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## **The impact of climate change management on banks profitability**

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# **The impact of climate change management on banks profitability**

## **Abstract**

This study empirically examines the influence of climate change management on banks' profitability using panel data of a sample of 137 banks from 36 emerging and developed countries during the period 2011–2019, using the Generalized Method of Moments. Our empirical evidence shows that, although banks seem to be aware of the consequences of climate change on their business, to the point of making it a strategic topic worthy of the board of directors, they remain very timid in terms of operational implementation. It leads to a positive impact on profitability limited to the overall quality of climate change management and disclosure and an ex-post justification of the topic's relevance to the board. The foreseeable introduction of new banking regulations and the current weak relationship between climate change managerial practices and financial performance should encourage banks to pay greater attention to these practices to preserve their future returns.

**Keywords:** Climate Change Management, Bank, Corporate Social Responsibility, Profitability, Carbon Disclosure Project

## **1. Introduction**

The recent Intergovernmental Panel on Climate Change (IPCC) report (2021) illustrates the growing scientific evidence that global warming may have catastrophic effects on the earth and, consequently, human activities. As the main economic players, corporations will increasingly be held accountable for their involvement in sustainability and the fight against global warming (Shrivastava & Hart, 1995). Banks, the main providers of financing for the economy, are impacted by climate change and are crucial for implementing sound practices and behaviors to combat climate change. Banking operations, particularly lending operations, affect and are affected by the environment, and a change in the criteria for making financial, lending, or investment decisions is required, for example, to include non-financial variables and long-term environmental impact. The banking regulation may also evolve in the near future, and the European Banking Authority (EBA), on behalf of the European Commission, is currently working on environmental, social, and governance disclosure rules. Banks' capital requirements concerning green (and brown) assets may also consequently change (Berenger et al., 2020). The issue arising from these debates is the ability of banks to become greener and more akin to sustainable development, without deteriorating their profitability. As in any business, profitability in banks depends on extra operating costs or additional risk (impairments) and equity capital. Specifically, risk exposure in terms of climate change impacts must be assessed in the context of the Risk Appetite Framework (RAF) and capital adequacy issues.

From a theoretical perspective, environmental performance is simultaneously considered detrimental. Environmental regulations lead to additional costs for firms (Palmer et al. 1995); however, favorable, properly designed environmental standards can trigger innovations that lower costs (Porter & van der Linde, 1995) for firms' profitability. Several empirical studies have analyzed banks' profitability determinants across various countries and regions. The vast literature in the field has examined a broad set of bank-specific (such as operational efficiency, leverage, risk, size), industry-specific (such as industry concentration), and macroeconomic (e.g., inflation, interest rates, economic growth) determinants of banks' profitability. However, as far as we know, while several studies have investigated the influence of environmental performance and, to a lesser extent, of green practices in various sectors, very few exist in the context of the banking industry (e.g., Bose et al., 2021; Jo et al., 2015). The current study tries to address this gap by investigating the influence of environmental management on bank profitability. This research aims to analyze the impact of climate-change-related managerial practices and managerial quality on banks' financial performance, based on the panel data of a sample of 137 international banks from 36 countries (both advanced and emerging) from 2011 to 2019.

We test and assess this impact using a specific dataset of Carbon Disclosure Project (CDP) data regarding banks' climate change managerial practices and quality (e.g., CDP Score, climate change governance, management, and strategy variables) from a broad perspective. In addition to the usual determinants of banks' profitability, we consider two new control variables regarding climate risk per country and investor protection per country, as their location should also impact banks' behavior. Most studies employ Return on Assets (ROA) and Return on Equity (ROE) to assess banks'

profitability. Along with these two traditional measures, we consider return on capital (ROC) and return on risk-weighted assets (RRWA) to account for the specificity of the banking industry. RWA is currently considered the most efficient way to evaluate residual risk exposure and serves as a practical proxy to estimate capital adequacy. To the best of our knowledge, no previous empirical study has considered these variables. The empirical investigation uses a Generalized Method of Moments model to avoid profit persistence and endogeneity problems.

The results of this paper show that although banks seem to be aware of the consequences of climate change on their business, making it a strategic topic with board-level considerations, they remain very timid in terms of operational implementation. It leads to a positive impact on profitability limited to the overall quality of climate change management and disclosure and an ex-post justification of the topic's relevance to the board of directors. The marginal existence of a risk management process specific to climate change among banks suggests that beyond the strategic issue, climate change management is still in its infancy in the banking industry in terms of its concrete and sound implementation.

The remainder of the paper is organized as follows. Section 2 reviews the main theoretical ideas and previous empirical research. Section 3 describes the sample, data, and empirical method. Section 4 contains the empirical results and provides discussions, and section 5 concludes the paper.

## **2. Theoretical background literature review**

From a theoretical perspective, various approaches regarding the impact of environmental performance on financial performance have been proposed. Furthermore, from a traditional benefit-cost analysis, it is argued that environmental regulations lead to additional costs for firms and a decreased financial performance (Palmer et al., 1995). Additionally, Porter and van der Linde (1995) indicate that properly designed environmental standards can trigger innovations that lower the total cost of a product or improve its value. Such innovations allow companies to use a range of inputs more productively—from raw materials to energy to labor—thus offsetting the costs of improving environmental impact and ending the stalemate. Additionally, Shrivastava and Hart (1995) mention that the aim of the sustainable corporation is the creation of financially and competitively viable businesses that conserve non-renewable resources, protect the health of workers and the public, and minimize technological risks faced by the communities.”

The business case argument has more recently backed this positioning, assuming the positive impact of environmental performance on financial performance. It argues that good behavior can lead to reduced business risks, efficiency gains, social branding, and new market creation (Hockerts, 2015). In addition, the natural-resource-based view (NRBV; Hart, 1995) and the instrumental stakeholder theory also support the positive assumption (Endrikat et al., 2014). The NRBV perspective helps understand the link between environmental and financial performance by emphasizing the contingent nature of resources and capabilities and their subsequent consequences on competitive advantage (Hart & Dowell, 2011). Businesses that can deal with the constraints of the physical environment by facilitating environmentally sustainable practices will gain a competitive advantage and become profitable (Boakye et al. 2020). Following the instrumental stakeholder theory (e.g., Donaldson & Preston, 1995), natural environment

preservation is a major expectation of the stakeholders. Improvement in this area may lead to superior financial performance due to reputation or adaptation of consumer demand enhancement.

A third perspective, which poses a neutral relationship between corporate social responsibility (CSR) and financial performance based on benefit-cost analysis has emerged (McWilliams & Siegel, 2001). It argues that reduced investment in CSR will incur lower costs, but that increased investment in CSR will increase revenues.

Banks, as corporations, are concerned with the relationship between environmental performance and financial performance, but, as key financial intermediaries, they exhibit some specificities that can influence this relationship. Gangi et al. (2019) argue that, in the case of banks, the relationship between environmental engagement and financial performance requests an analysis from at least three perspectives:

The financial benefits of financing environmentally friendly borrowers;

The efficient use of resources within the bank as an organization;

The lowering of reputational risk. The first two are based on NRBV, whereas the latter relies mainly on stakeholder theory.

The lending activity is specific to the banking sector and deserves further attention. Offering loans to eco-friendly companies can result in lower risk-taking and more innovative projects (Batae et al., 2021; Gangi et al., 2019). Conversely, refusing credit to dirty industries may reduce risk-taking and promote bank reputation. However, assessing borrowers' environmental performance and risk can generate additional costs and harm bank profitability. Banks may also supply green financial products and services, such as



green funds, to enhance their competitiveness, reputation, customer loyalty, and ultimately profitability (Batae et al., 2021).

Environmental performance and practices may impact bank profitability positively or negatively, but other factors also determine their performance. Thus, an empirical review of the traditional determinants of bank profitability is presented before addressing empirical evidence regarding the core topic of this paper, namely, the specific influence of environmental performance on financial performance.

## **2.1. The determinants of bank profitability**

Since the seminal works of Short (1979), Bourke (1989), and Molyneux and Thornton (1992), bank performance has been extensively studied, and numerous empirical studies have analyzed banks' traditional profitability determinants. Some empirical studies on bank profitability are country-specific (e.g., Athanasoglou et al., 2008; Dietrich & Wanzereid, 2011; Trujillo-Ponce, 2013). Conversely, others have focused on a panel of countries (e.g., Bourke 1989; Dietrich & Wanzereid, 2014; Elekdag et al., 2020; Molyneux & Thornton, 1992; Petria et al., 2015; Saona, 2016; Short, 1979; Teixeira et al., 2020). Not surprisingly, empirical results vary significantly given the differences in datasets, periods, environments, and countries.

Usually, bank profitability is measured by Return on Assets (ROA or return on average assets ROAA), Return on Equity (ROE or return on average equity ROAE), and Net Interest Margin (NIM) and is expressed as a function of various determinants. The popular GMM methodology is very often chosen to perform tests in recent works (e.g., Athanasoglou et al., 2008; Dietrich & Wanzereid, 2011, 2014; Saona, 2016; Teixeira

et al., 2020; Trujillo-Ponce, 2013)

This vast literature has studied a broad set of bank-specific (e.g., operational efficiency, solvency, asset quality, size, business structure), industry-specific (e.g., industry concentration), and macroeconomic (e.g., inflation, interest rates, economic growth) determinants of banks' profitability. According to the studies, the bank-specific determinants are generally similar across most empirical studies, while the industry-specific and macroeconomic variables are diverse. Table 1 summarizes the main variables used in empirical studies and their most significant impacts on bank profitability.

**INSERT TABLE 1 ABOUT HERE**

## **2.2. The influence of environmental performance on financial performance**

This topic has been empirically investigated widely, and some meta-analyses have tried to summarize the results. In 2010, Horvathova has carried out an analysis of 37 previous studies and stated, "after more than three decades of theoretical as well as empirical research, the results seem to remain inconclusive." However, the majority of the relationships were positive. In addition, Albertini (2013), Dixon-Fowler et al. (2013), and Endrikat et al. (2014) observe a positive, at least partial or weak, relationship between environmental performance and financial performance. Based on an investigation of 142 studies, Hang et al. (2019) show that increasing environmental performance has no short-term effect on corporate financial performance. In contrast, a firm significantly benefits in the long term, per the Porter hypothesis. In a more focused investigation based on 32 empirical studies, Busch and Lewandowski (2018) observe

that carbon emissions vary inversely with financial performance, indicating that good carbon performance is generally positively related to superior financial performance.

Although a positive influence of environmental performance on financial performance seems to arise, all these studies also mention that their results are hugely impacted by methodological choice, environmental and financial performance measures, time horizon, firm size, national and industry contexts. For instance, Noordewier and Lucas (2020) show that industry matters and find that firms within high growth/high concentration industries that implement environmental management practices realize the greatest improvement in financial performance.

These results suggest going beyond the overall influence of environmental performance on financial performance to assess the impact of corporate environmental practices on financial performance. Miroshnychenko et al. (2017) show that in 58 countries over 13 years, internal green practices (pollution prevention and green supply chain management) are the major environmental drivers of financial performance. In contrast, external green practices (green product development) play a secondary role in determining financial performance. The adoption of ISO 14001 appears to negatively impacts financial performance. Tang et al. (2018), in China, find that green process innovation (improvement of existing production processes and use of environmentally friendly technologies to produce goods and provide services that impose no or reduced negative impact on the environment) and green product innovation (new products or services that inflict no negative impact on the environment or less than the current or competing product) both significantly (positively) predict firm performance. This is when not considering managerial concern for the environment. Once managerial

concern is included, only the positive effect of green process innovation on firm performance is “surviving,” underlining the necessary involvement of top managers. Boakye et al. (2020) observe a significant and nonlinear (concave) relationship between sustainable environmental practices and firms' financial performance among small and medium-sized enterprises (SMEs) in the UK. Specifically, energy efficiency practices, greenhouse gases, material, and resource efficiency revealed an inverted U-shaped relationship with financial performance.

However, to the best of our knowledge, very few empirical studies have studied the impact of environmental performance on financial performance in the banking industry. Bose et al. (2021) identify a positive impact of green banking on Bangladeshi banks' financial performance. They also find that this result is mostly achieved through green banking's cost efficiency. Jo et al. (2015) observe that lowering environmental costs increases financial performance in the long term in the financial service industry. Their results also indicate that this effect is more pronounced in well-developed financial markets than in less-developed ones. In Europe, Batae et al. (2021) report a positive relationship between emission and waste reduction and bank profitability. In China, Yin et al. (2021) find that, unlike the state-owned banks, the green credit ratio of other domestic banks can increase their profitability and reduce their credit default risk. From a broader perspective, Wu and Shen (2013) use an international sample to show that banks' CSR positively affects their profitability. Additionally, Caby et al. (2020) show that country- and bank-level characteristics (including banks' ROA) are much better predictors of bank's commitment to carbon voluntary disclosure initiatives and environmental scores, compared to carbon disclosure quality.

### **3. Data and Methodology**

From a methodological point of view, the treatment of relationships between climate change management, green performance, and profitability in the banking sector is done using different data sources to consider the diversity and nature of the required information. Climate change management indicators are mainly qualitative information available through a specific and new database—the CDP project in our study. Green performance is usually approached by scoring methods to rank countries or firms in an ordinal, and as neutral as possible, manner. Financial and quantitative information on profitability is given by a sectorial and specific database, The Banker. As explained below, our international sample and the dependent and independent variables are built using different information extracted from data sources.

#### **3.1. Sample**

The starting point of the data collection is a dedicated source, the CDP project (formerly known as the Carbon Disclosure Project)<sup>1</sup>. The CDP, a not-for-profit organization supported by major institutional investors, runs the global disclosure system for investors, companies, cities, states, and regions to manage their environmental impact. CDP notably focuses on sending annual questionnaires to companies to collect information on GreenHouse Gas GHG emissions and related issues such as emission-reduction activities and efforts to fight climate change. We have gathered the complete CDP surveys on banks from across the world during 2010–2019. We faced a major issue concerning the evolution of the survey content over time, which grew from a few pages in 2010 to close to 200 in 2019. To gather homogeneous data for the entire period, we abandoned 2010 (a major evolution occurred in 2011), and collected data from 2011 to 2019, based on the 2011 survey version.

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<sup>1</sup> Refer to <https://www.cdp.net/en> for details.

Subsequently, we gathered additional data on banks for which we were able to get reliable CDP data. We used various sources. Data regarding banks' consolidated balance sheets and income statements were collected from The Banker database, a service from the Financial Times that provides standardized financial data and well-known rankings on the leading banks in many countries<sup>2</sup>. Germanwatch, an independent NGO promoting North–South equity and the preservation of livelihoods<sup>3</sup>, annually publishes an index per country, analyzing the extent to which countries and regions have been affected by weather-related loss events (such as storms, floods, and heat waves), known as the Climate Risk Index (CRI). As a global metric for ranking 180 countries on the level of exposure and vulnerability to extreme events, the CRI is based on the worldwide data collection and analysis provided by MunichRe, the world's leading reinsurance company. The following indicators are analyzed for weather-related events: number of deaths, number of deaths per 100,000 inhabitants, the sum of losses in US\$ in purchasing power parity (PPP), as well as losses per unit of gross domestic product (GDP). This metric gauges countries' climate change consequences exposure (the lower the score, the higher the exposure). Information about country-level economic data was collected from the World Economic Outlook Database of the International Monetary Fund and the Doing Business and the DataBank from the World Bank (see Table 3 for details).

Given the primacy of climate change management variables in our purpose, we focused on matching CDP surveys with financial data from The Banker. We obtained unbalanced panel data ranging from 82 in 2011 to 137 international banks from 36

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<sup>2</sup> See <https://www.thebankerdatabase.com/> for details.

<sup>3</sup> Refer to <https://germanwatch.org/en/19777> for details.

countries in 2019, following the growing interest of companies for the CDP global disclosure system during the last decade<sup>4</sup>. Finally, we completed with macroeconomic and institutional variables from the IMF and the World Bank. Table 2 depicts the distribution of data by region, type of economy, country, several banks available in 2019, and CRI score and ranking over the last decade. At the exclusion of the sub-Saharan Africa region, which has no occurrence in the CDP database, all major geographical areas of the world are considered in our panel, as well as the most important economies among the advanced (23) and emerging (13) countries in terms of weight as well of growth. The first few places in the CRI 1999–2018 ranking are occupied by small countries (e.g., Puerto Rico, Myanmar, Haiti, or Dominica), which are absent (CDP data) or poorly (The Banker) represented in databases. It appears that all geographical zones of our sample and both advanced and emerging economies have been significantly affected over the last decade by impacts of weather-related loss events, with maximum heterogeneity in Europe and minimum in the Middle East and North Africa.

**INSERT TABLE 2 ABOUT HERE**

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<sup>4</sup> To illustrate, the CDP Data count a total number of 1555 companies in 2011, 1896 firms in 2015 and 2013 in 2019. Consequently, the number of banks with entered climate change management variables is growing over the period. After matching with The Banker database, we obtain a panel of 82 banks in 2011, 86 in 2012, 96 in 2013, 98 in 2014, 109 in 2015, 112 in 2016, 116 in 2017, 118 in 2018 and 137 in 2019

## **3.2. Variables**

### **3.2.1. Dependent variables**

To address our research question and the relevant literature, we selected different proxies to measure banks' profitability. First, two common accounting measures, return on assets (ROA)—computed as a ratio of the net profit to the total assets—and return on equity (ROE)—computed as a ratio of the net profit to equity. The ROA is considered a measure of management efficiency, whereas ROE indicates the return to shareholders and is impacted by the leverage (Athanasoglou et al., 2008; Petria et al., 2016). Second, we added two measures specific to the banking industry: return on capital (ROC) computed as a ratio of the net profit to Tier 1 capital (the core capital, more accurate than the accounting concept of equity in the banking industry), resulting in an enhanced proxy of the traditional ROE for banks, and return on risk-weighted assets (RRWA) computed as the ratio of net profit to risk-weighted assets. A specific computation is made for each category of risk (credit, market, and operational) according to a common concept of RWA. Since the valuation methodology is different for each risk category, RRWA is a new ratio for banks that allows for simultaneous linking of profit and risk. This results in an enhanced proxy of the traditional ROA for banks. Another rationale for choosing this ratio is to consider the impact of climate change management on the risk exposure of banks and their profits, particularly their credit risk. Indeed, RWA on default risk exposure depends on the probability of default of each borrower and the corresponding internal rating estimated by the banks themselves or rating agencies. Considering the European Union's definition of climate change risks, one important dimension is the transition risk based involved in moving to a lower climatic impact and a low-carbon economy by making relevant changes in investment projects. The



consequential additional costs or higher investments pose financial risks for companies, which could increase the likelihood of short-term default.

### **3.2.2. Independent variables**

Following the previous empirical literature on the determinants of banks' profitability, we first distinguished two traditional categories of independent variables: one category relates to the financial characteristics of banks at the firm level and the other to the banks' national macroeconomic environment. They are control variables and do not address the purpose of our research directly. So, we added a third one, which specific to our research question and draws on bank-specific climate change management variables.

#### **3.2.2.1. Climate change management bank-specific variables**

As mentioned earlier, we have gathered data from the CDP annual surveys and selected questions that directly reflect climate change management by banks.

The CDP derives a score from the companies' responses. Scoring provides a roadmap for companies to achieve best practices; the score provides a snapshot of how they compare with other companies. The CDP collects detailed surveys on climate change management in business activities to rank companies across four consecutive levels representing the steps a company moves through toward environmental stewardship (disclosure, awareness, management, and leadership). The final grade of the letter that defines the so-called "CDP score" is awarded based on the score obtained in the highest

achieved level for each question using a “numerator” and “denominator” method for point allocation in the first two levels (disclosure and awareness). The number of points awarded to a company is divided by the maximum number that could have been awarded. The methodology differs for the highest levels (management and leadership), as the number of points achieved per scoring category is used to calculate the final score using scoring category weighting. Based on the CDP assessment, companies were ranked from A+ to D- and coded from 8 to 0 accordingly (from best to worst quality). CDP data have been extensively used in the previous empirical literature as a proxy for carbon disclosure quality and have become an international standard (e.g., Cotter & Najah, 2012; Luo et al., 2012, 2013; Stanny, 2013; Ben-Amar & McIlkenny, 2015; Liao et al., 2015; Grauel & Gotthardt, 2016; Ott et al., 2017; Ben-Amar et al., 2017; Ben-Amar & Chelli, 2018; Li et al., 2018; Hsueh, 2019). However, CDP scores are also a synthetic assessment of the quality of climate change management by companies themselves.

As Tang et al. (2018) highlight managerial concern can mitigate the influence of environmental practices on financial performance. To address specific climate change management practices, we selected five qualitative variables (coded as dummy variables, yes=1 and no =0) available from the 2011–2019 questionnaires. As we observe panel data over a period of nine years, these variables are dedicated to identifying quantitative and temporal trends and specific behaviors of banks in a context where the tragedy of the horizon and the need for climate-change action have been put on the forefront. The first variable, a governance one, identifies banks in which climate-related issues are a direct and explicit subject considered at the highest levels of management as a board-level interest. In touch with risk management, the second

variable, specific climate risk management, identifies banks' dedicated strategy to manage climate-change risk. It is equal to 1 for banks with a specific climate change risk identification, assessment, and management process and 0 for banks with no specific approach and an integration of climate change risk into multi-disciplinary company-wide risk processes. The third variable deals with the business strategy of surveyed banks; it identifies whether firms with climate-related issues have integrated it into their business strategy. Regarding targets and green performances of firms, the fourth variable is equal to 1 if banks have had a greenhouse gas emission target active during the reporting year and 0 otherwise. Finally, our last measure permits us to highlight the specific behaviors in terms of recognition. The incentive for the target variable is equal to 1 if the bank provides special incentives (financial or non-financial as recognition) for employees following the attainment of targets related to climate change issues. To sum up, these variables are supposed to improve banks' environmental performance and ultimately their profitability, per theories (business case, NRBV, and stakeholder theories) that posit a positive influence of environmental performance on financial performance.

#### **3.2.2.2. Financial bank-specific variables**

Our study considers traditional bank-specific variables such as size, cost to income, capital to assets, and non-performing loan rate. In Table 3, we selected these variables, which are the main drivers of bank profitability relative to our research question. Given our focus on the impact of climate change management, we identify indicators that are potentially the most affected by these new practices. Size is a good indicator when banks are now being asked to add more "green" to the balance sheet or to replace "brown" with "green" investments. The bigger they are, the higher the stakeholder

pressure should be to implement climate change management. As a result, stability or growth in the size of banks' balance sheets could be expected in the future due to this transition. Consistent with the literature review, the impact of size, as measured by the natural logarithm of total assets, remains uncertain in this context (e.g., Beltratti & Stulz, 2012; Petria et al., 2016; Teixeira et al., 2020).

In terms of operational efficiency and cost to income ratio, involvement in green policies can be considered to have a positive (Porter & van der Linde, 1995), negative (Palmer et al., 1995), or neutral (McWilliams & Siegel, 2001) impact on the cost structure of both banks and their customers. Due to the additional and indirect costs of controlling the low carbon emission of their investment projects, companies are increasingly submitting riskier loan applications to banks. Additionally, banks have to determine the "green rating" of investment projects and companies. For the banks themselves, their participation in broad CSR plans regarding carbon emissions, investment in high-quality buildings, or energy-saving programs generally increases costs. Looking at the revenue side of the cost-to-revenue ratio raises the question of whether the total revenue increases in the same proportion or even more than the total cost and, therefore, whether banks can re-bill those costs to their customers. Consistent with the existing empirical literature, the cost to income ratio is expected to negatively impact bank profitability (e.g., Athanasoglou et al., 2008; Dietrich & Wanzenried, 2011; Petria et al., 2016).

The banks' financial structure and solvency are measured by Tier 1 capital divided by total assets. As in any business, the capital may absorb losses in the event of an unexpected depreciation of the value of the assets and therefore is considered a safety

indicator. However, lower leverage may also result in lower profitability. In line with the empirical literature, the capital to assets is expected to have an uncertain impact on bank profitability (e.g., Dietrich & Wanzenried, 2011; Teixeira et al., 2020)

The non-performing loans (NPL) ratio (Gross non-performing loans divided by total gross loans) estimates the quality and safety of the credit portfolio. It allows assessing the sustainability of banks' credit risk. As a result of the depreciation policy, the level of NPL affects the level of net income by taking into account the cost of risk. Consistent with the previous empirical literature, the capital to assets is expected to negatively impact bank profitability (e.g., Petria et al., 2016)

As we introduced the RRWA dependent variable, we have to consider an additional independent variable related to risk exposure—risk density (RWA density). This indicator is very different compared to the NPL ratio. This ratio makes it possible to analyze whether the bank's risk profile impacts profitability that seems credible for financial services and banking in particular (Kishore, 2018). RWA measures all credit risk exposure, including the market risk (interest rates and assets values) and the operational risk. Usually, credit risk represents around 80–85% of the total exposure, 5% of the market risk, and 10% of the operational risk. These proportions are relatively homogeneous for all banks and correspond to the requirements of Basel regulation. The RWA density is expected to negatively impact bank profitability. However, risk exposure did not have a direct impact on net income until 2017. For the year 2018, published in 2019, this exposure had a small impact on the impairment resulting from the implementation of IFRS 9.

### **3.2.2.3. Country-specific variables**

The financial literature has identified a set of institutional country factors that play an important role in driving the profitability of banks from a macroeconomic perspective. Our specification first distinguishes countries regarding their economic development, using a classification between advanced and emerging countries following the International Monetary Fund (IMF) World Economic Outlook. In the year 2020, for instance, the FMI classifies 39 countries as advanced economies, representing 41% of the world GDP, and 152 countries as emerging economies, constituting 59% of the world GDP. A second variable is related to the Climate risk score to test a possible relation between the global exposure of countries to climate disasters and banks' profitability and to control potential macro effects regarding our purpose and the specific climate-related management variables we use. As financial intermediaries, banks play a specific role in the economy by being the liquidity providers for non-financial agents. Therefore, we should consider the extent to which the economy is financially advanced as a control variable. The World Bank provides a financial development index by year between 0 and 1, with a value near 1 for economies largely based on finance. We also use an index to protect minority investors' rights in the country to measure how the legal framework for property rights influences banks' long-term profit from a law and finance perspective (Caprio et al., 2007). The legal index is extracted from the Doing business database provided by the World Bank. Lastly, it appears important to consider the exposition of banks' profitability to the health of the economy (Bolt et al., 2012; Beltratti & Stulz, 2012). Then, we consider the GDP growth for each year and country surveyed using the DataBank of the World Bank.

The following Table 3 presents a summary of the definitions and sources of our variables.

**INSERT TABLE 3 ABOUT HERE**

### **3.2.3. Empirical Model**

The relationships previously proposed in section 2 between climate-related management and banks' profitability are materialized in the following panel data model. Using panel data is particularly well fitted. It enables us to assess conceptual aspects over time by analyzing observations from nine consecutive years for the same financial institutions and, for one specified year, over the total observed population. The double dimension of data, temporal and individual, enriches the study, especially in periods of great change as in the last decade regarding our research question. The estimated model highlights the impact of classical (financial) and specific (climate management) determinants on banks' performance measured by four different dependent variables (ROA, ROE, RRWA, ROC). Thus, bank-specific variables are included as explanatory variables and previously detailed macroeconomic and external country-specific variables. We also include variables representing the country and year. Then, we add to this basic profitability model the dummy variables crucial to our research question and relative to green management. Therefore, the model is designed as:

$$ROA_{it} = \beta_0 + \beta_1 ROA_{it-1} + \varphi BS_{i,t} + \delta CS_{i,t} + \gamma CCM_{i,t} + \sum \beta_j Country_i + \sum \beta_k Year_t + \eta_i + \mu_{i,t}$$

where  $ROA_{it-1}$  is in a dynamic panel model, the one-period lagged-dependent variable,  $BS_{i,t}$  is a vector of bank-specific factors,  $CS_{i,t}$  is a vector of country-specific variables including macroeconomic indicators,  $CCM_{i,t}$  is a vector including our variables dealing with climate change management (CDP score, Board level interest, Specific climate risk management, Climate risk integrated into strategy, Emission reduction target and Incentives for target). The error term is subdivided into the combined effect of individuals and time ( $\mu_{i,t}$ ) and the individual effect ( $\eta_i$ ). The above specification is duplicated for other dependent variables (ROE, RRWA, and ROC). However, we exclude the two independent variables, RWA density and Capital to assets, in the vector of bank-specific factors for estimations of RRWA and ROC, respectively. To consider unobserved heterogeneity and potential endogeneity that frequently affect profit estimation, we employ the GMM estimation method developed by Arellano and Bover (1995) and Blundell and Bond (1998) in our estimates. This technique combines the relevant regression expressed in first-differences and levels to correct endogeneity bias by instrumenting the explanatory variables. The instrument's validity and reliability are indicated by the serial correlation tests AR (1) and AR (2) and the Hansen test.

#### **4. Results and discussion**

This section presents descriptive statistics (Table 4) about our database and discusses the results of econometric panel-data estimation of banks' profitability (Table 5). In these tables, dependent variables refer to the bank, country-specific characteristics, and climate change management variables to illustrate the originality of the contribution.



Regarding the first part of descriptive statistics in Table 4, it appears that whereas financial and country data do not require specific comments, CDP data provide interesting information and knowledge about climate change management in banks. It was noted that most climate change variables have improved from 2011 to 2019, with a current average CDP score of 5.377 in 2019, whereas it was 2.251 in 2011. Similarly 97% of banks addressed the climate change issues at a broad level when it was 75.6% in 2011. The trend is the same for banks having integrated climate risk into their business strategy, with 94.7% concerned in 2019 against 84.6% eight years before and for those who choose to introduce climate-related incentives for the managers in relationship with green objectives (87.2% vs. 64.6%). The last example that illustrates green management by financial institutions is that banks providing emissions target active for the reporting year grow from 12 points with 82.1% in 2019 against 70.3% in 2011. The only disappointing observation is the existence of a specific climate change process of risk management (10.4% in 2019, similar to 2011, 9.4%). From a temporal perspective, even though the observed banks seem to be aware of the consequences of climate change on their business to make it a strategic topic worthy of the board of directors, this remains very timid in terms of operational implementation.

From a spatial and economic perspective, statistics of Table 4 indicate that advanced countries banks' compared to emerging ones exhibit a higher commitment to climate change issues, which is not surprising, as regulatory and stakeholder pressures are more demanding with two notable exceptions:

A slightly higher interest at a broad level (91.8% vs. 87%).

A more significant operational engagement in climate risk management (15.7 % vs. 6.1%) for emerging countries.

These findings indicate that, in terms of the management process, climate-change issues have attracted growing interest within the last decade, albeit not in a sufficient way. This is the case in developed and emerging economies, which account for nearly 60% of the world GDP in 2020 and suffer more from global warming than the poorest lands.

#### **INSERT TABLE 4 ABOUT HERE**

Table 5 shows the results of the GMM estimation. Regarding financial bank-level and country-specific variables, we obtain results similar to those of previous empirical studies, regardless of the proxy chosen to assess their performance. For bank-specific variables, the profitability of banks is positively and significantly influenced by their size, their operational efficiency (the higher their cost to income, the lower their profitability), their capital adequacy (capital to assets), and their asset quality (the lower their gross non-performing loans divided by total gross loans, the higher their profitability). In addition, banks in emerging countries are more profitable than their peers from advanced countries and banks located in less financially developed countries than their counterparts in the more financially developed world. These results are consistent with Teixeira et al.'s (2020) finding that stricter banking regulation reduces banks' profitability. As expected, the impact of GDP growth is mainly significantly positive. We have also tested two country-specific variables that are not usually used in previous studies: CRI country score and the protection of minority investors. Both have no significant influence on bank profitability, contrary to our expectations. The exposure of banks to weather-related loss events does not affect their profitability, which seems to mean that climate events are not yet frequent and important enough to impact them (but the situation may, unfortunately, evolve shortly). Additionally, the

main impacts of climatic risks are covered by the non-life insurance system. In the case of banks, which also have insurance subsidiaries, the impact is limited because of the focus on life insurance products rather than property and casualty products.

The level of protection of minority investors also has no significant effect on bank profitability. This is less surprising as the supposed positive effect of investor protection on financial development (La Porta et al., 2000) may be counterbalanced, i.e., a lower level of property rights favors banks that retain a higher portion of financial intermediation and eventually perform better (Diamond & Rajan, 2001). Teixeira et al. (2020) observe a negative impact of investor protection but only in OECD countries, whereas Hartwell (2015) finds a positive impact in transition economies. Since our sample includes banks from both developed and emerging countries, it is logical that the effects should be balanced, and no influence should be observed in regressions.

Our research aims to assess the influence of banks' climate change management on their profitability. Only two variables exhibit a significant and positive impact on banks' profitability—the CDP score and the board level interest; however, no significant influence is observed for other variables. For the CDP score, the impact is significant for ROA and RRWA but not ROE and ROC. First, it means that the overall quality of climate change management and its disclosure positively impact profitability (ROA and RRWA). This is adding a new piece of knowledge to the limited evidence in this matter, especially in the banking industry (Bose et al., 2021; Jo et al., 2015; Yin et al., 2021; Wu & Shen, 2013; Caby et al., 2020). Second, as ROE and ROC disregard the risk associated with leverage (Athanasoglou et al., 2008) compared to ROA and RRWA, it suggests that the positive influence of climate risk management quality could be hidden

by the positive impact of leverage on banks' profitability. The positive impact of the board-level interest is an ex-post justification of the topic's relevance to the board of directors.

The lack of influence of the other green management variables may be interpreted as a teething problem. Furthermore, the absence of significant negative or positive impact of green management variables on profits echoes the neutral relationship between CSR and financial performance based on benefit-cost analysis (McWilliams & Siegel, 2001). It also appears as a signal that implementing sound climate change management is not detrimental to profitability for banks during the period. Conversely, the marginal existence of risk management specific to the climate change process among banks (10.4% in 2019, Table 4) is the only truly operational criteria taken into account. This suggests that climate change management is still on its way in the banking industry beyond the strategic issue. Overall good quality of climate change management and disclosure and coverage of the topic by the board is a good starting point but not an end in itself. The theoretical positive impact claimed by Porter and van der Linde (1995) or the NRBV is still awaiting a concrete implementation in the banking industry. The tiny empirical evidence so far of Miroshnychenko et al. (2017), Tang et al. (2018), Boakye et al. (2020), Batae et al. (2021), among others in various industries, show that it seems to be a good choice.

**INSERT TABLE 5 ABOUT HERE**

## **5. Concluding remarks**

## 5.1. Summary of findings

So far, the influence of climate change management has received little attention from an empirical perspective. Our research provides new insight on this topic on a panel data sample of international banks over a long period (2011–2019). Using a dataset of Carbon Disclosure Project (CDP) data regarding banks' climate change managerial practices and quality, we test and assess their impact along with traditional determinants of banks' profitability. We also introduce new proxies to measure profitability in the banking industry: return on capital (ROC) and return on risk-weighted assets (RRWA). We consider two new control variables regarding climate risk per country and investor protection per country, as their location also impacts banks' behavior.

Our results confirm the influence of the traditional bank-specific and country-specific variables. In contrast, the exposure of banks to weather-related loss events and the level of protection of minority investors appear neutral concerning bank profitability. Our empirical results provide a nuanced answer to the research question. Furthermore, we observe a significant and positive impact on banks' profitability of the CDP score and the board-level interest. This means that the overall quality of climate change management and disclosure positively impacts profitability and an ex-post justification of the topic's relevance to the board of directors.

Conversely, all the other variables have no significant influence, that is, a signal that implementing sound climate change management is not detrimental to profitability; however, above all, climate change management is still awaiting a concrete implementation in the banking industry. At the Paris "One Planet Summit" in December 2017, eight central banks and supervisors established the Network of Central Banks and

Supervisors for Greening the Financial System (NGFS)<sup>5</sup>. The Network aims to strengthen the global response required to meet the goals of the Paris agreement and enhance the role of the financial system to manage risks and mobilize capital for green and low-carbon investments in the broader context of environmentally sustainable development.

## **5.2. Practical implications**

At the Paris “One Planet Summit” in December 2017, eight central banks and supervisors established the Network of Central Banks and Supervisors for Greening the Financial System (NGFS)<sup>6</sup>. The Network aims to strengthen the global response required to meet the goals of the Paris agreement and enhance the role of the financial system to manage risks and mobilize capital for green and low-carbon investments in the broader context of environmentally sustainable development.

The enhancement of the quality of disclosure is the first step towards this goal, as illustrated by our difficulty in gathering reliable, comparable, and precise data regarding banks’ climate change managerial practices (see also next subsection). However, such disclosure would be insufficient regardless of its quality if banks were likely to use it for marketing reasons under the greenwashing concept. The next step relies on the implementation of sound climate-related managerial practices. Our preliminary results show that benefit-cost analysis is either neutral or positive, supporting the business case analysis of environmental transition in the banking industry. Besides, the banking regulators may accelerate this implementation by introducing new capital requirements

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<sup>5</sup> See <https://www.ngfs.net/en> for details.

<sup>6</sup> See <https://www.ngfs.net/en> for details.

for green (and brown) assets (Berenger et al., 2020). In addition, in April 2021, the Banque de France conducted the world's first climate-change stress pilot on nine banks and fifteen insurers. In June, the Bank of England launched mandatory disclosure of climate risks by big British banks, with the U.S. Federal Reserve indicating that it intends to follow suit<sup>7</sup>. Japan is conducting similar climate stress tests of its biggest banks. The European Banking Authority is considering including “climate-change sensitivities” in its EU-wide stress tests for the first time in 2021 (Global Finance, 2020).

The ability of banks to comply with this expected bulk of new regulations and simultaneously maintain their financial performance is at stake. The current, weak relationship between climate change managerial practices and financial performance in the banking sector exhibited by our research should encourage banks to pay greater attention to these practices to secure their future returns.

### **5.3. Limitations and future research**

Our research has the following main limitations. We rely on CDP longitudinal data from 2011 to 2019 to measure climate change managerial practices. To gather homogeneous data for the entire period, we choose the 2011 CDP survey as benchmark, offering limited information compared to the recent versions and consequently omitted data that could have enriched our investigation. In addition, all but CDP Score climate change management variables are binary, which provides a very simplified picture of banks' concrete climate change managerial practices. Unfortunately, no standardized

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<sup>7</sup> See <https://e360.yale.edu/features/as-disasters-mount-central-banks-gird-against-threat-of-climate-change> for details.

data are provided by banks (and corporations as a whole). Furthermore, the CDP Score is considered a very good proxy for carbon disclosure quality in the literature. It is also a synthetic assessment of the quality of the climate change management by companies themselves (which was the purpose of our paper); but we only extensively examine the environmental performance. In the literature, climate change performance is often measured by changes in greenhouse gas emissions. Furthermore, the reliability and comparability of the data provided are questionable (for instance, CDP provides such information, but a careful assessment of the data leads us to forgo keeping this variable in our model). In contrast, the scope of the greenhouse gas emissions is most often limited to the company itself, ignoring their customers and suppliers, which is also highly questionable if, for example, a company outsources most of its operations. Our research is based on the assumption that effective climate change managerial practices should result in a good environmental performance, which could be considered a limitation of our research. However, conversely, it would be surprising to achieve a good climate change performance through low climate change management.

The reliability, quality, and comparability of data regarding climate change are growing. Further research may take this opportunity to measure better climate change managerial practices and, eventually, their impact on financial performance. In addition, banks offer very different financial products and services (such as loans, investments.), and the implementation of sustainable managerial practices can vary significantly from one activity to another. Future research may consider a more detailed analysis of banking activities in this regard. Finally, the simultaneous study of climate change managerial practices, climate change performance, and financial performance variables should



provide a better understanding of the mechanisms leading to companies (and banks) being more sustainable and competitive.

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**Table 1. Main determinants of bank profitability in the literature**

<b>Most frequently used explanatory variables</b>	<b>Main proxies</b>	<b>Predicted impact on banks' profitability</b>
<i>Bank specific characteristics (internal factors)</i>		
Size	Logarithm of total assets	Positive/Negative
Operational efficiency	Cost to income ratio	Negative
Financial structure/solvency	Equity over total assets	Positive/Negative
Asset structure/liquidity risk	Loans to assets Loans to deposits	Positive/Negative
Asset quality/credit risk	Impaired loans Non-Performing loans Loan loss provisions over gross loans	Negative
Business mix/diversification	Other operating income to average bank assets	Positive
<i>Country, industry, and macroeconomic characteristics (external factors)</i>		
Inflation	Annual inflation rate	Positive
GDP Growth	Yearly GDP growth Yearly GDP per Capita growth	Positive
Financial development	Stock Market Capitalization over GDP Private credit by deposit banks over GDP	Positive
Bank market concentration	Herfindahl–Hirschman index	Positive
Financial crisis	Dummy variable (crisis=1)	Negative
Nominal Interest rates	Long-term bond rate	Positive
Shareholders rights	Level of protection indexes	Positive/Negative
State ownership	Dummy variable (state-owned=1)	Negative

**Table 2. Sample Demographic characteristics**

<b>Regions</b>	<b>Economies</b>	<b>Countries</b>	<b>Number of banks in 2019</b>	<b>CRI Score 1999-2018</b>	<b>CRI Rank 1999-2018</b>
East Asia and Pacific	Advanced	Australia	7	50.17	33
		Japan	8	69.33	62
		R. of Korea	5	82.83	87
	Emerging	China	6	55.50	43
		Malaysia	1	103.33	114
Europe and Central Asia	Advanced	Austria	1	55.67	44
		Belgium	1	63.83	55
		Czechia	1	79.67	85
		Denmark	2	112.83	126
		Finland	2	155.67	166
		France	4	38.00	15
		Germany	2	38.67	17
		Greece	3	78.83	82
		Ireland	2	119.17	136
		Italy	4	43.67	26
		Netherlands	4	71.83	68
		Norway	3	138.83	148
		Portugal	2	38.83	19
		Spain	6	47.33	29
		Sweden	4	129.50	142
		Switzerland	7	52.33	34
		U.K.	7	65.00	58
		Emerging	Turkey	8	115.17
	Ukraine		1	88.00	94

Latin America and the Caribbean	Emerging	Argentina	1	79.50	84
		Brazil	3	83.17	88
		Colombia	1	55.67	44
		Mexico	1	61.83	54
Middle East and North Africa	Advanced	Israel	1	120.50	139
	Emerging	Egypt	1	143.67	156
		Qatar	1	173.67	181
		U.A.E.	1	158.33	167
North America	Advanced	Canada	7	88.17	95
		U.S.A.	18	44.17	27
South Asia	Emerging	India	6	38.67	17
Sub-Saharan Africa	Emerging	South Africa	5	77.33	79

**Table 3. Definitions and sources of variables**

<b>Bank and country specific variables</b>	<b>Definition</b>	<b>Source</b>
Return on assets	Net income for the year divided by book total assets	The Banker database
Return on equity	Net income for the year divided by total equity	The Banker database
Return on RWA	Net income for the year divided by total risk-weighted assets	The Banker database
Return on capital	Net income for the year divided by Tier 1 capital	The Banker database
Size	Natural log of book total assets	The Banker database
Cost to income	Operating costs divided by total operating income	The Banker database
Capital to assets	Tier 1 capital divided by total assets	The Banker database
RWA density	Total risk-weighted assets divided by total assets	The Banker database
Non-performing loans	Gross non-performing loans divided by gross total loans	The Banker database
Emerging vs. advanced	Classify the bank headquarters' country as an advanced (=1) or emerging economy (=0)	International Monetary Fund
CRI country score	Climate risk score by year From 0 (most exposed) to > 100 (lowest exposed)	Germanwatch
Financial development	Financial development index by year From 0 (lowest developed) to 1 (most developed)	International Monetary Fund
Protection of minority investors	Score-protecting minority investors From 0 (lowest protection) to 100 (highest protection)	Doing Business database World Bank
GDP growth	Annual GDP growth rate (in PPP)	DataBank database World Bank
<b>Climate management variables</b>	<b>Definition</b>	<b>Source</b>
CDP bank score	CDP score measuring, from D- to A+, bank's progress and incentive action on climate change, forests, and water security	CDP Scores database

Board level interest (0/1)	Identify banks with board-level oversight of climate-related issues (=1), or not (=0)	CDP Climate Change database
Specific climate risk management (0/1)	Identify banks with a specific climate change risk management process (=1), or not (=0)	CDP Climate Change database
Climate risk integrated in strategy (0/1)	Identify banks with climate-related issues integrated into their business strategy (=1), or not (=0)	CDP Climate Change database
Emission reduction target (0/1)	Identify banks with an emission target active (=1), or not (=0)	CDP Climate Change database
Incentives for target (0/1)	Identify banks offering incentives to employees for the management of climate-related issues (=1), or not (=0)	CDP Climate Change database

**Table 4. Descriptive statistics of variables**

<b>Bank and country variables</b>	<b>Mean</b>	<b>Std</b>	<b>Min</b>	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Max</b>
Return on assets	0.760	1.370	-16.330	0.390	0.690	1.140	14.740
Return on equity	8.984	8.370	-47.010	6.060	9.085	12.930	96.870
Return on RWA	1.497	2.058	-23.700	0.930	1.480	2.111	17.000
Return on capital	10.768	9.767	-47.520	7.000	10.920	15.590	47.380
Size	12.173	1.540	7.180	11.174	12.179	13.411	15.107
Cost to income	55.131	13.753	13.850	45.965	55.155	63.265	121.181
Capital to assets	7.096	3.564	1.900	5.090	6.470	8.480	53.010
RWA density	51.729	19.350	4.730	37.010	48.990	65.270	105.420
Non-performing loans	3.628	5.709	0.010	0.920	1.780	3.800	39.500
Emerging vs. advanced	0.748	0.434	0	0	1	1	1
CRI country score	57.586	28.207	5.500	36.170	54.170	74.670	173.670
Financial development	0.741	0.172	0.208	0.629	0.796	0.886	0.976
Protection of minority investors	67.422	12.495	28	60	70	76	88
GDP growth	2.412	2.567	-9.772	1.333	2.168	2.927	13.375
<b>Climate management variables</b>	<b>Mean</b>	<b>Std</b>	<b>Mean</b>			<b>Mean</b>	
			<b>2011</b>	<b>2015</b>	<b>2019</b>	<b>Emerging</b>	<b>Advanced</b>
CDP bank score (0 to 8)	3.800	2.905	2.251	3.437	5.377	2.627	4.195
Board level interest (0/1)	0.880	0.464	0.756	0.888	0.970	0.918	0.870
Specific climate risk management (0/1)	0.082	0.275	0.094	0.065	0.104	0.157	0.061
Climate risk integrated in strategy (0/1)	0.910	0.286	0.846	0.897	0.947	0.892	0.915
Emission reduction target	0.807	0.395	0.703	0.811	0.821	0.679	0.842



(0/1)							
Incentives for target (0/1)	0.832	0.373	0.646	0.861	0.872	0.713	0.865

This table reports the summary statistics for dependent and explanatory variables. The Q1, Q2, and Q3 are 25%, 50% (median), and 75% percentiles.

**Table 5. Results of GMM dynamic panel-data estimation of banks profitability**

<b>Bank and country variables</b>	<b>ROA</b>	<b>ROA</b>	<b>ROE</b>	<b>ROE</b>	<b>RRWA</b>	<b>RRWA</b>	<b>ROC</b>	<b>ROC</b>
ROA/ROE/RRWA/ROC (n-1)	0.259***	0.255***	0.317***	0.217***	0.322***	0.226***	0.199***	0.171***
Size	0.719**	0.883**	0.482	0.322	0.140***	0.107**	0.129***	0.143**
Cost to income	-0.022***	-0.010**	-0.032***	-0.023***	-0.037***	-0.045**	-0.042***	-0.042***
Capital to assets	0.274***	0.391***	0.115**	0.242**	0.332***	0.487***	-	-
RWA density	-0.014*	0.001	-0.067	0.083	-	-	0.034	0.010
Non-performing loans	-0.038**	-0.012**	-0.043	-0.059	-0.057*	-0.020***	-0.020	-0.044*
Emerging (0) vs. advanced (1)	-0.038**	-0.025*	-0.031	-0.025	-0.050*	-0.016	-0.065**	-0.016*
CRI country score	-0.001	-0.004	-0.025	-0.010	-0.003	-0.002	-0.039	-0.020
Financial development	-0.101*	-0.092*	-0.153	-0.163	-0.148**	-0.079*	-0.067**	-0.020*
Protection of minority investors	-0.001	-0.007	-0.028	-0.020	-0.024	0.045	-0.035	-0.018
GDP growth	0.046**	0.024*	0.013	0.018	0.039**	0.032*	0.023	0.009
<b>Climate change management variables</b>								
CDP bank score	-	0.031*	-	0.013	-	0.022*	-	0.020

Board level interest (0/1)	-	0.021**	-	0.010*	-	0.023**	-	0.008*
Specific climate risk management (0/1)	-	-0.024	-	-0.036	-	0.023	-	0.046
Climate risk integrated in strategy (0/1)	-	-0.008	-	-0.016	-	-0.007	-	-0.002*
Emission reduction target (0/1)	-	0.012	-	-0.027	-	0.017	-	0.038
Incentives for target (0/1)	-	-0.062	-	0.084	-	0.019	-	-0.064
Number of banks	137	126	137	126	137	126	137	126
AR1 Residual Test	0.000	0.000	0.002	0.000	0.000	0.000	0.001	0.000
AR2 Residual Test	0.640	0.775	0.515	0.687	0.585	0.595	0.637	0.437
Hansen P-value	0.148	0.175	0.214	0.211	0.124	0.174	0.274	0.228

\*\*\*, \*\*, \* indicate statistical significance at the 1, 5, and 10 % levels, respectively.