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The Impact of Central Bank Communication on Sustainable Finance Instruments

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ABSTRACT: This paper analyzes how central banks' communication influences corporate financial decisions and instruments. Empirically, we find that more active central bank communication is associated with a rise in firms' green bond issuance. The effect seems to be particularly strong among commercial banks, firms closely monitoring central bank climate communication, and firms with higher exposure to weather-related risks and opportunities. This likely reflects strategic responses to anticipated regulatory and market shifts.

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Keywords:	Central banking, Communication, Climate change, Green bonds, Sustainable finance, Natural language processing.
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WORKING PAPERS

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Marina Conesa Martinez[2]

This version: July 2025

Abstract

This paper analyzes how central banks' communication influences corporate financial decisions and instruments. Empirically, we find that more active central bank communication is associated with a rise in firms' green bond issuance. The effect seems to be particularly strong among commercial banks, firms closely monitoring central bank climate communication, and firms with higher exposure to weather-related risks and opportunities. This likely reflects strategic responses to anticipated regulatory and market shifts.

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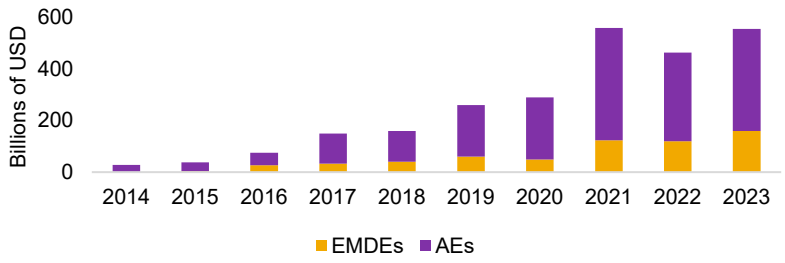
I. Introduction

Weather-related events, such as natural disasters and more slow-moving changes in the physical environment, such as rising temperatures and sea levels, impact economies and financial systems through numerous channels.[3] Risks from such events not only affect economic stability but also pose long-term challenges to achieving sustainable growth (NGFS, 2024). To mitigate these risks and align with the Paris Agreement's goal of limiting global warming to below 2°C, an estimated $4.5 trillion in annual investments is required (IEA, 2023). This financing must support mitigation efforts, such as reducing greenhouse gas emissions, and adaptation measures, including enhancing resilience to natural disasters. To build resilience to these shocks, mobilizing resources from both the public and private sectors will be required.

Green bonds have emerged as a key financial instrument in this effort (Flaherty et al., 2017; Maltais and Nykvist, 2020). The European Investment Bank issued the first green bond in 2007, followed by the World Bank in 2008. The market has experienced rapid growth over the last decade, surpassing $2.5 trillion in cumulative issuance by 2023, reflecting increasing investor demand for instruments that align financial flows with sustainability goals (see Figure 1). These fixed-income securities are specifically designed to fund environmentally beneficial projects.

Figure 1: Green bonds' issuance



Source: Climate Bonds Initiative

Green bonds promote green finance by supporting renewable energy, such as wind, solar and hydropower, improving energy efficiency, and reducing carbon emissions (Al Mamun et al., 2022, Hesary et al., 2023; Li et al., 2023). Beyond environmental benefits, they promote innovation by easing financial constraints and encouraging sustainable transformation in firms (Wu et al., 2022). Green bonds also enhance the information contained in stock prices by increasing transparency, and reducing information asymmetry (Wang and Jiang, 2023). Moreover, they positively impact firms' ESG performance by improving corporate reputation, and attracting more investors to sustainable projects (Zheng et al., 2023; Flammer, 2021).

The integrity of the green bond market depends on robust frameworks and standards to ensure transparency and accountability. Market initiatives have sought to provide standardized, transparent, and reliable criteria to determine the conditions under which a bond can be considered "green". Two key standards dominate the market: the International Capital Markets Association (ICMA) Green Bond Principles (GBP) and the Climate Bonds Initiative (CBI) certification scheme. The GBP emphasizes clear guidelines for the use of proceeds, project evaluation, and impact reporting, ensuring that green bonds finance verifiable and

[3] Physical risks, such as increasingly frequent and severe natural disasters or degradation, disrupt production, damage infrastructure, and threaten lives. Transition risks, including regulatory changes and technological shifts towards a low-carbon economy, introduce costs and uncertainties for businesses.

impactful projects.[4] The CBI certification complements the GBP by requiring third-party verification, providing an additional layer of assurance for investors.[5]

Central to address rising risks from weather events is the involvement of diverse stakeholders. Governments play a pivotal role, as they can establish overarching policies and frameworks to meet international commitments such as the Paris Agreement. However, central banks also face new challenges to their traditional mandates of price and financial stability (NGFS, 2019). From the perspective of price stability, natural disasters can disrupt supply chains, drive up energy and food prices, and create inflationary pressures. These pressures complicate monetary policy, as central banks must navigate short-term price shocks while maintaining long-term stability. Similarly, regulatory changes linked to the transition toward new energy sources can influence market expectations, introducing volatility and uncertainty. In terms of financial stability, physical risks can erode the value of collateral, disrupt financial flows, and destabilize financial institutions. Moreover, transition risks, such as the devaluation of stranded assets in carbon-intensive sectors, may threaten the solvency of financial institutions and could constrain credit availability. To navigate these challenges while maintaining their mandates, central banks are adapting their frameworks to integrate considerations of weather risks. This includes enhancing analytical capabilities, adjusting operational tools, and supporting sustainable finance to facilitate the necessary mitigation and adaptation measures aligned with the transition towards a resilient economy (see Dikau et al., 2020 for a detailed discussion of instruments central banks can deploy in this regard). These measures underscore the evolving role of central banks in addressing weather-related economic risks and fostering sustainable finance.

Indeed, these news considerations are increasingly becoming integral to central bank communication strategies. In this paper we study how central bank communication via speeches can potentially impact firms' financial decisions to issue green bonds, and whether this effect is higher for certain types of firms. The intuition is that by clearly acknowledging the risks of weather events for the economy and signaling their commitments and policies, central banks can shape market expectations and reduce uncertainty, effectively influencing financial and corporate decisions. This strategic use of communication via speeches serves several purposes.[6] On top of describing the economic and financial implications of weather risks, it aligns market behavior by fostering confidence among investors and reducing the perceived risks of long-term sustainable investments under predictable and stable policy environments. Central banks can achieve this by signaling their commitment or support of climate-related policies (Campiglio et al., 2025). This approach not only enhances market certainty but also channels critical capital toward financing the energy transition. In turn, this supports central banks in addressing the systemic risks posed by weather events, ensuring they can maintain their price and financial stability mandates.

[4] The eligible Green Project categories under the Green Bond Principles include: (i) renewable energy (e.g., production, transmission, and appliances); (ii) energy efficiency (e.g., smart grids, energy storage, and efficient buildings); (iii) pollution prevention and control (e.g., waste reduction, recycling, and air emissions control); (iv) environmentally sustainable management of living natural resources and land use (e.g., sustainable agriculture, reforestation); (v) terrestrial and aquatic biodiversity conservation (e.g., protection of marine and coastal environments); (vi) clean transportation (e.g., electric vehicles, public transit); (vii) sustainable water and wastewater management (e.g., wastewater treatment and flood mitigation); (viii) climate change adaptation (e.g., climate-resilient infrastructure and early warning systems); (ix) circular economy projects (e.g., reusable and recyclable products); and (x) green buildings (meeting recognized environmental certifications). For further details, see ICMA, Green Bond Principles: Voluntary Process Guidelines for Issuing Green Bonds, 2021, pp. 4–5.

[5] Recent regulatory efforts, including the European Union's Green Bond Standard (EUGBS), build on these principles to address challenges such as greenwashing—misrepresenting investments as sustainable without substantive environmental benefits—and enhancing market credibility by aligning proceeds with the EU Taxonomy, a classification system for environmentally sustainable activities. For further reference on green bonds, see Muñoz and Smoleńska, 2023.

6 Central bank speeches are a flexible and timely communication vehicle that allow reaching wider audiences, helping shape expectations and improve public understanding of economic policies (Blinder et al., 2008).

The analysis in this paper yields three key findings. First, we use web scraping and Natural Language Processing (NLP) techniques to quantify qualitative information in central bank communication related to weather events through speeches. This allows for a systematic measurement of messaging over time and across countries. We construct a novel Central Bank Climate Communication Index (CBCCI) that captures the intensive and extensive margin of climate-related communication following a dictionary approach proposed by Arseneau et al., 2022. The index reveals that climate-related communication has intensified in recent years and varies significantly by country income levels. Second, we apply the Local Projection Method (Jordà, 2005) to assess the dynamic effects of communication on firm-level green bond issuance. This approach enables the estimation of the time-dependent impact of central bank communication on financial decisions. Our findings reveal that the CBCCI is positively associated with the share of green bonds issued by firms, suggesting that stronger messaging by central banks supports the expansion of green finance via bonds. Finally, we exploit heterogeneities at the firm level and find that the effects of central bank communication vary along several dimensions. Results suggest that the impact is more pronounced for (i) commercial banks, (ii) firms that pay closer attention to central bank communication, and (iii) firms with greater exposure to weather events in terms of risks and opportunities. These results underscore the role of central banks in influencing market dynamics through their communication strategies, ultimately shaping the financing landscape for a more resilient economy.

This paper expands upon and contributes to three interrelated strands of literature. First, it relates to the expanding body of research on the role of central banks and financial regulators in addressing climate change, focusing on both policy implications and the legitimacy of their involvement. The literature has examined how climate risks should be integrated into central bank frameworks, particularly through monetary policy (McKibbin et al., 2021) and financial regulation (Campiglio et al., 2018). Alongside these policy debates, another key discussion revolves around the legitimacy of central bank intervention on climate issues (D'Orazio and Popoyan, 2019; Schoenmaker, 2021; Kedward et al., 2024; Hansen, 2022). There are significant cross-country differences in how climate objectives align with central bank mandates. Cross-country studies by Dikau and Volz, 2021 and Baer et al., 2021 reveal that more than half of central banks now carry explicit or implicit sustainability objectives, with advanced economies typically prioritizing prudential risk-mitigation and emerging markets often deploying promotional measures to channel capital toward low-carbon transitions. However, these studies focus primarily on formal policy instruments and mandate design, without addressing how central banks' communication of climate related issues (through speeches, press releases, and other public statements) may itself influence market behavior or financing decisions.

Second, this paper adds to the extensive literature examining how central bank communication shapes economic decisions, anchors market expectations, and potentially serves as an additional policy tool (Blinder et al., 2008; Blinder et al., 2024). A substantial body of research has studied how central bank communication—particularly around monetary policy decisions—influences monetary policy transmission and financial market behavior (Guthrie and Wright, 2000; Gürkaynak et al., 2005; Gorodnichenko et al., 2023). Indeed, Unsal et al. (2022) have explored central bank communication within the broader monetary policy framework, examining both content and accessibility. Recent methodological advances in natural language processing (NLP) and topic modeling have significantly enhanced researchers' capacity to extract informational content from textual data (Gentzkow et al., 2019). Related to central bank communication, several contributions have applied NLP and topic-modeling techniques to analyze speeches and press releases, studying their informational content, implications for financial markets, and identification of

policy priorities (Correa et al., 2021; Benchimol et al., 2021). Nonetheless, relatively few studies specifically apply these methods to central banks' climate-related communication. Notable exceptions include recent contributions examining the presence of climate-related themes in central bank speeches, and studies analyzing the macroeconomic and institutional factors influencing central banks' climate discourse (Dietsch et al., 2022; Arseneau et al., 2022; Feldkircher and Teliha, 2024, Campiglio et al., 2025).
Third, this paper also connects to the growing literature on corporate green bond issuance, which has been comprehensively reviewed by Al Hamrani and Al Hamrani (2025). Empirical evidence consistently shows that stronger ESG performance and robust governance, such as sustainability committees and greater board diversity, increase the likelihood of green bond issuance due to enhanced transparency and investor confidence (Dutordoir et al., 2023; García et al., 2023). The "greenium" debate remains unsettled: some studies document yield discounts for green bonds (Ehlers and Packer, 2017; Zerbib, 2019), while others find no systematic difference once bond characteristics are accounted for (Fatica et al., 2021; Flammer, 2021). Another central issue discussed in the literature is the risk of greenwashing, which is misrepresenting a company's environmental commitment. Research generally supports the argument that green bond issuance, especially when accompanied by external certifications, serves as a credible environmental signal rather than greenwashing (Flammer, 2021; Fatica et al., 2021). Finally, macroeconomic conditions also influence green bond markets. Countries with stronger ratings, larger populations, and stable macroeconomic environments characterized by favorable fiscal balances and low inflation exhibit higher green bond issuance volumes typically (Dan and Tiron-Tudor, 2021). Despite these insights into traditional drivers, the potential role of central bank climate-related communication as a determinant of green bond issuance remains unexplored.
Although prior research has explored separately the relationship between central bank and climate, the effects of communication on financial markets, and the determinants of climate finance through green bonds, few studies have explicitly integrated these areas. Several studies have further explored climate-related central bank communication: how it is associated with other topics within communication, and its macroeconomic and institutional determinants (Arseneau et al., 2022; Arseneau and Osada, 2023; Feldkircher and Teliha, 2024). The closest contribution to our work is Campiglio et al. (2025), who apply natural language processing methods to the largest set of central bank speeches that goes beyond the Bank of International Settlements (BIS) repository to study their effects on stock prices of green versus brown firms worldwide, finding that more active climate related communication is associated with higher returns for greener firms.
Within this scope, this paper contributes to the existing literature by examining how central banks' climate-related communication affects corporate green bond issuance. First, it constructs an updated index of climate-related central bank communication, refining Arseneau et al. (2022) methodology by applying their dictionary to an expanded dataset of speeches through the end of 2023, incorporating a higher-frequency and country-specific dimension. Second, it provides a firm-level perspective on how central bank communication influences the share of green bonds issued by different firms, focusing on its impact on issuers' financial decisions rather than focusing on firms' asset prices. Third, following the literature (Albrizio et al., 2023; Sautner et al., 2023), it leverages earnings call transcripts to capture firm heterogeneities, measuring two key aspects. On the one hand, it assesses firms' attention to central bank communication, evaluating whether firms that actively follow monetary authorities adjust their green financing strategies differently. On the other hand, it examines firms' exposure to weather events in terms

of risks and opportunities to determine whether those most affected alter their financial decisions in response to more active central bank communication.

The rest of the paper is organized as follows. Section II presents the data, and Section III delves into the CBCCI index construction and key trends. Section IV outlines the empirical methodology to evaluate the dynamic effects of the CBCCI on green bond issuance. Section V presents our results, and Section VI discusses their robustness. Section VII concludes.

II. Data

This section describes the data used in the paper, their sources, descriptive statistics, and key stylized facts.

A. Central bank communication data

We collect central bank speeches available from the Bank of International Settlements (BIS) website for more than twenty-five years for the period between January 1997 and December 2023.[7] The dataset includes 18,877 speeches delivered by officials from 104 different central banks.

Table 1 presents a summary of the dataset, distinguishing between advanced economies (AEs) and emerging market and developing economies (EMDEs), following the IMF classification for the World Economic Outlook.[8] The data reveals a strong concentration of speeches from advanced economies, which account for approximately 70% of the total, with an average of almost 17 speeches per central bank per year. Notably, speech frequency is highly skewed, with a small group of central banks, primarily in AEs, accounting for a large proportion of the dataset. The dataset also exhibits differences in speech length. On average, AEs central banks deliver longer speeches than EMDEs, with more than 500 words and almost 30 more sentences, on average. These differences may reflect variations in communication strategies, with some central banks opting for detailed policy statements, while others prioritize concise messaging.

Table 1: Summary Statistics of BIS speeches

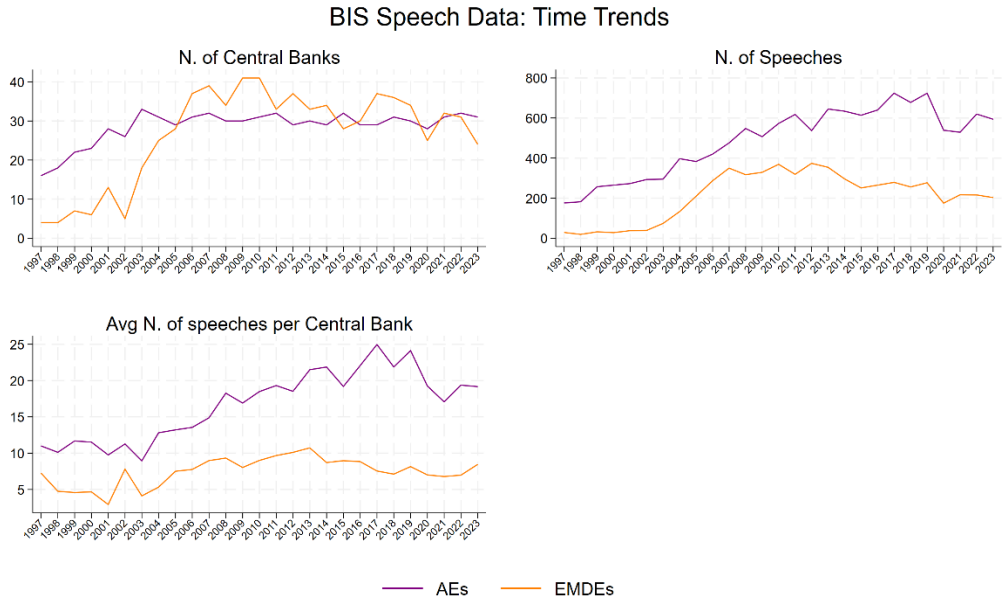
	N. of CB	N. of speeches	Avg N. of speeches per CB per year	Avg N. of words per speech	Avg N. of sentences per speech
AEs	37	13,141	16.7	2,947	127
EMDEs	67	5,736	7.4	2,403	99
Total	104	18,877	12.1	2,675	113.1

[7] The BIS maintains a database of central bank speeches in English, gathered from their official websites. However, for some central banks, the database only includes a limited selection of speeches, as certain central banks are entirely absent or sparsely represented, speech collection has been inconsistent across countries and periods, and non-English speeches have only recently been included, leading to under-representation of some institutions (Campiglio et al 2025). This database is updated daily and offers speeches in PDF format, along with a dedicated webpage containing metadata such as the title, subtitle (which may provide contextual details), institution, date, and speaker's name. The dataset is accessible at https://www.bis.org/cbspeeches/.

[8] See https://www.imf.org/en/Publications/WEO/weo-database/2024/April/groups-and-aggregates.

Figure 1 provides a visual representation of the evolution of central bank communication over time, highlighting key differences between AEs and EMDEs. Since 1997, central banks in AEs have consistently increased their engagement in public communication, both in terms of speech frequency and institutional participation. The number of AE central banks delivering at least one speech per year has remained relatively stable, whereas the total number of speeches issued by EMDEs has nearly doubled, reflecting greater transparency efforts. Still, the total number of speeches from EMDEs has remained below that of AEs, despite the larger number of institutions in this category.

Figure 1: Evolution of BIS speeches data



Source: BIS Speech Repository and own elaboration.

While the BIS dataset provides a valuable record of central bank communication, its coverage is shaped by institutional reporting practices. Not all central banks systematically publish their speeches, and the dataset primarily includes those available in English, which may underrepresent institutions that communicate predominantly in other languages. As a result, certain regions and institutions may be over or underrepresented. Campiglio et al. (2025) have addressed these limitations by supplementing BIS data with additional sources, extending the dataset by retrieving speeches directly from central bank websites and institutional archives, thereby capturing a broader range of communications. However, such efforts require substantial manual collection and processing, which falls beyond the scope of this study.

This database will be used to explore climate related communication and generate the CBCCI, which will be explained in the next section.

B. Green bonds data

We utilize data on green and conventional bond issuances from Dealogic DCM. As a leading global provider of bond primary market data, this dataset offers detailed information on bond characteristics, along with key issuer details such as name, country, and industry. Dealogic also serves as one of the main providers for green bond data, flagging bonds that are self-labeled as Green, Social, or Sustainable. When possible, Dealogic verifies the intended use of proceeds and assigns one or more green categories based on its classification system, which includes renewable energy, energy efficiency, and clean transportation, categories that closely align with the Green Bond Principles (GBP).

Our dataset encompasses all bonds issued by financial and non-financial corporations, as well as supranational institutions, during the period 2000–2023. The database provides qualitative details on various relevant bond characteristics, along with financial attributes and other features that influence investor decisions. In the case of green bonds, sometimes additional information includes the type of project funded by the proceeds, reporting practices, and, where applicable, the name of the external reviewer. From our dataset, we identify 6,634 green bonds among 967,101 fixed-income securities.

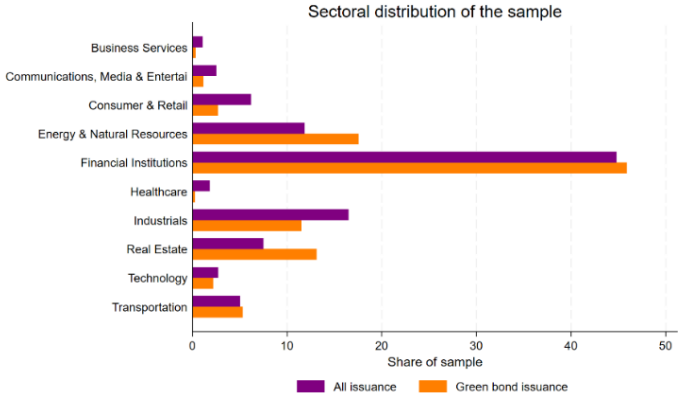
We convert this database into a panel of issuer firms at a quarterly frequency from 2000Q1 to 2023Q4, capturing at the firm level the proportion of green bonds relative to total bond issuances, both in terms of volume and number of bonds. This dataset also includes key issuer characteristics, such as the parent company's country and both broader and granular industry categorizations based on SIC and NAIC classifications.

As shown in Figure 2, the financial sector accounts for most issuances in general, but also dominates green bond issuance. This reflects, in part, the higher reliance of financial firms on the bond market compared to non-financial corporations, as well as their role in facilitating sustainable finance through lending and investment in green projects. Additionally, financial institutions, including banks and asset managers, may issue green bonds to fund sustainable lending portfolios or to meet investor demand for ESG-compliant instruments. Some sectors represent a higher share of the sample in terms of green bond issuance than in terms of overall issuance. For instance, the ‘Energy and Natural Resources’ sector naturally accounts for a larger proportion of green bonds given its direct involvement in renewable energy, water supply, and other sustainable infrastructure projects. This sector includes SIC categories such as electric services or water supply, where green financing is particularly relevant for transitioning toward cleaner energy sources. The transportation sector also represents a slightly higher proportion of green bond issuance compared to its share of overall bond issuance, reflecting the increasing use of green bonds to finance sustainable mobility projects. This includes SIC categories such as railroads and urban transit systems, where decarbonization efforts have led to a rise in investments in electric and low-emission transport solutions.

Interestingly, the real estate sector’s share in green bond issuance almost doubles its share in overall issuance. This includes SIC categories such as real estate agents, managers, and developers. A key reason for this could be the sector’s growing commitment to energy-efficient buildings, sustainable construction practices, and green certification standards such as LEED and BREEAM.[9]

9 LEED (Leadership in Energy and Environmental Design) is a green building certification by the U.S. Green Building Council, assessing energy efficiency, water use, and sustainability (USGBC, LEED). BREEAM (Building Research Establishment Environmental Assessment Method), developed in the UK, evaluates environmental performance across categories like energy, materials, and well-being (BRE, BREEAM).

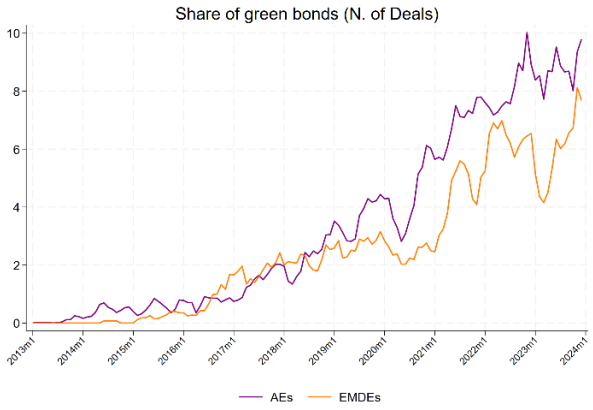
Figure 2: Sectoral distribution of the panel



Source: Dealogic and own elaboration.

Figure 3 illustrates the evolution of the share of green bonds in both AEs and EMDEs, highlighting a positive and comoving trend over the past decade. This trend suggests that firms across different economic contexts are increasingly allocating a larger portion of their bond issuance to sustainable financing. The growing share of green bonds over total issuance at the firm level reflects a broader shift in corporate financial strategies.

Figure 3: Evolution of the share of green bonds



Source: Dealogic and own elaboration.

C. Conference call transcripts

To capture firm-level heterogeneity, we use transcripts from corporate earnings conference calls, which provide real-time insights into issuers' financial conditions and perspectives. These calls are held quarterly between the management of publicly listed companies and their stakeholders to discuss financial results and future outlooks. Our approach builds on recent literature that applies NLP techniques and topic-specific

dictionaries to analyze earnings call transcripts (Hassan et al., 2019; Hassan et al., 2021a; Hassan et al., 2021b). We employ NL Analytics to process the textual data and extract relevant indicators. Our dataset includes more than 200,000 transcripts from publicly listed companies across 39 countries, comprising 26 AEs and 13 EMDEs (where each country has at least 500 transcripts). Firms hold quarterly earnings calls, yielding about four observations per year.

Building on this dataset, we construct two indicators based on the textual content of earnings call transcripts. The first indicator follows the methodology of Albrizio et al. (2023) to capture firms' attention to central bank communication. This measure is derived from a dictionary of keywords related to central banks and monetary policy, originally developed to identify discussions about the U.S. Fed. We extend their dictionary to include keywords that encompass a broader set of central banking functions, including financial stability concerns, to capture a more comprehensive perspective on central bank communication. The second indicator follows the keyword framework established by Sautner et al. (2023) to classify firms based on their exposure to climate-related risks and opportunities. Their methodology allows us to identify in a granular manner how much attention firms' managers and holders pay to climate change exposure in their conference calls. They cover three key dimensions: regulatory risks, physical climate risks, and opportunities arising from climate transition policies. The classification accounts for the potential financial burden on firms with high emissions (e.g., polluting industries) and the opportunities available to firms engaged in renewable energy, electric vehicle production, or energy storage solutions. Using this information, we define a time-invariant binary indicator D_i that equals one if the firm is above the fourth quartile of its sectoral distribution, and zero otherwise. This classification identifies firms with a high degree of attention to central bank communication or significant exposure to climate-related risks and opportunities. The full set of keywords used in these dictionaries and the methodology to construct the binary indicator is provided in Table A1 in the Appendix.

D. Other data

To incorporate firm-level characteristics, we rely on data from S&P Capital IQ, which provides comprehensive balance sheet information at a quarterly frequency. This dataset covers an extensive but unbalanced sample of around 100 countries from 2000Q1 to 2023Q4. Firms with negative values for assets or debt in any year are excluded. Our analysis focuses on two key financial indicators. First, we measure indebtedness as the ratio of total debt to total assets, capturing the extent of a firm's leverage. Second, we define firm size as the logarithm of total assets, which serves as a proxy for the overall scale of the company. To account for climate-related policies at the country level, we use the yearly Environmental Policy Stringency (EPS) Index from the OECD (Kruse et al., 2022), which measures the strictness of government regulations on environmental policies. The EPS captures the extent to which national policies impose costs on polluting activities to promote sustainability and reduce emissions. This composite index includes various regulatory and market-based instruments, such as carbon taxes, industrial emission limits, energy efficiency standards, and emissions trading systems.

Finally, we include real GDP growth from the IMF World Economic Outlook (WEO) to capture business cycle dynamics at a quarterly frequency. This variable provides a broad measure of macroeconomic conditions.

III. Central Bank Climate Communication Index (CBCCI)

To systematically measure central banks' communication on climate-related topics, we construct the Central Bank Climate Communication Index (CBCCI), utilizing NLP to transform qualitative speech data into a quantifiable indicator. As mentioned earlier, dataset comprises approximately 19,000 central bank speeches web scraped from the BIS repository, spanning from the late 1990s to 2023. Given the growing relevance of climate change in central banking discourse, the CBCCI provides a structured way to assess the evolution of this communication over time, capturing both the intensity and the extent of central banks' engagement with climate-related topics.

The identification of climate-related speeches follows a dictionary-based approach, aligning with methodologies in the existing literature. In particular, we rely on the keyword dictionary proposed by Arseneau et al., 2022, which was developed to systematically detect discussions of climate change in central bank communications. They construct this dictionary through an iterative refinement process, beginning with a seed word ("climate change") and expanding it to include the following additional relevant terms: "green finance", "climate-related risk", "Paris Agreement", "climate policy", "low-carbon economy", "carbon emission", and "green bond". This process ensures that the dictionary captures a broad spectrum of climate-related discussions. The dictionary-based method is particularly suitable for this analysis for several reasons. As the authors note, unsupervised topic modeling techniques such as Latent Dirichlet Allocation (LDA), which rely on statistical clustering without predefined categories, struggle to identify relatively new and infrequent topics like climate change in central bank speeches. Moreover, while supervised machine learning techniques (e.g., text regression or Naïve Bayes classification) require a manually labeled training set, such a dataset does not exist for central bank climate-related communication, making supervised methods impractical. Instead, the dictionary-based approach they propose provides a transparent, replicable methodology that is well suited for analyzing structured speech corpora.

Based on Arseneau et al. (2022) dictionary, we construct two complementary indices to quantify the degree of climate-related communication by central banks. These indices are calculated at both monthly and quarterly frequencies, allowing for a granular analysis of trends over time.

The intensive index measures the depth of climate-related discussion within a speech. For each speech *s*, we calculate the proportion of sentences that contain at least one term from the dictionary relative to the total number of sentences in the speech. Formally, let N_s represent the total number of sentences in speech *s*, and $N_s^{climate}$ denote the number of sentences that include at least one climate-related keyword. The speech-level intensity is given by:

$$I_s = \frac{N_s^{climate}}{N_s}$$

This proportion is then aggregated at the central bank level by taking the average across all speeches delivered by a given central bank *c* within a time period *t*. The intensive CBCCI is thus computed as:

$$CBCCI_{c,t}^{intensive} = \frac{1}{S_{c,t}} \sum_{s=1}^{S_{c,t}} I_s = \frac{1}{S_{c,t}} \sum_{s=1}^{S_{c,t}} \frac{N_s^{climate}}{N_s}$$

where $S_{c,t}$ represents the total number of speeches given by central bank *c* during period *t*. This approach captures not only whether a speech mentions climate change but also the extent to which climate-related issues are discussed in depth.

The extensive index captures the breadth of climate-related communication by measuring the share of speeches that contain at least one keyword from the climate dictionary within a given period. Specifically, for each speech *s*, we define an indicator function that takes the value of one if the speech includes at least one climate-related term from the dictionary and zero otherwise. This function allows for a systematic classification of speeches based on whether they engage with climate topics, regardless of the depth of discussion. The extensive CBCCI is then given by:

$$CBCCI_{c,t}^{extensive} = \frac{1}{S_{c,t}} \sum_{s=1}^{S_{c,t}} \delta_s$$

which represents the proportion of speeches in period *t* that include climate-related terms. For example, if a central bank delivers 10 speeches in a particular month or quarter, and 2 of them mention at least one climate-related keyword, the extensive index for that month would be 20%. This indicator provides insight into how frequently climate-related topics appear in central bank discourse, irrespective of the depth of discussion.

The index allows for cross-country and temporal comparisons of central banks' engagement with climate issues, helping to assess whether climate-related communication has become more prevalent, how it varies across institutions, and whether it aligns with broader policy shifts. Moreover, the combination of intensive and extensive measures provides a more nuanced understanding of central bank climate communication than binary classification methods. While the extensive index captures how frequently climate change is mentioned, the intensive index accounts for the depth of discussion, helping to distinguish between brief references to climate-related topics and more substantive policy discussions.

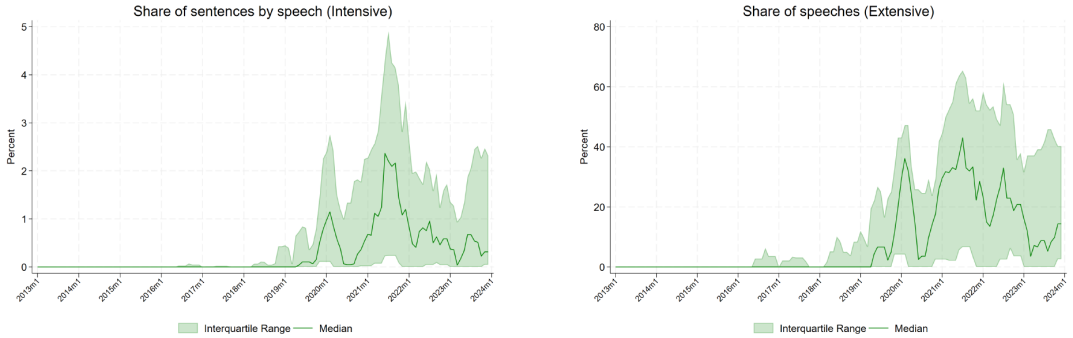
The CBCCI differs from Arseneau et al. (2022) in several ways. While they identify only 'climate-related speeches' based on the presence of terms from the dictionary in at least two separate sentences, the CBCCI captures all central bank climate communication, including instances where a related term to climate change is mentioned only once. This broader scope ensures that even brief references are accounted for, reflecting potential institutional priorities. Moreover, unlike Arseneau et al. (2022), which analyze only speeches classified as climate-related and then assess their intensity, the CBCCI benchmarks climate communication against overall central bank communication by assigning an index value of zero when no climate-related content is present. This approach allows for a relative measure of climate communication within the broader context of central bank discourse, rather than limiting the analysis to a subset of speeches. The CBCCI also offers extended coverage up to the end of 2023, compared to 2021 in Arseneau et al. (2022), and a higher frequency of measurement, as it is constructed at a monthly or quarterly level, rather than annually.

a. CBCCI Results and Trends

The analysis of the CBCCI reveals significant insights into the evolution of climate-related communication among central banks. Examining the median and interquartile ranges of both the intensive and extensive indices at a monthly frequency (Figure 4), three key observations arise. First, climate-related communication by central banks has increased over time, exhibiting a clear upward trend until 2021 in both indices. This suggests a growing recognition of the relevance of climate change for economic and financial stability, particularly as central banks progressively integrate these considerations into their discourse. The

increase aligns with broader institutional efforts to address climate-related risks and the inclusion of climate considerations in policy discussions. Second, while the intensive index, which measures the depth of climate content within speeches, remains relatively low, the extensive index reaches up to 45% at its peak, indicating that nearly half of all central bank speeches at certain times have included at least some mention of climate-related topics. This suggests that while detailed discussions of climate risks and policies may still be limited, central banks have incorporated climate considerations more frequently in their communication, signaling the increasing importance of climate issues in economic policymaking. Third, there is considerable dispersion in the CBCCI indices, indicating substantial variation across countries in the extent and intensity of climate-related communication. While some central banks have been proactive in incorporating climate change into their policy discourse, others have maintained a more limited engagement with the topic. Despite these cross-country differences, a common pattern emerges in 2021: there was a noticeable increase in climate-related discourse across all central banks. This period coincides with central banks globally acknowledging the relevance of climate change more actively, with some incorporating concrete policy adjustments. A notable example is the ECB's monetary policy framework review, which explicitly introduced climate considerations into its mandate.

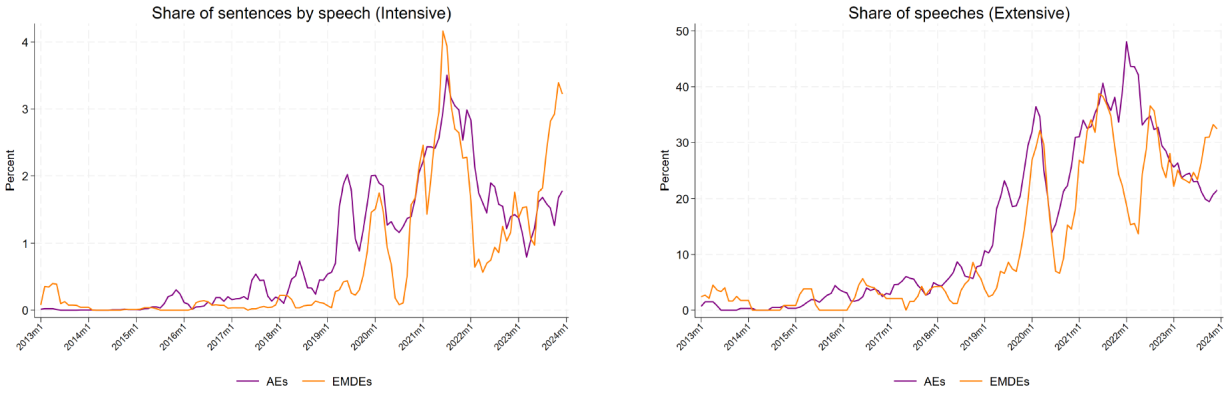
Figure 4: CBCCI Indices



Source: BIS Speech Repository and own elaboration.

Beyond country-level variations, differences in climate communication trends across income groups also stand out in Figure 5. The data reveals a strong correlation in climate-related communication trends between AEs and EMDEs, particularly before 2022. However, in the most recent period, a divergence has emerged: while AEs have reduced their climate-related communication, EMDEs have intensified their discussions on climate issues. This divergence likely reflects differences in policy priorities and macroeconomic conditions. In AEs, central banks have been primarily focused on controlling inflation in services, while new challenges such as geopolitical tensions and artificial intelligence have gained prominence in policy discussions, potentially diverting attention from climate-related topics. Conversely, in EMDEs, climate change remains a more pressing economic concern, particularly due to its impact on food prices and inflation volatility. Additionally, many central banks in EMDEs have broader mandates that extend beyond price stability, allowing them to play an active role in sustainability and green finance policies (Dikau and Volz, 2021).

Figure 5: CBCCI indices by income level



Source: BIS Speech Repository and own elaboration.

These findings highlight the evolving nature of climate-related communication by central banks and the varying degrees of engagement across different economic contexts. The literature finds that central bank climate communication is primarily driven by institutional and external pressures rather than direct climate risk exposure. Campiglio et al.(2025) highlight institutional factors, such as the breadth of a central bank's mandate, its role in financial supervision, and NGFS membership, as key drivers. In contrast, a country's exposure to climate risks, particularly physical risks such as climate disasters, has little to no impact. Similarly, Feldkircher and Teliha (2024) emphasize peer and political pressure as determinants, finding that NGFS membership fosters norm diffusion and that strong national climate policies lead to more green communication. Moreover, they show that central banks primarily frame climate discussions around financial stability rather than monetary policy.

IV. Empirical methodology

We use local projection methods following Jordà (2005) to estimate the dynamic effect of CBCCI on the share of green bonds for a panel of issuer firms, using quarterly data from 2000 to 2023. We proceed in two steps.

First, we estimate the average (unconditional) effect of the CBCCI on the share of green bonds using the following specification:

$$ShGB_{i,s,c,t+h} = \gamma^H ShGB_{i,s,c,t-1} + \beta^H_{t+h} CBCCI_{c,t} + \sigma^H X_{c,t,y} + \omega^H Z_{i,t-1} + \alpha^H_{iq} + \alpha^H_{sc} + \alpha^H_{yq} + \varepsilon_{i,c,t} \quad (1)$$

where $ShGB_{i,s,c,t+h}$ is the share of green bonds over total bonds issued by firm i in sector s and country c at time $t+h$. $ShGB_{i,s,c,t-1}$ controls for the persistence of firms' green bond issuance behavior. The key explanatory variable, $CBCCI_{c,t}$ captures the Central Bank Climate Communication Index (CBCCI), measured either intensively or extensively. We use the moving average of the latest four quarters to (i) smooth short-term fluctuations, (ii) account for the overall level of climate-related communication over a year, and (iii) reduce simultaneity bias, ensuring that communication precedes firms' financing decisions. The coefficient β^H_{t+h} reflects the average firm response in terms of the share of green bond issuance following an increase in central bank climate communication after h quarters.

The model includes a set of controls and fixed effects to account for endogeneity issues and omitted variable bias. Country-level controls denoted as $X_{c,t,y}$ account for regulatory and macroeconomic conditions, such as the Environmental Policy Stringency (EPS) Index to control for climate regulation, and real GDP growth to capture the business cycle. Firm-level controls, denoted as $Z_{i,t-1}$ include leverage and firm size, as these characteristics may influence bond issuance decisions. Then, we include a comprehensive set of fixed effects to capture unobservable factors. Firm-quarter fixed effects (α_{iq}^{H}) control for time-invariant firm characteristics, such as corporate culture or long-term financial strategy, as well as seasonal patterns in bond issuance. This ensures that the results are not biased by firms' individual tendencies to issue green bonds in specific quarters. For instance, an energy company may systematically issue more green bonds in the third quarter to finance solar projects, taking advantage of seasonal demand for renewable energy. Sector-country fixed effects (α_{sc}^{H}) account for structural differences across sectors and the country's specialization in certain industries, mitigating the risk that a country's comparative advantage at the sector level biases the estimated relationship between bond issuance and central bank climate communication. For example, Germany's leadership in electric vehicle manufacturing could result in a higher share of green bond issuance in the automotive sector. Finally, year-quarter fixed effects (α_{yq}^{H}) capture global factors and international shocks affecting all firms and countries simultaneously, such as changes in international regulations or oil prices, among others. For instance, COP meetings may have triggered a broad increase in green bond issuance, independent of central bank climate related communication. The model is estimated for horizons *h*=0,1,…,8, with standard errors clustered at the firm, country, time level. Summary statistics are provided in Table 2 in the Appendix.

In the second step, we extend equation (1) to examine how the dynamic effect of central bank climate communication on green bond issuance varies depending on firm-level characteristics. To do so, we estimate the following specification:

$$ShGB_{i,s,c,t+h} = \gamma^{H} ShGB_{i,s,c,t-1} + \beta_{t+h}^{H} CBCCI_{c,t} + \mu_{t+h}^{H} CBCCI_{c,t} * Characteristic_{i,s,c} + \sigma^{H} X_{c,t,y} + \omega^{H} Z_{i,t-1} + \alpha_{iq}^{H} + \alpha_{sc}^{H} + \alpha_{yq}^{H} + \varepsilon_{i,c,t} \quad (2)$$

where $Characteristic_{i,t,c}$ represents a time-invariant firm-specific variable, ensuring that the estimation is not affected by potential time-varying endogeneity in the response of green bond issuance to central bank climate-related communication. This extended specification remains consistent with the baseline model but now incorporates an interaction term between CBCCI and firm characteristics to capture heterogeneous responses across firms.

The coefficient μ_{t+h}^{H} captures the additional marginal effect of CBCCI on green bond issuance for firms with specific characteristics, relative to their counterparts. We focus on two key dimensions of firm heterogeneity. First, we distinguish firms based on their sectoral classification, identifying whether they are financial institutions or more specifically, commercial banks. Second, we incorporate firm-specific measures derived from earnings call transcripts, distinguishing between firms that pay greater attention to central bank communication and firms more exposed to climate change risks and opportunities compared to other firms in their sectors.

In the robustness checks, we consider alternative specifications of Equations (1) and (2) by using a broader set of central bank speeches to calculate the CBCCI, modifying the definitions of CBCCI, using different sets of control variables, and testing the sensitivity of results across various sample selections.

V. Results

This section presents the results of our empirical analysis. First, we examine the unconditional dynamic effect of central bank climate communication on the issuance of green bonds. Then, we explore how this effect varies across different types of firms, focusing on financial institutions, firms that pay greater attention to central bank communication, and firms more exposed to climate change risks and opportunities.

a. Unconditional dynamic effect

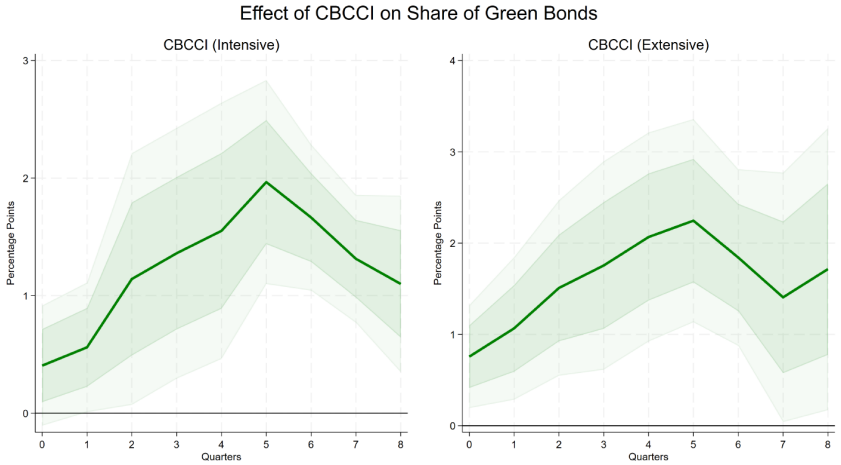
We begin by analyzing the general relationship between central bank climate communication and the issuance of green bonds, estimating the baseline model without interaction terms. Figure 6 illustrates the dynamic impact of an increase in the CBCCI on the share of green bonds issued by firms. The solid line in the figure represents the estimated average response, while the lighter bands denote the 90% and 68% confidence intervals, respectively.

Our findings indicate that greater central bank climate communication is associated with a statistically significant increase in the share of green bonds issued by firms. Specifically, a one-standard-deviation increase in central bank climate communication—measured either by the intensive margin (share of climate-related content in speeches) or the extensive margin (share of speeches mentioning some term of the climate dictionary)—increases firms' share of green bond issuance by approximately 2 percentage points at peak. Given the historically low average share of green bond issuance (1.9%) over the entire sample period (2000–2023), this effect represents a substantial increase, roughly doubling the average share. Even relative to the higher average share observed in 2023 (9.3%), a 2 percentage point increase remains economically meaningful, corresponding to about a 20% rise in firms' share of green bonds issuance. The similarity of coefficients across intensive and extensive measures indicates both variables reflect comparable signaling effects, likely due to their strong correlation and similar impacts on firms' issuance decisions. The persistence of this effect highlights the potential role of central banks in shaping financial markets' expectations regarding climate-related considerations.

The effect is not immediate but builds over time, reaching its peak after approximately four quarters. This lagged response is consistent with financial decision-making theories, such as the market timing hypothesis (Baker and Wurgler, 2002), which suggests that firms do not adjust their financing structures instantaneously in response to macroeconomic signals but instead plan their bond issuance strategically. Green bonds, in particular, require additional preparation time compared to conventional bonds that can extend issuance timelines by several months, as firms usually develop a green bond framework, secure third-party verification, and align eligible projects with sustainability criteria processes (World Bank, 2022). Thus, the observed delay likely reflects a combination of planning constraints, regulatory compliance, investor adaptation, and refinancing cycles, which take time to influence firms' financing decisions. Furthermore, since central bank climate communication is captured as a four-quarter moving average, firms' responses reflect an adjustment to a sustained pattern of climate-related communication rather than an isolated quarterly change. This reinforces the idea that central bank climate messaging can play a role in shaping firms' long-term financing decisions, particularly when communication remains persistent over time. This finding aligns with Campiglio et al. (2025), who show that climate-related

communication from central banks influences market expectations and investor behavior. Their study finds that such communication affects firm-level stock prices, with 'green' firms outperforming 'dirty' firms when central banks engage more frequently and intensely with climate-related topics.

Figure 6: Unconditional effect of CBCCI on the share of green bonds' issuance



Note: Impulse response function based on local projection methods following Jordà, 2005 using firm-level quarterly data from 2000 to 2023. This figure shows the dynamics of the CBCCI coefficient on the share of green bond issued by firms. The confidence interval is set at 68% and 90%, respectively. The model is estimated for horizons h=0,1,…,8, with standard errors clustered at the firm, country and time level.

b. Conditional Dynamic Effects: Heterogeneity Across Firms

Next, we explore how the impact of central bank climate communication on green bond issuance varies depending on firm characteristics. We estimate Equation (2), which interacts the CBCCI intensive index with different firm-specific attributes, allowing us to assess heterogeneous responses across different types of firms.

i. Financial Sector and Commercial Banks

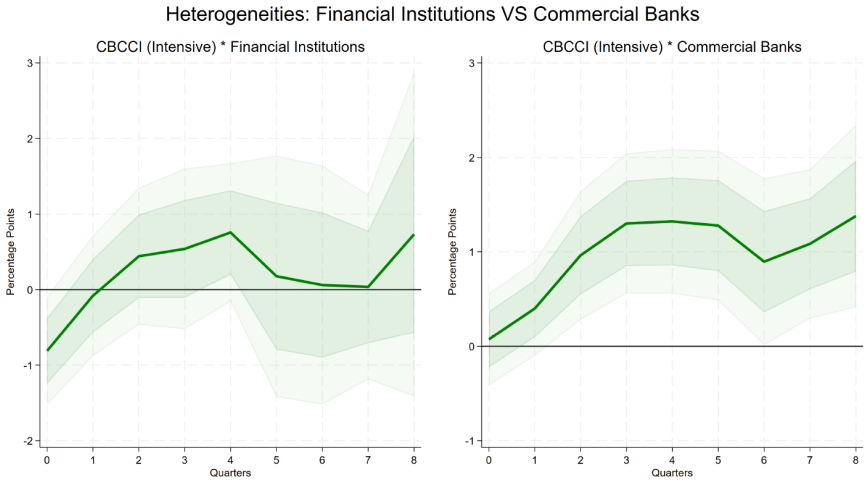
The results in Figure 7 indicate that the effect of CBCCI on green bond issuance is significantly stronger for commercial banks, while no significant additional effect is observed for financial institutions as a broader category. This finding aligns with the fact that commercial banks operate under direct central bank supervision, making them more responsive to signals from monetary authorities regarding climate-related risks and policies. Unlike other financial institutions, such as asset managers or insurance companies, commercial banks are subject to capital requirements, climate-related stress tests, and disclosure mandates, which may increase their sensitivity to central bank communication on sustainability. Evidence from Morse et al. (2024) suggests that financial institutions adjust their portfolios in anticipation of regulatory shifts related to climate policy. In particular, banks align lending and financing strategies to mitigate the risks associated with upcoming regulatory changes, such as carbon pricing mechanisms, disclosure requirements, and stress testing for climate-related risks. This goes in line with the fact that the number of banks that are aligning finance emission with the Paris Agreement's target through the Net-Zero Banking Alliance (NZBA) has more than tripled between 2021 and 2024 (UN, 2024).

Since central banks play a key role in defining the regulatory landscape for commercial banks, climate-related communication from monetary authorities may serve as a leading indicator of future central bank

policy directions, prompting banks to increase their issuance of green bonds as a strategic response to expected changes in financial regulations.

In contrast, the lack of a significant interaction effect for financial institutions as a broader category suggests that non-commercial financial firms, such as investment funds, insurance companies, and other entities that do not necessarily operate under the same regulatory and supervisory framework, do not exhibit a statistically distinct response beyond the average firm-level effect. This highlights the importance of regulatory exposure in shaping how firms react to central bank climate communication, reinforcing the role of commercial banks as key transmission channels for monetary authorities' climate-related messaging.

Figure 7: Conditional effect - financial institutions and commercial banks' characteristics



Note: Impulse response function based on local projection methods following Jordà, 2005 using firm-level quarterly data from 2000 to 2023. This figure shows the dynamics of the interaction coefficient between CBCCI coefficient and firms' characteristics (Financial Institution or Commercial Bank) on the share of green bond issued by firms. The confidence interval is set at 68% and 90%, respectively. The model is estimated for horizons h=0,1,…,8, with standard errors clustered at the firm, country and time level.

ii. Firms' Attention to Central Bank Communication

We also examine whether firms that pay closer attention to central bank communication exhibit a stronger response to climate-related messaging. Using the measures derived from earnings call transcripts, we classify firms based on the frequency with which they discuss central bank-related topics. Figure 8 (left) reports the differential response for firms in the top quartile of central bank communication attention.

The results show that firms that closely follow central bank communication experience a significantly larger increase in the share of green bonds issued following an increase in CBCCI. This suggests that these firms are more likely to interpret central bank signals as relevant for their financial strategy, adjusting their capital-raising activities accordingly.

A potential explanation for this result is that firms actively monitoring central bank communication are better positioned to anticipate shifts in the regulatory and financial environment. As highlighted in Albrizio et al. (2023), greater attention to central bank policies is likely associated with better firms' understanding of policy objectives and transmission mechanisms, allowing them to respond more effectively to central bank signals. While their study focuses on monetary policy and inflation expectations, the broader implication applies here: firms that closely follow central bank discourse are more likely to adjust their strategies in response to changes in financial conditions and regulatory priorities. In the context of climate-related policies, this attentiveness may lead firms to proactively issue green bonds to align with evolving

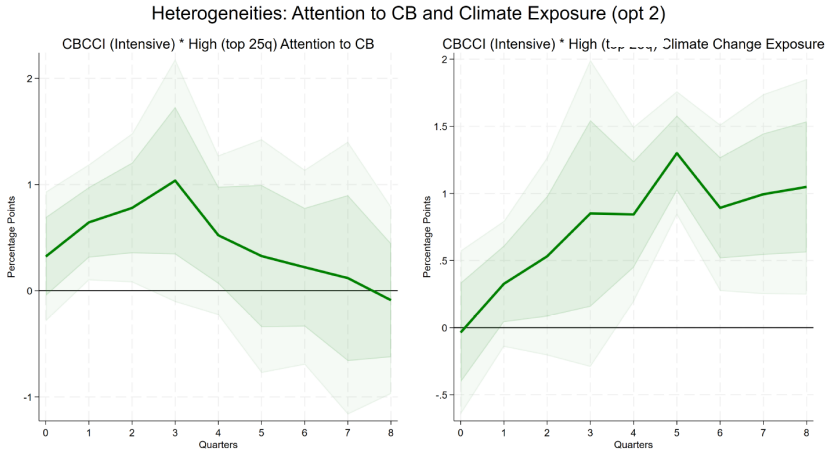
financial regulations and position themselves advantageously in a transitioning economic landscape. This finding supports the broader idea that central bank communication influences market behavior not only through direct policy actions but also by shaping firms' expectations and strategic decisions.

iii. Firms' Exposure to Climate Change Risks and Opportunities

Finally, we analyze how the effect of central bank climate communication varies for firms that are more exposed to climate change risks and opportunities. Figure 8 (right) presents the estimated impact for firms in the top quartile of climate exposure. The results indicate that more exposed firms exhibit a stronger response to central bank climate communication. This finding is consistent with the idea that firms facing higher climate-related risks or those positioned to benefit from climate transition opportunities are more sensitive to signals from central banks regarding future regulatory and financial conditions.

The mechanism behind this response is twofold. On the one hand, firms highly exposed to climate risks may respond to central bank communication, for example, by relocating production facilities to regions less exposed to physical hazards and financing these relocations with green bond issuance, or by issuing green bonds to hedge against transition risks such as stricter emission regulations. On the other hand, firms operating in industries linked to the green transition, such as renewable energy, electric vehicles, or sustainable infrastructure, may perceive central bank climate communication as a signal of a supportive financial environment for green investment. As a result, they increase green bond issuance to capitalize on favorable funding conditions. This aligns with Mueller and Sfrappini (2022), who classify firms' climate exposure using conference call transcripts (following Sautner et al., 2020) and examine how banks adjust credit supply in response to firms' climate-related risks and opportunities after the Paris Agreement. Their findings suggest that firms' exposure to climate policies influences financial decisions, as banks reallocate lending toward firms expected to benefit from regulation, particularly in Europe. While their study focuses on lending rather than financial issuance, it reinforces our argument that firms with higher climate exposure respond more strongly to policy signals, including central bank communication, by adjusting their financial strategies.

Figure 8: Conditional effect - characteristics based on earnings' call transcripts



Note: Impulse response function based on local projection methods following Jordà, 2005 using firm-level quarterly data from 2000 to 2023. This figure shows the dynamics of the interaction coefficient between CBCCI coefficient and firms' characteristics (High Attention to CB or High Climate Change Exposure) on the share of green bond issued by firms. The confidence interval is set at 68% and 90%, respectively. The model is estimated for horizons h=0,1,…,8, with standard errors clustered at the firm, country and time level.

VI. Robustness tests

This section presents several robustness tests to assess the validity and generality of our results. Specifically, we examine whether our findings remain consistent when using a broader set of central bank speeches. We then test the results by using different definitions of the CBCCI, variations in control variables, and different sample restrictions.

a. Alternative set of central bank speeches and dictionary

Campiglio et al. (2025) is one of the most relevant studies related to ours. A key contribution of their work is the development of a more comprehensive and diversified dataset of central bank speeches, which extends beyond the BIS repository by incorporating speeches directly collected from central bank websites. This approach enhances coverage, particularly by improving the representation of speeches from emerging economies and addressing gaps related to speeches in local languages. Notably, the authors have made their extensive speech database publicly available, the so-called CBS dataset, enabling researchers to utilize it for various analyses, including the calculation of the CBCCI. In addition to the dataset, they provide an interactive tool that allows users to input keywords and retrieve frequency counts of their occurrence within each speech. Leveraging this tool, we apply Arseneau et al. (2022) dictionary to compute an alternative version of the CBCCI, ensuring comparability across methodologies.

The indices exhibit a pattern similar to those derived from BIS repository speeches (see Figure A1 in the Appendix). However, the scale differs due to normalization proposed by Campiglio et al. (2025) that uses the number of words instead of sentences to evaluate the saliency of climate-related speeches, which we capture with the CBCCI Intensive index. A notable difference between their database and the BIS repository is the inclusion of a greater number of speeches, particularly from central banks in emerging markets. This inclusion is reflected in the average CBCCI, where the gap between advanced economies and emerging

markets is reduced, likely capturing the active climate communication from some emerging market central banks.

We then perform the empirical analysis from equation (1) using this new CBCCI constructed from the broad CBS dataset. The main results in Figure A2 in the Appendix indicate that the effect of the new CBCCI indices on the share of green bond issuance broadly aligns with the baseline specifications for the overall effect. However, the effect is higher and more persistent over time for the intensive index compared to the extensive index, and the extensive index shows a smaller and shorter effect with the new database.

Another robustness test that can be done with the broader set of speeches is to validate our results using the alternative dictionary suggested in Campiglio et al. (2025). While they acknowledge the climate-related expressions in Arseneau et al. (2022), they argue that the seeding method is highly sensitive to the chosen expression ('climate change'), potentially missing alternative terminologies used in the past. Therefore, they propose a dictionary of climate-related keywords that complements Arseneau et al. (2022) dictionary by incorporating the 'Environment' Thesaurus of the World Bank (WBG, 2018) and their expertise in green central banking literature, resulting in a dictionary of 104 expressions (see Table A3 in the Appendix). By using their dictionary and database, we can replicate the CBCCI on a monthly basis and compare it to Arseneau et al. (2022) dictionary with a broader set of speeches. Our findings (Figure A3 in the Appendix) show that the path is very similar, but the indices from Campiglio et al. (2025) dictionary have higher averages, potentially due to the inclusion of a broader set of climate-related terms. This similarity in paths could be because the most frequently used climate-related words in central bank speeches are already captured by Arseneau et al. (2022) dictionary, ensuring consistency in the overall trend.

After constructing the new CBCCI index with an alternative dictionary and a broader set of speeches, we tested its validity on green bond issuance with equation (1). Our findings confirm that the overall effect on the share of green bonds remains robust (Figure A4 in the Appendix). This suggests that while the alternative dictionary slightly alters the index, the significance of the results is maintained.

b. Differences by the nature of sustainability mandate of central banks

We explore whether the impact of the CBCCI on green bond issuance differs by the extent to which central bank mandates support a sustainability objective. Following Dikau and Volz, 2021 and operationalized as in Arseneau and Osada (2023), we construct a dummy equal to one for central banks with either explicit or implicit sustainability objectives. We then interact this mandate dummy with the CBCCI in the baseline regression on firms' green bond share. The weak but positive coefficient on the interaction term suggests that banks endowed with broader sustainability mandates amplify the transmission of their climate-related messages into higher green bond issuance (Figure A5 in the Appendix). This finding is aligned with Arseneau and Osada, 2023, who show that central banks with explicit or implicit sustainability objectives not only communicate on climate issues more frequently but also frame their messages differently. They find that explicit-mandate central banks focus narrowly on sustainable development goals and sustainable finance, whereas indirect-mandate central banks integrate climate into their traditional price and financial stability mandates, and that banks without any sustainability objective rely mainly on NGFS membership to drive their climate-related communication. The somewhat stronger green bond response for central banks that include either explicit or implicitly sustainability mandates is consistent with the idea that their climate

communications may derive more from internal mandate priorities than from simply echoing broader government policy.
The rest of the robustness tests exercises are reported in Table A4 in the Appendix., where we replicate our main specification at the peak effect (horizon 5) under different model variations.

c. Alternative Sample Restrictions

To ensure that our results are not driven by the earlier periods of our sample, when green bond issuance and central bank climate communication were relatively limited, we restrict the sample to 2013 onward. This reduces potential biases arising from lower green bond market activity and less frequent climate-related communication in earlier years. As shown in Column 2 of Table 2, the results remain qualitatively unchanged, confirming that our findings are not solely driven by the more recent expansion of the green bond market and climate finance initiatives.

d. Alternative Definitions of CBCCI for Eurozone Countries

For euro area countries, central bank communication can come from both the national central bank (NCB) and the European Central Bank (ECB). To assess whether our results are sensitive to the source of communication, we construct three alternative CBCCI indices: one based solely on NCB communication (baseline), one based solely on ECB communication, and one using the average of both. Columns 3-4 in Table 2 show that the estimated effect remains robust across the last specification, suggesting that firms respond similarly to climate-related communication, whether it originates from their national central bank or the ECB.

e. Excluding Controls

Our baseline specification includes firm-level balance sheet controls such as leverage and firm size, as well as country-level macroeconomic and regulatory controls. However, many green bond issuers are not publicly listed, leading to missing firm-level balance sheet data. Additionally, country-level controls may be unavailable for some countries, further restricting the sample. And gaps in bond issuance frequency reduce the sample when including lagged variables. To assess whether these constraints affect our results, we progressively relax these controls. First, in Column 5, we exclude firm-level controls while keeping the sample restricted to firms with available balance sheet data. This tests whether firm size and leverage drive the results, and we see that results hold. In Column 6, we expand the sample to all firms, including those without balance sheet data, to check if the relationship holds beyond listed issuers. In Column 7, we also remove GDP and EPS controls to further expand the sample to firms without this information at the country-level. Finally, in Column 8, we exclude the lag of the dependent variable, increasing the number of observations in a regression without controls. Since not all firms issue bonds every quarter, the inclusion of the lagged dependent variable restricts the sample to firms with continuous issuance, potentially introducing selection bias. Across all these specifications, while the coefficient decreases in magnitude, it retains its sign and significance.

f. Alternative Smoothing of CBCCI

In the baseline specification, we applied a four-quarter moving average to CBCCI to capture the longer-term trends in central bank climate communication and smooth out short-term fluctuations. To assess the impact of this choice, we re-estimate the model using the original, unsmoothed CBCCI raw index, which retains its full quarter-to-quarter volatility. Column 9 in Table 2 confirms that our results remain qualitatively similar to Column 8, though slightly noisier, indicating that the effect of central bank climate

communication on green bond issuance is robust to different treatments of high-frequency variation in the index.

VII. Conclusion

This paper investigates the role of central bank communication and its effects on firm-level financial decisions, particularly regarding the issuance of green bonds. Leveraging a novel Central Bank Climate Communication Index constructed through natural language processing techniques, we document a significant increase in central banks' climate-related communication via speeches up until 2023, both in depth and especially in breadth, as climate topics became embedded in regular central bank discourse. This trend highlights the growing recognition among central banks that weather related risks pose a direct threat to their core mandates. We then empirically analyze whether active communication affects firms' decisions to issue green bonds over time, thereby contributing to sustainable finance. The intuition is that by explicitly acknowledging the economic risks of weather events and clearly signaling policy commitments, central banks could shape market expectations and reduce uncertainty. This strategic communication potentially enhances investor confidence and directs critical capital toward sustainable investments, facilitating the energy transition and mitigating systemic climate risks.

Our findings suggest that active climate-related communication by central banks increases the share of green bonds in total bond issuance at the firm level. This effect seems to be even stronger for certain types of firms. For commercial banks, the effect is particularly high due to their direct supervision by central banks and their strategic alignment of lending and financing policies to mitigate regulatory risks, such as disclosure requirements or climate stress testing. Central bank communication thus acts as an early indicator of upcoming central bank policy directions, prompting banks to proactively increase their green bond issuance. Firms closely attentive to central bank discourse also show pronounced effects, reflecting their better understanding of policy objectives and transmission mechanisms. These firms interpret central bank signals as directly relevant to their financial strategies and accordingly adjust their capital-raising activities. Lastly, firms with higher exposure to climate-related risks or opportunities are especially responsive to central bank signals, likely anticipating regulatory tightening or market adjustments, which drives their strategic financial responses toward green finance.

These findings highlight a crucial role for central banks as facilitators of sustainable financial practices through effective communication, helping shape market expectations, reduce uncertainties, and redirect capital toward sustainable investments without directly intervening in markets. Consequently, central bank communication emerges as a soft yet powerful policy tool that aligns market incentives with broader sustainability and stability mandates, minimizing potential risks to central bank independence and market neutrality. Policy implications stemming from these results include enhancing transparency and accountability of central banks' strategies. Central banks should continue clarifying the economic rationale behind their engagement in emerging issues, emphasizing how addressing new risks aligns with their mandates of financial and price stability. Additionally, fostering international coordination to develop consistent frameworks, definitions, and metrics for weather risks and green investments could mitigate risks of greenwashing and further reinforce credibility.

Future research could delve deeper into differentiating the specific channels through which central bank communication influences market behavior. For instance, disentangling messages related to climate policies (mitigation) from those focused explicitly on managing physical climate risks (adaptation) could offer more nuanced insights. It would also be valuable to test whether increased green bond issuance

actually reduces GHG emissions, to distinguish genuine sustainability improvements from greenwashing. Another interesting avenue could be assessing how central bank communication affects financial actors beyond corporate bond issuers, particularly the insurance sector, which is inherently linked to adaptation measures. Exploring these dimensions would deepen the understanding of how central banks' communication shapes broader financial markets, ultimately contributing to improved strategies for managing weather-related financial risks and opportunities.

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Appendix

Table A1: Dictionaries for the earnings call transcripts

Attention to Central Bank (Following and complementing Albrizio et al., 2023)

central bank	quantitative easing	quantitative tightening	monetary policy	central bank rate
policy rate	fed funds	monetary tightening	monetary easing	central bank regulation
financial regulation	disclosure requirements	macroprudential policy	stress testing	*central bank's names*

Climate Change Exposure (From Table II in Sautner et al., 2023)

renewable energy	onshore wind	carbon intensity	electric vehicle	electric motor
energy application	clean energy	provide energy	produce electricity	new energy
efficient solution	help state	climate change	global warm	environmental standard
wind power	power generator	power agreement	wind energy	solar pv
supply energy	energy efficient	scale solar	electric hybrid	greenhouse gas
need clean	source power	solar energy	coastal area	sustainability goal
air quality	energy star	energy reform	clean air	environmental footprint
plant power	carbon emission	design use	compare conventional	gas emission
area energy	gas vehicle	extreme weather	charge station	effort energy
carbon dioxide	clean water	pass house	water resource	major design
carbon free	autonomous vehicle	vehicle manufacturer	driver assistance	energy environment
future energy	electrical energy	wind resource	motor control	solar installation
government india	combine heat	snow ice	battery power	electric bus
renewable natural	air pollution	distribute power	promote use	battery electric
environmental benefit	farm project	integrate resource	eco friendly	laser diode
clean power	electrical vehicle	deliver energy	carbon price	carbon neutral
protect environment	world population	fast charge	sustainable energy	solar farm
cell power	manage energy	energy regulatory	energy team	invest energy
obama administration	cycle gas	electric energy	heat power	coal gasification
forest land	carbon tax	environmental concern	capacity energy	unite nation

Earnings' call-based measures:

To construct the text-based indicators, we first generate two indices that capture the frequency of discussions in earnings calls related to central bank attention and climate change exposure at the firm level. For each earnings call transcript *e* of firm *i*, let N_e represent the total number of sentences and N_e^{topic} denote the number of sentences containing at least one relevant keyword from the respective dictionary in Table A1 in the Appendix. The transcript-level frequency index is given by:

$$I_e = \frac{N_e^{topic}}{N_e}$$

Next, we compute the firm-level index by taking the average of I_e across all earnings call transcripts for firm *i* over the sample period:

$$I_i = \frac{1}{E_i}\sum_{e=1}^{E_i} I_e = \frac{1}{E_i}\sum_{e=1}^{E_i} \frac{N_e^{topic}}{N_e}$$

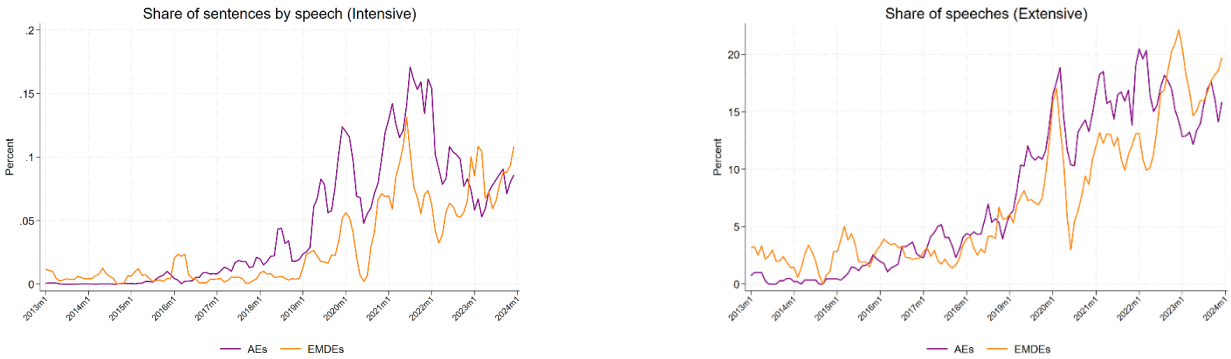
where E_i represents the total number of earnings' call transcripts available for firm *i*.

Finally, we define a time-invariant binary indicator D_i that equals one if I_i is above the fourth quartile of the sectoral distribution $Q_{0.75}^{sector}$, and zero otherwise. This classification identifies firms with a high degree of attention to central bank communication or significant exposure to climate-related risks and opportunities.

Table A2: Summary statistics for equation 1

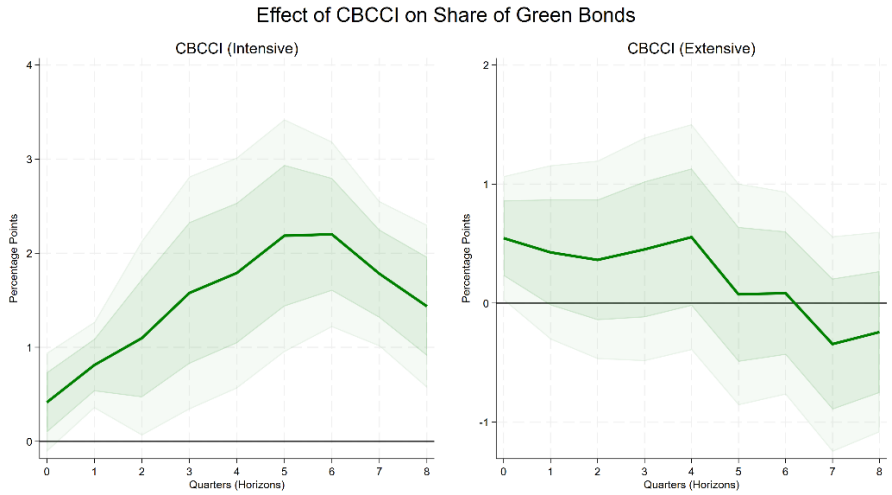
VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
Sh. of green bonds over total bond issuance	15,470.00	1.90	12.08	0.00	100.00
CBCCI Intensive raw	14,264.00	0.44	1.76	0.00	20.37
CBCCI Extensive raw	14,264.00	6.04	17.26	0.00	100.00
CBCCI Intensive ma4	15,470.00	0.44	1.31	0.00	11.81
CBCCI Extensive ma4	15,470.00	6.10	14.62	0.00	100.00
Environmental Policy Stringency	15,470.00	2.74	0.84	0.19	4.89
Real gross domestic product yoy	15,470.00	2.15	3.33	-21.94	25.73
Ln of assets	15,470.00	17.92	1.70	8.58	25.67
Debt over assets	15,470.00	36.42	21.55	0.00	191.73

Figure A1: Use of CBS dataset - CBCCI with Arseneau et al., 2022 dictionary:



Source: CBS Dataset and own elaboration.

Figure A2: Use of CBS dataset - LP of CBCCI on ShGB with Arseneau et al., 2022 dictionary:

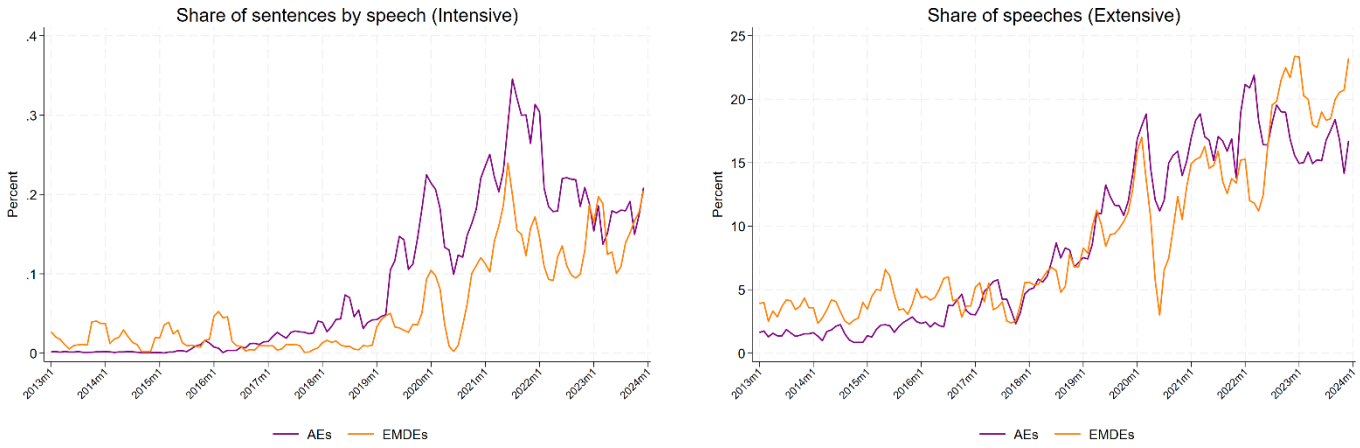


Note: Impulse response function based on local projection methods following Jordà, 2005 using firm-level quarterly data from 2000 to 2023. This figure shows the dynamics of the CBCCI coefficient on the share of green bond issued by firms. The CBCCI index here is derived from the CBS dataset and based on Arseneau et al., 2022 dictionary. The confidence interval is set at 68% and 90%, respectively. The model is estimated for horizons h=0,1,…,8, with standard errors clustered at the firm, country and time level.

Table A3: Dictionary for climate-relevant terms in Campiglio et al., 2025

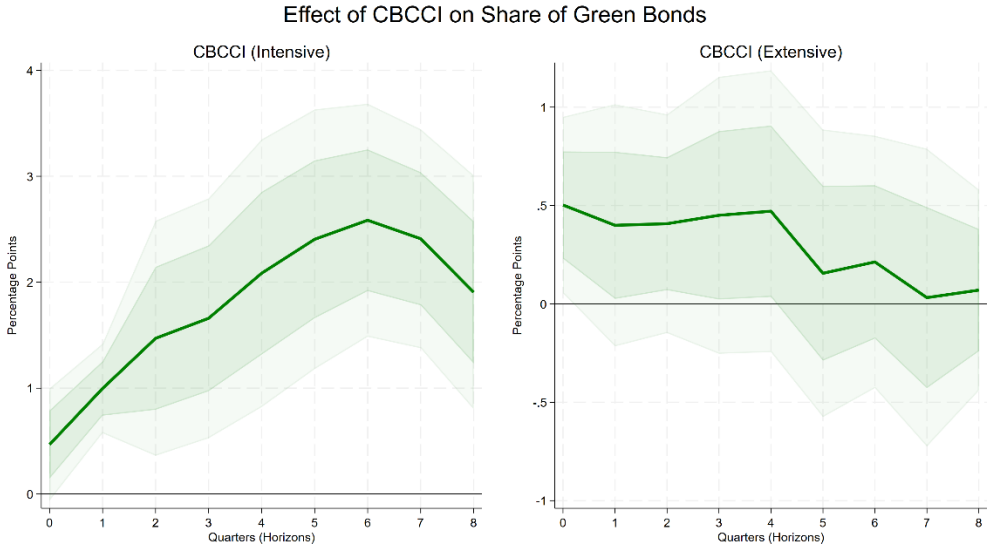
Campiglio et al., 2025				
abrupt transition	carbon price	carbon taxes	climate aligned	climate damage
climate events	climate finance	climate hazard	climate metrics	climate protection
climate risks	climate sensitivity	climate stress test	climatology	decarbonising
decarbonizing	environment risks	green bond	green finances	green policies
green supporting factor}	green technologies	greener	ngfs	stranded asset
sustainable investing	brown penalising factors	carbon prices	climate action	climate change
climate data	climate exposure	climate friendly	climate hazards	climate minsky moment
climate related	climate scenario	climate shock	climate stress tests	cotwo
decarbonization	disorderly transition	environmental risk	green bonds	green investment
green policy	green supporting factors	green technology	greenhouse	paris agreement
stranded assets	tefd	carbon emission	carbon pricing	climate actions
climate changes	climate economics	climate exposures	climate goals	climate impact
climate policies	climate relevant	climate scenarios	climate shocks	climatologist
decarbonise	decarbonize	disorderly transitions	environmental risks	green economy
green investments	green ge	green swan	green transition	greening
physical risk	sustainable finance	transition risk	carbon emissions	carbon tax
climate adaptation	climate crisis	climate event	climate extremes	climate harm
climate impacts	climate policy	climate risk	climate science	climate stability
climatologists	decarbonised	decarbonized	environment risk	global warming
green finance	green monetary	green quantitative easing	green swans	green transitions
low carbon	physical risks	sustainable finances	transition risks	

Figure A3: Use of CBS dataset - CBCCI with Campiglio et al., 2025 dictionary:



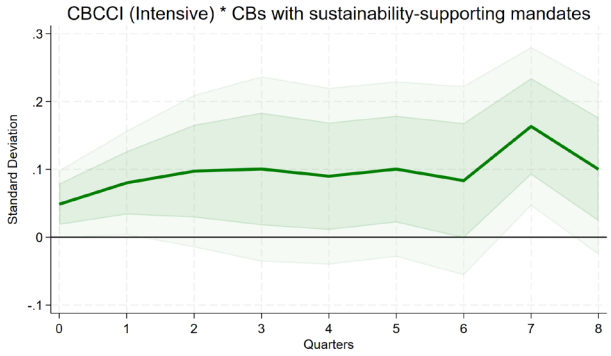
Source: CBS Dataset and own elaboration.

Figure A4: Use of CBS dataset - LP of CBCCI on ShGB with Campiglio et al., 2025 dictionary:



Note: Impulse response function based on local projection methods following Jordà, 2005 using firm-level quarterly data from 2000 to 2023. This figure shows the dynamics of the CBCCI coefficient on the share of green bond issued by firms. The CBCCI index here is derived from the CBS dataset and based on Campiglio et al., 2025 dictionary. The confidence interval is set at 68% and 90%, respectively. The model is estimated for horizons h=0,1,…,8, with standard errors clustered at the firm, country and time level.

Figure A5: Differences by the nature of sustainability mandate of central banks (based on Dikau and Volz, 2021):



Note: Impulse response function based on local projection methods following Jordà, 2005 using firm-level quarterly data from 2000 to 2023. This figure shows the dynamics of the interaction coefficient between CBCCI coefficient and a dummy for central banks with explicit or implicit sustainability mandates following Arseneau and Osada, 2023 and based on Dikau and Volz, 2021 on the share of green bond issued by firms. The confidence interval is set at 68% and 90%, respectively. The model is estimated for horizons h=0,1,…,8, with standard errors clustered at the firm, country and time level.

Table A4: Robustness tests

	Sh. of green bonds								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CBCCI Intensive mav	1.97***				1.97***	1.12**	0.95**	0.72**	
	(0.527)				(0.527)	(0.420)	(0.412)	(0.356)	
CBCCI Intensive mav (since 2013)		2.49***							
		(0.726)							
CBCCI Intensive mav (average ECB and NCB)			2.10***						
			(0.565)						
CBCCI Intensive mav (ECB index)				2.19***					
				(0.602)					
CBCCI Intensive raw									0.62*
									(0.328)
Lag of Sh. of green bonds	0.08*	0.05	0.09**	0.09**	0.08*	0.17***	0.16***		0.17***
	(0.041)	(0.054)	(0.041)	(0.041)	(0.041)	(0.033)	(0.033)		(0.025)
Observations	8,862	4,284	8,929	8,929	8,862	25,901	27,434	41,225	23,444
R-squared	0.401	0.460	0.401	0.402	0.401	0.378	0.375	0.370	0.380
Sample	2000 to 2023	2013 to 2023	2000 to 2023	2000 to 2023	2000 to 2023	2000 to 2023	2000 to 2023	2000 to 2023	2000 to 2023
Firm level controls	Yes	Yes	Yes	Yes	No	No	No	No	No
Country level controls	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
Firm*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country*Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year*Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specification	Baseline	Last 10 years	Average ECB and NCB	ECB index	No firm controls for issuers with balance sheet data	No firm controls for all issuers	No firm controls no country controls	No firm controls no country controls no lag of dep	No firm controls no country controls

Note: This table presents the regression coefficients of CBCCI on the share of green bonds at horizon 5, under different robustness test exercises in terms of samples, CBCCI definition, and control variables. Column 1 is the baseline specification for equation (1). The regression is estimated using firm-level quarterly data from 2000 to 2023, with standard errors clustered at the firm, country and time level. ∗ p < 0.10, ∗∗ p < 0.05, ∗∗∗ p < 0.01

PUBLICATIONS

The Impact of Central Bank Communication on Sustainable Finance Instruments

Working Paper No. WP/25/169