of the observations. However, the notable high standard deviation indicates a substantial degree of heterogeneity among the sampled firms, which is to be expected, as they operate in different markets, have different business strategies and different risk profiles. However, this highlights the importance of maintaining a diversified sample in the context of the current investigation. By accounting for this heterogeneity, the sample is more diverse, and may better capture the relationship between ESG performance and firm's value.

4.1.7.3. Model Summary

The model summary table (appendix Table 3.3.) exhibits a multiple correlation coefficient, R, of 0.82, indicating a strong positive correlation between $q(t)_i$ and the predictor variables. The coefficient of determination, R^2 is 0.672. Therefore, ≈ 67% of the variance of $q(t)_i$ can be explained by the model predictors. Considering the context of the study, where a varied degree of unpredictability is present, initially, given the nature of the Electric Vehicle Industry, and subsequently, due to the inherent complexity of the sample, where each firm operates under its distinct business model, has different internal policies, its own market background, social context, and financial sphere, it can be concluded that the coefficient of determination exhibits a high degree of predictive power. Controlling for the number of predictors, the model explains ≈ 65.1% of the variability in $q(t)_i$.

4.1.7.4. ANOVA

The F statistic (appendix Table 3.4.) of the model exhibits a value of 31.635, with a p-value < 0.001, indicating statistical significance to reject ANOVA H0, $\forall\ \alpha$. Therefore, at least one of the predictor variables significantly contributes to predict $q(t)_i$.

4.1.7.5. Interpretation of Results

This section discusses the main findings concerning the present study hypothesis, predicated upon the Parameter Estimates with Robust Standard Errors Table (appendix Table 3.11.), providing a more accurate interpretation by accounting for Heteroscedasticity, as detailed previously in section 4.2.4.4. The Robust Standard Error of $\beta_1 ESG_i$, 0.027, indicates a relatively high level of precision in the coefficient estimate, strengthening its statistical significance. The model illustrates a statistically significant, negative correlation between a firm's ESG overall performance and a firm's value (β $= -0.071, t = -2.668, p - value = 0.009$), resulting in the rejection of H0, $\forall\ \alpha$. Therefore, a firm's overall ESG performance is not independent from q_i. Given that q_i undergoes a natural logarithm transformation, the β of a firm's overall ESG score is interpreted in terms of percentage change, $(e^{-0,071} - 1) * 100\ \approx\ -6.85$, indicating that, for a one-unit increase in ESG_i, q_i is expected to decrease by approximately 6.85%. Despite the seemingly counterintuitive results, as we might anticipate firms adopting more sustainable practices to have increased value, it is crucial to take into consideration the specific industry under analysis. One can argue that a potential explanation might lie in the percentage of ESG disclosure of each firm, and thus, the ESG overall performance, not reflecting the full disclosure, do not represent the real ESG performance. However, research conducted by Clarkson et al. (2014) concludes that companies that disclose more information regarding their ESG practices consistently attain higher ESG scores across all dimensions, compared to firms disclosing less information, implying that ESG reporting is directly related to a higher ESG performance. To better understand and provide a comprehensive rationale for the negative correlation between a firm's overall ESG performance and q_i, it is important to also examine the ESG components individually. The next sections focus on the analysis of the ESG

Individual Performance model, to provide a more comprehensive conclusion to the present study.

4.1.8. ESG Individual Performance Model Analysis

4.1.8.1. Model Assumptions Validation

Autocorrelation

The Durbin-Watson (DW) statistic for the ESG Individual Performance model presents a value of 1.98 (appendix Table 4.3.). As the DW statistic is approximately 2, we reject the Durbin-Watson test null hypothesis, concluding that the model satisfies the assumption of independent errors.

Normality

The histogram of $q(t)_i$ exhibits a roughly bell-shaped curve, (appendix Chart 4.1.), despite the deviation observed in the right limit. Upon inspection of the Normal P-P Plot of Regression Standardized Residuals (appendix Chart 4.2.), it is observed that the data points closely trace the diagonal line, strongly indicating a normal distribution, more pronounced when comparing to the ESG Overall Performance model. Therefore, we conclude that the residuals are normally distributed, and the normality assumption is satisfied.

Multicollinearity

All variables remain below the standard threshold $VIF \geq 10$, with $SIZE_i$ as the only explanatory variable exceeding the conservative threshold $VIF \geq 3$ (appendix Table 4.5.), exhibiting a VIF of 3.627, not falling below the critical $CT \leq 0.25$. Examining the Collinearity Diagnostics Table (appendix Table 4.6.), Dimension 10 exhibits a $CI > 30$, with only $SIZE_i$ demonstrating a $VP > 0.5$. The same conclusion for the ESG Overall Performance model is derived, and thus, the ESG Individual Performance model does not exhibit significant collinearity within the explanatory variables.

Linearity and Homoscedasticity

The Scatterplot of Residuals and the Standardized Predicted Values of the criterion variable also fall within the acceptable bounds, -1.0 to 1.5, for the *y*-axis, and -2.0 to 3.0, for the *x*-axis. The ESG Individual Performance model presents the same conclusion of the ESG Overall Performance model concerning heteroscedasticity and linearity (appendix Chart 4.3.), with a p-value < 0.001 in both heteroscedasticity tests, and a discernible pattern in the scatterplot of residuals. Both Modified Breusch-Pagan and Breusch-Pagan tests (appendix Table 4.8, Table 4.9) corroborate the presence of heteroscedasticity, and thus, it is addressed with Parameter Estimates with Robust Standard Errors, applying the HC3 method, as previously detailed in section 4.2.3.4.

4.1.8.2. Descriptive Statistics

The Descriptive Statistics Table (appendix Table 4.1.) of the ESG Individual Performance model provides valuable information for the objective of the present study since it examines each ESG component individually. The mean Environmental score is $\approx$ 2.28, with a standard deviation of $\approx$ 1.44, indicating that, on average, the sampled firms exhibit an Environmental score of 22.8, with a relatively high level of variation around the mean, which reflects substantially different levels of commitment in implementing environmentally sustainable practices. Despite the environmental benefits associated with the reduction of GHG emissions, the production process of EVs, particularly the manufacturing of batteries, may negatively impact the environment. Habitat disruption, soil contamination, and water pollution might be environmental issues derived from the sourcing of cobalt and lithium for the lithium-ion batteries. Furthermore, the transformation of these raw materials into batteries require energy-intensive production processes. According to a review of studies evaluating the environmental impact of Li-Ion battery production (Peters et al. 2017), the authors found that, on average, the production of batteries of the 36 studies reviewed required 328 kWh of CED[17], while the average monthly consumption of electricity for a U.S. residential was ≈ 886 kWh in 2021 (U.S. Energy Information Administration 2021). Finally, Li-Ion batteries contain hazardous materials that present health risks if not managed properly at the end of their life cycle, as improper disposal practices result in the release of toxic materials.

The mean Social score is ≈ 3.20, with a standard deviation of ≈ 1.54. Electric Vehicle companies, on average, exhibit a slightly higher social performance than the environmental performance, as well as higher variation around the mean value, implying a broad range of social performance between EV firms. One factor that could potentially be linked to the variance in social performance across the firms is the supply chain management practices. EV socially aware manufacturers have enhanced their supply chain transparency and fostered sourcing practices, including rigorous supplier audits, collaborations with non-governmental organizations and invested in alternative technologies that reduce the reliance on cobalt. However, the precarious labor conditions and ethical practices, including child labor, documented in the DRC, underscore the need for EV manufacturers (and governments) to be proactive in the enhancement of its Corporate Social Responsibility. Finally, the mean Corporate Governance score is ≈ 5.35, with a standard deviation of ≈ 0.77, indicating a less degree of variation in the Governance performance of EV firms, compared to Environmental and Social performance, potentially attributed to the more universal comprehension of Governance standards. The more consistent Governance scores may reflect the industry adoption of these established practices, contributing to a relatively robust governance structure within the EV industry.

[17] Defined by the total primary energy demand, constituted by the Cumulative Energy Consumption, and the Cumulative non-Energy Demand.

4.1.8.3. Model Summary

The ESG Individual Performance model summary table (appendix Table 4.3.) exhibits a multiple correlation coefficient of 0.825. Additionally, the proportion of the total variance in $q(t)_i$ that can be explained by the predictors is 0.681. Accounting for the number of predictors, the model explains ≈ 65.4% of the variability of the criterion variable. Therefore, when comparing to the previous model, analyzing each ESG component individually slightly enhances the explanation of Tobin's q.

4.1.8.4. ANOVA

The F statistic of the model (appendix Table 4.4.) exhibits a value of 25.142, with a p-value < 0.001. Therefore, the explanatory variables exhibit statistical significance to the prediction of $q(t)_i$.

4.1.8.5. Interpretation of Results

Starting with environmental performance, the model demonstrates a statistically significant, negative correlation between a firm's Environmental performance within the EV industry and a firm's value (appendix Table 4.11.) ($\beta = -0.061, t = -2.487, p - value = 0.014$). For a one-unit increase in the Environmental performance of a firm within the EV industry, q_i is expected to decrease by approximately 5.92%, analogously to the conclusion presented in the ESG overall performance model. Regarding social performance, the model shows a non-significant correlation between a firm's social performance within the EV industry and its value ($p - value = 0.942$), and thus, EV industry firms' social performance is independent from q_i. Concerning corporate governance performance, the model also exhibits a non-significant correlation ($p - value = 0.933$). Therefore, EV industry firms' corporate governance performance is independent from q_i.

4.1.9. Conclusions, Considerations and Further Research

Significant insights can be discerned about the ESG Overall Performance model with the conclusions provided by the analysis of the ESG Individual Performance model. As observed in the individual model, social performance and corporate governance performance do not demonstrate statistical significance to the perceived value of a firm within the Electric Vehicle Industry, with $p - values \approx 1$. Other predictors, such as Market Capitalization, Leverage, and Sales Growth, are statistically significant, demonstrating a positive correlation with firm's value. The EV industry is characterized by its dynamic nature, exhibiting rapid growth, with a high level of technological advancement. However, it is also a non-matured industry, with greater uncertainty, increased volatility and associated risk. Consequently, it is conceivable that the explanatory variables mentioned previously may be the key determinants of q_i, instead of ESG performance. Furthermore, considerable environmental concerns and challenges within the EV industry are still present. The lifecycle of Li-Ion batteries, from the extraction of raw materials through to production and recycling, has been one of the major concerns. A more skeptical perspective would then question the environmental practices within the EV industry. To disprove this view, one counterargument would be indicating Tesla as an example of a firm with a relatively superior q_i, as well as a relatively better ESG performance. However, it is important to note that, in 2021, Tesla accounted for nearly 45% of the total Market Capitalization within the globally scoped sample in our study. Moreover, a comparison of the carbon footprints of the C40 Recharge and the XC40 ICE models (E5 petrol) (Volvo Carbon footprint report 2021) revealed that the first model has a fifteen percent lower carbon footprint than the XC40 ICE, thirteen percent when using the EU-28 electricity mix, and fifty percent when charged with wind power. However, the GHG emissions for the "Materials production and refining" phase, not including the production of Li-ion battery modules, are approximately 30% higher for the EV model, compared to the ICE one, due to the increased material requirements and the higher proportion of aluminum used. Considering the Li-Ion battery modules, the GHG emissions are nearly 70% higher. Nevertheless, considering the inherent intricacies of the explanatory variables, and acknowledging the identified partial linearity within both models, additional research may be needed. A potential direction for future research lies in the development of a Generalized Additive Model (GAM), utilizing the R statistical software. The central advantage of these models lies in their capacity to model non-linear relationships between the criterion and explanatory variables, with an increased level of flexibility and adaptability compared to linear regression models.

4.1.10. CAPM Analysis

4.1.11. Portfolio Data Set

The selection criteria for the portfolio construction is based on the average ESG performance over the most recent three-year period for which ESG data is available. The three-year averages are calculated for each dimension, as well as for the ESG overall score, and the six highest and six lowest scoring stocks are selected to form each portfolio. Stocks with incomplete share price data for the designated period are excluded from the portfolio and replaced with the next highest (lowest) scoring stocks that meet the selection criteria. To limit the influence of outliers, the study also excludes stocks in the 1st and 99th percentiles of returns from the data set. Eight portfolios are created, each comprising six stocks. For this analysis, an equal weight distribution is assumed for the portfolios. The calculation of average annual return and average annual standard deviation is based on returns from January 2018 to December 2022. The STOXX Global 1800 index is used as benchmark for the market portfolio.

4.1.11.1. Environmental Portfolios

Results

The upper environmental portfolio presents an average annual return of -2.32% (appendix Table 26), with an annual standard deviation of 28.53%, leading to a Sharpe Ratio of -21.72%. The lower environmental portfolio presents higher return and lower risk, with an average annual return of 0.43% (appendix Table 28) and an annual standard deviation of 24.62%, leading to a slightly better Sharpe Ratio of -14.01%. The β of the upper portfolio is approximately 1.287, while the lower exhibits a β of 0.901. The upper portfolio presents a Jensen's Alpha of -9.79%, while the lower portfolio presents a slightly higher α of -5.97%. Both portfolios are underperforming the expected returns given their level of systematic risk, not generating enough return to compensate for the respective risk levels. The Treynor Ratio addresses the excess return per unit of systematic risk, measured by β . Hence, the upper portfolio presents a ratio of -4.82%, while the lower portfolio presents a ratio of -3.83%, indicating that the lower environmental portfolios provide a better risk-adjusted return in relation to systematic risk.

Analysis

The results derived from the Environmental portfolios imply that higher Environmental performance within firms in the Electric Vehicle Industry does not necessarily translate into better financial performance, at least in the short-term. Firms with environmentally better practices show a lower level of risk management, having higher systematic risk, higher average annual standard deviation, and lower average annual return, compared to firms with lower Environmental performance. However, firms in the upper environmental portfolio hold high ranks in Research and Development Expenditure within the industry, which may be associated with investments in environmental sustainability. While such investments are integral to long-term environmental performance and could potentially generate higher average annual return in the future, they may lead to diminished short-term financial returns, due to its associated costs. Contrastingly, Ford, despite being in the upper environmental portfolio, is one of the firms within the sample that less invest in R&D, which might explain its higher positive returns. Furthermore, being one of the oldest automakers and having a significant history and experience in the industry, Ford may already have established and matured environmental sustainability, and may no longer need to allocate significant resources towards improving its environmental score. In contrast, the lower environmental portfolio managed to secure a positive average annual return, exhibiting a better risk management, reinforced by a lower β of 0.901 compared to the upper environmental performance portfolio. However, given the current global recent events, such as the war and the pandemic, which have injected significant uncertainty and risk into markets, a portfolio with a lower β may offer an advantage, as they are typically less sensitive to market fluctuations. Therefore, in periods of increased market turbulence and downturns, these portfolios are more resilient. The higher average annual returns observed in the lower environmental portfolio may be because firms are at a different stage of environmental implementation, where investments in sustainability initiatives have not yet begun to impact their financial performance significantly. It can be pointed out that SAIC Motor Corp Ltd. contradicts this point of view, as it shows a negative average annual return. However, closer examination shows that nearly 96.6% of its total risk is specific risk, which is attributed to its internal decisions, not explained by the market.

The negative Jensen's Alpha suggests that both portfolios are underperforming compared to the market. However, the lower environmental portfolio is performing slightly better than the upper environmental portfolio, and firms with lower environmental performance exhibit a slightly better risk-adjusted return, as given through the Sharpe Ratio, even though both present a negative value.

4.1.11.2. Social Portfolios

Results

The upper social portfolio presents a return of 7.51% (appendix Table 30), with a risk, measured by the annual standard deviation, of 24.14%. When compared to the lower portfolio (appendix Table 32), there is a very significant outperformance of the upper portfolio in terms of return. The lower portfolio presents a return of -2.44%, with a risk of 25.03%. This leads to a huge disparity when analyzing the Sharpe Ratio. The upper portfolio presents a ratio of 15.06%, while the lower portfolio presents a negative ratio of 25.23%.

The β for the upper portfolio is 1.101, which leads to a Jensen's α of 0.56%. The lower portfolio presents a β of 0.834, which leads to an alpha of -8.64%. As for the Treynor Ratio, the upper portfolio shows a ratio of 3.3%, while the lower portfolio presents a ratio of -7.57%.

Analysis

Results indicate that both social portfolios have similar levels of total risk. However, the lower social portfolio presents a significantly lower β, below the unity. Therefore, it is possible to infer that the lower social portfolio is exposed to more specific risk, whereas the upper social portfolio, with a β above the unity, has a higher systematic risk. The upper social portfolio exhibits significantly higher average annual returns than the lower portfolio, which could be explained by the public outlash that lower social performance companies are exposed to. Firms with lower social performance may see their reputation affected, which might result in lower operating profits, ultimately having a negative impact on returns. Moreover, this reinforces the higher specific risk observed in the results. Therefore, this leads to a much higher Sharpe Ratio, observed in the upper social portfolio. Jensen's α shows a value very close to zero for the upper social portfolio, translating into a very close position to the equilibrium price. Conversely, the lower social portfolio exhibits a negative α, which means the portfolio is underperforming compared to the market.

4.1.11.3. Governance Portfolios

Results

The upper portfolio shows a return of -1.21% (appendix Table 34), with an annual standard deviation of 26.63%. The lower portfolio presents a superior return of 5.72% (appendix Table 36), while presenting slightly lower risk, with an average annual standard deviation of 25.26%. This leads to a Sharpe Ratio of -19.09% for the upper portfolio and a ratio of 7.31% for the lower portfolio.

The upper portfolio shows a β of 1.228, which leads to a Jensen's Alpha of -8.51% and a Treynor Ratio of -4.14%. The lower portfolio presents a β of 0.976, which leads to a Jensen's Alpha of -0.88% and a Treynor Ratio of 1.89%.

Analysis

The upper governance portfolio exhibits lower average annual returns than the lower portfolio, which could be partially explained by the overlap observed by the upper environment portfolio. Four out of the six firms within the upper environment portfolio are also in the composition of the upper governance portfolio. Assuming the R&D vs environmentally sustainable practices' argument holds, this might explain the lower level of return of the upper portfolio. The total risk of the upper portfolio is slightly higher, partially explained by the higher β, making this portfolio more exposed to the market fluctuations. Even though the lower portfolio presents a lower β, it is possible to infer that this portfolio is more exposed to idiosyncratic risk, which means that this portfolio could benefit from diversification effects. Moreover, the lower portfolio seems to be more attractive from an investor's perspective due to its higher Sharpe Ratio. This is further corroborated by the Jensen's Alpha, as the upper governance portfolio underperforms compared to the market. If an investor were to place their funds in a portfolio that has lower performance compared to the overall market, they would indeed incur more losses than if they directly invested in the market. However, the extent of these losses would be relatively small. In fact, the returns from investing in this lower-performing portfolio would be nearly the same as the returns from investing directly in the market.

4.1.11.4. ESG Portfolios

Results

The upper ESG portfolio presents an annual average return of -0.97% (appendix Table 38), with an annual standard deviation of 25.2%. This leads to a Sharpe Ratio of -19.24%. The lower ESG portfolio presents a lower return, -3.32% (appendix Table 40), but better risk, 23.14%. This leads to a lower Sharpe Ratio of -31.09%. The β of the upper portfolio is 1.151, leading to a Jensen's α of -8.06% and a Treynor Ratio of -4.21%. The Lower portfolio presents a lower β, of 0.76, which leads to a Jensen's Alpha of -9.32%, and a Treynor Ratio of -9.47%.

Analysis

Both portfolios show negative average annual returns, with the upper ESG portfolio presenting slightly higher returns. However, it exhibits considerably lower levels of risk management, as the total and systematic risk are superior. Analyzing the Sharpe Ratio leads to the conclusion that the upper ESG portfolio is more attractive to invest in than the lower ESG portfolio, although an investor would be better off to invest in the risk-free rate, since both portfolios have negative ratios. Similarly, both portfolios present a negative α, which means they are underperforming compared to the market. Additionally, it is possible to infer that both portfolios are overvalued.

4.1.12. ESG Portfolio Optimization

Long-sell Scenario

A description of the portfolio composition and optimal weights is presented on appendix Tables 41 and 43, with the assumption that only long positions are allowed. It is relevant to mention that both portfolios are only composed of one stock.

The optimized ESG upper portfolio presents an average annual return of 7.81% (appendix Tables 42), with an annual standard deviation of 42.64%. This leads to a Sharpe Ratio of 9.22%. The optimized lower portfolio presents a return of 7.33% (appendix Table 44), with a risk of 52.04%. Leading to a Sharpe Ratio of 6.64%.

The β of the upper portfolio is 1.492, which results in a Jensen's Alpha of -0.24% and a Treynor Ratio of 2.63%. The lower portfolios present a β of 0.99, leading to a Jensen's Alpha of 0.69% and a Treynor Ratio of 3.49%.

Short-sell Scenario

The optimization process, assuming short-selling is allowed, requires a further restriction: short-selling in a specific stock cannot exceed by ten times the total amount invested in the portfolio. A detailed summary of the optimal portfolio weights is described in appendix Tables 45 and 47.

The upper portfolio presents an average annual return of 208.07% (appendix Table 46) and an annual standard deviation of 223.01%. This leads to the maximum Sharpe Ratio achieved by this portfolio composition of 91.56%. The lower portfolio presents an average annual return of 208.54% (appendix Table 48), which is very similar to the upper portfolio. However, the risk is far greater, with an annual standard deviation of 361.08%. This leads to the maximum Sharpe Ratio of 56.68%.

The β of the upper portfolio is -1.298, leading to a Jensen's Alpha of 207.81%, as the β of the portfolio is negative, the Treynor Ratio is not useful to be analyzed. The lower portfolio presents a β of 7.789, leading to a Jensen's Alpha of 182.91% and a Treynor Ratio of 26.28.

Analysis

Compared to the equally distributed weights scenario, the scenario where only long positions are allowed shows a significant increase in returns. However, there is also a significant risk in the overall risk. This is explained by the absence of diversification effects since both portfolios are composed of a single stock. Additionally, by analyzing the βs, we can conclude that the lower portfolio is more exposed to specific risk, as it exhibits a higher total risk and a lower β. The upper portfolio presents a better risk-adjusted return, given the superior Sharpe Ratio. Observing Jensen's Alpha, it seems that the lower ESG portfolio is overperforming compared to the market, as opposed to the upper ESG portfolio, which may be indicative of being more attractive. However, one must consider the proportion of the specific risk, as mentioned above. Analyzing the scenario where short selling is allowed, both portfolios present similar levels of return. However, there is an abnormal disparity in risk, reinforced by the disparity in β values. Concerning this specific scenario, given the high negative value of weights, it would not be realistic to be able to realize this portfolio, especially when the initial investment is very high, such as in for institutional investors. Therefore, this amount of short selling would only be possible for low value investments. Given these implications, the purpose of this scenario is to analyze which portfolio is the most attractive, in terms of risk-adjusted returns. By analyzing the Sharpe Ratio, the upper ESG portfolio is more attractive, exhibiting a higher SR. The high level of risk for these portfolios could discourage more risk-averse investors. Nonetheless, this optimal portfolio could be hedged with the risk-free rate to achieve a lower level of risk at the expense of lower return, whilst still maintaining the same value of Sharpe ratio, of 91.56%

5. Conclusion

The last Chapter of this thesis concludes the main findings on the relation between a firm's investment attractiveness and its ESG performance in the European Energy Sector, the European technology sector, and in the Electric Vehicle Industry.

5.1. Summary

The current study investigates the impact of a firm's ESG performance on its investment attractiveness. The methodology employed incorporates two distinct analytical approaches: a Multiple Linear Regression analysis and further support analysis trough ESG performance portfolio construction evaluated through the Capital Asset Pricing Model. The study reveals a significant correlation between the ESG Overall Performance and the perceived value of a firm across all three sectors analyzed. In the European Technology and Energy Sectors, this relationship is positive, implying that a higher ESG performance enhances the value of a firm, as measured by Tobin's Q. Conversely, in the Electric Vehicle Industry, a significant negative correlation is observed, suggesting that higher ESG performance might inversely affect firm value. However, this negative correlation appears to be predominantly influenced by the environmental individual performance, as the social and governance individual performance exhibit no significant correlation with Tobin's Q. Consequently, any conclusions drawn about the correlation between ESG Overall Performance and firm value in the EV Industry should be treated with caution. Diving deeper into the individual dimensions of ESG, the social dimension does not exhibit a significant correlation for all industries analyzed, while the environmental dimension shows a significant correlation in each sector. The environmental individual performance is positively associated with firm's value in the European Technology and Energy Sectors, but negatively related in the EV Industry. The governance individual performance displays a significant positive correlation in the European Technology and Energy Sectors, whereas in the EV Industry, this correlation is non-significant. Regarding the CAPM model, it is concluded that portfolios with better environmental performance show lower returns for the EV industry and the European technology sector, which could be attributed to the increased expense in the short term to improve greener practices within a firm. The governance portfolios present higher performance metrics for the technology sector, whilst the opposite happens for the energy sector and EV industry. Finally, optimized ESG portfolios that presents higher ESG scores are more attractive to invest in the technology sector and EV industry, as given by the superior maximum Sharpe ratio. However, in the energy industry the opposite conclusion is reached.

5.2. Further Research

The main findings presented in this study could be further boosted and more accurate models could be developed with the evolution of firms' sustainability reporting, as well as a consolidation on rating agencies methodologies. As ESG is a relatively new concept, many firms still present a low disclosure score of their sustainability practices. Furthermore, rating agencies lack comparability and standardization in the way scores are computed. Hence, an improvement in both these areas will increase the reliability and accuracy in the way ESG performance is measured, leading to more accurate scores that will increase the relevance of the presented models. Furthermore, it is relevant to notice that the EV industry is still far from maturity, meaning there is a high degree of disruption and uncertainty. This has an impact on the investment attractiveness of this industry, as more risk averse investors will not deploy their capital in this industry. The European technology sector presents a high number of "unicorns," which upon the entrance of these companies on the stock market, the dataset available will be expanded, making it possible to realize a more robust analysis. The expansion of the dataset, by either including more companies or increasing the defined range, will result in a higher number of observations, leading to a more robust MRL model.

On a final note, CAPM is a widely used model, but it relies on unrealistic assumptions, the expansion of the dataset through the inclusion of more companies could make possible the use of other models, like Fama-French, which could lead to a better analysis of portfolio performance. In addition, the MLR is a good starting point to observe the relationship between ESG performance and a firm's investment attractiveness. However, due to the complexity of said relationship, the Generalized Additive Model (GAM) could provide more accurate insights, as it captures the complexity of the explanatory variables by considering non-linear relationships.

References

1. Almeida, Heitor, Murillo Campello, and Michael S. Weisbach. 2005. The Cash Flow Sensitivity of Cash. *Journal of Finance*, 59(4): 1777-1804. DOI: https://doi.org/10.1111/j.1540-6261.2004.00679.x.
2. Amel-Zadeh, Amir, and George Serafeim. 2017. "Why and How Investors Use ESG Information: Evidence from a Global Survey." *Harvard Business School*, 17-079 http://nrs.harvard.edu/urn-3:HUL.InstRepos:30838135.
3. Amnesty International. 2016. *This Is What We Die For*: *Human Rights Abuses In The Democratic Republic Of The Congo Power The Global Trade In Cobalt*. Amnesty International Ltd, International Secretariat, United Kingdom. https://www.amnesty.org/en/wp-content/uploads/2021/05/AFR6231832016ENGLISH.pdf.
4. Arslan-Ayaydin, Özgür, and James Thewissen. 2016. "The Financial Reward for Environmental Performance in the Energy Sector." *Energy & Environment* 27, (3–4): 389–413 https://www.jstor.org/stable/90006620.
5. Bardhan, Indranil, Viswanathan Krishnan, and Shu Lin. 2013. "Research Note: Business Value of Information Technology: Testing the Interaction Effect of IT and R&D on Tobin's Q." *Information Systems Research* 24, (4): 1147–61 http://www.jstor.org/stable/24700299.
6. Baumann-Pauly, Dorotheé. 2023. "Cobalt Mining in the Democratic Republic of the Congo: Addressing Root Causes of Human Rights Abuses." New York University and Geneva Center for Business and Human Rights. https://static1.squarespace.com/static/5b6df958f8370af3217d4178/t/63e2dc7bad25b047da9100d7/1675811964954/NYU+CBHR+Cobalt+Mining_FINAL+Feb7.pdf.

7. Becker, Jan-Michael, Christian M. Ringle, Marko Sarstedt, and Franziska Völckner. 2015. "How Collinearity Affects Mixture Regression Results." *Marketing Letters* 26, (4): 643–59. http://www.jstor.org/stable/24571623.

8. Berg, Florian, Julian F. Kölbel, and Roberto Rigobon. 2022. "Aggregate Confusion: The Divergence of ESG Ratings." *Review of Finance*, 26(6): 1315-1344. https://doi.org/10.1093/rof/rfac033.

9. Bernow, Sara, Bryce Klemoner, and Clarisse Magnin. 2017. "From 'why' to 'why not': Sustainable investing as the new normal" McKinsey&Company https://www.mckinsey.com/industries/private-equity-and-principal-investors/our-insights/from-why-to-why-not-sustainable-investing-as-the-new-normal

10. Bloomberg. 2023. "Bloomberg Markets: The Close" Filmed May 2023, n.d. BLOOMBERG TV, 2:13:43. https://www.bloomberg.com/news/videos/2023-05-06/-bloomberg-markets-the-close-05-05-2023-video.

11. Bloomberg. "ESG Data | Bloomberg Professional Services." Accessed April 18, 2023.https://www.bloomberg.com/professional/product/esg-data/?tactic-page=747672.

12. Bloomberg, 2023. "Ford Europe EV Boss Says Costs Coming Down" Filmed January 2023, Filmed January 2023, Cologne. BLOOMBERG TV, 11:41. https://www.bloomberg.com/news/videos/2023-01-30/ford-s-general-manager-martin-sander-video.

13. Boffo, R., and R. Patalano. 2020. "ESG Investing: Practices, Progress and Challenges". OECD Paris. www.oecd.org/finance/ESG-Investing-Practices-Progress-and-Challenges.pdf

14. Bowerman, Bruce L., and Richard T. O'Connel. 1990. *Linear Statistic Models: An Applied Approach*. Belmont: Duxbury.

15. Brandon, Rajna Gibson, Phillip Krueger, and Peter Steffen Schmidt. 2021. "ESG Rating Disagreement and Stock Returns." *Financial Analysts Journal*, 77(4): 104–27. https://doi.org/10.1080/0015198X.2021.1963186.

16. Brigham, Eugene F., and Michael C. Ehrhardt. 2016. *Financial Management: Theory & Practice*. Boston, MA: Cengage Learning.

17. Cadbury, Adrian. 1992. *Report of the Committee on the Financial Aspects of Corporate Governance*. London, UK: Gee Publishing.

18. Caldwell, Lynton K. 1984. "Political Aspects of Ecologically Sustainable Development." *Environmental Conservation*, 11(4): 299-308. https://doi.org/10.1017/S037689290001465X.

19. Carter, Craig R., and Dale S. Rogers. 2008. "A Framework of Sustainable Supply Chain Management: Moving Toward New Theory." *International Journal of Physical Distribution & Logistics Management*, 38(5): 360-387. https://doi.org/10.1108/09600030810882816.

20. Chatterjee, Samprit, and Ali S. Hadi. 2015. *Regression Analysis by Example*. Hoboken, NJ: John Wiley & Sons.

21. Cheng, Beiting, Ioannis Ioannou, and George Serafeim. 2014. 'Corporate Social Responsibility and Access to Finance: CSR and Access to Finance'. *Strategic Management Journal*, 35(1): 1–23. https://doi.org/10.1002/smj.2131.

22. China SIF. 2019. *China Sustainable Investment Review 2019*. China Social Investment Forum. https://en.chinasif.org/products/%E4%B8%AD%E5%9B%BD%E8%B4%A3%E4%BB%BB%E6%8A%95%E8%B5%84%E5%B9%B4%E5%BA%A6%E6%8A%A5%E5%91%8A2019

23. CFI. 2022. “Market Capitalization - Learn About Market Cap & How to Calculate It.” Accessed April 24, 2023. https://corporatefinanceinstitute.com/resources/valuation/what-is-market-capitalization/.

24. Chatterji, Aaron K., Rodolphe Durand, David I. Levine, and Samuel Touboul. 2016. “Do Ratings of Firms Converge? Implications for Managers, Investors and Strategy Researchers: Do Ratings of Firms Converge?” *Strategic Management Journal*, 37(8): 1597–1614. https://doi.org/10.1002/smj.2407.

25. Chauvin, Keith W., and Mark Hirschey. 1993. “Advertising, R&D Expenditures and the Market Value of the Firm.” *Financial Management* 22, (4): 128–40. https://www.jstor.org/stable/3665583?searchText=2.%20Chauvin%2C%20Keith%20W.%2C%20and%20Mark%20Hirschey.%20(1993&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3D2.%2509Chauvin%252C%2BKeith%2BW.%252C%2Band%2BMark%2BHirschey.%2B%25281993&ab_segments=0%2Fbasic_search_gsv2%2Fcontrol&refreqid=fastly-default%3Af784ec6cf02fa2712885e67b6961f0e7.

26. Christensen, Hans B., Luzi Hail, and Christian Leuz. 2021. “Mandatory CSR and Sustainability Reporting: Economic Analysis and Literature Review”. *Review of Accounting Studies*, 26(3): 1176–1248. https://doi.org/10.1007/s11142-021-09609-5.

27. Chung, Kee H., and Stephen W. Pruitt. 1994. “A Simple Approximation of Tobin’s q.” *Financial Management*, 23(3): 70-74. https://doi.org/10.2307/3665623.

28. Clark, Gordon L., Andreas Feiner, and Michael Viehs. 2015. "From the Stockholder to the Stakeholder: How Sustainability Can Drive Financial Outperformance." *SSRN*. https://ssrn.com/abstract=2508281.

29. Clarkson, Peter M., Yue Li, Gordon D. Richardson, and Florin P. Vasvari. 2008. “Revisiting the Relation between Environmental Performance and Environmental

Disclosure: An Empirical Analysis". *Accounting, Organizations and Society* 33 (4–5): 303–27. https://doi.org/10.1016/j.aos.2007.05.003.

30. Constanza, Robert, Ralph d'Arge, Rudolf de Groot, Stephen Farber, Monica Grasso, Bruce Hannon, Karin Limburg, et al. 1997. "The value of the world's ecosystem services and natural capital." *Nature*, 387(6630): 253-260. https://doi.org/10.1038/387253a0.
31. Crane, Andrew, Guido Palazzo, Laura J. Spence, and Dirk Matten. 2014. "Contesting the Value of "Creating Shared Value." *California Management Review*, 56(2): 130-153. https://doi.org/10.1525/cmr.2014.56.2.130.
32. Dahllöf. 2021. "Carbon footprint report – Volvo C40 Recharge." Accessed May 3, 2023. https://www.volvocars.com/images/v/-/media/Market-Assets/INTL/Applications/DotCom/PDF/C40/Volvo-C40-Recharge-LCA-report.pdf
33. Daly, Herman. E. 1996. "Part I. Economic Theory and Sustainable Development: Introduction." In *Beyond Growth: The Economics of Sustainable Development*. Beacon Press.
34. Daly, Herman. E, and Joshua Farley. 2011. *Ecological Economics: Principles and Applications*. Island Press.
35. Damodaran, Aswath. 2012. *Tools and Techniques for Determining the Value of Any Asset*. Hoboken, NJ: John Wiley & Sons.
36. DiMaggio, Paul J., and Walter W. Powell. 1983. "The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields." *American Sociological Review* 48, (2): 147–60. https://doi.org/10.2307/2095101.
37. Dimson, Elroy, Oğuzhan Karakaş, and Xi Li. 2015. "Active Ownership." The Review of Financial Studies, 28(12): 3225-3268. https://doi.org/10.1093/rfs/hhv044.

38. Donaldson, Thomas, and Lee E. Preston. 1995. "The Stakeholder Theory of the Corporation: Concepts, Evidence, and Implications." *The Academy of Management Review* 20, (1): 65–91. https://doi.org/10.2307/258887.

39. Doshi, Tilak. 2020. The Dirty Secrets of "Clean" Electric Vehicles. *Forbes*, n.d. Accessed May 5, 2023. https://www.forbes.com/sites/tilakdoshi/2020/08/02/the-dirty-secrets-of-clean-electric-vehicles/.

40. Du Pisani, Jacobus A. 2006. "Sustainable Development – Historical Roots of the Concept." *Environmental Sciences,* 3(2): 83-96. https://doi.org/10.1080/15693430600688831.

41. Dyck, Alexander, Karl V. Lins, Lukas Roth, and Hannes F. Wagner. 2019. "Do Institutional Investors Drive Corporate Social Responsibility? International Evidence." *Journal of Financial Economics,* 131(3): 693–714. https://doi.org/10.1016/j.jfineco.2018.08.013.

42. Eccles, Robert G., Ioannis Ioannou, and George Serafeim. 2014 "The Impact of Corporate Sustainability on Organizational Processes and Performance." *Management Science* 60, (11): 2835–57. http://www.jstor.org/stable/24550546.

43. Edvinsson, Leif, and Michael S. Malone. 1997. *Intellectual Capital: Realizing Your Company's True Value by Finding Its Hidden Brainpower*. Harper Business.

44. Egorova, Alexandra A., Sergei V. Grishunin, and Alexander M. Karminsky. 2022. "The Impact of ESG Factors on the Performance of Information Technology Companies." *Procedia Computer Science*, 199: 339–45. https://doi.org/10.1016/j.procs.2022.01.041.

45. Eisenhardt, Kathleen M. 1989. "Agency Theory: An Assessment and Review." *The Academy of Management Review* 14, (1): 57–74. https://doi.org/10.2307/258191.

46. Elkington, John. 1997. "Part I: The Triple Bottom Line". In *Cannibals with forks: The triple bottom line of 21st century business.* CAPSTONE. https://www.sdg.services/uploads/9/9/2/1/9921626/cannibalswithforks.pdf.
47. Elbannan, Mona A. 2014. "The Capital Asset Pricing Model: An Overview of the Theory." *International Journal of Economics and Finance*, 7(1): 216. https://doi.org/10.5539/ijef.v7n1p216.
48. Enel. 2020. "Enel's 2030 Vision in 2021–2023 Strategic Plan: A Decade of Opportunities | Enel Group." n.d. Accessed April 23, 2023. https://www.enel.com/media/explore/search-press-releases/press/2020/11/enels-2030-vision-in-20212023-strategic-plan-a-decade-of-opportunities-.
49. Erlich, Paul R., and Anne H. Erlich. 1991. *The Population Explosion*. New York, NY: Touchstone.
50. Escrig-Olmedo, Elena, María Fernández-Izquierdo, Idoya Ferrero-Ferrero, Juana Rivera-Lirio, and María Muñoz-Torres. 2019. "Rating the Raters: Evaluating How ESG Rating Agencies Integrate Sustainability Principles." *Sustainability*, 11(3): 915. https://doi.org/10.3390/su11030915.
51. Esser, Ralf, Alexander Börsch, Samuel Guenther and Elke-Christlan Koring. 2022 "Europe's Tech Industry Plugged in for Cross-Industry Success." Deloitte Insights https://www2.deloitte.com/us/en/insights/industry/technology/eu-european-tech.html
52. EUROSIF. "Responsible Investment Strategies." Accessed April 16, 2023. https://www.eurosif.org/responsible-investment-strategies/.
53. European Commission. "EU Emissions Trading System (EU ETS)." Accessed April 23, 2023. https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets_en.

54. Federal Ministry for Economic Affairs and Climate Action. "BMWK - Renewable Energy." n.d. Accessed April 23, 2023. https://www.bmwk.de/Redaktion/EN/Dossier/renewable-energy.html.

55. Flammer, Caroline. 2015. "Does Corporate Social Responsibility Lead to Superior Financial Performance? A Regression Discontinuity Approach." *Management Science,* 61(11). https://doi.org/10.1287/mnsc.2014.2038.

56. Ford Motor Company. 2022. "Ford Takes Bold Steps Toward All-Electric Future In Europe; 7 New Connected EVs Support Plans To Sell 600k + EVs Annually By 2026.". Ford Media Center. March 2022. https://media.ford.com/content/fordmedia/fna/us/en/news/2022/03/14/Ford-Takes-Bold-Steps-Toward-All-Electric-Future-in-Europe.html

57. Friedman, Milton. 1970. "A Friedman Doctrine: The Social Responsibility of Business Is to Increase Its Profits." *The New York Times.* https://www.nytimes.com/1970/09/13/archives/a-friedman-doctrine-the-social-responsibility-of-business-is-to.html.

58. Friedman, Thomas L. 2005. *The World Is Flat: A Brief History of the Twenty-First Century*. New York: Farrar, Straus and Giroux.

59. Freeman, R. Edward, and John McVea. 2001. "A Stakeholder Approach to Strategic Management." *SSRN Electronic Journal*, (2): 401-407. https://doi.org/10.2139/ssrn.263511.

60. Gavrilakis, Nektarios, and Christos Floros. 2023. "ESG Performance, Herding Behavior and Stock Market Returns: Evidence from Europe." *Operational Research*, 23(1): 3. https://doi.org/10.1007/s12351-023-00745-1.

61. George, Sreyssha, Vikash Jain, Rohan Jain, Ayon Banerjee, and David Young. 2021. "'The Next Big Leap' Towards ESG Maturity in Tech Sector" BCG NASSCOM

https://web-assets.bcg.com/91/07/1973562141cd9f024e9d1d319c40/the-next-big-leap-2021-in.pdf.

62. Gimenez, Cristina, Vicenta Sierra, and Juan Rodon. 2012. "Sustainable Operations: Their Impact on the Triple Bottom Line." *International Journal of Production Economics*, 140(1): 149-159. https://doi.org/10.1016/j.ijpe.2012.01.035.
63. Global Reporting Initiative. 2022. "Consolidated Set of GRI Standards." Retrieved from https://www.globalreporting.org/how-to-use-the-gri-standards/gri-standards-english-language/.
64. Global Sustainable Investment Alliance. 2018. *Global Sustainable Investment Review 2018*. Global Sustainable Investment Alliance. http://www.gsi-alliance.org/wp-content/uploads/2019/03/GSIR_Review2018.3.28.pdf.
65. Goss, Allen, and Gordon S. Roberts. 2011. 'The Impact of Corporate Social Responsibility on the Cost of Bank Loans'. *Journal of Banking & Finance,* 35(7): 1794–1810. https://doi.org/10.1016/j.jbankfin.2010.12.002.
66. Grewal, Jody, Clarissa Hauptmann, and George Serafeim. 2021. "Material Sustainability Information and Stock Price Informativeness". *Journal of Business Ethics,* 171 (3): 513–44. https://doi.org/10.1007/s10551-020-04451-2.
67. GRP. 2021. "The 2021 ESG Index Is Out! Nordic Countries at the Top of the 2021 ESG Index -." GRP. n.d. Accessed April 23, 2023. https://globalriskprofile.com/2021-esg/.
68. GRP. 2022. "ESG Index - 174 Countries 174 Scores." GRP. Accessed April 23, 2023. https://risk-indexes.com/esg-index/.
69. Griliches, Zvi. 1981. "Market Value, R&D, and Patents." *Economics Letters* 7 (2): 183–87. https://www.nber.org/system/files/chapters/c10052/c10052.pdf.
70. GSIA. 2021. "Global Sustainable Investing Review 2020" Accessed April 16, 2023. https://www.gsi-alliance.org/.

71. Habib, Sufyan, and Nawaf N. Hamadneh. 2021. "Impact of Perceived Risk on Consumers Technology Acceptance in Online Grocery Adoption amid COVID-19 Pandemic." *Sustainability*, 13(18): 10221. https://doi.org/10.3390/su131810221.

72. Hall, Bronwyn H. 1993. "The Stock Market's Valuation of R&D Investment During the 1980's." *The American Economic Review* 83, (2): 259–64. http://www.jstor.org/stable/2117674.

73. Harrison, Jeffrey S., and Andrew C. Wicks. 2013. "Stakeholder Theory, Value, and Firm Performance." *Business Ethics Quarterly* 23, (1): 97–124. http://www.jstor.org/stable/41967821.

74. Hart, Stuart L., and Glen Dowell. 2011. "Invited Editorial: A Natural-Resource-Based View of the Firm: Fifteen Years After". Edited by Jay B. Barney, David J. Ketchen, and Mike Wright. *Journal of Management*, 37(5): 1464–79. https://doi.org/10.1177/0149206310390219.

75. Hawkins, Troy R., Bhawna Singh, Guillaume Majeau-Bettez, and Anders Hammer Strømaan. 2012. "Comparative Environmental Life Cycle Assessment of Convention and Electric Vehicles." *Journal of Industrial Ecology*, 17(1): 53-64.https://doi.org/10.1111/j.1530-9290.2012.00532.x.

76. Henriques, Adrian, and Julie Richardson. 2004. *The Triple Bottom Line: Does It All Add Up?* London: Earthscan.

77. Hestinoviana, Vidyanita., Suhadak, Siti Ragil Handayani. 2013. "The Influence of Profitability, Solvability, Asset Growth, and Sales Growth Toward Firm Value (Empirical Study on Mining Companies Which Listed on Indonesia Stock Exchange)." *Jurnal Administrasi Bisnis S1 Universitas Brawijaya* 4, (1): 11. https://media.neliti.com/media/publications/74865-EN-the-influence-of-profitability-solvabili.pdf.

78. Hoang, Thi-Hong-Van, Elysé A. Segbotangni, and Amine Lahiani. 2020. “Does ESG Disclosure Transparency Help Mitigate the COVID-19 Pandemic Shock? An Empirical Analysis of Listed Firms in the UK.” SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3738256.

79. International Energy Agency. 2023. *Global EV Outlook 2023: Catching up with climate ambitions*. IEA, Paris. https://www.iea.org/reports/global-ev-outlook-2023.

80. International Energy Agency (IEA). 2022. “World Energy Outlook 2022”. Retrieved from https://www.iea.org/reports/world-energy-outlook-2022.

81. Intergovernmental Panel on Climate Change. 2006. “2006 IPCC Guidelines for National Greenhouse Gas Inventories.” Retrieved from https://www.ipcc-nggip.iges.or.jp/public/2006gl/.

82. Ioannou, Ioannis, and George Serafeim. 2012. “What drives corporate social performance? The role of nation-level institutions.” *Journal of International Business Studies*, 43, 834-864. https://doi.org/10.1057/jibs.2012.26.

83. Jensen, Michael C., and William H. Meckling. 1976. "Theory of the Firm: Managerial Behaviour, Agency Costs, and Ownership Structure." *Journal of Financial Economics 3*, (4): 305-360. https://www.sfu.ca/~wainwrig/Econ400/jensen-meckling.pdf.

84. Jo, Hoje, and Marteno A. Harjoto. 2011. “Corporate Governance Firm Value: The Impact of Corporate Social Responsibility.” *Journal of Business Ethics*, 103: 351-383. https://doi.org/10.1007/s10551-011-0869-y.

85. Jones, Thomas M. 1995. “Instrumental Stakeholder Theory: A Synthesis of Ethics and Economics.” *The Academy of Management Review* 20, (2): 404–37. https://doi.org/10.2307/258852.

86. Kenway, Natalie. 2023. “Global Sustainable Flows Bounce Back in Q4 - ESG Clarity.” ESG Clarity. Accessed May 13, 2023. https://esgclarity.com/global-sustainable-flows-bounce-back-in-q4/.

87. Keynes, John M. 1936. *The General Theory of Employment, Interest and Money*. London: Palgrave Macmillan. Accessed through https://www.files.ethz.ch/isn/125515/1366_keynestheoryofemployment.pdf.

88. Kolk, Ans. 2016. ‘The Social Responsibility of International Business: From Ethics and the Environment to CSR and Sustainable Development.’ *Journal of World Business,* 51 (1): 23–34. https://doi.org/10.1016/j.jwb.2015.08.010.

89. Lenain, Patrick. 2022. “Denmark’s Green Tax Reform: G20 Countries Should Take Notice.” CEP. n.d. Accessed April 23, 2023. https://www.cepweb.org/denmarks-green-tax-reform-g20-countries-should-take-notice/.

90. Linda, Gaines. 2014. The future of automotive lithium-ion battery recycling: Charting a sustainable course. *Sustainable Materials and Technologies*, 1(2): 2-7. https://doi.org/10.1016/j.susmat.2014.10.001.

91. Lindenberg, Eric B., and Stephen A. Ross. 1981. “Tobin’s q Ratio and Industrial Organization.” *The Journal of Business,* 54(1): 1-32. https://www.jstor.org/stable/2352631.

92. Lintner, John. 1965. “The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets.” The Review of Economics and Statistics 47 (1): 13. https://doi.org/10.2307/1924119.

93. Markowitz, Harry M. 1952. “Portfolio Selection.” The Journal of Finance. Vol. 7, No. 1. Pp. 77-91 http://links.jstor.org/sici?sici=0022-1082%28195203%297%3A1%3C77%3APS%3E2.0.CO%3B2-1.

94. Markowitz, Harry M. 1991. “Foundations of Portfolio Theory.” The Journal of Finance. Vol. 46. No. 2. pp. 469-477. https://www.jstor./stable/2328831.

95. Martini, Alice. 2021. “Socially Responsible Investing: From the Ethical Origins to the Sustainable Development Framework of the European Union.” *Environment, Development and Sustainability*, 23 (11): 16874–90. https://doi.org/10.1007/s10668-021-01375-3.

96. Max B. E. Clarkson. 1995. “A Stakeholder Framework for Analyzing and Evaluating Corporate Social Performance.” *The Academy of Management Review* 20, (1): 92–117. https://doi.org/10.2307/258888.

97. McKerracher, Colin. 2022. “EV Markets Feel the Impact of War.” Bloomberg. March 2022. https://www.bloomberg.com/news/articles/2022-03-15/electric-vehicles-will-be-pulled-in-different-directions-by-war?leadSource=uverify%20wall.

98. McKerracher, Colin. 2023. “Electric Vehicle Sales Top $1 Trillion in Wake-Up Call for Carmakers.” Bloomberg. February 2023. https://www.bloomberg.com/news/articles/2023-02-14/electric-vehicle-sales-top-1-trillion-in-wake-up-call-for-carmakers.

99. Meyer, John W., and Brian Rowan. 1977. “Institutionalized Organizations: Formal Structure as Myth and Ceremony.” *American Journal of Sociology* 83, (2): 340–63. http://www.jstor.org/stable/2778293.

100. Mill, John S. 1848. *Principles of Political Economy with Some of Their Applications to Social Philosophy*. Longmans, Green and Co.

101. Mitchell, Ronald K., Bradley R. Agle, and Donna J. Wood. 1997. “Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of Who and What Really Counts.” *The Academy of Management Review* 22, (4): 853–86. https://doi.org/10.2307/259247.

102. Michelson, Joan. 2022. "ESG Investing Is 'Soaring.' What Does It Mean?" Forbes. Accessed May 13, 2023. https://www.forbes.com/sites/joanmichelson2/2022/11/18/esg-investing-is-soaring-what-does-it-mean/.

103. Nakajima, Tadahiro, Shigeyuki Hamori, Xie He, Guizhou Liu, Wenting Zhang, Yulian Zhang, and Tiantian Liu. 2021. ESG Investment in the Global Economy. SpringerBriefs in Economics. Singapore: Springer Singapore. https://doi.org/10.1007/978-981-16-2990-7.

104. Nasution, Monica Angelin, Tengku Mella Syafrian Putri, Ahmad Sani, and Syamsul Bahri Syamsul Bahri. 2023. "The Influence of Cash Flow, Profitability, and Sales Growth on Stock Prices With Capital Structure as Intervening Variables in Banking Companies Listed on the Indonesia Stock Exchange 2015-2019." *International Journal of Economics and Management*, 1(1): 37–46. https://doi.org/10.54209/iem.v1i01.5.

105. Nguyen, Anh Phong, Huyen Linh Dang, Thi Tra My Nguyen, Hoang Nam Cao, Ha Nam Phuong Nguyen, and Huynh Phuong Vy Nguyen. 2022. "Investment Approach by Alpha Value: Case of Firms Listed on the Stock Market in Vietnam Period Before and After the Covid-19 Pandemic." In Frontiers in Artificial Intelligence and Applications, edited by Antonio J. Tallón-Ballesteros. IOS Press. https://doi.org/10.3233/FAIA220093.

106. Nirino, Niccolò, Felice Petruzzella, Gazi Mahabubul Alam, and Francesco Campobasso. 2022. "Can Sustainable Practices Protect Investors during Financial Market Instability? A Multi-Sector Analysis during the COVID-19 Pandemic." *Management Decision*, 60(10): 2875–94. https://doi.org/10.1108/MD-12-2021-1654.

107. O'brien, Robert M. 2007. "A Caution Regarding Rules of Thumb for Variance Inflation Factors." *Quality & Quantity* 41 (5): 673–90. https://www.researchgate.net/publication/226005307_A_Caution_Regarding_Rules_of_Thumb_for_Variance_Inflation_Factors.

108. O'Connor, Martin, and Clive L. Spash. 1999. *Valuation and the Environment: Theory, Method and Practice*. Cheltenham, UK: Edward Elgar Publishing.

109. OECD. 2015 "Green bonds: Mobilising the debt capital markets for a low-carbon transition". Policy Perspectives Bloomberg Philantropies https://www.oecd.org/environment/cc/Green%20bonds%20PP%20%5Bf3%5D%20%5Blr%5D.pdf.

110. Oliver, Christine. 1991. "Strategic Responses to Institutional Processes." *The Academy of Management Review*, 16, (1): 145–79. https://doi.org/10.2307/258610.

111. Orlitzky, M., Schmidt, F. L., & Rynes, S. L. 2003. "Corporate Social and Financial Performance: A Meta-Analysis." *Organization Studies*, 24, (3): 403-441. https://journals.sagepub.com/doi/epdf/10.1177/0170840603024003910.

112. Pástor, Ľuboš, Robert F. Stambaugh, and Lucian A. Taylor. 2021. "Sustainable Investing in Equilibrium." *Journal of Financial Economics*, 142(2): 550–71. https://doi.org/10.1016/j.jfineco.2020.12.011.

113. Pearce, David, Markandya Anil, and Edward B. Barbier. 1989. *Blueprint for a Green Economy*. London: Earthscan.

114. Pedersen, Lasse Heje, Shaun Fitzgibbons, and Lukasz Pomorski. 2021. "Responsible Investing: The ESG-Efficient Frontier." *Journal of Financial Economics* 142 (2): 572–97.https://reader.elsevier.com/reader/sd/pii/S0304405X20302853?token=601913DBFC99508958052B80FCB38901FEBBBC5A83912BE74C8A7B04ACA73643E782520

A6ACEF6D1A057CA840641906E&originRegion=eu-west-1&originCreation=20230501090513.

115. Peters, Jens F., Manuel Baumann, Benedikt Zimmermann, Jessica Braun, Marcel Weil. 2017. "The environmental impact of Li-Ion batteries and the role of key parameters – A review." *Renewable and Sustainable Energy Reviews*, 67(2017): 491-506. DOI: https://doi.org/10.1016/j.rser.2016.08.039.

116. Porter, Michael E., and Mark R. Kramer. 2011. "Creating Shared Value". *Harvard Business Review*, 89(1-2).

117. PRI. 2023 "What Are the Principles for Responsible Investment?" Accessed April 17, 2023.https://www.unpri.org/about-us/what-are-the-principles-for-responsible-investment.

118. Purvis, Benjamin, Yuxuan Mao, and Darren Robinson. 2019. "Three pillars of sustainability: in search of conceptual origins. *Sustain Sci*, 14: 681-695. https://doi.org/10.1007/s11625-018-0627-5.

119. PWC. 2022. "ESG-Focused Institutional Investment Seen Soaring 84% to US$33.9 Trillion in 2026, Making up 21.5% of Assets under Management: PwC Report." Accessed May 13, 2023. https://www.pwc.com/gx/en/news-room/press-releases/2022/awm-revolution-2022-report.html.

120. Qualtrics. 2023. "Interpreting Residual Plots to Improve Your Regression." Accessed May 3, 2023. https://www.qualtrics.com/support/stats-iq/analyses/regression-guides/interpreting-residual-plots-improve-regression/.

121. Radley-Gardner, Oliver, Hugh Beale, and Reinhard Zimmermann, eds. 2016. *Fundamental Texts On European Private Law*. Hart Publishing. https://doi.org/10.5040/9781782258674.

122. Ricardo, David. 1821. *On The Principles of Political Economy and Taxation, Third Edition*. Kitchener, Ontario: Batoche Books. Accessed April 10, 2023 https://socialsciences.mcmaster.ca/econ/ugcm/3ll3/ricardo/Principles.pdf.

123. Sassen, Remmer, Anne-Kathrin Hinze, and Inga Hardeck. 2016. "Impact of ESG Factors on Firm Risk in Europe." *Journal of Business Economics*, 86(8): 867–904. https://doi.org/10.1007/s11573-016-0819-3.

124. Scholz, Hendrik, and Marco Wiikens. 2005. "INVESTOR-SPECIFIC PERFORMANCE MEASUREMENT: A Justification of Sharpe Ratio and Treynor Ratio". *The International Journal of Finance,* 17(4):3671-3691. https://ssrn.com/abstract=555840.

125. Servaes, Henri, and Ane Tamayo. 2013. "The Impact of Corporate Social Responsibility on Firm Value: The Role of Customer Awareness." *Management Science*, 59(5): 1045-1061. https://doi.org/10.1287/mnsc.1120.1630.

126. Sharpe, William F. 1964. "CAPITAL ASSET PRICES: A THEORY OF MARKET EQUILIBRIUM UNDER CONDITIONS OF RISK*." *The Journal of Finance*, 19(3): 425–42. https://doi.org/10.1111/j.1540-6261.1964.tb02865.x.

127. Shleifer, Andrei, and Robert W. Vishny. 1997. "A Survey of Corporate Governance". *The Journal of Finance,* 52(2): 737–83. https://doi.org/10.1111/j.15406261.1997.tb04820.x.

128. Singh, Shveta, and Surendra S. Yadav. 2021. "Security Analysis and Portfolio Management: A Primer." Classroom Companion: Business. Singapore: Springer Singapore. https://doi.org/10.1007/978-981-16-2520-6.

129. Silvola, Hanna, and Tiina Landau. 2021. Sustainable Investing: Beating the Market with ESG. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-71489-5.

130. Slaper, Timothy and Tanya Hall. 2011. "The Triple Bottom Line: What Is It and How Does It Work?" *Indiana Business Review*, 86(1): 4-8. https://www.ibrc.indiana.edu/ibr/2011/spring/article2.html.

131. Smith, Adam. 1776. An Inquiry into the Nature and Causes of The Wealth of Nations. London: W. Strahan and T. Cadell.

132. Spence, Michael. 2010. "Signaling Theory: A Review and Assessment." Annual Review of Economics 2, (1): 1-23. https://journals.sagepub.com/doi/epdf/10.1177/0149206310388419.

133. Steinbarth, Emily, and Scott Bennett. 2018. "Materiality Matters: Targeting the ESG Issues that Impact Performance." *Harvard Law School Forum on Corporate Governance*. Available at: https://corpgov.law.harvard.edu/2018/05/10/materiality-matters-targeting-the-esg-issues-that-impact-performance/.

134. Stewart, Thomas A. 1997. *Intellectual Capital: The New Wealth of Organizations*. Doubleday/Currency.

135. Taylor, Tania L., and Sean Collins. 2022"Ingraining Sustainability in the next Era of ESG Investing." Deloitte. https://www2.deloitte.com/us/en/insights/industry/financial-services/esg-investing-and-sustainability.html.

136. Tesla, Inc. 2020. "Impact Report 2020." Accessed May 7, 2023. https://www.tesla.com/ns_videos/2020-tesla-impact-report.pdf.

137. Tobin, James. 1969. "A General Equilibrium Approach To Monetary Theory." *Journal of Money, Credit and Banking*, 1(1): 15-29. https://doi.org/10.2307/1991374.

138. Trahan, Ryan Thomas, and Brad Jantz. 2023. "What Is ESG? Rethinking the "E" Pillar." *Business Strategy and the Environment*, January, bse.3371. https://doi.org/10.1002/bse.3371.

139. United States Congress. 2021. “H.R.3684 – Infrastructure Investment and Jobs Act.” Accessed May 10, 2023. https://www.congress.gov/bill/117th-congress/house-bill/3684.

140. United Nations. 1972. “Report of the United Nations Conference on the Human Environment, Stockholm, 5-16 June 1972.” Retrieved from https://digitallibrary.un.org/record/523249#record-files-collapse-header.

141. United Nations Global Compact, and Asset Management Working Group of the UNEP Finance Initiative. 2055. “Who Cares Wins: Connecting Financial Markets to a Changing World.” Report.

142. United Nations Framework Convention on Climate Change. 2015. *Paris Agreement*. Paris. Accessed May 6. https://unfccc.int/sites/default/files/english_paris_agreement.pdf.

143. United Nations Global Compact, and Asset Management Working Group of the UNEP Finance Initiative. 2055. “Who Cares Wins: Connecting Financial Markets to a Changing World.” Report.

144. UN. 2022. “The Sustainable Development Goals Report” United Nations https://unstats.un.org/sdgs/report/2022/.

145. U.S Energy Information Administration. 2021. “Frequently Asked Questions (FAQs) - How much electricity does an American home use?” United States Energy

146. Information Administration. Accessed May 4, 2023. https://www.eia.gov/tools/faqs/faq.php?id=97&t=3.

147. UNDP, ed. 1995. *Gender and Human Development*. Human Development Report / Publ. for the United Nations Development Programme (UNDP) 1995. New York: Oxford Univ. Press.

148. Fukuyama, Francis. 1995. *Trust: The Social Virtues and the Creation of Prosperity*. London: Hamish Hamilton.

149. Vidal-García, Javier, and Marta Vidal. 2021. "Sharpe Ratio: International Evidence." https://ssrn.com/abstract=2765647.

150. Wanday, Julia, and Samer Ajour El Zein. 2022. "Higher Expected Returns for Investors in the Energy Sector in Europe Using an ESG Strategy." *Frontiers in Environmental Science* 10: 1031827. https://doi.org/10.3389/fenvs.2022.1031827.

151. Whiteman, Gail, and William H. Cooper. 2000. "Ecological Embeddedness." *Academy of Management Journal*, 43(6): 1265-82. https://www.jstor.org/stable/1556349.

152. Wooldridge, Jeffrey M. 2012. *Introductory econometrics: A Modern Approach, Fifth Edition*. Mason, OH: South-Western Cengage Learning.

153. World Commission on Environment and Development. 1987. "Report of the World Commission on Environment and Development: Our Common Future". *Oxford: Oxford University Press*. Retrieved from https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf

154. Zakamulin, Valeriy. 2011. "Sharpe (Ratio) Thinking about the Investment Opportunity Set and CAPM Relationship." Economics Research International 2011 (July): 1–9. https://doi.org/10.1155/2011/781760.

Appendixes

Table 25

EV Upper Environmental Portfolio

Company Name	Ticker	Weight	Return	Risk	Beta
Nissan Motor Co Ltd	7201 JP Equity	16,7%	-17,33%	32,9%	1,177137
Ford Motor Co	F US Equity	16,7%	7,81%	43,0%	1,492007
Bayerische Motoren Werke AG	BMW GR Equity	16,7%	1,81%	31,8%	1,258587
Toyota Motor Corp	7203 JP Equity	16,7%	3,35%	19,3%	0,645682
Renault SA	RNO FP Equity	16,7%	-12,05%	46,2%	1,66062
Volkswagen AG	VOW GR Equity	16,7%	2,51%	40,6%	1,485738

Table 26

EV Upper Environmental Portfolio Results

Results	
Return	-2,32%
Risk	28,53%
Beta	1,2866
CAPM Er	7,5%
Alpha	-9,79%
Sharpe	-21,72%
Treynor	-4,82%

Table 27

EV Lower Environmental Portfolio

Company Name	Ticker	Weight	Return	Risk	Beta
Dongfeng Motor Group Co Ltd	489 HK Equity	16,7%	-7,53%	39,9%	0,919258
Ferrari NV	RACE IM Equity	16,7%	17,68%	26,5%	0,952606
Isuzu Motors Ltd	7202 JP Equity	16,7%	-0,31%	36,8%	1,171841
Chongqing Changan Automobile C	200625 CH Equity	16,7%	7,33%	52,5%	0,989661
SAIC Motor Corp Ltd	600104 CH Equity	16,7%	-12,81%	29,3%	0,471678
FAW Jiefang Group Co Ltd	000800 CH Equity	16,7%	-1,78%	35,9%	0,902297

Table 28

EV Lower Environmental Portfolio Results

Results	
Return	0,43%
Risk	24,62%
Beta	0,90122
CAPM Er	6,4%
Alpha	-5,97%
Sharpe	-14,01%
Treynor	-3,83%

Table 29

EV Upper Social Portfolio

Company Name	Ticker	Weight	Return	Risk	Beta
Hyundai Motor Co	005380 KS Equity	16,7%	3,96%	37,3%	1,168877
Toyota Motor Corp	7203 JP Equity	16,7%	3,35%	19,3%	0,645682
Ford Motor Co	F US Equity	16,7%	7,81%	43,0%	1,492007
Kia Corp	000270 KS Equity	16,7%	17,70%	38,5%	1,181283
Mazda Motor Corp	7261 JP Equity	16,7%	-5,41%	32,8%	1,165824
Ferrari NV	RACE IM Equity	16,7%	17,68%	26,5%	0,952606

Table 30

EV Upper Social Portfolio Results

Results	
Return	7,51%
Risk	24,14%
Beta	1,101
CAPM Er	7,0%
Alpha	0,56%
Sharpe	15,06%
Treynor	3,30%

Table 31

EV Lower Social Portfolio

Company Name	Ticker	Weight	Return	Risk	Beta
Isuzu Motors Ltd	7202 JP Equity	16,7%	-0,31%	36,8%	1,171841
Dongfeng Motor Group Co Ltd	489 HK Equity	16,7%	-7,53%	39,9%	0,919258
Guangzhou Automobile Group Co	2238 HK Equity	16,7%	-11,49%	37,5%	0,391668
FAW Jiefang Group Co Ltd	000800 CH Equity	16,7%	-1,78%	35,9%	0,902297
Maruti Suzuki India Ltd	MSIL IN Equity	16,7%	-0,83%	33,4%	0,630892
Chongqing Changan Automobile C	200625 CH Equity	16,7%	7,33%	52,5%	0,989661

Table 32

EV Lower Social Portfolio Results

Results	
Return	-2,44%
Risk	25,03%
Beta	0,83427
CAPM Er	6,2%
Alpha	-8,64%
Sharpe	-25,23%
Treynor	-7,57%

Table 33

EV Upper Governance Portfolio

Company Name	Ticker	Weight	Return	Risk	Beta
Renault SA	RNO FP Equity	16,7%	-12,05%	46,2%	1,66062
Honda Motor Co Ltd	7267 JP Equity	16,7%	-5,15%	23,3%	0,82753
Ford Motor Co	F US Equity	16,7%	7,81%	43,0%	1,492007
Bayerische Motoren Werke AG	BMW GR Equity	16,7%	1,81%	31,8%	1,258587
Nissan Motor Co Ltd	7201 JP Equity	16,7%	-17,33%	32,9%	1,177137
Ferrari NV	RACE IM Equity	16,7%	17,68%	26,5%	0,952606

Table 34

EV Upper Governance Portfolio Results

Results	
Return	-1,21%
Risk	26,63%
Beta	1,22808
CAPM Er	7,3%
Alpha	-8,51%
Sharpe	-19,09%
Treynor	-4,14%

Table 35

EV Lower Governance Portfolio

Company Name	Ticker	Weight	Return	Risk	Beta
FAW Jiefang Group Co Ltd	000800 CH Equity	16,7%	-1,78%	35,9%	0,902297
Suzuki Motor Corp	7269 JP Equity	16,7%	-3,41%	39,8%	1,090876
Maruti Suzuki India Ltd	MSIL IN Equity	16,7%	-0,83%	33,4%	0,630892
Hyundai Motor Co	005380 KS Equity	16,7%	3,96%	37,3%	1,168877
Volkswagen AG	VOW GR Equity	16,7%	2,51%	40,6%	1,485738
BYD Co Ltd	1211 HK Equity	16,7%	33,90%	53,5%	0,577928

Table 36

EV Lower Governance Portfolio Results

Results	
Return	5,72%
Risk	25,26%
Beta	0,97610
CAPM Er	6,6%
Alpha	-0,88%
Sharpe	7,31%
Treynor	1,89%

Table 37

EV Upper ESG Portfolio

Company Name	Ticker	Weight	Return	Risk	Beta
Ford Motor Co	F US Equity	16,7%	7,81%	43,0%	1,492007
Bayerische Motoren Werke AG	BMW GR Equity	16,7%	1,81%	31,8%	1,258587
Mazda Motor Corp	7261 JP Equity	16,7%	-5,41%	32,8%	1,165824
Nissan Motor Co Ltd	7201 JP Equity	16,7%	-17,33%	32,9%	1,177137
Toyota Motor Corp	7203 JP Equity	16,7%	3,35%	19,3%	0,645682
Hyundai Motor Co	005380 KS Equity	16,7%	3,96%	37,3%	1,168877

Table 38

EV Upper ESG Portfolio Results

Results	
Return	-0,97%
Risk	25,20%
Beta	1,15135
CAPM Er	7,1%
Alpha	-8,06%
Sharpe	-19,24%
Treynor	-4,21%

Table 39

EV Lower ESG Portfolio

Company Name	Ticker	Weight	Return	Risk	Beta
Guangzhou Automobile Group Co	2238 HK Equity	16,7%	-11,49%	37,5%	0,391668
Isuzu Motors Ltd	7202 JP Equity	16,7%	-0,31%	36,8%	1,171841
SAIC Motor Corp Ltd	600104 CH Equity	16,7%	-12,81%	29,3%	0,471678
Maruti Suzuki India Ltd	MSIL IN Equity	16,7%	-0,83%	33,4%	0,630892
Chongqing Changan Automobile C	200625 CH Equity	16,7%	7,33%	52,5%	0,989661
FAW Jiefang Group Co Ltd	000800 CH Equity	16,7%	-1,78%	35,9%	0,902297

Table 40

EV Lower ESG Portfolio Results

Results	
Return	-3,32%
Risk	23,14%
Beta	0,75967
CAPM Er	6,0%
Alpha	-9,32%
Sharpe	-31,09%
Treynor	-9,47%

Table 41

EV Optimized Upper ESG Portfolio with Long-Sell Assumption

Company Name	Ticker	Weight	Return	Risk	Beta
Ford Motor Co	F US Equity	100,0%	7,81%	43,0%	1,492007
Bayerische Motoren Werke AG	BMW GR Equity	0,0%	1,81%	31,8%	1,258587
Mazda Motor Corp	7261 JP Equity	0,0%	-5,41%	32,8%	1,165824
Nissan Motor Co Ltd	7201 JP Equity	0,0%	-17,33%	32,9%	1,177137
Toyota Motor Corp	7203 JP Equity	0,0%	3,35%	19,3%	0,645682
Hyundai Motor Co	005380 KS Equity	0,0%	3,96%	37,3%	1,168877

Table 42

EV Optimized Upper ESG Portfolio with Long-Sell Assumption Results

Results	
Return	7,81%
Risk	42,64%
Beta	1,49201
CAPM Er	8,0%
Alpha	-0,24%
Sharpe	9,22%
Treynor	2,63%

Table 43

EV Optimized Lower ESG Portfolio with Long-Sell Assumption

Company Name	Ticker	Weight	Return	Risk	Beta
Guangzhou Automobile Group Co	2238 HK Equity	0,0%	-11,49%	37,5%	0,391668
Isuzu Motors Ltd	7202 JP Equity	0,0%	-0,31%	36,8%	1,171841
SAIC Motor Corp Ltd	600104 CH Equity	0,0%	-12,81%	29,3%	0,471678
Maruti Suzuki India Ltd	MSIL IN Equity	0,0%	-0,83%	33,4%	0,630892
Chongqing Changan Automobile C	200625 CH Equity	100,0%	7,33%	52,5%	0,989661
FAW Jiefang Group Co Ltd	000800 CH Equity	0,0%	-1,78%	35,9%	0,902297

Table 44

EV Optimized Lower ESG Portfolio with Long-Sell Assumption Results

Results	
Return	7,33%
Risk	52,04%
Beta	0,98966
CAPM Er	6,6%
Alpha	0,69%
Sharpe	6,64%
Treynor	3,49%

Table 45

EV Optimized Upper ESG Portfolio with Short-Sell Assumption

Company Name	Ticker	Weight	Return	Risk	Beta
Ford Motor Co	F US Equity	166,8%	7,81%	43,0%	1,492007

Bayerische Motoren Werke AG	BMW GR Equity	218,9%	1,81%	31,8%	1,258587
Mazda Motor Corp	7261 JP Equity	73,4%	-5,41%	32,8%	1,165824
Nissan Motor Co Ltd	7201 JP Equity	-1000,0%	-17,33%	32,9%	1,177137
Toyota Motor Corp	7203 JP Equity	595,8%	3,35%	19,3%	0,645682
Hyundai Motor Co	005380 KS Equity	45,1%	3,96%	37,3%	1,168877

Table 46

EV Optimized Upper ESG Portfolio with Short-Sell Assumption Results

Results	
Return	208,07%
Risk	223,01%
Beta	-1,29786
CAPM Er	0,3%
Alpha	207,81%
Sharpe	91,56%
Treynor	-157,33%

Table 47

EV Optimized Lower ESG Portfolio with Short-Sell Assumption

Company Name	Ticker	Weight	Return	Risk	Beta
Guangzhou Automobile Group Co	2238 HK Equity	-381,4%	-11,49%	37,5%	0,391668
Isuzu Motors Ltd	7202 JP Equity	177,5%	-0,31%	36,8%	1,171841
SAIC Motor Corp Ltd	600104 CH Equity	-1000,0%	-12,81%	29,3%	0,471678
Maruti Suzuki India Ltd	MSIL IN Equity	151,3%	-0,83%	33,4%	0,630892

Chongqing Changan Automobile C	200625 CH Equity	646,5%	7,33%	52,5%	0,989661
FAW Jiefang Group Co Ltd	000800 CH Equity	506,1%	-1,78%	35,9%	0,902297

Table 48

EV Optimized Lower ESG Portfolio with Short-Sell Assumption Results

Results	
Return	208,54%
Risk	361,08%
Beta	7,7888
CAPM Er	25,6%
Alpha	182,91%
Sharpe	56,68%
Treynor	26,28%

3. ESG Overall Performance Model

EV Industry

Table 3.1. - Descriptive Statistics

	Mean	Std. Deviation	N
qt	,1285	,45511	116
ESG	3,6121264368	,96865556479	116
LIQ	1,2809678121	,33718170489	116
MKT Cap	40707,568573	43387,669000	116
SG	6,3544292273	18,057674151	116
LEV	108,43189951	94,869929732	116
RD(adj.)	2864,8289369	3660,5586818	116
SIZE	11,128353946	1,2860019473	116

Table 3.2. - Correlations

		qt	ESG	LIQ	MKT Cap	SG	LEV
Pearson Correlation	qt	1,000	-,213	,164	,091	,317	-,057
	ESG	-,213	1,000	-,006	,230	,122	,399
	LIQ	,164	-,006	1,000	-,236	-,178	-,148
	MKT Cap	,091	,230	-,236	1,000	,137	,134
	SG	,317	,122	-,178	,137	1,000	-,186
	LEV	-,057	,399	-,148	,134	-,186	1,000
	RD(adj.)	-,229	,206	-,168	,672	-,048	,109
	SIZE	-,521	,420	-,323	,587	-,095	,467
Sig. (1-tailed)	qt	.	,011	,040	,166	<,001	,270
	ESG	,011	.	,477	,007	,095	,000
	LIQ	,040	,477	.	,005	,028	,056
	MKT Cap	,166	,007	,005	.	,072	,075
	SG	,000	,095	,028	,072	.	,023
	LEV	,270	,000	,056	,075	,023	.
	RD(adj.)	,007	,013	,036	,000	,306	,122
	SIZE	,000	,000	,000	,000	,155	,000
N	qt	116	116	116	116	116	116
	ESG	116	116	116	116	116	116
	LIQ	116	116	116	116	116	116
	MKT Cap	116	116	116	116	116	116
	SG	116	116	116	116	116	116
	LEV	116	116	116	116	116	116
	RD(adj.)	116	116	116	116	116	116
	SIZE	116	116	116	116	116	116

Table 3.2. - Correlations (cont.)

		RD(adj.)	SIZE
Pearson Correlation	qt	-,229	-,521
	ESG	,206	,420
	LIQ	-,168	-,323
	MKT Cap	,672	,587
	SG	-,048	-,095
	LEV	,109	,467
	RD(adj.)	1,000	,693
	SIZE	,693	1,000
Sig. (1-tailed)	qt	,007	<,001
	ESG	,013	,000
	LIQ	,036	,000
	MKT Cap	,000	,000
	SG	,306	,155
	LEV	,122	,000
	RD(adj.)	.	,000
	SIZE	,000	.
N	qt	116	116
	ESG	116	116
	LIQ	116	116
	MKT Cap	116	116
	SG	116	116
	LEV	116	116
	RD(adj.)	116	116
	SIZE	116	116

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	SIZE, SG, LIQ, ESG, LEV, MKT Cap, RD[b].	.	Enter

a. Dependent Variable: qt

b. All requested variables entered.

Table 3.3. - Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics	
					R Square Change	F Change
1	,820[a]	,672	,651	,26889	,672	31,635

Table 3.3. - Model Summary (cont.)[b]

Model	Change Statistics df1	df2	Sig. F Change	Durbin-Watson
1	7	108	<,001	2,023

a. Predictors: (Constant), SIZE, SG, LIQ, ESG, LEV, MKT Cap, RD(adj.)

b. Dependent Variable: qt

Table 3.4. - ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	16,011	7	2,287	31,635	<,001[b]
	Residual	7,808	108	,072		
	Total	23,819	115			

a. Dependent Variable: qt

b. Predictors: (Constant), SIZE, SG, LIQ, ESG, LEV, MKT Cap, RD(adj.)

Table 3.5. - Coefficients[a]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.	Correlations Zero-order
1	(Constant)	3,681	,386		9,546	<,001	
	ESG	-,071	,031	-,152	-2,292	,024	-,213
	LIQ	,137	,083	,101	1,647	,102	,164
	MKT Cap	6,169E-6	,000	,588	7,431	<,001	,091
	SG	,007	,002	,265	4,320	<,001	,317
	LEV	,002	,000	,457	6,562	<,001	-,057
	RD(adj.)	1,201E-5	,000	,097	1,063	,290	-,229
	SIZE	-,363	,036	-1,025	-10,179	<,001	-,521

Table 3.5. - Coefficients (cont.)[a]

Model		Correlations Partial	Part	Collinearity Statistics Tolerance	VIF
1	(Constant)				
	ESG	-,215	-,126	,692	1,446
	LIQ	,157	,091	,800	1,250
	MKT Cap	,582	,409	,485	2,064
	SG	,384	,238	,805	1,242
	LEV	,534	,362	,626	1,597
	RD(adj.)	,102	,059	,367	2,723
	SIZE	-,700	-,561	,300	3,339

a. Dependent Variable: qt

Table 3.6. - Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	ESG	LIQ	MKT Cap
1	1	5,725	1,000	,00	,00	,00	,01
	2	,927	2,486	,00	,00	,00	,00
	3	,758	2,748	,00	,00	,01	,11
	4	,341	4,100	,00	,00	,02	,01
	5	,172	5,774	,00	,00	,00	,83
	6	,045	11,331	,00	,49	,51	,02
	7	,032	13,395	,03	,46	,28	,01
	8	,002	52,608	,97	,04	,18	,03

Table 3.6. - Collinearity Diagnostics (cont.)[a]

Model	Dimension	Variance Proportions SG	LEV	RD(adj.)	SIZE
1	1	,00	,01	,00	,00
	2	,71	,02	,00	,00
	3	,00	,01	,14	,00
	4	,06	,58	,01	,00
	5	,09	,02	,54	,00
	6	,10	,22	,02	,00
	7	,00	,00	,01	,03
	8	,03	,14	,28	,97

a. Dependent Variable: qt

Table 3.7. - Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-,3929	1,2234	,1285	,37313	116
Std. Predicted Value	-1,398	2,934	,000	1,000	116
Standard Error of Predicted Value	,038	,134	,067	,022	116
Adjusted Predicted Value	-,4080	1,1632	,1302	,37307	116
Residual	-,66536	,90499	,00000	,26058	116
Std. Residual	-2,474	3,366	,000	,969	116
Stud. Residual	-2,653	3,580	-,003	1,013	116
Deleted Residual	-,76468	1,02385	-,00162	,28499	116
Stud. Deleted Residual	-2,731	3,796	-,001	1,026	116
Mahal. Distance	1,277	27,670	6,940	5,478	116
Cook's Distance	,000	,210	,012	,027	116
Centered Leverage Value	,011	,241	,060	,048	116

a. Dependent Variable: qt

Chart 3.1. - Histogram

Dependent Variable: qt

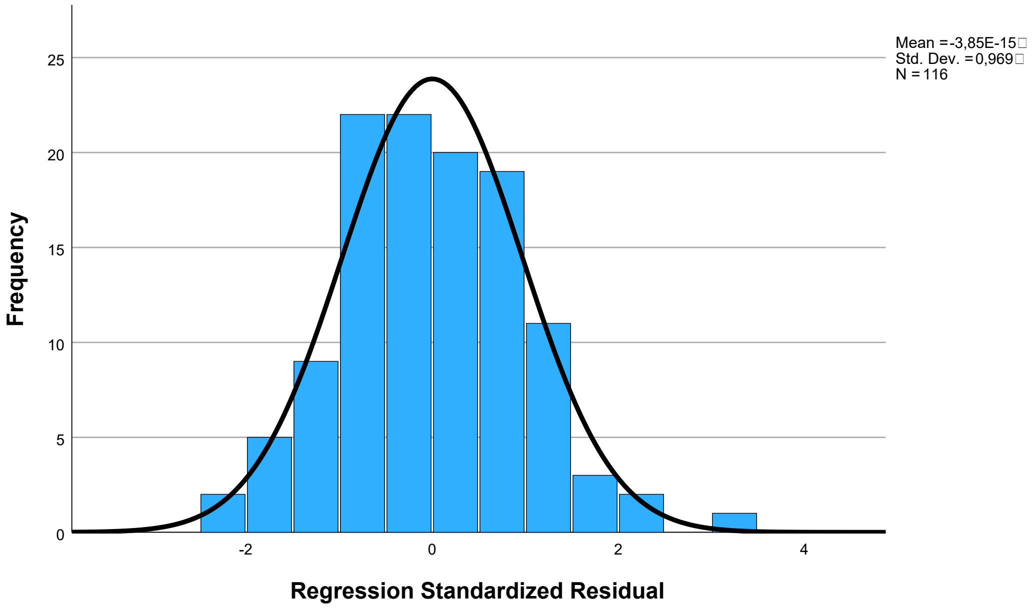


Chart 3.2. - Normal P-P Plot of Regression

Standardized Residual Dependent Variable: qt

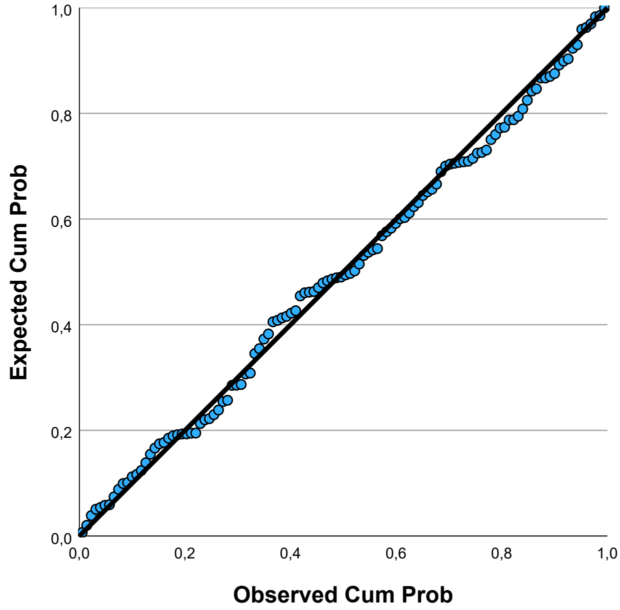
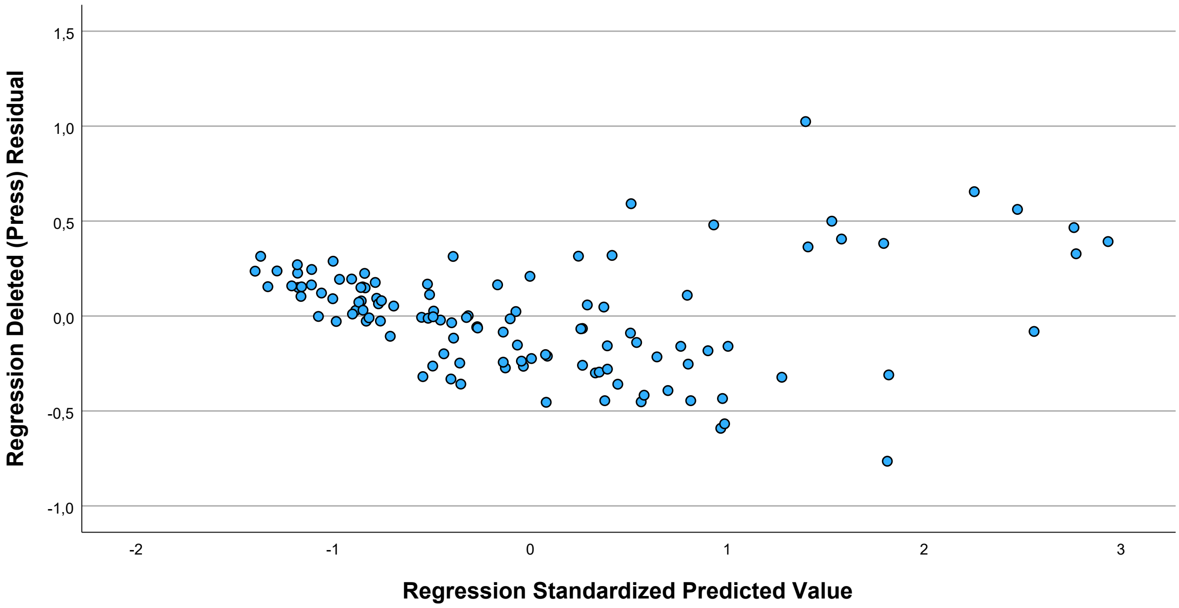


Chart 3.3. - Scatterplot

Dependent Variable: qt



Notes

Syntax		UNIANOVA Lntobin WITH ESG CurrentRatio MktCap DebttoEquity SalesGrowth RampDExpAdjust Size /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /PRINT MBP BP /CRITERIA=ALPHA(.05) /ROBUST=HC3 /DESIGN=ESG CurrentRatio MktCap DebttoEquity SalesGrowth RampDExpAdjust Size.
Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,00

Addressing Heteroskedasticity

Table 3.8. - Modified Breusch-Pagan Test for Heteroskedasticity[a,b,c]

Chi-Square	df	Sig.
29,516	1	<,001

a. Dependent variable: qt

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Predicted values from design: Intercept + ESG + CurrentRatio + MktCap + DebttoEquity + SalesGrowth + RampDExpAdjust + Size

Table 3.9. - Breusch-Pagan Test for Heteroskedasticity[a,b,c]

Chi-Square	df	Sig.
37,135	1	<,001

a. Dependent variable: qt

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Predicted values from design: Intercept + ESG + CurrentRatio + MktCap + DebttoEquity + SalesGrowth + RampDExpAdjust + Size

Table 3.10. - Tests of Between-Subjects Effects

Dependent Variable: qt

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	16,011[a]	7	2,287	31,635	<,001
Intercept	6,589	1	6,589	91,133	<,001
ESG	,380	1	,380	5,253	,024
CurrentRatio	,196	1	,196	2,714	,102
MktCap	3,992	1	3,992	55,216	<,001
DebttoEquity	3,113	1	3,113	43,057	<,001
SalesGrowth	1,350	1	1,350	18,666	<,001
RampDExpAdjust	,082	1	,082	1,130	,290
Size	7,491	1	7,491	103,608	<,001
Error	7,808	108	,072		
Total	25,735	116			
Corrected Total	23,819	115			

a. R Squared = ,672 (Adjusted R Squared = ,651)

Table 3.11. - Parameter Estimates with Robust Standard Errors

Dependent Variable: qt

Parameter	B	Robust Std. Error[a]	t	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	3,681	,610	6,036	<,001	2,472	4,889
ESG	-,071	,027	-2,668	,009	-,124	-,018
CurrentRatio	,137	,126	1,083	,281	-,114	,388
MktCap	6,169E-6	1,182E-6	5,220	<,001	3,826E-6	8,511E-6
DebttoEquity	,002	,000	6,444	<,001	,002	,003
SalesGrowth	,007	,002	3,985	<,001	,003	,010
RampDExpAdjust	1,201E-5	9,262E-6	1,297	,197	-6,344E-6	3,037E-5
Size	-,363	,051	-7,163	<,001	-,463	-,262

a. HC3 method

4. ESG Individual Performance Model

EV Industry

Table 4.1. - Descriptive Statistics

	Mean	Std. Deviation	N
	,1285	,45511	116
LIQ	1,2809678121	,33718170489	116
MKT Cap	40707,568573	43387,669000	116
SG	6,3544292273	18,057674151	116
LEV	108,43189951	94,869929732	116
RD(adj.)	2864,8289369	3660,5586818	116
SIZE	11,128353946	1,2860019473	116
E	2,2839	1,43770	116
S	3,1992	1,54260	116
G	5,3533	,77447	116

Table 4.2. - Correlations

		qt	LIQ	MKT Cap	SG	LEV	RD(adj.)
Pearson Correlation	qt	1,000	,164	,091	,317	-,057	-,229
	LIQ	,164	1,000	-,236	-,178	-,148	-,168
	MKT Cap	,091	-,236	1,000	,137	,134	,672
	SG	,317	-,178	,137	1,000	-,186	-,048
	LEV	-,057	-,148	,134	-,186	1,000	,109
	RD(adj.)	-,229	-,168	,672	-,048	,109	1,000
	SIZE	-,521	-,323	,587	-,095	,467	,693
	E	-,370	-,047	,291	-,025	,398	,348
	S	-,034	,007	,139	,285	,188	,043
	G	-,045	,052	,045	-,062	,386	,039
Sig. (1-tailed)	qt	.	,040	,166	<,001	,270	,007
	LIQ	,040	.	,005	,028	,056	,036
	MKT Cap	,166	,005	.	,072	,075	,000
	SG	,000	,028	,072	.	,023	,306
	LEV	,270	,056	,075	,023	.	,122
	RD(adj.)	,007	,036	,000	,306	,122	.
	SIZE	,000	,000	,000	,155	,000	,000
	E	,000	,307	,001	,396	,000	,000
	S	,359	,469	,069	,001	,022	,322
	G	,316	,288	,314	,254	,000	,338
N	qt	116	116	116	116	116	116
	LIQ	116	116	116	116	116	116

Table 4.2. - Correlations (cont.)

		SIZE	E	S	G
Pearson Correlation	qt	-,521	-,370	-,034	-,045
	LIQ	-,323	-,047	,007	,052
	MKT Cap	,587	,291	,139	,045
	SG	-,095	-,025	,285	-,062
	LEV	,467	,398	,188	,386
	RD(adj.)	,693	,348	,043	,039
	SIZE	1,000	,559	,190	,160
	E	,559	1,000	,429	,398
	S	,190	,429	1,000	,254
	G	,160	,398	,254	1,000
Sig. (1-tailed)	qt	<,001	<,001	,359	,316
	LIQ	,000	,307	,469	,288
	MKT Cap	,000	,001	,069	,314
	SG	,155	,396	,001	,254
	LEV	,000	,000	,022	,000
	RD(adj.)	,000	,000	,322	,338
	SIZE	.	,000	,020	,043
	E	,000	.	,000	,000
	S	,020	,000	.	,003
	G	,043	,000	,003	.
N	qt	116	116	116	116
	LIQ	116	116	116	116

Table 4.2. - Correlations (cont.)

		qt	LIQ	MKT Cap	SG	LEV	RD(adj.)
	MKT Cap	116	116	116	116	116	116
	SG	116	116	116	116	116	116
	LEV	116	116	116	116	116	116
	RD(adj.)	116	116	116	116	116	116
	SIZE	116	116	116	116	116	116
	E	116	116	116	116	116	116
	S	116	116	116	116	116	116
	G	116	116	116	116	116	116

Table 4.2. - Correlations (cont.)

		SIZE	E	S	G
	MKT Cap	116	116	116	116
	SG	116	116	116	116
	LEV	116	116	116	116
	RD(adj.)	116	116	116	116
	SIZE	116	116	116	116
	E	116	116	116	116
	S	116	116	116	116
	G	116	116	116	116

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	G, RD(adj.), SG, LIQ, S, LEV, E, MKT Cap, SIZE[b]	.	Enter

a. Dependent Variable: qt

b. All requested variables entered.

Table 4.3. - Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics	
					R Square Change	F Change
1	,825[a]	,681	,654	,26774	,681	25,142

Table 4.3. - Model Summary (cont.)[b]

Model	Change Statistics			Durbin-Watson
	df1	df2	Sig. F Change	
1	9	106	<,001	1,980

a. Predictors: (Constant), G, RD(adj.), SG, LIQ, S, LEV, E, MKT Cap, SIZE

b. Dependent Variable: qt

Table 4.4. - ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	16,221	9	1,802	25,142	<,001[b]
	Residual	7,598	106	,072		
	Total	23,819	115			

a. Dependent Variable: qt

b. Predictors: (Constant), G, RD(adj.), SG, LIQ, S, LEV, E, MKT Cap, SIZE

Table 4.5. - Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Correlations Zero-order
1	(Constant)	3,408	,457		7,452	<,001	
	LIQ	,141	,083	,104	1,697	,093	,164
	MKT Cap	6,089E-6	,000	,581	7,354	<,001	,091
	SG	,006	,002	,248	3,952	<,001	,317
	LEV	,002	,000	,452	6,339	<,001	-,057
	RD(adj.)	1,341E-5	,000	,108	1,186	,238	-,229
	SIZE	-,347	,037	-,981	-9,386	<,001	-,521
	E	-,061	,024	-,194	-2,516	,013	-,370
	S	-,001	,019	-,005	-,071	,943	-,034
	G	-,003	,037	-,005	-,073	,942	-,045

Table 4.5. - Coefficients (cont.)[a]

Model		Correlations Partial	Correlations Part	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)				
	LIQ	,163	,093	,800	1,251
	MKT Cap	,581	,403	,483	2,070
	SG	,358	,217	,762	1,313
	LEV	,524	,348	,591	1,692
	RD(adj.)	,114	,065	,364	2,750
	SIZE	-,674	-,515	,276	3,627
	E	-,237	-,138	,508	1,967
	S	-,007	-,004	,697	1,435
	G	-,007	-,004	,744	1,345

a. Dependent Variable: qt

Table 4.6. - Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	LIQ	MKT Cap	SG
1	1	7,386	1,000	,00	,00	,00	,00
	2	,943	2,798	,00	,00	,00	,64
	3	,797	3,045	,00	,00	,11	,00
	4	,357	4,550	,00	,02	,00	,06
	5	,199	6,100	,00	,00	,29	,00
	6	,165	6,690	,00	,00	,52	,16
	7	,099	8,624	,00	,01	,02	,07
	8	,041	13,481	,01	,81	,02	,04
	9	,012	24,574	,02	,00	,01	,00
	10	,002	66,420	,97	,15	,02	,02

Table 4.6. - Collinearity Diagnostics (cont.)[a]

Model	Dimension	Variance Proportions LEV	RD(adj.)	SIZE	E	S	G
1	1	,00	,00	,00	,00	,00	,00
	2	,02	,01	,00	,00	,00	,00
	3	,01	,13	,00	,00	,00	,00
	4	,47	,01	,00	,02	,00	,00
	5	,10	,09	,00	,33	,05	,00
	6	,11	,41	,00	,08	,10	,00
	7	,01	,08	,00	,39	,84	,00
	8	,10	,01	,01	,00	,00	,04
	9	,01	,04	,07	,02	,00	,83
	10	,17	,22	,92	,15	,00	,13

a. Dependent Variable: qt

Table 4.7. - Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-,3973	1,2487	,1285	,37556	116
Std. Predicted Value	-1,400	2,983	,000	1,000	116
Standard Error of Predicted Value	,044	,134	,076	,020	116
Adjusted Predicted Value	-,4379	1,1907	,1295	,37625	116
Residual	-,65148	,97879	,00000	,25705	116
Std. Residual	-2,433	3,656	,000	,960	116
Stud. Residual	-2,614	3,951	-,002	1,011	116
Deleted Residual	-,75206	1,14339	-,00095	,28532	116
Stud. Deleted Residual	-2,690	4,259	,001	1,027	116
Mahal. Distance	2,078	27,751	8,922	5,399	116
Cook's Distance	,000	,263	,011	,028	116
Centered Leverage Value	,018	,241	,078	,047	116

a. Dependent Variable: qt

Charts

Chart 4.1. - Histogram

Dependent Variable: qt

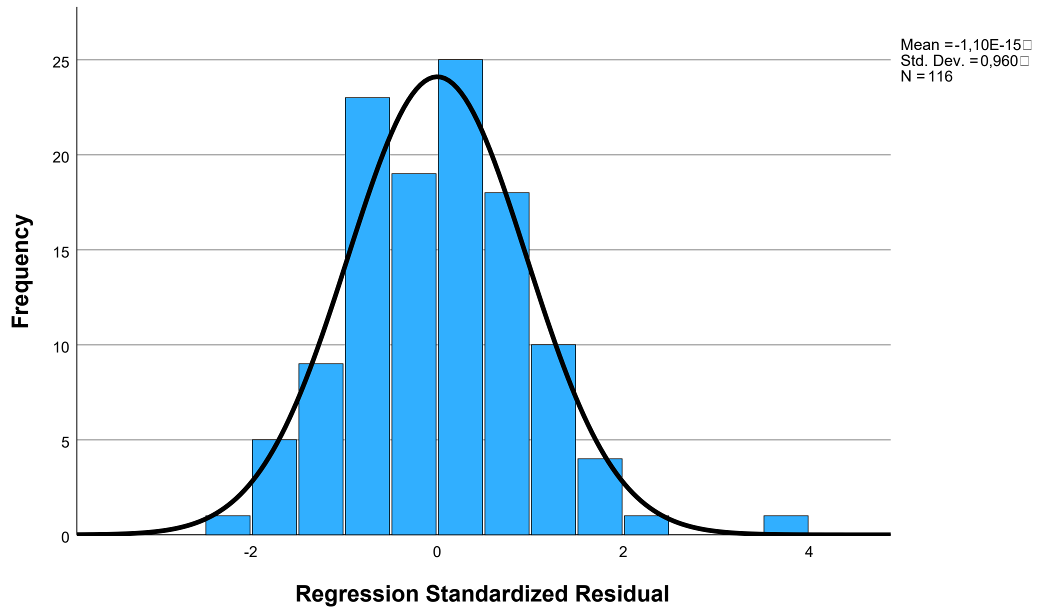


Chart 4.2. - Normal P-P Plot of Regression

Standardized Residual Dependent Variable: qt

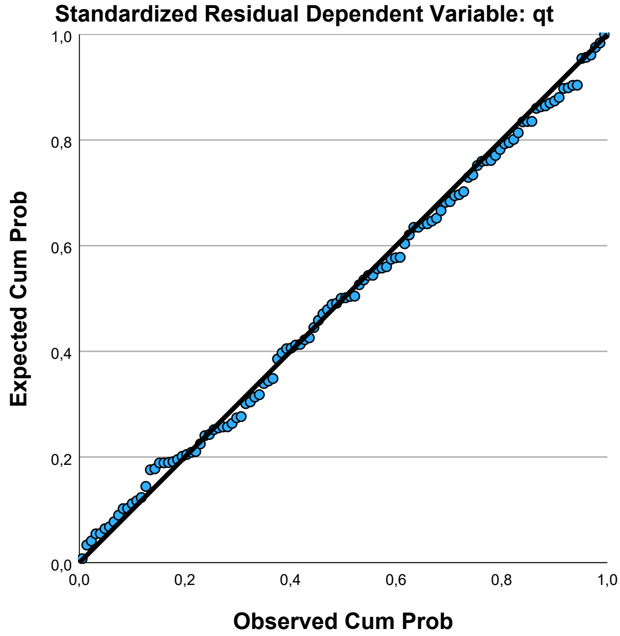
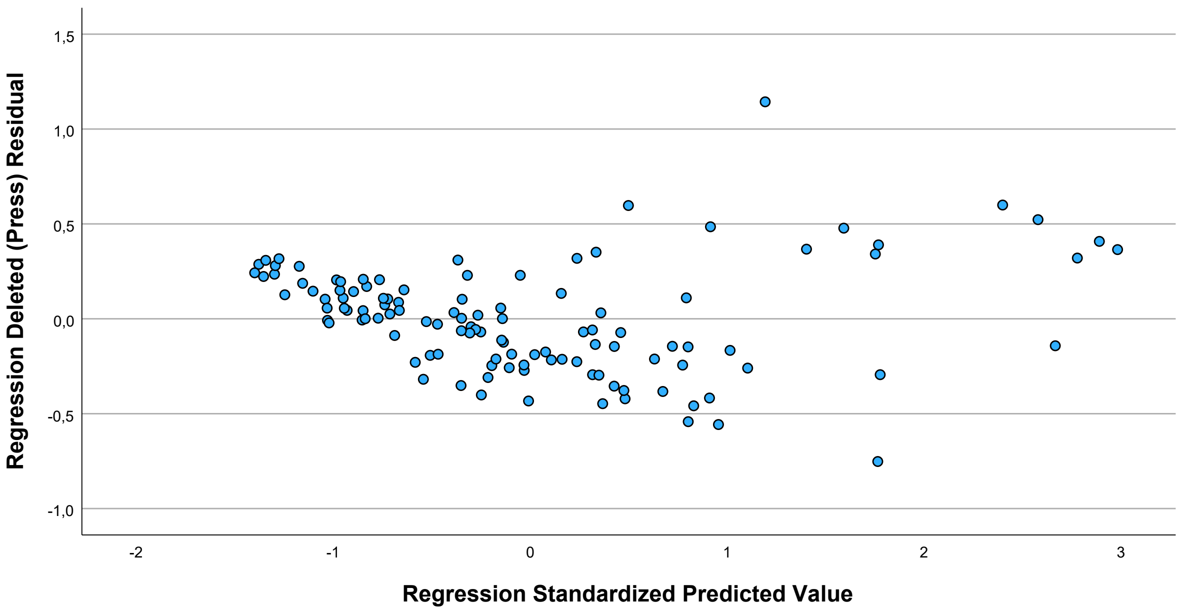


Chart 4.3. - Scatterplot

Dependent Variable: qt



Addressing Heteroskedasticity

Syntax		UNIANOVA Lntobin WITH CurrentRatio MktCap DebttoEquity SalesGrowth RampDExpAdjust Size E S G /METHOD=SSTYPE(3) /INTERCEPT=INCLUDE /PRINT MBP BP /CRITERIA=ALPHA(.05) /ROBUST=HC3 /DESIGN=CurrentRatio MktCap DebttoEquity SalesGrowth RampDExpAdjust Size E S G.
Resources	Processor Time	00:00:00,00
	Elapsed Time	00:00:00,01

Tests for Heteroskedasticity

Table 4.8. - Modified Breusch-Pagan Test for Heteroskedasticity[a,b,c]

Chi-Square	df	Sig.
20,022	1	<,001

a. Dependent variable: qt

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Predicted values from design: Intercept + CurrentRatio + MktCap + DebttoEquity + SalesGrowth + RampDExpAdjust + Size + E + S + G

Table 4.9. - Breusch-Pagan Test for Heteroskedasticity[a,b,c]

Chi-Square	df	Sig.
28,805	1	<,001

a. Dependent variable: qt

b. Tests the null hypothesis that the variance of the errors does not depend on the values of the independent variables.

c. Predicted values from design: Intercept + CurrentRatio + MktCap + DebttoEquity + SalesGrowth + RampDExpAdjust + Size + E + S + G

Table 4.10. - Tests of Between-Subjects Effects

Dependent Variable: qt

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	16,221[a]	9	1,802	25,142	<,001
Intercept	3,981	1	3,981	55,531	<,001
CurrentRatio	,206	1	,206	2,879	,093
MktCap	3,877	1	3,877	54,086	<,001
DebttoEquity	2,880	1	2,880	40,179	<,001
SalesGrowth	1,119	1	1,119	15,615	<,001
RampDExpAdjust	,101	1	,101	1,406	,238
Size	6,315	1	6,315	88,101	<,001
E	,454	1	,454	6,329	,013
S	,000	1	,000	,005	,943
G	,000	1	,000	,005	,942
Error	7,598	106	,072		
Total	25,735	116			
Corrected Total	23,819	115			

a. R Squared = ,681 (Adjusted R Squared = ,654)

Table 4.11. - Parameter Estimates with Robust Standard Errors

Dependent Variable: qt

Parameter	B	Robust Std. Error[a]	t	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Intercept	3,408	,759	4,491	<,001	1,904	4,913
CurrentRatio	,141	,133	1,060	,291	-,122	,403
MktCap	6,089E-6	1,159E-6	5,254	<,001	3,792E-6	8,387E-6
DebttoEquity	,002	,000	6,683	<,001	,002	,003
SalesGrowth	,006	,002	3,668	<,001	,003	,010
RampDExpAdjust	1,341E-5	9,551E-6	1,404	,163	-5,526E-6	3,234E-5
Size	-,347	,054	-6,442	<,001	-,454	-,240
E	-,061	,025	-2,487	,014	-,110	-,012
S	-,001	,019	-,073	,942	-,039	,036
G	-,003	,033	-,084	,933	-,068	,062

a. HC3 method