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Financial Impact of Environmental Costs on Corporate Resilience for European Energy Technology Companies

Summary

This research studies the relationship between environmental cost and corporate financial resilience on major energy and technology companies in Europe, including Iberdrola SA, Endesa SA, Schneider Electric SE, and Siemens AG. Research focuses on 5 years of data (2019-2023) to analyze data using methodology of S&P and Trucost. Profit margin is determined as a key indicator of corporate resilience. Regression analysis reveals a negative correlation between environmental impact ratios and profit margins, suggesting that investments in environmental sustainability can enhance profitability and operational efficiency. However, the moderate explanatory power of the model indicates that other factors, such as economic and market conditions, also influence outcomes. The findings of this research provide insight for policymakers and corporates on aligning Environmental, Social and Governance practices with financial performance goals.

Keywords: ESG, Corporate Resilience, Profitability
JEL codes: G32, Q56, M14, L94, O31

Introduction

In today's global economy, environmental sustainability is gradually becoming a core aspect of corporate strategy. Again, this is perpetrated not only by rising societal expectations but also by stringent regulatory frameworks. Among the influential regulations in this regard is the Green Deal of the European Union, purposed to make Europe the first carbon-neutral continent by 2050. An ambitious goal now put into practice, the sustainability regulations across a variety of sectors have enormously tightened, most especially the ones with huge environmental footprints like energy and technology. As a result, companies in all these industries are increasingly expected to have greener practices, transparent reporting of their environmental performance, and to align long-term goals with standards set for Environmental, Social, and Governance (ESG) (Sandri et al., 2023).

Of these industries, energy has the most significance concerning sustainable development and is responsible for 65% of carbon emissions worldwide. This therefore forces energy companies to move from the traditional sources of fossil fuel into renewable energy. This has been crucial for both compliance with regulations and economic viability, with companies such as Iberdrola SA and Endesa SA already massively investing in projects related to renewable energy sources. These companies, each in their own right, try to provide valuable insight into how ESG initiatives can help a company become more resilient-defined herein, as the ability of a company to absorb any disruption and sustain business operations in turbulent conditions. Their search for clean energy has not only helped them reach regulatory requirements but also allowed them to stabilize their financial foundation by strategic investment into sustainable technologies (Gielen et al., 2019).

Likewise, technology is increasingly being used as an enabling variable for sustainability, particularly in the development of solutions that enhance energy efficiency and automation. Companies such as Schneider Electric SE and Siemens AG embrace sustainability as one of the main aspects of their business models by developing automation solutions that lessen environmental impacts while reinforcing the efficiency of operations. Asif et al., (2023). The following technological advances testify to how ESG investments can work for sustainability and profitability. This research shall explore the extent to which investment in ESG initiatives influences corporate resilience and financial performance in the energy and technology sector in relation to profit margins.

The question that this research will try to answer is how ESG investments influence profitability. Study will employ profit margin as a profitability metric, which is one of the comprehensive indicators regarding the health status of a company. It reflects profit margins, or how well the company converts revenue into profit after deducting all forms of expenses. Inasmuch as the ESG initiatives equally require colossal financial investments, there is a need to understand their eventual impact on profitability. Previous research showed that there is a positive relationship between the performance on ESG and financial stability, especially for those industries with stringent environmental regulations (Chen et al., 2023). However, this present study will further research whether companies with strong ESG commitments attain a higher profit margin against the ones with poor environmental performance (Bruna et al., 2022).

The study will employ data of five continuous fiscal years of reporting for the selected companies to carry out an in-depth examination of how sustained ESG investments influence fi-

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nancial results over time. By comparing the environmental impact ratios with profit margins, this study attempts to bring out the broader relationship between environmental performance and corporate resilience. The selected companies for this research, such as Iberdrola and Endesa, are market leaders in renewable energies and, therefore, always under pressure from regulations to reduce their carbon footprint. Such commitment by them offers a unique view for understanding the dynamic nature of ESG investments and financial resiliency.

Applying both qualitative and quantitative data, the regression analysis will quantify to what degree environmental impact is associated with profitability. This would show if a company with low environmental costs can be related to its higher profit margins, adding to the rapidly building body of literature linking ESG initiatives to improved financial performance. These findings are likely to underline insights for corporate practitioners and policymakers on how sustainability initiatives could shape corporate success in a rapidly changing global environment.

Hypothesis

There is a negative correlation between environmental cost and corporate profitability. The hypothesis is based on the assumption that when the corporates generate less environmental impact their profitability is higher (Ambec & Lanoie, 2008).

By analyzing this relationship, the study investigates whether corporate policies and investments aimed to reduce environmental impacts end up strengthening profitability. Understanding this connection is crucial, as it can reveal whether investments in environmental sustainability align with the forward-looking corporate objective of achieving short- or long-term positive financial returns.

The hypothesis developed from the broader context of sustainability and ESG investments. Studies suggest that companies tend to perform financially better with the adoption of strong environmental practices (Nandini et al., 2022). Environmental practices that companies mostly focus on are often regulated by institutions. These practices are costly and operationally inefficient. Some studies and examinations confirm that reduction of environmental impact is a better substitute (Trevlopoulos et al., 2021). The research aims to understand whether this kind of relationship, where environmental regulations are high and strict, is potentially beneficial as investment. Additionally, this study will consider corporate resilience, reflected through profit margins, as a key factor in assessing the impact of environmental strategies.

Literature Review

This is well documented in the recent literature emanating from both academia and industry, where environmental sustainability has become increasingly important for corporate strategy. In this respect, corporate sustainability, underpinned by the integration of environmental, social, and governance criteria, has been advanced as a key driver of long-term business success. Evidence indicates that high-ESG-performance companies usually operate more efficiently, manage their risks more effectively, and therefore show better financial performance compared to less sustainable firms. The intent of this paper is to review available literature related to ESG investments, corporate resilience, and financial performance within two particularly environmentally regulated industries: the energy and technology sectors, both significantly impacted by environmental policy initiatives like the European Union's Green Deal (Eccles et al., 2014).

ESG has grown to become a key concern for companies because of the regulatory framework and pressure exerted by investors. The European Union's Green Deal, promoted in 2020, marks a turning point policy in making Europe the first carbon-neutral continent by 2050. The Green Deal has been influential in changing corporate behavior, especially for those industries with large ecological footprints such as energy and technology. Such policy framework leads to greater regulation of emissions, resource consumption, and reporting on sustainability matters; efforts of firms to adhere to green behaviors have also grown (Sandri et al., 2023).

A couple of studies depict how ESG investments result in greater resilience within firms. For instance, Eccles et al., (2014) claim that companies with strong ESG practices have a greater chance of surviving market turbulence since they can be more prepared to handle regulatory demands, alleviate environmental hazards, and stay alert to emerging consumer behavior trends. It speaks to the energy industry, where companies like Iberdrola SA and Endesa SA have been in the vanguard of switching to renewable energy-a factor that diminishes the risks linked to climate change and others relating to dependence on fossil fuels. The companies involved in renewable energy projects provide service and solutions in a manner that not only complies with the most exigent environmental legislation but also secures a leading position from which to benefit from the fast-growing demand for clean energy. In this instance, long-term economic performance can be improved (Falk et al., 2020).

Besides, there are numerous empirical studies that investigate the relationship between ESG investment and financial performance. (Bocken et al., 2014) conducted a meta-analysis of over 200 studies; the results showed that companies with sound sustainability practices would tend to outperform their peers through superior stock price and profitability. The authors have attributed this to improvements in operational efficiency, better risk management, and enhancement of brand reputation.

The related talk of corporate resilience among ESG investments may thus apply to the energy sector as well. After all, it is an industry that contributes a lot to the world's ghg emissions, and there is also further pressure for transition and change away from fossil fuels toward renewable sources. Companies in this sector include Iberdrola and Endesa, which are case studies in how ESG efforts enhance corporate resilience. Both firms have highly invested in renewable energy, thus being able to graduate through different regulatory and market changes that have been taking place within the industry. IEA, (2021) presents such a view based on huge investments by both firms in renewable energy. Research by Bocken et al., (2014) shows firms involved in high-impact industries such as energy must show sustainability of their business at their core if they have to endure. By aligning their operations with environmental goals, these firms thus mitigate the risk for climate change, regulatory regime shifts, and market volatility.

ESG investments are also found to make energy companies perform even better financially. In fact, Eccles et al., (2014)

have demonstrated that energy firms with higher ESG scores tend to enjoy better profit margins, in large measure from operational efficiencies gleaned from investments in renewable energy technologies and sustainable practices. This is supported by the work of Pham et al., (2021), who investigated sustainability versus profitability in various industries and deduced that those firms that show more intensity of ESG commitment usually depict better financial performance over the longer run.

Though directly, the energy sector experiences regulatory pressures, technology acts as a driver for sustainability through innovation. Companies like Schneider Electric and Siemens have made sustainability part of their core business models through technological development that advances energy efficiency and automation. Such actions not only reduce the environmental impact of industrial operations but also enable companies to achieve operational efficiencies, thereby further improving financial performance. For instance, Schneider Electric's energy management systems have been designed to ensure industries can optimize their use of energy for low levels of emissions and reduced operations costs. Thus, technology has also been studied in relation to being able to play a major role in the assurance of sustainability. According to a study conducted by Porter and Porter & Heppelmann, (2015), emerging technologies such as automation, artificial intelligence, and IoT will turn the course of industries toward more environmentally friendly directions while sustaining, if not improving, the financial performance of organizations. This view is more pertinent in view of the EU Green Deal, wherein technological innovation has come into play in respect of Europe's sustainability goals. Other studies have also pointed out the economic efficiency of sustainability-driven technological innovations. For example, McKinsey & Company reported in 2020 that the financial returns of companies that invest in sustainable technologies can be higher for firms operating in industries that are highly dependent on energy. These findings thus demonstrate that the technology sector contributes to global sustainability while strengthening the resilience and profitability of corporations by adopting a focused approach toward innovation and operational efficiencies (Christoffersen et al., 2013).

ESG performance and profitability have been a big focal area of academic interest. Previous studies have indicated that firms with strong ESG commitments tend to realize better financial performance in industries which have strict environmental regulations. Such would be the case with the energy and technology sectors, where ESG investments have driven profitability. Iberdrola and Endesa are two companies within the renewable energy sector that have become increasingly profitable due to their investments, while companies in the technology sector, such as Schneider Electric and Siemens, financially benefit from innovating products with sustainability in mind. A key factor of profitability within ESG is operational efficiency. Chen et al., (2023) illustrate how ESG contributes to enhancing resource allocation and reducing waste and energy overconsumption, thus contributing to better profit margins. More specifically, for industries such as energy and technology, whose operations are extremely costly, even small margins of efficiency improvements may bring substantial financial benefits. It therefore follows from the literature that the relationship between ESG performance and profitability will be much stronger in industries with strict environmental regulation, which compels firms to innovate and adopt more efficient practices. Indeed, this has been the case in both the energy and technology sectors, where the regulatory pressures from the EU Green Deal have seen substantial ESG investment by firms, matching improved financial performance and resilience (Xu et al., 2021).

Methods

Considering the new EU regulation of sustainability – European Green Deal – strict sustainability and environmental regulations had come to an effect for the variety of corporates operating in the Europe. With this policy the main goal approved is to reach carbon neutrality by 2050. Within the time span of reporting standards considered applicable, many corporates revised their bylaws to report transparent numbers. This makes the selected geography an excellent area to study for ESG related matters (European Commission, 2020).

Subject companies for this research are chosen from the energy sector. The energy sector is highly relevant due to its direct involvement in environmental sustainability and the transition to renewable energy. Selected companies operate in many energies related activities.

Two of the biggest energy companies in Europe, Iberdrola SA and Endesa SA, have a strong commitment to investing in renewable energy. This industry is essential for evaluating the connection between resilience and ESG investments because it has been subject to tremendous pressure to adjust to climate change regulations and manage the volatility of the energy markets (IEA, 2021).

Technology developments like automation and energy efficiency are key components that enable sustainable solutions. Leaders in automation, industrial solutions, and energy management with a heavy emphasis on sustainability include Schneider Electric SE and Siemens Aktiengesellschaft. This industry offers an alternative viewpoint on how advances in technology, backed by ESG commitments, can improve operational stability and energy efficiency to increase resilience in times of crisis (Gielen et al., 2019).

The time span of the data included covers 5 years of fiscal reporting period for selected subjects to keep the high quality of transparency and consistency (El Ghoul et al., 2023).

The companies in question are significant players in their fields, and because of their scale and impact, they can be used as indicators of general trends in the industry. They offer a strong foundation for comprehending the effect of ESG investments on resilience and have significant ESG commitments.

Profit margin is a comprehensive indicator of overall profitability and financial health, reflecting how efficiently a company converts revenue into profit after accounting for all operating and non-operating expenses. This serves as the main element of corporate resilience (Jiranck, 2023). In the analysis, profit margin, represented as "P", of each chosen company has been selected as dependent, key variable. The profit margins can be calculated by finding the percentage of net sales from overall revenue for the respective fiscal year. This data is collected from the open-source public financial statements of each company through 2019–2023.

Companies that report high profit margins are considered better in terms of allocating resources towards investments,

strategic movements and tend to improve their operational efficiency with those allocations (Kulwizira Lukanima, 2023).

Unlike other profitability margins, such as EBIT and EBITDA, profit margin solely captures operational performance. If the company margin increases through the fiscal years, room for investing in ESG and leading to better environmental costs can be achieved. In the vice-versa scenario, the attention to green investments and operational efficiency may be lost, due to the attention of other financial factors. Similar concerns raised by energy giant, BP, led the company to refuse the reduction of its upstream business and lead towards ESG alignment (Visavadia, 2023).

Another variable of this research is environmental impact ratio. Environmental impact, as S&P defines, is the sum of the global average damage costs for each company divided by company revenue, measured in U.S. dollars (S&P, 2024).

Calculation of Environmental Costs

S&P has an estimated method of calculating the environmental costs using coefficients. To assess different categories, methods use the negative externalities generated by corporation's activities that damage the environment both directly and indirectly. Finally, the environmental categories which included for the ratio expressed with USD ($). In this study S&P categorizes the impacts as below:

1. Greenhouse Gas Emissions (measured in tons of CO_2 equivalent, tCO_2e)
2. Water Consumption (measured in cubic meters, m^3)
3. Waste Generation (measured in kilograms, kg)
4. Pollutant Emissions (e.g., sulfur dioxide emissions, wastewater discharged, etc.)
5. Resource Depletion (use of natural or non-renewable resources)

For each impact category data resembling the resources and pollutants are gathered from publicly available sustainability or ESG reports of the companies which are shared annually. S&P uses "Trucost" database to give coefficient for each variable for expressing it with monetary value.

The estimated environmental cost for each category is calculated by multiplying the quantity of resources or pollutants by corresponding valuation coefficient. The S&P methodology uses the formula below:

$$\textit{Environmental Cost (per category)} = \textit{Quantity of Impact} \times \textit{Valuation Coefficient}$$

The calculation is repeated for each environmental caegory. The results as per each category of companies are presented in the table below *(Table 1, 2, 3 and 4)*:

To evaluate the relationship between environmental performance and financial outcomes, the environmental impact ratio, from now on marked as "E", calculated using the outcome for each category from table 1 to table 4 divided by relative fiscal year revenue. This allows for a comparative analysis of the environmental efficiency of a company's operations. Formula looks as below:

$$E_n = \frac{\textit{Estimated Environmental Cost}_n}{\textit{Revenue}_n}$$

Table 1. Environmental costs calculated of each category for Iberdrola SA for period of 2019-2023 years.

$, mm	2019	2020	2021	2022	2023
Environmental direct and indirect cost	1393.02	1118.16	1437.05	1174.74	1099.15
Air pollution	145.55	136.79	146.97	126.6	119.82
Greenhouse gasses	786.73	741.07	817.05	717.28	682.34
Land & Water pollution	12.37	10.09	11.02	9.48	8.13
Natural resource usage	17.8	13.61	12.95	12.38	9.8
Waste	267.42	166.38	366.3	206.98	186.66
Water	163.16	50.22	82.76	102.03	92.4

Source: S&P Capital IQ Pro, Iberdrola SA, Environmental history.

Table 2. Environmental costs calculated of each category for Endesa SA for period of 2019-2023 years.

$, mm	2019	2020	2021	2022	2023
Environmental direct and indirect cost	1967.92	1360.85	1698.91	1964.72	1541.7
Air pollution	195.72	137.47	165.6	193.27	156.24
Greenhouse gasses	893.41	553.11	661.69	850.39	715.27
Land & Water pollution	43.94	14.73	15.31	18.77	12.89
Natural resource usage	150.31	34.42	31.09	49.84	24.75
Waste	626.71	583.09	776.48	794.45	590.87
Water	57.83	38.04	48.75	58	41.68

Source: S&P Capital IQ Pro, Endesa SA, Environmental history.

Table 3. Environmental costs calculated of each category for Schneider Electric SE for period of 2019-2023 years.

$, mm	2019	2020	2021	2022	2023
Environmental direct and indirect cost	490.37	469.22	591.71	507.70	535.15
Air pollution	100.19	95.30	119.51	106.50	114.86
Greenhouse gasses	226.55	217.07	277.85	229.89	244.12
Land & Water pollution	27.97	26.88	32.70	28.55	29.56
Natural resource usage	14.37	13.37	16.74	18.25	14.96
Waste	16.47	15.51	20.16	18.31	19.66
Water	104.81	101.09	124.74	106.19	111.98

Source: S&P Capital IQ Pro, Schneider Electris SE, Environmental history.

Table 4. Environmental costs calculated of each category for Siemens Aktiengesellschaft for period of 2019-2023 years.

$, mm	2019	2020	2021	2022	2023
Environmental direct and indirect cost	1,207.29	743.77	935.03	811.62	670.43
Air pollution	210.35	131.64	168.95	146.67	116.61
Greenhouse gasses	606.20	357.55	456.04	389.91	330.38
Land & Water pollution	56.72	36.51	45.35	39.38	33.65
Natural resource usage	37.29	21.64	27.46	30.32	18.80
Waste	49.88	34.61	36.78	33.35	31.00
Water	246.83	161.82	200.45	171.97	139.97

Source: S&P Capital IQ Pro, Siemens Aktiengesellschaft, Environmental history.

To derive a comprehensive measure of a company's total environmental cost, the impact ratios of all categories are summed to form the Total Environmental Impact Ratio, represented as "E_t":

$$E_t = \sum_{1}^{n} (E_1, E_2, \dots, E_n)$$

This aggregate ratio reflects the overall environmental cost intensity and is used in subsequent analyses to examine its correlation with the company's profit margin. The results of total environmental impact ratio, E_{total}, are gathered in the *Table 5*.

Analysis

To further analyze the relationship between profit margin and the environmental impact ratio, regression analysis was performed. Method will allow to quantify strength of the relationship between both ratio and will allow to see if the selected companies demonstrate more efficient environmental performance. For matching the quantitative data environmental impact ratio demonstrated in percentages to match the profit margin data for same year and subject.

Model

In the linear regression, total impact ratios *(Table 1–4)* will be independent variable while profit margins *(Table 5)* will be dependent variable. The formula will be:

$$P = \beta_0 + \beta_1 * E_t + \in$$

In this formula P is a predicted value of dependent variable, β_0 is the intercept, representing the estimated profit margin when environmental impact is zero, β_1 is representing the change of profit margin for each unit of difference in environmental impact and represents the term of error where it accounts for the difference between observed and predicted values that model cannot explain.

RESULTS

Incorporating the variables from *Table 6* into the formula, below scatter diagram and regression line generated.

The specific regression equation for the above chart resulted from the analysis shared as below:

$$P = 0.4263 - 0.0074 * E_t$$

Equation suggestions include:

– The interception of 0.4263 represents the profit margin when the environmental impact ratio is zero. The interpretation is that when a company has zero environmental impact, the profit margin for the respected year will be equal or over 42.63%.
– The coefficient of –0.0074 represents every unit increase of environmental impact ratio, profit margin decreases 0.0074 units.

As a result of linear Pearson correlation test, there is a high, negative correlation exists between variables with $r = -0.58$. R^2 value of 0.337 indicates that only 33.7% of the variance in profit margin accounts for the ESG Ratio. This number shows that the model has moderate explanatory power, meaning there are other factors not included in this model that may also influence the profit margin.

To assess whether the analysis is statistically significant, an ANOVA test was performed. The F statistics were found to be 9.167, with a corresponding p value of 0.00723. This result in-

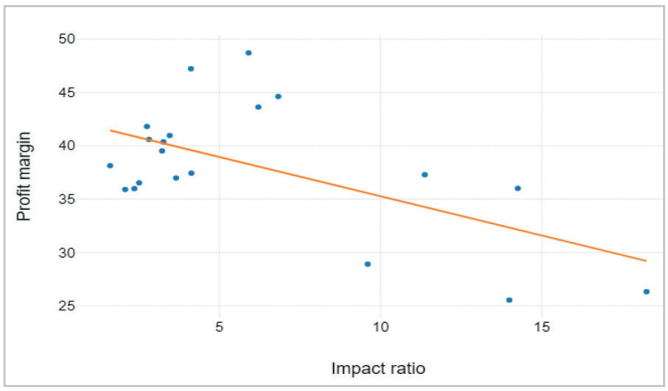

Figure 1. Scatter diagram for environmental impact ratio (X axis) and respective profit margin (Y axis) for selected companies.
Source: Author's calculations.

Table 5. Calculated total environmental impact ratio for analyzed companies for period of 2019-2023 years.

E_t	2019	2020	2021	2022	2023
Iberdrola SA	0.068293761	0.059091558	0.062125327	0.04133792	0.041201331
Endesa SA	0.18251055	0.14258749	0.139949339	0.0960287	0.113724044
Schneider Electric SE	0.032255715	0.032667525	0.03461466	0.028201444	0.027564876
Siemens Aktiengesellschaft	0.03659749	0.023650333	0.025125679	0.020803045	0.016144851

Source: S&P Capital IQ Pro, Author's calculations.

dicates that the model is statistically significant, meaning that the variance explained by environmental impact ratio is not likely due to chance.

The P value associated with the analysis confirms that the independent variable of environmental impact ratio does not interpret any variance in the dependent variable of profit margin. This confirms the hypothesis that lower environmental impacts are resulting in higher profit margins for selected companies, meaning it is accepted.

Conclusions

The result of this study demonstrates that environmental impact and corporate profit margins are negatively correlated. Companies with lower environmental costs achieve higher profit margins, explained by the investments in sustainable initiatives can contribute to financial resilience.

However, the moderate explanatory power of the model indicates that other factors, such as market conditions, geopolitical situation, economic macro and micro conditions might play a role in determining profitability. Findings suggest that companies prioritizing environmental performance can achieve competitive advantage, but further research is needed to understand the dynamics.

Limitations and Future Research

The research mainly focuses on 4 companies from the combination of energy and technology companies. This sample does not represent the full capability of the sector and shows a limited landscape. In future research, more sectors such as manufacturing and consumer staples can analyzed with the bigger selection of companies.

The implemented model has a 33.7% variance in profit margin as per ANOVA calculation, indicating that other factors are influencing the variable beyond environmental costs. It is possible to explore the effect of technological advancements such as AI and automation to further expand the connection.

Public companies, responding to the new environmental regulations, recently started to implement the new chain of reporting standards in the terms of ESG disclosures. The absence of standard reporting procedures, metrics and methodologies creates a variety of approaches through reported years. In the last couple of years only new standards were implemented and this gave a few years of fiscal data to research for this study. As the new standard of reporting is adopted, there will be a possibility of gathering more than 5 years of data to include for each subject and broaden the research.

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