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Sustainability Reporting in European Banking: Evaluating Environmental Disclosure and Financed Emissions

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Abstract

This thesis examines whether sustainability reporting in European commercial banks reflects the actual climate impact of their lending activities. Focusing on banks that disclose financed emissions under the Partnership for Carbon Accounting Financials (PCAF) framework, the thesis uses panel regression with time and bank fixed effects to link environmental disclosure intensity and tone to financed emissions intensity between 2022 and 2024. Environmental disclosure measures are constructed through a textual analysis of banks' annual and sustainability reports, using a validated environmental dictionary and tone indicators. The findings demonstrate a disconnect between sustainability communication and lending related climate outcomes, with higher levels of environmental disclosure consistently linked to higher financed emissions intensity. On the other hand, positive and negative disclosure tones, do not account for variations in financed emissions. While the findings do not allow a definitive claim of greenwashing, they point toward environmental window dressing, where sustainability communication outpaces substantive changes in lending behaviour. Overall, the thesis highlights the limitations of narrative sustainability reporting as a proxy for climate performance and stresses the importance of outcome based metrics, such as financed emissions, for assessing banks' contribution to the low carbon transition.

Kurzfassung

Diese Masterarbeit untersucht, ob die Nachhaltigkeitsberichterstattung europäischer Geschäftsbanken die tatsächlichen Klimaauswirkungen ihrer Kreditvergabe widerspiegelt. Am Beispiel von Banken, die finanzierte Emissionen gemäß dem Rahmenwerk der Partnership for Carbon Accounting Financials (PCAF) offenlegen, wird eine Panelregression mit Zeit- und Bankfixeffekten verwendet, um die Intensität und den Ton der Umweltberichterstattung mit der Intensität der finanzierten Emissionen im Zeitraum von 2022 bis 2024 zu verknüpfen. Die Kennzahlen für die Umweltberichterstattung werden durch eine Textanalyse der Jahres- und Nachhaltigkeitsberichte der Banken unter Verwendung eines validierten Umweltwörterbuchs und von Tonindikatoren ermittelt. Die Ergebnisse zeigen eine Diskrepanz zwischen Nachhaltigkeitskommunikation und den klimabezogenen Auswirkungen der Kreditvergabe. Ein höherer Umfang der Umweltberichterstattung korreliert durchgängig mit einer höheren Intensität der finanzierten Emissionen. Andererseits erklären positive und negative Töne in der Berichterstattung keine Schwankungen bei den finanzierten Emissionen. Obwohl die Ergebnisse zwar keinen eindeutigen Beweis für Greenwashing zulassen, deuten sie auf sogenanntes environmental window dressing hin, bei dem die Nachhaltigkeitskommunikation den tatsächlichen Veränderungen im Kreditverhalten vorausläuft. Insgesamt hebt die Arbeit die Grenzen narrativer Nachhaltigkeitsberichterstattung als Indikator für die Klimaleistung hervor und betont die Bedeutung ergebnisorientierter Kennzahlen, wie z. B. finanzierter Emissionen, für die Bewertung des Beitrags von Banken zum Übergang zu einer kohlenstoffarmen Gesellschaft.

Table of Contents

List of Tables

List of Figures

1. Introduction

Climate change has become one of the defining challenges for the global financial sector, and banks occupy a central position in this transition (Rebelo & Vieira, 2024). Through their lending decisions, banks play a decisive role in shaping the pace and direction of decarbonization, because every euro of credit lent to a customer enables activities that either contribute to or mitigate greenhouse gas emissions (McKinsey & Company, 2022). As a result, the environmental footprint of banks' loan portfolios, captured through financed emissions is emerging as a critical benchmark for assessing whether the financial institutions are supporting the transition to a low carbon economy (PCAF, 2022). In parallel, banks have increasingly expanded their environmental disclosures, publishing sustainability reports and climate related information in their annual and non-financial reports (European Central Bank [ECB], 2023). These disclosures are intended to help stakeholders assess whether banks integrate environmental considerations into their strategies and lending activities. However, whether such disclosures genuinely reflect banks' environmental performance or instead serve symbolic purposes remains an unresolved question.

Sustainability disclosures may not reliably reflect actual climate performance and instead may represent greenwashing, situation where firms use environmental rhetoric to signal commitment without making a tangible change in their behaviour (Marquis, Toffel & Zhou, 2016). Recent research has actually begun examining the relationship between sustainability disclosure and lending behaviour. Gambacorta et al. (2023) find that European banks with higher disclosure index tend to reduce lending to highly polluting firms. On the other hand, Giannetti et al. (2024) document that banks that heavily emphasize sustainability in their reporting do not necessarily reduce exposure to brown borrowers and may even increase it, especially when borrowers are financially weak. This study points to a potential disconnect between what banks disclose and how they lend. However, both papers focus on whether banks direct more or less credit toward carbon intensive sectors or high emission borrowers. While this approach offers insights into portfolio allocation, it does not reveal the actual climate outcome of lending activity. A bank may lend proportionately less to brown sectors yet still finance substantial emissions if the remaining brown borrowers emit heavily and a bank might maintain lending to brown sectors while financed emissions decline if those borrowers decarbonise. What is still missing in the literature is an evaluation of whether environmental disclosure practices translate into the environmental footprint of banks' portfolios, not only into who receives loans, but how much CO_2 those loans finance.

This thesis addresses that gap by linking banks' environmental disclosure characteristics, including environmental disclosure index and the tone of sustainability reporting to the financed emissions intensity of their portfolios, based on Scope 1 and 2 emissions reported under the Partnership for Carbon Accounting Financials (PCAF) framework. Financed emissions intensity captures the carbon footprint of the bank's financing activities, expressed as tonnes of CO_2 financed per units of exposure (PCAF, 2022). To quantify disclosure index, this thesis conduced a textual analysis of banks' annual and sustainability reports, following the methodology developed in *"Do Banks Practice What They Preach?"* (Gambacorta et al., 2023). More precisely, a validated dictionary of environmental terminology was used to construct the environmental disclosure index based on the frequency of environmental terms, while the Loughran & McDonald, 2011 Master Dictionary was used to compute positive and negative disclosure tone. By focusing on the outcome based climate metric rather than on sectoral loan allocation, this thesis evaluates whether sustainability reporting in European banks serves as a credible signal of actual environmental performance or whether it functions primarily as a reputational device.

This thesis also holds high practical relevance as regulators, investors and the public increasingly rely on sustainability reports to evaluate banks' exposure to climate related financial risks (Basel Committee on Banking Supervision [BCBS], 2023). According to recent research, sustainability reporting has become a crucial part of corporate reporting, and sustainability disclosures receive reading time and attention levels that are on the same level with those of traditional financial disclosures (Hagemeier & Müller, 2025). Importantly, sustainability sections are not only widely accessed but also read more intensively by a broad range of stakeholders, suggesting that environmental language plays a meaningful role in shaping perceptions of credibility and responsibility. If a stronger emphasis on sustainability topics in reports is associated with lower financed emissions, then disclosure acts as a meaningful signal that helps markets identify climate responsible banks. But if an increase in environmental reporting intensity is unrelated or linked to higher financed emissions, then stakeholders may struggle to separate banks that are genuinely transitioning their lending portfolios from those that simply communicate more extensively about sustainability without changing their financing behaviour.

Hence, this thesis aims to answer the following research question: *"Do European commercial banks with a higher Environmental Disclosure Index (based on the frequency of environmental*

terminology), and a specific disclosure tone, finance lower levels of greenhouse gas emissions, as measured by financed emissions intensity?"

2. Literature Review and Hypotheses

2.1 PCAF Framework

The growing role of financial institutions in the transition to a low carbon economy has led to increased attention on how banks measure and disclose the climate impact of their activities (Brescia et al., 2025). While banks' own operational emissions are relatively small, their lending and investment decisions enable economic activities that can generate high amounts of greenhouse gas emissions. As a result, the concept of financed emissions is becoming a key indicator for evaluating financial institutions' indirect climate impact. Financed emissions measure the portion of borrowers' greenhouse gas emissions that can be attributed to bank financing, thereby connecting banks' lending activities to climate outcomes in the real economy (Sumday, 2024).

The most widely adopted framework for measuring financed emissions is developed by the Partnership for Carbon Accounting Financials (PCAF). PCAF is an industry-led initiative that offers financial institutions standardized approaches to measuring, reporting, and comparing greenhouse emissions (PCAF, 2022). By offering detailed accounting rules, the PCAF framework aims to improve transparency and comparability across institutions. Under this framework, financed emissions are primarily calculated by allocating a proportion of a borrower's Scope 1 and Scope 2 greenhouse gas emissions to the financial institution, based on its share of the total financing provided. Scope 1 emissions refer to direct greenhouse gas emissions from sources owned or controlled by the borrower, Scope 2 emissions capture indirect emissions from the consumption of purchased energy such as electricity or heat, while Scope 3 emissions comprise all other indirect emissions occurring along the value chain, including those from suppliers, transportation, and the use of sold products (McKinsey & Company, 2024). Although the PCAF framework also allows the inclusion of Scope 3 emissions if data are available and material, the measurement of these emissions is still uncertain and usually not precise. As a result, Scope 1 and 2 emissions are more commonly reported and represent more comparable components of financed emissions across banks.

A key feature of the PCAF framework is its coverage across a wide range of asset classes, recognizing the diversity of banks' balance sheets. Financed emissions can be calculated for

listed equity and corporate bonds, business loans and unlisted equity, project finance, commercial real estate, mortgages, motor vehicle loans, and sovereign debt exposures. Each asset class is associated with specific methodological guidance reflecting differences in data availability.

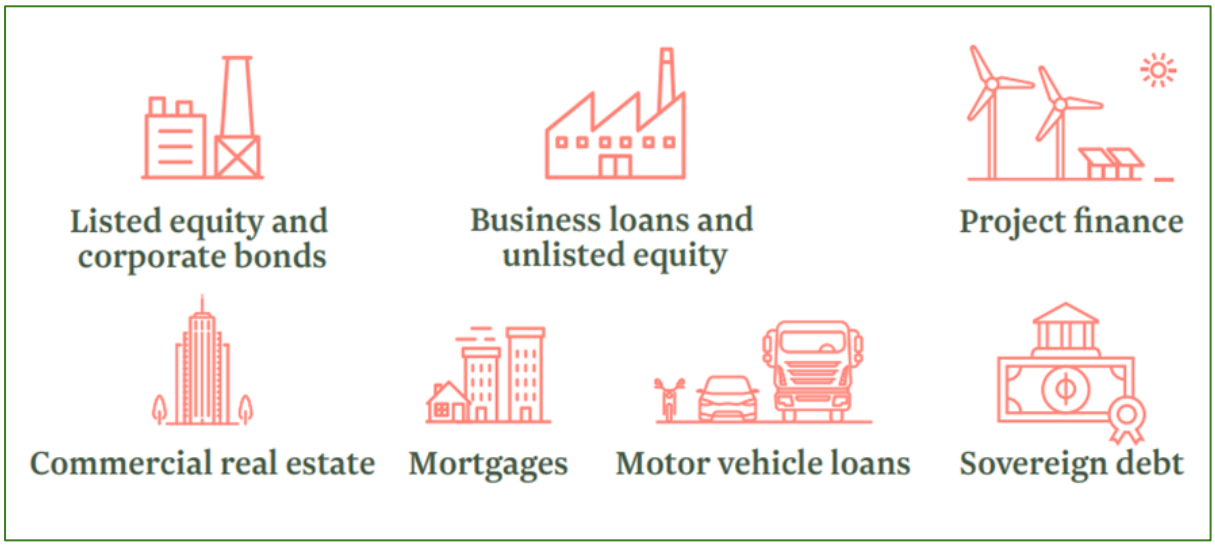

Figure 1 PCAF Asset Classes (source: Partnership for Carbon Accounting Financials, 2022)

As illustrated above, integration of multiple asset classes allows the PCAF framework to capture the full scope of banks' financing activities. This is especially important for commercial banks as their climate impact is mostly concentrated in their loan portfolios. By aggregating financed emissions across asset classes, banks can assess the overall carbon footprint of their portfolios and identify key sources of climate risk and transition exposure. Moreover, the PCAF framework has become an important reference point for regulators and investors seeking to standardize sustainability reporting practices. Importantly, PCAF is a voluntary, industry-led initiative, and banks are not legally required to report financed emissions under its framework.

2.2 Environmental Disclosure and Financed Emissions

H1: *"Banks with higher levels of Environmental Disclosure Index have a lower carbon footprint of their lending portfolios."*

The first hypothesis builds on the idea that sustainability disclosure in the banking sector is not only for symbolic communication purpose, but a signal of actual environmental risk management. A central starting point is the economics based view of disclosure: when firms have comparatively strong underlying performance, they have incentives to disclose more because transparency can strengthen credibility and reduce information asymmetry

(Verrecchia, 1983; Dye, 1985). Consistent with this logic, empirical research finds that environmental disclosure, environmental performance, and economic performance may be jointly determined rather than independent outcomes, implying that more transparent firms tend to be better performers and may experience economic benefits from such transparency (Al-Tuwaijri et al., 2004). In the banking sector, the link between disclosure and underlying climate performance is particularly relevant because climate risk is not seen as just an abstract corporate responsibility issue, but increasingly a financial risk management issue. Transition and physical risks can affect borrowers' cashflows, collateral values, probabilities of default, all resulting with distress on banks' balance sheets. Accordingly, supervisory bodies have increasingly emphasized that banks should identify, monitor, and manage climate related financial risks, and that meaningful disclosure is part of a broader risk governance architecture (BCBS, 2023). Against this background, environmental disclosure can be interpreted as an observable signal of a bank's internal attention to climate risks and its strategic orientation toward a lower carbon lending portfolio. If disclosure reflects substantive risk awareness and portfolio adjustments, banks that more frequently and extensively discuss environmental issues in their reports should, over time, finance fewer emissions per unit of lending.

The signalling theory (Spence, 1973) provides the most plausible theory for expectations around disclosure and financed emissions. Banks that are less exposed to polluting borrowers, face fewer risks associated with climate change and thus have incentives to signal this strength. The key mechanism is credibility: disclosure can serve as a separating signal between banks that are genuinely managing climate risk and those that are not. If environmental disclosure reflects real risk management and strategic reallocation, banks with higher disclosure should be financing relatively fewer emissions, observable as lower financed emissions intensity. This is consistent with the idea that disclosure is not only for communication purpose but part of a management system: when banks invest in climate governance and monitoring, they can both disclose more and gradually reduce exposure to the most emissions intensive borrowers or sectors.

Empirical findings from prior literature also support this logic. Gambacorta et al. (2023) document that banks with higher environmental disclosure lend less to firms with high greenhouse gas emission intensities, indicating alignment between transparency and green credit allocation. Although Giannetti et al. (2024) find evidence of "glossy green" disclosure among European banks, their results show that banks emphasizing sustainable lending in reports do not reduce brown lending but importantly, these studies focus on portfolio

composition, not on financed emissions. The present thesis deepens the theoretical argument by analysing whether disclosure corresponds to a lower environmental footprint of lending**,** measured through financed emissions intensity.

There is also sceptical view in the research that treats sustainability reporting as potentially symbolic. Boiral (2013) argues that sustainability reports can function as "simulacra," where reporting creates an appearance of transparency while selectively presenting information. Similarly, Cho et al. (2015) discuss "organized hypocrisy" and "organizational façades" in sustainability reporting, emphasizing that institutional pressures can lead organizations to produce reports that satisfy expectations without necessarily changing underlying behaviour. These perspectives imply that disclosure could be uncorrelated with (or even positively correlated with) financed emissions intensity if sustainability communication is used to offset reputational risk stemming from carbon intensive financing.

H1 is formulated as a negative relationship between environmental disclosure intensity and financed emissions intensity because the hypothesis is grounded in the disclosure channel: banks that genuinely manage climate exposure should both disclose more and finance fewer emissions. This prediction is strengthened by banking specific considerations. First, climate risk is steadily becoming an important segment of credit risk, thus making it plausible that banks with more advanced risk frameworks both disclose more and shift portfolios to reduce climate exposed lending (BCBS, 2023). Second, as disclosure becomes more featured to stakeholders, banks with comparatively stronger climate positioning have incentives to credibly differentiate themselves through more extensive reporting, consistent with signalling theory (Spence, 1973). If environmental disclosure is substantive rather than symbolic, banks that communicate heavily about sustainability should allocate less capital to carbon intensive sectors or to borrowers with high operational emissions. Therefore, such banks should exhibit systematically lower financed emissions intensity**.** On the other hand, if disclosure has no relationship to financed emissions intensity, it would undermine the signalling theory and support purely symbolic disclosure.

2.3 Positive Tone and Financed Emissions

H2: *"Banks that use a more Positive Tone in their environmental disclosures have a higher carbon footprint of their lending portfolios."*

The second hypothesis builds on the argument that sustainability disclosures may not always reflect substantive climate performance but can instead serve impression purposes. While

transparency theory assumes that disclosure communicates real underlying performance (Al-Tuwaijri et al., 2004), impression management theory shows that firms often strategically frame information to influence stakeholder perceptions without changing their underlying behaviours (Merkl-Davies & Brennan, 2007). In the context of sustainability, a positive or overly optimistic tone in corporate reporting can be implemented to reassure investors and regulators about climate commitment, even when actual environmental performance does not improve. This allows banks to present themselves favourably even when there are limited climate improvements.

The greenwashing literature provides further support for this interpretation. Greenwashing is defined as the strategic use of environmental rhetoric to signal responsibility and commitment while underlying practices essentially stay the same (Marquis, Toffel, & Zhou, 2016). Firms operating in industries with high regulatory pressure are especially likely to engage in symbolic communication to maintain their legitimacy (Delmas & Burbano, 2011). In banking, this risk is increased because lending decisions are less transparent, climate impacts are indirect, and sustainability performance is difficult for external stakeholders to verify. As a result, tone becomes a powerful mechanism through which banks can manage perceptions of environmental responsibility without the need to change their financing practices.

Banks are criticised for financing "brown" companies, yet many of them still give out loans to them. Due to the profitability of lending to brown industries, banks choose to keep financing given sector while publicly committing to sustainable practices. In this setting, positive tone in sustainability or annual reports can serve as a impression management tool rather than a reflection of a reduced environmental footprint. Recent empirical evidence supports this logic. Gambacorta et al. (2023) show that banks using a more positive tone in sustainability disclosures tend to lend more to high emission firms, consistent with environmental or green window dressing. Importantly, green window dressing differs from greenwashing in that disclosures are not necessarily false or misleading, but rather selectively framed to create a more sustainable image than underlying practices would suggest (Parise & Rubin, 2025). Likewise, Giannetti et al. (2024) document that banks that heavily highlight sustainability in their communication do not reduce brown lending and may even increase it, particularly to financially weak polluting firms. Since these borrowers pay higher margins and have limited alternative financing, banks benefit financially from maintaining such exposures even while publicly stressing sustainability.

A positive tone therefore functions not as a signal of genuine climate risk awareness but as a misconception device. If banks were really cutting their environmental risks, they would not need to constantly sound positive. They would be more honest in acknowledging the challenges and uncertainties that come with climate transition. Consequently, if positive disclosure tone reflects impression management rather than substantive climate risk reduction, banks that sound especially optimistic about their environmental achievements should continue to finance borrowers with high emissions. This implies that a more positive tone in environmental disclosures is associated with a higher carbon footprint of lending portfolios. Therefore, the second hypothesis predicts a positive relationship between positive disclosure tone and financed emissions intensity.

2.4 Negative Tone and Financed Emissions

H3: *"Banks that use a more Negative Tone in their environmental disclosures have a lower carbon footprint of their lending portfolios."*

The third hypothesis builds on the idea that the tone of sustainability reporting does not simply reflect communication style, but can also reveal how seriously banks perceive climate related risks. A negative tone, expressed through language of concern, uncertainty, and risk suggests that banks recognise the financial and operational challenges associated with environmental issues and the transition to a low carbon economy. Impression management literature argues that organisations tend to use positive tone when trying to shape stakeholder perceptions positively, while a more cautious tone is associated with the acknowledgement of real organisational vulnerabilities and risks (Merkl-Davies & Brennan, 2007). Therefore, when banks adopt a negative tone in their environmental disclosures, this may indicate that they genuinely view environmental and transition risks as material and are taking concrete actions to reduce their exposure.

Empirical evidence supports the interpretation of negative tone as a signal of substantive climate risk management. Gambacorta et al. (2023) find that European banks using a more negative tone in their sustainability reporting lend significantly less to firms with high greenhouse gas emission intensities. Their results suggest that negative tone is associated with a more cautious credit allocation strategy and a greater sensitivity to environmental risk factors. In contrast to positive tone, which may be used to project progress regardless of actual lending behaviour, negative tone appears more closely aligned with concrete adjustments in loan portfolios.

This interpretation is consistent with broader evidence on bank behaviour under risk. Banks that perceive certain exposures as threatening tend to respond by tightening credit conditions, reducing exposures, or reallocating capital toward less risky borrowers (de Bandt et al., 2023). Climate risks increasingly fall into this category, as supervisors and central banks have emphasized that climate related shocks can spread through the financial system and undermine financial stability. The European Central Bank (2024) explicitly highlights that continued financing of carbon intensive activities may expose banks to higher credit risk, legal risk, and reputational damage as climate policies tighten and market conditions change.

From this perspective, negative disclosure tone can be interpreted as a risk management signal rather than a reputational tool. By openly discussing environmental challenges and transition risks, banks demonstrate awareness that climate change poses constraints on future lending strategies. Such acknowledgment is costly in reputational terms, as it may draw attention to vulnerabilities and uncertainties. Consequently, banks are less likely to adopt a negative tone unless it reflects genuine concern and corresponding action. This stands in contrast to positive tone, which can be deployed more easily and at lower cost to convey commitment without requiring immediate loan portfolio adjustments.

When placed in the context of financed emissions, these mechanisms imply that banks using a more negative tone in their environmental disclosures should ultimately finance fewer emissions. If negative tone reflects heightened risk awareness and a cautious approach to carbon intensive lending, then such banks are more likely to reduce exposure to high emission borrowers or support decarbonization among existing clients. This should translate into a lower financed emissions intensity over time. Therefore, the third hypothesis predicts a negative relationship between negative disclosure tone and the carbon footprint of banks' lending portfolios.

3. Model and Data

3.1 Model and Data Sample

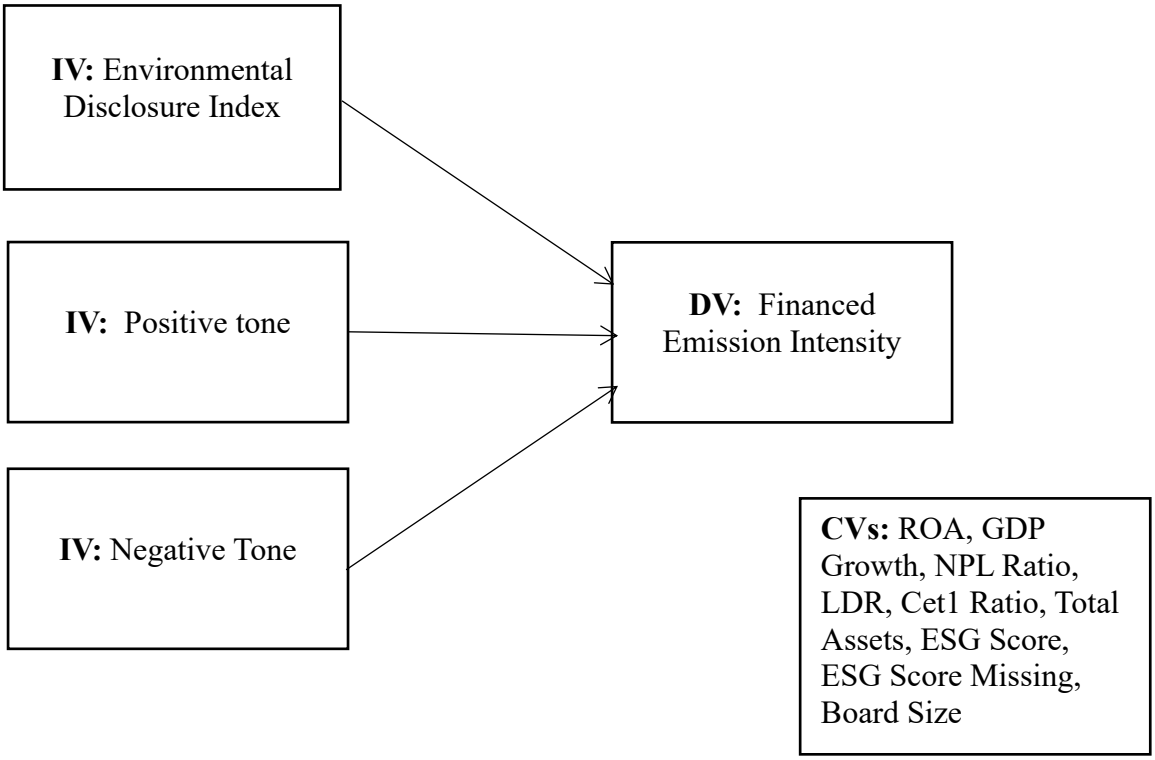

Figure 2 Conceptual Model Diagram (source: own illustration)

This thesis examines European commercial banks that are signatories of the Partnership for Carbon Accounting Financials (PCAF). The sample construction started from the official disclosure list published on the PCAF website, which includes financial institutions that have committed to measuring and disclosing greenhouse gas emissions associated with their financial activities in line with the PCAF Standard. From this list, institutions were filtered by region (Europe) and by institution type, retaining only commercial banks. Because the dependent variable financed emissions intensity is a completely new variable that banks report, and only available for recent years, banks were screened based on whether they disclosed PCAF aligned financed emissions intensity (Scope 1 and Scope 2) consistently for 2022, 2023 and 2024. All banks that did not report on their financed emissions intensity in all three years were excluded, resulting in a balanced panel of 50 banks over three years (N = 150 observations). Financed emissions intensity values were hand collected mostly from

sustainability and annual reports but also from some other reports like climate reports or impact reports, wherever the data was available.

To construct the independent or disclosure based variables, all annual and sustainability reports published by each bank in each year were downloaded. Because reporting practices vary across banks, with some institutions publishing standalone sustainability reports and others merging ESG reports with annual reports, all reports corresponding to the same bank and year observation were merged into a single PDF document. This approach standardises the textual analysis and avoids systematically favouring banks with particular reporting formats or document structures.

The textual analysis was conducted in Python, which automated the extraction of disclosure index and tone variables from the merged annual, sustainability and other reports for each bank and year. The code first imported the PDF documents, converted them into machine readable text and applied several preprocessing steps, including transforming all characters to lowercase, removing punctuation and special symbols, and filtering out non alphabetic strings to avoid numerical and formatting noise. The cleaned text was then tokenised into individual words. Before applying the code to the full document set, a unit test was performed on a smaller sample to verify that dictionary matching and term counting worked as expected.

To construct the environmental disclosure index, the script compared each token against the validated 109 term environmental dictionary from "*Do Banks Practice What They Preach"* (Gambacorta et al., 2023) and counted the total number of matches. Example dictionary terms included *climate change*, *renewable energy*, *carbon footprint*, *net-zero*, *green lending*, *ESG*, *greenhouse gas*, and *sustainability transition*. The rest of the environmental terms used in the dictionary can be found in the appendix. The index was computed as the share of environmental dictionary terms relative to the total number of words in the report.

$$Evnironmental\ Disclosure\ Index_{b,t} = \sum \frac{occurences\ of\ environmental\ dictionary\ words}{total\ \ number\ of\ words}$$

To capture disclosure tone, positive and negative tone measures were constructed using the Loughran and McDonald (2011) Master Dictionary, which is specifically designed for financial and corporate texts. The dictionary classifies words according to their orientation in a financial context, allowing for a more accurate assessment of tone rather than general dictionaries. Importantly, the tone analysis was conducted conditional on environmental context. Specifically, the text was segmented into sentences, and only those segments containing at least

one environmental dictionary term were classified as environmental sentences. Positive and negative words from the Loughran and McDonald dictionary were then counted only within these environmental sentences, ensuring that the tone measures capture sentiment related to environmental issues rather than general corporate communication. This approach aligns the tone measures conceptually with the Environmental Disclosure Index and avoids contamination from sentiment expressed in unrelated sections of the reports. The resulting environmental positive and negative tone measures were scaled by the total number of words in the report to ensure comparability across banks and over time:

$$Positive\ Tone_{b,t} = \sum \frac{count\ of\ negative\ L\&M\ words\ in\ environmental\ sentences}{total\ \ number\ of\ words}$$

$$Negative\ Tone_{b,t} = \sum \frac{count\ of\ negative\ L\&M\ words\ in\ environmental\ sentences}{total\ \ number\ of\ words}$$

By scaling environmental sentiment by total report length, these measures capture the importance of environmentally framed positive and negative language within overall bank communication. This also ensures consistency with the construction of the Environmental Disclosure Index.

To test whether the results depend on the simple frequency of environmental terminology, a robustness check was performed using the inverse document frequency weighting approach developed by Brown and Tucker (2011). Instead of treating all environmental terms equally, this method assigns larger weights to dictionary terms that appear in fewer reports across the sample, on the premise that words used rarely are more informative than generic or widely repeated terminology.

$$\text{BT\_}Environmental\ Disclosure\ Index_{b,t} = \sum \frac{occurences\ of\ environmental\ dictionary\ words}{total\ \ number\ of\ words} * log\ \frac{M}{m}$$

In this formulation, M represents the total number of documents in the sample, and m denotes the number of documents in which each specific environmental term appears. The resulting BT_Environmental Disclosure Index follows the methodology introduced by Gambacorta et al. (2023) in "*Do Banks Practice What They Preach?"*.

3.2 Variables

All variables were manually compiled into a panel dataset, collected from secondary data sources. The dependent variable, financed emissions intensity (Scope 1 and 2), was hand collected for the years 2022–2024 from banks' sustainability and annual reports, as well as from other non-financial disclosures such as climate reports, impact reports and similar ESG publications wherever financed emissions information was provided. For the independent variables, environmental disclosure measures were derived through textual analysis performed on merged annual and sustainability reports of each bank, as already described. Control variables were predominantly sourced from annual reports: return on assets (ROA), non-performing loans ratio (NPL), loan-to-deposit ratio (LDR), common equity tier 1 (CET1) ratio. Total assets and board size were extracted individually for each observation, while the NPL and the LDR were taken directly when disclosed and manually calculated from the underlying reported figures (non-performing loans and total loans for NPL and total loans and total deposits for LDR) when the ratios were not explicitly provided. Real GDP growth was sourced externally from the FocusEconomics database to ensure consistent macroeconomic comparability across countries. ESG Scores were obtained from the Refinitiv database via University of Vienna institutional access.

3.2.1 Dependent Variable

Financed emissions intensity (Scope 1 and 2)

The dependent variable in this thesis is financed emissions intensity (Scope 1 and Scope 2), which measures the carbon footprint of banks' lending activities. Financed emissions intensity is defined as the amount of greenhouse gas emissions, expressed in tonnes of CO_2, that a bank finances per million euros of exposure. This metric captures the extent to which banks' credit portfolios support emission intensive economic activities and therefore reflects the environmental impact of their lending decisions. A higher financed emissions intensity indicates that a bank participated in production of a larger volume of emissions for a given level of lending, while a lower value suggests a relatively cleaner lending portfolio.

Scope 1 and 2 financed emissions were used rather than Scope 3 because Scope 3 is typically the most difficult emission category to quantify reliably, requiring extensive value chain data. In addition, Scope 3 emissions are subject to substantial estimation uncertainty. Therefore, focusing on Scope 1 and 2 ensures higher data reliability and comparability across banks. Since financed emissions intensity requires financing exposure to be expressed in the same currency,

banks that reported exposures in other currencies (e.g., British pounds for UK banks or other non-euro currencies) were converted into euros using standard exchange rates for the corresponding reporting year. This ensured a common unit of measurement and facilitated cross bank comparability. Finally, because the raw distribution of financed emissions intensity was right-skewed, with most banks financing low emissions and a few banks financing high levels, the variable was log-transformed, which reduced the influence of extreme outliers and improves the interpretability of the regression coefficients. As a result, estimated coefficients can be interpreted as approximate percentage changes in financed emissions intensity associated with changes in the explanatory variables.

3.2.2 Independent Variables

Environmental Disclosure Index

The Environmental Disclosure Index captures the intensity with which banks discuss environmental topics in their public reporting. It measures how frequently environmental terminology appears in banks' annual and sustainability reports and is intended to proxy the overall importance of environmental issues in bank communication. It is calculated as the share of environmental dictionary terms relative to the total number of words in the merged bank-year report. The index is constructed using the validated 109-term environmental dictionary of Gambacorta et al. (2023). A higher value of the Environmental Disclosure Index indicates that a bank devotes a larger share of its overall reporting to environmental topics.

Positive Tone

The Positive Tone variable captures the extent to which banks use optimistic or favourable language when discussing environmental issues. Positive tone is intended to reflect the degree to which environmental disclosures emphasize progress, opportunities, leadership, or achievements related to sustainability. To measure positive tone, the analysis relies on the Loughran and McDonald (2011) Master Dictionary.

Importantly, positive tone is measured conditional on environmental context. Positive words from the Loughran and McDonald dictionary are counted only within sentences that contain at least one environmental dictionary term. This ensures that the tone measure captures sentiment related to environmental issues rather than general corporate optimism expressed elsewhere in the report. The resulting count of positive environmental words is then scaled by the total number of words in the merged report, yielding a measure of environmentally framed positive

language in overall bank communication. A higher value of the Positive Tone variable indicates a greater emphasis on optimistic rhetoric in environmental disclosures.

Negative Tone

This variable reflects risk oriented or cautious climate communication and is constructed as the share of negative terms from the Loughran & McDonald (2011). Negative words are counted only within environmental sentences, defined as text segments containing at least one environmental dictionary term. This conditional approach ensures that the variable reflects sentiment related specifically to environmental and climate related issues rather than general discussions of financial risk. The count of negative environmental words is scaled by the total number of words in the report to maintain comparability across banks and reporting years. A higher value of the Negative Tone variable therefore indicates that a bank's environmental communication places greater emphasis on risks, uncertainties, and challenges rather than achievements or progress.

All three independent variables were standardised using z-scores, subtracting the mean and dividing by the standard deviation, so that each variable has a mean of zero and a standard deviation of one. This places disclosure, positive tone, and negative tone on the same scale. Standardization makes the coefficients easier to interpret, because a one unit change no longer reflects an arbitrary number of words in a report but a one standard deviation increase in the underlying construct. This allows a more meaningful comparison of effect sizes across the three variables.

3.2.3 Control Variables

Return on Assets (ROA)

Return on assets (ROA), calculated as net income divided by total assets, measures the overall profitability of a bank (Hargrave, 2025). Profitable banks are more likely to invest in sustainability initiatives, allocate resources to environmental risk management, and support disclosure efforts because they face fewer financial constraints (Cheng, Ioannou & Serafeim, 2014). Moreover, banks with stronger profitability may be better positioned to reduce exposure to high emission borrowers without jeopardising returns, which would influence financed emissions outcomes. ROA was included as a control variable to ensure that the estimated relationship between disclosure characteristics and financed emissions is not affected by differences in profitability.

Non-Performing Loans Ratio (NPL Ratio)

The non-performing loans ratio represents the share of loans that are unlikely to be repaid, serving as an indicator of credit risk and portfolio quality (Segal, 2025). Banks with high NPL ratios tend to operate under financial stress and may prioritise short-term revenue over long-term sustainability goals. In addition, NPLs are highly relevant in the context of climate transition because borrowers in carbon intensive or brown sectors face stronger transition risk, including strict regulatory supervisions, carbon pricing, and loss of market competitiveness as economies shift toward lower carbon production (Semieniuk et al., 2020). Firms exposed to these pressures may experience declining profitability and reduced repayment capacity, which increases the likelihood of loan default. As a result, banks that continue to finance highly emitting companies are exposed to a greater probability of future loan impairments, and therefore may already exhibit higher NPL ratios. Including the NPL ratio therefore controls for the possibility that banks with weaker asset quality finance more emission intensive activities regardless of how they communicate sustainability in their reporting.

Loan-to-Deposit Ratio (LDR Ratio)

The loan-to-deposit ratio is defined as total loans divided by total deposits and captures the liquidity position of a bank (Allred, 2025). A high LDR indicates tighter liquidity, which may limit the bank's ability to shift lending away from carbon intensive sectors even when it publicly emphasises sustainability. On the other hand, banks with higher liquidity have more flexibility to restructure portfolios toward low emission clients. By including LDR, this thesis controls for liquidity driven constraints that could otherwise bias the connection between environmental disclosure and financed emissions intensity.

Common Equity Tier 1 Ratio (CET1 Ratio)

The CET1 ratio is calculated as common equity tier 1 capital divided by risk weighted assets and reflects a bank's regulatory capital strength (Grant, 2025). Banks with higher CET1 ratios face lower regulatory pressure and enjoy greater flexibility (Berger & Bouwman, 2013), potentially enabling them to pursue lending strategies aligned with climate goals. Strongly capitalised banks are also better positioned to absorb potential transition related losses, which may make them more responsive to climate risk expectations and more willing to reduce exposure to high emission borrowers.

Total Assets

Total assets are a widely used proxy for firm or bank size. Larger banks have more complex organisational structures, broader stakeholder expectations and greater resources that they can dedicate to sustainability reporting and risk management (Bătae et al., 2020). However, size can also correlate with larger financed emissions simply because big banks lend more in absolute terms. To avoid scale driven distortion, total assets were log-transformed, and also because the raw distribution was highly right-skewed, with a small number of very large banks dominating the scale of the sample. Including total assets in this transformed form, it ensures that the estimated effect of environmental disclosure is not solely capturing differences in bank scale.

Board Size

Board size refers to the number of directors serving on the bank's board. Corporate governance literature suggests that larger boards are associated with greater stakeholder diversity and monitoring capacity (Walls, Berrone & Phan, 2012), which can increase attention to environmental risks and sustainability commitments. However, large boards are also associated with slower decision making, which may delay rapid decarbonisation decisions. Although the distribution of board size in the sample is only mildly right skewed rather than extreme, the variable was log-transformed to maintain consistent scaling with the other size related variables.

Gross Domestic Product Growth (GDP Growth)

GDP growth represents annual real economic growth in the bank's home country. Macroeconomic conditions heavily influence credit demand and sectoral lending patterns. During periods of strong growth, banks may increase exposure to industrial or construction sectors that are typically more carbon intensive, while during downturns, they may reduce corporate lending overall (Aiyar, Calomiris & Wieladek, 2015). By including the GDP growth variable, the model ensures that the effect of disclosure on financed emissions is not driven by macroeconomic cycles that shift lending patterns across sectors.

Environmental Social Governance Score (ESG Score)

The ESG Score reflects the external evaluation of a bank's performance on environmental, social and governance dimensions. Including the ESG Score in the model is important because differences in a bank's overall sustainability orientation may influence both its environmental

disclosure practices and the climate footprint of its lending activities. In other words, banks that are generally more committed to ESG issues may simultaneously disclose more environmental information and make lending decisions that reduce their financed emissions.

ESG Score Missing

Because, ESG score data from Refinitiv were not available for all banks and years in the sample period (2022–2024), missing values were handled using the missing indicator method (Van Ness et al., 2023), combined with bank level imputation where partial information was available. For banks with at least one observed ESG Score during the sample period, missing yearly values were imputed using the bank specific average of the available ESG Scores. In this framework, an indicator binary variable, ESG Score Missing, was constructed and takes the value of 1 when a bank does not have an ESG Score available and 0 when the ESG Score is observed.

3.3 Testing approach

To empirically test whether environmental disclosure characteristics predict the environmental footprint of banks' lending portfolios, this thesis employs a panel data fixed-effects regression model in StataSE 18. Fixed effects are used because they control for all time invariant characteristics of each bank, ensuring that the analysis captures how changes in disclosure within the same bank over time relate to changes in its financed emissions intensity, rather than differences between banks. The dependent variable is the natural logarithm of financed emissions intensity (Scope 1 and 2), and the key independent variables are the standardized environmental disclosure index, standardized positive tone, and standardized negative tone. The baseline specification also controls for profitability (ROA), credit risk (NPL), liquidity (LDR), regulatory capitalisation (CET1 ratio), size (log total assets), corporate governance (log board size), macroeconomic conditions (GDP growth), and sustainability orientation (ESG score and ESG score missing dummy). The model is estimated as:

$$ln(FinEm_{b,t}) = \beta_1 \cdot EDI_{b,t} + \beta_2 \cdot PosTone_{b,t} + \beta_3 \cdot NegTone_{b,t} + \beta Controls_{b,t} + \alpha_b + \delta_t + \varepsilon_{b,t}$$

Where b denotes the bank, t the year, α_b captures bank fixed effects, δ_t captures year fixed effects, and $\varepsilon_{b,t}$ represents the error term. Bank fixed effects (α_b) control for all characteristics of each bank that do not change over time such as business model, risk culture, or geographic focus, so that banks are compared only with themselves rather than with each other. Year fixed

effects δ_t capture shocks that affect all banks in the same year, such as new climate regulations or macroeconomic developments, ensuring that the results reflect the relationship between disclosure and financed emissions rather than broad time trends. Standard errors are clustered at the bank level because observations from the same bank across different years are not fully independent, meaning a bank's behaviour in one year is often related to its behaviour in the next. Clustering adjusts the standard errors to account for this within bank correlation over time, ensuring that the statistical significance of the results is not overstated. The notation βControls denotes a vector of coefficients for the set of control variables included in the model, allowing the regression equation to be expressed concisely without listing each coefficient individually.

4. Analysis and Result

4.1 Descriptive Statistics

Table 1 presents the descriptive statistics for all variables included in the empirical analysis. The dependent variable, Financed Emissions Intensity (Scope 1 and 2), exhibits substantial variation across banks, ranging from 7.5 to 1,051 tonnes of CO_2 financed per €1 million of lending, with a mean of 138.607. Most banks fall within a relatively low range of financed emissions (approximately 0–100), while a small number finance extremely high emissions, producing a strongly right-skewed distribution. To address this skewness, the natural logarithm of financed emissions intensity was used in the regression analysis, as already described.

Turning to the disclosure variables, the Environmental Disclosure Index shows a low mean value (0.003) and a narrow standard deviation (0.003), reflecting that environmental terminology appears infrequently relative to total report length. After standardization, the index has the expected mean of zero and standard deviation of one. Positive Tone and Negative Tone indicators show similarly low frequencies (means of 0.014 and 0.013, respectively), reinforcing that environmental sections of reports represent a relatively small portion of narrative disclosures. Their standardized forms used in the regressions also display the expected mean of zero and standard deviation of one.

Regarding financial controls, ROA averages 0.928%, indicating modest profitability with considerable cross bank variation. The mean Loan-to-Deposit Ratio of 93.199% is broadly consistent with standard commercial banking practice, while the average NPL Ratio of 2.042% suggests overall good asset quality. The CET1 Ratio averages 17.437%, indicating strong capitalisation of banks in the sample. Total Assets display very large dispersion (Mean =

€295,934.684 million; SD = €517,626.059 million), indicating substantial size differences across banks. The standard deviation being considerably higher than the mean suggests that the sample includes a small number of extremely large banks, consistent with a right-skewed distribution. Because these outliers can distort estimation results, Total Assets were log-transformed prior to regression to reduce scale effects and improve comparability across institutions. Board Size varies across banks (between 5 and 37 board members with a mean of 14.180), indicating different governance structures within the sample. Because the distribution showed mild right skewness, it was also included in log form for consistent scaling.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Financed Emissions Intensity - Scope 1 & 2	150	138.607	158.512	7.500	1051.000
ln(Financed Emissions Intensity)	150	4.403	1.066	2.015	6.957
Environmental Disclosure Index	150	0.003	0.003	0.000	0.028
Environmental Disclosure Index (standardized)	150	0.000	1.000	-0.996	10.016
Positive Tone	150	0.014	0.065	0.004	0.805
Positive Tone (standardized)	150	0.000	1.000	-0.162	12.161
Negative Tone	150	0.013	0.002	0.008	0.024
Negative Tone (standardized)	150	0.000	1.000	-2.232	4.122
Return on Assets (%)	150	0.928	0.668	-0.740	2.700
GDP Growth (%)	150	1.687	2.455	-2.700	8.800
NPL Ratio (%)	150	2.042	1.846	0.000	14.030
Loan-to-Deposit Ratio (%)	150	93.199	28.696	21.770	164.200
CET1 Ratio (%)	150	17.437	4.084	11.910	33.300
Total Assets (€ mn)	150	295934.684	517626.059	207.500	2828000.000
ln(Total Assets)	150	10.956	2.228	5.335	14.855
ESG Score (Refinitiv, raw)	66	73.499	12.271	38.000	93.000
ESG Score Missing	150	0.560	0.498	0.000	1.000
Board Size	150	14.180	6.270	5.000	37.000
ln(Board Size)	150	2.574	0.383	1.609	3.611
Observations	150				

Table 1 Descriptive Statistics of Variables (source: own illustration)

As already mentioned, the ESG Score obtained from Refinitiv is available for only a subset of banks in the sample, resulting in 66 observations out of the total 150 observations. To avoid mechanically dropping observations from the regression analysis, an ESG Score Missing

indicator was constructed. In the descriptive statistics, the raw ESG score is reported only for observations with available data, while the missing indicator highlights the extent of incomplete ESG coverage across the sample. For the observations with available data, the ESG score has a mean value of 73.499 and ranges from 38 to 93, indicating substantial variation in externally assessed ESG performance across banks. The relatively high average score suggests that the banks covered by Refinitiv are, on average, evaluated as having comparatively strong ESG practices, although this assessment is not available for the full sample. To document the extent of missing ESG coverage, the table also reports an ESG Score Missing indicator, which takes the value of one for observations without a Refinitiv ESG score and zero otherwise. This indicator has a mean of 0.560, implying that approximately 56% of the observations lack an ESG score. The presence of a large share of missing ESG ratings highlights the uneven availability of third party ESG assessments in the banking sector.

4.2 Pairwise Correlations

Figure 3 reports Pearson pairwise correlations among all variables included in the analysis. The dependent variable, ln(Financed Emissions Intensity), is negatively correlated with the Environmental Disclosure Index (–0.197), indicating that banks which devote a larger share of their reporting to environmental topics tend, on average, to finance lower levels of emissions. This preliminary result is consistent with the view that more extensive environmental disclosure is linked to a cleaner lending portfolio. In contrast, ln(Financed Emissions Intensity) is weakly positively correlated with Positive Tone (0.088) and more strongly positively correlated with Negative Tone (0.144). While these simple correlations do not control for other factors, they suggest that tone alone may not straightforwardly reflect lower emissions exposure.

The correlations among the disclosure related variables are generally low, suggesting that disclosure volume and disclosure tone capture distinct dimensions of sustainability communication. The Environmental Disclosure Index is only weakly correlated with Positive Tone (0.010) and weakly negatively correlated with Negative Tone (–0.040), indicating that banks that talk more about environmental issues do not necessarily adopt a systematically more positive or negative tone.

Turning to the control variables, ln(Financed Emissions Intensity) exhibits a moderate positive correlation with the NPL Ratio (0.472), suggesting that banks with weaker asset quality tend to finance higher emissions. A positive correlation is also observed with ROA (0.248), indicating that more profitable banks may be more exposed to emission intensive lending, potentially

reflecting higher returns associated with carbon intensive borrowers. By contrast, financed emissions intensity is strongly negatively correlated with the CET1 Ratio (–0.381), implying that better capitalised banks are typically associated with lower financed emissions. Bank size, measured as ln(Total Assets), shows a positive but relatively modest correlation with financed emissions intensity (0.123), indicating that larger banks tend to finance somewhat higher emissions, though the relationship is not particularly strong in simple correlations.

The ESG Score from Refinitiv is weakly correlated with financed emissions intensity (0.040), suggesting that externally assessed ESG performance does not exhibit a strong unconditional relationship with the climate footprint of lending. However, the ESG Score Missing indicator is negatively correlated with financed emissions intensity (–0.271), reflecting that banks without Refinitiv ESG coverage tend to be smaller institutions with lower absolute and relative emissions exposure. As expected, ESG Score Missing is strongly negatively correlated with ln(Total Assets (–0.565), reinforcing the interpretation that missing ESG coverage is concentrated among smaller banks.

Correlations among the remaining control variables are generally low to moderate, and none approach levels that would raise concerns about multicollinearity. This assessment is confirmed later by Variance Inflation Factor (VIF) tests. Overall, the correlation matrix provides preliminary evidence consistent with several theoretical expectations. Because pairwise correlations do not account for unobserved bank specific characteristics or common time effects, the fixed-effects panel regression framework presented in the following section is required to formally test the hypotheses.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) ln(Financed Emissions Intensity)	1.000												
(2) Environmental Disclosure Index (standardized)	-0.197	1.000											
	(0.016)												
(3) Positive Tone (standardized)	0.088	0.010	1.000										
	(0.286)	(0.904)											
(4) Negative Tone (standardized)	0.144	-0.040	0.065	1.000									
	(0.078)	(0.626)	(0.433)										
(5) Return on Assets (%)	0.248	-0.017	-0.074	0.122	1.000								
	(0.002)	(0.836)	(0.366)	(0.136)									
(6) GDP Growth (%)	0.112	-0.048	-0.086	0.089	-0.119	1.000							
	(0.173)	(0.556)	(0.293)	(0.280)	(0.146)								
(7) NPL Ratio (%)	0.472	-0.120	0.021	0.541	0.186	0.155	1.000						
	(0.000)	(0.142)	(0.795)	(0.000)	(0.023)	(0.058)							
(8) Loan-to-Deposit Ratio (%)	-0.108	0.174	-0.042	-0.323	-0.069	-0.052	-0.204	1.000					
	(0.189)	(0.033)	(0.606)	(0.000)	(0.399)	(0.529)	(0.012)						
(9) CET1 Ratio (%)	-0.381	0.010	-0.073	-0.038	-0.050	-0.033	-0.184	0.103	1.000				
	(0.000)	(0.905)	(0.377)	(0.648)	(0.547)	(0.685)	(0.025)	(0.208)					
(10) ln(Total Assets)	0.123	-0.018	0.118	-0.156	-0.148	0.069	-0.078	0.151	-0.356	1.000			
	(0.135)	(0.828)	(0.150)	(0.057)	(0.070)	(0.402)	(0.344)	(0.065)	(0.000)				
(11) ESG Score (Refinitiv, raw)	0.040	0.014	0.078	0.101	-0.334	0.219	0.178	-0.095	-0.665	0.618	1.000		
	(0.752)	(0.911)	(0.533)	(0.418)	(0.006)	(0.077)	(0.153)	(0.446)	(0.000)	(0.000)			
(12) ESG Score Missing	-0.271	-0.015	-0.090	-0.062	-0.137	-0.147	-0.160	-0.044	0.503	-0.565		1.000	
	(0.001)	(0.856)	(0.273)	(0.449)	(0.095)	(0.072)	(0.051)	(0.597)	(0.000)	(0.000)	(.)		
(13) ln(Board Size)	0.291	-0.117	0.165	-0.016	-0.057	-0.163	0.163	0.109	-0.274	0.439	0.094	-0.219	1.000
	(0.000)	(0.153)	(0.044)	(0.844)	(0.486)	(0.046)	(0.046)	(0.182)	(0.001)	(0.000)	(0.452)	(0.007)	

Figure 3 Pairwise Correlations (source: own illustration)

4.3 Main Regression

Table 2 below, reports the results of four fixed effects panel regressions examining the relationship between banks' environmental disclosure characteristics and the carbon footprint of their lending portfolios, measured as the logarithm of financed emissions intensity. The main regression model includes bank and time fixed effects, and standard errors are clustered at the bank level.

Model (1) presents a pooled OLS specification without bank fixed effects, time fixed effects, or additional control variables. In this baseline model, the Environmental Disclosure Index enters with a negative and statistically significant coefficient ($\beta = -0.205$, $p < 0.10$), suggesting that banks with higher environmental disclosure intensity tend to finance lower emissions on average. Positive Tone is positively and highly significantly associated with financed emissions ($\beta = 0.087$, $p < 0.01$), indicating that banks employing more optimistic sustainability language tend to finance higher emissions. Negative Tone is not statistically significant in this model. However, because this model does not control for unobserved bank specific characteristics or common time trends, the estimated relationship reflects cross-sectional differences between

banks rather than within bank changes over time. The explanatory power of the model is limited ($R^2 = 0.064$), and the results from Model (1) should be interpreted as descriptive results rather than causal relationships. While Model (1) provides a useful descriptive benchmark, its pooled OLS structure does not account for unobserved heterogeneity across banks. Banks differ systematically in size, business models, geographic exposure, and historical lending portfolios, all of which may influence both disclosure behaviour and financed emissions. To address this concern, the following models progressively introduce bank fixed effects and time fixed effects, allowing the analysis to focus on how changes in disclosure within the same bank over time relate to changes in financed emissions intensity.

Model (2) introduces bank fixed effects while still excluding time fixed effects and financial control variables. This specification exploits within bank variation over time and controls for all time-invariant characteristics of each bank. Once bank fixed effects are included, the coefficient on Environmental Disclosure becomes small and statistically insignificant ($\beta = 0.009$), indicating that changes in disclosure intensity within a given bank are not associated with changes in financed emissions. Positive Tone enters with a negative and weakly significant coefficient ($\beta = -0.003$, $p < 0.10$), suggesting that, within banks, a more optimistic sustainability tone is associated with slightly lower financed emissions. Negative Tone remains statistically insignificant. The very low R^2 (0.004) highlights that this setup explains little of the within bank variation in financed emissions.

Model (3) replaces bank fixed effects with time fixed effects, capturing common sector wide developments and macroeconomic conditions that affect all banks simultaneously, such as regulatory changes, or different shifts in the economic environment. In this specification, Environmental Disclosure becomes positive and highly statistically significant ($\beta = 0.033$, $p < 0.01$), suggesting that in years when banks report more intensively on environmental topics, financed emissions intensity is higher on average across the sector. Positive Tone and Negative Tone remain statistically insignificant. The significant negative coefficients on the year indicators for 2023 and 2024 indicate a general decline in financed emissions intensity over time relative to 2022. The increase in R^2 (0.141) suggests that common time effects account for a meaningful share of the variation in financed emissions.

Model (4) presents the full specification and includes bank fixed effects, time fixed effects, and a comprehensive set of control variables capturing profitability, macroeconomic conditions, asset quality, funding structure, capitalization, bank size, governance, and ESG characteristics.

In this main model, the Environmental Disclosure Index remains positive and highly statistically significant ($\beta = 0.043$, $p < 0.01$). This result implies that, even after accounting for differences in financial metrics and institutional characteristics, banks that increase the intensity of environmental disclosure over time tend to finance higher emissions per euro of lending. Neither Positive Tone nor Negative Tone exhibit a statistically significant relationship with financed emissions intensity in this specification, indicating that the linguistic framing of sustainability communication does not provide additional explanatory power beyond disclosure intensity.

Among the control variables, bank size plays a central role. The coefficient on ln(Total Assets) is negative and highly significant ($\beta = -0.794$, $p < 0.01$), suggesting that larger banks finance fewer emissions per euro of exposure, potentially due to greater diversification, or stronger risk management capabilities. Other controls, including ROA, GDP growth, NPL Ratio, Loan-to-Deposit Ratio, CET1 Ratio, ESG Score, and Board Size, are not statistically significant in the full model. Once these controls are included, the year fixed effects lose significance, indicating that differences in financed emissions are primarily driven by bank-specific characteristics rather than common time trends.

Overall, the progression from pooled ordinary least squares (OLS) to fixed-effects models reveals that the negative association between environmental disclosure and financed emissions observed in cross-sectional comparisons does not hold once unobserved bank heterogeneity and time effects are controlled for. In the fully specified model, environmental disclosure is systematically associated with higher financed emissions intensity, while disclosure tone plays no meaningful role. These findings suggest that sustainability disclosure in the banking sector may function more as a reputational or symbolic mechanism than as a reflection of substantive changes in lending related climate behaviour.

	(1) ln(Financed Emissions Intensity)	(2) ln(Financed Emissions Intensity)	(3) ln(Financed Emissions Intensity)	(4) ln(Financed Emissions Intensity)
Environmental Disclosure Index (standardized)	-0.205*	0.009	0.033***	0.043***
	(0.112)	(0.015)	(0.010)	(0.014)
Positive Tone (standardized)	0.087***	-0.003*	-0.001	0.001
	(0.016)	(0.002)	(0.003)	(0.005)
Negative Tone (standardized)	0.140	0.036	0.021	0.096
	(0.138)	(0.086)	(0.069)	(0.080)
Year=2022			0.000	0.000
			(.)	(.)
Year=2023			-0.133***	-0.105
			(0.049)	(0.075)
Year=2024			-0.190***	-0.121
			(0.057)	(0.082)
Return on Assets (%)				0.129
				(0.085)
GDP Growth (%)				0.003
				(0.014)
NPL Ratio (%)				-0.032
				(0.024)
Loan-to-Deposit Ratio (%)				-0.001
				(0.005)
CET1 Ratio (%)				-0.026
				(0.022)
ln(Total Assets)				-0.794***
				(0.230)
ESG Score (conditional)				-0.005
				(0.009)
ln(Board Size)				0.252
				(0.339)
Constant	4.403***	4.403***	4.511***	13.153***
	(0.143)	(0.000)	(0.032)	(2.595)
Observations	150	150	150	150
R^2	0.064	0.004	0.141	0.239

Table 2 Main Regression (source: own illustration)

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.4 Hypotheses Evaluation and Discussion

Hypothesis 1 (H1) stated that banks with higher levels of Environmental Disclosure Index finance a lower carbon footprint of their lending portfolios. The empirical results do not support this hypothesis. While the pooled OLS specification in Model (1) suggests a negative correlation between environmental disclosure and financed emissions intensity, this relationship disappears once bank fixed effects are introduced and reverses sign when time fixed effects and control variables are included. In the fully specified model, higher environmental disclosure is associated with higher financed emissions intensity. This indicates that banks that increase the amount of environmental terminology in their reports over time do not reduce, but instead increase, the emissions financed per euro of lending.

Hypothesis 2 (H2) proposed that banks using a more positive tone in their environmental disclosures finance a higher carbon footprint. The results provide limited and unstable support for this hypothesis. In the pooled OLS model, positive tone is positively and significantly associated with financed emissions intensity, suggesting that banks employing more optimistic sustainability language tend to finance higher emissions on average. However, this relationship disappears once bank fixed effects, time fixed effects, and financial controls are included. In the full model, positive tone has no statistically significant relationship with financed emissions. Consequently, H2 is not supported in the fixed effects framework, indicating that positive tone does not systematically explain within bank changes in financed emissions.

Hypothesis 3 (H3) argued that banks using a more negative tone in their environmental disclosures finance a lower carbon footprint of their lending portfolios. Across all model specifications, negative tone remains statistically insignificant and does not show a stable connection to the financed emissions intensity. This suggests that H3 is not supported, and that more cautious or risk oriented environmental language does not correspond to systematically lower financed emissions. Together, these results imply that the stylistic framing of sentences in sustainability reporting carries limited informational value regarding banks' actual climate friendly lending impact.

The empirical findings suggest a disconnect between what banks communicate about sustainability and the climate impact of their lending activities. Contrary to the signalling based interpretation of sustainability disclosure, higher environmental disclosure intensity is not associated with a reduction in financed emissions. Instead, banks that expand their environmental reporting tend to finance higher emissions per euro of exposure. This pattern is consistent with

the view that sustainability disclosure in the banking sector may function primarily as symbolic communication rather than as a reflection of substantive changes in lending behaviour.

From a theoretical perspective, these results challenge disclosure theories that assume transparency is driven by superior underlying performance (Verrecchia, 1983; Al-Tuwaijri et al., 2004). If environmental disclosure were a credible signal of climate risk management, increases in disclosure intensity would be expected to correlate with lower financed emissions. The findings align closely with the greenwashing literature, which argues that firms often rely on environmental rhetoric to signal commitment while continuing environmentally harmful activities (Marquis, Toffel & Zhou, 2016). In banking, this tendency may be particularly visible because environmental consequences of credit allocation are more difficult for external stakeholders to observe. As a result, banks with more carbon intensive portfolios may face stronger incentives to communicate extensively about sustainability to offset reputational risks. The positive association between environmental disclosure and financed emissions intensity in the fixed-effects models is consistent with this mechanism.

Importantly, the strong and negative association between bank size and financed emissions intensity highlights that structural characteristics are more important than the disclosure tone itself. Larger banks may benefit from diversification, stronger governance frameworks, or greater regulatory pressure, enabling them to manage climate risks more effectively. Overall, the results suggest that environmental disclosure in European banking does not operate as a reliable signal of lower climate impact. Instead, higher disclosure intensity appears to be connected with higher financed emissions, pointing to a form of merely symbolic sustainability communication. This has important implications for regulators and market participants who rely on disclosure based metrics to assess banks' climate performance.

Although this thesis follows the textual methodology of *Do Banks Practice What They Preach?* (Gambacorta et al., 2023), the empirical results differ in important ways. While Gambacorta et al. (2023) find that higher environmental disclosure is associated with lower lending to carbon-intensive (brown) firms, this thesis arrives to a different conclusion when focusing on financed emissions intensity. This difference arises from the distinct conceptual focus of the outcome variables. Reductions in brown lending reflect changes in portfolio allocation, whereas financed emissions intensity captures the actual carbon footprint of the lending portfolio. A bank may reduce the share of loans to brown sectors while still financing high emissions if remaining borrowers emit heavily, increase production, or decarbonise slowly. Additionally, banks may

maintain exposure to brown sectors while financed emissions decline if borrowers reduce emissions. By examining financed emissions rather than sectoral exposure, this thesis evaluates climate outcomes rather than lending composition. The results suggest that although banks with higher environmental disclosure may reallocate lending away from certain high-emission sectors, this does not necessarily translate into lower financed emissions.

Table 4 presents illustrative examples of financed emissions intensity in the sample, together with total assets, to provide an intuitive sense of the size and dispersion of banks' lending related carbon footprints. Specifically, the table reports three groups of banks: five banks with the highest financed emissions intensity, five banks with medium intensity values, and five banks with the lowest financed emissions intensity observed in the data. The purpose of this comparison is not to rank banks exhaustively, but to highlight the substantial variation in financed emissions intensity across institutions with different sizes and business models. Including total assets helps to put these figures in context, as banks differ in size. Importantly, the table also shows that financed emissions intensity is not mechanically driven by bank size. Overall, the table illustrates the range of financed emissions intensity in the sample.

Bank	Financed Emissions Intensity - Scope 1 & 2	Total Assets (M€)	Intensity	Year
BBVA	1051 (tCO2e/M€)	713.140,00	High	2022
ProCredit Group	735 (tCO2e/M€)	8.260,00	High	2022
Bank of Cyprus	528 (tCO2e/M€)	26.484,00	High	2024
Cooperative Bank of Karditsa Coop.L.L.	501 (tCO2e/M€)	243,50	High	2023
Kommunalkredit Austria AG	463 (tCO2e/M€)	4.628,30	High	2022
Raiffeisen Bank International	119 (tCO2e/M€)	199.851,00	Medium	2024
Rabobank	104 (tCO2e/M€)	629.253,00	Medium	2024
ING	91 (tCO2e/M€)	975.583,00	Medium	2023
Erste Group Bank AG	81 (tCO2e/M€)	337.155,00	Medium	2023
Luminor Bank AS	73,10 (tCO2e/M€)	15.723,70	Medium	2024
Triodos Bank	15 (tCO2e/M€)	16.968,00	Low	2024
ASN Bank	14,61 (tCO2e/M€)	7.3691,00	Low	2024
Ecology Building Society	13,2 (tCO2e/M€)	241,00	Low	2024
Leeds Building Society	7,5 (tCO2e/M€)	34.755,00	Low	2024
Merkur Cooperative Bank	7,5 (tCO2e/M€)	612,00	Low	2022

Table 3 Distribution of Financed Emissions Intensity (source: own illustration)

Figure 4 illustrates the distribution of environmental terminology across the banks in the sample, based on a textual analysis of merged annual and sustainability reports. The figure focuses on the ten most frequently used environmental terms in the full sample, identified by aggregating word occurrences across all banks and years. These 10 most frequently used terms are: climate change, carbon, biodiversity, environmental risk, ecosystem, sustainable development, renewable energy, pollution, greenhouse gas and coal. Each bar represents one

bank, ordered by the total number of environmental term occurrences, while the stacked segments show how often each of the ten most common environmental terms appears in that bank's disclosures. All remaining environmental dictionary terms are grouped under the category "Other."

The figure reveals institutional differences on how banks engage with environmental language. Although the same set of core environmental terminology dominates reports, such as climate change, carbon, biodiversity, and environmental risk, the intensity with which these terms are used differs across banks. Some institutions make only limited reference to environmental topics, while others rely heavily on a broad range of environmental terminology. Importantly, this figure presents differences in disclosure intensity and sustainability emphasis itself rather than environmental performance. As such, it provides a descriptive overview of reporting behaviour and motivates the subsequent analysis.

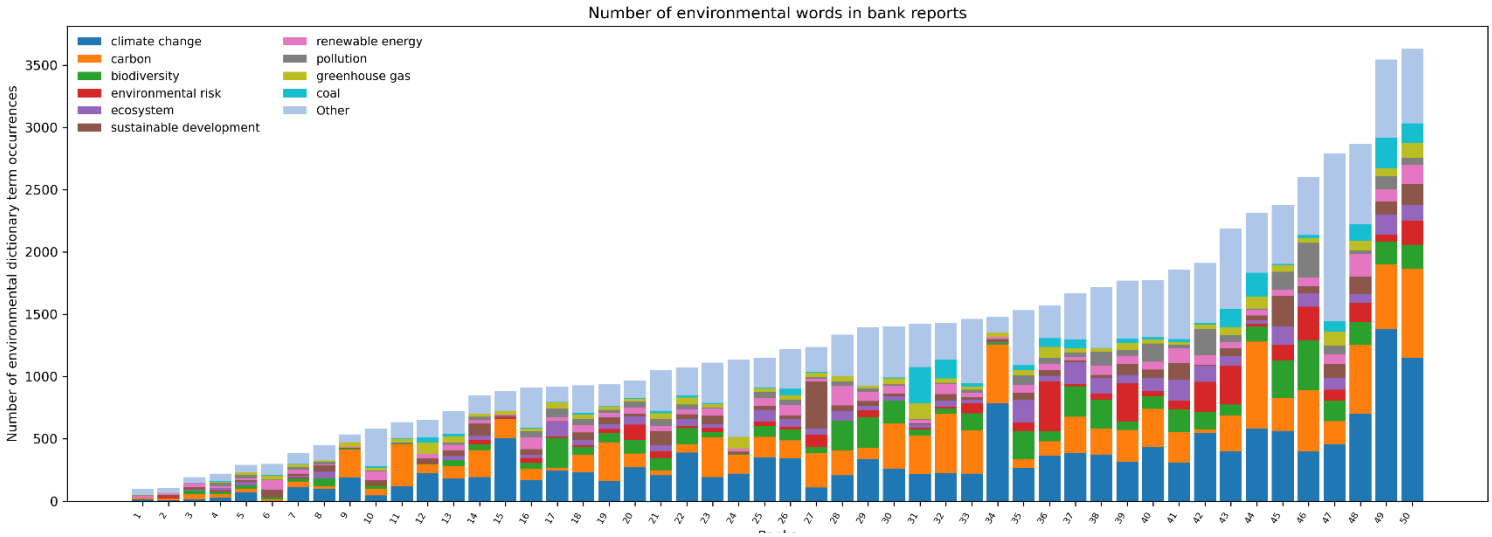

Figure 4 Number of Environmental Words in Bank Reports (source: own illustration)

4.5 Model Diagnostics

To make sure the regression results are statistically reliable, several diagnostic tests were carried out. First, multicollinearity was checked using the Variance Inflation Factor (VIF). All VIF values were well below the common threshold of 10, which means that the independent variables are not so strongly correlated with each other that they would distort the coefficient estimates. Second, heteroskedasticity was tested using the Modified Wald test for groupwise heteroskedasticity. The test result showed significant heteroskedasticity across banks ($p < 0.01$), meaning the variance of the residuals is not constant across institutions. This issue does

not threaten the validity of the results because the regression was already estimated with standard errors clustered at the bank level, which explicitly corrects for both heteroskedasticity and within bank serial correlation. Third, autocorrelation was assessed using the xtregar command. The estimated rho value was close to 0, suggesting that residuals are not serially correlated within banks over time. This supports the suitability of the fixed-effects model.
Finally, residual normality was checked using the Shapiro Wilk test and a histogram. The test indicated that the residuals are not perfectly normally distributed, but the histogram showed approximate symmetry. Since the model relies on clustered standard errors rather than distributional assumptions about the residuals, any deviation from normality is not expected to bias the inference. Overall, the diagnostics show that the empirical specification is statistically robust: multicollinearity is not a concern, heteroskedasticity is corrected for through clustering, autocorrelation is not detected, and non normality of residuals does not undermine the reliability of the estimates.

4.6 Robustness Check

To assess whether the main findings depend on the specific construction of the Environmental Disclosure Index, Table 4 presents a robustness check in which the baseline disclosure measure is replaced with the inverse document frequency weighted index proposed by Brown and Tucker (2011). This alternative measure gives greater weight to environmental terms that are less common across banks' reports, and this thesis follows the approach used in Gambacorta et al. (2023). The regression structure, control variables and fixed effects setup remain identical to the main model.

	(1) ln(Financed Emissions Intensity)	(2) ln(Financed Emissions Intensity)	(3) ln(Financed Emissions Intensity)	(4) ln(Financed Emissions Intensity)
BT_Environmental Disclosure Index (standardized)	-0.157	0.013	-0.005	0.084
	(0.139)	(0.062)	(0.058)	(0.063)
Positive Tone (standardized)	0.145***	0.001	0.014***	0.009
	(0.015)	(0.001)	(0.003)	(0.019)
Negative Tone (standardized)	-0.025	-0.002	0.010	0.011
	(0.076)	(0.022)	(0.023)	(0.023)
Year=2022			0.000	0.000
			(.)	(.)
Year=2023			-0.131***	-0.093
			(0.048)	(0.078)
Year=2024			-0.182***	-0.118
			(0.058)	(0.086)
Return on Assets (%)				0.119
				(0.083)
GDP Growth (%)				0.006
				(0.015)
NPL Ratio (%)				-0.039
				(0.038)
Loan-to-Deposit Ratio (%)				-0.000
				(0.005)
CET1 Ratio (%)				-0.038*
				(0.020)
ln(Total Assets)				-0.663***
				(0.203)
ESG Score (conditional)				-0.007
				(0.009)
ln(Board Size)				0.026
				(0.322)
Constant	4.403***	4.403***	4.507***	12.566***
	(0.146)	(0.000)	(0.159)	(2.533)
Observations	150	150	150	150
R^2	0.000	0.042	0.113	0.220

Table 4 Robustness Check (source: own illustration)

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The robustness results broadly confirm the central points observed in the main analysis, while also highlighting important differences. Across all model specifications, the Brown and Tucker weighted disclosure index is statistically insignificant and its coefficient fluctuates around zero. In contrast to the baseline Environmental Disclosure Index, which exhibits a positive and statistically significant association with financed emissions intensity in the full model, the weighted index does not display a systematic relationship with financed emissions. This suggests that the positive association found in the main specification is driven primarily by the overall volume of environmental language rather than by the use of less frequent, more distinctive environmental terminology. In other words, banks that finance higher emissions tend to increase generic sustainability communication, but they do not systematically rely on more specialised or uncommon environmental terms.

The tone variables display patterns that are largely consistent with the main results. Positive Tone is significant in the simpler specifications but loses statistical significance once time effects and full controls are introduced, indicating that optimistic language does not robustly explain differences in financed emissions once bank characteristics are accounted for. Negative Tone remains statistically insignificant across all specifications, reinforcing the conclusion that cautious or risk oriented environmental language does not systematically align with lower carbon intensity in lending portfolios. Control variables behave similarly to the main model, with bank size keeping a strong negative association with financed emissions intensity in the full specification.

5. Conclusion

The goal of this thesis was to examine whether sustainability communication in reports of European banks reflects actual environmental performance, focusing on the relationship between environmental disclosure, disclosure tone, and the carbon footprint of banks' lending portfolios as measured by financed emissions intensity. By combining textual analysis of banks' annual and sustainability reports with newly available financed emissions data under the PCAF framework, this thesis moved beyond portfolio composition and investigated whether what banks say about sustainability corresponds to the climate outcomes of their financing activities.

The central finding is that higher levels of environmental disclosure are associated with higher financed emissions intensity once bank specific characteristics and time effects are taken into account. In the fully specified fixed effects model, banks that increase the intensity of environmental language in their reporting tend to finance more emissions per euro of lending. This

result points to a meaningful disconnect between sustainability communication and actual lending related climate impact. Importantly, this finding does not allow for a definitive claim of greenwashing in a narrow sense. The thesis does not observe banks' intentions, nor does it evaluate the truthfulness of individual statements in sustainability reports. However, the empirical evidence does point in the direction of green window dressing. Banks appear to increase sustainability communication specifically in periods when their financed emissions remain high or increase, suggesting that disclosure may function as a reputational tool. In this sense, environmental disclosure seems to serve a symbolic role, responding to stakeholder expectations and regulatory pressure, without yet translating into lower climate impact through lending. If disclosure intensity rises independently of actual emissions outcomes, stakeholders may struggle to distinguish genuinely transitioning banks from those that are only expanding their sustainability narratives.

A further important finding concerns disclosure tone. Neither positive nor negative tone explain differences in financed emissions intensity once bank fundamentals and fixed effects are included. While positive tone appears significant in simple pooled models, this effect disappears in the fixed effects framework, and negative tone remains insignificant throughout all the four models tested. This suggests that how banks frame their sustainability language, positively or negatively, does not add value to the context of their green financing. Tone, at least as captured through dictionary based measures, does not appear to reflect underlying changes in lending related climate performance. Instead, control variables such as bank size help to explain the effect of financed emissions intensity. Larger banks tend to finance fewer emissions per euro of exposure, likely reflecting diversification benefits or stronger risk management frameworks.

Taken together, the results challenge the assumption that sustainability disclosure in banking operates as a credible signal of environmental performance. Contrary to signalling theory predictions, increased disclosure does not align with lower financed emissions. Instead, the findings are more consistent with perspectives from the greenwashing and impression management literature, which argue that banks may rely on environmental communication to maintain their "green image" under growing pressure, even when underlying practices remain largely unchanged.

At the same time, several limitations of the analysis should be acknowledged. First, the sample size is relatively small, consisting of 50 European banks observed over three years. While this reflects the current state of financed emissions disclosure, it limits statistical power and constrains the ability to explore heterogeneity across business models or countries in greater depth.

Second, the short time window restricts the ability to assess long term causality. Changes in lending portfolios and financed emissions may take time to materialize. Third, the textual analysis captures the quantity and tone of environmental language, but not its context. Statements such as “we reduced emissions” and “we failed to reduce emissions” both contribute to environmental term counts, even though their implications differ fundamentally. As a result, the analysis cannot distinguish between the context.

These limitations also point directly toward promising paths for future research. As PCAF disclosures become more widespread and standardized, future studies will be able to work with larger samples and longer time horizons, enabling stronger causal analysis. In addition, financed emissions remain a relatively new and underexplored variable in banking research. More advanced natural language processing techniques such as context based methods could also allow researchers to move beyond pure dictionary-based approaches and capture context and in sustainability reports more precisely.

Overall, this thesis contributes to the growing literature on sustainability reporting and climate finance by showing that how much banks say about sustainability does not yet align with the climate impact of what they finance. Environmental disclosure in European banking appears to have increased without a corresponding improvement in the climate impact of lending portfolios. This disconnect raises important questions about whether disclosure based measures accurately capture banks’ true environmental performance. For regulators and market participants, these findings underscore the need to complement narrative sustainability reporting with outcome based metrics such as financed emissions. Without such alignment, sustainability reporting remains a powerful communication tool that shapes perceptions, but not a reliable indicator of real environmental progress in baking.

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7. Appendix

List of words of the dictionary

Acid rain

Acid soil

Air quality

Alluvial

Alternative energy

Alternative fuel

Biodegradable

Biodiversity

Carbon

Chemical agent

Chemical emergency

Chemical weathering

Climate action

Climate change

Climate neutral

Chlorofluorocarbon (CFC)

Coal

Compostable

Contamination

COP21

Critical habitat

Deforestation

Desertification

Deoxygenation

Ecology

Ecosphere

Ecosystem

Energy transition

Environmental accounting

Environmental assessment

Environmental conservation

Environmental law

Environmental preservation

Environmental protection

Environmental quality

Environmental regulation

Environmental reporting

Environmental risk

Environmental standard

Environmental strategy

Environmental sustainability

Environmental, Social and Governance (ESG)

European Environment Agency

Eutrophication

Extinction

Extremely hazardous substance

Fauna

Flocculation

Flood

Flora

Forest conservation

Fossil fuel

Glacial ice

Glacial retreat

Glacier

Global Environmental Monitoring System

Global warming

Greenhouse effect

Greenhouse gas (GHG)

Habitat conservation plan

Habitat loss

Habitat preservation

Habitat restoration

Hydrosphere

International energy agency

Kyoto protocol

Life cycle analysis

Life cycle assessment

Marine protection

Marine system

Marine resource

Natural disaster

Natural ecosystem

Natural resources

Nitrification

Nuclear waste

Ocean dumping

Overharvesting

Overexploitation

Ozone

Paris agreement

Permafrost

Pesticide

Petroleum

Planned obsolescence

Plastic

PM10

PM2.5

Pollution

Radioactive waste

Recycling

Renewable energy

Renewable resource

Resource depletion

Reuse

Sea levels

Sea dumping

Soil acidification

Soil conservation

Sustainable development

Toxic

Transuranic waste

Waste reduction

Waste management

Waste minimization

Water conservation

Weather

Wildlife

Wild animal