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The Influence of ESG Practices on Bank Credit: The Moderating Role of Climate Policy Across Countries

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ABSTRACT. This paper investigates how banks' Environmental, Social and Governance (ESG) performance interacts with national climate policy to shape bank credit, as measured by net loans. Using an unbalanced panel of 389 listed commercial banks from multiple countries over the period 2010–2023, we combine bank- level ESG and financial data with the Climate Change Performance Index (CCPI), a synthetic indicator of the ambition and effectiveness of national climate policy. The results of the two-step System-GMM show that, on average, stronger ESG performance and stricter climate policy are associated with a more cautious expansion of net loans. However, the positive, statistically significant interaction between ESG and CCPI indicates that the adverse baseline effect is attenuated as climate policy becomes more ambitious. Overall, the findings suggest that ESG alone is not a sufficient driver of green credit; its effectiveness as a conduit for sustainable lending critically depends on the broader climate policy framework.

1. Introduction

The growing impacts of climate change, environmental degradation, and social inequality are putting pressure on the global financial system and requiring a reconsideration of its role in reallocating capital towards a greener, more inclusive growth model [1]. In particular, commercial banks are increasingly expected to act not only as major financial intermediaries, but also as "policy transmission channels," capable of providing capital for sustainable development activities [2]. In this context, integrating Environmental, Social, and Governance (ESG) factors into credit-granting policies and processes has emerged as a strategic approach that can help banks manage non-financial risks, enhance credibility, and create long-term value [3]. Despite

this momentum, there are relatively few studies offering a comprehensive view of how ESG shapes banks' core intermediation activities, especially bank credit [4].

At the global level, Abdelsalam et al. [5] show that ESG activities dampen the cyclicality of bank lending; in other words, ESG-active institutions experience more stable credit growth. Supporting Abdelsalam et al. [5], Danisman and Tarazi [6] find that banks with higher ESG activity cut lending less during financial crises, mitigating credit supply contractions. Indicating that the ESG–credit nexus is not monotonic, AlHamrani et al. [7] document a non-linear impact of ESG disclosure on credit growth of banks in MENA countries. More recently, Bressan [10] shows that US banks with higher ESG scores tilt their loan portfolios towards consumer and commercial lending and away from construction and real-estate loans, highlighting that ESG affects both the volume and composition of credit.

Overall, these studies suggest that ESG performance can influence banks' lending dynamics. Still, the evidence remains fragmented across regions and episodes and primarily focuses either on lending cyclicality or on portfolio composition rather than on sustained credit growth across countries.

In parallel, a distinct strand of research emphasises that climate-related risks and policies materially affect banks' performance and loan supply. Using Chinese data, Li and Wu [8] show that higher climate risk is associated with a reduction in banks' loan supply, especially to carbon-intensive sectors. Pan et al. [9] find that local air pollution increases bank risk-taking and worsens asset quality, underscoring the importance of environmental conditions for financial stability. Targeted regulations such as China's Green Credit Policy have been shown to alter banks' risk profiles and portfolio allocation by encouraging green lending and constraining credit to polluting industries [11].

While this literature demonstrates that climate risk and policy are important determinants of bank be- haviour, climate policy is typically treated as an exogenous macro shock, proxied by country dummies or individual regulatory events, rather than by a harmonised cross-country indicator. The interaction between these two strands of research remains under-explored. Existing studies rarely ask whether the impact of bank-level ESG performance on credit supply depends on the ambition and effectiveness of a country's cli- mate policy framework. Intuitively, high-ESG banks operating in jurisdictions with stringent and credible climate policies may face stronger regulatory incentives and market signals to expand green lending and retrench from brown exposures. Conversely, where climate policy is weak or inconsistent, ESG may remain largely symbolic, with limited consequences for banks' credit decisions. Understanding this interaction is crucial for assessing whether ESG can serve as an effective channel for realigning credit flows with the goals of the Paris Agreement, or whether its impact is contingent on the broader policy environment.

To capture cross-country differences in climate policy and performance in a systematic way, this study employs the Climate Change Performance Index (CCPI) as a proxy for the effectiveness of national climate policy frameworks. The CCPI is an independent monitoring tool developed by Germanwatch, NewClimate Institute and CAN International that has been published annually since 2005. It evaluates 63 countries plus the European Union, which together account for over 90% of global greenhouse-gas emissions, across four dimensions: emissions, renewable energy, energy use and climate policy [12]. By combining information on both current outcomes and future targets, the index provides a synthetic but rich measure of how far a country has progressed towards a low-carbon trajectory relative to global climate goals. Using CCPI allows us to move beyond country dummies or single policy indicators and to examine explicitly how cross-country variation in climate-policy ambition conditions the ESG-credit relationship.

Building on these considerations, this paper addresses two related research questions. First, does bank- level ESG performance foster bank credit in term of net loans once we control for bank-specific characteristics? Second, does the effectiveness of a country's climate policy framework, as proxied by CCPI, amplify or dampen the impact of ESG performance on credit growth? To answer these questions, we assemble an unbalanced panel of 389 listed commercial banks from multiple countries over the period 2010–2023 and merge bank-level ESG and financial data with country-level CCPI scores. The empirical strategy relies on a dynamic panel framework estimated using the System-GMM estimator, which allows us to account for the persistence of bank credit, control for unobserved heterogeneity and mitigate endogeneity concerns arising from reverse causality and omitted variables.

This study makes three main contributions to the literature. First, it provides new cross-country evi- dence on the association between ESG performance and bank credit, extending prior work that has focused primarily on lending cyclicality, crisis episodes or loan-portfolio composition [5–7,10]. Second, it explicitly links bank-level ESG performance with a comprehensive indicator of national climate-policy performance, thereby bridging the ESG–lending literature with emerging research on climate risk, green credit and bank behaviour [8,9,11,12]. Third, from a methodological standpoint, the use of a dynamic System-GMM speci-ification enables us to jointly consider bank-level ESG drivers, macro-climate conditions and the dynamic nature of credit growth, offering a more rigorous assessment of the ESG–credit–policy nexus than static panel approaches. The remainder of the paper is organised as follows. Section 2 reviews the theoretical framework and related literature, Section 3 presents the research model and methodology, Section 4 reports and discusses the empirical results, and Section 5 concludes with policy implications and avenues for future research.

2. Literature review

2.1. Theoretical framework of the relationship between ESG and credit growth

Four theoretical perspectives are particularly relevant for explaining the relationship between ESG performance and bank credit growth: signalling theory, stakeholder theory, legitimacy theory and agency theory. Each offers a distinct mechanism through which ESG can shape banking behaviour in general and lending expansion in particular.

2.1.1. Signalling theory

Signalling theory, developed by Spence [13], focuses on how agents with private information convey credible signals to reduce information asymmetries in the market. For a signal to be effective, it must be sufficiently costly or challenging to imitate so that only high-quality entities can afford to send it. In the banking context, ESG performance and disclosure can serve as a quality signal. By consistently implementing and reporting ESG practices, banks convey to investors, regulators and other market participants that they possess strong governance structures, a forward-looking strategic orientation and higher resilience to environmental and social risks.

From a signalling perspective, therefore, higher ESG performance is expected to be associated with greater capacity to expand credit, especially when external stakeholders believe that ESG scores are reliable indica- tors of long-term stability.

2.1.2. Stakeholder theory

Developed by Freeman [14], Stakeholder theory posits that firms depend on a wide range of stakeholders-such as customers, employees, regulators, and local communities. As a result, sustainable success requires balancing the interests of all stakeholders rather than focusing exclusively on short-term shareholder value. Within this framework, ESG performance is an essential means by which firms demonstrate responsiveness to stakeholder concerns about environmental protection, social responsibility, and ethical governance.

Empirical studies show that strong ESG practices can enhance corporate reputation, employee commit- ment and customer loyalty, thereby improving operational efficiency and competitive positioning [15]. In the banking industry, stakeholder theory suggests that ESG integration is not merely a compliance obligation but also a strategic tool for building enduring relationships with key constituencies. Particularly, banks that actively offer sustainable financial products, adopt responsible lending standards, and engage with commu- nities are more likely to gain the trust of depositors, corporate clients, and retail customers. Consequently, stakeholder theory supports the expectation that higher ESG performance contributes to stronger and more sustainable credit growth.

2.1.3. Legitimacy theory

Formulated by Dowling and Pfeffer [16], Legitimacy theory argues that firms must operate within the boundaries of prevailing social norms and values to maintain their legitimacy and preserve their "social licence to operate." When an organisation is perceived as violating societal expectations-for example, through environmental damage, social misconduct or governance failures-its legitimacy may be called into question, threatening its survival and performance.

Banks are susceptible to legitimacy concerns because they operate under close public and regulatory scrutiny and rely heavily on public trust. As awareness of ESG increases, banks can reduce reputational risk, lower the likelihood of litigation or regulatory sanctions, and mitigate the risk of public boycotts by adopting robust ESG policies and transparently disclosing their implementation.

This will enhance the confidence of depositors, investors and other counterparties, which can translate into more stable funding and easier access to wholesale and retail sources of finance. Legitimacy theory thus suggests that ESG performance can indirectly foster credit growth by consolidating the social and regulatory foundations upon which banking activities rest.

2.1.4. Agency theory

Developed by Jensen and Meckling [17], Agency theory highlights conflicts of interest between shareholders (principals) and managers (agents). However, more recent works emphasise that strong ESG performance-particularly in the governance dimension-can help mitigate agency problems. Enhanced governance practices, such as independent boards, transparent reporting and well-designed incentive schemes, improve oversight and align managerial incentives with the long-term interests of shareholders and other capital providers. At the same time, environmental and social policies that reduce long-term risks (e.g., reputational, regulatory and transition risks) can protect the bank's franchise value and earnings capacity.

From this perspective, ESG-oriented governance can improve the bank's risk–return profile and strategic discipline, supporting prudent yet growth-oriented credit policies. As a result, ESG performance can provide a stronger foundation for sustainable credit expansion.

Taken together, these four theoretical perspectives provide a coherent rationale for expecting a positive association between bank-level ESG performance and credit growth. Signalling theory emphasises the role of ESG as a credible quality signal that lowers funding costs. Stakeholder theory highlights how ESG can strengthen relationships with key constituencies and expand the demand and supply conditions for lending. Legitimacy theory underscores the importance of ESG in maintaining the social licence to operate and reducing reputational and regulatory risks that could constrain credit activities. Agency theory points to

the potential of ESG-especially governance-related practices-to mitigate agency problems and enhance long-term value creation.

At the same time, these theories also imply that the ESG–credit relationship is likely to be context- dependent. The costs and benefits of ESG investments, and the extent to which stakeholders reward ESG performance, may vary across countries depending on their institutional environment and climate policy frameworks. In countries with more effective climate policies, ESG signals may be more salient to stakeholders, legitimacy pressures stronger and governance reforms more tightly linked to climate-related regulatory requirements. This suggests that the impact of ESG on credit growth may be amplified where national climate policy is more effective.

Building on these insights, we derive two main hypotheses for empirical testing:

• H1: Bank-level ESG performance is positively associated with net loans.

• H2: The effectiveness of a country's climate policy framework, proxied by the Climate Change Performance Index (CCPI), positively moderates the relationship between bank-level ESG performance and net loans.

These hypotheses guide the empirical analysis presented in the subsequent sections.

2.2. Empirical research on the impact of ESG on bank credit

Abdelsalam et al. [5] examine the role of ESG in relation to lending cyclicality. Using data of 277 listed banks all over the world and a two- step system GMM estimator, it demonstrates that banks having a high ESG score (especially environmental factors (E)) have more stable lending behaviour over the business cycle. To explain this impact, according to the researchers, ESG is not only a quality signal (reducing information asymmetry), but it can also manage risks, which helps banks maintain their credit supply when macroeconomic conditions worsen.

Following the same opinion as Abdelsalam et al. [5], Danisman and Tarazi [6] demonstrate that banks with high ESG scores experience lower credit reduction than others. Additionally, the impact of ESG on credit growth is obvious in banks with traditional lending models, according to the results of a two-step system GMM from European banks' data between 2002 and 2020.

Adding a nonlinear perspective to the ESG–credit growth relationship, AlHamrani, Awad, and Albaity [7] examine 394 banks across 11 MENA countries from 2010 to 2023 using quantile regression based on disclosed ESG data. The results reveal an inverted U-shaped relationship at lower quantiles and a U-shaped relationship at higher quantiles. According to the authors, this pattern may stem from ESG compliance and investment costs eroding profit margins and limiting credit expansion among high-growth banks. However, as the study focuses solely on the MENA region, the generalizability of its findings remains to be tested across more diverse economies.

Although not directly analyse the impact of ESG on credit growth, Herbohn et al. [18] and Wu & Shen [19] suggest that banks with strong ESG or CSR practices tend to enjoy more favourable borrowing conditions (e.g., lower spreads and more favourable maturities). These funding advantages can enhance banks' capital positions, thereby enabling them to expand credit more effectively.

3. Research models and methodology

3.1. Research models

The empirical analysis investigates how banks' ESG performance and national climate policy stringency jointly affect the scale of bank lending. We estimate the following panel data model:

(3.1)
$$log\,N\,L_{it} = \beta_0 + \beta_1 * ESG_{i,(t-1)} + \beta_2 * logSize_{i,(t-1)} + \beta_3 * EA_{i,(t-1)} + \beta_4 * LLPR_{i,(t-1)} + \beta_5 * NIM_{i,(t-1)} + \beta_6 * CCPI_{nt} + \beta_7\left(ESG_{i,(t-1)}CCPI_{nt}\right) + u_i + \varepsilon_{it}$$

where i indexes banks and t years. The dependent variable $log\,NL_{it}$ is the logarithm of total loans outstanding, capturing the scale of credit on the balance sheet.

The key regressors are: lagged ESG score ($ESG_{i,(t-1)}$), national climate policy stringency ($CCPI_{nt}$), and their interaction $ESG_{i,(t-1)} \times CCPI_{nt}$ (operationalised as CCPI*ESG). The interaction term captures whether the effect of ESG on lending is conditioned by the climate policy regime. Interpreting multiplicative interactions via conditional marginal effects follows Brambor et al. [20].

Bank-specific controls, all lagged one period, include log total assets (log $Size_{i,(t-1)}$), the equity-to-asset ratio ($EA_{i,(t-1)}$), loan loss provisions to loans ($LLPR_{i,(t-1)}$), and net interest margin ($NIM_{i,(t-1)}$). Using logs and ratios is standard in empirical banking studies, as it mitigates skewness and yields economi- cally interpretable semi-elasticities (Athanasoglou et al. [21]).

3.2. Methodolory

The dataset is an unbalanced panel of several hundred banks (389 banks) over at most 14 years, i.e. a typical "large N, small T" banking panel. In this context, two issues are central: (i) unobserved bank heterogeneity, because time-invariant features such as business model, risk culture or long-run governance can affect both ESG performance and lending; and (ii) endogeneity of ESG and bank controls, as these variables may adjust in response to past shocks in lending or risk. Dynamic panel GMM estimators are explicitly designed to address these problems in large-N, small-T settings by using lagged values as internal instruments ([22-24]).

The empirical implementation proceeds in three main steps. First, we construct the bank–year panel, com- pute logarithmic and ratio variables, and generate one-period lags of ESG, bank controls and the interaction term CCPI*ESG.

Second, we estimate a two-step System GMM model of logNL on lagged ESG, CCPI, the interaction term and the lagged controls. Lagged levels of ESG serve as instruments for its differenced values and lagged differences serve as instruments in the level equation, under the standard System GMM moment conditions [23,24]. We use the finite-sample correction to the two-step covariance matrix proposed by Windmeijer [25] to obtain reliable standard errors in finite samples.

Third, we assess serial correlation and instrument validity. We report the Arellano–Bond tests for second- order serial correlation in the differenced residuals; absence of significant AR(2) is required for the validity of lagged instruments [22]. We also use the Hansen test of over-identifying restrictions to evaluate the joint validity of the instrument set and monitor the number of instruments relative to the number of banks to keep the Hansen test informative [26].

As robustness checks, we re-estimate the model using a bank fixed-effects estimator with cluster-robust standard errors and augment the specification with squared terms for ESG and CCPI to probe potential non-linearities in a simpler framework ([21], [24]).

Table 1. Data explanation

Variable	Explanation	Data source
NL	Net loans	Thomson Reuters
ESG	ESG score	Thomson Reuters
Size	Total assets	Thomson Reuters
EA	Equity to total assets	Thomson Reuters
LLPR	Loan loss provision to gross loans	Thomson Reuters
NIM	Net interest margin	Thomson Reuters
CCPI	Climate Change Performance Index	CCPI Team's annual report

4. Results and Discussions

4.1. Descriptive statistic results

Table 2 reports the descriptive statistics for the main variables used in the empirical analysis. Bank lending (NL) exhibits substantial cross-sectional dispersion, with a mean of 1.38e+11 and a standard deviation of 2.98e+11; the minimum and maximum range from about 26,000 to 3.27e+12. A similar pattern is observed for bank size (SIZE) of which the mean is 2.87e+11, the standard deviation is 6.41e+11, and values span from 3.61e+08 to 5.74e+12. This strong right-skewness in the distributions of lending and total assets justifies the use of logarithmic transformations in the regression models.

Table 2. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
NL	3806	1.38e+11	2.98e+11	26044.9	3.27e+12
ESG	3806	46.831	21.101	2.398	95.739
CCPI	3806	45.646	13.653	11.2	79.61
SIZE	3806	2.87e+11	6.41e+11	3.61e+08	5.74e+12
EA (%)	3806	0.096	0.036	-0.042	0.455
LLPR (%)	3806	0.008	0.262	-0.139	0.998
NIM (%)	3211	0.029	0.017	-0.115	0.217

The ESG variable has an average score of 46.83 (on a 0–100 scale), with a relatively large standard deviation of 21.10 and values ranging from 2.40 to 95.74. The lowest ESG score in the sample is observed for Chugin Financial Group Inc in 2022 (ESG ≈ 2.40), while the highest score corresponds to BNP Paribas SA in 2017 (ESG ≈ 95.74) . These extremes illustrate the large dispersion in ESG practices across banks, from institutions with almost no reported ESG engagement to those that are close to best-practice benchmarks. The climate policy indicator CCPI, which is measured at the country level, has a mean of 45.65 and a standard deviation of 13.65, with observed values between 11.20 and 79.61. The minimum CCPI value of 11.2 is recorded for Saudi Arabia in 2018, whereas the maximum value of 79.61 corresponds to Denmark in 2023. This wide cross-country range confirms that banks in the dataset operate under highly heterogeneous climate policy regimes, from relatively lax to very stringent, providing a suitable setting to study how national climate policy conditions interact with bank-level ESG performance.

The balance-sheet and income-statement ratios are reported in levels (fractions) rather than percentages. The equity-to-asset ratio (EA) has a mean of 0.096 with a standard deviation of 0.036 and ranges from -0.042 to 0.455. Negative EA values indicate episodes in which book equity becomes negative, implying that total liabilities exceed total assets. In our data, such situations arise for a small set of Greek banks- Eurobank Ergasias Services and Holdings SA, National Bank of Greece SA and Piraeus Financial Holdings SA - around 2011-2012, a period consistent with severe balance-sheet stress during the euro-area sovereign debt crisis. The loan-loss provision ratio (LLPR) averages 0.008 with a high standard deviation of 0.262 and values between –0.139 and 0.998, reflecting substantial differences in credit risk and provisioning practices across banks and over time; negative LLPR values capture years in which reversals of previous provisions or recoveries on non-performing loans dominate new provisioning.

The net interest margin (NIM) has a mean of 0.029 and a standard deviation of 0.017, with a minimum of -0.115 and a maximum of 0.217. Most banks enjoy a positive intermediation margin, but a number of bank-year observations display negative NIM, meaning that interest expenses exceed interest income in those years. These negative margins are concentrated in

Japanese banks, including Aozora Bank Ltd, Japan Post Bank Co Ltd, Mizuho Financial Group Inc and Seven Bank Ltd over the period 2010-2023, and are consistent with episodes of particularly compressed interest spreads in a prolonged low-rate environment.

Overall, the descriptive statistics reveal pronounced heterogeneity in bank size, lending activity, ESG performance and risk–return profiles, as well as considerable cross-country variation in the stringency of climate policy. This rich combination of bank-level and country-level variation underpins the subsequent dynamic panel analysis of how ESG and climate policy jointly shape bank lending behaviour.

The pairwise correlations between logNL and the main explanatory variables are broadly consistent with economic priors. LogNL is positively and significantly associated with ESGScore (0.5945) and LogSize (0.9732) indicating that larger banks and banks with stronger ESG profiles tend to exhibit higher loan volumes. The positive correlation between logNL and CCPI (0.3307) suggests that banks operating in countries with more stringent climate policies are, on average, also embedded in larger and more active credit markets.

The relationships among ESGScore, CCPI and LogSize are also noteworthy. ESGScore is positively correlated with both CCPI (0.2392) and LogSize (0.6095). This pattern is consistent with the view that banks located in countries with ambitious climate policies, and banks with greater resources, are more likely to invest in ESG-related practices and disclosure. These correlations underline the importance of controlling for bank size and the policy environment when identifying the marginal effect of ESG on lending.

Capitalisation, risk and profitability indicators exhibit the expected signs. The equity-to-asset ratio EA is negatively correlated with logNL (-0.5226) and LogSize (-0.4973), implying that larger and more loan- intensive banks tend to operate with thinner capital buffers. EA is also negatively related to ESGScore and CCPI, although with more moderate magnitudes, suggesting that higher ESG scores and stricter climate policies are not mechanically associated with higher leverage in the sample. The loan-loss provision ratio LLPR shows relatively low correlations with the other regressors ($|\rho| \leq 0.19$). The net interest margin NIM is negatively correlated with logNL (-0.3241) and LogSize (-0.3686), but positively and quite strongly correlated with EA (0.5200), consistent with better-capitalised banks enjoying higher margins, while large, loan-intensive institutions typically operate with thinner spreads.

From a multicollinearity perspective, the correlations among the explanatory variables remain below 0.7 in absolute value, with the highest value observed between ESGScore and LogSize ($\rho = 0.6095$). This suggests that severe multicollinearity is unlikely to be a major concern in the subsequent regression analysis.

Table 3. Correlation matrix

	logNL	**ESGScore**	**CCPI**	**LogSize**	**EA**	**LLPR**	**NIM**
logNL	1.0000	0.5945***	0.3307***	0.9732***	-0.5226***	-0.1000***	-0.3241***
ESGScore	0.5945***	1.0000	0.2392***	0.6095***	-0.2270***	0.0669***	0.0083
CCPI	0.3307***	0.2392***	1.0000	0.3461***	-0.1928***	0.1088***	-0.0051
LogSize	0.9732***	0.6095***	0.3461***	1.0000	-0.4973***	0.0192	-0.3686***
EA	-0.5226***	-0.2270***	-0.1928***	-0.4973***	1.0000	0.1910***	0.5200*
LLPR	-0.1000***	0.0669***	0.1088***	0.0192	0.1910***	1.0000	0.0088
NIM	-0.3241***	0.0083	-0.0051	-0.3686***	0.5200***	0.0088	1.0000

Note: t statistics in parentheses; ∗p < 0.1, ∗ ∗ p < 0.05, ∗ ∗ ∗p < 0.01

4.2. Main empirical results

The findings outlined in Table 4 indicate that the S-GMM model utilised in this research demonstrates a high level of reliability. In particular, the Hansen test results show a p-value of 0.072, which does not reject the null hypothesis (H0) regarding the validity and independence of the instruments from the error term. This validates the appropriateness of the instrument system employed, ensuring that there are no weak instruments or biased estimates. At the same time, the Arellano–Bond quadratic (AR(2)) test demonstrates the value p 0.974 without evidence about quadratic autocorrelation in the residuals. It is a necessary condition in order to ensure the consistency of estimation in dynamic panel models according to the GMM system method [22], [23]. These two tests strengthen the model's reliability, creating a strong basis for explaining the subsequent quantitative results.

Table 4. S-GMM model

	S-GMM with moderating factor CCPI
L.ESG	-0.00235***
CCPI	-0.00144**
L.LogSize	0.934***
L.EA	-0.466
L.LLPR	-2.291***
L.NIM	2.404
L.CCPI*ESG	0.000041**
cons	0.584***
AR(2)	0.974
Hansen	0.072

Note: t statistics in parentheses; ∗p < 0.1, ∗ ∗ p < 0.05, ∗ ∗ ∗p < 0.01

The estimation result indicates that the logarithm of net loans (logNL) is regressed on lagged ESG per- formance, climate-policy stringency (CCPI), their interaction, and standard bank-specific controls. Among the controls, lagged bank size (L.LogSize) and the loan-loss provision ratio (L.LLPR) are statistically sig- nificant and display the expected signs. Larger banks exhibit higher net lending, suggesting that scale and diversification advantages support credit expansion, consistent with cross-country evidence that bigger insti- tutions are better able to sustain loan growth and mitigate lending constraints over the cycle ([27], [28]). By contrast, higher loan-loss provisions are associated with a contraction in net loans, indicating that deterio- rating asset quality tightens capital and risk constraints and forces banks to curb lending, in line with recent studies linking provisioning behaviour to a more cautious supply of credit ([29]; [30]). Capitalisation and net interest margin are not robustly significant once risk and ESG–policy variables are included, suggesting that within-bank variation in these indicators is less important than balance-sheet risk and the ESG–climate interaction for explaining loan dynamics.

Turning to the main variables of interest, both ESG performance and climate-policy stringency have individually significant and economically meaningful effects on bank lending. In particular, the coefficient on lagged ESG (L.ESGScore) is approximately –0.00235 ($p < 0.01$), while the coefficient on CCPI is about –0.00144 ($p < 0.05$), contrasting with much of the existing bank-level literature on ESG and credit supply. Using a large global panel, Abdelsalam et al. [5] show that banks with higher ESG scores display less procyclical lending, thereby dampening credit booms and busts. Danisman and Tarazi [6] find that ESG- active banks in Europe curtail lending less during financial crises and maintain a more stable supply of credit. Focusing on MENA banks, AlHamrani et al. [7]) document a generally positive, but non-linear, association between ESG disclosure and bank credit growth, with ESG enhancing credit expansion at specific ranges of the ESG distribution.

Our negative average coefficients on ESG and CCPI therefore suggest that, in the multi-country setting considered here, stronger ESG engagement and tighter climate policy correlate with more cautious lending on average. This pattern is not inconsistent with recent work on climate policy and bank behaviour. Studies using the Climate Change Performance Index show that increases in climate-policy stringency can induce banks to contract domestic lending to transition-risk-intensive sectors and to rebalance their portfolios away from "brown" exposures (Benincasa et al. [31]; Covi et al. [32]). In relatively weak ESG or early-transition environments, strengthening ESG policies may initially manifest as stricter screening, higher internal capital charges for high-emitting borrowers, and the withdrawal from some legacy clients, which mechanically reduces net loan volumes before a sufficiently deep pipeline of green projects has emerged.

The key to reconciling our findings with the more optimistic ESG–lending literature lies in the interaction between ESG and CCPI. The interaction term L.CCPI*ESG is positive and statistically significant, with an estimated coefficient of about 0.000041 (p < 0.01), indicating that the effect of ESG on lending is conditional on the level of climate-policy stringency. Economically, this pattern suggests a regime change: in countries with weak climate policies, ESG-oriented banks tend to shrink or re-profile their loan books, consistent with a "de-risking" phase; as climate policy becomes more stringent, ESG capabilities gradually turn into a competitive advantage that enables banks to originate new green and transition-aligned loans, so that ESG evolves from a constraint on lending into a mild driver of sustainable credit growth.

This moderating role of climate-policy stringency is broadly consistent with recent bank-level studies. Abdelsalam et al. [5]) show that banks with higher ESG scores smooth lending over the cycle, indicating that once macro-financial and regulatory conditions support sustainability, ESG can help sustain credit rather than suppress it. Danisman and Tarazi [6] find that banks with stronger ESG activity maintain lending during crises by reducing both credit and funding risk, which is in line with our finding that, in more ambitious climate-policy regimes, ESG no longer compresses loan volumes. For MENA banks, AlHamrani et al. [7] report non-linear relationships between ESG disclosure and bank credit growth, in which ESG enhances credit expansion only within certain ESG ranges; this is similar in spirit to our result that the ESG–lending relationship changes sign along the CCPI dimension. Our estimates therefore extend this literature by highlighting the institutional environment-captured by CCPI-as a critical moderating factor: the positive ESG–credit nexus documented in earlier studies is more likely to emerge precisely in countries where climate-policy frameworks already generate strong demand and regulatory support for green lending. To make the moderating effect of CCPI more transparent within the overall empirical strategy, we com- plement the system-GMM results with a fixed-effects robustness specification that includes the same ESG, CCPI and interaction terms.

Table 5 reports the robustness checks based on a bank fixed-effects model with CCPI as moderating factor and additional quadratic terms in ESG and CCPI. The signs and significance of the standard bank-specific controls are very close to those obtained from the system-GMM specification. In particular, lagged banksize (L.LogSize) remains strongly positive, confirming that larger banks systematically hold higher levels of net lending, while the lagged loan-loss provision ratio (L.LLPR) is again negative and highly significant, indicating that a deterioration in asset quality is associated with a contraction in lending. Net interest margin (L.NIM) becomes positive and statistically significant in this specification, suggesting that more profitable banks tend to expand credit more aggressively, whereas the capital ratio (L.EA) is still not significant.

Table 5. Fixed effect model

	FEM with moderating factor CCPI
L.ESG	-0.00227
CCPI	-0.00030
L.LogSize	0.98777***
L.EA	-0.18579
L.LLPR	-0.44692***
L.NIM	4.787*
L.CCPI*ESG	0.000012*
CCPI²	6.26e-07
ESG²	0.0000174
_cons	-0.135
AR(2)	0.974
Hansen	0.072

Note: t statistics in parentheses; ∗p < 0.1, ∗∗p < 0.05, ∗∗∗p < 0.01

With respect to ESG and climate policy, the fixed-effects model largely confirms the pattern uncovered by the GMM estimates. The coefficient on lagged ESG remains negative (*L.ESG* ≈ -0.00227), while the interaction term between ESG and CCPI (*L.CCPI∗ESG* ≈ 0.000012, significant at the 10% level) is again positive. As in the system-GMM model, this implies that ESG has a negative impact on lending in low-CCPI countries, the effect becomes progressively less negative as climate policy tightens. The fixed- effects estimates and the associated marginal-effects plot therefore corroborate the GMM evidence that the ESG–lending nexus is not purely linear but is crucially conditioned by the policy environment: stronger climate policy systematically attenuates, and in high-CCPI regimes may almost neutralise, the adverse baseline effect of ESG on bank lending.

Moreover, the quadratic terms *ESG²* and *CCPI²* are both statistically insignificant, implying that we do not detect a simple U-shaped or inverted-U relationship between ESG (or CCPI) and lending when these variables are considered in isolation.

5. Conclusion

This paper provides new cross-country evidence on the link between banks' ESG performance and credit growth, while explicitly incorporating the moderating role of national climate-policy effectiveness, as prox- ied by the Climate Change Performance Index (CCPI). Using a dynamic System-GMM framework on an unbalanced panel of listed commercial banks over 2010–2023, the results show that the impact of ESG on credit growth is not uniform but conditional on the climate-policy environment. In countries with weak or moderate climate-policy performance, stronger ESG is associated with a more cautious expansion of lending. By

contrast, in jurisdictions with more ambitious and effective climate policies, the adverse baseline effect of ESG on lending is progressively attenuated. This pattern underscores that ESG alone is not a sufficient driver of green credit; its effectiveness critically depends on the surrounding policy framework.

From an academic perspective, the paper contributes in two main ways. First, it extends the emerging literature on the ESG–credit nexus by moving beyond single-country or crisis-focused settings and by show- ing that bank-level ESG effects are systematically conditioned by macro-climate institutions. Second, the multi-layer empirical design-combining micro-level ESG and financial indicators with macro-level CCPI in a dynamic panel-offers a more nuanced view of when and where ESG "matters" most for lending behaviour. In doing so, the study complements prior work that has emphasised lending cyclicality or portfolio shifts, by documenting how ESG and climate policy jointly shape the trajectory of bank credit growth.

The findings also carry several policy implications. For policymakers and regulators, the results suggest that promoting ESG in the banking sector is unlikely to yield its full potential if pursued in isolation from credible and stringent climate policies. Efforts to encourage banks to integrate ESG into credit assessment and risk management should therefore be aligned with broader climate-policy packages that create clear and stable incentives for low-carbon investment. For banks, the evidence implies that ESG capabilities can evolve from a short-run constraint on lending to a strategic advantage in high-CCPI environments, where regulatory signals and market demand for green finance are sufficiently strong.

Like any empirical study, this paper has limitations that open avenues for future research. The sample focuses on listed commercial banks and does not fully capture smaller or unlisted institutions, nor does it explicitly distinguish between short-run and long-run effects of ESG on credit. Future work could compare the ESG–credit–policy nexus across income groups or levels of financial development, explore heterogeneity by loan type or sectoral exposure, and examine regime shifts around major climate-policy milestones such as the Paris Agreement or COP26. Incorporating alternative measures of climate policy and more granular ESG dimensions would also help to deepen our understanding of how sustainability and regulation jointly reshape bank lending.

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References

[1] UNEP FI, Principles for Responsible Banking – Progress Report 2022, UNEP FI, Geneva, 2022. https://www.unepfi.org/banking/bankingprinciples.

[2] S. Galletta, S. Mazzù, ESG Controversies and Bank Risk Taking, Bus. Strat. Environ. 32 (2022), 274-288. https://doi.org/10.1002/bse.3129.

[3] E. Nizam, A. Ng, G. Dewandaru, R. Nagayev, M.A. Nkoba, The Impact of Social and Environmental Sustainability on Financial Performance: A Global Analysis of the Banking Sector, J. Multinatl. Financ. Manag. 49 (2019), 35-53. https://doi.org/10.1016/j.mulfin.2019.01.002.

[4] S. Galletta, S. Mazzù, V. Naciti, A Bibliometric Analysis of ESG Performance in the Banking Industry: From the Current Status to Future Directions, Res. Int. Bus. Financ. 62 (2022), 101684. https://doi.org/10.1016/j.ribaf.2022.101684.

[5] O. Abdelsalam, W. Azmi, M. Disli, V. Kowsalya, Bank Lending Cyclicality and ESG Activities: Global Evidence, Financ. Res. Lett. 58 (2023), 104541. https://doi.org/10.1016/j.frl.2023.104541.

[6] G.O. Danisman, A. Tarazi, ESG Activity and Bank Lending during Financial Crises, J. Financ. Stab. 70 (2024), 101206. https://doi.org/10.1016/j.jfs.2023.101206.

[7] A.R. AlHamrani, A. Awad, M. Albaity, Unveiling the Impact of ESG Disclosure on Bank Credit Growth, Econ. Res. Istraživanja 38 (2025), 269-309. https://doi.org/10.32728/er-ei.38.1.10.

[8] S. Li, X. Wu, How Does Climate Risk Affect Bank Loan Supply? Empirical Evidence from China, Econ. Chang. Restruct. 56 (2023), 2169-2204. https://doi.org/10.1007/s10644-023-09505-9.

[9] Z. Pan, S. Li, J. Li, C. Gong, Air Pollution and Bank Risk Taking: Evidence from China, Financ. Res. Lett. 65 (2024), 105594. https://doi.org/10.1016/j.frl.2024.105594.

[10] S. Bressan, Environmental, Social, and Governance Scores and Loan Composition Inside United States Banks, Sustainability 16 (2024), 8075. https://doi.org/10.3390/su16188075.

[11] X.Y. Zhou, B. Caldecott, A.G.F. Hoepner, Y. Wang, Bank Green Lending and Credit Risk: An Empirical Analysis of China's Green Credit Policy, Bus. Strat. Environ. 31 (2022), 1623-1640. https://doi.org/10.1002/bse.2973.

[12] Germanwatch, NewClimate Institute, Climate Change Performance Index (CCPI) 2022, Germanwatch, Berlin, 2022. https://newclimate.org/resources/publications/climate-change-performance-index-2022.

[13] M. Spence, Job Market Signaling, Q. J. Econ. 87 (1973), 355-374. https://doi.org/10.2307/1882010.

[14] R.E. Freeman, Strategic Management, Cambridge University Press, 2010. https://doi.org/10.1017/CBO9781139192675.

[15] C. Wang, The Relationship Between ESG Performance and Corporate Performance - Based on Stakeholder Theory, SHS Web Conf. 190 (2024), 03022. https://doi.org/10.1051/shsconf/202419003022.

[16] J. Dowling, J. Pfeffer, Organizational Legitimacy: Social Values and Organizational Behavior, Pac. Sociol. Rev. 18 (1975), 122-136. https://doi.org/10.2307/1388226.

[17] M.C. Jensen, W.H. Meckling, Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure, J. Financ. Econ. 3 (1976), 305-360. https://doi.org/10.1016/0304-405X(76)90026-X.

[18] K. Herbohn, R. Gao, P. Clarkson, Evidence on Whether Banks Consider Carbon Risk in Their Lending Decisions, J. Bus. Ethics 158 (2019), 155-175. https://doi.org/10.1007/s10551-017-3711-3.

[19] M. Wu, C. Shen, Corporate Social Responsibility in the Banking Industry: Motives and Financial Performance, J. Bank. Financ. 37 (2013), 3529-3547. https://doi.org/10.1016/j.jbankfin.2013.04.023.

[20] T. Brambor, W.R. Clark, M. Golder, Understanding Interaction Models: Improving Empirical Analyses, Polit. Anal. 14 (2006), 63-82. https://doi.org/10.1093/pan/mpi014.

[21] P.P. Athanasoglou, S.N. Brissimis, M.D. Delis, Bank-Specific, Industry-Specific and Macroeconomic Determinants of Bank Profitability, J. Int. Financ. Mark. Inst. Money 18 (2008), 121-136. https://doi.org/10.1016/j.intfin.2006.07.001.

[22] M. Arellano, S. Bond, Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations, Rev. Econ. Stud. 58 (1991), 277-297. https://doi.org/10.2307/2297968.

[23] M. Arellano, O. Bover, Another Look at the Instrumental Variable Estimation of Error-Components Models, J. Econ. 68 (1995), 29-51. https://doi.org/10.1016/0304-4076(94)01642-D.

[24] R. Blundell, S. Bond, Initial Conditions and Moment Restrictions in Dynamic Panel Data Models, J. Econ. 87 (1998), 115-143. https://doi.org/10.1016/S0304-4076(98)00009-8.

[25] F. Windmeijer, A Finite Sample Correction for the Variance of Linear Efficient Two-Step GMM Estimators, J. Econ. 126 (2005), 25-51. https://doi.org/10.1016/j.jeconom.2004.02.005.

[26] D. Roodman, How to Do Xtabond2: An Introduction to Difference and System GMM in Stata, Stata J.: Promot. Commun. Stat. Stata 9 (2009), 86-136. https://doi.org/10.1177/1536867X0900900106.

[27] P. Bhowmik, Macroeconomic and bank-specific determinants of loan growth in commercial banks: A fixed effect model analysis. Journal of Management Accounting, Governance and Performance, 1(1), (2024), 92–112. https://doi.org/10. 63817/JMAGP.06.2024.007

[28] J. M. Berrospide, R. M. Edge, The Effects of Bank Capital On Lending: What Do We Know, and What Does It Mean? FEDS Working Paper No. 2010-44, (2010). https://doi.org/10.2139/ssrn.1895532.

[29] H.T. Hessou, R. Lensink, I. Soumaré, H. Tchakoute Tchuigoua, Provisioning Over the Business Cycle: Some Insights from the Microfinance Industry, Int. Rev. Financ. Anal. 77 (2021), 101825. https://doi.org/10.1016/j.irfa.2021.101825.

[30] R. Arhinful, L. Mensah, B.A. Gyamfi, H.A. Obeng, The Impact of Non-Performing Loans on Bank Growth: The Moderating Roles of Bank Size and Capital Adequacy Ratio—Evidence from U.S. Banks, Int. J. Financ. Stud. 13 (2025), 165. https://doi.org/10.3390/ijfs13030165.

[31] E. Benincasa, G. Kabas, S. Ongena, "There is No Planet B", but for Banks "There are Countries B to Z": Domestic Climate Policy and Cross-Border Bank Lending, Swiss Finance Institute Research Paper No. 22-28 (2022). https://doi.org/10.2139/ssrn.4075737.

[32] G. Covi, M. Froemel, D. Reinhardt, N. Wegner, Climate Policy and Banks' Portfolio Allocation, Bank of England, (2025). https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2025/climate-policy-and-banks-portfolio-allocation.pdf.