

Balancing profit and sustainability: Assessing the impact of European Union environmental policies on the automotive sector

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ABSTRACT

The European Union (EU) has drafted policy documents to promote socially responsible practices among companies, emphasizing non-financial disclosure and sustainability reporting. This study compares the reporting practices and profitability of the EU region and the United Kingdom (UK) and investigates the responses of 48 automotive companies from 2019 to 2022. The findings reveal significant differences based on geographic location. UK companies demonstrate a positive correlation between the quality of sustainability reporting and profits, whereas the profits of automotive companies in the EU decrease as sustainability reporting quality improves. This study found that EU policies effectively enhance sustainability practices in the automotive sector by aligning them with the broader concept of corporate social responsibility (CSR), which goes beyond financial performance. Furthermore, it contributes to understanding CSR, emphasizes the need for tailored interventions based on geographical contexts, and highlights the risk of woke-washing strategies to comply with regulations without genuine sustainability efforts. The study also provides implications and recommendations for policymakers.

1. Introduction

Corporate social responsibility (CSR) comprises economic, social, and political dimensions worldwide (Baughn, Bodie, & McIntosh, 2007). The European Union (EU) has drafted several policy documents to raise awareness of CSR among companies to operate and contribute to the welfare of communities (Sila & Cek, 2017; United Nations, 2015). The main tool that the EU emphasizes is related to non-financial disclosure for companies to provide their stakeholders with information on sustainability. Specifically, Directive 2014/95/EU regulates the disclosure of non-financial information by companies and large groups (European Union, 2014). The companies involved in the process are required to report non-financial information encompassing environmental impacts, social and personnel practices, respect for human rights, and anti-corruption measures. These details need to be included in a non-financial statement integrated into the management report, drawing on recognized national or international standards. Furthermore, in

recent decades, CSR developments have shifted focus to corporate sustainability, including responsible resource management, environmental impact reduction, and ethical practices throughout the supply chain (Chi, 2011). Corporate reporting systems enable organizations to transparently communicate with their stakeholders, highlighting progress and performance on environmental and social issues (Adams, 2004). Emphasizing strategies to address sustainability offers information on initiatives and programs implemented to address energy efficiency, greenhouse gas emissions reduction, water conservation, workplace diversity and inclusion, and local community engagement (Chandel, Shrivastva, Sharma, & Ramasamy, 2016). Moreover, stakeholders increasingly guide organizations' decisions in fostering accountability and transparency, empowering consumers and investors with critical data and indicators to assess social and environmental impacts (Dorfleitner, Utz, & Wimmer, 2018).

However, the dimension of voluntariness indicates that companies must operate above regulatory requirements, establishing the minimum

Abbreviations: CSR, Corporate social responsibility; EBIT, Earnings before interest, and taxes; EBITDA, Earnings before interest, taxes, depreciation, and amortization; ESG, Environmental, Social and Governance; ESGC, Environmental, Social and Governance Combined Score; EU, European Union; GPM, Gross profit margin; SDG, Sustainable development goals; TRBC, The Refinitiv Business Classification; UK, United Kingdom.

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acceptable performance level (Dahlsrud, 2008). Although the commitment of the EU is incremental and aims to broaden the boundaries of the obligation to produce non-financial reporting, currently the law involves only large companies (European Union, 2022).

Simultaneously, the automotive sector is targeted for further restrictions by the EU, which, through the European Green Deal, aims for net carbon neutrality across the entire region by 2050 (European Commission, 2019). The plan will be achieved through green economy initiatives and a single European law to transform political commitments into legal obligations to trigger valuable investments (Huang, Kuo, & Chou, 2018).

Therefore, this study examines the results and consequences of EU sustainability policies on the automotive sector (Babiak & Trendafilova, 2011). The EU has been compared with the United Kingdom (UK), considering that CSR research is more prevalent in developed countries (Dobers & Halme, 2009). Sustainability in the two geopolitical areas has dissimilar ambitions, and the required level of commitment for companies is different. However, to improve stakeholder communication, EU policies are pushing toward expanding the scope of mandatory reporting for companies on their actions (European Union, 2014). Meanwhile, UK companies with mandatory disclosure adopt less stringent criteria, such as being publicly traded or having more than 500 employees (Ahern, 2016). Therefore, observing differences in implementing comparable policies over geographic and economic areas that differ in size and homogeneity is possible.

This study tests several quantitative hypotheses and examines how the reporting process affects companies' profits. Specifically, the study's experiment was conducted on 48 automotive companies extracted from the Refinitive database from 2019 to 2022 (Apergis, Poufinas, & Antonopoulos, 2022; D'Amato, D'Ecclesia, & Levantesi, 2022; Demers, Hendrikse, Joos, & Lev, 2021).

The results reveal interesting differences in correlation between Profitability and Sustainability reporting based on geographic position. This study demonstrates a positive correlation between high-quality sustainability reporting and profits among UK companies. Meanwhile, a significant difference is observed for automotive companies in the EU. Notably, EU company profits fall as the quality of sustainability reporting increases. Furthermore, our study reveals that EU policies are effectively increasing the sustainability level of automotive companies by better accommodating the CSR concept of going beyond profits (Barauskaite & Streimikiene, 2021).

This study makes various relevant contributions. First, it extends the concept of CSR to the exogenous pushes of international entities, incentivizing voluntary information reporting concurrently with reporting obligations of companies in the EU (Jackson, 2014). Second, this study reveals the fragility of the traditional automotive system, whose profits decline under a radical change in business outlook (Barauskaite & Streimikiene, 2021). Finally, it underscores the need for policymakers to adjust interventions based on geographic area to prevent companies from activating distortions such as woke washing to appear compliant with new regulatory requirements without incurring significant profit losses.

The study is structured as follows. Following the Introduction in Section 1, Section 2 presents the literature review and the hypotheses development. Section 3 describes the methodology. Section 4 discusses the main study results. Finally, Sections 5 and 6 conclude the paper.

2. Literature overview

2.1. Corporate social responsibility (CSR) and environmental, social and governance (ESG) factors

CSR has its roots in the previous century when a corporate philanthropy model was promulgated after the economic boom succeeding World War II (Bowen, 2013). Emphasizing the willingness of corporations to transcend profit, further developments extended the domain of

CSR toward social responsibility more broadly (Davis, 1960). The connection between the actions of businesses and the impacts on communities indicated the growing focus on production. Numerous investigations have highlighted negative outputs from pollution and natural resource use (Abbott & Monsen, 1979; Wong, Ho, So, & Poo, 2022). Furthermore, growing environmental awareness has pushed companies to intentionally integrate environmental and social dimensions into their governance models (Gu & Xie, 2022; Moon, 2007). Scholarly findings have led organizations to consider social aspects in corporate strategies (Mazurkiewicz, 2004; Orazalin & Baydauletov, 2020). Consequently, workers' rights, safety, and equity have gained momentum for organizations and their stakeholders (Furlotti & Mazza, 2020; McGuire, Sundgren, & Schneeweis, 1988).

CSR can mitigate risks from environmental, social, and governance (ESG) factors (Karwowski & Raulinajtys-Grzybek, 2021). Despite falling within the corporate sustainability and social responsibility domain, ESG and CSR are distinct concepts (Ortas, Álvarez, Jaussaud, & Garayar, 2015). First, the literature differentiates them based on scope. ESG factors are the three main pillars of ethical finance (Billio, Costola, Hristova, Latino, & Pelizzon, 2021) and are primarily concerned with the operational practices of a company that have direct financial implications. ESG criteria are increasingly used by investors to screen potential investments, assessing a company's behavior and the risk it presents relative to environmental stewardship, social impact, and leadership governance (Lanzalonga, Oppioli, Calandra, & Secinaro, 2024).

Meanwhile, CSR refers to companies' actions and commitments to operate socially responsibly and contribute to communities' well-being (Sila & Cek, 2017). CSR is broader in its outreach and integration into corporate ethos, focusing on the overall contribution of a business to societal goals, which includes voluntary efforts that may not have immediate financial returns but foster long-term benefits like enhanced goodwill and community trust. In other words, ESG entails how a company minimizes its negative impacts through direct practices that affect its financial standing, while CSR identifies and implements programs designed to maximize the positive effects a company can have on the society at large, beyond the immediate financial considerations (Barauskaite & Streimikiene, 2021).

Given increasing sustainability awareness, various companies have undertaken reporting programs and voluntary non-financial disclosure (Jackson, 2014; Raimo, Caragnano, Zito, Vitolla, & Mariani, 2021). Despite normative attempts to increase compulsory sustainability disclosure by international entities, the non-financial information of several companies remains voluntary (Kinderman, 2020). Therefore, ESG reporting belongs to the CSR boundary if the attributes of transparency, accuracy, and the requirement for comparison of information among companies are present.

2.2. Sustainability drivers in the automotive industry

Exogenous pressure from various supranational bodies has increased attention on environmental parameters and actions to mitigate climate change (Secinaro, Calandra, Lanzalonga, & Ferraris, 2022). In 2019, the EU estimated that approximately 30 % of pollutant emissions are from the transport sector (European Parliament, n.d.). Consequently, the EU has encouraged the deployment of new modes of transport by setting a new target of 100 % emission reduction by 2035 (European Parliament, 2022). Moreover, massive decarbonization has accelerated the transition to vehicles powered by alternative propulsion systems, forcing automotive companies to focus on corporate social responsibility and customer satisfaction as key factors in maintaining competitive advantage (Asadi et al., 2021; Fuzi, Desa, Hibadullah, Zamri, & Habidin, 2012). For companies in the automotive sector, adapting radically and rapidly to regulatory change is a crucial challenge for business continuity and survival (Brescia, Degregori, Maggi, & Hadro, 2023). The path to decarbonized and sustainable mobility affects the economic, social,

and natural systems of countries, and the proposed policies aim to promote adopting sustainable practices to meet growth targets and manage production in an environmentally responsible manner (Degirmenci & Breitner, 2017).

The variety of reporting standards and the integration of CSR into corporate strategy demonstrate the complexities faced by companies in aligning their operations with societal expectations and environmental regulations (Russo-Spena, Tregua, & De Chiara, 2018). Therefore, stakeholders are increasingly affected by the efforts undertaken by automotive companies to pursue sustainability (Ben-Amar, Comyns, & Martinez, 2022). Despite regulatory efforts to expand sustainability reporting (environmental and social report) requirements, non-financial disclosure remains voluntary for several companies, contributing to the challenges in identifying key elements to include in the stakeholder disclosure perimeter (Dincă, Vezeteu, & Dincă, 2022; Pagani, Moggi, & Gaetano, 2020). Moreover, the variety of reporting standards and the lack of rigorous guidelines to represent factors create challenges in identifying key elements to include in the stakeholder disclosure perimeter (Erkens, Paugam, & Stolowy, 2015). Likewise, voluntary drafting introduces bias into the validity process (Tarquinio & Posadas, 2020). Therefore, this study involves only listed companies falling within the scope of Directive 2014/95/EU, which regulates non-financial information disclosure (European Union, 2014).

Furthermore, the exploration of sustainability in the automotive industry reveals a tension between genuine efforts and superficial practices. The focus on sustainability in the automotive sector has generated distorted behavior popularly known as “woke washing” in which companies misleadingly and fraudulently communicate their sustainable practices (Vredenburg, Kapitan, Spry, & Kemper, 2020). Studies such as those on Volkswagen’s emissions scandal underline the critical need for transparency and integrity in environmental claims (Heidarzadeh Hanzae & Sadeghian, 2014). In September 2015, the United States Environmental Protection Agency blamed Volkswagen for manipulating emissions results from its diesel vehicles (Majláth, 2016). The German company had installed software on diesel vehicles sold in the United States; when a car’s emissions were tested, it would activate emission controls to temporarily reduce the number of pollutants. When the vehicles were on the road, the software turned off the emission controls, allowing the engine to produce significantly more nitrogen oxides. Independent researchers uncovered the deception, and an investigation revealed that approximately 11 million Volkswagen vehicles were equipped with software that manipulated emissions (Lane, 2016). This activity falls within the scope of greenwashing since Volkswagen had long advertised its diesel vehicles as clean and environmentally friendly, falsely claiming to produce diesel cars with minimal pollutant emissions (Turna, 2022).

Moreover, the emphasis on CSR as an informal structure within corporations introduces new dimensions in evaluating firm behavior and stakeholder perception, highlighting the nuanced interplay between regulatory compliance and ethical obligations in corporate operations (De Giuli & Tanda, 2024). Additionally, the distinction between CSR and ESG practices provides a framework for understanding the broader implications of sustainable development initiatives across different sectors, including automotive (Kazmierczak, 2022). This underscores the complexity of implementing sustainable practices that are both genuinely impactful and strategically aligned with business objectives, ultimately influencing both market performance and societal outcomes.

2.3. Hypothesis development

Decarbonizing the transport sector involves all countries participating in the sustainable development goals (SDGs) of the 2030 agenda (United Nations, 2015). However, with Brexit in 2020, the United Kingdom has diverged from EU sustainability policy implementations, significantly influencing regional strategies in the automotive sector (Hepburn & Teytelboym, 2017). Although the UK acts as an

international green hub for reducing transport sector emissions (Scott, 2016), differences in regional policies and greater legislative autonomy allow for varied compliance and application of environmental policies. Despite rigorous carbon reduction policies, the Climate Change Committee argues that a critical opportunity to push progress is yet to be recovered (Climate Change Committee, 2021). Furthermore, the independent organization that monitors government climate policies expressed reluctance toward effectively implementing various regulations.

While the EU has strengthened non-financial reporting requirements for companies, significantly expanding the scope of such regulations, companies in the UK are subject to less stringent requirements. EU policies are pushing toward broadening the scope of mandatory reporting on company actions to improve disclosure to stakeholders (European Union, 2014). Meanwhile, UK companies, for which non-financial reporting is mandatory, embrace fewer criteria, such as being listed on a stock exchange or having more than 500 employees (Ahern, 2016). This reflection of divergent approaches highlights the unique challenges companies face in different regions. Therefore, considering regional and market differences, the first hypothesis considers the impacts of changes in sustainability reporting for the UK compared with the EU automotive sectors.

H1: The economic impact of sustainability regulations and reporting differs between UK and EU automotive companies.

The testing activity for H1 will benefit from the support of the following two sub-hypotheses:

H1a: Sustainability regulations negatively influence the economic impact on EU automotive companies.

H1b: Sustainability regulations positively influence the economic impact on UK automotive companies.

Since non-financial reporting can influence the following year’s performance, this study tests whether increased sustainability practices will affect the following year’s profits in the automotive sector (Flöstrand & Ström, 2006). However, EU policies extend the application domain to various companies during the observation period (European Union, 2022). Therefore, considering how policy may affect companies’ planning, the second hypothesis is developed.

H2: The quality of ESG reports influences the next year’s financial performance of automotive companies, with varying effects between EU and UK.

The testing activity for H2 will benefit from the support of the following two sub-hypotheses:

H2a: The quality of ESG reports negatively influences next year’s profits of EU automotive companies.

H2b: The quality of ESG reports positively influences next year’s profits of UK automotive companies.

Finally, one of the central dynamics of CSR is to move beyond profit to pursue sustainability goals (Barauskaite & Streimikiene, 2021). Therefore, the following hypothesis tests whether lower EU profit growth is countered by a higher increase in sustainability ratings than that of UK automotive companies.

H3: EU regulation impacts the sustainability growth of automotive companies more than UK regulation does.

3. Methodology

3.1. Dataset

The initial dataset contained information on 225 European automotive companies, obtained through the protocol outlined below

Table 1
Description of variables (Source: Authors' elaboration).

Variable	Explanation	Variable type	References
GPM	Gross Profit Margin	Response Variable	Bordeianu and Radu (2020); Lukic and Lalic (2019)
EBITDAM	EBITDA Margin	Response Variable	Bordeianu and Radu (2020); Lukic and Lalic (2019)
EBITM	EBIT Margin	Response Variable	Bordeianu and Radu, (2020); Lukic and Lalic (2019)
ESGC	ESG Combined Score	Independent Variable	Aydođmuş et al. (2022)

Table 2
Measures of central tendency and spread for the analyzed variables (Source: Authors' elaboration).

Variable	Min	Mean	Median	Max	St. dev.
GPM ₂₂	0.057	0.294	0.228	1.000	0.192
EBITDAM ₂₂	0.041	0.162	0.137	1.033	0.150
EBITM ₂₂	0.014	0.103	0.070	1.033	0.157
ESGC ₂₂	19.37	61.98	62.41	90.96	15.546
ESGC ₂₁	15.37	57.76	59.43	79.88	14.531

without further refinements within Refinitiv, the global data provider widely used in business and management ESG research (Apergis et al., 2022; D'Amato et al., 2022; Demers et al., 2021). Specifically, the cluster includes Auto Truck & Motorcycle Parts, Tires & Rubber Products, Auto & Truck Manufacturers, and Auto Vehicles and Parts & Service Retailers. This dataset contains numerous variables that describe sustainability ratings and economic performance. In the present study the following variables were considered: *Company Name* (anonymized), *Incorporation*, *TRBC (The Refinitiv Business Classification) Industry Name*, *Market Cap*, *Gross Profit Margin %*, *EBITDA Margin %*, *EBIT Margin %*, and *ESG Combined Score* (Table 1). Gross profit margin (GPM) compares gross profit to sales revenue. A low profit margin indicates a high cost of goods sold, which can be attributed to adverse purchasing policies, low

selling prices, low sales, stiff market competition, or wrong sales promotion policies (Bordeianu & Radu, 2020; Lukic & Lalic, 2019). The EBITDA (Earnings Before Interest, Taxes, Depreciation, and Amortization) margin can differ greatly from net profit and actual cash flow, which are better business performance indicators (Bordeianu & Radu, 2020). Removing the non-financial dimensions of depreciation and amortization from the previous item yields EBIT (Earnings Before Interest, Taxes), which can provide a cleaner assessment than the previous one. For the final four variables, the values for the years 2022, 2021, 2020, and 2019, were considered respectively. Table 1 summarizes the variables used.

After removing numerous missing values, the dataset consists of 48 observations. Subsequently, the dataset was divided into the EU and UK datasets with the data concerning 41 European and 7 UK companies, respectively, allowing for the separate treatment of the two sets of companies. Considering that the required information was not unavailable for many companies, especially for the previous years, these datasets can be taken as representative of the analyzed sector. Table 2 summarizes the measures of central tendency and spread for the analyzed variables.

Figure 1 illustrates the distribution of companies based on two key metrics: Market Capitalization, which reflects the overall size of the company, and total emissions, highlighting their involvement in ESG dynamics. This chart also emphasizes some of the most prominent companies in the research scope and distinguishes UK-based companies within the cluster using red coloring.

3.2. Multiple linear regression

To analyze the impact of ESG reporting on company profit, the present research used multiple linear regression (Chatterjee & Simonoff, 2020; Uyanik & Güler, 2013). The authors distinguish between two types of variables, namely, the response variable (or output variable) Y , which is to be predicted, and the independent variables (or input variables) X_1, \dots, X_n used to predict the value of Y . The following equation, called the population regression line, defines the linear regression

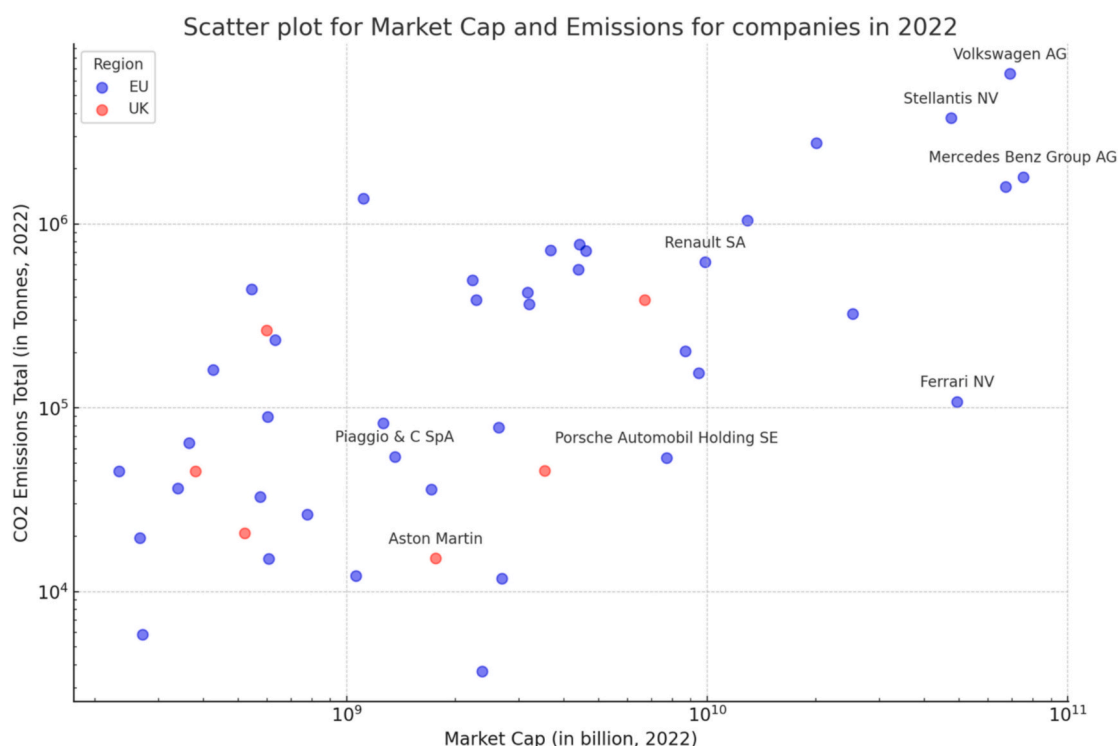


Fig. 1. Scatter plot for Market Cap and Emissions for companies in 2022.

Table 3

Coefficient estimates for the three models using ESGC₂₂ and EU_UK as predictors and including the interaction between the two predictor variables (Source: Authors' elaboration).

	b_0	p -val	b_1	p -val	b_2	p -val	b_3	p -val
GPM_{22}	0.629	1.45e - 06 ***	-0.005	0.004 **	-0.812	0.004 **	0.015	0.007 **
$EBITDAM_{22}$	0.407	1.96e - 05 ***	-0.004	0.005 **	-0.450	0.033 *	0.007	0.090.
$EBIT_{22}$	0.381	8.44e - 05 ***	-0.004	0.002 **	0.368	0.089.	0.005	0.268

p-value <0.1; * p-value <0.05; ** p-value <0.01; *** p-value<0.001.

model.

$$Y = \beta_0 + \beta_1 X_1 + \dots + \beta_n X_n + \varepsilon$$

This model describes the relation between the response variable and the predictors for the observations in the studied population (Matthews, 2005). The goal is to find the best possible linear equation that describes this relation in the population, that is, the coefficients β_0, \dots, β_n . These coefficients are estimated by using an adequate sample, because studying the whole population is impossible. The least squares method is typically used to find the estimates b_0, \dots, b_n for β_0, \dots, β_n .

The following equation, the sample regression line, is the model obtained from sample data.

$$\hat{y} = b_0 + b_1 x_1 + \dots + x_n$$

The response values $\hat{y}_i, i = 1, \dots, n$ obtained from this equation are the fitted values, and they differ from the values effectively observed in the sample.

Predictors in the linear regression model can be numerical or categorical variables. Categorical variables are normally used to model a certain property's presence or absence and introduce interactions between variables into linear regression models.

3.3. Linear regression models with the dummy variable EU_UK and interactions

After analyzing the correlation tables included in the Appendix, the linear regression models were estimated. To test H1, the authors designed three linear models with GPM_{22} , $EBITDAM_{22}$, and $EBIT_{22}$ as response variables and $ESGC_{22}$ and a dummy variable EU_UK as predictor variables. Subsequently, the interaction between the two predictor variables was included in the model.

To test H2, similar linear models were designed with GPM_{22} , $EBITDAM_{22}$, and $EBIT_{22}$ as response variables and $ESGC_{21}$ and a dummy variable EU_UK as predictor variables. We again analyzed both models, with and without the interaction between the two predictor variables.

Since the models with the interactions proved to be more significant, this section includes the details only about the models with the interactions. An interested reader can consult the models without interactions in the Appendix.

$$GPM_{22} = \beta_{oi}^{GPM} + \beta_{1i}^{GPM} ESGC_{22} + \beta_{2i}^{GPM} EU_UK + \beta_{3i}^{GPM} ESGC_{22} \bullet EU_UK + \varepsilon$$

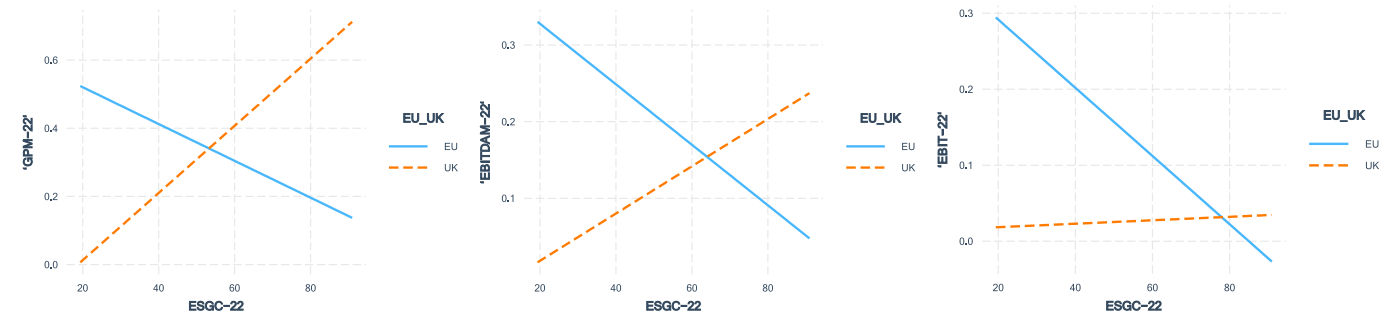


Fig. 2. The linear regression lines for each response variable with ESGC₂₂ as a predictor, distinguishing between EU and UK companies (models with interactions) (Source: Authors' elaboration).

$$EBITDAM_{22} = \beta_{oi}^{EBITDA} + \beta_{1i}^{EBITDA} ESGC_{22} + \beta_{2i}^{EBITDA} EU_UK + \beta_{3i}^{EBITDA} ESGC_{22} \bullet EU_UK + \varepsilon$$

$$EBIT_{22} = \beta_{oi}^{EBIT} + \beta_{1i}^{EBIT} ESGC_{22} + \beta_{2i}^{EBIT} EU_UK + \beta_{3i}^{EBIT} ESGC_{22} \bullet EU_UK + \varepsilon$$

$$GPM_{22} = \beta_{oi}^{GPM} + \beta_{1i}^{GPM} ESGC_{21} + \beta_{2i}^{GPM} EU_UK + \beta_{3i}^{GPM} ESGC_{21} \bullet EU_UK + \varepsilon$$

$$EBITDAM_{22} = \beta_{oi}^{EBITDA} + \beta_{1i}^{EBITDA} ESGC_{21} + \beta_{2i}^{EBITDA} EU_UK + \beta_{3i}^{EBITDA} ESGC_{21} \bullet EU_UK + \varepsilon$$

$$EBIT_{22} = \beta_{oi}^{EBIT} + \beta_{1i}^{EBIT} ESGC_{21} + \beta_{2i}^{EBIT} EU_UK + \beta_{3i}^{EBIT} ESGC_{21} \bullet EU_UK + \varepsilon$$

4. Results

As described earlier, European sustainability regulations influence EU and UK automotive company profits differently.

4.1. Results for H1

H1 states that the economic impact of sustainability regulations and reporting differs between UK and EU automotive companies, supported by two sub-hypotheses: H1a, which points out that sustainability regulations negatively influence the economic impact on EU automotive companies, and H1b, which suggests that sustainability regulations positively influence the economic impact on UK automotive companies.

Table 3 summarizes the estimates $b_0, b_1, b_2,$ and b_3 for the coefficients $\beta_0, \beta_1, \beta_2,$ and β_3 and the corresponding p -values for the first three models, using ESGC₂₂ and EU_UK as the predictors and including the interactions between predictor variables.

A p -value is the probability of obtaining the observed results if the null hypothesis of a statistical test is true. It provides the smallest significance level at which the null hypothesis would be rejected. Hence, a lower p -value means that we have stronger evidence in favor of the alternative hypothesis. A p -value of 0.05 or lower is considered statistically significant, although the values between 0.01 and 0.1 or even smaller can be used.

The authors observe that almost all the coefficient estimates (apart from b_3 for EBIT₂₂) are statistically significant, although two of the coefficients (b_2 for EBIT₂₂ and b_3 for EBITDAM₂₂) are only significant at the

Table 4
Analysis of variance table (Source: Authors' elaboration).

	Model 1 vs. Model 2	Model 1 vs. Model 3	Model 2 vs. Model 3
<i>GPM</i> ₂₂ p-value	0.354	0.016 *	0.007 **
<i>EBITDAM</i> ₂₂ p-value	0.064	0.043 *	0.090.
<i>EBIT</i> ₂₂ p-value	0.022 *	0.041 *	0.268

p-value <0.1; * p-value <0.05; ** p-value <0.01; *** p-value<0.001.

significance level $\alpha = 0.1$. The meaning is more easily understood when the linear regression lines for each response variable are written out, distinguishing EU and UK companies and illustrating them by interaction graphs given in Fig. 2.

$$GPM_{22}^{EU} = 0.629 - 0.005 \cdot ESGC_{22} \quad GPM_{22}^{UK} = -0.183 + 0.01 \cdot ESGC_{22}$$

$$EBITDAM_{22}^{EU} = 0.407 - 0.004 \cdot ESGC_{22} \quad EBITDAM_{22}^{UK} = -0.043 + 0.066 \cdot ESGC_{22}$$

$$EBIT_{22}^{EU} = 0.381 - 0.004 \cdot ESGC_{22} \quad EBIT_{22}^{UK} = 0.749 + 0.001 \cdot ESGC_{22}$$

First, it can be observed that for all three response variables, *GPM*₂₂, *EBITDAM*₂₂, and *EBIT*₂₂, the intercept b_0 is higher for EU companies than for UK companies. Notably, the response variables decrease as the independent variable *ESGC*₂₂ increases for EU companies; on the contrary, they increase for the UK companies, indicating that the EU regulations negatively impact EU companies, whereas the UK companies still manage to increase their profit.

It is also possible to observe that all the coefficients have relatively low values. This is because the ESGC score is between 0 and 100, whereas the values for *GPM*, *EBITDAM*, and *EBIT* are percentages; thus, the values are between 0 and 1. Hence, even the low values of the coefficients have the influence on the predicted variables.

Instead of a single model for each response variable *GPM*₂₂, *EBITDAM*₂₂, and *EBIT*₂₂, two separate linear models could have been designed for each response variable: one for the EU dataset and one for the UK dataset. While this approach would have produced the same estimates for the coefficients, it would not have allowed for a comparison of the differences between the intercepts and the slopes of the regression lines.

4.2. Comparison of models for H1

Even though the analysis of the models without the interactions is not presented in this section, the authors compared the following three models for each of the three response variables *GPM*₂₂, *EBITDAM*₂₂, and *EBIT*₂₂.

- **Model 1** includes only *ESGC*₂₂ as a predictor variable without distinguishing between EU and UK companies (this base model without the dummy variable EU_UK has not been analyzed).
- **Model 2** includes *ESGC*₂₂ and EU_UK as predictor variables, making it possible to distinguish between EU and UK companies but only at the intercept level.

Table 5
Coefficient estimates for the three models using *ESGC*₂₁ and EU_UK as predictors and including the interaction between the two predictor variables (Source: Authors' elaboration).

	b_0	p-val	b_1	p-val	b_2	p-val	b_3	p-val
<i>GPM</i> ₂₂	0.574	1.08e - 05 ***	-0.005	0.016 *	-0.745	0.007 **	0.015	0.010 *
<i>EBITDAM</i> ₂₂	0.416	1.16e - 05 ***	-0.004	0.003 **	-0.451	0.023 *	0.008	0.078.
<i>EBIT</i> ₂₂	0.385	8.44e - 05 ***	-0.005	0.002 **	-0.333	0.101	0.004	0.350

p-value <0.1; * p-value <0.05; ** p-value <0.01; *** p-value<0.001.

- **Model 3** includes *ESGC*₂₂, EU_UK and the interaction between *ESGC*₂₂, and EU_UK as predictor variables, making it possible to distinguish between EU and UK companies also at the slope level of the regression line.

Table 4 summarizes the p-values resulting from the analysis of variance, comparing the three models.

It can be observed that including only the dummy variable EU_UK makes the model more expressive for *EBITDAM*₂₂ and *EBIT*₂₂. However, adding the dummy variable EU_UK and the interaction between *ESGC*₂₂ and EU_UK to the regression model improves the model for all three response variables (p-values in the last column corresponding to Model 1 vs. Model 3).

4.3. Results for H2

The approach and models used to test H2 are similar to those used for testing H1, with specific focus on the development of the sub-hypotheses H2a and H2b. The only difference is the usage of *ESGC*₂₁ as the predictor instead of *ESGC*₂₂. Hence, the below section briefly summarizes the main results.

The important difference when using *ESGC*₂₁ as a predictor is that when *ESGC*₂₁ is used to predict *EBIT*₂₂, the value for b_2 is negative but not significant, suggesting that the difference between EU and UK companies is not large when predicting *EBIT*₂₂ (Table 5). The graphs are provided in Fig. 3. The regression line has a negative slope even for UK companies for *EBIT*₂₂.

The comparison of models follows the same pattern as for H1.

Table 6 shows the same pattern of behavior as when using *ESGC*₂₂ as the predictor. In contrast to UK companies, EU companies tend to be penalized by strict European regulations.

4.4. Results for H3

An increasing trend for the ESGC variable is observed in both geopolitical areas. However, the quality of sustainability reporting for the EU region is higher and shows that the policies have been implemented (Fig. 4). Although the trend of UK's companies is increasing, the quality of reporting must become closer to the reporting level under EU jurisdiction. In addition, t-tests indicate a statistically significant increase for the mean ESGC values for the EU, both for the two consecutive years (p-value = 0.003 **) and for the difference between 2019 and 2022 (p-value = 2.202e - 06 ***). In contrast, the increase for the mean ESGC values for the UK is not statistically significant for the two consecutive years; only the difference between 2019 and 2022 is significant at the 10 % significance level. Furthermore, the period under observation emphasizes 2020 as the year the COVID-19 pandemic erupted, which slowed and changed paradigms for various companies (Ben-Amar et al., 2022). Although the profits in the automotive sector may have been affected by the pandemic (Matthews, 2005), sustainability continued its path of improvement.

5. Discussion

This study highlights the need for a parallel increase in awareness of sustainability and productivity in the automotive industry. Specifically,

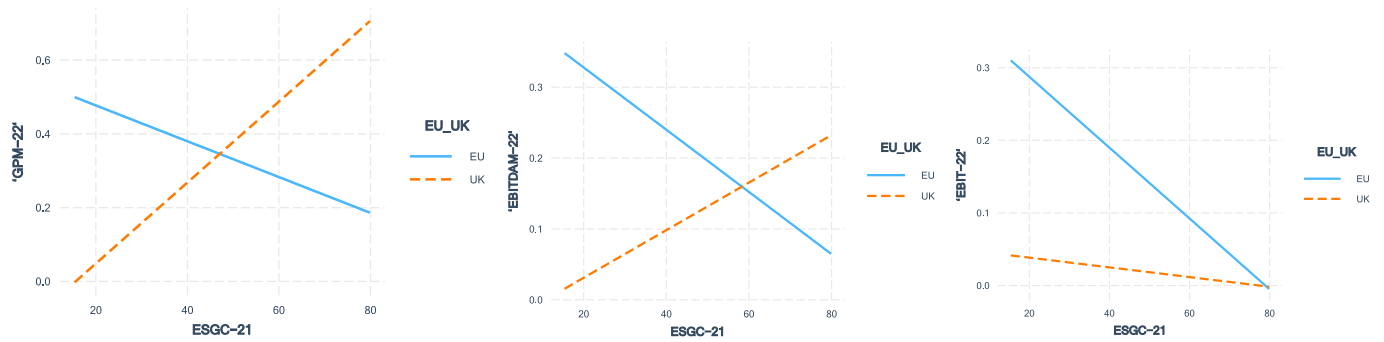


Fig. 3. The linear regression lines for each response variable with ESGC₂₁ as a predictor, distinguishing between EU and UK companies (models with interactions) (Source: Authors' elaboration).

Table 6

Analysis of variance table (Source: Authors' elaboration).

	Model 1 vs. Model 2	Model 1 vs. Model 3	Model 2 vs. Model 3
GPM ₂₂ p-value	0.401	0.025 *	0.010 *
EBITDAM ₂₂ p-value	0.045 *	0.028 *	0.077.
EBIT ₂₂ p-value	0.013 *	0.031 *	0.350

p-value <0.1; * p-value <0.05; ** p-value <0.01; *** p-value<0.001.

the analysis of H1 reveals that EU policies have been found to decrease automotive company profits, which resonates with the CSR ethos of prioritizing more than just profit (Barauskaite & Streimikiene, 2021). Moreover, it is evident from the data that sustainability disclosure documents significantly influence the economic performance of the following year (Frieske & Stieler, 2022). Therefore, this study investigates the effects of sustainability reporting on the next year's economic performance, confirming that a high ESG rating adversely impacts the next year's performance of EU companies. In contrast, an enhancement in economic performance is observed for UK companies.

Thus, it appears that EU policies may limit economic growth in the automotive sector, whereas UK companies experience benefits from their market and regional uniformity. In particular, similar policies fit better in a homogeneous economic area, such as the UK, than in an area with cultural and economic dissimilarities, such as the EU. Although there is a decline in economic performance due to an increased focus on ESG among automotive companies, the validation of H3 indicates substantial growth in sustainability reporting. Notably, EU companies have significantly improved their ESG reporting quality, more so than their UK counterparts.

The findings enable a discussion that extends into several areas. Firstly, the study sample solely consists of companies required to

prepare mandatory sustainability reporting, facilitating an unbiased quality assessment in line with major international reporting standards (Petera, Wagner, & Pakšiová, 2021). It has been consistently observed that a higher rating in assessing sustainability actions correlates with reduced profit for the current and following year in the EU, whereas the UK demonstrates consistency with studies from different sectors showing a correlation between a greater focus on ESG elements and higher current and near-future profits (EFRAG - ESRS 1, 2022). Furthermore, the results indicate no positive correspondence for the EU area in the margins. In other words, the EU is unaffected by the fluctuation of external raw material costs removed from the total turnover to highlight the GPM.

Even removing labor costs in the EU area, which are among the highest (Chen, Kuo, & Chen, 2022), and highlighting the EBITDA margin do not result in a positive matching effect. Finally, the regression line appears negative for the last performance indicator (EBIT margin), which does not consider the depreciation and amortization amounts, allowing for removing the possible various investments. However, UK companies show positive correlations across all three economic performance indicators, suggesting a more favorable, less invasive policy environment for automotive companies.

The extension of non-financial reporting requirements in the EU will likely provide clearer documentation preparation for the automotive sector. Traditional industry ubiquity indicates listed companies as the end point of a broad supply chain (Bobeica, Ciccarelli, & Vansteenkiste, 2019). Consequently, the ESG values of these companies are occasionally impacted by information only sporadically validated by supplier companies. Therefore, the automotive sector will be more sustainable when the entire body of sustainability information, which also indirectly involves other companies, is more reliable. Hence, EU policies appear more oriented toward comprehensive sustainability reporting than UK policies.

Lastly, it is clear that EU companies are bearing the cost of increased

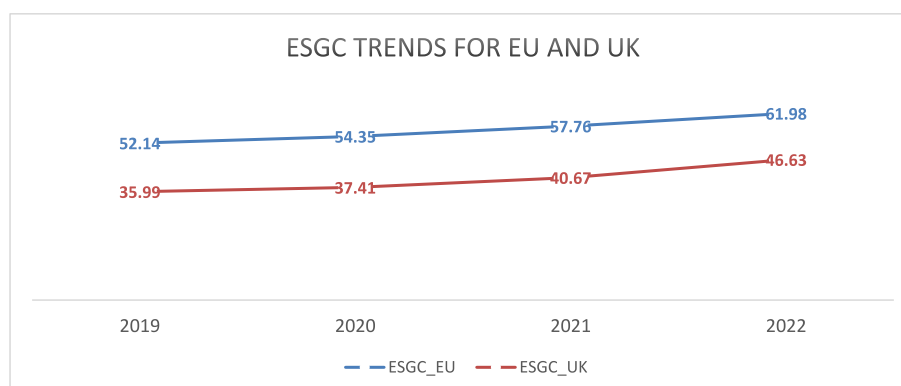


Fig. 4. ESGC Trends for EU and UK (Source: Authors' elaboration).

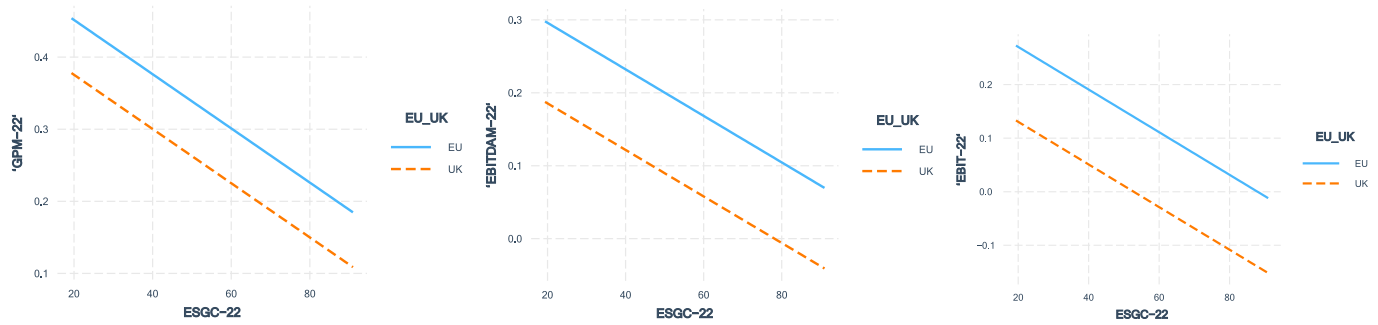


Fig. 5. The linear regression lines for each response variable with $ESGC_{22}$ as a predictor, distinguishing between EU and UK companies (models without interactions) (Source: Authors' elaboration).

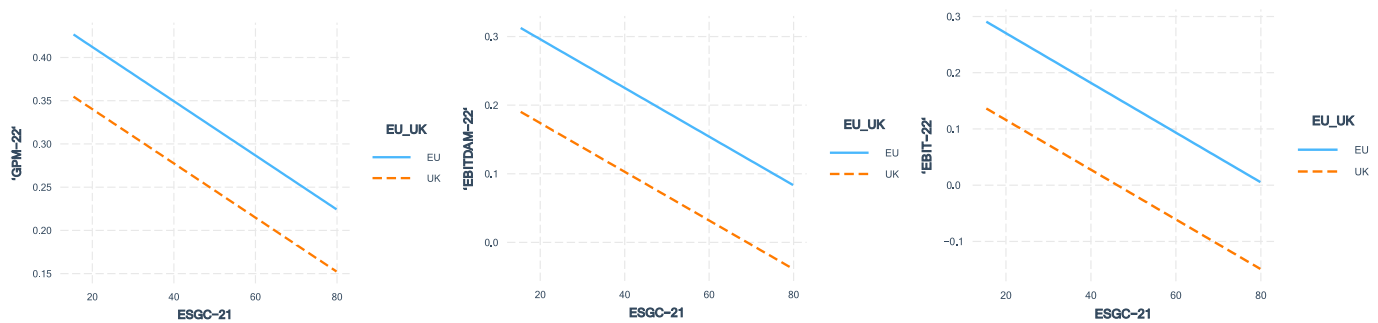


Fig. 6. The linear regression lines for each response variable with $ESGC_{21}$ as a predictor, distinguishing between EU and UK companies (models without interactions) (Source: Authors' elaboration).

sustainability awareness in the automotive sector. In particular, the rising cost of renewable raw materials, green energy sources, and the need for extensive investment toward alternative mobility are absorbing industry revenues. Research supports the need for incentive policies that discourage woke-washing practices, ensuring sustainability efforts are more evenly distributed rather than solely impacting companies (Vredenburg et al., 2020). Furthermore, there is an evident need for enhanced incentives for firms that mitigate the risk of fraudulent and fictitious disclosure.

6. Conclusion

International entities' exogenous push for sustainability has required companies to promptly meet the requirements of the new reporting paradigm (European Union, 2014; United Nations, 2015). Specifically, the automotive sector is the EU's target for a radical change in business models and expanding the number of companies for which non-financial reporting is mandatory (European Union, 2014).

Therefore, this study assesses the consequences of European policies on the automotive sector by considering the quality of non-financial reporting and the profits generated. Significant support for H1 and H2 reveal the fragility of EU's automotive sector. For the reporting year and the following year, an increase in overall quality of non-financial reporting documents is matched by a significant decrease in profits. Traditionally, the EU region appears economically unbalanced and culturally inconsistent. Similar adjustments to promote sustainability have been implemented in the UK, an area that no longer belongs to the EU due to Brexit (Hepburn & Teytelboym, 2017). In the UK, the increase in the quality of reporting statements corresponds to a rise in profits. The comparison between the two regions highlights how implementing a reporting system and pushing toward zero-emission mobility in an area characterized by cultural and economic homogeneity is more feasible.

However, the third hypothesis test confirms the foresight of EU policies. Indeed, the increase in the quality of sustainability reporting,

which governance identifies as evidence of increasing sustainability, is incrementally more significant than in the UK. The importance of this comparison lies in anticipating the limitations and consequences of expanding the scope of companies obligated to perform non-financial reporting (European Union, 2022). Indeed, there is a need to reflect on how EU policies can reduce automotive profits, which are already committed to investments to achieve the net-zero carbon targets set for 2050 (European Commission, 2019).

6.1. Theoretical implications

The present research reveals several theoretical implications. First, the study determines EU policies as strategies to foster CSR diffusion. Although CSR involves a voluntary decision to increase the positive impacts of operations (Barauskaite & Streimikiene, 2021), the need to comply with the regulation is a pretext for evolving in this direction. Through the results, it is possible to recognize the EU's willingness to force companies to look beyond profits and achieve a more comprehensive understanding of sustainability that benefits stakeholders (Barauskaite & Streimikiene, 2021). However, it also reveals the contradictory fragility of this profit-absorbing policy for companies in the automotive sector. Therefore, this research highlights the ambiguity of EU sustainability strategies in requiring investments from the automotive industry to achieve emission reductions while simultaneously seeking to increase CSR. The negative profit impact involves every marginality and is not limited to the nonoperating costs of increased investment. Therefore, the paradigm shift requires attention and a gradual approach to avoid crowding out one of the EU area's major industrial sectors. A final implication is the shallowness of current mandatory reporting; measuring sustainability on listed or large companies alone does not identify any information leakage along the supply chain.

6.2. Practical implications

This study also suggests several practical implications. First, in contrast to what the current study reveals, the phased introduction of sustainability policies allows companies to absorb economic losses from the sudden involvement of all stakeholders in the non-financial reporting domain. Therefore, managers of companies that will soon be compulsorily involved in the perimeter of sustainability reporting will have to prepare the entire corporate system in advance to accommodate the information needs. The main consequence of this change in approach is the return of a non-financial reporting mechanism enabled by the EU and consistent with CSR. Second, the need for CSR practices to comply with regulatory requirements activates improved non-financial reporting. Specifically, the increasing number of companies included in the reporting scope stimulates large standard-setting organizations to provide tools closer to sectoral needs. Disseminating sectoral standards makes overcoming sustainability bias and woke washing possible by elevating the quality of the standards (Vredenburg et al., 2020). Finally, this study indicates the need for policymakers to embed a non-financial reporting process through a cultural change on all corporate levels. Preventing corporate profits from falling will only through gradual inclusion or consideration of cultural and economic differences.

6.3. Limitations and future research

This study focuses primarily on publicly traded European automotive companies; therefore, its findings may not be generalizable to private firms or entities operating outside of Europe. The impact of the COVID-19 pandemic, especially significant during the year 2020, is acknowledged. Consequently, the dataset utilized spans from 2021 to 2022, postdating the official completion of Brexit. This allows for a focused analysis of the post-Brexit regulatory environment, mitigating the confounding impacts of the pandemic’s most severe disruptions.

Future research could broaden the scope to include private companies and ventures in emerging markets, thus providing a comprehensive view across various economic contexts. Moreover, exploring the distinct impacts of environmental, social, and governance components separately could elucidate how these factors individually contribute to

company performance.

Differences in regulatory responses to the pandemic between the EU and the UK, such as variations in economic support plans and health regulations, are crucial for understanding the broader economic implications. These variances offer a fertile ground for investigating how regulatory divergences may affect economic outcomes beyond the immediate impacts on sales and profitability.

It would also be beneficial to investigate how the quality of sustainability reporting influences profitability targets. While profitability values from 2021 and 2022 are treated as standalone figures rather than part of a continuous historical series in this study, examining these within a broader temporal framework could enhance understanding of long-term trends and regulatory impacts.

In conclusion, the analytical approach adopted in this study is designed to examine regulatory impacts rather than annual changes. By incorporating these considerations into the limitations and future research sections, the study aims to provide a richer context, thereby enhancing the understanding of its findings and their implications for policy and corporate strategy.

CRedit authorship contribution statement

Federico Lanzalonga: Writing – original draft, Resources, Project administration, Methodology, Conceptualization. **Silvia Likavec:** Writing – original draft, Visualization, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Paolo Pietro Biancone:** Visualization, Validation, Supervision, Methodology, Investigation, Conceptualization.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Appendix

Tables 7 and 8 are the correlation tables with the corresponding *p*-values (in parentheses) for EU and UK companies.

Table 7. Correlations and *p*-values for EU companies (Source: Authors’ elaboration).

	Market Cap	GPM ₂₂	EBITDAM ₂₂	EBIT ₂₂	ESGC ₂₂	ESGC ₂₁
Market Cap	1.00					
GPM ₂₂	-0.11 (0.497)	1.00				
EBITDAM ₂₂	0.14 (0.392)	0.66 (0.000)	1.00			
EBIT ₂₂	0.08 (0.617)	0.66 (0.000)	0.99 (0.000)	1.00		
ESGC ₂₂	0.06 (0.726)	-0.44 (0.004)	-0.41 (0.008)	-0.44 (0.004)	1.00	
ESGC ₂₁	-0.09 (0.583)	-0.37 (0.018)	-0.43 (0.006)	-0.45 (0.003)	0.82 (0.000)	1.00

Table 8. Correlations and *p*-values for UK companies (Source: Authors’ elaboration).

	Market Cap	GPM ₂₂	EBITDAM ₂₂	EBIT ₂₂	ESGC ₂₂	ESGC ₂₁
Market Cap	1.00					
GPM ₂₂	-0.17 (0.712)	1.00				
EBITDAM ₂₂	-0.09 (0.846)	0.89 (0.007)	1.00			
EBIT ₂₂	-0.16 (0.730)	0.16 (0.738)	-0.12 (0.799)	1.00		
ESGC ₂₂	0.05 (0.907)	0.67 (0.097)	0.81 (0.026)	0.06 (0.896)	1.00	
ESGC ₂₁	0.26 (0.575)	0.71 (0.077)	0.83 (0.020)	-0.17 (0.716)	0.91 (0.004)	1.00

A.1. Models without interactions

Three linear models with GPM_{22} , $EBITDAM_{22}$, and $EBIT_{22}$ as response variables and $ESGC_{22}/ESGC_{21}$ and a with a dummy variable EU_UK as predictor variables.

$$GPM_{22} = \beta_0^{GPM} + \beta_1^{GPM} ESGC_{22} + \beta_2^{GPM} EU_UK + \varepsilon$$

$$EBITDAM_{22} = \beta_0^{EBITDA} + \beta_1^{EBITDA} ESGC_{22} + \beta_2^{EBITDA} EU_UK + \varepsilon$$

$$EBIT_{22} = \beta_0^{EBIT} + \beta_1^{EBIT} ESGC_{22} + \beta_2^{EBIT} EU_UK + \varepsilon$$

$$GPM_{22} = \beta_0^{GPM} + \beta_1^{GPM} ESGC_{21} + \beta_2^{GPM} EU_UK + \varepsilon$$

$$EBITDAM_{22} = \beta_0^{EBITDA} + \beta_1^{EBITDA} ESGC_{21} + \beta_2^{EBITDA} EU_UK + \varepsilon$$

$$EBIT_{22} = \beta_0^{EBIT} + \beta_1^{EBIT} ESGC_{21} + \beta_2^{EBIT} EU_UK + \varepsilon$$

Table 9 summarizes the estimates b_0 , b_1 , and b_2 for the coefficients β_0 , β_1 , and β_2 and the corresponding p -values for the first three models, which use $ESGC_{22}$ as the predictor and do not include interactions.

Table 9. Coefficient estimates for the first three models (without interaction) using $ESGC_{22}$ as a predictor (Source: Authors' elaboration).

	b_0	p -val	b_1	p -val	b_2	p -val
GPM_{22}	0.527	3.7e - 05 ***	-0.004	0.042 *	-0.076	0.354
$EBITDAM_{22}$	0.360	7.26e - 05 ***	-0.003	0.017 *	-0.111	0.064
$EBIT_{22}$	0.350	0.0001 ***	-0.004	0.004 **	-0.140	0.022 *

p -value <0.1; * p -value <0.05; ** p -value <0.01; *** p -value <0.001.

It can be seen that all the coefficients, except for b_2 for GPM_{22} , are statistically significant. Furthermore, b_1 and b_2 are both negative, indicating that the increase in $ESGC_{22}$ results in a decrease in GPM_{22} , $EBITDAM_{22}$, and $EBIT_{22}$.

The meaning of the estimated coefficients can be understood more clearly by expressing the linear regression lines for each response variable, distinguishing between EU and UK companies, and illustrating them graphically.

$$GPM_{22}^{EU} = 0.527 - 0.004 \cdot ESGC_{22} \quad GPM_{22}^{UK} = 0.451 - 0.004 \cdot ESGC_{22}$$

$$EBITDAM_{22}^{EU} = 0.360 - 0.003 \cdot ESGC_{22} \quad EBITDAM_{22}^{UK} = 0.249 - 0.003 \cdot ESGC_{22}$$

$$EBIT_{22}^{EU} = 0.350 - 0.004 \cdot ESGC_{22} \quad EBIT_{22}^{UK} = 0.210 - 0.004 \cdot ESGC_{22}$$

These models illustrate how the response variables depend on $ESGC_{22}$ differently for EU and UK companies. The result reveals that the intercept coefficients b_0 are higher for EU than for UK companies in all cases and the correlation is negative (i.e., coefficients b_1 , describing the slope of the regression line are negative). This finding implies that the GPM is higher for EU than for UK companies for the same values of ESGC. As there are more EU companies in our sample, the behavior of the regression line follows the one for EU companies. This can also be observed in the graphs in Fig. 5.

Table 10. Coefficient estimates for the first three models (without interaction) using $ESGC_{21}$ as a predictor.

	b_0	p -val	b_1	p -val	b_2	p -val
GPM_{22}	0.475	1.9e - 04 ***	-0.003	0.116	-0.072	0.401
$EBITDAM_{22}$	0.367	4.83e - 05 ***	-0.004	0.013 *	-0.122	0.045 *
$EBIT_{22}$	0.359	8.09e - 05 ***	-0.004	0.003 **	-0.154	0.013 *

p -value <0.1; * p -value <0.05; ** p -value <0.01; *** p -value <0.001.

It is observed that the only difference when using $ESGC_{22}$ as a predictor is that, when $ESGC_{21}$ is used to predict GPM_{22} , the value for b_1 is not significant, indicating a not very strong influence of $ESGC_{21}$ on GPM_{22} (Table 10). The graphs are provided in Fig. 6.

Data availability

Data will be made available on request.

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