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Key Drivers of Corporate Green Bond Growth in Europe: A Structural Equation Modeling Approach

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Abstract:

This study investigates the key factors driving corporate green bond issuance across 19 European countries between 2013 and 2024, with a focus on institutional quality, financial market dynamics, and regulatory frameworks. Employing structural equation modeling, the research examines the interactions shaping green bond market growth. The findings underscore the pivotal role of institutional quality—particularly governance and transparency—in enhancing investor confidence and issuance volumes. However, deeper financial markets unexpectedly hinder green bond issuance, as resources are diverted toward traditional, high-yield investments lacking sustainability mandates. Additionally, higher coupon rates deter issuers, further emphasizing the importance of cost-effective financing mechanisms. The study highlights the need for balanced policy interventions that streamline regulatory processes, reduce compliance burdens, and foster market access. These insights offer valuable guidance for strengthening green finance and advancing Europe’s ambitious climate goals.

Keywords: Green Bonds, Corporate Finance, Institutional Quality, Structural Equation Model, Sustainable Investment, Regulatory Framework

JEL Code: C39, E02, G28, G32

Introduction

In recent years, the escalating urgency of addressing global environmental challenges has reshaped corporate strategies, with businesses increasingly embedding Environmental, Social, and Governance (ESG) principles into their decision-making. This shift represents a departure from shareholder-centric finance toward sustainable growth that balances economic and environmental goals (Magill et al., 2015). Yet, the academic debate on the impact of ESG adoption on firm value remains unresolved.

The global transition to sustainability is critical to achieving the United Nations Sustainable Development Goals (SDGs), particularly in reducing industrial CO₂ emissions (Sarkodie & Strezov, 2018). The Paris Agreement emphasizes the need for immediate climate action, but these goals require unprecedented financial investments. The International Energy Agency (IEA) estimates \$53 trillion will be needed by 2035, with \$14 trillion allocated to energy efficiency alone (IEA, 2018). In the EU, annual investments of \$1.6 trillion will be essential from 2031 to 2050 to meet emissions reduction targets (European Investment Bank, 2023).

Despite this pressing need, mobilizing private capital for climate initiatives remains challenging. Barriers include insufficient incentives, high risks of low-carbon technologies, and fragmented policy coordination (Bhandary et al., 2021; Polzin, 2017). Green bonds have emerged as a critical tool to address these gaps. These instruments, earmarked exclusively for financing environmentally friendly projects, have seen global issuance grow from \$103 billion in 2016 to \$699 billion in 2021. However, green bonds still represent only 3–3.5% of the total bond market, reflecting significant untapped potential (Sachs et al., 2019).

Europe leads the global green bond market, accounting for over 50% of total issuance in 2023. The corporate green bond market, in particular, has expanded from 4.7% of total corporate bond issuance in 2020 to 11% in 2022 (European Environment Agency, 2023). This growth aligns with the EU's Green Deal, which aims to make Europe the first carbon-neutral continent by 2050. Yet, disparities in green bond adoption across EU member states, regulatory fragmentation, and challenges such as high issuance costs and greenwashing persist (Flammer, 2021; Zerbib, 2019).

This study explores the drivers of corporate green bond issuance in Europe, focusing on the interplay of institutional quality, regulatory frameworks, and financial market conditions. By employing structural equation modeling (SEM) on a robust dataset, the research addresses gaps

in existing literature by integrating institutional and market dynamics to offer actionable insights. The findings emphasize the critical role of governance, transparency, and balanced policies in fostering green finance.

The paper is structured as follows: Section 1 provides an overview of corporate green bond issuance in Europe. Section 2 reviews institutional, regulatory, and market determinants. Section 3 outlines the research hypotheses derived from the literature. Section 4 details the methodology, including exploratory factor analysis (EFA) and SEM. Section 5 presents the results and discusses their implications. Finally, the conclusion summarizes the study's contributions and offers policy recommendations to enhance corporate engagement in green finance.

1. Corporate Green Bond Issuance in Europe

The evolution of corporate objectives has shifted from a traditional focus on maximizing shareholder value to addressing broader stakeholder interests. Stakeholder theory emphasizes that a company's long-term success depends on balancing the expectations of diverse groups, including employees, customers, suppliers, and communities (Brenner & Cochran, 1991). This perspective fosters a more sustainable and strategic approach to business. Growing awareness of climate change has further amplified this shift, driving companies to embed environmental considerations into their strategies. Risks such as natural disasters and economic disruptions have made sustainability integral to corporate planning. The adoption of the Paris Agreement (COP21) and the United Nations Sustainable Development Goals (SDGs) in 2015 institutionalized these priorities, highlighting the need for substantial investments in renewable energy and other sustainable projects.

Green bonds have emerged as a key financial instrument for mobilizing capital toward environmentally beneficial initiatives. These bonds fund projects such as renewable energy, energy efficiency, clean transportation, and water management. The green bond market began with a EUR 600 million issuance by the European Investment Bank (EIB) in 2007 and has since expanded significantly. Initially dominated by public institutions and multilateral banks, the market saw increased private sector participation in 2014, with notable issuances from Iberdrola and Apple for renewable energy and resource efficiency projects, respectively.

From modest beginnings, green bond issuance has grown to several hundred billion euros annually. The Climate Bonds Initiative (CBI) reported that global green bond issuance reached

nearly \$600 billion in 2023, with the first quarter of 2024 alone recording \$195.9 billion—an increase of 25% from the same period in 2023. This growth reflects rising investor interest in sustainable investments and recognition of green bonds as an essential tool for financing the energy transition.

Europe leads the global green bond market, accounting for over 53% of issuance in 2023, amounting to more than \$300 billion—a 23% increase from 2022 (European Environment Agency, 2023). This growth is driven by ambitious environmental policies, regulatory incentives, and strong investor demand. The European Green Deal and supporting frameworks, such as the European Green Bond Standard (EU GBS), the EU Taxonomy, and the Sustainable Finance Disclosure Regulation (SFDR), provide a robust regulatory foundation for green finance. These frameworks enhance the credibility of green bonds by setting strict criteria, requiring external verification, and mandating transparency through comprehensive reporting.

National initiatives, including France’s Green Label and Germany’s green bonds via Kreditanstalt für Wiederaufbau (KfW), further bolster Europe’s leadership. These measures ensure the integrity of green bonds and position Europe as a model for sustainable finance.

However, challenges remain. Regulatory fragmentation complicates the issuance of green bonds across jurisdictions, particularly for multinational issuers (Flammer, 2021). Issuance costs, including certification and ongoing impact monitoring, are higher than for conventional bonds, posing barriers for smaller companies (Ehlers & Packer, 2017; Zerbib, 2019). Greenwashing practices, where environmental claims are misleading or exaggerated, deter investor confidence and emphasize the need for stricter oversight (Xu et al., 2022; Shi et al., 2023).

While the market benefits from a “green premium” or greenium—strong demand that lowers yields for green bonds—this advantage does not always offset the higher costs of issuance (Nanayakkara & Colombage, 2019). Liquidity challenges also persist, particularly in regions and sectors with limited issuance, making it harder for investors to buy and sell green bonds without price penalties (Tolliver et al., 2019).

2. Key Factors Driving Corporate Green Bond Market Growth

This paper investigates the drivers of the green bond market's growth in Europe, focusing on disparities across countries and emphasizing global institutional, economic, and governance factors. By shifting attention beyond issuer motivations, the study provides a comprehensive perspective on market dynamics and determinants.

Previous research has primarily explored regulatory support and issuer-investor preferences in promoting green projects (Tu et al., 2020; Azhgaliyeva & Kapsalyamova, 2021; Spielberger, 2024) but has overlooked external factors shaping the broader market. This study addresses this gap, emphasizing the dual role of financial market development in green finance.

On one hand, financial markets enhance access to capital and improve allocation, which could unintentionally favor high-emission sectors unless sustainability policies intervene. While such financing stimulates economic growth, it may reduce the appeal of long-term green bonds when focused on short-term, high-yield industries (Colombage, 2009; Pradhan et al., 2020). On the other hand, developed financial markets can actively channel resources into eco-friendly initiatives, fostering sustainable technologies and ESG-focused investments (Aggarwal & Goodell, 2009; Tamazian et al., 2009; Pan et al., 2019). This is evident in sectors like renewable energy and electric vehicles.

However, financial market development alone is insufficient. Studies by Horobet et al. (2022) and Acheampong et al. (2020) highlight the pivotal role of regulatory frameworks in directing resources toward sustainable goals. Thus, we hypothesize:

2.2. The Role of Environmental Regulatory Frameworks

The literature emphasizes the pivotal role of environmental regulatory frameworks in driving the growth of the green bond market. Flammer (2021) highlights that environmental regulations incentivize corporations to issue green bonds, positioning them as key instruments for financing sustainable projects. Hyun, Park, and Tian (2020) underscore how supportive regulatory environments reduce issuance costs and enable favorable pricing, making green bonds more attractive. Zerbib (2019) and Packer & Ehlers (2017) further explore the impact of regulatory backing and certifications on demand and pricing, noting that robust policies and standards build investor confidence and foster market growth. Similarly, Tolliver et al. (2020) stress the importance of well-designed policies in establishing incentives, shaping market structures, and attracting participants to green finance.

However, regulatory frameworks can also present challenges. Complex or stringent requirements may raise compliance costs, discouraging participation from smaller issuers. Inconsistent policies or high certification demands can create volatility, reducing investor confidence. Policies prioritizing short-term economic objectives over sustainability risk diverting resources toward high-emission sectors, undermining green bond market development.

2.3. Impact of Institutional Quality

Institutional quality—encompassing governance, regulatory transparency, and effective legislative frameworks—plays a critical role in fostering green bond issuance. Strong institutions enhance investor confidence, enabling financial markets to issue and absorb green instruments, whereas weak or corrupt systems undermine these efforts. Studies affirm this relationship; for instance, Xu et al. (2023) found that indicators like control of corruption, government effectiveness, and rule of law positively correlate with green finance in South Asia. Similarly, Nguyen et al. (2023) demonstrated that robust institutional quality strengthens the link between national culture and green bond issuance, especially in lower-income nations.

Institutional quality also amplifies the effectiveness of environmental policy support. Acemoglu et al. (2001) and Panayotou (1997) emphasize its mediating role in ensuring policy success, while Dinda (2004) and Dasgupta et al. (2002) note its impact on governance and corruption in shaping environmental outcomes. Borghesi and Vercelli (2003) further highlight how governance frameworks mitigate globalization's adverse effects, bolstering sustainable policies. These findings underline the importance of enforcing environmental standards and regulations to advance green finance.

2.4. Impact of Issuance Characteristics

Issuance characteristics significantly shape the volume of corporate green bonds issued. Among these, the coupon rate is particularly influential. Lower coupon rates attract investors willing to trade financial returns for environmental impact, a phenomenon known as the “greenium.” This dynamic reduces issuers' cost of capital and broadens participation in green bond markets. Studies by Flammer (2021) and Gianfrate & Peri (2019) confirm that lower coupon rates correlate with higher issuance volumes, demonstrating their critical role in market expansion.

The maturity period of green bonds also impacts issuance volumes. Institutional investors favor longer maturities for their stability and alignment with the extended timelines of environmental projects. Hachenberg & Schiereck (2018) show that this preference often drives higher issuance volumes, satisfying demand for sustainable, long-term returns.

The callable feature, allowing issuers to redeem bonds before maturity, has mixed implications. While it may deter investors due to early repayment risks, especially in declining interest rate environments, it also offers issuers flexibility to refinance debt under favorable conditions. This flexibility can encourage issuance, particularly when investors are compensated with premium

yields. ESG-focused investors may overlook callable risks, prioritizing environmental alignment, especially in rising interest rate scenarios.

Lastly, the sector in which a company operates plays a pivotal role. High-impact sectors facing regulatory pressures and opportunities for sustainable innovation tend to issue larger volumes of green bonds. These sectors benefit from investor preferences and government incentives, creating conducive conditions for significant green bond issuance.

2.5. Macroeconomic Determinants

Macroeconomic factors such as inflation, unemployment, and government debt significantly shape the environment for corporate green bond issuance. These indicators influence investor behavior, borrowing costs, and the broader feasibility of green financing in diverse economic contexts.

Inflation is a key measure of economic stability, directly affecting default risk and borrowing costs. High inflation reduces government creditworthiness (Nickel et al., 2011) and access to long-term financing, particularly in emerging economies (Presbitero et al., 2016). For green bonds, elevated inflation creates uncertainty, diminishing the appeal of long-term projects commonly financed by these instruments (Tu et al., 2020). This instability discourages green bond issuance by increasing risks and costs.

Unemployment, a crucial social indicator, impacts green bond issuance through its influence on interest rates and investor behavior. In low-interest-rate environments, driven by central banks aiming to stimulate economic activity, green bonds become attractive due to reduced financing costs. Additionally, such conditions enhance corporate ESG profiles, aligning with sustainable investment goals. Conversely, during economic downturns marked by high unemployment, firms may prioritize liquidity and short-term financial stability, reducing green bond issuance. Increased credit spreads and diminished investor confidence further exacerbate these challenges.

Government debt influences corporate green bond issuance through its effects on market conditions and investor confidence. High debt levels can crowd out corporate bond issuance by increasing competition for capital and raising interest rate spreads (Presbitero et al., 2016; Yamahaki et al., 2022). Conversely, elevated public debt may push investors toward alternative assets like green bonds to diversify portfolios and manage risk. Additionally, governments facing fiscal pressures may promote green finance through public-private partnerships or incentives, creating opportunities for corporate issuers.

3. Research hypothesis

Building on the literature and theoretical frameworks, this study proposes the following hypotheses:

- **H1:** Financial market development influences corporate green bond issuance volumes, with outcomes contingent on capital allocation.
 - **H1a:** Financial market access positively affects corporate green bond issuance.
 - **H1b:** Financial market depth negatively affects corporate green bond issuance.
 - **H1c:** Financial market efficiency negatively affects corporate green bond issuance.
- **H2:** Environmental regulatory frameworks positively influence the volume of corporate green bond issuance.
- **H3:** Institutional quality significantly impacts corporate green bond issuance.
 - **H3a:** Institutional quality positively influences corporate green bond issuance.
 - **H3b:** Institutional quality mediates the relationship between policy support and green bond issuance volumes.
- **H4:** Issuance characteristics significantly influence corporate green bond issuance.
 - **H4a:** Coupon rates negatively affect corporate green bond issuance volumes.
 - **H4b:** Maturity periods positively influence corporate green bond issuance volumes.
 - **H4c:** Callable features positively influence corporate green bond issuance volumes.
 - **H4d:** Issuance volumes vary across sectors.
- **H5:** Macroeconomic factors shape corporate green bond issuance.
 - **H5a:** Higher inflation rates reduce the volume of corporate green bond issuance.
 - **H5b:** Unemployment rates have a dual impact on corporate green bond issuance, with both positive and negative effects.

- **H5c:** Government debt influences corporate green bond issuance by shaping investor demand and green finance policies.

4. Data and econometric methodology

4.1. Data source

This study utilizes comprehensive datasets sourced from Bloomberg to analyze both green and conventional European bonds. Bloomberg's database provides detailed classifications of bond types, issuers, sectors, and sustainability attributes. Corporate green bonds were identified using Bloomberg's "Green Bond" classification, which ensures bonds are certified or labeled as green under recognized standards. This process yielded a dataset of 841 corporate (non-bank) green bonds issued between January 2013 and October 2024. The data includes extensive information such as yield to maturity, coupon rate, maturity date, issue date, tenor, issued amount, and issuer's local currency. Additionally, attributes like coupon type, sector, and the use of proceeds were captured, forming the basis for Figure 1, which illustrates cumulative issuance amounts of green bonds (Source: Bloomberg).

To align with macroeconomic data availability for issuing countries, the analysis period was refined to 2013-2024, resulting in a final dataset of 836 corporate green bonds. Table 1 presents a detailed breakdown of corporate green bonds by sector, including issued amounts (in millions of U.S. dollars) from May 2013 to October 2024. The sectoral classification adheres to issuers' reports in Bloomberg's database.

In this study, a range of supplementary data sources are utilized to provide a comprehensive analysis:

1. **Climate Policies:** The Climate Actions and Policies Measurement Framework (CAPMF) database is integrated to track climate mitigation efforts using 130 policy variables across 50 countries from 1990 to 2022. A two-year lag accounts for the time required for policy changes to influence corporate decisions and market dynamics.
2. **Green Growth Metrics:** Data from the OECD Green Growth Indicators database is employed to monitor sustainable economic progress. These metrics are also lagged by two years to reflect their impact on corporate green bond issuance.
3. **Economic Indicators:** Additional data includes economic metrics from the OECD database and the IMF Financial Development Index, which measures financial system development across countries. Insights into global economic trends, such as inflation

and government debt, are sourced from the IMF World Economic Outlook (WEO). A one-year lag is introduced for economic variables.

4. Governance Quality: Governance metrics are drawn from the World Bank's Worldwide Governance Indicators (WGI), providing assessments of governance across countries. A two-year lag accounts for the time needed for governance changes to influence corporate decisions.

These datasets collectively enhance the study's robustness by incorporating climate policies, economic factors, financial development, and governance quality.

Table 1 reveals significant disparities in green bond issuance across industries. The Utilities sector leads with 175 bonds totaling \$102.0 billion, followed by the Financials sector with 443 bonds amounting to \$100.9 billion. The Consumer Discretionary and Materials sectors have issued \$21.2 billion and \$17.3 billion, respectively. Other sectors, including Energy, Communication Services, and Industrials, contribute to the market with lower volumes. Overall, the dataset comprises 836 green bonds across sectors, with a total issuance of approximately \$275.3 billion.

Table1. Corporate Green Bonds by Sector (Million US\$)

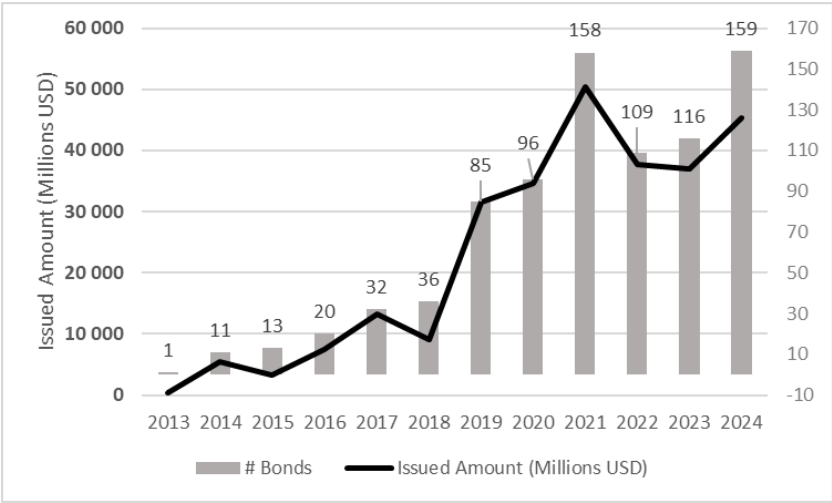
Sector	# Bonds	Issued Amount
Communication Services	13	5 046,3
Consumer Staples	23	4 440,4
Consumer Discretionary	38	21 182,9
Energy	27	8 210,5
Financials	443	100 891,7
Industrials	58	13 269,2
Materials	53	17 306,8
Utilities	175	102 012,9
Health Care	4	1 857,9
Information Technology	2	1 076,0
Total	836	275 294,7

Source: Bloomberg Database

The data in Figure 1 highlights the significant growth of the corporate green bond market between 2013 and 2024. Starting with a single bond issuance of \$391.4 million in 2013, the market gained momentum, particularly after 2016. A peak was reached in 2021 with \$50.4 billion raised across 158 bonds, demonstrating heightened market activity. Although 2022 saw a slight decline to \$37.7 billion from 109 bonds, market strength persisted into 2023 with similar levels of issuance. Across the period, 836 bonds were issued, amounting to \$275.3 billion,

emphasizing the increasing importance of green financing in driving corporate sustainability initiatives.

Figure 1. Corporate Green Bonds over time



Source: Bloomberg Database

Table 2 highlights France as the leader in Europe’s corporate green bond market, issuing \$61.2 billion across 108 bonds. Germany follows closely with \$60.4 billion from 107 bonds, demonstrating their dominance. Italy ranks third with \$27.4 billion, while Spain and Sweden issued \$21.8 billion and \$20.5 billion, respectively, with Sweden leading in bond count at 260. Denmark and the Netherlands contributed \$15.3 billion and \$14.8 billion. Finland, Portugal, and Norway issued \$8–12 billion each, while smaller players like Switzerland, Austria, and Belgium also participated. Iceland and Hungary recorded the lowest volumes at \$91.0 million and \$44.1 million, respectively.

Table 2. Corporate Green Bonds by Country (Million US\$)

Country	Issued Amount (Millions USD)	# Bonds
FRANCE	61 248,9	108
GERMANY	60 368,7	107
ITALY	27 366,2	50
SPAIN	21 755,6	44
SWEDEN	20 483,6	260
DENMARK	15 311,6	26
NETHERLANDS	14 801,2	25
FINLAND	12 131,6	40
PORTUGAL	9 377,0	13
NORWAY	8 151,2	62
SWITZERLAND	6 567,3	42
AUSTRIA	4 817,0	20
BELGIUM	4 310,3	16
LUXEMBOURG	3 987,7	7
GREECE	2 136,9	5
POLAND	1 483,3	5

IRELAND	861,3	1
ICELAND	91,0	2
HUNGARY	44,1	3

Source: Bloomberg Database

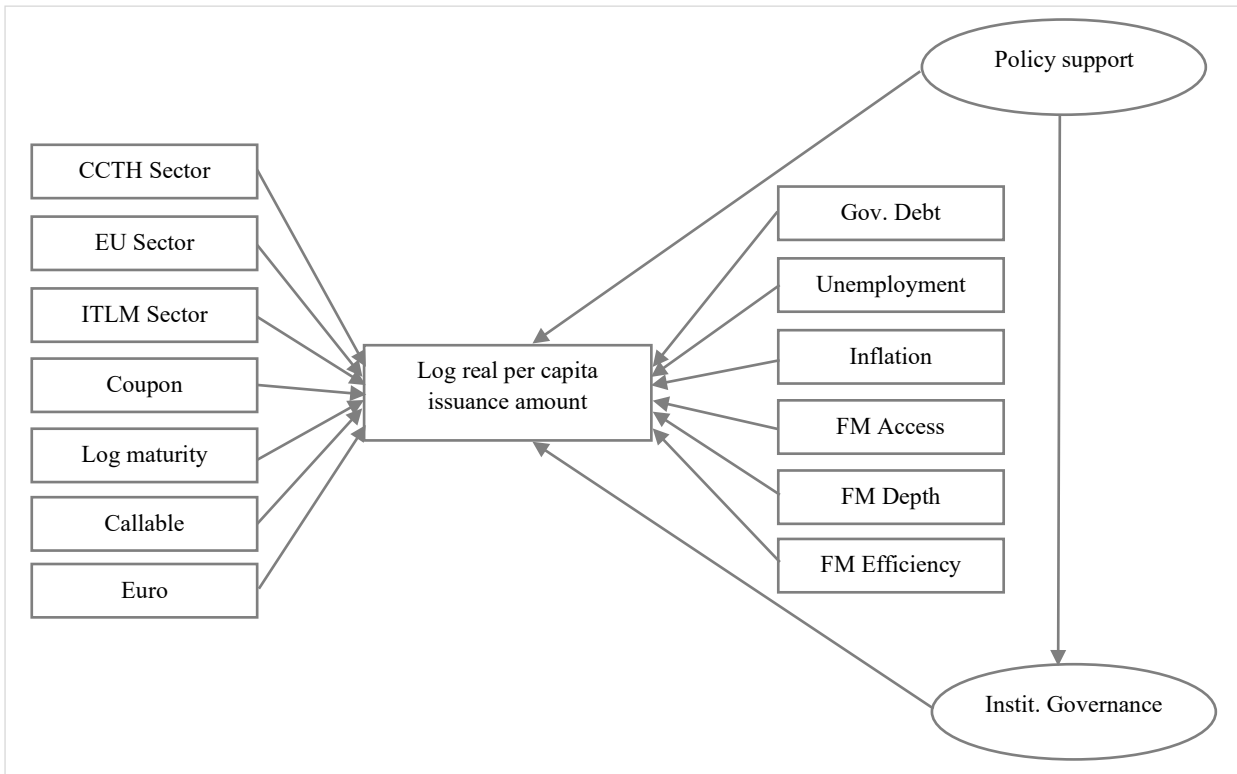
4.2. Econometric methodology

Building on prior research (Huang & Yue, 2020; Tolliver et al., 2020; Liu et al., 2022), this paper employs a structural equation modeling (SEM) approach to investigate the determinants of corporate green bond issuance in Europe. SEM is a robust method for examining complex relationships among variables and explaining variance in the model (Bollen, 2014; Kline, 2023). It enables the integration of observed (manifest) and unobserved (latent) variables, allowing a detailed exploration of how economic, institutional, and policy factors interact to shape green bond issuance. Path diagrams used within the SEM framework visually represent causal relationships, enhancing clarity about market dynamics. This method is especially suited for corporate green finance as it consolidates economic indicators, institutional governance, and policy support into a cohesive model.

The SEM diagram (Figure 2) outlines a two-level model for analyzing the log of per capita corporate green bond issuance in Europe. At the first level, the model focuses on issuance-specific characteristics, such as callable status, maturity, coupon rate, and issuance currency. Sectoral diversity is captured through dummy variables: “ccth_sector” includes consumer, communication, technology, and healthcare; “eu_sector” represents energy and utilities; “itlm_sector” covers industry, transportation, logistics, and materials; and the reference group comprises real estate, insurance, and financial services. This categorization facilitates a nuanced understanding of sectoral impacts on bond issuance volumes.

The second level examines macroeconomic and institutional factors. Key economic indicators, including financial development (spanning access, efficiency, and depth), inflation, unemployment, and government debt, provide insights into the macroeconomic conditions shaping green bond issuance. Institutional Governance and Policy Support are modeled as latent variables. Policy Support reflects the scope and enforcement of environmental policies at international, intersectoral, and sectoral levels. Institutional Governance includes metrics like control of corruption, regulatory quality, rule of law, and political stability. Together, these components highlight the broader economic and regulatory contexts influencing green bond issuance across Europe.

Figure 2. Structural model for corporate green bond issuance volumes



Through this modeling approach, the study aims to comprehensively understand the interplay between direct bond characteristics and the broader economic and regulatory conditions influencing corporate green bond issuances in Europe. The model's structure is designed to not only capture the direct effects of bond features on issuance volumes but also elucidate the conditioning effects of the economic and regulatory environments in which these issuances occur. To facilitate this analysis, all structural equation models are constructed and analyzed using Stata econometric software.

4.3. Data description

Level 1: Issuance Characteristics

This level focuses on specific attributes related to corporate green bond issuances. The data includes:

- **Callable:** A dummy variable representing bonds that can be redeemed by the issuer before the maturity date, affecting investor returns.
- **Coupon:** The interest rate that the bond pays to its holders, which can influence investor demand based on market conditions.
- **Log maturity:** The natural logarithm of the bond's maturity period, measured in months.
- **Euro:** A dummy variable equal to 1 if the issuance currency is in euros, and 0 otherwise.
- **CCTH sector, EU sector, ITLM sector:** Categorical dummy variables representing different sectors of the economy where the issuers operate. CCTH groups consumer, communication, technology, and healthcare; EU represents energy and utilities; and ITLM encompasses industry, transportation, logistics and Materials.

These characteristics are critical for understanding how specific features of green bonds may influence their attractiveness and issuance volumes. The data for these issuance characteristics is primarily sourced from Bloomberg database.

Level 2: Market Conditions & Economic Indicators

This level incorporates broader economic and institutional variables that indirectly impact green bond issuance:

- The IMF's Financial Market Development Index includes three key sub-indices for financial institutions:
 - **Financial Institutions Depth:** This sub-index expands on traditional banking sector depth by incorporating assets from mutual funds, pension funds, and the size of life and non-life insurance premiums. Insurance premiums are used instead of insurance assets due to better data coverage, enhancing the country-year scope of this indicator.
 - **Financial Institutions Access:** This measure is primarily bank-focused due to limited data from other financial institutions. It uses the number of bank branches and ATMs per 100,000 adults to gauge access, omitting indicators with

limited temporal or geographic coverage, like the number of bank accounts and mobile banking usage.

- Financial Institutions Efficiency: This sub-index assesses bank efficiency through three dimensions: savings-to-investment intermediation efficiency (net interest margin and lending-deposit spread), operational efficiency (non-interest income to total income and overhead costs), and profitability (return on assets and equity).
- Unemployment: Reflects the economic stability of the region, as higher unemployment may affect corporate financing decisions. Unemployment data is typically obtained from national statistics agencies and OECD database.
- Inflation: Represents the rate of price increase, which can impact borrowing costs and investor sentiment regarding long-term investments like green bonds. Inflation rates are sourced from the IMF WEO database.
- Government Debt: Indicates the level of public debt, which can affect the cost of capital and influence investor confidence in the economic environment. Government debt data is also available from the IMF WEO database.

Additionally, this level includes latent variables such as:

- Institutional Governance: Encompasses aspects like control of corruption, government effectiveness, political stability, regulatory quality, rule of law, and voice and accountability. Data on these variables is obtained from the World Bank's Worldwide Governance Indicators (WGI).
- Policy Support: This latent variable encompasses the policies and rigor of implementing international, intersectoral, and sectoral environmental policies, which can significantly impact the green bond market. Data for policy support is drawn from the CAPMF database, a structured and harmonized climate mitigation policy database developed by the OECD as part of the International Programme for Action on Climate. It tracks climate actions across 52 countries using 128 policy variables, providing valuable insights into the effectiveness of various climate policies.

5. Results and discussion

To prepare for the structural equation model (SEM), an exploratory factor analysis (EFA) was conducted on data from 19 European countries issuing corporate green bonds between 2013

and 2024. Variables with factor loadings above 0.6 were retained as latent and exogenous variables for the SEM. A confirmatory factor analysis (CFA) followed to validate the latent constructs and ensure model fit. These analyses informed the SEM design, integrating validated latent variables and their corresponding manifest variables.

Table 3 summarizes reliability and validity tests, confirming strong data reliability. Bartlett’s sphericity tests are significant at the 1% level, while the Kaiser-Meyer-Olkin (KMO) values for two latent variables are 0.878 and 0.758, demonstrating good validity and a robust basis for the SEM analysis.

Table 3: Reliability and Validity Test

Latent Variable	Explicit Variable	Standard Cronbach’s Alpha	KMO	Bartlett test P-value
Institutional Governance	1. Control of corruption	0.971	0.878	0.000
	2. Government effectiveness			
	3. Political stability and absence of violence			
	4. Regulatory quality			
	5. Rule of law			
	6. Voice accountability			
Policy Support	1. Number of sectoral climate policies adopted	0.911	0.758	0.000
	2. Number of cross-sectoral climate policies adopted			
	3. Number of international climate policies adopted			
	4. The rigor of sectoral climate policies, measured on a scale from 0 to 10			
	5. The rigor of cross-sectoral climate policies, measured on a scale from 0 to 10			
	6. The rigor of international climate policies, measured on a scale from 0 to 10			

The structural equation model (SEM) estimation results, summarized in Table 4, shed light on the factors influencing corporate green bond issuance. The dependent variable is the logarithm of the real amount of corporate (non-bank) green bond issuances per capita, ensuring a balanced analysis. Normalizing by population size addresses the 2021 green bond issuance surge and mitigates sample imbalances in the SEM framework. This standardization enhances comparability across years, reduces the dominance of high-issuance periods, and offsets the

disproportionate influence of large issuers such as France and Germany. By minimizing variance from absolute issuance differences, this approach facilitates fairer cross-country and cross-period comparisons.

The findings highlight a complex interaction among financial market development, institutional quality, policy support, issuance characteristics, and macroeconomic conditions, driving green bond market expansion.

Table 4: Results of SEM analysis: Estimated coefficients

Latent and independent variables	Standardized coefficients	
<i>Institutional Governance (latent)</i>	0.491***	(0.017)
1. Control of corruption	0.988***	(0.001)
2. Government effectiveness	0.926***	(0.003)
3. Political stability and absence of violence	0.748***	(0.008)
4. Regulatory quality	0.956***	(0.002)
5. Rule of law	0.951***	(0.002)
6. Voice accountability	0.934***	(0.003)
Policy support (impact on Institutional Governance)	0.211***	(0.014)
<i>Policy support (latent)</i>	-0.111***	(0.026)
1. Number of sectoral climate policies adopted	0.703***	(0.021)
2. Number of cross-sectoral climate policies adopted	0.854***	(0.012)
3. Number of international climate policies adopted	0.641***	(0.012)
4. The rigor of sectoral climate policies, measured on a scale from 0 to 10	0.830***	(0.010)
5. The rigor of cross-sectoral climate policies, measured on a scale from 0 to 10	0.870***	(0.007)
6. The rigor of international climate policies, measured on a scale from 0 to 10	0.854***	(0.009)
Financial market access	0.164***	(0.002)
Financial market depth	-0.165***	(0.028)
Financial market efficiency	-0.163***	(0.022)
Unemployment	0.202***	(0.028)
Inflation	-0.028	(0.018)
Government debt	0.103***	(0.034)
Maturity	0.213***	(0.021)
Callable	0.317***	(0.022)
Coupon	-0.092***	(0.022)
Euro	-0.093***	(0.033)
Consumer, communication, technology, and healthcare	0.113***	(0.023)
Energy and utilities	0.098*	(0.028)
Industry, transportation, logistics and Materials	0.054*	(0.020)

Satorra-Bentler estimated standard errors are in parentheses, *** for $p < .001$, ** for $p < .01$ and * for $p < .05$. Standardized root mean squared residual = 0.036, Root mean squared error of approximation = 0.028 and Coefficient of determination (pseudo-R²) = 0.96

5.1. Financial Market Development (H1)

The hypothesis that financial market development drives green bond issuance is partially supported, with contrasting effects across market components. Financial market access positively influences issuance volumes, aligning with expectations that broader access enables greater participation in green finance by both issuers and investors. This inclusive environment fosters the growth of corporate green bond issuance. However, financial market depth, measured through metrics like stock market capitalization to GDP and private debt securities

to GDP, exhibits a negative impact. Deeper markets may prioritize high-yield or traditional financial products over long-term, low-return green bonds unless sustainability incentives are in place.

Additionally, financial market efficiency shows a negative relationship with green bond issuance. Highly efficient markets, focused on cost minimization and short-term gains, may deprioritize green bonds due to higher transaction costs and lower yields. These findings highlight that while broader market access supports green finance, deeper and more efficient markets may hinder it without sustainability-focused policies.

Interestingly, our findings diverge from existing literature, which primarily links financial market depth to broader green growth. For instance, Yuan et al. (2023) identify a U-shaped relationship between financial market depth and green growth, suggesting that initially, deeper markets may hinder green growth but later facilitate it as maturity advances. This dynamic underscores the nuanced role of financial markets in environmental sustainability.

5.2. Institutional Quality and Policy Support (H2, H3)

Policy support influences green bond issuance both directly and indirectly. Directly, environmental policy support exhibits a surprising negative effect on green bond issuance per capita. This suggests that high compliance costs, complex regulations, and operational challenges may deter issuers, particularly smaller firms with limited resources. Policies without clear incentives or those imposing extensive certification and reporting requirements could inadvertently hinder green bond growth. This finding contrasts with Mertzanis (2023), who identified a positive link between diverse energy policies and green bond issuance across 70 countries from 1991 to 2021.

Indirectly, policy support significantly enhances institutional quality, which positively impacts green bond issuance. Institutional quality mediates policy frameworks, translating them into market stability, transparency, and improved investor confidence. For example, the European Green Bond Standard (EGBS) highlights how strong governance fosters clarity and trust in green finance, encouraging higher issuance volumes.

These results suggest that governance-focused policies are more effective in advancing green finance than standalone regulatory measures, aligning with Tolliver (2020).

5.3. Issuance Characteristics (H4)

Issuance characteristics play a critical role in determining green bond volumes. Lower coupon rates attract issuers by reflecting the "greenium" effect, where environmentally conscious

investors accept reduced yields, thereby lowering financing costs and encouraging issuance. Conversely, higher coupon rates deter issuance by signaling increased risks and higher borrowing costs, pushing firms toward alternative funding options. These findings align with prior research (Agliardi & Agliardi, 2019; Gianfrate & Peri, 2019), emphasizing the need to balance coupon rates to sustain investor demand while managing costs.

Callable bonds positively influence issuance by offering issuers flexibility to redeem bonds under favorable conditions, particularly in volatile markets. This observation supports Hachenberg and Schiereck (2018), who highlighted the appeal of callable features in green bond pricing. Additionally, longer maturities drive issuance, aligning with the extended timelines required for environmental projects, making green bonds attractive to both issuers and long-term investors.

Sectoral factors also significantly impact issuance volumes, with industries like energy and utilities leading the market. These sectors, subject to intense regulatory oversight and environmental pressures, are more active in green financing, reflecting their capacity to drive substantial environmental progress. This sectoral alignment underscores the strategic role of targeted green bond issuance in addressing critical sustainability challenges.

5.4. Macroeconomic Determinants (H5)

The analysis of macroeconomic variables reveals nuanced effects on green bond issuance. Elevated inflation rates tend to impede issuance by raising borrowing costs and creating economic uncertainties, though this relationship lacks statistical significance. This aligns with Mertzanis (2024) but contrasts with Dan and Tiron-Tudor (2021), who identified a positive correlation, attributing it to higher implementation costs of green projects during inflationary periods, which may incentivize governments to mitigate risks and attract investors.

Unemployment rates exhibit a significant positive effect, suggesting that economic downturns encourage investments in sustainable projects aimed at job creation and recovery. This finding supports the notion that unemployment may indirectly promote green bond issuance. Government debt, while showing a weak positive impact, highlights the appeal of green bonds as secure, socially responsible assets in high-debt contexts, offering a haven for risk-averse investors.

Institutional quality emerges as a crucial mediator, transforming policy support into favorable conditions for green bond growth. Strong governance and transparency amplify the effectiveness of environmental policies, surpassing the impact of standalone mandates.

Issuance characteristics, such as lower coupon rates, callable features, and longer maturities, also significantly drive issuance, while sectoral differences position energy and utilities as leaders in green financing.

These findings underscore the importance of a balanced approach combining market access, robust governance, and supportive macroeconomic policies to foster a thriving green bond market. Institutional quality and well-designed policies are vital for bridging gaps and driving sustainable finance growth.

6. Conclusion

The corporate green bond market in Europe has emerged as a critical mechanism for mobilizing private capital to address pressing environmental challenges and advance sustainable development. This study sheds light on the complex interplay of factors driving corporate green bond issuance, including financial market development, institutional quality, policy support, issuance characteristics, and macroeconomic conditions.

The findings highlight the dual role of financial markets. While greater access to financial services facilitates broader participation in green finance, deeper and more efficient markets tend to prioritize traditional, high-yield investments over green bonds. This underscores the importance of targeted sustainability mandates and policies that can redirect financial flows toward green projects.

Institutional quality and governance emerge as pivotal drivers of green bond issuance. Enhanced regulatory quality, transparency, and control of corruption stabilize financial markets and bolster investor confidence, enabling green finance growth. However, policy frameworks imposing high compliance costs or complex certification requirements deter smaller issuers, highlighting the need for streamlined processes to support more inclusive participation.

Issuance characteristics significantly shape green bond volumes. Lower coupon rates attract environmentally conscious investors willing to accept reduced yields, while callable bonds and longer maturities align with the extended timelines of environmental projects. Sectoral differences remain pronounced, with energy and utilities leading issuance due to regulatory pressures and their capacity for meaningful environmental impact. Expanding green finance to underrepresented sectors could unlock further potential for sustainable growth.

Macroeconomic conditions add another layer of complexity. Inflation exerts a mild negative influence by increasing borrowing costs, whereas higher unemployment correlates with

increased green bond issuance, as sustainable projects are often leveraged during economic downturns to stimulate job creation. Additionally, government debt provides mixed implications, as investors view green bonds as secure alternatives during times of fiscal uncertainty.

From a policy perspective, the findings emphasize the need to enhance institutional quality through measures that promote regulatory efficiency, transparency, and accountability. Streamlining regulatory frameworks, particularly for smaller issuers, is crucial to making green finance more accessible. Tailored incentives, such as tax benefits, public-private partnerships, and subsidies for certification costs, can further promote green bond issuance. Moreover, fostering collaboration across EU member states to harmonize green bond standards would reduce regulatory fragmentation and facilitate cross-border issuances.

Future research should explore the evolving role of European regulations in shaping green bond adoption, with a focus on industry-specific and regional variations. Additionally, the interplay between traditional green bonds and emerging instruments, such as sustainability-linked bonds, warrants further examination to understand their complementary roles in advancing sustainable finance. Expanding the scope to global markets could also provide valuable insights into institutional frameworks and investor behaviors, offering lessons to enhance green finance initiatives worldwide.

The corporate green bond market holds immense potential to drive Europe's transition to a carbon-neutral economy. By addressing existing barriers and fostering an enabling environment through institutional and policy innovations, stakeholders can accelerate the growth of green finance, bridging the gap between financial markets and climate action.

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