

ESG, Risk Management and SMEs: What Are the Potential Links? An Empirical Analysis of Friulia S.p.A.'s Investment Portfolio

Tommaso Cortivo

University of Trieste, DEAMS, Italy
tommaso.cortivo@phd.units.it

Giorgio Valentinuz

University of Trieste, DEAMS, Italy
giorgio.valentinuz@deams.units.it

Abstract. This paper examines the determinants of Environmental, Social, and Governance (ESG) adoption in small and medium-sized enterprises (SMEs) financed by Friulia S.p.A., a privately managed institutional investor under public control of the Friuli Venezia Giulia Region. Using data collected through a structured questionnaire, we build a synthetic indicator of ESG activation through Principal Component Analysis (PCA), which captures the degree to which firms internalise sustainability practices. The first three principal components extracted through PCA represent distinct ESG dimensions and are used, separately, as dependent variables in Ordinary Least Squares (OLS) regressions, with environmental certification and firm size as explanatory factors. Results show that the presence of an environmental certification is significantly associated with stronger ESG activation – particularly along the operational dimension – confirming its role as a key driver of structured sustainability practices. By contrast, firm size does not emerge as a significant predictor, suggesting that financial support (equity, specifically) from a professional investor may offset resource disparities across SMEs. Secondary ESG dimensions related to governance and residual social behaviours are not explained by structural variables, pointing instead to cultural and organisational factors. The findings contribute to the literature on SME sustainability by demonstrating that certifications serve as both signalling and learning tools, while also providing practical guidance for policymakers and public investors on how to design effective strategies to support the ESG transition of SMEs.

Keywords: SMEs, ESG, certification, PCA, risk management, sustainability, Friulia S.p.A.

1. Introduction

The growing relevance of Environmental, Social, and Governance (ESG) criteria is profoundly transforming the regulatory and financial environment in which European companies operate. While large firms are directly subject to stringent obligations such as those introduced by the Corporate Sustainability Reporting Directive (CSRD) and the Corporate Sustainability Due Diligence Directive (CSDDD), small and medium-sized enterprises (SMEs) are increasingly involved in these processes, albeit indirectly. This involvement occurs through their role in the value chains of larger firms and their inclusion in the investment portfolios of banks and public funds (Testa et al., 2018; Graafland & Smid, 2016).

The introduction of instruments such as the Banking Book Taxonomy Alignment Ratio (BTAR), an integral component of the ESG disclosures required under Pillar 3 for European financial institutions, further strengthens the pressure on SMEs to align with sustainability criteria to maintain access to credit and public funding (European Banking Authority, 2021; European Commission, 2018). In addition, the growing attention of investors to environmental, social, and governance metrics is expanding expectations for companies of all sizes, both at the regulatory and reputational levels (Khamisu et al., 2024).

Despite the strategic role SMEs play in the national production system and their potential contribution to a sustainable transition, these firms face structural challenges in adopting and reporting ESG practices. Among the main obstacles are the scarcity of human and financial resources, often informal governance structures, the lack of staff dedicated to sustainability, and uneven levels of digitalisation (Florio & Leoni, 2017; Brustbauer, 2016; Ferreira de Araújo Lima et al., 2020). Additionally, there is a risk that sustainability may be perceived as merely a regulatory compliance requirement rather than a strategic lever integrated into business processes (Gebhardt et al., 2023; Florio & Leoni, 2017).

However, a growing body of studies emphasises that the integration of ESG objectives also represents a strategic opportunity for SMEs. Sustainable practices can contribute to strengthening organisational resilience, improving reputation with customers and stakeholders, and expanding opportunities for access to capital, public funding, and partnerships (Gebhardt et al., 2023; Baah et al., 2024). In this sense, the adoption of ESG criteria can be viewed as a proxy for a long-term entrepreneurial approach, in which risk management becomes a crucial tool to ensure business continuity and growth (Dreassi et al., 2023).

This study aims to investigate the degree of ESG activation in a specific sample of SMEs, namely those that have received equity support for capitalisation from Friulia S.p.A., a privately managed institutional investor under public control of the Friuli Venezia Giulia Region. Using an original dataset obtained through a structured questionnaire (Khan & Valentinuz, 2025), we construct a synthetic indicator of ESG activation via principal component analysis (PCA), intending to capture the extent to which sustainability principles are internalised, going beyond mere formal compliance.

The ESG activation indicator is then employed as the dependent variable in a linear regression model designed to identify the structural characteristics of firms (size, sector, environmental certifications) associated with a higher level of engagement in sustainable practices. Unlike many analyses based on self-referential indicators or mandatory reports, this study focuses on concrete and measurable behaviours adopted by firms in their actual operational context.

In doing so, the paper contributes to the emerging literature on the implementation of sustainability in SMEs, offering both theoretical and empirical insights into how the adoption of ESG criteria relates to risk culture, governance, and entrepreneurial capability. Moreover, it provides valuable guidance for regional policymakers, public investors, and financial intermediaries on how to design effective tools to support companies in their sustainable transition journey.

Beyond the specific focus on ESG activation, the case of Friulia S.p.A. can also be interpreted within a broader regional institutional architecture aimed at supporting the sustainable transition of SMEs. As a publicly controlled yet professionally managed equity investor, Friulia operates at the intersection between regional industrial policy and market-based finance, channeling patient capital towards firms considered strategic for the territorial development of Friuli Venezia Giulia. In this sense, Friulia acts both as a financial intermediary and as a policy instrument, embedding sustainability considerations into its investment processes and transmitting regulatory and societal expectations to the portfolio firms. This institutional positioning is crucial for understanding how external investors can influence the internalisation of ESG practices within smaller companies.

A growing strand of research suggests that the adoption of ESG practices can act as a catalyst for both process and product innovation in SMEs. Sustainability-oriented investments often require firms to redesign operations, introduce cleaner technologies and develop new solutions for customers and stakeholders, thereby stimulating learning and organisational upgrading. In this perspective, ESG activation becomes a potential source of competitive advantage rather than a mere compliance exercise, as it can enhance operational efficiency, risk management capabilities and the firm's attractiveness to investors and business partners. The strong association observed in this study between environmental

certification and operational ESG activation is consistent with this view, as certified firms appear to have internalised more structured practices and routines that may support innovation and long-term value creation.

2. Literature Review

2.1 ESG and Risk Management in SMEs

The integration of Environmental, Social, and Governance (ESG) criteria into business management has become increasingly relevant in the European context, raising central issues not only of compliance but also of strategic risk management, particularly for small and medium-sized enterprises (SMEs). The more established literature has long overlooked SMEs, focusing predominantly on large corporations with formalised governance structures and dedicated resources (Beasley et al., 2005). However, there is now growing interest in how SMEs perceive and manage sustainability-related risks, often in the absence of codified structures or personnel dedicated to ESG compliance (Henschel, 2010; Ferreira de Araújo Lima et al., 2020).

According to the Committee of Sponsoring Organizations (COSO, 2017) framework, Enterprise Risk Management (ERM) represents an integrated and proactive approach to risk management, based on principles of strategic planning, continuous monitoring, and alignment between objectives and performance. In SMEs, the adoption of ERM systems can serve as an effective tool to overcome structural constraints such as limited resources, fragmented decision-making, and weak information systems (Florio & Leoni, 2017; Brustbauer, 2016). Nevertheless, the diffusion of such approaches remains limited, hindered by a perception of sustainability as a regulatory burden rather than as a competitive lever (Gebhardt et al., 2023; Florio & Leoni, 2017).

One of the key turning points in recent literature is the idea that ESG practices, if properly internalised, may represent a natural extension of an organisational culture oriented towards risk. According to Gebhardt et al. (2023), the presence of ESG Key Performance Indicators (KPIs) in internal management systems fosters a structured and conscious approach to sustainability, thereby reducing information asymmetry and enhancing the quality of decision-making. ESG practices as a risk management tool are particularly relevant for SMEs, which, despite operating with limited resources, can benefit from agile and integrated approaches (Baah et al., 2024; Ferreira de Araújo Lima et al., 2020).

2.2 Governance and Strategic Orientation

The literature highlights how specific structural features of SMEs can positively or negatively impact the adoption of ESG practices. In particular, corporate governance emerges as a key factor: the presence of a board of directors with external members, the separation of ownership and management, and the adoption of ethical codes of conduct are associated with higher levels of sustainability practice implementation (Brunninge et al., 2007; Pfajfar et al., 2022).

In the case of family businesses, Florio et al. (2022) show that the absence of formal structures and reliance on informal decision-making mechanisms hinder the adoption of ERM systems. By contrast, firms with a strong strategic orientation and managerial openness tend to integrate sustainability more easily into business planning. Risk orientation, in this sense, becomes part of the entrepreneurial mindset, where long-term choices prevail over short-term logics (Zahra et al., 2009).

Analyses conducted by Khan & Valentinuz (2025) on Friulia S.p.A.'s investee companies reveal that the lack of diversity in boards of directors and the absence of ESG training for senior management represent significant obstacles to the translation of intentions into concrete practices. These results

confirm the importance of complementing financial instruments with training and capacity-building interventions to strengthen sustainable governance in SMEs.

2.3 Environmental Certifications and Formalisation Tools

Another widely discussed element in the literature is the role of environmental certifications (e.g., ISO 14001, EMAS) as enablers of ESG adoption. Far from being a mere formal requirement, certifications can serve as positive signals to external stakeholders, as well as internal tools to structure processes, monitor performance, and enhance management quality (Graafland & Smid, 2016; Testa et al., 2018). The link between certification and the adoption of ESG KPIs has been confirmed by several empirical investigations (European Commission, 2018; Xu et al., 2023).

In our sample of SMEs invested in by Friulia S.p.A., about 48% already hold environmental certifications. Our hypothesis, consistent with the literature, is that such firms have developed greater maturity in implementing ESG practices and that certification is associated with a stronger structuring of decision-making and control processes.

2.4 ESG as a Proxy for Entrepreneurial Resilience

Finally, an emerging strand of academic literature suggests that the activation of ESG practices can be interpreted as a synthetic indicator of resilience and long-term entrepreneurial vision. From this perspective, ESG is not only a response to regulatory pressures but also reflects a conscious strategy of sustainable value creation, with positive impacts on operational continuity, reputation, and attractiveness to financiers (Dreassi et al., 2023).

The role of public professional investors, as in the case of Friulia S.p.A., can amplify this effect if accompanied by ESG selection tools and evaluation criteria that reward not only past performance but also future sustainability orientation (European Commission, 2018; Testa et al., 2018). The inclusion of ESG KPIs in public or semi-public financing processes can thus stimulate the adoption of good practices even among less structured SMEs, contributing to the diffusion of a more mature approach to risk and sustainability management.

A growing strand of research suggests that the adoption of ESG practices can act as a catalyst for both process and product innovation in SMEs. Sustainability-oriented investments often require firms to redesign operations, introduce cleaner technologies and develop new solutions for customers and stakeholders, thereby stimulating learning and organisational upgrading. In this perspective, ESG activation becomes a potential source of competitive advantage rather than a mere compliance exercise, as it can enhance operational efficiency, risk management capabilities and the firm's attractiveness to investors and business partners. The strong association observed in this study between environmental certification and operational ESG activation is consistent with this view, as certified firms appear to have internalised more structured practices and routines that may support innovation and long-term value creation.

3. Research Hypotheses

Building on the theoretical framework outlined in the previous section, this study aims to analyse the structural factors influencing the activation of ESG practices in SMEs. The underlying assumption is that the concrete adoption of ESG practices reflects, at least in part, the firm's internal awareness of risk management and its strategic orientation towards sustainability. In this context, ESG practices are not considered solely as compliance tools, but as signals of the firm's capacity to integrate sustainability into its long-term vision (Gebhardt et al., 2023; Florio & Leoni, 2017).

Based on this theoretical framing, the following hypotheses are formulated:

H1. SMEs holding environmental certifications (e.g., ISO 14001, EMAS) display a higher degree of ESG activation.

Rationale: Environmental certifications represent not only a tool for regulatory compliance but also an indicator of internal structuring, commitment to continuous improvement, and ability to measure and communicate environmental performance (Florio et al., 2022; Graafland & Smid, 2016). Their adoption signals a higher level of managerial maturity and a tendency to formalise ESG processes (Testa et al., 2018).

H2. Larger SMEs (in terms of turnover or number of employees) are more likely to activate ESG practices.

Rationale: Larger firms generally possess broader resources, greater managerial capacity, and higher exposure to regulatory, market, or reputational pressures. All these factors can facilitate the adoption of ESG practices, both operationally and strategically (Baah et al., 2024; Ferreira de Araújo Lima et al., 2020). However, the literature notes that this effect may weaken when analysing SMEs alone, as internal variability is more limited (Florio & Leoni, 2017).

H3. The degree of ESG activation varies significantly across economic sectors.

Rationale: Sectoral differences—in terms of environmental impact, exposure to social risk, regulatory scrutiny, and public visibility—shape the salience of ESG issues for firms. For instance, manufacturing companies are generally more exposed to environmental pressures, while service firms tend to focus more on social or governance aspects (Xu et al., 2023; Testa et al., 2018). These sectoral differences also affect the likelihood of certification adoption and the structure of internal governance systems (Khamisu et al., 2024).

These three hypotheses will be tested empirically through a synthetic ESG activation indicator constructed via Principal Component Analysis (PCA) and employed as the dependent variable in linear regression models. Independent variables will include the presence of environmental certification, the firm's size class, and, where available, its sectoral affiliation.

4. Data and Methodology

4.1 The Dataset: Firms Invested in by Friulia S.p.A.

This study is based on an original dataset constructed through the administration of a structured questionnaire to a sample of 46 small and medium-sized enterprises (SMEs) that have received equity investments from Friulia S.p.A. The firms included in the sample were not randomly selected but represent a targeted population of companies that have already established a relationship with a regional public investor and are therefore in a strategic position to undertake the path towards sustainable transition (Khan & Valentinuz, 2025).

The questionnaire was developed based on a literature review of key ESG Key Performance Indicators (KPIs) (Falch, 2016; Testa et al., 2018; Xu et al., 2023), with methodological input from Friulia S.p.A. to ensure adherence to the regional operational context. The questionnaire's structure comprises 32 closed-ended questions, each using a 1-to-5 Likert scale, designed to assess the effective implementation of ESG practices across three key areas: environmental, social, and governance.

In addition to closed-ended questions, qualitative fields were included, along with sections to indicate certifications obtained, sectoral affiliation, and size class. The data were recoded into a numerical format to facilitate statistical analysis. After a quality control and data cleaning process (elimination of missing responses via listwise deletion), the real sample size was reduced to 31 firms for the primary analysis.

The final dataset used for the empirical analysis thus consists of 31 SMEs for which complete information was available after data cleaning. The firms are heterogeneous in terms of age, with relatively young companies coexisting alongside more mature businesses that have been operating for several decades. The sample also covers various sectors, including manufacturing, business services and other activities, reflecting Friulia's diversified investment strategy and the variety of regional industrial characteristics. In terms of size, medium-sized enterprises represent the largest group, followed by small enterprises and, to a lesser extent, micro-enterprises, in line with the overall composition of Friulia's portfolio.

Table 1. Sectoral distribution of the sample

Sector (NACE macro-category)	Number of firms (N)	Share of sample (%)
Manufacturing	25	54.3
Transport & logistics	6	13.0
Energy & utilities	2	4.3
Other services	13	28.3
Total	46	100.0

Table 2. Age of firms (year of incorporation)

Year of incorporation class	Number of firms (N)	Share of sample (%)
Before 1980	10	21.7
1980–1999	19	41.3
2000–2009	6	13.0
2010–2019	9	19.6
2020 and later	2	4.3
Total	46	100.0

Table 3. Firm size distribution (number of employees)

Number of employees class	EU size class	Number of firms (N)	Share of sample (%)
< 10	Micro	4	8.7
10–49	Small	19	41.3
50–249	Medium	13	28.3
≥ 250	Large	10	21.7
Total		46	100.0

4.2 Construction of the ESG Indicator: Principal Component Analysis (PCA)

To synthesise the multidimensional ESG information collected through the questionnaire and reduce data complexity, Principal Component Analysis (PCA) was employed. PCA is a statistical technique for dimensionality reduction that transforms a set of correlated variables into a smaller number of uncorrelated components, maximising explained variance (Jolliffe & Cadima, 2016). This approach is particularly suitable for perceptual or behavioural data collected via ordinal scales, as in the present case (Xu et al., 2023).

All variables were standardised (zero mean, unit variance) to avoid distortions due to differences in measurement scales. The analysis was conducted in RStudio using the readxl and stats packages for statistical analysis, resulting in the identification of four principal components that together explain 55.76% of the total variance. The selection threshold for components was determined using the elbow criterion and a cumulative variance of greater than 50%, in line with established practice (Baah et al., 2024; Florio et al., 2022).

Table 4 – Variance Explained by Principal Components (PCA)

Component	Variance Explained (%)	Cumulative Variance (%)
PC1	27.19	27.19
PC2	10.80	37.98
PC3	9.74	47.72
PC4	8.04	55.76

Composition of Principal Components (included variables).

For methodological transparency, we report the macro-variables that most strongly characterise each component:

- PC1 – Operational ESG Activation (27.19%): monitoring/environmental indicators; sustainability objectives and targets; ESG strategic planning; operational procedures and responsibilities on environmental/social issues; emissions/resource management.
- PC2 – Governance Signals and Social Dimension (10.80%): formal governance elements (structured board of directors, presence of external members/diversity, separation of ownership and management); basic social initiatives and internal policies.
- PC3 – Residual/Non-formalised ESG Practices (9.74%): voluntary initiatives, community engagement, sporadic unsystematic actions.
- PC4 – Heterogeneous Factor (8.04%): mix not univocally interpretable, with weak and dispersed loadings across heterogeneous variables.

Selection of Components for Regression (Why PC4 is excluded).

Although PCA yielded four factors with a cumulative variance of 55.76%, only the first three components are used in the regressions. The fourth component (PC4) explains a reduced share of variance (8.04%) and lacks clear theoretical meaning or interpretive consistency with the ESG dimensions analysed. Its inclusion would increase statistical noise without providing substantial information. In line with good practices (Jolliffe & Cadima, 2016), we therefore restrict the analysis to interpretable and more informative components (PC1–PC3).

4.3 Explanatory Variables: Structure and Coding

To test the formulated hypotheses, the synthetic ESG indicator obtained through PCA was used as the dependent variable in linear regression models. The selected explanatory variables relate to structural characteristics of the firm, considered in the literature as potential drivers of ESG adoption (Henschel, 2010; Ferreira de Araújo Lima et al., 2020):

Firm size class (based on Commission Delegated Directive (EU) 2023/2775):

- Micro (<10 employees)
- Small (10–49 employees)
- Medium (50–249 employees)

Firm size was encoded as a categorical variable for the regression analysis, with the “Medium” class selected as the reference category. This choice reflects both its operational relevance—in regression, all effect estimates are interpreted relative to the medium-sized firms—and the fact that “Medium” is the most represented class in our sample. This allows for a more robust and statistically meaningful comparison between groups.

Presence of environmental certification:

- Binary dummy (1 = certified firm, 0 = not certified).

Sector of activity (optional):

- In a possible extension, sector of activity was coded as a dummy variable based on ATECO classification (this is an Italian classification system for economic activities), whenever the sample allowed. However, after merging the ESG dataset with the file containing structural characteristics, the final sample for regression models was reduced to 30 observations. Given the limited and incomplete availability of sectoral data, especially following the reduction in sample size, the sector variable was only tested in robustness checks, as reported in the following paragraph. As such, the core results discussed in the main text do not always include sector as a regressor.

The merging also resulted in no remaining observations for the Micro class; thus, dimensional comparisons in regressions are only between Small and Medium firms (reference category).

4.4 Model Specification: OLS Regression

Objective and Structure.

We estimate three independent OLS models, one for each principal component score, PC_i , with $i \in \{1, 2, 3\}$. The dependent variable is the component score (centred around 0). The explanatory variables are: Certification (dummy: 1 = firm with environmental certification; 0 = otherwise) and SizeClass_Small (dummy: 1 = “Small” firm; 0 = otherwise). The Medium class serves as the reference category. An intercept is included. The regression sample consists of $n = 30$ observations (after merging and listwise deletion).

The model can be expressed as follows:

$$PC_i = \beta_0 + \beta_1 \cdot \text{Certification} + \beta_2 \cdot \text{SizeClass_Small} + \varepsilon_i, i \in \{1, 2, 3\}.$$

where β coefficients are specific to each principal component, allowing for distinct effects to be estimated for each ESG dimension captured by the PCA.

Estimation and Inference.

Models are estimated via OLS with heteroskedasticity-robust standard errors (HC3). Reported outputs include: coefficients β , robust standard errors, p-values, 95% confidence intervals, R^2 and adjusted R^2 . Significance conventions: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Diagnostics (OLS assumptions).

- Multicollinearity: VIF < 5 for regressors.
- Heteroskedasticity: Breusch–Pagan test (robust SE selected accordingly).
- Normality of residuals: Q–Q plot; with small n , normality is not binding for robust inference.

Interpretation of Coefficients.

- $\beta_{\square}$ (Certification): average difference in PC_i score between certified and non-certified firms, holding size constant (reference = Medium).
- $\beta_{\square}$ (Small): average difference in PC_i score between Small and Medium firms.
- Sign and meaning (PC1): since PC1 loads positively on ESG activation practices (monitoring, targets, planning), a negative coefficient indicates a higher level of ESG activation. For PC2–PC3, interpretation follows the dimensions described in §4.2.

Robustness Checks (Alternative Specifications).

1. Inclusion of PC4 as dependent variable: unstable and non-interpretable results → excluded for theoretical consistency.
2. Inclusion of sectoral dummies (where available): results on Certification in PC1 remain qualitatively unchanged.
3. Scaling: regressors are dummies; no further standardisation required (PC_i scores are centred).

Note on Size Classes.

After data merging, no observations remained for the Micro class; therefore, the dimensional comparison in regressions is Small vs Medium (reference).

5. Results

The empirical analysis involved the estimation of three OLS linear regression models, where the dependent variables are represented by the scores of the first three principal components (PC1, PC2, and PC3) derived from the Principal Component Analysis (PCA). The models include as explanatory variables the presence of an environmental certification and the firm's size class. The main results are reported below.

5.1 Regression on PC1 – General ESG Activation Index

The first principal component (PC1), interpreted as a synthetic indicator of ESG activation, shows a significant relationship with the variable referring to environmental certification. Before interpreting the results, it is essential to clarify that the scores on PC1 are derived from the PCA. In this case, PC1 summarises all ESG practices into a single synthetic indicator: firms with lower scores on PC1 are those that scored higher on the original ESG variables (e.g., environmental monitoring, sustainability

objectives, strategic plans). For this reason, a negative coefficient in the regression indicates that the explanatory variable is associated with greater ESG activation.

Table 5 – OLS Regression Results on PC1 (General ESG Index)

Variable	Coefficient	Std. Error	p-value
Intercept (Medium, uncertified)	0.6273	0.285	0.038 *
Certification (dummy)	-3.3671	0.826	0.001 ***
SizeClass = Small	-0.1986	0.398	0.628
SizeClass = Medium	omitted	—	—

Interpretation: The negative coefficient associated with the Certification variable indicates that certified firms display significantly lower values on PC1, which, given the positive loadings of ESG variables on this component, corresponds to greater ESG engagement. Certification thus emerges as a relevant driver of operational sustainability.

Firm size, by contrast, is not significantly associated with the general ESG index. This result suggests that, within the analysed sample, firm size does not represent a discriminating factor.

The model yields $R^2 = 0.311$ and adjusted $R^2 = 0.287$, with F-statistic = 13.09 ($p = 0.001$), indicating overall statistical significance.

The regression models account for a non-negligible share of the variance in ESG activation. When environmental certification is included among the explanatory variables, the R^2 of the model for PC1 (operational ESG activation) increases compared with a baseline specification that only controls for firm size. This pattern indicates that certification captures a meaningful portion of the differences in ESG practices across firms, over and above structural characteristics such as size. From a practical standpoint, the estimated coefficients suggest that certified firms exhibit systematically higher scores on the operational ESG dimension, reinforcing the interpretation of certification as both a signalling device and a learning mechanism for structuring sustainability-related routines.

5.2 Regression on PC2 – Social and Governance Dimension

The second component (PC2), mainly associated with variables related to formal governance and specific social indicators, does not show statistically significant relationships.

Table 6 – OLS Regression Results on PC2 (Governance and Social Dimension)

Variable	Coefficient	Std. Error	p-value
Intercept (Medium, uncertified)	0.2761	0.379	0.473
Certification	-0.0741	1.097	0.946
SizeClass = Small	-0.1869	0.528	0.731

$$R^2 = 0.005, \text{ Adjusted } R^2 = -0.030, F(2, 27) = 0.13, p = 0.875$$

Interpretation: The model is not statistically significant, and there is no evidence that the certification or the firm size influences the PC2 score. The results suggest that practices related to weaker social or

governance dimensions may depend on idiosyncratic factors, such as organisational culture or leadership style, rather than observable structural characteristics.

5.3 Regression on PC3 – Residual ESG Behaviours

The third component (PC3), which can be interpreted as residual variance not directly attributable to the principal ESG axes, also yields weakly significant results.

Table 7 – OLS Regression Results on PC3 (Residual ESG Behaviours)

Variable	Coefficient	Std. Error	p-value
Intercept (Medium, uncertified)	-0.3306	0.312	0.299
Certification	-0.6637	0.900	0.470
SizeClass = Small	-0.3491	0.433	0.422

$$R^2 = 0.054, \text{ Adjusted } R^2 = 0.021, F(2, 27) = 1.61, p = 0.223$$

Interpretation: Similarly, neither environmental certification nor firm size significantly explains the observed variability. The PC3 index may capture more nuanced and non-formalised aspects of sustainable behaviour, possibly linked to local initiatives, informal practices, or emerging routines.

6. Discussion

The main objective of this study was to explore the factors that determine the activation of ESG practices in SMEs invested in by Friulia S.p.A., using data collected through a structured questionnaire and a quantitative methodology based on Principal Component Analysis (PCA) and OLS regression models.

The results provide relevant insights for the literature on sustainability in SMEs, as well as for policymakers and investors interested in promoting sustainable behaviours in this crucial segment of the productive economy.

6.1 Certification as a Lever for ESG Activation

The most robust and statistically significant result concerns the presence of an environmental certification, which emerges as a factor strongly associated with a higher level of ESG activation, particularly along the axis summarised by the first principal component (PC1). This component includes practices such as environmental monitoring, emissions management, ESG strategic planning, and the adoption of measurable objectives.

This finding is consistent with a broad body of literature identifying environmental certifications as enabling mechanisms for the internalisation of sustainability (Testa et al., 2018; Florio et al., 2022). Certifications serve not only as tools for external reporting but also as organisational learning mechanisms, facilitating the adoption of more structured internal processes (European Commission, 2018; Xu et al., 2023).

In the context of SMEs, where resources are often limited and management is frequently entrusted to multifunctional figures, certification can serve as both a simplification and a focusing tool, as well as a quality guarantee for clients, banks, and institutional partners (Gebhardt et al., 2023). The evidence from this study reinforces the idea that incentivising the acquisition of certifications may be correlated to an increase in ESG maturity of SMEs, particularly when supported by regional or national public bodies.

In addition, certification can strengthen both transparency and accountability mechanisms while acting as a practical tool to enhance risk management. Indeed, the integration of robust ESG practices tends to foster a more structured and proactive approach to identifying, assessing, and mitigating risks, thus improving the overall resilience of the organisation.

6.2 The Unexpected Role of Firm Size

Contrary to expectations and some of the existing literature (Baah et al., 2024; Ferreira de Araújo Lima et al., 2020), firm size does not appear to be a significant predictor of ESG activation. Small and medium-sized firms in the analysed sample do not show systematic differences compared to micro-enterprises in terms of ESG activation.

A possible explanation lies in the relative homogeneity of the sample, which is composed exclusively of SMEs, potentially reducing observable structural variability. Moreover, it is plausible that Friulia's role as a public institutional investor has contributed to levelling disparities in terms of resources and managerial capacity, acting as an "equalising" factor across firms of different sizes.

This result suggests that, at least in the context of SMEs supported by a publicly controlled investor, size is not in itself a constraint to sustainability implementation, provided that adequate financial, advisory, and technical support is available. Such evidence reinforces the idea that well-designed public policies can overcome structural obstacles linked to firm size, supporting ESG adoption even in smaller firms.

6.3 Marginal ESG Dimensions: Governance and Social Aspects

The results for PC2 and PC3—interpreted respectively as weak governance signals and residual ESG behaviours—do not show significant associations with the structural variables considered. This absence of significance suggests that these dimensions—less formalised and more closely tied to organisational culture—are less influenced by observable factors such as certifications or size, and more by values, leadership, and non-codified internal processes.

The result is consistent with the view expressed by Gebhardt et al. (2023), who argue that social and governance practices in SMEs are often informal, fragmented, and unsystematic. In these areas, the standardised approach of certification is less applicable, while soft support measures such as training, mentoring, peer learning, and dissemination of best practices may prove more effective.

7. Conclusions, Policy Implications, and Future Research

This study investigated the determinants shaping the adoption of Environmental, Social, and Governance (ESG) practices within a sample of small and medium-sized enterprises (SMEs) supported by Friulia S.p.A., the privately managed institutional investor under public control of the Friuli Venezia Giulia Region. Drawing on data collected through a structured questionnaire and analysed via Principal Component Analysis (PCA), a synthetic indicator of ESG activation was developed and employed in regression analyses to identify the principal structural factors underlying ESG engagement.

The empirical evidence indicates that the presence of environmental certifications (e.g., ISO 14001, EMAS) is positively associated with higher levels of ESG activation, underscoring their role as effective instruments for embedding sustainability within SMEs. Conversely, firm size does not emerge as a significant determinant, suggesting that institutional incentives and internal cultural features may have a more substantial influence on behavioural convergence across small and medium-sized firms. Moreover, secondary ESG dimensions, related to formal governance or residual social behaviours,

remain unexplained by the analysed structural variables, revealing the need for complementary qualitative inquiry to capture the underlying organisational and contextual dynamics.

From an analytical perspective, these findings contribute to the literature by reinforcing the conceptualisation of ESG activation as a measurable construct in the SME domain, while emphasising the necessity of differentiated support mechanisms that integrate financial, structural, and cultural considerations.

At the policy level, the evidence highlights the value of integrated strategies combining economic, institutional, and behavioural instruments. Public authorities and institutional investors should promote ESG certifications not merely as compliance requirements but as catalysts for strategic and organisational transformation. Financial incentives, such as vouchers, grants, or preferential access to public funding, can facilitate the uptake of certification and, in turn, enhance ESG maturity. Moreover, public investors can act as developmental partners by complementing financial interventions with non-financial instruments, including training, monitoring, and assistance in adopting sustainability standards.

Equal importance should be assigned to the softer dimensions of sustainability, governance, leadership, and organisational culture, which demand qualitative and context-sensitive policy responses. In this regard, the diffusion of transparent reporting and certification practices can enhance risk awareness and management capabilities, positioning ESG engagement as a mechanism for improving resilience and accountability, rather than merely as a regulatory obligation.

7.1 Limitations and Future Research

As with any empirical investigation, the present study is subject to certain limitations. The small sample size ($n = 30$) constrains the generalisability of the results. Furthermore, the non-probabilistic composition of the sample, which is limited to firms already equity supported by Friulia, may introduce a positive bias in the observed ESG behaviours. The exclusion of qualitative dimensions, such as leadership, values, and organisational culture, also restricts the understanding of the deeper determinants underlying sustainable practices.

Future research could build on this work by adopting a mixed-methods design. On the quantitative side, a larger survey covering a broader set of SMEs, including firms that are not financed by Friulia, would make it possible to test the robustness and generalisability of the results obtained in this study. On the qualitative side, semi-structured interviews with entrepreneurs, managers and investment officers could shed light on the decision-making processes, cultural factors and perceived barriers that shape ESG activation in practice. Combining statistical evidence with in-depth narratives would help uncover the mechanisms through which certifications, governance structures and external investors jointly influence the sustainability trajectories and risk management approaches of SMEs.

The study confirms the analytical utility of rigorous measurement frameworks for assessing sustainability activation within SMEs. Well-designed public sustainability policies, anchored in transparency, proactive risk management, and institutional support, can function as impact multipliers, transforming sustainability from a regulatory constraint into a strategic lever for competitiveness, innovation, and long-term value creation.

Financial supports

This research received support from the Regione Autonoma Friuli Venezia Giulia, both for the use of the results obtained through a research grant financed under Regional Law 34/2015, Article 5, paragraphs 29-33, and through a doctoral scholarship co-financed by the European Social Fund Plus.

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