

Determinants of Sustainability Reporting in the Romanian Banking Sector

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Abstract

This paper investigates the determinants of Sustainable Development Goals (SDG) reporting in the Romanian banking sector over an extended time horizon (2017-2023), employing a mixed-method approach that combines content analysis, fixed-effects regression, and regression trees. The analysis covers 17 commercial banks. The results indicate that report size and type are the primary determinants of SDG reporting. Additionally, the study highlights a positive effect of gender diversity on the transparency and quality of reported information, although its influence varies depending on bank-specific characteristics. Other governance factors, such as the frequency of board meetings or the independence of board members, exhibit either a negative or insignificant impact, potentially signaling organizational challenges. While macroeconomic factors such as inflation and economic growth do not have a direct effect on SDG scores, they may amplify the impact of governance variables and bank characteristics. The key contribution of this study lies in integrating two complementary methodological approaches, capturing both overarching relationships and conditional effects. Regression trees facilitate the identification and modeling of non-linear and conditional relationships between variables, enabling the detection of complex interactions that traditional fixed-effects regression models cannot capture. The findings provide a nuanced perspective on the role of board activity and composition in fostering transparency and sustainability in the banking sector.

Key words: Sustainable Development Goals (SDGs); sustainability reporting; corporate governance; gender diversity; banks;

JEL Classification: M41, M14, G34

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Introduction

The United Nations (UN) drew global attention in September 2015 with the adoption of a 15-year action plan for People, Planet, Prosperity, and Peace - the *2030 Agenda for Sustainable Development*. This plan was designed to balance the dimensions of sustainable development and be implemented through a global partnership. The agenda includes 17 Sustainable Development Goals (SDGs) and 169 universal targets, applicable to both developed and developing countries, depending on their specific realities and aligned with national policies and priorities. These objectives serve as a wake-up call for governments, businesses, and other stakeholders, as they address many of the pressing global challenges affecting nations worldwide, such as poverty, hunger, health, climate change, and other global concerns (Erin and Olojede, 2024).

The success of the SDGs largely depends on the collective efforts of UN member states in progressing toward the 17 goals, as well as on the collaboration between governments and other stakeholders, including non-governmental organizations (NGOs), the private sector, industry associations, consumers, and corporate managers. Although SDG achievement is assessed at the national level, the business sector plays a critical role in their realization, as many of the SDGs directly target corporate strategies and behaviors (Pizzi et al., 2020). Companies are therefore expected to integrate sustainability practices into their business models, align with the SDGs, and demonstrate their corporate commitment to the 2030 Agenda through publicly disclosed sustainability reports (Bose, Khan, and Bakshi, 2024).

The 2030 Agenda has placed increasing social and political pressure on companies across all industries to acknowledge and quantify the positive and/or negative impact of their activities on key sustainability issues and to improve transparency regarding their SDG-related engagement (Datta and Goyal, 2022).

Some experts argue that while corporate awareness of SDG relevance is growing, businesses are still far from fully aligning their corporate ambitions with the SDGs, implementing the necessary organizational changes, and reflecting them in reporting practices. Companies are primarily driven in this process by the need to influence stakeholder perception, regulatory requirements, or the desire to maintain legitimacy (Albu et al., 2024; Zampone

et al., 2024). As a result, the promotion of SDGs through enhanced reporting is, in some cases, perceived as "opportunistic," "symbolic," or even "greenwashing," lacking genuine effort and offering low informational value to external stakeholders (Khan et al., 2023).

Sustainability reporting is currently at different levels of maturity across countries and regions, closely correlated with the institutional context of each country. This leaves significant room for improving reporting quality and studying its comparability (Paridhi and Arora, 2023). For example, companies in Central and Eastern Europe have engaged in sustainability reporting later and to a lesser extent compared to their counterparts in more developed countries. Consequently, sustainability reporting in these countries is generally inferior in terms of both the quantity and quality of disclosures (Albu et al., 2024). The Sustainable Development Report 2024 (Sachs, Lafortune, and Fuller, 2024) ranks Romania 40th out of 167 UN member states based on their progress toward achieving the 17 SDGs, with a score of 76.70 out of 100, the latter representing the full achievement of all SDGs. This suggests that, compared to developed countries where sustainability reporting is more established and extensively studied, Romania provides a context in which reporting practices and models are still in the process of maturing.

The UN 2030 Agenda has established itself as a central theme not only in public discourse but also in academic research, particularly in accounting research focused on SDG reporting, which has seen notable growth since 2018 (Datta and Goyal, 2022; Paridhi and Arora, 2023). Research in the field (Zampone et al., 2024) highlights a clustering of studies on this topic into two categories: 1) studies investigating the degree of SDG integration into non-financial reporting systems, which also provide initial knowledge about SDGs (Fonseca and Carvalho, 2019; Cosma et al., 2020; Nicolò et al., 2023; Erin and Olojede, 2024); methodologically, these studies primarily use content analysis in relation to GRI standards and scoring systems that assess the completeness and comprehensibility of reported information; 2) studies examining the determinants of SDG adoption and disclosure by organizations (Pizzi, Rosati, and Venturelli, 2021; Datta and Goyal, 2022; Bose, Khan, and Bakshi, 2024; Hua Sim and Yuan Fung, 2024; Mazumder, 2024). These are fewer in number and explore the motivations and impact behind SDG disclosure, often yielding inconclusive or contradictory results due to the novelty of the subject (Datta and Goyal, 2022).

Most studies in the field have focused on developed countries and large companies (multinationals, publicly listed firms) or on "sensitive industries" (oil and gas, chemicals, transportation, energy, and mining), which are more likely to cause social and environmental harm due to pollution, resource exploitation, waste production, or the manufacturing of ecologically harmful products (Hua Sim and Yuan Fung, 2024). Some researchers (Pizzi et al., 2020; Mazumder, 2024; Datta and Goyal, 2022; Erin, Bamigboye, and Oyewo, 2022) advocate for prioritizing SDG studies in the context of emerging economies, where sustainable development deserves special attention. They suggest focusing on specific regions, sectors, or industries, including "non-sensitive" ones (finance, technology, tourism, real estate). Such research could expand knowledge, offering a more nuanced understanding of the factors influencing sustainability reporting practices in these contexts.

Given this positioning of researchers, we are motivated to study the determinants of Sustainable Development Goals (SDG) reporting in the Romanian banking sector for at least two reasons: 1) both the banking sector and our country represent under-researched contexts in terms of sustainability reporting; 2) many social and environmental programs led by governments in emerging economies are implemented through commercial banks, which, as financial intermediaries, engage in ongoing dialogue with stakeholders (Khan et al., 2023). According to some estimates, the transition to a sustainable and inclusive global economy by 2030 requires \$5–7 trillion annually (Avrampou et al., 2019), with a significant share coming from financial institutions. In this regard, 63.3% of European banks have launched SDG-based products, services, or commercial initiatives, such as green and social bonds, sustainable investment funds, and green mortgages (EBEF and KPMG, 2021).

Our research is guided by the following questions:

- *Do report-level determinants (report type and report size) influence the quality of SDG-related information disclosed by banks?*
- *To what extent do bank governance structures (gender diversity, board director independence, and board meeting frequency) impact the quality of SDG reporting?*

Answering these questions - and thereby achieving our research objective - involved conducting a content analysis of reports from 17 commercial banks over a

seven-year period and testing five research hypotheses developed based on a review of the relevant literature. This was done by applying fixed-effects regression analysis and regression trees. The results indicate that report size and type are the main determinants of SDG reporting, and gender diversity positively influences the transparency and quality of reported information.

To the best of our knowledge, this paper is the first to address the factors influencing the disclosure of Sustainable Development Goals (SDGs) by banking institutions in Romania, an emerging country that has been less studied in this context. An innovative aspect of the study is the use of regression trees, which allow for the capture of relationships conditioned by specific factors, revealing details that are not identified through conventional fixed-effects regression. These trees provide a more nuanced understanding of variable interactions and can contribute to the development of literature by highlighting the various conditions under which internal and external factors influence SDG reporting in the Romanian banking sector.

The remainder of the paper is structured as follows: a section reviewing the literature on the determinants of SDG reporting is followed by an outline of the research methodology, a discussion of the results obtained from testing the research hypotheses, and, finally, the conclusions, which summarize the key insights, highlight the study's limitations, and discuss its implications.

1. Determinants of SDG sustainability reporting

Previous literature highlights the need to identify the factors explaining the differences and gaps in SDG reporting between countries. Rosati and Faria (2019), analyzing a sample of firms from different countries, empirically demonstrate that institutional factors at the country level ("politics and law, economy and finance, society and culture, technology and innovation, education and workforce, and sustainability") and organizational factors ("firm size, a higher proportion of intangible assets, greater commitment to sustainability frameworks and their external assurance, a higher proportion of female directors on the board, and a younger board of directors") are linked to SDG disclosure. Datta and Goyal (2022) identify three categories of determinants influencing SDG reporting: firm-level determinants (industry sector, regulatory context, risks, size, financial performance, and

stakeholder orientation); report-level determinants (reporting processes and choices); and regulatory-level determinants (sustainability committees and compliance with international reporting frameworks). Bose, Khan, and Bakshi (2024) examine SDG disclosure determinants and consequences for the period 2016–2019, analyzing firms from 30 countries (6,941 annual observations). The authors identify the following determinants of SDG reporting: national sustainability regulations, governance models (shareholder-oriented versus stakeholder-oriented), and the economic status of countries. Other studies delve into the influence of governance-related determinants (board structure, gender diversity, and the presence of independent directors) on SDG reporting (Pizzi et al., 2020; Zampone et al., 2024).

In recent years, companies from various countries have paid increased attention to the disclosure of non-financial information through sustainability reports separate from traditional financial reports, as it is believed that the publication of standalone reports demonstrates a stronger commitment to sustainable development (Datta and Goyal, 2022; Bose, Khan and Bakshi, 2024). In other words, when non-financial disclosure is developed independently, it enhances credibility with stakeholders (Bose, Khan and Bakshi, 2024). Pizzi, Rosati and Venturelli (2021) showed that, in Italy, the use of independent reports to disclose sustainability performance is positively correlated with SDG reporting. In the same research direction, Galeazzo, Miandar and Carraro (2024), attempting to demonstrate the superiority of integrated annual reports over separate sustainability reports, do not find a significant influence of the former. Therefore, based on the existing literature, it is anticipated that companies adopting independent sustainability reports will have a higher level of SDG information disclosure.

In this context, the first research hypothesis is developed:

H1 The publication of standalone sustainability reports positively influences the quality of SDG disclosures.

The lack of a standardized format for reporting SDG information also causes their dimensions to vary significantly from one entity to another, even within the same industry. However, some studies argue that the number of pages in reports is an adequate proxy for the quality and coverage capacity of SDG information (Datta and Goyal, 2022). On the other hand, Schena et al. (2022) document that depth, defined as the total volume of SDG-

based information reported by a company, remains statistically insignificant in a model analyzing its performance.

To test whether the size of reports indicates a greater orientation towards SDGs, the second research hypothesis is formulated:

H2 Banks that publish more extensive sustainability reports are more inclined to report information on the SDGs.

The inclusion of women in corporate governance structures, such as general managers or members of the board of directors (BOD), brings multiple benefits, both from a social justice perspective and from a strategic viewpoint (Farisyi et al., 2022). Thus, women contribute with unique perspectives and a stronger sense of responsibility towards the sustainability agenda (Mazumder, 2024). They are considered more diligent than their male counterparts, more dedicated to maintaining high ethical standards in organizations, and their important communication and social skills encourage the sharing and exchange of information, including SDG-related information (Huian, Curea and Apostol, 2024). Female members of the board are often perceived as more transparent and ethical, which translates into more honest and accurate disclosures regarding sustainability (Yahaya, 2025). In an empirical study on SDG disclosures in the banking industry in an emerging economy, Mazumder (2024) finds that a critical mass of at least three female directors is necessary to establish a significant positive relationship between gender diversity on the board and SDGs. According to agency theory and stakeholder theory, greater gender diversity in the board contributes to reducing information asymmetry between management and investors, thus improving transparency and corporate accountability, and the company's involvement in SDG reporting, responding to the multiple expectations of stakeholders (Flórez-Parra et al., 2024; Zampone et al., 2024). Additionally, resource dependence theory suggests that the presence of women on the board brings essential human and social capital, influencing the economic, social, and environmental strategies of companies, which adds value and leads to greater involvement in sustainable business networks, with positive effects on sustainability and SDG-related disclosures (Mazumder, 2024; Zampone et al., 2024). These last two studies show a positive relationship between board gender diversity and SDG reporting. However, in the literature, a weak correlation or even the

absence of a significant relationship has sometimes been found (Rosati and Faria, 2019; Pizzi, Rosati and Venturelli, 2021).

Despite the mixed results, most studies consider gender diversity an important determinant factor, even in the presence of other organizational and cultural factors that may explain the quality of SDG reporting, which is why we develop the hypothesis:

H3 Gender diversity in banking corporate governance structures significantly influences the quality of SDG disclosures.

Other governance indicators, which appear in well-known studies (Farisiy et al., 2022; Zampone et al., 2024), include board activity, assessed by the number of meetings held by the board in a year, and the proportion of independent directors relative to the total number of directors on the board, which reflects the independence of the board. Extant studies present mixed results regarding the impact of these variables on SDG reporting. Like gender diversity, it is expected that the independence of directors will have a positive impact on SDG reporting due to their superior monitoring skills, impartiality, high concern for their reputation, and unique expertise (Rao and Tilt, 2016). This is due to the lack of material ties to the role, which drives directors to fulfill their duty acting in the long-term interests of shareholders, including improving sustainability performance. Similar results were obtained by Bae, Masud, and Kim (2018). Independent directors bring impartiality to the board, ensuring that sustainability disclosures are not influenced by internal biases or conflicts of interest. Independent boards are more likely to request evidence-based reporting and adherence to global standards, thus reducing the risks of

greenwashing. However, Yahaya (2025) argues that excessive reliance on independent directors without adequate expertise in the field may limit the board's capacity to deeply engage in sustainability issues. Thus, findings from authors such as Rao and Tilt (2016) and Zampone et al. (2024) suggest that the number of board meetings does not have a significant impact on SDG reporting, while the percentage of independent directors has a negative influence. Sekarlangit and Wardhani (2021) observe that the effectiveness of the board is limited by the lack of time allocated by directors to fulfill their duties, making an adequate number of board meetings necessary to make effective strategic decisions. According to the same authors, a higher frequency of board meetings can reduce agency problems by increasing transparency.

In the context of these contradictions, we develop hypotheses H4 and H5.

H4 The independence of the directors of the Board of Directors of Romanian banks has a significant impact on the quality of SDG disclosures.

H5 The activity of the Board of Directors of Romanian banks has a significant impact on the quality of SDG disclosures.

2. Research methodology

2.1 The variables analyzed

Table no. 1 shows the calculation of the dependent variables and those of interest in the model used.

Table no. 1. Dependent variables, variables of interest, and control variables		
Variable	Calculation method	Data source
<i>Dependent variable</i>		
SDG Reporting Score	The scores are calculated in three variants:	Non-financial statements, Sustainability Reports, CSR Reports, Social impact reports, Directors' reports, Annual Reports, Information Transparency Reports
• Totalvar1	-Totalvar1 – The SDGs are weighted according to their relative importance for Romanian banks	
• Total ponderat dimensiuni	- Total ponderat dimensiuni – The SDGs are grouped into the three dimensions of sustainability, with each dimension having a different specific weight in the total score	
• TotalWS	-TotalWS – the scores were weighted according to the maximum number of points that can be obtained in a full report	

Main variables of interest		
Type and size of reports - Standalonerep - Report Dimensions (PAG)	- dummy variable, taking the value 1 if the ratio is standalone, 0 otherwise - the number of pages of the report	Non-financial statements, Sustainability Reports, CSR Reports, Social Impact Report Directors' reports, Annual Reports, Information Transparency Reports
Banking Corporate Governance - Gender of CEO (CEOF_M) - Independence of the Board of Directors (Indep_dir) - Frequency of BD meetings (BoDmeet) - Presence of women on the Board of Directors (WBoD)	- dummy variable, taking the value 1 if the chief executive officer is a woman and 0 if he is a man - the share of independent directors on the Board of Directors in the total members - the number of meetings of the Board of Directors in a year - the share of female directors in the total number of members of the Board of Directors	Non-financial statements, Sustainability Reports, CSR Reports, Social Impact Report Administrators' reports, Annual Reports, Information Transparency Reports
Control variables		
Total Deposit Rate (TDR)	Ratio of total deposits to total assets	BankFocus – Bureau van Dijk and Moody's Analytics
Share of loans in total assets (CapR)	Ratio of total loans to total assets	BankFocus – Bureau van Dijk and Moody's Analytics
Bank size (Size)	Natural log of total assets	BankFocus – Bureau van Dijk and Moody's Analytics
Ownership structure (OwnRFM)	Categorical variable, having 3 categories: 1 – Romanian ownership 2 - Foreign ownership 3 – Mixed ownership	Annual reports of banks
Inflation rate (Inflation)	Annual inflation rate (%)	National Institute of Statistics - INSSE
Economic Growth (GDPg)	Annual GDP growth (%)	Worldbank Data

Source: Authors' processing, 2025

The quality of reporting was captured through the SDG information reporting scores, which were calculated, as in other similar studies (Erin and Olojede, 2024; Zampone et al., 2024), after conducting a content analysis of the banks' reports. The scoring system chosen, widely used in the literature (Tsalis et al., 2020), involves assigning two points for reporting quantitative and qualitative data on SDG targets and one point for reporting qualitative data. The scores were determined in three variants as follows:

- **Totalvar1** involved weighting the SDGs according to their relative importance for Romanian banks. It was taken into account that, depending on the specificities and priorities of the banking activity, some SDGs are better outlined in the reports of the banks in the sample than the rest (Sardianou et al., 2021; Bose, Khan and Bakshi, 2024). This has led to a triple score for some SDGs, such as SDG 8, SDG 9 or SDG12, a double score for others, such as SDG 10, SDG 16

and SDG 17, and a single score for the rest of the SDGs;

- **Total ponderat dimensiuni** consisted of grouping the SDGs on the three dimensions of sustainability, with each dimension having a different weight in the total score (social – 3 points, economic – 2 points, environmental – 1 point), as each dimension unequally affects the overall performance of the bank (Budsaratragoon and Jitmaneeoj, 2019);
- **TotalWS** – scores were weighted according to the maximum number of points that could be obtained in a full report, to ensure comparability between SDGs and between banks, but all SDGs were given equal importance in the total score (Pizzi, Rosati and Venturelli, 2021; Cohen, Manes-Rossi and Brusca, 2023).

The type and size of sustainability reports are considered key organizational factors in the literature that analyzes the determinants of SDG reporting (Bose, Khan and Bakshi, 2024). The type of report (Standalonerep) takes different forms at Romanian banks, being found as non-financial statements, sustainability reports, Corporate Social Responsibility (CSR) reports or social impact reports. An indicator of effective orientation towards non-financial themes (Pizzi, Rosati and Venturelli, 2021), the number of pages of the Sustainability Report (PAG), has the potential to be an important quantitative indicator of SDG reporting.

Gender diversity is operationalized through two complementary variables: the gender of the CEO (CEOF_M) and the share of female directors in the total number of Board members (WBoD). These indicators, widely used in recent studies (Rosati and Faria, 2019; Flórez-Parra et al., 2024; Mazumder, 2024; Zampone et al., 2024) are expected to generate mixed results, interesting to interpret in the particular context of Romanian banks. Other governance variables that appear in the analyzed papers are related to the existence of independent directors (Bae, Masud and Kim, 2018; Farisyi et al., 2022; Zampone et al., 2024), expressed as their share in the total number of Board members (Indep_dir), and the number of Board meetings (BoDmeet) in a year (Farisyi et al., 2022).

Based on analyzed literature, control variables were also selected to complete the set of determinants of the quality of SDG reporting. These are the share of deposits attracted (TDR) and loans granted (CapR) in total assets (Nguyen and Vo, 2021; Yitayaw, 2021; Badarin et al., 2024); the size of banks (Size), measured by total bank assets (Datta and Goyal, 2022; Farisyi et al., 2022; Bose, Khan and Bakshi, 2024; Mazumder, 2024), with generally positive expected effects; ownership structure (OwnRFM), with a focus on the presence of foreign shareholders (Farisyi et al., 2022; Mazumder, 2024) from which a greater concern for the transparency of reports is expected. Two macroeconomic indicators, widely used in the literature (Badarin et al., 2024), the annual inflation rate (Inflation) and economic growth (GDPg), measured by annual GDP growth, complete the picture of the control variables analyzed.

2.2 Sample and data source

The sample consisted of 17 commercial banks (out of a total of 21, according to the National Bank of Romania Annual Report 2023) that published non-financial reports (BNR, 2023). From the full list of 24 credit institutions, two subsidiaries of groups already included in the sample and one credit cooperative were removed. Four other banks were eliminated due to lack of data. Of the 17 banks for which non-financial information was publicly available, four had majority Romanian capital in 2023 and two were state-owned. Three of the banks in the sample were listed on the Bucharest Stock Exchange. The period under analysis was 2017-2023 (the most recent year for which non-financial reports were available), the starting year being selected because it was the first year for banks to apply the European regulations on non-financial reporting, through NBR Order no. 7/2016. The non-financial data came from 110 annual observations, unevenly distributed by year. The source of the other data is presented in

Table no. 1.

2.3 Research methods and models

In order to test the determinants of SDG reporting, a panel data analysis with fixed effects was performed, by developing the model in equation (1), which contains the variables of interest and control variables:

$$Y_{it} = \alpha_0 + \alpha_1 \times \text{Standalonerep}_{it} + \alpha_2 \times \text{PAG}_{it} + \alpha_3 \times \text{CEOF_M}_{it} + \alpha_4 \times \text{Indep_dir}_{it} + \alpha_5 \times \text{BoDmeet}_{it} + \alpha_6 \times \text{WBoD}_{it} + \alpha_7 \times \text{TDR}_{it} + \alpha_8 \times \text{CapR}_{it} + \alpha_9 \times \text{Size}_{it} + \alpha_{10} \times \text{OwnRFM}_{it} + \alpha_{11} \times \text{Inflation}_{it} + \alpha_{12} \times \text{GDPg}_{it} + \mu_{it} \quad (1)$$

Where, t = time period (year); i = bank at time t ; Y = dependent variable (reporting score (calculated in three variants, as described in Table no. 1)); Standalonerep = standalone report; PAG = report size; CEOF_M = CEO gender; Indep_dir = independence of board directors; BoDmeet = frequency of board meetings; WBoD = presence of women on the board; TDR = total deposit ratio; CapR = share of loans in total assets; Size = bank size; OwnRFM = ownership structure; Inflation = inflation rate; GDPg = economic growth; α_0 = constant; α_1 - α_{12} = coefficients of the independent and control variables; μ = error term.

For the regression models, we used fixed effects estimation, with the selection of this model being validated through the Hausman test. The results of the test indicated that the fixed effects model is more appropriate, as it more effectively controls for heterogeneity between banks. Additionally, to ensure the normality of the distribution, the control variable Size was logarithmically transformed, given the significant skewness of its values.

Another method used to identify the factors that significantly influence SDG reporting in Romanian banks is the regression tree method, a non-parametric approach based on recursive partitioning (Breiman et al., 2017). This method involves dividing the sample into sub-samples based on threshold values of certain variables, until no further splitting is possible (Beyaert, Garcia-Solanes, and Lopez-Gomez, 2023). The partitioning process generates a structure similar to that of a tree. The regression tree method is considered suitable for analyzing SDG reporting by Romanian banks because it allows for the automatic selection of relevant variables and visualization of interactions between them. It has both descriptive and predictive potential (Taskin et al., 2025). Compared to conventional analysis methods, regression trees facilitate better segmentation of the data and highlight conditioned relationships.

The regression tree method is frequently used by authors from various fields to study the factors that influence the behaviors of entities or individuals (Galletta, 2016; Bocci et al., 2024; Jing and Simonoff, 2024; Jarra et al., 2025). In line with existing research, the performance of the regression trees in this study is evaluated using RMSE (Root Mean Squared Error), MAE (Mean Absolute Error), and R^2 (Coefficient of Determination). RMSE is used to measure the overall difference between predicted and observed values, indicating the average prediction error.

MAE is used to calculate the mean absolute error and is a useful method for evaluating model performance as it is less sensitive to extreme values. Additionally, R^2 is calculated to determine how well the model explains the variations in the dependent variable, with the aim of validating the regression tree's ability to describe the relationships between the modeled variables.

3. Results and discussions

3.1 Descriptive statistics and correlations

Tables no. 2 and no. 3 present the descriptive statistics of the variables included in the model, as part of the univariate analysis performed, with relevant indicators selected for continuous and categorical variables. The results show that SDG reporting is inconsistent in the banking sector in Romania, with large variations identified in terms of the extent of the reports and the level of reporting. Romanian banks exhibit a moderate level of engagement in SDG reporting, with an average SDG reporting score of 24.81 ($TOTALvar1$: mean = 24.811, std. dev. = 8.108). Although the majority of banks (74.55%) publish standalone sustainability reports, the extent of reporting varies significantly - some reports are only 2 pages long, while others exceed 200 pages. This lack of standardization in sustainability reporting suggests that, while some banks are committed to transparency in SDG reporting, others provide fragmented information, not extending reporting beyond the legal requirements.

Governance structures are traditional and male-dominated, with low female representation in leadership positions, which may limit the integration of sustainability into the banks' strategy. Only 12.73% of banks have a female CEO, and women represent, on average, 26.1% of board members. This reflects a leadership structure dominated by men, which may influence the decision-making process, including policies related to sustainability. Research suggests that board diversity is associated with stronger commitments to SDGs (Mazumder, 2024), and the underrepresentation of women may have repercussions on SDG reporting. The proportion of independent directors is, on average, 29.7%, although it should be noted that some banks have no independent directors at all. The frequency of board meetings ($BoDmeet$) varies significantly, from 4 to 96 meetings per year, with an average of 23.6. This high variability suggests different levels of board involvement - banks with

more frequent meetings might be more engaged in strategic decision-making, including sustainability initiatives, as suggested by a recent study (Umar, 2024),

while banks with fewer meetings may prioritize operational efficiency, placing sustainability initiatives as a secondary concern.

Table no. 2. Descriptive statistics for continuous variables					
Variables	Obs	Mean	Std. Dev.	Min	Max
Totalvar1	110	24.81	8.10	11.48	41.56
Total ponderat dimensiuni	110	29.33	8.40	15.34	47.14
TotalWS	110	0.40	0.16	0.16	0.76
PAG	110	41.36	48.59	2.00	217
Indep dir	110	0.29	0.17	0.00	0.85
BoDmeet	110	23.60	19.93	4.00	96.00
W BoD	110	0.26	0.15	0.00	0.71
TDR	110	0.71	0.18	0.015	0.87
CapR	110	0.58	0.13	0.14	0.86
Size	110	16.60	1.27	14.08	18.94
Inflation	110	6.05	4.15	1.30	13.80
GDPg	110	3.64	3.49	-3.68	8.20

Source: authors' processing, 2025

Table no. 3. Descriptive statistics for categorical variables				
Categories	0	1	2	3
StandaloneRep				
-frequency	28	82		
-percentage	25.45	74.55		
CEOF_M				
-frequency	96	14		
-percentage	87.27	12.73		
OwnRFM				
-frequency		16	53	41
-percentage		14.55	48.18	37.27

Source: Authors' processing, 2025

In terms of funding sources, Romanian banks are focused on attracting deposits, which finance 71.7% of total assets (*TDR*: average = 0.717). Lending activity varies significantly, with loans representing only 14% of assets in some banks, while in others, they account for up to 86.6% (*CapR*). The results also show a significant influence of foreign capital in the Romanian banking sector (*OwnRFM*: 48.18% foreign capital and 37.27% mixed capital), which could affect both governance and sustainability practices of the banks (Amidjaya and Widagdo, 2020; Sumarta et al., 2023).

Macroeconomic conditions fluctuated during the analyzed period, with an average inflation rate of 6.05% and volatile economic growth (*GDPg*), ranging from -3.68% to 8.2%. This economic instability is likely to explain the moderate level of SDG reporting by Romanian banks.

To assess the risk of multicollinearity, we calculated Pearson correlation coefficients (**Figure no. 1**) and variance inflation factors (VIF) (**Table no. 4**).

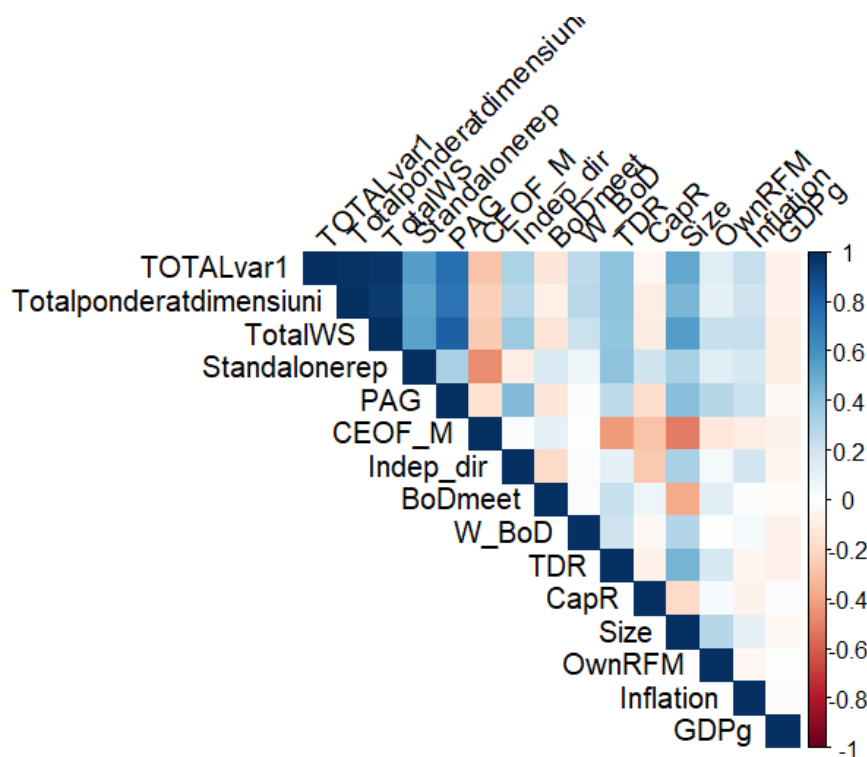
The results of the correlation analysis show that the modeled variables exhibit weak or moderate correlations. The VIF analysis confirms these observations, with the average VIF value being 1.76, suggesting that there are no multicollinearity issues. The highest VIF values are for *Size* (VIF = 3.59) and *CEOF_M* (VIF = 2.22), but these are below the critical threshold of 5 (Studenmund, 2016), confirming that there are no signs of multicollinearity affecting the stability of the regression estimates.

Table no. 5 shows a positive and statistically significant relationship between the type of sustainability report (*StandaloneRep*) and the quality of SDG reporting in all three calculation variants ($p < 0.01$ in columns 1 and 2, and $p < 0.05$ in column 3). Thus, providing non-financial information in a standalone report is a determinant of SDG reporting in Romanian banks, which, according to **Table no. 3**, use separate reports from financial ones 74.55% of the time to demonstrate their commitment to sustainability

through transparency and accountability in communicating progress toward achieving the SDGs. The positive association with the quality of SDG reporting is similar to the results obtained by Bose, Khan, and Bakshi (2024) on

firms (including banks) from 30 countries, or by Pizzi, Rosati, and Venturelli (2021) on a sample of 153 Italian public interest companies (including financial institutions). These findings validate hypothesis H₁.

Figure no. 1. Correlation matrix



Source: Authors' processing, 2025

Table no. 4. Variance inflation factors

	VIF	1/VIF
Size	3.594	0.278
CEO F M	2.220	0.450
TDR	2.000	0.500
BoDmeet	1.922	0.520
Standalonerep	1.828	0.547
PAG	1.752	0.571
Indep dir	1.514	0.660
CapR	1.471	0.680
OwnRFM	1.347	0.742
W BoD	1.281	0.780
Inflation	1.179	0.848
GDPg	1.039	0.963
Mean VIF	1.762	

Source: Authors' processing, 2025

3.2 Regression analysis with fixed effects

Table no. 5 illustrates the results of the regression analysis, each column having as a dependent variable

one of the three variants for calculating the SDG reporting score, described in Table 1.

Table no. 5. Results of the regression analysis			
	(1) TOTALvar1	(2) Totalponderatdimensiuni	(3) TotalWS
Standalonerep	4.7311*** (1.1988)	3.4204*** (1.1955)	0.0642** (0.0283)
PAG	0.0370*** (0.0102)	0.0440*** (0.0101)	-0.0001 (0.0002)
CEOF_M	1.7177 (1.3905)	2.6471* (1.3866)	0.0299 (0.0329)
Indep_dir	2.7311 (4.5747)	0.6664 (4.5618)	-0.0283 (0.1081)
BoDmeet	-0.0937** (0.0445)	-0.1304*** (0.0444)	-0.0024** (0.0011)
W_BoD	4.0084 (2.7488)	3.1291 (2.7411)	0.2810*** (0.0650)
TDR	4.0476 (2.9941)	5.4557* (2.9857)	0.0426 (0.0708)
CapR	-18.3975** (7.1387)	-25.6141*** (7.1188)	-0.2468 (0.1687)
Size	5.6377*** (1.661)	6.0831*** (1.6564)	0.1298*** (.0393)
OwnRFM	-0.2232 (2.4224)	-0.8629 (2.4156)	-0.0117 (.05730)
Inflation	0.0403 (.0857)	-0.0132 (.0855)	0.0033 (0.0020)
GDPg	0.0558 (0.0783)	0.0444 (0.0781)	-0.0003 (0.0019)
_cons	-65.8204** (26.6494)	-61.4098** (26.5748)	-1.6814*** (0.6298)
Observations	110	110	110
R-squared	0.7059	0.7057	0.5855

Standard errors are in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Source: Authors' processing, 2025

In the same vein, the larger size of the report (PAG) proves to be a determinant factor for the quality of SDG reporting by Romanian banks, when calculating scores by weighting according to the relative importance of each SDG and the specific weight of each sustainability dimension. Thus, for each additional page in the report, the reporting score increases by 0.0370 units (for *Totalvar1*) and by 0.0440 units (for *Total ponderat*

dimensiuni). These results, which confirm other existing studies (Pizzi, Rosati, and Venturelli, 2021; Datta and Goyal, 2022), demonstrate that larger reports better illustrate, through detailed narratives and numerical data, the focus on achieving the SDGs, which validates hypothesis H₂.

Corporate governance structures in banking have mixed effects on the level of SDG reporting. Thus, the gender

diversity of CEOs (*CEOF_M*) and board members (*WBoD*) exerts positive influences, statistically significant to varying degrees (2.6471 with $p < 0.1$, column 2, Table 5 for *CEOF_M*, and 0.2810 with $p < 0.01$, column 3, Table 5 for *WBoD*), suggesting that the higher presence of women in leadership structures can be considered a guarantee for providing quality information about SDG achievements (Flórez-Parra et al., 2024; Mazumder, 2024; Zampone et al., 2024). The lack of higher statistical significance can also be attributed to the underrepresentation of women in the management bodies of Romanian banks, as shown by the descriptive statistics in **Table no. 3**, as well as other studies documenting a positive relationship of weaker intensity (Rosati and Faria, 2019). In this context, we consider hypothesis H_3 to be validated.

Regression analysis shows that the proportion of independent directors on the board (*Indep_dir*) appears to have little impact on decision-making regarding sustainability reporting and, therefore, is unlikely to influence SDG disclosure by Romanian banks. Similar results are found in Rao and Tilt's (2016) study of 150 Australian listed companies or Mazumder's (2024) study on a sample of 30 commercial banks in Bangladesh. A common feature with the latter study is the low proportion of independent directors in the total number of board members (around 20% compared to 29% in Romania), which may explain the lack of significance of the variable. Therefore, hypothesis H_4 is invalidated.

The last governance variable, corresponding to hypothesis H_5 , reveals the negative influence of board activity on SDG reporting in all three reporting score calculation variants. A possible explanation may be attributed to the very high dispersion of the variable (the standard deviation, according to **Table no. 3**, is 19.93, with the number of board meetings varying from 4 to 96 per year). In other words, board activity is less efficient in SDG reporting because, in Romanian banks, no optimal frequency of meetings has been found that allows adequate time allocation by directors to fulfill strategic sustainability duties (Sekarlangit and Wardhani, 2021). Other studies also report similar results, with Pizzi, Rosati, and Venturelli (2021) documenting a negative association, though statistically insignificant, for the entire sample and some of the sub-samples analyzed in their study. In our paper, although the influence of this variable is negative, it is statistically significant, which validates hypothesis H_5 .

Regarding the control variables, it is worth noting the positive influence of the size of the reporting bank on the

SDG scores, which is widely confirmed by other studies in the literature (Datta and Goyal, 2022; Farisyi et al., 2022; Bose, Khan, and Bakshi, 2024; Mazumder, 2024; Zampone et al., 2024), as well as the negative impact of the proportion of loans granted in the total assets. A possible explanation for this situation can be found in the fluctuations in lending activity during the analyzed period (Ozili, 2024), which includes the pandemic years and regional geopolitical crises, during which more consistent financial information was provided by Romanian banks, to the detriment of non-financial information.

3.3 Regression Tree Analysis

Figure no. 2 presents three regression trees corresponding to the three variants of the SDG reporting score calculation. The graphical representations display the variables and decisions in the nodes, the average prediction, and the number of observations in each node. The color scheme is informative, with nodes colored from red (low values) to green (high values). Unlike fixed-effects regression, where all variables are included in the model regardless of their actual impact, regression trees identify and retain only those variables that have a significant influence on the outcomes.

In the case of the regression tree (a) for *Totalvar1*, the first split is made based on the report size (*PAG* variable). This indicates that report size is the variable that most influences the SDG reporting score across the entire dataset. If the report is smaller than 15 pages, it follows the left branch; if the report is at least 15 pages, it follows the right branch. If the report size is reduced (less than 15 pages), it checks whether the bank publishes a standalone report. If this is the case, it further checks if the proportion of independent directors on the board (*Indep_dir*) exceeds 35%. If this condition is also met, the tree reaches a leaf (terminal node). The reporting score is approximately 27 in this case. It is also noted that 6% of the total observations fall into this category. If the report is not standalone, the path leads to the left branch, indicating a higher probability of lower reporting scores.

As can be seen, if the report is at least 49 pages long, the tree continues with splits concerning the board of directors' activity (*BoDmeet*). The regression tree predicts the highest reporting score (40) for those banks that publish extensive SDG-related information (at least 49 pages) but do not hold more than 8 board meetings. Contrary to expectations and previous studies (Umar, 2024), a higher frequency of board meetings does not

lead to the highest reporting score. However, this result aligns with the findings from the regression analysis. If the board meets more than 8 times per year, the predicted score is more modest (around 30-35), varying depending on the number of pages in the report. Depending on the specifics of the bank, a higher number of meetings may be associated with a need to compensate for organizational issues, which may actually indicate internal difficulties rather than better management, as demonstrated by a recent study (Haque et al., 2025). The result could also be explained by the concept of "diminishing returns," where there are significant initial benefits, but each additional meeting brings progressively smaller benefits (Bettinelli et al., 2023).

The variables that most influence SDG reporting, according to the first tree, are report size (the variable used in the first split and other key splits) and report type. Other notable variables include inflation, the proportion of independent directors on the board, and the frequency of board meetings. It is worth noting that the model selected only 5 variables as being relevant for predicting the dependent variable (*TOTALvar1*). This indicates that the other variables included in the model did not have a significant impact on the construction of the tree.

At the root level, the decision tree (b) for the *Totalponderatdimensiuni* starts the division based on the report size (the *PAG* variable), with the threshold set at 23 pages. Thus, it separates banks into two categories. Conditions in the subsequent nodes of the tree (such as report type, bank size, total deposit rate, board meeting frequency) will differentiate the prediction score. Banks with shorter reports (less than 23 pages) may have more concise or less complex reports. It is suggested that, if they are also associated with other conditions (e.g., absence of a standalone report or modest performance in attracting deposits), the SDG reporting score could be negatively affected. Banks with reports of at least 23 pages tend to have more detailed reports, reflecting a stronger commitment to SDG reporting. As in the previous tree, it is observed that reporting scores tend to be higher if the report size is larger, if the report is standalone, and if board meetings are not very frequent. The tree predicts the highest reporting score for those banks with large reports (at least 49 pages) and fewer than 8 board meetings per year.

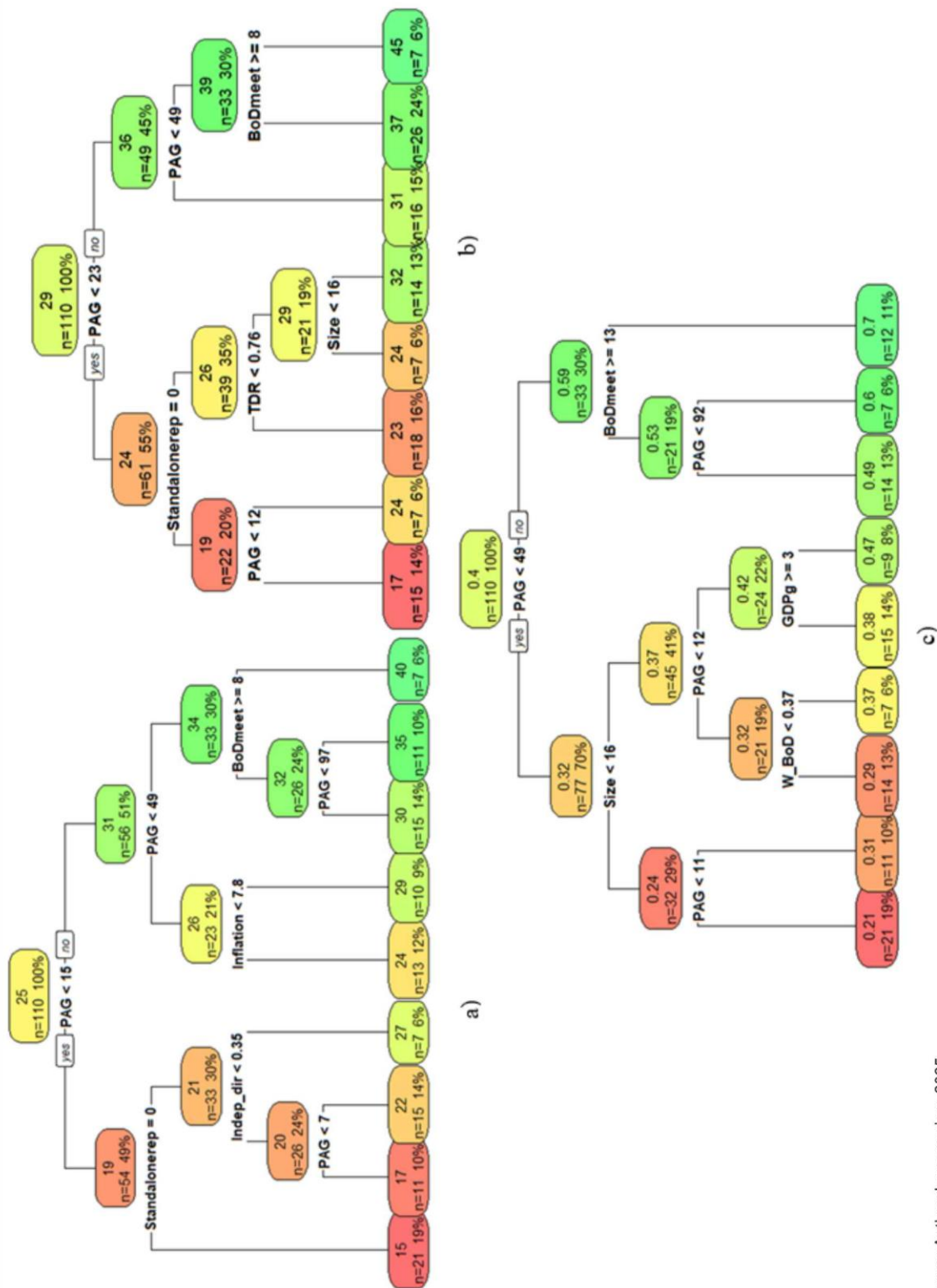
The decision tree (c) for *TotalWS* highlights those variables related to report size (*PAG*), bank size (*Size*), board meeting frequency (*BoDmeet*), gender diversity

(*W_BoD*), and the economic context (*GDPg*) are important determinants of the SDG reporting score. Each path in the tree provides a specific combination of conditions that determine the predicted score. The presence of women on the board is used to subdivide larger banks, highlighting that gender diversity on the board can positively influence the reporting score. If the proportion of female directors in the total number of board members exceeds 37%, the predicted score is higher (0.37 compared to 0.29). This structure of the regression tree suggests that for smaller banks (both in size and report), a determining factor is the complexity of the report itself, while for larger banks, aspects related to institutional governance (e.g., the number of board meetings) and the economic context play a major role.

The previous predictions for higher scores in banks that publish detailed reports and do not frequently hold board meetings are supported. In fact, report size (*PAG*) appears as the first splitting variable in all the regression trees, suggesting that it is the main determinant of the SDG reporting score. This means that differentiating banks based on this variable has the largest effect on the variability of scores. The type of report is also a key factor in SDG reporting. The intermediate nodes clarify the role of other important factors. Governance-related variables and bank-specific variables (size, total deposit rate) are integrated into subsequent decisions, amplifying their effects on SDG scores. Inflation and economic growth (*GDPg*) can influence, in a second phase, how a bank's internal conditions translate into reporting scores. All models suggest that the number of pages is a key factor that, following the details provided by governance variables and financial indicators, consistently influences the SDG reporting score.

The "Actual vs. Predicted" graph is a visual tool used to evaluate the performance of regression trees. **Figure no. 3** reveals that the regression trees perform well, meaning that a large portion of the data variation is explained by the tested models. These aspects are also confirmed by the metrics in **Table no. 6** (RMSE, MAE, R^2). For *Totalvar1* and *Totalponderatdimensiuni*, the model achieves very good performance, with low errors (RMSE and MAE) and a high R^2 , indicating a large explanation of the variation in reporting scores. For *TotalWS*, although the errors (RMSE and MAE) are higher and the R^2 coefficient is significantly lower, the results suggest that the model has an average performance.

a) Totalvar1 b) Totalponderatdimensiuni c) TotalWS



Source: Authors' processing, 2025

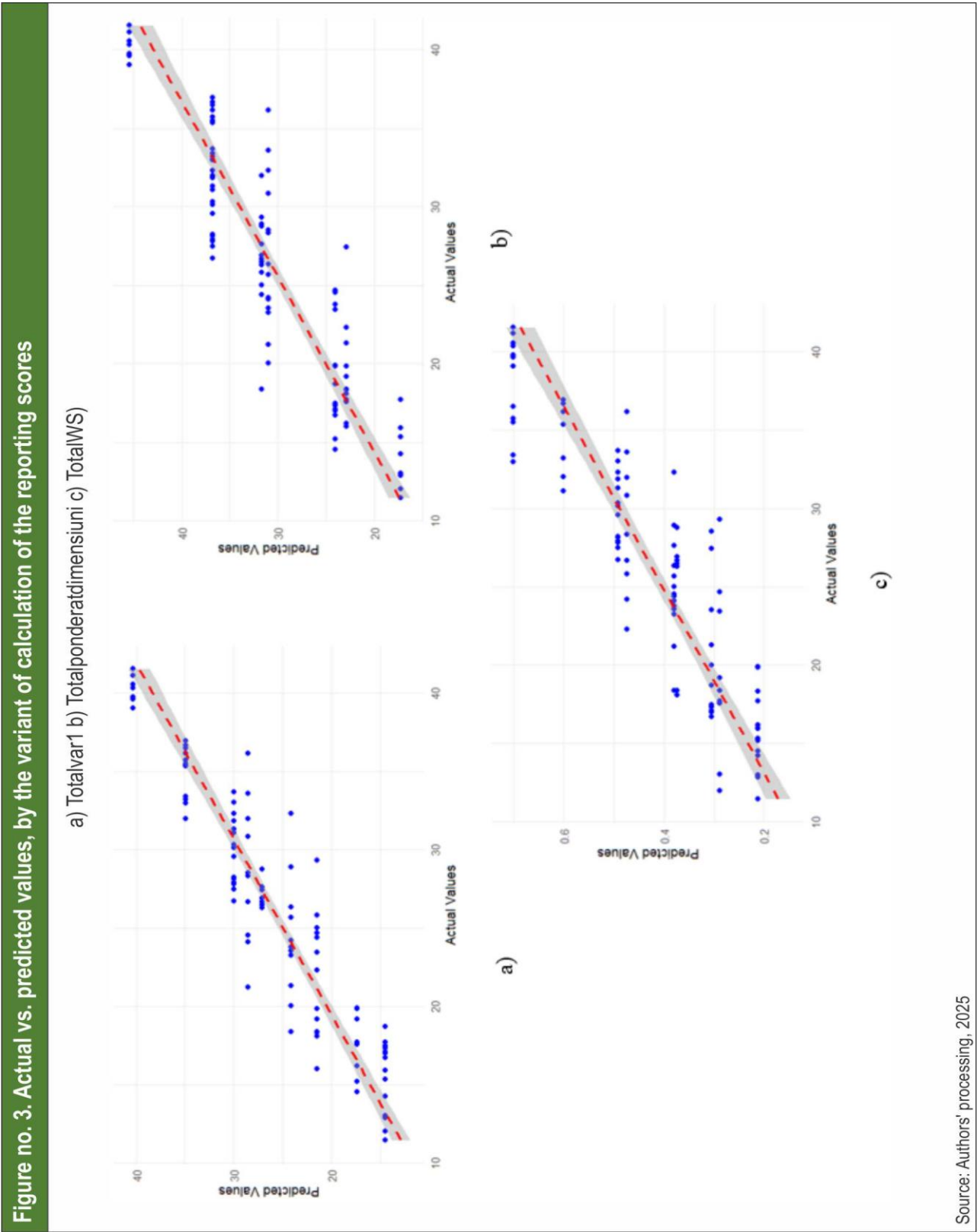


Table no. 6. Performance indicators of regression trees

Performance indicators	(1) TOTALvar1	(2) Totalponderatdimensiuni	(3) TotalWS
RMSE	2.694550	2.694551	5.478280
MAE	2.105364	2.105364	4.806247
R ²	0.888554	0.888554	0.539341

Source: Authors' processing, 2025

4. Conclusions

This study explores the determinants of SDG reporting in the banking sector in Romania, using a complex methodology that combines content analysis, fixed-effects regression, and regression trees, applied to an extensive and up-to-date dataset. Beyond the predictable influence of the report's size and type on SDG reporting scores, certain results deserve special attention and will be discussed further.

The frequency of Board of Directors (*BoD*) meetings does not have a direct positive impact on SDG reporting scores, contrary to some expectations. Both the regression trees analysis and the fixed-effects regression suggest that too many meetings may be associated with organizational difficulties or inefficient decision-making processes, rather than improved governance. Additionally, the idea of diminishing returns emerges, where the benefits of frequent BoD meetings decrease after a certain threshold. In this context, an optimal balance regarding meeting frequency could contribute more effectively to better SDG reporting, rather than simply increasing the number of BoD meetings.

Regression trees can identify complex interactions and non-linear relationships between variables, whereas fixed-effects regression assumes linear relationships between predictors and the dependent variable. This explains why the proportion of independent directors on the BoD (*Indep_dir*) seems to have no impact on sustainability reporting decisions, but regression trees show that this variable may influence SDG reporting under specific conditions (e.g., a standalone report not exceeding 15 pages), which a linear model does not capture. Furthermore, regression trees segment the data and generate rules based on certain thresholds (e.g., the 35% threshold for the proportion of independent directors on the board), while fixed-effects regression estimates an average effect of the variables on SDG reporting. We find that the influence of independent directors is present only

in specific subsets of the data but is not strong enough to be significant at the global level in the fixed-effects regression.

The results obtained from both the regression analysis and decision trees underline the importance of gender diversity in the leadership structures of banks for SDG reporting. Although the identified effects vary in intensity and statistical significance, the general trend indicates that a higher representation of women on the Board of Directors contributes to a higher SDG reporting score. This suggests that the presence of women in leadership positions can enhance transparency and the quality of the information provided, aligning with the conclusions of other studies in the literature. However, the moderate statistical significance of this relationship may be attributed to the underrepresentation of women in the leadership bodies of Romanian banks, which limits their impact on the decision-making process. In the case of larger banks, gender diversity becomes a more relevant factor, confirming the hypothesis that corporate governance significantly influences the level of transparency in sustainability reporting. Therefore, promoting greater gender equity in leadership structures could be an important step toward improving SDG reporting in the Romanian banking sector.

Macroeconomic factors, such as inflation and economic growth, do not directly influence SDG reporting scores, but they may amplify the effects of other factors. The size and type of the report remain the main determinants, while governance variables and bank characteristics also play an important role.

This study contributes to the literature by combining fixed-effects regression and decision trees, highlighting both global relationships and effects conditioned by specific factors. However, the results must be interpreted in the particular context of the Romanian banking sector, and future research could extend this analysis through international comparisons or by integrating other corporate governance variables. Promoting effective and balanced

governance in terms of diversity could represent a significant step in improving transparency in the Romanian banking sector.

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