IFC-ECCBSO-Bank of Spain Workshop on "New insights from financial statements"

17 October 2024

Green financing and the relationship between banks and non-financial corporations through the lens of balance-sheet interaction[1]

Michael Harrison and Mimoza Shabani,
University of East London

[1] This contribution was prepared for the workshop. The views expressed are those of the authors and do not necessarily reflect the views of the European Committee of Central Balance Sheet Data Offices (ECCBSO), the Bank of Spain, the BIS, the IFC or the other central banks and institutions represented at the event.

Green financing and the relationship between banks and non-financial corporations through the lens of balance-sheet interaction

Michael Harrison[1] and Mimoza Shabani[2]

Abstract

Green investment is a crucial element in the transition towards achieving lower emissions on a global scale. Non-financial corporations (NFCs) have a pivotal role in the transition process by investing in green projects together with banks in providing the necessary finance. This paper uses a novel dataset which includes all the green financing transactions between banks and NFCs in all countries in the European Economic Area (EEA), United Kingdom (UK), and Switzerland for the period between 2014-2024. Our analysis focuses on examining the factors that explain the demand side for green financing, which reflects the NFCs, and the supply side, which reflects banks as the providers of green finance. Our empirical results suggest that there are distinct differences in the factors that determine the amount and preference for green finance and relate to the size of NFCs as well as the sectors in which they operate. Similarly, banks' balance sheet variables also explain their supply of green finance and their likelihood to issue loans or bonds.

Keywords: green finance; syndicated loans, non-financial corporation; banks.

JEL classification: Q56; G21; G15.

[1] Senior Lecturer in Economics, University of East London, UK, email: m.harrison@uel.ac.uk
[2] Associate Professor in Economics, University of East London, UK, email: m.shabani@uel.ac.uk

We thank Carmela D'Avino and Maria Tselika for their valuable comments, and conference participants at the Forecasting Financial Markets (FFM) conference (University of Oxford). Special thanks to Siddhesh Metkar and Daniela Tulgara for their research assistance. All errors remain our own.

Contents

1. Introduction

Recently, significant attention has focused on the economic impact of climate change with governments, regulators, and international supervisory authorities alike, striving to achieve a greener economy. Banks are key players in the transition, as they play a fundamental role in providing green finance to non-financial corporations (NFC)[3] that need to fund investments (Del Gaudio *et al.*, 2022; Filipava and Murshudli, 2023). This paper explores the factors influencing the interaction between banks and NFC in supporting projects designed to mitigate the global effects of climate change. We obtain bank and firm-level data from Bloomberg, which provides granular financing transaction details, and analyse the factors of the supply and demand for green finance. Using data for 2297 green bonds and 1968 use of proceeds term loans we link banks which have issued loans and have underwritten bonds to/for corresponding NFC. The transaction level data allows for capturing the amount, maturity, and costs of green financing activities. The dataset contains 292 banks and 1910 NFCs located in European Economic Area (EEA) countries, the United Kingdom and Switzerland for 2014-2024.

Our goal is to identify the determinants of banks and NFC's preferences for green finance. To this aim, we employ a binomial logistic regression model that sheds light on and quantifies the factors determining a firm's preference for green financing through bonds or loans. The empirical approach is two-fold: We first estimate the model using NFC's balance sheet variables to determine their bond or loan preference, similar to the methodology employed in Altunbaş *et al* (2010). Secondly, we also estimate banks' likelihood to issue loans or underwrite bonds taking into account other balance sheet activities.

Overall, the results suggest that balance sheet variables are key determinants in explaining the total amount of green finance NFCs obtained. In particular, leverage, liquidity and size appear to be positively associated with the total amount of green finance, encompassing both loans and bonds. However, the findings indicate that profitability is not a significant factor in determining the amount of green finance raised. Distinguishing between green firms, and potentially polluting firms known as brown firms, the findings yield distinct results. More specifically, the size of the firms and the cost of finance do not explain the amount of green finance received by green firms. In contrast, both variables along with other balance sheet variables remain positive and significant for brown NFCs.

Regarding the preference of NFCs for the type of green finance raised, we find that more profitable and larger firms tend to select bond issuance as the source of funding for their green projects rather than loans. Balance sheet variables for green firms have a more pronounced effect on their choice of green finance. Indeed, green firms with greater liquidity ratios are found to favour bonds over loans.

[3] We use the terms NFC and firm interchangeably.

In contrast, brown firms' liquidity does not explain the preference for the type of finance they raise. However, the cost of finance and the firm's size remain key factors in explaining the preference for all sectors in which firms operate.

Banks' balance sheet indicators also play a significant role in explaining the amount of green finance they issue to the NFCs. Most notably liquidity and size of the bank are positive and significant with the total amount of green finance banks provide. Profitability and the loan growth rate on the other hand are negatively associated with green finance. Therefore, when banks achieve higher profitability levels by more traditional lending activities they tend to reduce the amount of green lending to corporations. Regarding the environmental scores recorded for all banks engaged in green lending, the findings point to a positive relationship. Therefore, banks with higher reported environmental scores increase their green lending activities. However, the higher these scores are, the higher the likelihood that a bank would prefer the issuance of bonds rather than loans to support NFCs green investment. Similar results yield when we account for the size of the banks suggesting that larger banks also increase the likelihood of issuing or underwriting a corporate bond as opposed to issuing loans.

The results enable a new understanding of the factors determining the supply and demand dynamics of green financing. The micro nature of the granular data used in this paper provides detailed insight on the determinants of green finance allowing regulators and market participant to optimise their approaches to green finance. This has far-reaching implications for policymakers as it can serve as a guide and assist them in tailoring policy to support green financial markets as a whole. More specifically, we argue that smaller NFCs must have additional support both accessibility and affordability of green finance.

2. Literature review

There is a growing body of literature on the intersection of climate change and banking. Several studies have focused on banks' role in advancing the transition to low-carbon economies after committing to the goals of the 2015 Paris Agreement. Delis et al (2023) examine the loan prices that banks charge fossil fuel firms and find evidence of higher loan rates in the corporate loan market following the Paris Agreement.

Kacperczyk and Peydro (2022) analyse how banks distribute credit among non-financial corporations and their role in reducing emissions by decreasing credit supply to brown firms and promoting green investment. Using data from 2013-2018, the analysis captures banks with significant exposure to the syndicated loan market that have committed to goals in emission reduction levels in light of the 2015 Paris Agreement. The empirical results suggest that committed banks support low-emission firms by allocating more credit to them while reducing credit to high-emission brown firms. Similarly, Reghezza et al (2022) employ loan and firm-level data to assess the impact of the Paris Agreement and find that banks reallocated credit away from polluting firms.

However, others have cast doubt on the credibility of banks in delivering green finance, as their actions often do not fully reflect their reported sustainability

commitments. Nauman and Morris (2021) report that post-2015 global banks have actually expanded their lending to fossil fuel companies, providing a total of $750bn in 2020 alone. There are also concerns about the transparency of banks in disclosing information on their environmental impact (ECB 2023). Giannetti et al (2023) examine the environmental disclosures and the lending decisions for 101 systemically important European banking groups. The findings suggest that banks claiming to emphasise sustainable lending activities are in fact extending more new loans to firms in brown industries, without a corresponding increase in lending to green industries.

Growing concerns have also emerged regarding the 'greenwashing' practices, casting doubts about the reliability of information surrounding green bond issuance, with the latter being an important product in green financing. The strong demand for green bonds among investors is incentivising their issuance even when firms may not have the means to meet their climate pledges fully[4]. Flammer (2021) examines corporate green bond issuance by public and private firms worldwide from 2013 to 2018 and finds that the stock market reacted positively to the announcement of these issuances. Furthermore, the paper tracks the environmental performance of the firms engaged in green bond issuance and observes an increase in their environmental ratings along with a decrease in CO2 emissions.

3. Data

To examine the factors that influence the amount and type of green financing received by firms and issued by banks, we use transactional level data for the issuance of 2297 bonds and 1968 syndicated loans. We do so for all beneficiary NFC located in EEA, Switzerland and the UK[5] for the period between 2014 and quarter two of 2024[6].

Bloomberg captures individual financing transactions which take the form of bond issuances and syndicated loans to companies. Each transaction reflects an investment in reducing the recipient firm's carbon emissions, not necessarily eliminating all emissions, especially in the case of brown industries. In each case, Bloomberg can consistently apply a green flag to financing activity, where set criteria are met. Bloomberg's process for flagging involves verifying the declared use of proceeds. Issuers must demonstrate, usually with the aid of an ESG verification partner, that 100% of the net proceeds are dedicated to projects promoting climate change mitigation, adaptation, or other environmental sustainability purposes (Bloomberg, 2023). We only consider bonds/loans where Bloomberg has verified the use of proceeds so that we can be sure that greenwashed transactions do not feature in the dataset.

---

[4] See 'Fears rise over 'greenwash' bonds', Financial Times, March 21, 2022.

[5] Full list of countries included: Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom, Switzerland, Iceland, Liechtenstein and Norway.

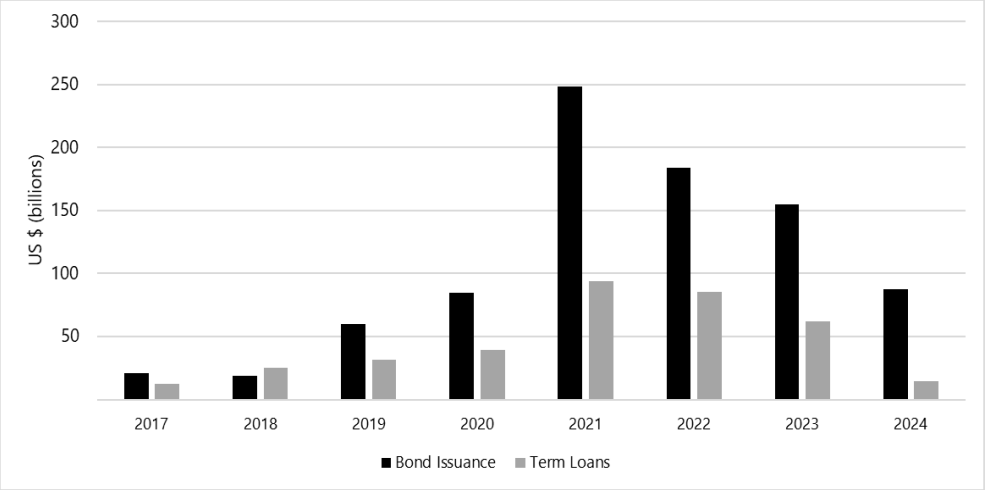
[6] Data from 2014- 2016 is scarce due to inconsistent reporting practices by banks (Bloomberg 2023) and therefore they have been excluded from the final dataset.

We identify a total of 4265 individual transactions for which we also collect balance sheet variables for all NFCs that received green financing. This constitutes all the recorded transactions in the period available from Bloomberg. Further, we identify, in most cases, the bank which has facilitated the transaction. That is, facilitated a bond issuance or served as syndicate lead for a loan issuance. Having identified the banks which are involved in the supply of green finance we also collect individual bank-level data. In this sense we capture data pertaining to both sides of an individual transaction, the demand side using firm-level data and the supply side using bank-level data.

Graph 1 shows the total amount of bond and loan financing obtained by NFCs over the sample period. In 2021, green financing reached a total of $341.65 billion, with bond issuance accounting for $248.09 billion of that amount.

Total bond and loan financing 2017-2024

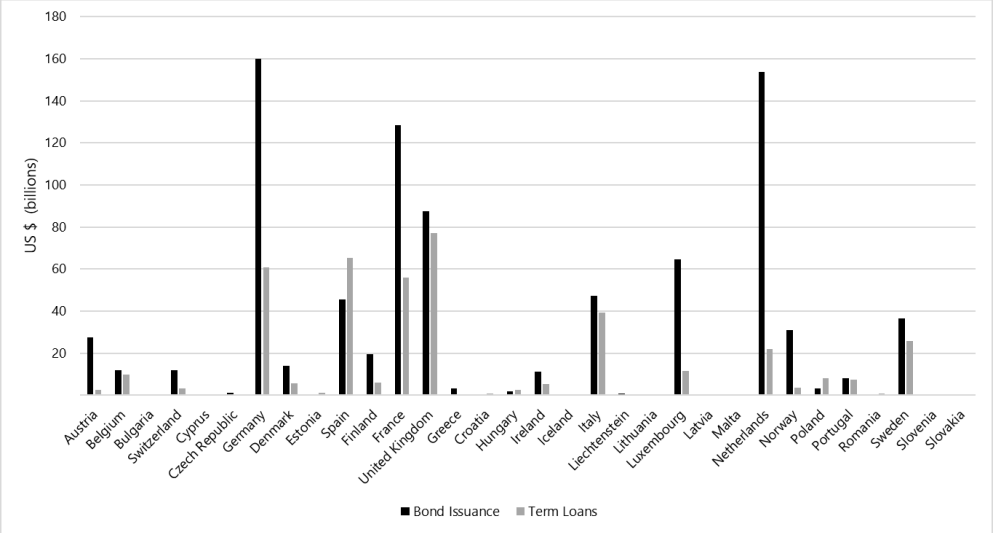
Graph 1



Graph 2 presents the amount and type of green financing based on the domicile of the recipients, highlighting the countries in which the NFCs are located. Firms domiciled in Germany, Netherlands, France, the UK, Spain, and Luxembourg are the largest recipients of green financing. As shown in Graph 2 bond issuance is the dominant channel through which green finance has been obtained.

Total Green Financing sorted by type and domicile of recipient

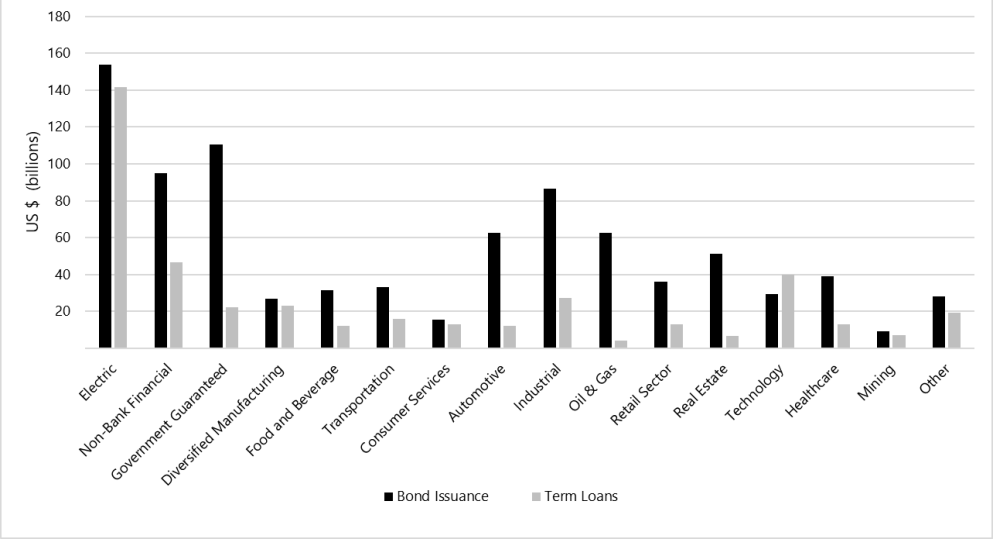
Graph 2



Regarding the sectors in which NFCs operate, as presented in Graph 3, a significant variation in the amount of funding obtained by each sector can be observed. However, the Electric sector emerges as the largest recipient in our dataset, having secured $145 billion in bond issuance and $14 billion in loans.

Total Bond and Loan Financing 2017-2024 (US$) by sector of recipient

Graph 3



On the other side of the transaction, we have identified the banks that have facilitated the issuance of syndicated loans or underwriting corporate bond issuance. Table 1 provides information on the largest top 10 banks that have supported green finance to NFCs. As can be seen, BNP Paribas is a prominent bank providing a total of $53.77 billion in green loans and underwriting green bonds, between 2014-2024.

Ten largest banks by total green financing

Table 1

Bank Name	Bank Country	Syndicated Loans	Bond Issuance	Total Green Financing
BNP Paribas	France	8.22	45.55	53.77
UniCredit (Germany)	Germany	11.99	26.21	38.19
JPMorgan Chase	US	4.49	29.98	34.48
CACIB	France	20.22	12.28	32.50
HSBC	UK	2.36	28.91	31.28
ING	Netherlands	12.20	18.69	30.90
Société Générale	France	7.66	22.63	30.29
Santander	Spain	17.71	10.14	27.85
Mitsubishi UFJ (London)	UK	24.68	0.30	24.99
NATIX	France	13.52	11.04	24.56

Note: Largest banks by total amount of green financed issued for the period between 2014-2024. Mitsubishi UFJ is a subsidiary located in London and does not reflect transactions from the headquarters. Similarly, UniCredit is an Italian-owned bank, but the transactions recorded in our dataset reflect the German-based subsidiary only. All values are in US $ in billion.

4. Methodology

We estimate two models to evaluate the demand side of the green finance market. First, we estimate the following baseline model that examines the factors determining the total amount of green financing received by NFCs:

$$log\ (totalgreenfinancing_{i,j,t,c}) = \alpha + Y_{i,j,t}\beta + \gamma_j + \theta_t + \delta_{c,t} + \epsilon_{i,j,t,c} \quad (1)$$

Where, the dependent variable is the logarithm of the total amount of green finance, including both use of proceeds loans and bonds, obtained by firm *i* in sector *j,* during year *t,* and in country *c*. $Y_{i,j,t}$ is a vector of firm-level balance sheet variables such as leverage, profitability, liquidity, size of the firm, and the cost of finance for firm i and time t with corresponding coefficient vector β. γ_j denotes sector fixed effects for sector *j,* in which firm *i* operates and θ_t denotes time-fixed effects for year *t*. $\delta_{c,t}$ represents country-level macroeconomic variables such as GDP per capita, inflation, and investment for country *c* at time *t*. A complete list of variables and their definitions is provided in Appendix I. [7]

Next, we estimate a binominal logistic regression model aimed at explaining the determinants of the type of green finance an NFC has secured, rather than the

[7] The cost of finance variable consists of the lending rate in the case of loans and the coupon rate where green financing was raised through bond issuance. The coupon rate reflects the cost of finance to the firm at the point of bond issuance, but perhaps not in future periods where interest rates change.

amount[8]. The model considers whether a firm received a bond or a loan, allows us to identify the significant factors influencing NFCs decision-making and has the following form:

$$Indicator_{itb} = \alpha + \beta Y_{i,t,b} + \delta_{c,t} + \gamma_j + \theta_t + \mu_i + \varepsilon_{i,t,b} \quad (2)$$

Here $Indicator_{i,t,b}$ is a binary variable which takes the value of 1 if a loan was issued to firm *i* at time *t*, and by bank *b*, and 0 otherwise to denote the issuance of a bond. $Y_{i,t,b}$ is a vector of bank balance sheet variables. $\delta_{c,t}$ represents country-level macroeconomic variables. θ_t denotes time-fixed effects for year *t*. μ_i represents an indicator variable to denote if the recipient firm is in a green or a brown industry. The Bloomberg data provides information on the industry in which the NFCs operate allowing us to distinguish between green and brown sectors. A key barrier here is the lack of a standardised approach to delineating between green activity and brown activity at the sector level (Shapira *et al.*, 2014). The approach taken in this paper is similar to Ardia *et al.* (2023) and He *et al.* (2024), where the delineation is made based on the sector's tendency to pollute in the course of the production or consumption of the good/service.

We proceed in a similar fashion and estimate the baseline model (1) on the supply side of the green finance market. Specifically, we include bank balance sheet variables and bank-level ESG scores to analyse the factors influencing the amount of green finance provided by a bank in a given year as outlined in the following baseline model:

$$\log (totalgreenfinancing_{i,t,b}) = \alpha + \beta_1 Y_{b,t} + \beta_2 \rho_{b,t} + \lambda_b + \theta_t + \varepsilon_{b,t} \quad (1.1)$$

Where the dependent variable is the natural log of the total amount of green finance a bank b issued to firm i in year t. $Y_{b,t}$ is a vector of bank balance sheet variables such as leverage, profitability, liquidity and loan growth rate. $\rho_{b,t}$ is a vector of bank-level ESG indicators which we consider sequentially. They comprise the Bloomberg environmental score, overall ESG score, ESG disclosure score and climate annual report, which reflects the discussion of climate change risk in the bank's b annual report at time t. λ_b denotes bank-level fixed effects for bank b. θ_t denotes time-fixed effects for year t.

We also estimate a binomial logistic regression model to assess the factors which determine the form of finance a bank is willing or able to offer and the factors which explain the bank's likelihood of issuing loans rather than bonds (and vice versa). The model takes the following form:

$$Indicator_{itb} = \alpha + \beta_1 Y_{b,t} + \beta_2 \rho_{b,t} + \lambda_b + \theta_t + \varepsilon_{b,t} \quad (2.1)$$

[8] The model is estimated using information on transactions which occurred and cannot reflect the demand from NFCs which was not realized.

For which the $Indicator_{i,t,b}$ is a binary variable to denote the issuance of a bond (coded as 0) or a loan made to firm *i*, at time *t*, and by bank *b*. $Y_{b,t}$ is a vector of bank balance sheet variables. $\rho_{b,t}$ is a bank-level ESG indicator at time *t*. λ_b denotes bank-level fixed effects for bank *b*. θ_t denotes time-fixed effects for year *t*.

5. Results

Table 2 presents the results of the baseline model (1), which controls for NFCs' balance sheet variables along with macroeconomic factors. The findings indicate that balance sheet variables play a significant role in determining the amount of green finance which NFCs obtain, as shown in specifications (1) and (2). Higher leverage, greater liquidity, and larger firms are associated with obtaining a higher amount of green finance. Profitability, on the other hand, does not appear to be a significant factor in explaining the amount of green finance, except when accounting for country fixed effect, as shown in specification (4). The results also provide some evidence that macroeconomic variables play a role in determining the amount of green finance raised by NFCs. Interestingly, the results indicate a negative relationship between country-level investment and total green finance, which may suggest that green finance is subject to a crowding-out effect. The results in the specification (3) suggest significant sector-level variations within our dataset. The last two specifications in Table 2 present the results for brown and green firms. For green firms, as shown in specification (5), firm size and the cost of finance do not appear to be significant factors in determining the total amount of green finance firms obtain, although other balance sheet variables remain significant. In contrast, specification (6), reveals that for brown firms, firm size and the cost of finance are the primary determinant of the total amount of green finance.

We extend model (1) to include the maturity of the bonds issued during the period in our dataset. Due to data limitations, the estimation only takes into account the bond issuance for which the results are presented in Table A2, Appendix II. The maturity of the bond appears to have a positive effect on brown firms and does not significantly explain the finance raised from bond issuance for green firms.

Baseline regressions using NFCs balance sheet variables

Table 2

Dependant variable	*Log Total Green Financing*					
Sample	All	All	All	All	Green	Brown
	(1)	(2)	(3)	(4)	(5)	(6)
Leverage	0.003*	0.004**	0.003	-0.003	0.006*	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
Profitability	-0.000	-0.000	0.000	0.001***	-0.001	0.000
	(0.001)	(0.001)	(0.000)	(0.000)	(0.002)	(0.001)
Liquidity	0.184***	0.211***	0.155***	0.133***	0.253***	0.077
	(0.048)	(0.047)	(0.042)	(0.040)	(0.087)	(0.057)
Size	0.106***	0.113***	0.143***	0.136***	0.032	0.174***
	(0.020)	(0.019)	(0.018)	(0.017)	(0.029)	(0.026)
Cost of Finance	-0.038**	-0.076***	-0.059***	-0.001	-0.015	-0.045**
	(0.017)	(0.018)	(0.019)	(0.019)	(0.024)	(0.022)
GDP	-0.000***	-0.000**	-0.000***	0.000	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	0.010*	-0.000	0.002	0.021***	-0.009	0.019**
	(0.006)	(0.006)	(0.007)	(0.007)	(0.009)	(0.007)
Investment	-0.058***	-0.072***	-0.063***	0.055**	-0.099***	-0.016
	(0.012)	(0.012)	(0.012)	(0.025)	(0.021)	(0.015)
Constant	19.216***	19.206***	18.708***	16.799***	20.350***	18.108***
	(0.350)	(0.592)	(0.562)	(0.760)	(0.639)	(0.413)
Observations	1,188	1,188	1,187	1,188	430	757
R-squared	0.102	0.157	0.258	0.376	0.187	0.097
Time FE	No	Yes	Yes	Yes	No	No
Country FE	No	No	No	Yes	No	No
Sector FE	No	No	Yes	No	No	No

Notes: All specifications are estimated using OLS regressions. The dependent variable is the log of the total amount of green finance, including both the use of proceeds loans and bond issuance. Robust standard errors are in parentheses. The statistical significance of results is indicated by ***,**, and * and refer to 1%, 5% and 10% levels, respectively.

Table 3 presents the results of the binomial logistic regression model (2). Specifications (1) and (2) show that profitability influences green finance preferences but not the amounts, as shown in the result of Table 2. Specifically, more profitable firms tend to prefer issuing bonds to finance their green projects. Additionally, larger firms favour bonds over loans, and a higher cost of finance shifts their preference toward bond issuance. In determining the financing choices available to firms, balance sheet variables are slightly more significant for green firms, as shown in specification (3). In particular, firms with greater liquidity tend to prefer raising green finance by issuing bonds. For brown firms, however, only profitability is marginally significant. Regarding macroeconomic conditions, investment stands out as a key difference between the two sectors in that it is a significant factor for brown firms but not green ones.

Binominal Logistic regression

Table 3

Dependant variable	*Green loan =1, bond =0*			
Sample	All	All	Green	Brown
	(1)	(2)	(3)	(4)
Leverage	0.002	0.006	0.007	0.005
	(0.004)	(0.004)	(0.008)	(0.005)
Profitability	-0.005**	-0.003*	-0.006*	-0.002*
	(0.002)	(0.002)	(0.003)	(0.001)
Liquidity	-0.014	0.095	0.466***	-0.178
	(0.089)	(0.095)	(0.151)	(0.126)
Size	-0.241***	-0.258***	-0.207***	-0.280***
	(0.036)	(0.037)	(0.065)	(0.046)
Cost of Finance	-0.399***	-0.589***	-0.660***	-0.545***
	(0.039)	(0.055)	(0.106)	(0.071)
GDP	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	-0.003	-0.012	-0.034	-0.021
	(0.012)	(0.014)	(0.037)	(0.018)
Investment	-0.123***	-0.128***	-0.054	-0.168***
	(0.026)	(0.029)	(0.040)	(0.041)
Constant	5.088***	4.743***	4.956***	7.679***
	(0.710)	(1.201)	(1.391)	(1.352)
Observations	1,192	1,192	426	761
Time FE	No	Yes	Yes	Yes
ROC	0.750	0.786	0.813	0.797

Notes: All specifications are estimated using a logistic regression model. The dependent variable is a dummy variable taking the value of 1 for use of proceeds loans and 0 otherwise. Robust standard errors in parentheses. The statistical significance of results is indicated by ***,**, and * and refer to 1%, 5% and 10% levels, respectively.

Next, we present the results of the regression model that examines the factors influencing banks' loan and bond issuance to NFCs. Table 4 displays the findings from the baseline regression model (1.1). Similar to the analysis of NFCs discussed above, balance sheet variables appear to play a significant role in determining the total amount of green finance issued by banks during our sample period. Specifically, bank liquidity and size are positively associated with the amount of green finance issues, as indicated in specification (1). However, banks with higher profitability and loan growth rates show a negative relationship with green finance issuance. This could be because banks may reduce green financing to NFCs during periods of strong profitability and rapid loan growth rates. These results remain consistent even after accounting for bank and time-fixed effects, as shown in specifications (2) and (3). The results in Table 4 also show that all environmental performance measures, such as the Bloomberg environmental score, ESG disclosure score and the indicator associated

with the annual reports which discuss climate change, are positive and significant in all specifications.

Baseline regression with bank balance sheet variables

Table 4

Dependant variable	*Log Total Green Financing*					
	(1)	(2)	(3)	(4)	(5)	(6)
Leverage	0.000	-0.000	-0.000	0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Profitability	-0.255***	-0.074***	-0.265***	-0.283***	-0.212***	-0.263***
	(0.024)	(0.017)	(0.018)	(0.024)	(0.019)	(0.021)
Liquidity	0.704**	1.182*	0.551	0.842*	0.821*	0.587*
	(0.343)	(0.688)	(0.337)	(0.433)	(0.427)	(0.321)
Size	0.645***	2.987***	0.582***	0.564***	0.419***	0.570***
	(0.055)	(0.357)	(0.049)	(0.061)	(0.055)	(0.044)
Loan growth rate	-0.040***	0.031**	-0.100***	-0.017	-0.031***	-0.057***
	(0.011)	(0.012)	(0.011)	(0.010)	(0.009)	(0.010)
Environmental score	0.141***	0.311***	0.052***			
	(0.037)	(0.028)	(0.019)			
Overall ESG score				0.373***		
				(0.047)		
ESG disclosure score					0.042***	
					(0.004)	
Climate annual report						0.314***
						(0.072)
Constant	11.733***	-21.736***	12.971***	11.799***	12.997***	13.112***
	(0.675)	(4.885)	(0.639)	(0.710)	(0.623)	(0.574)
Observations	1,573	1,573	1,573	1,565	1,699	1,802
R-squared	0.208	0.826	0.312	0.219	0.221	0.168
Time FE	No	No	Yes	No	No	No
Bank FE	No	Yes	No	No	No	No

Notes: All specifications are estimated using OLS regressions. The dependent variable is the log of the total amount of green finance, including both the use of proceeds loans and bond issuance. Robust standard errors are in parentheses. The statistical significance of results is indicated by ***,**, and * and refer to 1%, 5% and 10% levels, respectively.

Regarding banks' likelihood of the type of green finance issuance, Table 5 shows that most balance variables do not significantly explain their activity. The only notable exception is bank size, which appears to be significant, as shown in specification (1). The results suggest that the larger a bank is the higher the likelihood to issue green bonds over green loans. Additionally, a bank with higher environmental scores also has a tendency towards bond issuance. The results are robust in all three specifications presented in Table 5.

Binominal Logistic regression

Table 5

Dependant variable	*Green loan =1, bond =0*		
	(1)	(2)	(3)
Leverage	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)
Profitability	-0.138	-0.179	0.819
	(0.125)	(0.185)	(0.564)
Liquidity	0.280	0.404	-2.830
	(1.408)	(1.445)	(1.835)
Size	-0.651***	-0.579***	-5.639***
	(0.166)	(0.150)	(1.786)
Loan growth rate	-0.052	-0.074	0.067
	(0.053)	(0.055)	(0.075)
Environmental score	-0.186***	-0.082***	-0.253**
	(0.051)	(0.026)	(0.100)
Constant	9.581***	10.818***	81.112***
	(1.925)	(2.037)	(24.973)
Observations	1,575	1,575	1,302
Time FE	No	Yes	No
Bank FE	No	No	Yes
ROC	0.713	0.734	0.911

Notes: All specifications are estimated using a logistic regression model. The dependent variable is a dummy variable taking the value of 1 for use of proceeds loans and 0 otherwise. Robust standard errors in parentheses. The statistical significance of results is indicated by ***,**, and * and refer to 1%, 5% and 10% levels, respectively.

6. Conclusion and Policy Recommendations

Using transaction-level data on both banks and NFCs, this paper empirically examines the factors influencing the amount of green finance and the choice between use of proceeds loans or bond issuance. The findings highlight that firm balance sheets play a significant role in determining both the quantity and type of green finance obtained. Additionally, we observe distinct differences between brown and green firms in their green finance behaviour. For brown firms, balance sheet variables such as liquidity, profitability and leverage do not significantly impact the total green finance raised. Instead, factors like the cost of finance and firm size are crucial. For brown firms, higher interest or coupon rates reduce the amount of green finance they raise. On the other hand, larger firms tend to secure more green financing.

In contrast, for green firms, the cost of finance is not a key determinant, but liquidity and leverage significantly influence the amount of green finance obtained. Regarding the choice of financing type, profitability drives a preference for bond

issuance over loans. Other balance sheet factors, such as liquidity, also matter more for green firms, with more liquid green firms favouring bonds over loans.

From a bank's perspective, our findings suggest that as they become larger, more profitable or improve their own ESG performance the likelihood of banks in bond issuance increases as opposed to loan issuance. On the other hand, we also find that smaller firms are potentially at a disadvantage in relation to larger firms due to their preference for loans rather than bonds. This potential mismatch between what firms prefer and what banks provide could lead to slowing down the green transition whereby firms are unable to access suitable funds for green projects.

Our findings lead to wide-ranging policy implications. The results presented in this paper reveal that common factors influencing green finance for both green and brown firms include the cost of finance and their size. The implications of the results suggest that the cost of financing can significantly impact a firm's ability to pursue green projects. If green finance is available at lower costs, it could increase the green projects small firms could undertake and hence increase their overall contribution towards the transition to greener economies. Therefore, it is crucial to consider the needs and challenges of smaller firms which are more exposed to the cost of finance given their size predisposes them to the loan market rather than bonds. Furthermore, a lower cost of finance compared to traditional finance could further enhance green projects all-size firms undertake.

References:

Altunbaş, Y., Kara, A. and Marques-Ibanez, D. (2010) 'Large debt financing: syndicated loans versus corporate bonds', *The European Journal of Finance*, 16(5), pp. 437–458.

Ardia, D. *et al.* (2023) 'Climate Change Concerns and the Performance of Green vs. Brown Stocks', *Management Science*, 69(12), pp. 7607–7632.

Bloomberg (2023) *Green, Social, Sustainability & Sustainability linked Instruments Guide*. Bloomberg.

Del Gaudio, B.L. *et al.* (2022) 'Syndicated green lending and lead bank performance', *Journal of International Financial Management & Accounting*, 33(3), pp. 412–427.

Delis, M.D., De Greiff, K. and Ongena, S. (2023) 'Being stranded on the carbon bubble? Climate policy risk and the pricing of bank loans', Swiss Finance Institute Research Paper No.18-10.

Filipava, L. and Murshudli, F. (2023) 'The Development of the Global Green Finance Market: The Role of Banks and Non-banking Institutional Investors', in N. Naifar and A. Elsayed (eds) *Green Finance Instruments, FinTech, and Investment Strategies*. Cham: Springer International Publishing, pp. 27–46.

Giannetti, M., Jasova, M., Loumioti, M. and Mendicino, C. (2023) 'Glossy green" banks: the disconnect between environmental disclosures and lending activities', European Central Bank, Working Paper Series No 2882.

He, W. *et al.* (2024) 'Dynamic spillovers of green, brown, and financial industries under the low-carbon transition: Evidence from China', *Energy Economics*, 139, p. 107901.

Nauman, B., and Morris, S., (2021). Global banks' $750bn in fossil fuels finance conflicts with green pledges, The Financial Times, available on: https://www.ft.com/content/c1e31c6f-6319-4bfc-bde3-3ace80b46a2b

Reghezza, A., Y. Altunbas, D. Marques-Ibanez, C. R. d'Acri, and M. Spaggiari (2022). Do Banks Fuel Climate Change? *Journal of Financial Stability*, Vol.62, 101049.

Shapira, P. *et al.* (2014) 'Probing "green" industry enterprises in the UK: A new identification approach', *Technological Forecasting and Social Change*, 85, pp. 93–104.

Appendix

Appendix I- Variable Definitions

Table A1

Variable	Definition
Balance Sheet Variables	
Log Total Green Financing	The total amount of finance raised by an NFC in an individual financing transaction. *Value is taken in natural logarithms*
Bond/Loan Indicator	An Indicator variable to denote if an individual financing transaction allowed a firm to obtain a bond issuance or obtain a syndicated term loan. 0 denotes a bond.
Leverage	*Debt-to-Capital Ratio*
Profitability	*EBITDA Margin*
Current Ratio	*Current Ratio*
Size	Natural Logarithm of Total Assets
Cost of Finance	The coupon rate of the individual bond transaction (Bloomberg Data) or the lending rate at the country level (World Bank WDI) in year *t* for firm *i* located in country *c*.
Maturity	Number of years for which a bond has been issued (Calculated based upon Bloomberg Data)
Green/Brown Sector Indicator	An indicator variable where 0 denotes an NFC in a Brown industry
Bank Balance Sheet Variables	
Log Total Green Financing	The total amount of green finance raised by given bank *Value is taken in natural logarithms.*
Loan Growth Rate	(Total Loans$_t$ – Total Loans$_{t-1}$) / Total Loans$_{t-1}$
Size	Natural Logarithm of Total Assets
Liquidity	(Cash & Cash Equivalents + Inter-banking Assets + Trading Securities + Assets Available for Sale)/Total Assets
Profitability	Return on Total Assets - Ratio
Leverage	Average Assets/Average – Equity
ESG Variables	
Bank Balance Sheet Variables	
Overall ESG Score	Bloomberg ESG Materiality Scorecard Indications Values between 0-10, 10 is best
Environmental Score	Bloomberg ESG Materiality Scorecard Indications Values between 0-10, 10 is best
Bloomberg ESG Disclosure Score	Values between 0-100, 100 is best
Annual Report Discusses Opportunities and Risks w.r.t Climate Change	Indicator variable, where 1 denotes the annual report discussing Climate Change
Macroeconomic Control Variables	
GDP	Nominal GDP per Capita (World Bank WDI)
Inflation	Annual GDP Deflator (World Bank WDI)
Investment	Gross Fixed Capital Formation (World Bank WDI)

Appendix II- Supplementary findings

Table A2 presents the regression estimates for the baseline model (1) on green bond financing. Due to data limitations, we could only obtain information on the maturity of green finance for NFCs in the context of bond issuances. As a result, model (1) is estimated using data exclusively from bond issuances to account for bond maturity. The results suggest that higher profitability reduces the amount of green bond finance obtained by firms, possibly indicating that firms may prefer to use retained earnings to fund green projects. However, this finding applies only to green firms, as shown in specification (2) of Table A2. In contrast, bond maturity affects only brown firms, with longer bond maturities associated with higher amounts of green bond issuance by firms.

Green bond financing

Table A2

Dependant variable	*Log Green Bond Financing*		
Sample	All	Green	Brown
	(1)	(2)	(3)
Leverage	0.004	0.004	0.003
	(0.003)	(0.004)	(0.004)
Profitability	-0.006***	-0.005***	-0.002
	(0.001)	(0.002)	(0.002)
Liquidity	0.186***	0.163	0.124**
	(0.055)	(0.110)	(0.059)
Size	0.076***	0.057*	0.114***
	(0.025)	(0.033)	(0.035)
Cost of Finance	-0.079***	-0.021	-0.111***
	(0.022)	(0.028)	(0.039)
Maturity	0.001*	0.005	0.001**
	(0.001)	(0.014)	(0.001)
GDP	-0.000***	0.057*	-0.000**
	(0.000)	(0.033)	(0.000)
Inflation	0.002	-0.021	0.007
	(0.006)	(0.028)	(0.007)
Investment	-0.103***	0.005	-0.072***
	(0.015)	(0.014)	(0.018)
Constant	21.252***	21.650***	20.507***
	(0.422)	(0.898)	(0.500)
Observations	762	296	465
Time FE	0.391	0.407	0.377

Notes: The dependent variable is the log of the amount of bond green financing. Robust standard errors are in parentheses. The statistical significance of results is indicated by ***,**, and * and refer to 1% 5% and 10% levels, respectively.

Green financing and the relationship between banks and non-financial corporations through the lens of balance-sheet interaction

Michael Harrison and Mimoza Shabani
University of East London

New Insights from Financial Statements Conference
17th of October 2024
Banco de España

University of East London | 125 Years of Pioneering Futures

Motivation

- Recently, significant attention has focused on the economic impact of climate change with the aim achieve a greener economy
- Banks are key players in the transition, as they play a fundamental role in providing green finance to non-financial corporations (NFC) that need to fund investments (Del Gaudio *et al.*, 2022; Filipava and Murshudli, 2023).
- A growing literature examines banks' engagement in green financing but very little is known about the determinants of green lending behaviour
- What about the role of NFC and what are the (internal) determinants of raising green finance?

Contribution

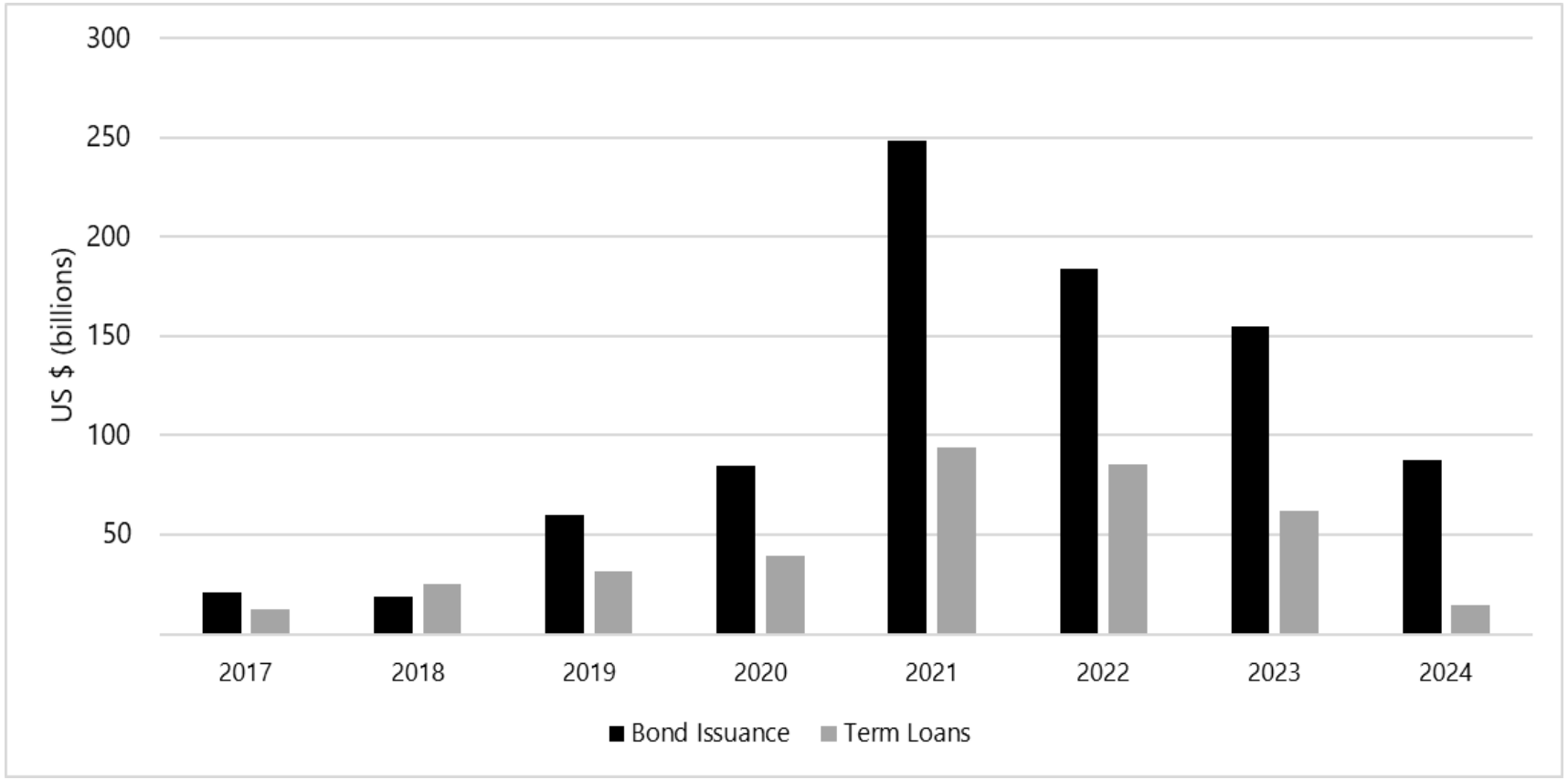
- Our goal is to identify the determinants of NFC's preferences for green finance through green corporate bonds or the use of proceeds loans
- We employ a binomial logistic regression model that will shed light and quantify the factors determining a firm's preference for green financing through bonds or loans
- We also estimate the likelihood of banks issuing loans or/or underwriting bonds taking into account bank-level balance sheet factors
- Using data for 2297 green bonds and 1968 use of proceeds term loans we link banks which have issued loans and have underwritten bonds to/for corresponding NFC.
- The granular data allows us to examine the internal factors on both sides of the market.
- This deeper understanding could guide policymakers to tailor policy to support green finance provision

Dataset and ESG Screening

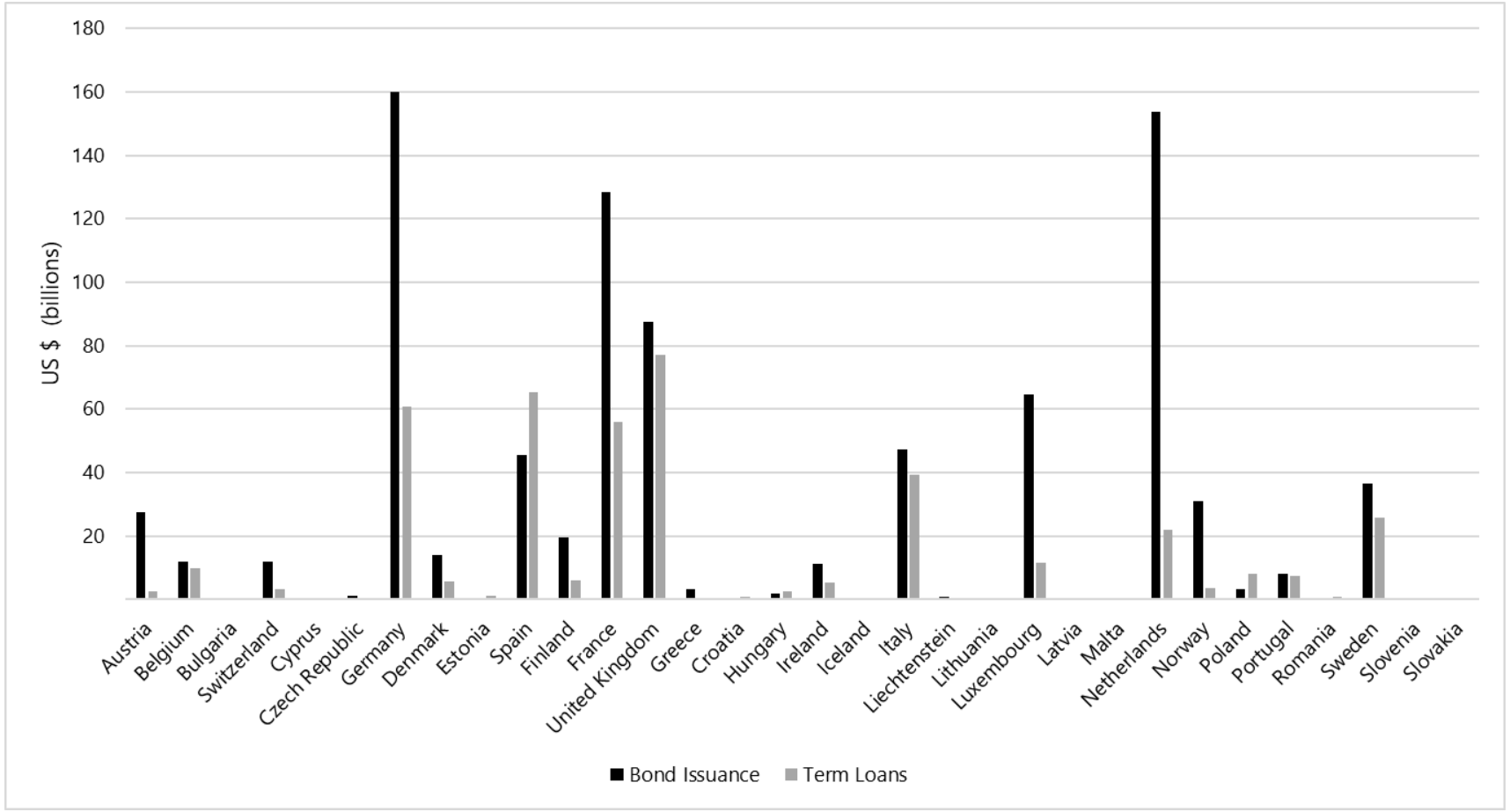
- 4265 individual financing transactions between 2017 and 2024(Q2) identified via Bloomberg LP *SRCH Function*
  - 2297 Bond Issuances
  - 1968 Syndicated Loan Issuances
- Bloomberg screening criteria consistently applied - verified green use of proceeds
  - All transactions considered had an ESG verification partner involved
  - Minimal risk of including greenwashed transactions in our dataset

- Countries Included: EEA, UK and Switzerland
  - Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom, Switzerland, Iceland, Liechtenstein and Norway

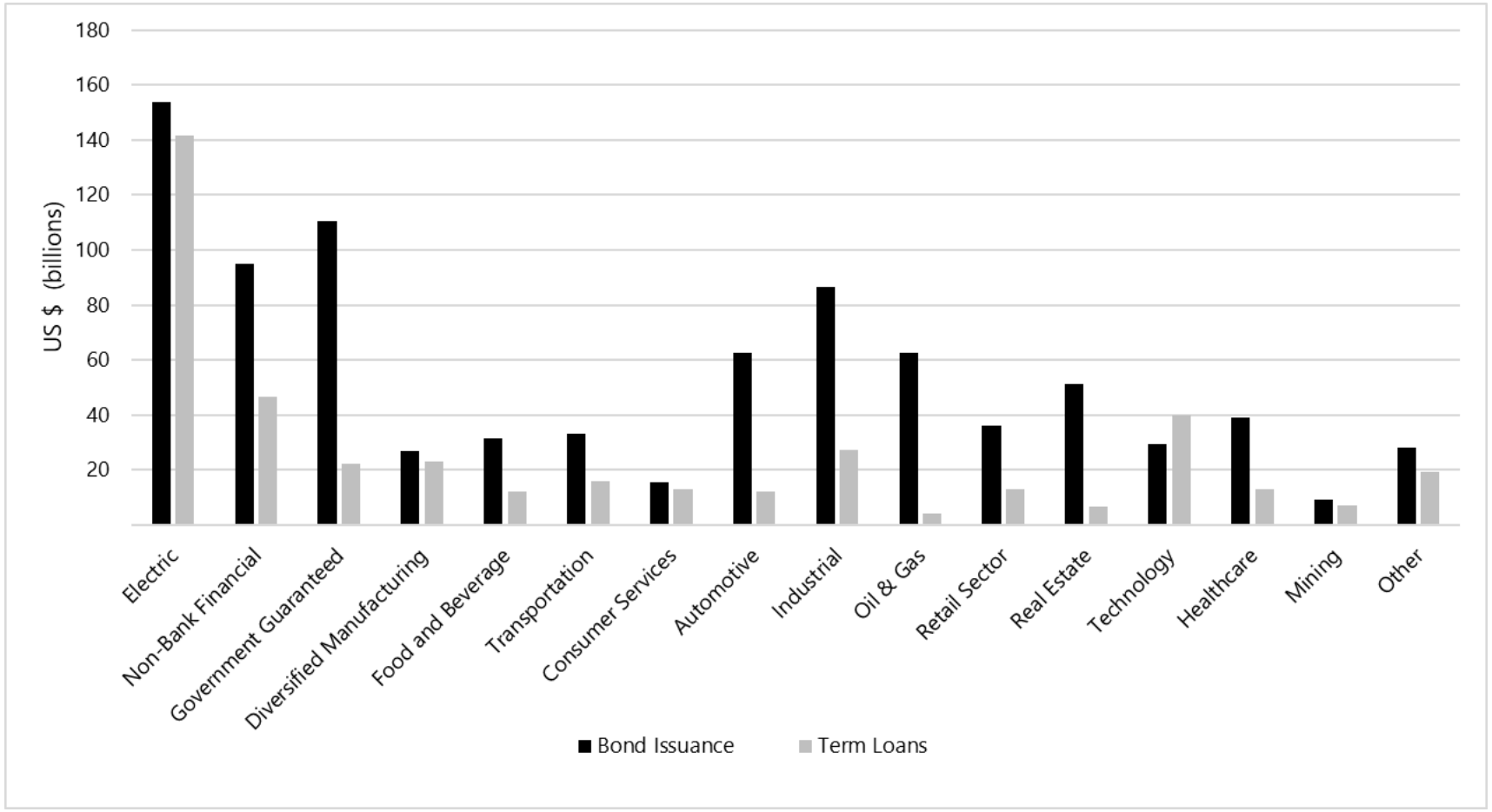
Total bond and loan financing 2017-2024



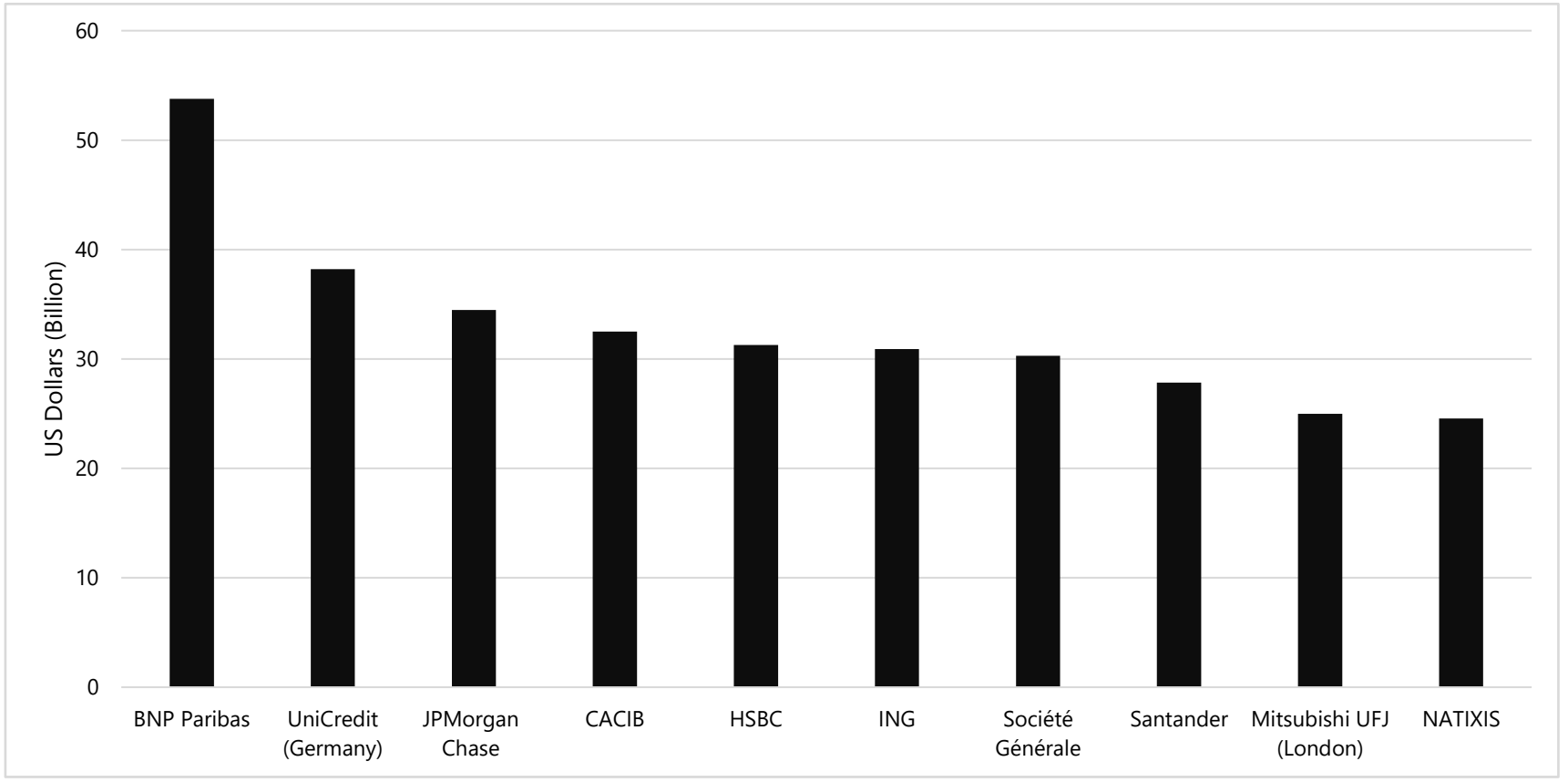
Total Green Financing sorted by type and domicile of recipient



Total Bond and Loan Financing 2017-2024 (US$) by sector of recipient



Ten largest banks by total green financing



Explanatory Variables Collected

Firm Level Balance Sheet Data (From Bloomberg FA Function)	Bank Balance Sheet Variables (From Bloomberg FA Function)
• Financial Leverage – Debt-to-Capital Ratio • Profitability – EBITDA Margin • Liquidity – Current Ratio • Market-to-Book Value • Size – Natural Log of Total Assets • Cost of Finance – Coupon Rate (Bonds) or Lending Rage (Loans) • Industry Classification • Brown/Green Sector Indicator	• Loan Growth Rate – Year on year change on total loans issued • Size – Natural Log of Total Assets • Liquidity – Liquid Assets / Total Assets Profitability – Return on Total Assets Ratio • Leverage - Average Assets/Average Equity
Bank Level ESG Variables (From Bloomberg FA Function)	**Macroeconomic Control Variables** (World Bank WDI Dataset)
• Overall ESG Score - Bloomberg ESG Materiality Scorecard Indicator • Environmental Score - Bloomberg ESG Materiality Scorecard Indicator • ESG Disclosure Score – Bloomberg Transparency Indicator • Climate Annual Report - Indicator variable, where 1 denotes the annual report discussing Climate Change	• Inflation, GDP deflator (annual %) • Nominal GDP per capita • Investment - Gross fixed capital formation

Baseline results - *Firm Level*

- Leverage and liquidity are significant determinants of the amount of green financing but not profitability
- The rate of borrowing and firm size are strongly significant
- Macro variables also play a role
- Higher country investment levels are associated with lower green financing
- Cross-sectoral and country differences in the amount of green financing

Dependant variable	*Log Total Green Financing*					
Sample	All	All	All	All	Green	Brown
	(1)	(2)	(3)	(4)	(5)	(6)
Leverage	0.003*	0.004**	0.003	-0.003	0.006*	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
Profitability	-0.000	-0.000	0.000	0.001***	-0.001	0.000
	(0.001)	(0.001)	(0.000)	(0.000)	(0.002)	(0.001)
Liquidity	0.184***	0.211***	0.155***	0.133***	0.253***	0.077
	(0.048)	(0.047)	(0.042)	(0.040)	(0.087)	(0.057)
Size	0.106***	0.113***	0.143***	0.136***	0.032	0.174***
	(0.020)	(0.019)	(0.018)	(0.017)	(0.029)	(0.026)
Cost of Finance	-0.038**	-0.076***	-0.059***	-0.001	-0.015	-0.045**
	(0.017)	(0.018)	(0.019)	(0.019)	(0.024)	(0.022)
GDP	-0.000***	-0.000**	-0.000***	0.000	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	0.010*	-0.000	0.002	0.021***	-0.009	0.019**
	(0.006)	(0.006)	(0.007)	(0.007)	(0.009)	(0.007)
Investment	-0.058***	-0.072***	-0.063***	0.055**	-0.099***	-0.016
	(0.012)	(0.012)	(0.012)	(0.025)	(0.021)	(0.015)
Constant	19.216***	19.206***	18.708***	16.799***	20.350***	18.108***
	(0.350)	(0.592)	(0.562)	(0.760)	(0.639)	(0.413)
Observations	1,188	1,188	1,187	1,188	430	757
R-squared	0.102	0.157	0.258	0.376	0.187	0.097
Time FE	No	Yes	Yes	Yes	No	No
Country FE	No	No	No	Yes	No	No
Sector FE	No	No	Yes	No	No	No

Logistic model results

- Firms' balance sheet variables do not influence their preference for bonds or loans
- Except for profitability and size
- Some macro variables are also significant determinants in firms' choice for green finance
- Balance sheet variables differ in explaining the preference between green and brown industries

Dependant variable	*Green loan =1, bond =0*			
Sample	All	All	Green	Brown
	(1)	(2)	(3)	(4)
Leverage	0.002	0.006	0.007	0.005
	(0.004)	(0.004)	(0.008)	(0.005)
Profitability	-0.005**	-0.003*	-0.006*	-0.002*
	(0.002)	(0.002)	(0.003)	(0.001)
Liquidity	-0.014	0.095	0.466***	-0.178
	(0.089)	(0.095)	(0.151)	(0.126)
Size	-0.241***	-0.258***	-0.207***	-0.280***
	(0.036)	(0.037)	(0.065)	(0.046)
Cost of Finance	-0.399***	-0.589***	-0.660***	-0.545***
	(0.039)	(0.055)	(0.106)	(0.071)
GDP	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Inflation	-0.003	-0.012	-0.034	-0.021
	(0.012)	(0.014)	(0.037)	(0.018)
Investment	-0.123***	-0.128***	-0.054	-0.168***
	(0.026)	(0.029)	(0.040)	(0.041)
Constant	5.088***	4.743***	4.956***	7.679***
	(0.710)	(1.201)	(1.391)	(1.352)
Observations	1,192	1,192	426	761
Time FE	No	Yes	Yes	Yes
ROC	0.750	0.786	0.813	0.797

Baseline results - *Bank Level*

- Regarding banks, profitability, liquidity and previous lending positively relate to the amount of green financing.
  - However, bank leverage is not a significant factor
- Larger banks lend more
- All ESG variables considered indicate that banks with better environmental performance and transparency engage more in green lending

Dependant variable	*Log Total Green Financing*					
	(1)	(2)	(3)	(4)	(5)	(6)
Leverage	0.000	-0.000	-0.000	0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Profitability	-0.255***	-0.074***	-0.265***	-0.283***	-0.212***	-0.263***
	(0.024)	(0.017)	(0.018)	(0.024)	(0.019)	(0.021)
Liquidity	0.704**	1.182*	0.551	0.842*	0.821*	0.587*
	(0.343)	(0.688)	(0.337)	(0.433)	(0.427)	(0.321)
Size	0.645***	2.987***	0.582***	0.564***	0.419***	0.570***
	(0.055)	(0.357)	(0.049)	(0.061)	(0.055)	(0.044)
Loan growth rate	-0.040***	0.031**	-0.100***	-0.017	-0.031***	-0.057***
	(0.011)	(0.012)	(0.011)	(0.010)	(0.009)	(0.010)
Environmental score	0.141***	0.311***	0.052***			
	(0.037)	(0.028)	(0.019)			
Overall ESG score				0.373***		
				(0.047)		
ESG disclosure score					0.042***	
					(0.004)	
Climate annual report						0.314***
						(0.072)
Constant	11.733***	-21.736***	12.971***	11.799***	12.997***	13.112***
	(0.675)	(4.885)	(0.639)	(0.710)	(0.623)	(0.574)
Observations	1,573	1,573	1,573	1,565	1,699	1,802
R-squared	0.208	0.826	0.312	0.219	0.221	0.168
Time FE	No	No	Yes	No	No	No
Bank FE	No	Yes	No	No	No	No

Bank logistic model

- Balance sheet variables explain the amount of finance issued, but do not explain the likelihood of the type of finance
- Larger banks are more likely to underwrite bonds as opposed to issuing syndicated loans
- Banks with higher ESG scores have a higher likelihood of underwriting green bonds

Dependant variable	*Green loan =1, bond =0*		
	(1)	(2)	(3)
Leverage	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)
Profitability	-0.138	-0.179	0.819
	(0.125)	(0.185)	(0.564)
Liquidity	0.280	0.404	-2.830
	(1.408)	(1.445)	(1.835)
Size	-0.651***	-0.579***	-5.639***
	(0.166)	(0.150)	(1.786)
Loan growth rate	-0.052	-0.074	0.067
	(0.053)	(0.055)	(0.075)
Environmental score	-0.186***	-0.082***	-0.253**
	(0.051)	(0.026)	(0.100)
Constant	9.581***	10.818***	81.112***
	(1.925)	(2.037)	(24.973)
Observations	1,575	1,575	1,302
Time FE	No	Yes	No
Bank FE	No	No	Yes
ROC	0.713	0.734	0.911

Conclusion

- Balance sheet variables are significant in explaining green finance for both firms (receive) and banks (issue)
  - However, for banks the type of finance issued is unrelated to balance sheet factors – only size and ESG factors.
- The determinants of green financing differ among industries

- When considering only green industries' balance sheets and macro variables remain significant but not the same for brown industries
  - The borrowing costs and size of the firm have different effects on brown and green industries

- Common factors for both brown and green industries are the cost of borrowing and the size of the firm, implying needed support for smaller size firms from a policy perspective
- A mismatch between what firms prefer and what banks provide could lead to a slowing down of green transition