Climate and Environmental Risk Integration in EU Banks

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This draft is submitted to the NBER conference on Climate Finance, Fall 2025
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Abstract

Based on survey evidence from European banks under the Single Supervisory Mechanism, most institutions (83%) report collecting granular firm-level climate and environmental (C&E) data. So far, half integrate C&E risks into credit risk measures such as internal ratings, provisioning, or economic capital and just a quarter use firm-level data in doing so. The remainder rely on non-granular proxies, due to data quality, cost, or internal technical constraints. Thus, 70% of banks appear to have C&E risks implicitly reflected in risk-based pricing through existing credit risk measures. Four years after its release, ECB's supervisory expectation has driven notable, albeit uneven, progress, with two-thirds of banks meeting or actively working toward meeting the expectation by late 2024. Variations in integration are partly explained by institutional size and voluntary climate commitments. These results inform current policy debates on the CSRD, EU Taxonomy, and the C&E risks in microprudential policy.

Keywords: climate and environmental risks; credit risk; disclosure; European banks; survey
JEL Classification: G2, G3, G11,Q54

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1. Introduction

Since the 2015 Paris Agreement, which committed signatory nations to Nationally Determined Contributions to reduce greenhouse gas emissions, financial sector regulation has increasingly focused on managing climate risk. In response, the Financial Stability Board established the Task Force on Climate-related Financial Disclosures (TCFD) to provide a global framework for assessing and disclosing physical, liabilities, and transition risks. The Network for Greening the Financial System, launched in 2017, has further advanced the integration of climate risk into financial supervision. At the European level, the European Central Bank issued its Guide on Climate and Environmental (C&E) Risks in 2020 (European Central Bank 2020a) outlining supervisory expectations for how banks should identify, assess, and manage these risks. Corporate disclosure requirements have further expanded since then, enhancing data availability but raising questions about its sufficiency and use in financial risk management of C&E risks.

Europe is warming faster than other world regions, leading to an increase in the frequency and severity of climate-related disasters, as reflected by the mounting related economic losses over the past years (European Environment Agency 2024). In 2024 alone, severe floods and storms in Germany, Italy, France, Spain, and Central and Eastern European nations resulted in economic damages amounting to billions of euros (European Commission 2025). The European Union has taken a leading role in climate policy, committing to climate neutrality by 2050 (Bäckstrand 2022) and implementing some of the most ambitious regulatory frameworks to address C&E risks in the real economy.[1] To improve the transparency and measurement of C&E-related financial risks, the EU has progressively introduced disclosure requirements, from the NFRD (applicable since 2018) to the more detailed EU taxonomy and CSRD in response to financial institutions and market participants' data needs (Ilhan et al. 2023).

[1] Key initiatives include the EU Emissions Trading System (2005), the Climate & Energy Package (2009), the European Green Deal (2019), and the Fit-for-55 Package (2021).

This naturally calls for an examination of how banks collect and use C&E data in their risk management frameworks, particularly in the context of credit risk. While research confirms the financial materiality of C&E risks[2], banks' integration remains incomplete. A 2022 review of 186 banks shows that despite 85% adopting basic risk management practices, most lack robust methodologies and the use of granular data (European Central Bank 2022).

In this paper, we investigate how financial institutions collect and utilize C&E data, particularly granular firm-level data, for risk assessment, in light of expanding data availability and evolving sustainability disclosure frameworks for large corporates[3]. While archival evidence provides some insights into the collection and use of such data, it often falls short of capturing how institutions collect and use this information in practice, since there is limited visibility that public disclosures, filings, and financial statements provide into internal processes of financial institutions. Our study addresses this gap using survey evidence along with regression analysis to shed light on this question.

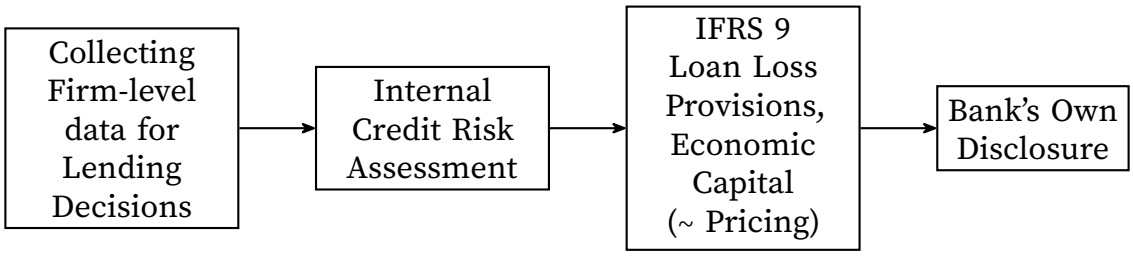
Traditional credit risk frameworks mainly focus on near-term indicators, such as credit ratings (typically over a 2–3 year horizon), IFRS 9 loan loss provisions (capturing expected losses and calculated over a 12-month or lifetime horizon, depending on the credit stage), and economic capital (which captures unexpected losses). These tools are designed to reflect expected or unexpected losses based on current loan performance and prevailing macroeconomic conditions. In contrast, C&E risks may affect bank portfolios across short-, medium-, and long-term horizons. Furthermore, banks face methodological challenges when integrating such risks into existing frameworks, not only in identifying data needs for credit risk measurement but also in collecting and ultimately using the data while balancing availability and reliability. Consequently, embedding C&E factors into risk

[2]C&E risks increase firms' borrowing costs and credit exposure (Chava 2014; Javadi and Masum 2021; Capasso et al. 2020; Altavilla et al. 2024; Delis et al. 2024).

[3]The term "large corporate" refers to "any corporate undertaking having consolidated annual sales of more than EUR 500 million or belonging to a group where the total annual sales for the consolidated group is more than EUR 500 million" in line with the legal framework established under Article 5a of the Capital Requirements Regulation (European Union 2024)

indicators requires adjustments to the data collection, credit risk assessment processes, and methodological approaches, as depicted in Figure 1.

FIGURE 1. Integration of C&E factors into risk indicators



Notes: Integration of C&E factors into risk indicators requires adjustments in data collection, credit risk assessment processes, and methodological approaches. This figure illustrates a sequential workflow starting with the collection of firm-level data for lending decisions, followed by internal credit risk assessment, the application of economic capital and IFRS 9 loan loss provisions (pricing), and culminating in the bank's disclosure. Regulatory guidelines highlight the need for banks to adopt a forward-looking approach in addressing C&E factors across varying time horizons in credit risk management.

To investigate how C&E risks are currently managed within banks' credit risk frameworks, this study draws on novel survey evidence collected from significant institutions operating in the European Union. We focus on credit exposures to large non-financial corporates, where data availability and disclosure practices are relatively advanced by comparison with other types of borrowers.

In this regards, we analyze how European banks are adapting their credit risk infrastructure to incorporate C&E risks, with a focus on both current practices and institutional readiness. The analysis also assesses whether banks possess the data and systems infrastructure needed to channel these data from collection in the front office to credit risk measurement and ultimately to disclosure functions. In addition to mapping current practices, we explore how supervisory guidance has influenced banks' integration trajectories. In particular, we evaluate the role of the ECB's supervisory expectation 8.2, which requires significant institutions to incorporate C&E risks into their borrower risk classification frameworks.

The employed survey was administered online by KPMG Germany between September and October 2024. It targeted professionals with direct experience in quantitative credit

risk modeling, to ensure responses were technically grounded and internally consistent. To focus on the European Union, we restrict our sample to banks classified as significant institutions under the Single Supervisory Mechanism (SSM) which ensures a homogeneous regulatory context and greater comparability in integration efforts, particularly in relation to ECB supervisory expectations on C&E risks set out in 2020. With this approach, we can explore both the current state and the institutional readiness for C&E data integration across credit risk processes.

The findings highlight that a vast majority of banks (83%) are collecting granular C&E information. Banks, in contrast to institutional investors, are more likely to collect raw C&E information directly from clients' reports than relying on external ESG data providers. At the same time, the observed use of several sources for collecting data may serve as a strategy to manage data quality concerns, especially in light of widespread skepticism regarding the consistency and cost-effectiveness of third-party ESG data. This behavior may reflect the dual pressures of internal risk modeling needs and supervisory expectations, which create a demand for high-resolution, decision-useful data.

While around half of the banks report some level of systematic integration of C&E data into selected risk measurement processes such as internal credit rating, IFRS9 loan loss provisions, or economic capital estimation, only a quarter of respondents would ultimately use granular firm-level C&E data for that purpose. This implies that many institutions continue to rely on proxies such as sector-level estimates — an approach likely driven by concerns over either data quality, high costs of data acquisition and processing, and / or internal technical infrastructure limitations. In the context of risk-based pricing for large corporate lending, approximately 67% of banks implicitly factor in climate and environmental risks information. The implementation of functional data infrastructures by 27% of respondents marks a step toward more effective use of C&E data across the organisation. Nonetheless, most institutions continue to encounter challenges in operationalizing firm-level C&E information, which limits its integration into internal

processes. Without robust end-to-end data pipelines, banks may struggle to align credit risk assessment, disclosure, and supervisory expectations. This means that the reliance on proxies rather than client-specific data may be possibly due not only to data quality, cost of acquiring and/or processing data, but also to internal technical infrastructure limitations. For instance, geolocation-specific information on the numerous operations and/or value chain of a large corporate, even if it would be available, it would require technical infrastructure to manage such data for a detailed risk assessment. These findings show the importance of data infrastructure as a missing link between disclosure mandates and actual risk integration, while also signaling a broader need for policy interventions to improve the availability and standardization of climate-related corporate disclosures and to encourage banks' efforts to establish functional internal C&E data infrastructure. Finally, four years after setting the ECB's Supervisory Expectation 8.2 (introduced in November 2020), two-thirds of respondents indicate notable progress, meeting or actively working toward meeting the expectation by end-2024, while one-third report delays, suggesting that supervisory expectations may contribute to driving progress.

Finally, we present new empirical evidence on how institutional features shape banks' implementation of C&E risk practices such as size, regional location, and commitment to the Net-Zero Banking Alliance (NZBA). Namely, heterogeneity observed in descriptive statistics across banks and countries may suggest a role of both institutional capacity and national regulatory environments in shaping climate risk integration. Results of regression analysis show that larger banks are significantly more likely to adopt a broader range of C&E data collection methods, pointing to scale-related differences in organizational capacity. In contrast, integration into pricing appears more closely associated with a bank's voluntary commitment to net-zero targets, regardless of size. Other practices such as aligning credit risk classification procedures with supervisory expectations, or developing fully functional data architectures, do not display variation along observable institutional dimensions. These results suggest that while some C&E practices are more likely to emerge

in larger or more committed institutions, others may depend on internal prioritization or context-specific factors not captured by structural characteristics.

Our results have several policy implications. First, our study shows that the limited use of client-level C&E data in credit risk measurement underlines the need for standardized and audited disclosures, such as those promoted by the CSRD, to ensure data reliability and comparability. Second, the effective integration of such data requires robust internal infrastructures that connect front-office data collection with back-office modeling systems; policymakers could consider encouraging investments in a common industry-wide data pooling platform to facilitate this process as well as articulate supervisory expectations on internal C&E data infrastructure for financial institutions. Third, banks' reliance on proxies, driven likely by the cost of integration and concerns over data quality, points to the importance of improving the availability, reliability, and usability of firm-level C&E data through clearer disclosure requirements with more standardized formats, where quantitative data points are prioritized and assurance requirements guarantee data quality.

This paper advances understanding of the incorporation of C&E risks related information in banks. By designing a survey that captures conceptual and empirical aspects not readily accessible through archivable research, we contribute to multiple strands of the literature. First, we contribute to the strand of literature institutional investors' consideration of C&E risks. By surveying institutional investors, Krueger et al. (2020) find that most respondents incorporate climate risks into their portfolio allocation decisions as these risks become increasingly material, although stock market valuations do not yet fully reflect such risks. Ilhan et al. (2023) provide evidence that institutional investors demand high-quality climate disclosures. We contribute to this literature complementing existing evidence with new insights into whether and how financial institutions, specifically banks, consider climate and environmental risks in lending decisions. Namely, we document how banks integrate these risks into credit processes, the data challenges they face, and the institutional factors that may shape the integration of C&E risks in credit risk measure-

ment, thereby expanding the understanding of C&E risk management beyond the asset allocation context typically studied in the institutional investor literature. Additionaly, we contribute to the growing literature that highlights the challenges banks face in integrating C&E risks into credit risk measurement due to the limited availability of firm-level C&E data. de Bandt et al. (2024) reviews emerging empirical evidence and notes that, while climate risk effects on banks appear modest in some studies, measurement uncertainties, potential underestimation of risks, and data limitations remain key concerns. Our study extends this literature by documenting how banks themselves assess and manage these data challenges in practice, and how data infrastructure shape the operational integration of C&E risks into credit risk measurement and ultimately decision-making. Finally, we contribute to the literature on the pricing of C&E risks in bank lending (e.g., Altavilla et al. (2024); Delis et al. (2024); Mueller and Sfrappini (2022); Erten and Ongena (2024)) by documenting how C&E risks are integrated indirectly through credit risk measurement in loan pricing. While prior studies use archival data to show that banks charge higher rates to high-emission firms, respond to climate policy risks in selected regions, and adjust pricing in line with regional environmental attitudes, we offer survey-based evidence on the integration of C&E data in components of pricing, and the extent of the use of granular firm-specific data versus proxies, such as sectoral averages.

The remainder of this paper is organized as follows. Section 2 outlines the survey and research design. Section 3 examines how banks collect the C&E data. Section 4 analyzes the use of C&E information in credit risk measurement and pricing practices. Section 5 discusses the disclosure of banks' own C&E data at the portfolio level. Section 5 also evaluates the impact of the ECB's supervisory expectation 8.2 on credit risk classification procedures. Section 7 investigates how banks' characteristics influence the implementation of C&E risk management practices. Finally, Section 8 concludes.

2. Methodology and research design

2.1. Survey development and delivery

The survey investigates questions regarding the integration of C&E risk into credit risk that cannot be easily addressed using archival data. It covers aspects of C&E risk integration into credit risk measurement, such as related data and processes in rating assignment, internal credit ratings, economic capital models, and IFRS 9 provisioning models. In this study, we focus on a subset of the survey results, specifically examining banks' credit exposure to large non-financial corporations, where "large corporate" refers to "any corporate undertaking having consolidated annual sales of more than EUR 500 million or belonging to a group where the total annual sales for the consolidated group is more than EUR 500 million" in line with the legal framework established under Article 5a of the Capital Requirements Regulation (European Union 2024).

The decision to focus on large corporations reflects two key factors. First, data availability on C&E risk factors is most advanced in this segment as large companies, particularly issuers, have been increasingly disclosing relevant information to assess climate-related and environmental risks (see, for example, Carbone et al. (2025)). Moreover, capital market expectations have created a demand for such information (Ilhan et al. 2023), and where such information is not disclosed, data providers attempt to close this gap by providing estimates (see, for example, Busch et al. (2022)). Second, focusing on large corporates allows us to address the heterogeneity in approaches to integrating C&E risk across different credit portfolios, while looking at the most significant category of assets when it comes to how much capital banks need to set aside to cover potential risks (Authority 2025). For instance, the integration of the C&E risk into Commercial Real Estate, Residential Real Estate, and Retail SME portfolios involves distinct transmission channels, data availability needs, challenges, and process variations (see, for instance, European Banking Authority (2025)).

Policy certainty is necessary for organizations, whether firms or banks, to plan and implement changes effectively, as it provides a stable, foreseeable framework for making investment decisions and adjusting operations to meet future regulatory requirements. Given the consistent and long-term focus of the European Union on the low-carbon transition of the real economy, we restrict our analysis to this region. In other economies, such as the United States, the commitment to climate-related policies has been less consistent since 2015, with changes in policy frameworks over the past decade. Moreover, recognizing variations in systemic importance and supervisory attention among banks, we focus exclusively on significant institutions as defined under the Single Supervisory Mechanism (SSM) that are directly supervised by the ECB. Significant institutions are defined by the following criteria[4]:

:*Size:* Total assets exceeding €30 billion. *Economic Importance:* Significance to the economy of the home country or the EU. *Cross-Border Activities:* Assets over €5 billion with cross-border activities in multiple participating Member States exceeding 20% of total assets. *Direct Public Financial Assistance:* Receipt of funding from the European Stability Mechanism or the European Financial Stability Facility. *Top Three Ranking:* Being among the three most significant banks in a participating Member State.

The ECB's supervisory expectations on integrating C&E risk, including in credit risk, have been published in 2020 (European Central Bank 2020b), followed by the communication of the timeline for significant institutions to fully meet the expectations by 2024. Throughout that period, the ECB published good practices to guide the implementation process (see, for instance, European Central Bank (2022)). Focusing on significant institutions ensures a more homogeneous sample, reducing the risk that variations in responses stem from differing regulatory expectations rather than substantive differences in C&E risk integration practices.

[4]For more details, see the European Central Bank's definition of significant institutions under the Single Supervisory Mechanism at `https://www.bankingsupervision.europa.eu/framework/supervised-banks/criteria/html/index.en.html`.

The survey instrument was developed through an iterative process. Initially, the survey questions were formulated based on conceptual frameworks, prior research, and policy discussions on climate-related financial risks and their transmission to credit risk. As part of the refinement process, feedback was solicited from two experts, whose suggestions helped improve the clarity and relevance of the questions. Additionally, the survey structure was assessed for coherence and logical flow, with refinements made to the ordering of questions to enhance respondent engagement and minimize potential biases. Beta tests were then conducted with practitioners to ensure that the wording, terminology, and structure of the questions were accessible to respondents in line with good practices in survey research (Krosnick and Presser 2010). Also, efforts were made to structure response choices in a way that reduced ambiguity and cognitive load. The survey questionnaire was administered online and deployed by KPMG Germany in the the timeframe September - October 2024. The invitations to fill out the survey specified that, given the technical nature of the questions, it was intended for professionals with quantitative expertise in credit risk measurement to ensure meaningful and comparable responses. Designed for self-administration, the online questionnaire allowed participants to complete it at their convenience, forward it to another expert for specific questions where one's expertise was not sufficient, while maintaining consistency in data collection. Participation was entirely voluntary. To ensure confidentiality, the survey guaranteed full anonymity by avoiding the collection of names, employer details, or extensive institution-specific information.

Subsequently, we employ the survey results to answer the following research questions: 1. Do banks collect firm-level C&E information? If so, how is the data collection done, e.g. through manual / automatized retrieval from reports, individual requests to borrowers, buying data from commercial providers? 2. Do banks use C&E information at all – whether firm-level or aggregate (e.g. sector) – for measuring credit risk (internal ratings, economic capital, loan loss provisions) ? If so, how many use firm-level information? What does this internal credit risk measurement imply for pricing? 3. Are banks equipped to use collected

firm-level C&E disclosed information for the bank's own C&E credit risk measurement and disclosure? 4. How does setting a supervisory expectation, i.e. the ECB's supervisory expectation 8.2., mobilise progress of banks to integrate climate and environmental risks into banks' credit risk classification procedures?

Surveys have become an invaluable method in finance research, especially for exploring topics like climate-related financial risks that are difficult to measure through traditional archival data. They provide direct insights into investor beliefs, decision-making processes, and behaviors that influence market outcomes. For instance, surveys examining the expectations of investors regarding ESG investments have uncovered key insights into their motivations and beliefs, such as the widespread expectation that ESG investments will underperform the broader market, despite growing demand for these assets (Giglio et al. 2025). Additionally, surveys conducted with finance professionals have highlighted the varying perceptions of climate risks, including regulatory risks in the short term and physical risks in the long term, illustrating how these risks influence investor behavior and market dynamics (Stroebel and Wurgler 2021). The use of surveys has also proven effective in understanding individual preferences for sustainable investments, with evidence showing that individuals are more likely to choose sustainable options even when financial performance is considered (Bauer et al. 2021). Furthermore, surveys of institutional investors have provided systematic evidence of how their demand for climate risk disclosures is driving firms to improve transparency, demonstrating how survey data can directly inform policy and corporate practices (Ilhan et al. 2023). Krueger et al. (2020) also highlight that institutional investors recognize the financial implications of climate risks, particularly regulatory risks, and that many believe that engagement with portfolio firms, rather than divestment, is the better strategy for addressing these risks. These examples highlight the growing role of surveys in advancing our understanding of how climate risks and ESG factors shape financial decision-making.

2.2. Respondent characteristics and response bias

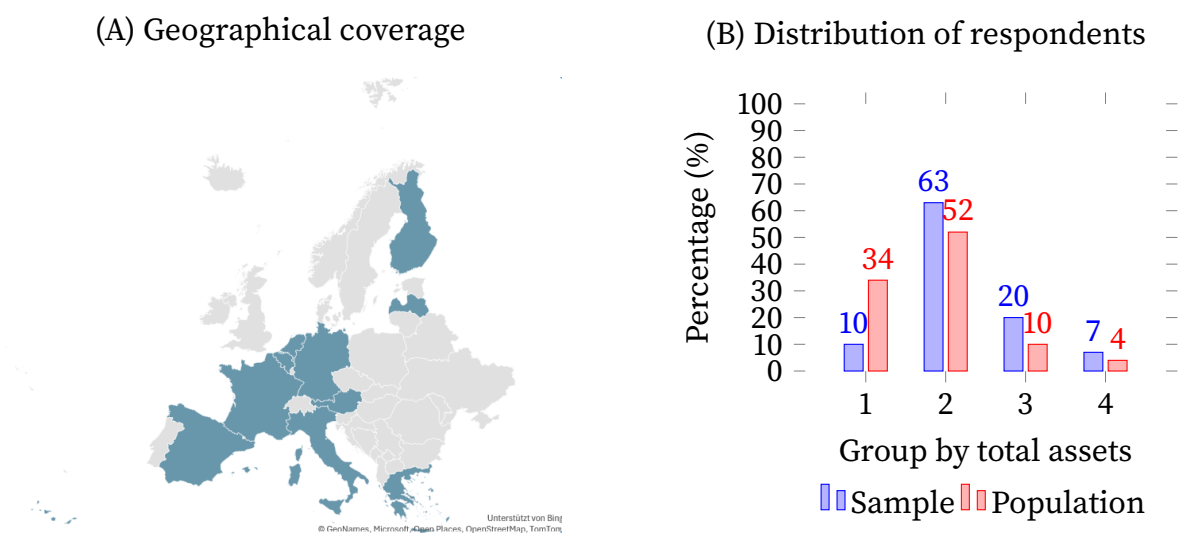
This section provides an overview of the characteristics of the survey respondents, particularly focusing on number of respondents, basic bank's characteristics, and the professional quantitative background self-reported by the respondent. Of the 114 significant institutions (SIs) supervised under the Single Supervisory Mechanism (SSM) as per January 1, 2025[5], a total of 33 completed the survey, representing approximately 30% of all SIs. However, not all SIs maintain substantial credit exposures to large corporates, as some institutions primarily focus on retail banking activities. Namely, savings banks, cooperative banks, and retail-focused lenders primarily serve retail customers and small and medium-sized enterprises (SMEs), with limited direct lending to large corporates. Analyzing publicly available Pillar 3 reports of banks, we estimate that approximately 70-80 banks out of the 114 SIs have notable credit exposures to large corporates. The final sample consists of 30 institutions with material involvement in lending to large corporates.

Given the composition of the sample, which includes a diverse range of banks in terms of geographical coverage and size, it is broadly representative of the broader population of significant institutions, as illustrated in Figure 2. The distribution of respondents by total assets, as shown in Panel B, illustrates the representativeness of the sample relative to the overall population of significant institutions. Imbalances in Group 1 are due mainly to survey sample's tilt to institutions with credit exposure to large corporates, which tend to be larger. Namely, smaller institutions (Group 1) are typically more retail-oriented and therefore appear underrepresented in the survey sample by comparison to the total population, while mid-sized institutions (Group 2) are overrepresented. Care should be taken when generalizing results to the entire population of significant institutions, particularly those without large corporate credit exposure. Moreover, those responding to the survey may likely be more inclined to participate due to their advanced practices in integrating climate-

[5]The list of supervised banks under ECB direct supervision as per January 1, 2025 can be found under: `https://www.bankingsupervision.europa.eu/framework/supervised-banks/html/index.en.html`.

related and environmental risks. As a result, the sample may overrepresent institutions with more sophisticated risk management frameworks, while potentially underrepresenting those with still emerging practices. However, understanding the views and practices of banks with more advanced climate-related risk management frameworks is particularly valuable due to their role influencing practices in the industry at large. Finally, we note that the confidentiality approach adopted in the survey deployment helps mitigate the risk of strategic or inaccurate responses to the survey. The implied limitations that come with this deliberate choice are that the broad categorization of bank characteristics may limit the precision of cross-sectional analyses and discard possibilities to link survey responses to other bank-specific data (e.g., Pillar 3).

FIGURE 2. Characteristics of respondents in terms of geography and size

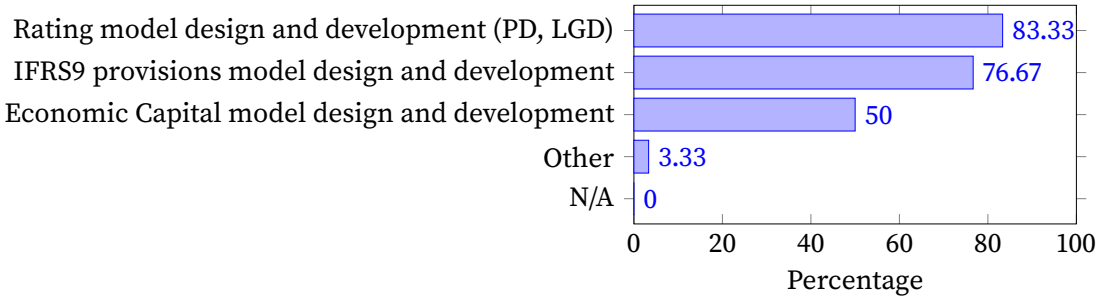


Notes: Panel A illustrates the geographical coverage of the the sample. Panel B illustrates the survey sample based on survey data relative to the overall population of significant institutions as per data published by the ECB (version as of January 1, 2025). Group 1 entails significant institutions meeting one of the following criteria: Size (Total assets EUR 30-50 bn), Among the three largest credit institutions in the Member State, Article 6(5)(b) of Regulation (EU) No 1024/2013, National economic importance (quantitative assessment - GDP), Significant cross-border activities; Group 2 entails significant institutions with Size (Total assets EUR 51-500 bn); Group 3 - Size (Total assets EUR 501-1000 bn); Group 4 - Size (Total assets EUR above 1000 bn).

To ensure the validity and relevance of the survey results, we also check the participation of respondents with direct experience in credit risk modeling, including data handling,

since their technical expertise allows for a more accurate assessment of current practices, by comparison with other profiles. 83% of survey respondents reported being engaged in the design and development of internal credit rating models, specifically related to Probability of Default (PD) and Loss Given Default (LGD), which are fundamental components in a bank's credit risk assessment and measurement. 77% of respondents indicated being involved in the design and development of IFRS9 provisions models, which are key elements for provisioning and loss allowances under accounting standards. Half of respondents reported experience in the development of economic capital models, which play a central role in measuring the capital adequacy and steering of financial institutions. Only one respondent indicated involvement in other areas, while none reported having a role that was not applicable to credit risk modeling. These results suggest a strong concentration of respondents with expertise in core areas of credit risk modeling, particularly PD and LGD models, which are foundational to credit risk management in financial institutions.

FIGURE 3. Professional quantitative background of respondents



Notes: This chart illustrates the self-reported distribution of respondents based on their roles in credit risk modeling, normalized to 30 responses. Survey question: "What is your role in relation to the modeling of credit risk? (multiple-choice)".

3. C&E Data Collection in Risk Assessment Process (Survey Area 1)

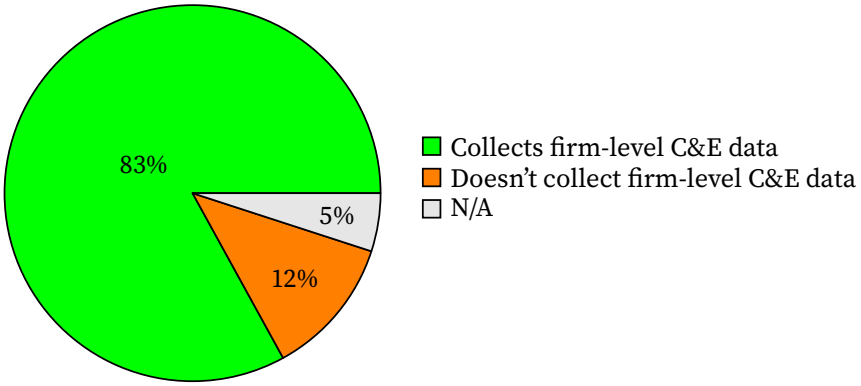
An important aspect of climate and environmental (C&E) risk integration in credit assessment is whether banks collect firm-level C&E information and how they retrieve it. Therefore, in this section we ask: How widespread is the practice of collecting firm-level

C&E information among banks? If they do collect such information, how is this done, e.g., through manual / automatized retrieval from reports, individual requests to borrowers, buying data from commercial data providers ?

Firm-level C&E information comprises company-specific data, including emissions, energy use, and location identifiers (e.g., NUTS codes) to assess transition and physical climate risks, and may be both quantitative and qualitative (e.g., narrative disclosures). In contrast, non-firm-level C&E data include information such as industry, country, industry-wide carbon intensity, flood risk maps. Both in combination are necessary for comprehensive climate risk evaluation. While firm-level data enables precise risk assessment, non-firm-level data supports macroeconomic and scenario analysis. Finally, non-firm-level C&E data may help fill gaps when firm-level data are not available.

The survey results indicate that 83% of banks collect client-specific C&E data for rating assignments of large corporates. The methods employed vary considerably, reflecting different levels of sophistication in data collection processes.

FIGURE 4. Prevalence of C&E firm-level data collection relevant for rating assignment



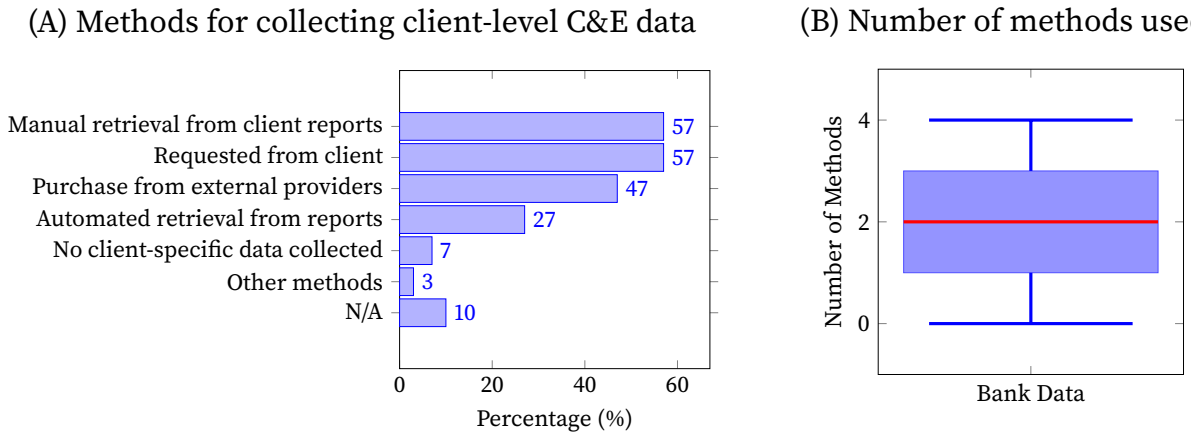
Notes: Self-reported indication of banks' C&E data collection for credit rating assignments. Survey question: "How does the bank collect client-level C&E information relevant for rating assignment?"

Banks employ multiple approaches for collecting C&E data. The most common methods include manual retrieval from client reports (57%), direct client requests (57%), and purchasing data from external providers (47%). Automated retrieval, while less common, is used by 27% of banks, indicating growing adoption of digital solutions. A small frac-

tion (7%) does not collect client-specific data, which may suggest reliance on sector-level assessments or other indirect approaches.

Survey results also show variations in the number of methods employed by banks for retrieving C&E risk-related client-level data. While some banks rely on a single method, others combine multiple approaches, with the median respondent employing two methods. This suggests that comprehensive C&E risk assessments often require integrating multiple data sources to ensure on one-hand complementarity of informations and on the other hand accuracy of information.

FIGURE 5. Methods for collecting C&E firm-level data



Notes: Panel A presents self-reported methods for collecting C&E risk data, while Panel B shows the distribution of the number of methods used. Survey question: "Which methods does the bank use to collect client-level C&E information?"

These findings align with the European Banking Authority's (EBA) 2025 report on ESG data availability based on data from a heterogenous group of 36 banks (both SI and LSI in the European Economic Area), which notes improvements among banks in data collection for large corporates, particularly concerning data on climate-related transition risks, by comparison with non-climate environmental risks. Similarly, European Banking Authority (2025) observes collection of client-sourced data through sustainability reports, ESG questionnaires, interviews, and transition plans.

Next, we discuss our findings relative to the literature on institutional investors. While

47% of our respondents report acquiring client-specific C&E risk information for rating assignments for large corporates from external providers, BaFin (2024) notes that 83% of institutional investors in Germany rely on external ESG data providers. Compared to institutional investors, banks appear to make greater use of client sustainability reports and direct data requests for large corporates, with 57% of respondents indicating employing these methods. The widespread use of multiple data sources among banks may also indicate an effort to mitigate concerns regarding the quality of C&E risk-related data and the high costs. Similarly, among institutional investors in Germany, only 38% perceive the quality of external ESG data as "high", and even less participants consider the cost appropriate BaFin (2024). Standardized and externally audited data, for instance under the Corporate Sustainability Reporting Directive (CSRD), could help address these issues by ensuring consistency and comparability across large corporates, who would fall by enlarge in the scope of CSRD. Enhanced transparency through CSRD-aligned disclosures would support more robust risk assessments, ultimately improving the integration of climate and environmental risks into financial decision-making.

4. Use of C&E Data in Credit Risk Measurement and Pricing (Survey Area 2)

Therefore, in this section we ask: Do banks use C&E information at all – whether firm-level or aggregate (e.g. sector) – for measuring credit risk (internal ratings, economic capital, loan loss provisions) ? If so, how many use firm-level information ? What does this internal credit risk measurement imply for pricing ?

4.1. Internal Credit Ratings Models

In this section, we ask: Do banks use C&E information at all – whether firm-level or aggregate (e.g. sector) – for its internal credit ratings ? If so, how many use firm-level

information ?

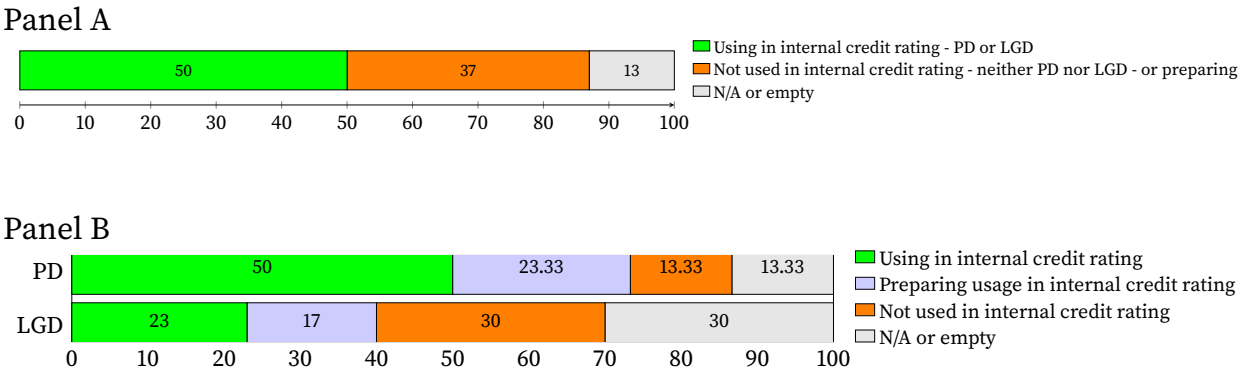
The results from the survey, as depicted in figure 6 panel A, show that 50% of the banks surveyed integrate C&E information directly into their internal credit ratings, specifically in either Probability of Default (PD) or Loss Given Default (LGD) models. However, a significant proportion, 37%, does not currently use this data in their ratings, while 13% of responses fall into the "N/A" or empty category. This indicates variation in the extent to which C&E risks are incorporated into internal credit models, reflecting differences in institutional practices and maturity in integrating these risks.

When considering the integration of C&E data in the PD and LGD models specifically, as shown in figure 6 Panel B, the picture becomes more nuanced. For PD models, 50% of respondents report using C&E information, while for LGD models, this figure drops to 23%. This difference between PD and LGD models suggests that banks are more inclined to incorporate C&E data in assessing the likelihood of default rather than the potential loss in case of default. Interestingly, 17% of banks are preparing for future use of C&E data in their ratings, indicating that these factors are gradually gaining prominence in the credit risk models of some institutions.

The survey also examines the use of granular, client- or asset-level C&E information, which serves as the basis for more accurate and tailored credit assessments. Figure 7 Panel A shows that while 30% of banks use granular C&E data, the majority, 70%, do not. This suggests that banks are still in the early stages of fully leveraging granular data related to climate and environmental risks at the client or asset level.

Figure 7 Panel B provides further insight into the types of C&E information used in the ratings process. It reveals that climate transition and physical risk data are used by 27% of respondents, whereas non-climate physical risks are utilized by 10%. Notably, a larger proportion of banks envision using these data types in the future, with significant increases in the percentage of banks that plan to use climate-related data, specifically climate transition (57%) and climate physical (50%) risks. It is important to note that

FIGURE 6. Use of C&E information in internal credit ratings

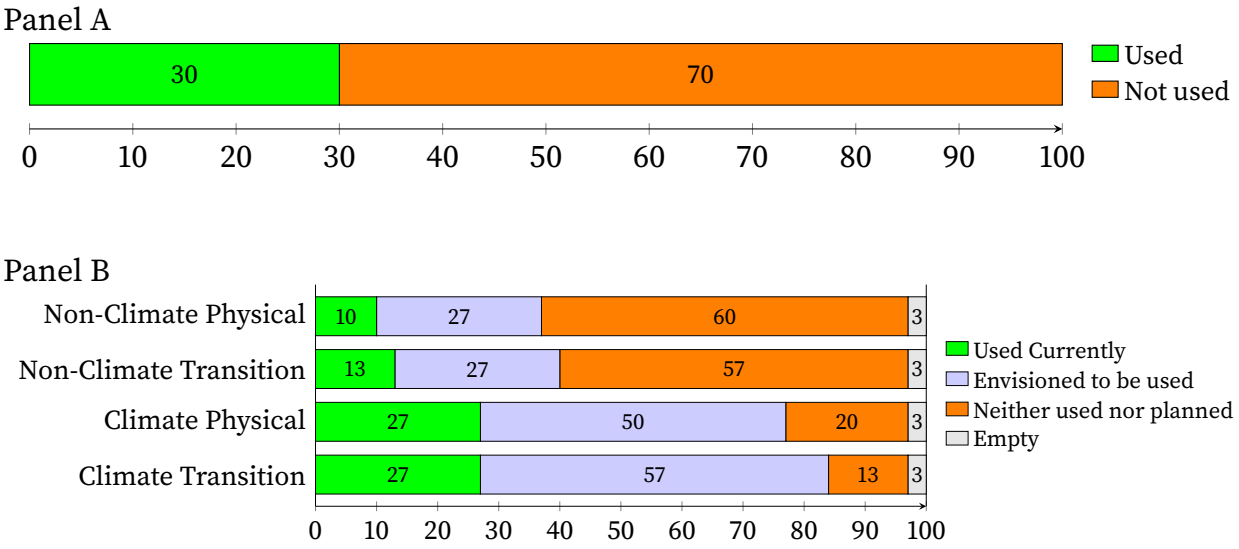


Notes: Panel A: This chart presents self-reported insights on the state of integrating climate and environmental risk-related elements into internal credit ratings, cumulatively based on internal PD / LGD models. *Panel B:* This chart presents self-reported insights on the state of integrating climate and environmental risk-related elements into internal credit ratings, separately for internal PD and LGD models. Survey question: "What is the status of structural and/or tactical integration of C&E risk-related elements in PD models? (Single choice)", "What is the status of structural and/or tactical integration of C&E risk-related elements in LGD models?" (Single choice).

non-climate environmental risks also encompass biodiversity-related risks, such as the potential impact of biodiversity loss on a firm's operations. As biodiversity increasingly becomes a focus of sustainability and financial risk management, its integration into credit risk assessments is expected to rise, adding a new layer of complexity to the assessment of non-climate environmental risks.

The survey findings on the collection of client-level C&E data, as shown in Figure 4, indicate that 83% of banks collect client-level C&E information relevant for rating assignment. However, the limited usage of client-level C&E data in internal credit ratings (30%) while still indicating usage of C&E risk-related elements in internal credit ratings suggest that non-client level C&E data is likely employed as a supplementary or secondary source of information. Thus, in addition to the client-level C&E data collection, banks still consider the role of non-client-level C&E data, such as sector-wide or regional environmental data. This data can be particularly relevant in situations where client-specific data is unavailable or unreliable. Given that many banks are still in the process of incorporating C&E

FIGURE 7. Use of granular client-/asset-level C&E information in internal credit ratings



Notes: Panel A: This chart presents self-reported data on the usage of granular client- or asset-level climate and environmental risk information in internal credit ratings models. Unit: percentage of respondents. *Panel B:* This chart presents self-reported data on the types of granular client or asset-level C&E risk information currently used and envisioned to be used in internal credit ratings models. Unit: percentage of respondents. Survey question: "What kind of C&E risk client-/asset-level information is currently used or envisioned to be used in the PD / LGD determination for the following aspects: Climate Transition Information, Climate Physical Information, Non-Climate Environmental Transition Information, Non-Climate Environmental Physical Information ? (Single choice)".

data into their models, non-client level data might provide a valuable tool for completing risk assessments, particularly for firms in sectors facing high exposure to non-climate environmental risks like biodiversity degradation or water scarcity.

When bridging these results with the earlier findings on banks' collection of client-level C&E information, as depicted in figure 4, the connection becomes apparent. The data reveals that 83% of banks collect client-specific C&E information relevant for rating assignment. However, only 50% appear to integrate this information into their internal credit ratings models. This points to a gap between the collection and the utilization of C&E data, suggesting that while banks are increasingly gathering C&E client-level data, they are not yet fully translating it into internal credit risk measurement, at least not in internal credit ratings.

These observations suggest that collecting client-level data does not equate with using client-level data in internal credit ratings models.

4.2. IFRS9 Loan Loss Provisions

In this section, we ask: Do banks use C&E information at all – whether firm-level or aggregate (e.g. sector) – for its IFRS9 loan loss provisioning estimation ? If so, how many use firm-level information ?

IFRS9 loan loss provisioning estimation is a fundamental component of credit risk management, ensuring that banks allocate sufficient reserves to cover expected credit losses (ECL). Under IFRS9, provisions are determined based on a forward-looking approach, accounting for changes in credit risk over time. The methodology distinguishes between different stages of credit risk:

- **Stage 1**: Assets with no significant increase in credit risk since initial recognition, requiring a 12-month ECL estimate.
- **Stage 2**: Assets that have experienced a significant increase in credit risk, necessitating a lifetime ECL estimate.
- **Stage 3**: Credit-impaired assets, where provisions reflect expected lifetime losses.

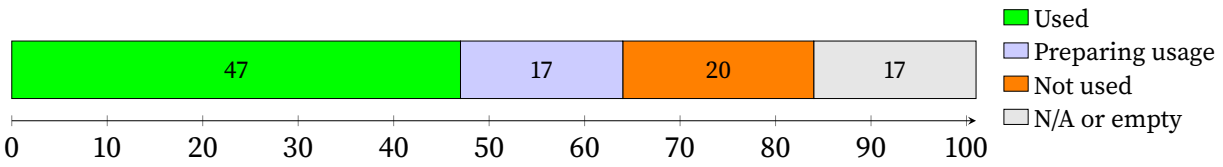
This framework aims to enhance the responsiveness of credit risk management by incorporating macroeconomic forecasts and borrower-specific risk factors, including C&E risks. The extent to which banks integrate C&E information into IFRS9 provisioning is important for ensuring that financial risks include the ones inflicted by C&E risks.

The survey results indicate that a notable share of banks has already begun integrating C&E risk factors into their IFRS9 loan loss provisioning processes. As shown in Figure 8, 47% of respondents report that they are already using C&E-related elements in their IFRS9 impairments estimation, demonstrating a solid commitment to incorporating sustainability risks into financial risk assessments. This represents a meaningful step forward in aligning financial risk modeling with evolving sustainability considerations.

In addition to those already employing C&E data, 17% of banks are actively preparing to integrate such information in the near future. Their efforts signal a growing recognition of the importance of climate and environmental factors in credit risk management, with potential for significant uptake in the coming years.

Still, 20% of respondents indicate that they do not currently incorporate C&E elements in IFRS9 provisioning, and 17% either did not provide a response or considered the question not applicable. While these figures suggest room for further progress, they also highlight the nascent stage of integration efforts in this area. Given that the systematic use of C&E information in IFRS9 provisioning has only recently gained momentum, the survey results suggest an encouraging trajectory, with a significant proportion of banks either already implementing or preparing to implement such considerations.

FIGURE 8. Status of integration of C&E risk-related elements in IFRS9 loan loss provisions

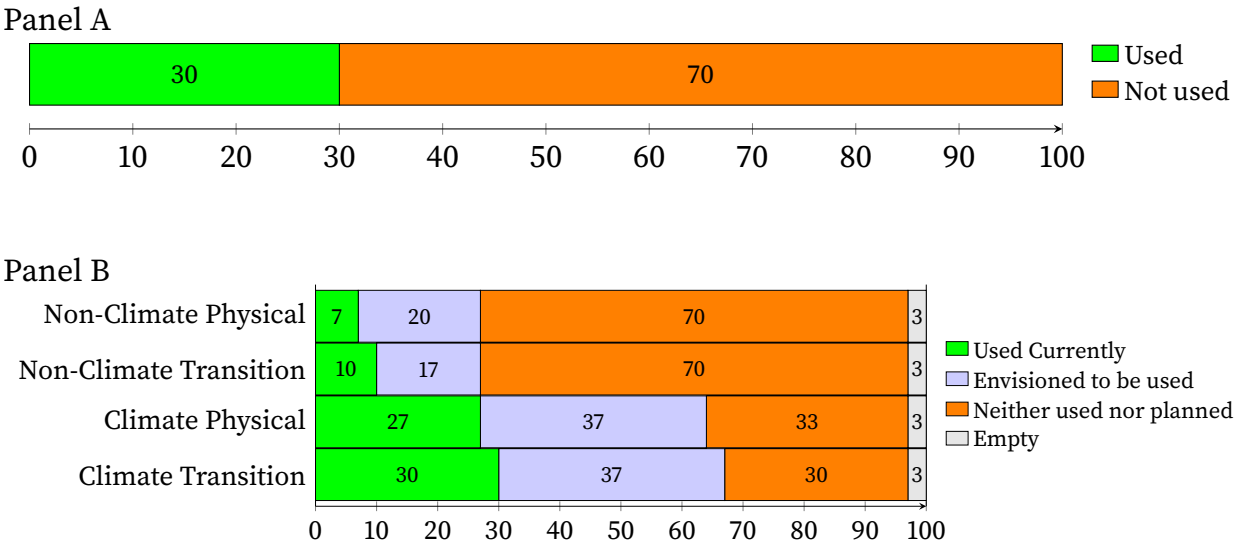


Notes: This chart presents self-reported insights into the state of integration of climate and environmental risk related elements in IFRS 9 impairments estimation. Unit: percentage of respondents. Related survey question: "What is the status of (structural and/or tactical) integration of C&E risk-related elements in IFRS9 impairments estimation (incl. Staging criteria, ECL, add-on/overlay/post-model-adjustment)? (Single choice)".

Focusing on the usage of granular, client- or asset-level C&E information, Figure 9 Panel A shows that 30% of banks have already embedded at least one type of granular C&E data into their IFRS9 loan loss provisioning estimation. While this represents a smaller share compared to the aggregate integration in Figure 8, it indicates that a core group of institutions has developed capabilities to incorporate entity-specific C&E information into their IFRS9 loan loss provisions estimation.

The specific types of granular C&E information used in IFRS9 provisioning are further detailed in Figure 9 Panel B. Climate transition risks emerge as the most commonly

FIGURE 9. Integration in IFRS9 provisions of granular client-/asset-level C&E information



Notes: Panel A: This chart presents self-reported data on the usage of granular client- or asset-level climate and environmental risk information in IFRS9 impairments estimation. Unit: percentage of respondents. *Panel B:* This chart presents self-reported data on the types of granular client or asset-level C&E risk information currently used and envisioned to be used in the IFRS9 impairments estimation. Unit: percentage of respondents. Survey question: "What kind of C&E risk client-/asset-level information is currently used or envisioned to be used in the IFRS9 impairments estimation for the following aspects: Climate Transition Information, Climate Physical Information, Non-Climate Environmental Transition Information, Non-Climate Environmental Physical Information ? (Single choice)".

integrated, with 30% of banks currently using such data, followed closely by climate physical risk (27%). A smaller share has integrated non-climate environmental factors, with 10% using non-climate transition risk data and 7% incorporating non-climate physical risk elements. Beyond current adoption, a significant proportion of banks anticipate leveraging these data types in the near future. For example, an additional 37% of respondents envision incorporating climate physical and transition information into their IFRS9 provisioning processes, while between 17% and 20% foresee using non-climate-related factors.

These findings suggest that while the integration of C&E risks into IFRS9 provisioning is still developing, close to half of respondents are already acknowledging these in their estimations. The significant share of banks actively preparing to integrate these elements further reinforces the trajectory toward broader adoption. Meanwhile, those that have

yet to start may benefit from the experiences of emerging good practices as the industry advances toward a more comprehensive incorporation of C&E risks in IFRS9 provisioning.

4.3. Economic Capital

In this section, we ask: Do banks use C&E information at all – whether firm-level or aggregate (e.g. sector) – for its Economic Capital estimation ? If so, how many use firm-level information ?

Economic capital is a fundamental component of risk management in banking, representing the amount of capital a bank needs to hold to absorb unexpected losses while maintaining solvency. The allocation of economic capital is closely linked to risk-adjusted return on capital (RAROC), ensuring that higher-risk exposures—such as lower-rated borrowers with higher probabilities of default (PDs)—require greater capital buffers. Conceptually, Economic Capital is calculated as:

$$\text{Economic Capital} = \text{Unexpected Loss} - \text{IFRS9 Provisions}$$

where IFRS9 provisions represent reserves already set aside for expected credit losses under accounting rules. The cost of holding economic capital is embedded in loan pricing to ensure that shareholder value is preserved, expressed as:

$$\text{EC Cost} = \text{EC} \times \text{Target Return on Capital}$$

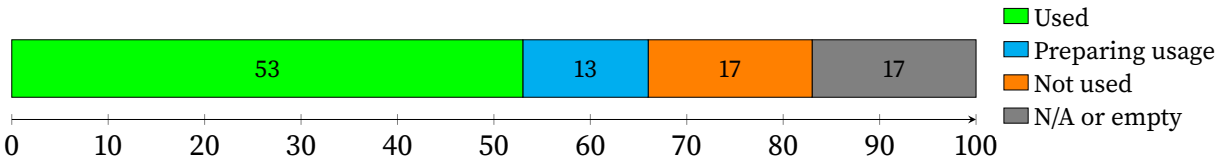
If a corporate loan portfolio requires a high EC allocation, this implies greater unexpected loss volatility. Consequently, higher loan spreads are needed to compensate for the associated risks.

The survey results indicate that banks are progressively integrating climate and environmental (C&E) risk factors into their Economic Capital estimation processes. As shown in Figure 10, 53% of respondents report that they are already incorporating C&E-related

elements into their Economic Capital calculations, signifying a strong commitment to embedding sustainability considerations in risk management. An additional 13% are actively preparing to do so, reflecting a growing awareness of the significance of climate and environmental risks in capital planning.

Still, 17% of banks indicate that they do not currently integrate C&E factors into their Economic Capital framework, and another 17% either did not respond or considered the question not applicable. These figures highlight that while notable advancements have been made, there remains substantial scope for further adoption.

FIGURE 10. Status of integration of C&E risk-related elements for EC

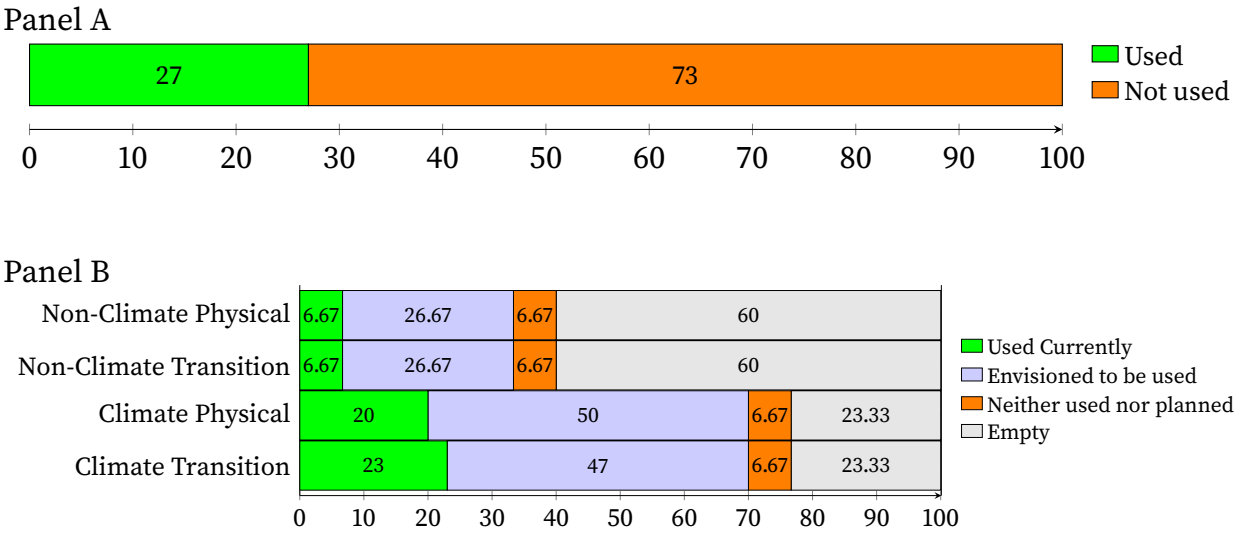


Notes: This chart presents self-reported insights into the state of integration of climate and environmental risk-related elements in Economic Capital estimation. Unit: percentage of respondents. Related survey question: "What is the status of (structural and/or tactical) integration of C&E risk-related elements in EC estimation (incl. add-on/overlay/post-model-adjustment)? (Single choice)".

Regarding the use of granular, client- or asset-level C&E data, Figure 11 Panel A shows that 27% of banks have already incorporated at least one type of C&E information into their Economic Capital estimation. Although this represents a smaller share compared to the overall integration of C&E factors, it suggests that a subset of banks has developed the capability to embed detailed, entity-specific sustainability insights into their capital allocation models.

A more detailed breakdown of the types of C&E information used in Economic Capital estimation is presented in Figure 11 Panel B. Climate transition risks are the most frequently integrated, with 23% of banks currently employing such data, followed by climate physical risks at 20%. In contrast, non-climate environmental risks are less commonly considered, with only 6.67% of banks incorporating either non-climate transition or physical risks.

FIGURE 11. Use of granular client-/asset-level C&E information in Economic Capital estimation



Notes: Panel A: This chart presents self-reported data on the usage of granular client- or asset-level climate and environmental risk information in Economic Capital estimation. Unit: percentage of respondents. *Panel B:* This chart presents self-reported data on the types of granular client or asset-level climate and environmental risk information currently used and envisioned to be used in the Economic Capital estimation. Unit: percentage of respondents. Survey question: "What kind of C&E risk client-/asset-level information is currently used or envisioned to be used in the Economic Capital estimation for the following aspects: Climate Transition Information, Climate Physical Information, Non-Climate Environmental Transition Information, Non-Climate Environmental Physical Information? (Single choice)".

Looking ahead, many banks anticipate expanding their use of C&E data. An additional 47% foresee incorporating climate transition risk information, while 50% plan to integrate climate physical risk data into their Economic Capital estimation processes. The expected adoption of non-climate-related risks remains comparatively lower, with approximately 27% envisioning the use of non-climate transition or physical risk information.

These findings suggest that while the incorporation of C&E risks into Economic Capital estimation is still evolving, 50% adoption refects that integration is possible, setting a precedent for broader industry adoption.

4.4. Implied risk-based pricing

In this section, we ask: Do banks use climate and environmental (C&E) information implicitly for pricing?

Risk-based pricing is a fundamental approach in banking, ensuring that the price of a loan reflects the underlying risk characteristics of the borrower. The core component of risk-based pricing is the credit spread, which consists of three key elements:

- **Expected Loss (EL)**: Defined as $EL = PD \times LGD \times EAD$, expected loss represents the bank's anticipation of default-related losses, which are captured under IFRS 9 loan loss provisioning.
- **Economic Capital (EC) Cost**: The cost of holding economic capital, calculated as $EC\times$ the bank's target return on risk-weighted capital. EC itself is determined by unexpected loss, ensuring sufficient capital buffers against tail-risk events.
- **Liquidity Premium**: A compensation factor reflecting potential difficulties in selling or hedging the loan in secondary markets.

The relationship between these components dictates that higher probabilities of default (PD) and loss given default (LGD) result in a higher credit spread, thereby increasing the loan pricing to offset additional credit risk exposure.

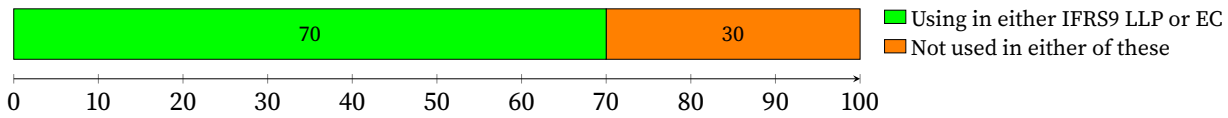
The survey results, presented in Figure 12, indicate that a significant proportion of banks (70%) incorporate C&E risk elements implicitly in risk-based pricing through one of the two key mechanisms: IFRS 9 Loan Loss Provisions (LLP) or Economic Capital (EC). This suggests that environmental and climate-related risks are being factored into pricing indirectly, even if not explicitly stated as dedicated pricing components. The majority of these respondents (53% of the total sample) appear to be using implicitly C&E granular data into pricing, while the remaining share of 27% of respondents seem to be relying solely on non-granular C&E information.

Conversely, 30% of respondents do not integrate C&E information into these pricing elements at all, suggesting that, for a subset of banks, C&E-related risks are not yet reflected

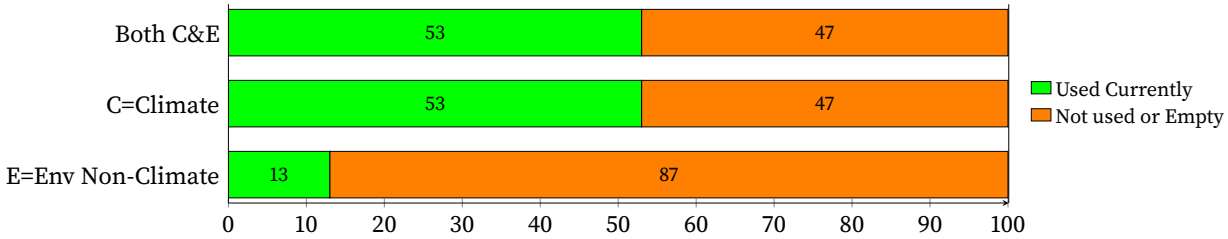
in loan interest rates through traditional financial risk metrics.

FIGURE 12. Implied usage of C&E risk elements in risk-based pricing

Panel A: Implied integration of C&E Risks



Panel B: Implied usage of granular C&E data



Notes: Panel A: This chart presents implied use of climate and environmental risk information in risk-based pricing, based on usage in IFRS 9 Loan Loss Provisions (LLP) or Economic Capital (EC).
Panel B: This chart presents implied use of granular - client and/or asset-level - data on climate and environmental risk in risk-based pricing, based on usage in IFRS 9 LLP or EC.

These findings highlight the evolving nature of C&E integration in banking, showing that implicit adjustments via risk components such as economic capital, loan loss provisions, and credit ratings are already in use. While explicit methodologies for incorporating C&E risks in loan pricing frameworks are still evolving, 70% of respondents already account for these factors indirectly, whether through adjustments in credit ratings, provisioning, or capital allocation. This suggests a pragmatic, risk-sensitive approach where banks are adapting existing frameworks to capture emerging climate and environmental risks, rather than overhauling their pricing models outright. However, the adoption across institutions remains heterogeneous, with some banks embedding C&E factors more systematically than others. For instance, when considering the number of respondents, that systemically account for C&E information in credit ratings, provisioning, and economic capital, only 20% of respondents indicate systematic integration across these three areas.

Overall, the observations on credit risk measurement and risk-based pricing suggest

that while client-level C&E data is increasingly collected (83%) and, its usage in internal credit ratings models, IFRS9 loan loss provisions estimation, economic capital estimation, although already occuring, it is not as widespread, especially when it comes to the usage of client-level C&E data with at maximum 53% of respondents making use of such data in at least one area of credit risk measurement. Also, significant differences exist in the usage of data on climate-related versus other non-climate related environmental aspects. Moving forward, policy measures such as the implementation of standardized and audited data through frameworks like the CSRD could facilitate the integration of such data into internal credit ratings models. Standardization would mitigate data quality concerns, ensuring that banks have reliable and comparable C&E information for their risk assessments.

Considering the varying degrees of granular C&E data usage across different areas, banks would need to establish a robust data architecture with appropriate data flows to ensure the effective integration of C&E information into credit risk measurement. This architecture should enable the seamless feeding of collected client-level C&E data into the back-office modeling systems. Without a coherent data infrastructure that connects data collection in the front office to the modeling processes in the back office, the potential of this information cannot be fully realized. Such an integrated data architecture would not only improve the accuracy of risk identification, but also allow for more timely and effective decision-making regarding the environmental risks faced by clients. Therefore, in the next section we explore the practices for C&E Data Feeding.

5. C&E Data Feeding: From C&E Firm-level Disclosure to Bank's Usage for Risk Management and Disclosure (Survey Area 3)

In this section, we ask: Are banks equipped to use collected firm-level C&E disclosed information for the bank's own C&E credit risk measurement and disclosure?

Under the Capital Requirements Regulation (CRR), which forms part of the European

banking regulatory framework, banks are required to disclose certain climate-related and environmental (C&E) risks under Pillar 3 ESG disclosures. These disclosures are necessary to ensure that financial institutions assess and integrate C&E risks into their risk management processes. Specifically, banks must report their exposure to climate-related and environmental risks, including but not limited to, biodiversity, pollution, and water use. These disclosures are aimed at enhancing transparency, allowing market participants to understand the extent to which banks are managing these risks and how they may impact the financial system. The intention is to ensure that banks are not only aware of their direct environmental impact but also of the risks embedded within their lending and investment portfolios.

In addition to the Pillar 3 ESG disclosures, banks, like other large undertakings, are also subject to the Corporate Sustainability Reporting Directive (CSRD). Under the CSRD, large undertakings must disclose information regarding their exposure to sustainability risks, including C&E risks. These disclosures must follow the European Sustainability Reporting Standards (ESRS), which require a comprehensive assessment of the double materiality of ESG factors. Specifically, banks are required to report how C&E risks may impact their financial performance (financial materiality) and how their activities may affect the environment and society (environmental and social materiality).

For banks, this means that they must disclose information about the environmental risks embedded in their loan books, investment portfolios, and overall operations. The CSRD also mandates that banks collect data on C&E risks across their value chains, particularly from the corporates to whom they provide loans and financing. Banks must make "reasonable efforts" to obtain this data, especially when it is difficult to access directly. If this data cannot be collected despite reasonable efforts, banks are permitted to estimate the necessary information using proxies or sector-average data, provided these estimates are based on reasonable and supportable data (see Paragraph 65, 68, 69 of ESRS 1).

The integration of climate- and environmental-related (C&E) risks data into bank

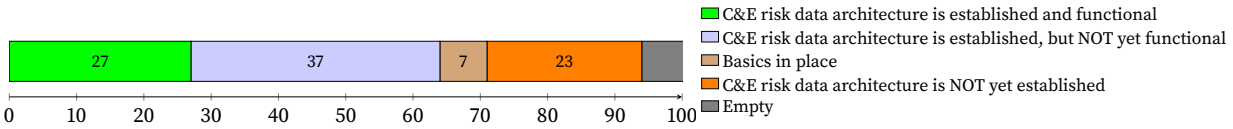
systems is a critical factor in meeting both Pillar 3 ESG and CSRD disclosure obligations. As depicted in Figure 13, only 27% have a well-established and functional data infrastructure. Another, 37% report that their C&E data infrastructure is established but not yet fully functional, and 23% report that they have not yet developed such infrastructure at all.

The less mature state of C&E data integration systems, as highlighted in Figure 13, suggests that while a majority of banks are collecting C&E risks data, many still face significant challenges in operationalizing this data across their systems. This could pose substantial challenges for banks in making the data available for their own disclosures under both Pillar 3 ESG and CSRD. The lack of fully functional integration could limit banks' ability to pull data from various sources, such as client documents, open sources, or third-party providers, and use it effectively for disclosure and risk management.

This issue of system integration is further underscored by the insights from Figure 12, which shows that while 70% of banks appear to be already considering C&E risks factors implicitly into their risk-based pricing models, 30% of banks are not yet considering these factors. Considering this with the relatively low level of full integration in Figure 13, we note that a substantial portion of banks may still struggle from a system-wide perspective to utilize C&E risks data across all relevant internal processes, including pricing, as well as disclosure. Without a functional data infrastructure for C&E data, even those banks already collecting client-specific C&E data for credit rating assignments (see Figure 4) may face difficulties in leveraging these data for their disclosure requirements.

Banks may prefer using estimates or proxies over collecting client-specific C&E data for several reasons. First, the costs associated with storing and integrating such data from front-office processes can be substantial, making the use of proxies a more cost-effective solution. Second, banks may be more inclined to use proxies when client-specific C&E data does not meet the required data quality standards for internal risk management processes and disclosure, since under "reasonable effort" clause the use of estimates is allowed. Thus, while cost considerations likely play a primary role, issues with quality of client-specific

FIGURE 13. Readiness of C&E risk data architecture



Notes: This chart illustrates the self-reported level of integration of C&E risk factors data into the bank's end-to-end data systems, from front-end collection to back-end usage, ranging from functional integration (where C&E risk data ownership, regular updates, and data storage for future use are established) to less integrated approaches. Unit: percentage of respondents. Survey question: "How would you rate the level of integration of C&E factors data (whether bought from data providers, retrieved from open sources, collected from client documents) into the bank-wide data & systems infrastructure?" (Single choice). Note: "functional" means C&E risk data ownership is outlined, C&E risk database is created, regular C&E risk data updates take place, C&E risk data points (whether inputs or outcome) are stored enabling back-testing of models and building up of historical time series for future model developments.

C&E data may also contribute to banks' decision to use proxies instead. To make this more tangible, a key data gap is the lack of information on the locations of assets and activities for large corporates, extending beyond just the counterparty to include the entire value chain (European Banking Authority 2025). Collecting this data would require extensive datasets, which are currently lacking. Additionally, banks' internal databases are often not equipped to integrate such detailed information for counterparties. To effectively use this data for risk assessment, it must also evaluate the materiality and significance of specific assets and activities, as well as their exposure to physical and transition risks, alongside potential mitigating factors. Due to the complexity of this task, simplified approaches, such as using proxies focused on industry sectors, have been developed.

Policymakers should therefore consider measures to enhance the availability, reliability, and standardization of firm-level C&E data, ensuring that banks can efficiently access and integrate this information into their credit risk measurement and disclosure. Strengthening data quality requirements whether through common disclosure standards or through encouraging sector-wide data-sharing initiatives could reduce reliance on estimates while improving risk identification for banks, and transparency in financial markets, while reducing financing red-tape for businesses.

6. Influence of Supervisory Expectation (Survey Area 4)

In this section, we ask: How does setting a supervisory expectation, i.e. the ECB's supervisory expectation 8.2., mobilizes progress of banks to integrate of climate and environmental risks into banks' credit risk classification procedures?

Since the publication of the ECB's Guide on climate-related and environmental risks in November 2020, banks have been required to progressively incorporate C&E risks into their materiality assessments, governance frameworks, and risk management processes[6]. The outlined 13 expectations are structured into three key milestones for banks: March 2023 for conducting a full materiality assessment, end-2023 for integrating C&E risks into governance and risk management, and end-2024 for full compliance with all 13 supervisory expectations. Under the expectation 8 on credit risk management, the ECB outlined the supervisory sub-expectation 8.2. on C&E risks integration into their risk classification procedures to be met by the miletstone end-2023. It states as follows: *"Institutions are expected to adjust risk classification procedures in order to identify and evaluate, at least qualitatively, climate-related and environmental risks. Institutions are expected to define appropriate general risk indicators or ratings for their counterparties that take into account climate-related and environmental risks. As part of risk classification procedures, institutions are expected to identify borrowers that may be exposed, directly or indirectly, to increased climate-related and environmental risks. Critical exposures to such risks should be highlighted and, where applicable, considered under various scenarios with the aim of ensuring the ability to assess and introduce in a timely manner any appropriate risk mitigation measures, including pricing. Institutions are expected to consider, for example, the use of heat maps that highlight sustainability risks based*

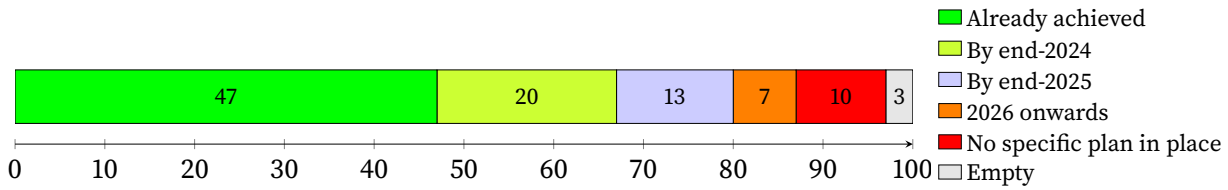
[6]The ECB was among the first supervisors to outline expectations on climate risks for banks, but it was not the very first. Some national supervisors, such as the Bank of England's Prudential Regulation Authority (PRA), had already issued guidance. The PRA published its Supervisory Statement SS3/19 on managing financial risks from climate change in April 2019, setting out expectations for UK banks and insurers. However, the ECB's Guide on climate-related and environmental risks (November 2020) was a major milestone at the EU level, providing a comprehensive supervisory framework for climate and environmental risk management in the banking sector.

on the relevance of individual (sub-)economic sectors for a given client."

Since 2020, the ECB has conducted thematic reviews and on-site inspections, to evaluate banks' progress in integrating C&E risks into their risk management frameworks, including into credit risk management, and published good practices to guide the integration. Moreover, since 2023 significant institutions were required to start reporting on C&E risks, including exposure to physical and transition risks, financed emissions, and green asset ratios (GAR), in compliance with the European Banking Authority (EBA) Implementing Technical Standards (ITS) on Pillar 3 ESG disclosures (following the Capital Requirements Regulation mandate).

The survey results presented in Figure 14 show the current status of banks' alignment with the ECB's supervisory expectations on integrating C&E risks into credit risk classification. The data suggest significant heterogeneity in adoption timelines across banks. While 47% of respondents have already integrated these risks into their classification processes, an additional 20% expect to achieve compliance by the end of 2024, in line with the ECB's final deadline. However, 30% of banks anticipate further delays, with 13% planning implementation by end-2025, 7% only by 2026 or later, and 10% lacking a concrete plan for compliance.

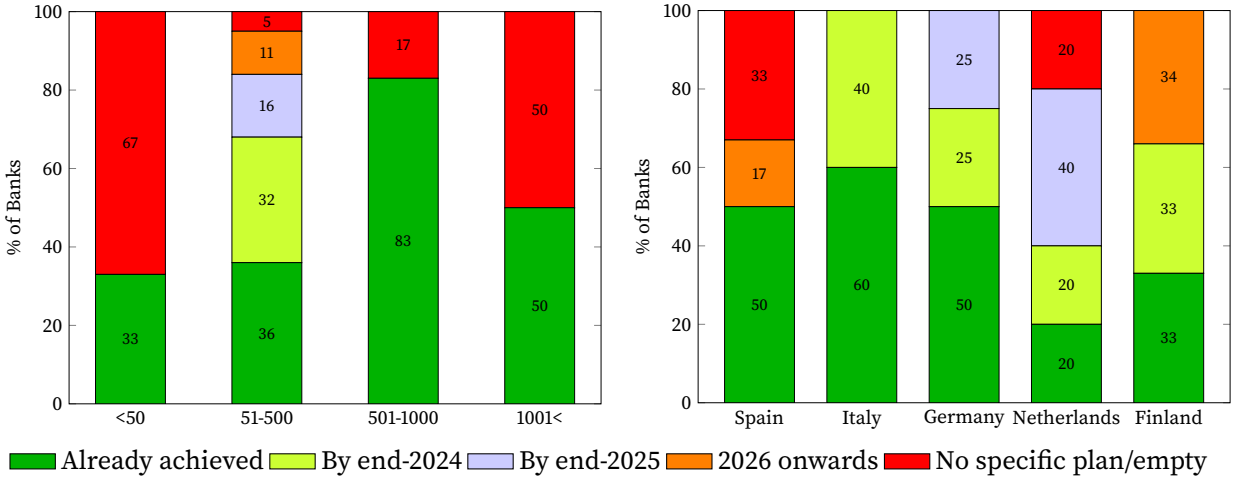
FIGURE 14. Meeting ECB supervisory expectation on integration of C&E information in risk classification procedures



Notes: This chart illustrates the self-reported timelines for adjusting risk classification procedures in line with Expectation 8.2 of the ECB Guide on Climate and Environmental Risks. It highlights when institutions expect to incorporate climate-related and environmental risks into their risk classification processes. Unit: percentage of respondents. Survey question: "By when does your bank expect to adjust risk classification procedures in order to identify and evaluate C&E risk in line with Expectation 8.2. of the ECB Guide on Climate and Environmental Risks? (Single Choice)".

Figure 14 further illustrates the variation in integration across bank size and country. Larger banks (assets exceeding €500 billion) demonstrate a higher degree of compliance, with 83% of banks in the €501-1000 billion category reporting that they have already met the ECB's expectations. In contrast, smaller banks (total assets below €50 billion) show significant delays, with 67% of these institutions lacking a clear integration plan. At the country level, banks in Italy and Germany appear to be more advanced in compliance, whereas banks in Finland and the Netherlands exhibit greater variation, with a notable proportion targeting implementation only after 2025.

FIGURE 15. Size and Country vs Integration Timeline (100% Stacked)



Notes: These charts illustrate the self-reported timelines for adjusting risk classification procedures in line with Expectation 8.2 of the ECB Guide on Climate and Environmental Risks. The left panel groups all responses by bank size, and the right panel focuses on a sub-sample of selected countries. Unit: percentage of respondents. Survey question: "By when does your bank expect to adjust risk classification procedures in order to identify and evaluate C&E risk in line with Expectation 8.2. of the ECB Guide on Climate and Environmental Risks? (Single Choice)".

The survey results indicate a heterogeneous response among banks regarding the integration of climate and environmental (C&E) risks into risk classification procedures following the ECB's supervisory expectations, due by the end of 2023. While 47% of banks report having already aligned their risk classification frameworks with the ECB's guidance on C&E risks, an additional 20% anticipate full compliance by the end of 2024. This suggests that a significant share of institutions have proactively adjusted their risk management

practices in response to supervisory expectations. The data also reveal that a proportion of banks are catching up even if behind schedule: 13% expecting compliance by the end of 2025, and 7% deferring alignment to 2026 or beyond. Still, 10% of respondents indicate having no specific implementation plan.

The degree of progress appears to be influenced by both bank size and jurisdiction. Larger institutions (total assets exceeding €500 billion) report higher levels of integration compared to smaller banks, reflecting possibly superior institutional capacity for incorporating climate-related financial risks. Similarly, cross-country variations may suggest different levels of attention in the respective region for addressing these risks.

Overall, these findings suggest that supervisory expectations have driven significant advancements in the incorporation of C&E risks into credit risk classification procedures of significant institutions.

7. Regression Analysis

This section examines the relationships among four survey dimensions concerning banks' climate and environmental practices and their characteristics. Factors such as a bank's commitment to Net Zero, its size, the level of climate awareness in its home country, and its nation's recent experience with natural disasters may all influence its ability to manage related risks (e.g., Erten and Ongena 2024; Ilhan et al. 2023). Sastry et al. (2024), for instance, show that European banks with voluntary net-zero lending commitments reduce credit in targeted sectors, yet they do not divest more from emissions-intensive firms or alter their behavior compared to other banks.

Given our limited sample of 30 respondents, we treat the survey area variables as measures of intensity on an ordinal scale rather than as nominal categorical indicators. This approach preserves degrees of freedom and ensures reliable estimation in our regression models. Specifically, we detail the intensity for each survey area as follows:

- *SurveyArea1: Number of methods employed for collection*

This variable quantifies the extent of a bank's data collection efforts by counting the number of distinct methods it uses to gather climate and environmental information. Higher values indicate that a bank employs a broader range of methods.

- *SurveyArea2: C&E information implicitly for pricing*

  This variable captures the degree to which banks implicitly incorporate climate and environmental factors into their pricing decisions. Greater values reflect a higher level of implicit pricing integration.

- *SurveyArea3: Risk classification procedures*

  This variable assesses the status of banks' risk classification procedures for climate and environmental risks. It is coded as follows: (1) Already Achieved; (2) By End-2024; (3) By End-2025; (4) 2026 Onwards;(5) No Specific Plan in Place; and (6) Empty. Lower values denote a more advanced stage of risk classification.

- *SurveyArea4: Readiness of data architecture*

  This variable evaluates how prepared a bank's data architecture is to manage and process climate and environmental information. It is coded as follows: (1) C&E risk data architecture is established and functional; (2) Established but not yet functional;(3) Some basics in place; (4) Not yet established; and (5) Empty. Lower values indicate a higher degree of readiness.

As for bank characteristics, we consider bank size, which is grouped into four ordinal categories based on total assets (EUR millions): (1) <50, (2) 50–500, (3) 501–1,000, and (4) >1,000. The variable NZBA is a binary indicator that measures commitment to the Net-Zero Banking Alliance, as evaluated in December 2024. Regarding geographic location, we classify banks into three regions: North, Central (reference), and South. For each model, we estimate both an OLS specification and an ordered logit model.

C&E data collection and bank characteristics

First, we examine Survey Area 1 and consider the number of methods banks employ for data collection, ranging from 0 (no methods in place) to 4. We estimate the regression model in Equation 1 using available bank characteristics:

$$\begin{aligned}\text{SurveyArea1}_i = \beta_0 + \beta_1, \text{NZBA}_i + \beta_2, \text{Size}_i + \beta_3, \text{CenterLocation}_i \\ + \beta_4, \text{SouthLocation}_i + \varepsilon_i, \text{ for } i = 1, \ldots, 30.\end{aligned} \tag{1}$$

As an alternative specification in Equation 2, we include the variable "C&E architecture established" (Yes/No) retrieved from Survey Area 4, which measures the readiness of a bank's data architecture that is signaled by a bank as established and functional. In this respect, this specification tests whether the number of data collection methods is related to the readiness of a bank's data architecture.

(2)

$$\begin{aligned}\text{SurveyArea1}_i = \beta_0 + \beta_1 \text{NZBA}_i + \beta_2 \text{Size}_i + \beta_3 \text{CenterLocation}_i \\ + \beta_4 \text{SouthLocation}_i + \beta_5 \text{C\&E architecture established}_i + \varepsilon_i, \text{ for } i = 1, \ldots, 30.\end{aligned}$$

Results for Equations 1 and 2 are presented in Table 1, where columns (1) and (2) report the ordinary least squares estimates and columns (3) and (4) display the ordered logit estimates. Findings indicate that bank size is positively and significantly associated with the number of methods employed for data collection, suggesting that larger banks tend to adopt a broader range of methods. In contrast, the coefficients for commitment to the Net-Zero Banking Alliance, geographical location, and data architecture established are not statistically significant, indicating that these factors are not associated with the number of data collection methods employed.

TABLE 1. Regression on SurveyArea1 (Number of methods employed for data collection)

Dependent: SurveyArea1	(1)	(2)	(3)	(4)
const	0.095	0.105		
	(0.877)	(0.895)		
NZBA	−0.160	−0.163	−0.272	−0.297
	(0.573)	(0.590)	(0.906)	(0.944)
Size	0.804**	0.775**	1.221*	1.160*
	(0.308)	(0.324)	(0.645)	(0.662)
North Location	0.338	0.299	0.542	0.540
	(0.903)	(0.857)	(1.366)	(1.305)
South Location	0.074	0.006	0.118	0.048
	(0.612)	(0.634)	(1.119)	(1.127)
C&E architecture established		0.344		0.433
		(0.598)		(0.914)
R^2 (Pseudo R^2)	0.167	0.178	0.0593	0.0624
F-statistic (Wald χ^2)	1.77	1.86	3.91	6.12
Observations	30	30	30	30

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Columns (1) and (2) show results from ordinary least squares regressions, whereas columns (3) and (4) display estimates from ordered logit models. Pseudo R^2 and Wald χ^2 refer to the ordered logit specifications. The dependent variable, SurveyArea1, measures the number of methods employed for data collection (ranging from 0, indicating no methods, to 4).

C&E risk measurement, pricing, and bank characteristics

As a second examination, we consider Survey Area 2, which describes if a bank uses (or not) climate and environmental information implicitly for pricing:

$$\begin{aligned} \text{SurveyArea2}_i = \beta_0 + \beta_1, \text{NZBA}_i + \beta_2, \text{Size}_i + \beta_3, \text{CenterLocation}_i \\ + \beta_4, \text{SouthLocation}_i + \varepsilon_i, \text{ for } i = 1, \ldots, 30. \end{aligned} \tag{3}$$

In the alternative specification given in Equation 4, we include the binary variable

"Collecting firm-level data" (Yes/No) based on responses recorded in Survey Area 1. This specification aims to test whether banks' C&E pricing reflects the collection of firm-level data.

(4)

$$\begin{aligned}\text{SurveyArea2}_i = \beta_0 + \beta_1\,\text{NZBA}_i + \beta_2\,\text{Size}_i + \beta_3\,\text{CenterLocation}_i \\ + \beta_4\,\text{SouthLocation}_i + \beta_5\,\text{Collecting firm-level data}_i + \varepsilon_i, \text{ for } i = 1, \ldots, 30.\end{aligned}$$

Results for SurveyArea2 are presented in Table 2. In these regressions, the dependent variable indicates whether a bank considers climate and environmental information implicitly when setting prices. Columns (1) and (2) report the ordinary least squares estimates, whereas columns (3) and (4) display the logit estimates. Notably, the coefficient for the commitment to the Net-Zero Banking Alliance (NZBA) is positive and statistically significant at the 10% level, suggesting that banks committed to net-zero targets are more likely to incorporate climate and environmental considerations into their pricing. In contrast, bank size and geographical location do not exhibit statistically significant effects. Interestingly, the coefficient on the firm-level data collection variable is positive and statistically significant, suggesting that the practice of collecting firm-level data is associated with higher C&E risk pricing.

Meeting supervisory expectations and bank characteristics

In the third examination, we exploit, in Equation 5, Survey Area 3, which measures the status of the integration of C&E Risks in risk classification procedures. This variable is coded as follows: (1) Already Achieved; (2) By End-2024; (3) By End-2025; (4) 2026 Onwards; (5) No Specific Plan in Place; and (6) Empty. Lower values indicate a higher degree of integration, while higher values signal a lack of implementation. This measure allows us to evaluate the progress banks have made in incorporating C&E risk classification into

TABLE 2. Regression on SurveyArea2 (Climate and environmental information implicitly for pricing)

Dependent: SurveyArea2	(1)	(2)	(3)	(4)
const	0.575	0.490	0.241	0.236
	(0.342)	(0.308)	(1.634)	(1.730)
NZBA	0.299*	0.320*	1.643*	2.166**
	(0.170)	(0.157)	(0.949)	(1.038)
Size	0.033	−0.052	0.203	−0.408
	(0.132)	(0.116)	(0.631)	(0.623)
North Location	0.036	−0.128	0.211	−1.200
	(0.263)	(0.262)	(1.449)	(1.828)
South Location	−0.174	−0.238	−0.951	−1.731
	(0.185)	(0.175)	(0.943)	(1.244)
Collecting firm-level data		0.412*		2.467*
		(0.218)		(1.319)
R^2 (Pseudo R^2)	0.119	0.238	0.1053	0.2236
F-statistic (Wald χ^2)	1.23	2.41		
Observations	30	30	30	30

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Columns (1) and (2) show results from ordinary least squares regressions, whereas columns (3) and (4) display estimates from logit models. Pseudo R^2 and Wald χ^2 refer to the ordered logit specifications. The dependent variable, SurveyArea2, measures whether a bank considers climate and environmental information implicitly for pricing.

their risk management practices. As an alternative specification in Equation 6, we include the variable “Collecting firm-level data”, as previously illustrated.

$$\begin{aligned} \text{SurveyArea3}_i = \beta_0 + \beta_1, \text{NZBA}_i + \beta_2, \text{Size}_i + \beta_3, \text{CenterLocation}_i \\ + \beta_4, \text{SouthLocation}_i + \varepsilon_i, \text{ for } i = 1, \ldots, 30. \end{aligned} \tag{5}$$

(6)

$$\begin{aligned}\text{SurveyArea3}_i = \beta_0 + \beta_1\,\text{NZBA}_i + \beta_2\,\text{Size}_i + \beta_3\,\text{CenterLocation}_i \\ + \beta_4\,\text{SouthLocation}_i + \beta_5\,\text{Collecting firm-level data}_i + \varepsilon_i, \text{ for } i = 1, \ldots, 30.\end{aligned}$$

Results for Survey Area 3 are presented in Table 3 and show that none of the coefficients, whether for commitment to NZBA, bank size, geographic location, or Collecting firm-level data, are statistically significant implying that the observed determinants do not play a role in the integration of C&E risk classification.

C&E data architecture and bank characteristics

Finally, we consider Equation 7, where the dependent variable, previously discussed, SurveyArea4, measures the readiness of a bank's data architecture. This variable is coded as follows: (1) C&E risk data architecture is established and functional; (2) established but not yet functional; (3) some basics in place; (4) not yet established; and (5) empty. Lower values indicate a higher level of readiness, while higher values signal a lack of readiness.

(7)

$$\begin{aligned}\text{SurveyArea4}_i = \beta_0 + \beta_1, \text{NZBA}_i + \beta_2, \text{Size}_i + \beta_3, \text{CenterLocation}_i \\ + \beta_4, \text{SouthLocation}_i + \varepsilon_i, \quad \text{for } i = 1, \ldots, 30.\end{aligned}$$

As an alternative specification in Equation 8, we include the "C&E Risk Classification Achieved" (Yes/No) indicator to describe the status of the bank's risk classification proce-

TABLE 3. Regression on SurveyArea3 (Status of the integration of climate and environmental risk classification)

Dependent: SurveyArea3	(1)	(2)	(3)	(4)
const	2.097	1.921		
	(1.346)	(1.305)		
NZBA	−0.577	−0.533	−0.962	−0.820
	(0.733)	(0.756)	(1.069)	(1.147)
Size	0.077	−0.099	0.006	−0.267
	(0.593)	(0.676)	(0.971)	(1.160)
North Location	0.644	0.304	0.554	0.173
	(1.025)	(1.063)	(1.297)	(1.323)
South Location	0.277	0.144	0.362	0.145
	(0.719)	(0.767)	(0.954)	(1.062)
Collecting firm-level data		0.855		0.953
		(0.611)		(0.978)
R^2 (Pseudo R^2)	0.052	0.100	0.023	0.0356
F-statistic (Wald χ^2)	1.01	0.60	1.88	3.08
Observations	30	30	30	30

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes:Notes. Columns (1) and (2) show results from ordinary least squares regressions, whereas columns (3) and (4) display estimates from ordered logit models. Pseudo R^2 and Wald χ^2 refer to the ordered logit specifications. The dependent variable, SurveyArea3, measures the status of the integration of climate and environmental risk classification. This variable is coded as follows: (1) Already Achieved; (2) By End-2024; (3) By End-2025; (4) 2026 Onwards; (5) No Specific Plan in Place; and (6) Empty. Lower values indicate a higher degree of integration, while higher values signal a lack of implementation.

dures for C&E risks, as obtained from Survey Area 3:

(8)

$$\begin{aligned}\text{SurveyArea4}_i = \beta_0 + \beta_1, \text{NZBA}_i + \beta_2, \text{Size}_i + \beta_3, \text{CenterLocation}_i \\ + \beta_4, \text{SouthLocation}_i + \beta_5, \text{C\&E Risk Classification Achieved}_i + \varepsilon_i,\end{aligned}$$

for $i = 1, \ldots, 30$.

TABLE 4. Regression on SurveyArea4 (Readiness of a bank's data architecture)

Dependent: SurveyArea4	(1)	(2)	(3)	(4)
const	1.395	1.455		
	(0.877)	(0.869)		
NZBA	–0.205	–0.129	–0.277	–0.048
	(0.497)	(0.545)	(0.676)	(0.760)
Size	0.467	0.488	0.545	0.636
	(0.330)	(0.340)	(0.623)	(0.667)
North Location	–0.028	–0.015	–0.038	–0.007
	(0.678)	(0.698)	(0.949)	(0.971)
South Location	0.259	0.224	0.310	0.267
	(0.530)	(0.524)	(0.939)	(0.888)
C&E Risk Classification Achieved		–0.269		–0.748
		(0.565)		(0.864)
Observations	30	30	30	30
R^2 (Pseudo R^2)	0.072	0.082	0.0145	0.0266
F-statistic (Wald χ^2)	0.60	0.51	1.24	1.67

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Columns (1) and (2) show results from ordinary least squares regressions, whereas columns (3) and (4) display estimates from ordered logit models. Pseudo R^2 and Wald χ^2 refer to the ordered logit specifications. The dependent variable, SurveyArea4, measures the measures the readiness of a bank's data architecture. This variable is coded as follows: (1) C&E risk data architecture is established and functional; (2) established but not yet functional; (3) some basics in place; (4) not yet established; and (5) empty.

Table 4 presents the regression results for SurveyArea4, which measures the readiness of a bank's data architecture. The variable is coded from 1 to 5, with lower values indicating a higher level of readiness. Also, in this case, estimates are not statistically significant suggesting that none of the considered determinants are associated with the readiness of a bank's data architecture.

8. Conclusion and Policy Implications

We survey banks to better understand how they are incorporating C&E data into their credit risk measurement for the lending portfolio to large corporates. The base of our assessment considers a homogenous pool of respondents, i.e. significant institutions, to which the C&E supervisory expectation apply since November 2020. We find that a significant majority of significant institutions (83%) gather firm-specific C&E data, although the methods of collection vary widely, with data retrieval from client reports and client requests being the most common.

In terms of integrating C&E data into internal credit ratings, we find that 50% of banks incorporate this data into their Probability of Default (PD) and/or Loss Given Default (LGD) models. However, only 30% of respondents use granular client-level C&E data for these models, indicating that banks are still in the early stages of fully utilizing this more detailed and comprehensive information. In many cases, banks continue to rely on proxies and estimates, which underscores the ongoing challenges they face in obtaining high-quality, reliable, and complete client-level C&E data. Furthermore, our analysis shows that an increasing number of banks are beginning to incorporate C&E data into their IFRS9 loan loss provisioning and economic capital estimations, reflecting a growing recognition of the importance of climate-related risks in their financial decision-making processes.

Regarding risk-based pricing, 70% of banks appear to factor in climate and environmental elements when setting pricing for a loan to a large corporate. However, client-level data is still not widely used for these purposes, and it seems that many banks still rely on proxies. While 27% of banks report having established functional data infrastructures, the big majority still face significant hurdles in operationalizing C&E data effectively. The ECB's Supervisory Expectation 8.2 - set in November 2020 - has driven by end 2024 notable, though uneven, progress among banks in integrating C&E considerations into credit risk classification procedures, with roughly two-thirds responding as either already meeting or

actively working toward alignment with this expectation, while the remaining one-third indicate delays.

The regression analysis offers additional insights into the factors affecting how banks use C&E data in credit risk measurement. We find that bank size is positively correlated with the number of data collection methods employed, suggesting that larger banks have more capacity to adopt a wider range of data collection techniques.

Regarding the incorporation of C&E risks into pricing models, the analysis shows that banks with a NZBA commitment are more likely to integrate these risks into their pricing strategies. However, meeting supervisory expectations appears to be less influenced by bank size, commitment to NZBA, or geographic location, suggesting that other factors, e.g. governance, may be more significant in driving the pace of integration. Similarly, the analysis of data architecture readiness shows that neither bank size nor net-zero commitment had a significant impact on the state of a bank's data infrastructure, implying that other elements, such as institutional priorities, may play a more important role.

Overall, our evidence suggests that banks are increasingly recognizing the importance of incorporating climate and environmental data into their credit risk measurement. While many banks have begun integrating C&E data into their internal credit ratings, provisioning, or economic capital models, the industry has not yet achieved full and comprehensive adoption. For example, although a significant portion of banks collect granular client-level C&E data, only a small percentage are utilizing these data in credit risk assessment. While larger banks and those committed to the Net-Zero Banking Alliance (NZBA) seem to be better positioned to integrate C&E risks, in many instances, these factors do not appear to be decisive. This suggests that other elements, such as governance practices and "tone-from-the-top", may play a more significant role in driving the pace of integration. Our analysis contributes to the research emphasizing the importantce for financial institutions to account for C&E risks. We hope that our findings encourage further theoretical and empirical studies in this area, fostering a deeper understanding of how

C&E risks can be better integrated into financial decision-making processes.

The findings of this study yield several policy implications concerning the integration of C&E data into the credit risk measurement of banks, particularly in the context of ongoing regulatory developments.

First, the results highlight the importance of good quality, standardized, and audited firm-level C&E data for enabling usage in credit risk measurement. While client-level information is increasingly collected (83% of respondents), its systematic integration into internal credit rating models, IFRS 9 loan loss provisioning, and economic capital estimation are more limited (circa 50% of respondents). The implementation of the CSRD, with its emphasis on mandatory, standardized, and audited disclosures, has the potential to significantly enhance the usability of such data for financial institutions, while acknowledging that CSRD alone will not resolve all challenges. For example, the variability of double materiality assessment methodologies applied by non-financial corporates under CSRD may limit the comparability of reported data for banks' counterparty risk assessments.

Second, functional internal data infrastructures are necessary to enable the consistent and timely incorporation of C&E information across banks' risk management, reporting, and disclosure processes. This requires connecting data collection in the front office with modeling and reporting systems in the back office. Without such integration, the potential of firm-level C&E data to improve risk sensitivity and support forward-looking assessments remains largely untapped. Policymakers can play a key role by fostering improvements in banks' internal data governance and systems architecture.

Third, firm-level data quality and/or cost considerations may drive banks to rely on proxies rather than firm-level C&E metrics. For instance, under CSRD banks may justify the use of approximations under the "reasonable effort" clause when client-specific data for loans does not meet internal quality standards or is costly to obtain. To reduce the reliance on proxies, policymakers would need to consider a minimum set of reported sustainability data across all firms.

Fourth, prudential regulation and corporate disclosure requirements must evolve in a coherent and coordinated manner. The European Commission's 2025 Omnibus Package introduces a welcome effort to simplify and streamline the CSRD, CSDDD, and EU Taxonomy frameworks. However, as highlighted by financial supervisors, regulatory simplification should not undermine the availability of granular sustainability data needed for credit risk analysis and supervisory compliance (Times 2025; European Central Bank 2025). Simplification must therefore be balanced with the need to preserve key elements that support robust prudential oversight.

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