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How Green are Green Debt Issuers?

by Jochen M. Schmittmann and Chua Han Teng

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I N T E R N A T I O N A L M O N E T A R Y F U N D

IMF Working Paper
Asia and Pacific Department

How Green are Green Debt Issuers?

Prepared by Jochen M. Schmittmann and Chua Han Teng

Authorized for distribution by Chikahisa Sumi

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Abstract

Green debt markets are rapidly growing while product design and standards are evolving. Many policymakers and investors view green debt as an important component in the policy mix to achieve the transition to a low carbon economy and ensure the pricing of climate risks. Our analysis contributes to the nascent literature on the environmental impact of green debt by documenting the CO₂ emission intensity of corporate green debt issuers. We find lower emission intensities for green bond issuers relative to other firms, but no difference for green loan and sustainability-linked loan borrowers. Green bond, green loan, and sustainability-linked loan borrowers lower their emission intensity over time at a faster rate than other firms.

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Keywords: ESG, Sustainable Finance, Green Finance, Green Bonds, Green Loans, Sustainability-linked Debt, Climate Finance

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Abbreviations

BNEF	Bloomberg New Energy Finance
Bps	Basis points
CBI	Climate Bonds Initiative
CO2	Carbon dioxide
ESG	Environmental, Social, and Governance
EUR	Euro
GHG	Greenhouse gas
ICMA	International Capital Market Association
USD	US dollar

I. INTRODUCTION¹

Green debt markets are rapidly growing alongside investor interest in climate change issues. As part of climate finance more broadly, green debt can play an important role in pricing climate risks, raising funds for a low-carbon economy, and advancing investors' and issuers' thinking and capacity on climate issues. Green debt markets and products are still evolving, shaped by investor and issuer preferences, standards, and regulations. A fundamental yet little researched question relates to the environmental impact of green debt – how and to what extent does green debt achieve its environmental objectives?

This paper aims to contribute to the nascent literature on green debt by providing an overview of green debt products and market developments for corporate issuers. It then proceeds to present data on CO₂ emissions of green debt issuers. We would expect issuers of green debt to outperform peers on CO₂ emission reductions if green debt is achieving its environmental objectives. CO₂ emissions are a crude measure of the success of green debt and any association does not imply causality. That said, the advantages of using institution-level emissions as a measure are simplicity and its association with the ultimate environmental goal of reducing overall firm level CO₂ emissions.

Green debt is part of the broader sustainable debt universe that includes debt instruments linked to social and other objectives under the ESG umbrella.² Sustainable debt instruments are conventional debt plus a sustainability commitment by the issuer. There are two flavors of sustainability commitments associated with sustainable debt. With activity-based instruments the issuer must use the raised money for a specified sustainable activity or project. The overall sustainability profile of the issuer is not a criterion. The largest product group among activity-based instruments is green bonds. In contrast, issuer-based instruments include sustainability targets for the issuing entity, while the money raised from the debt issuance can be used for general purposes. Issuer-based instruments typically link interest rate discounts or penalties to entity-wide sustainability targets. Sustainability-linked bonds and loans are examples of issuer-based instruments. This paper focuses on debt with climate change objectives which accounts for most of the sustainable debt outstanding.³ For simplicity, we use the term 'green debt' for all sustainable debt with environmental objectives.

¹ We thank Chikahisa Sumi, Jonathan Dunn, Kay Chung, Peter Lindner, Chris Walker, and seminar participants at the IMF Regional Office for Asia and the Pacific for helpful comments.

² Environmental, Social, and Governance (ESG) refers to the three central factors in measuring the sustainability and societal impact of an investment in a company or business. See IMF (2019) and Grippa, Schmittmann & Suntheim (2019) for an overview of sustainable and ESG finance.

³ Some green debt has other environmental objectives including biodiversity and water and waste management. This is, however, a small percentage of green debt.

The ultimate purpose of corporate green debt should be to reduce greenhouse gas (GHG) emissions or increase climate change resilience at the entity level.⁴ Direct and indirect channels through which this could be achieved are conceivable with some differences in channels between activity-based and issuer-based instruments. For activity-based green debt, a direct channel could be through funding projects that would otherwise not be undertaken. This direct channel requires two conditions to hold. First, the funded projects need to be environmentally valuable. This condition could be violated in several ways, a practice called greenwashing. A project may not have any environmental value to begin with or it could lose its environmental benefits due to poor execution or unforeseen circumstances. Second, the debt funds projects that would otherwise not be funded, so called additionality. Additionality based purely on a lower cost of capital is unlikely to be a big factor given that green debt is generally issued at yields similar or only slightly below conventional debt (see section II). Indirect channels through which activity-based green debt has a positive environmental impact are probably more important than direct channels. Indirect channels include the fostering of internal awareness and capacity to manage climate issues; oversight and engagement from investors and other stakeholders; and making climate and green issues investable which fosters an ecosystem of infrastructure that includes taxonomies, standards, and certification.

Turning to issuer-based instruments, the link between interest payments and sustainability targets provides a clear incentive for issuers. However, poorly defined or unambitious targets could render issuer-based instruments ineffective analogous to activity-based instruments. Additionality may also be a concern for issuer-based instruments as it is not clear that additional investments are undertaken that would otherwise not be financed.⁵ Indirect channels apply explicitly to issuer-based instruments which include issuer-level sustainability commitments and incentivize the overall integration of sustainability objectives in the issuing entities' agenda.

The literature on the environmental impact of green debt is limited and focused on green bonds. Flammer (2021) finds that green bond issuers improve their environmental performance post issuance. She distinguishes between different motivations for green bond issuers and finds her results consistent with issuers providing a credible signal for their climate change commitments by issuing green bonds. Ehlers et al. (2020) find no clear evidence that green bond issuers have lower or decreasing carbon intensity. They propose to complement green bonds with issuer-level emissions ratings to incentivize firm-level improvements in carbon emissions. Tuhkanen and Vulturius (2020) find that many of the largest green bond

⁴ Emission reductions at the firm level for green debt issuers do not necessarily translate into lower overall emissions because firms may sell dirty assets to other firms, possibly a broad or private. This underscores the need for economy-wide and global action on carbon pricing and regulation. Firms may also outsource dirty activities through their supply chains which are harder to capture in emissions reporting.

⁵ The channel through which issuer-based instruments could lead directly to more green projects is by lowering issuers' overall cost of capital which would allow issuers to undertake more green projects.

issuers in Europe do not link their green bond frameworks with their climate targets. In addition, they find important shortcomings in post issuance reporting that raise the risk of greenwashing.

The paper proceeds as follows. Section II describes the attributes of green debt and surveys the literature. Section III provides an overview of the green debt market. Section IV shows CO2 emission intensities for green debt issuers and non-issuing peers and for green debt issuers around their first issuance of green debt. Section V concludes.

II. BACKGROUND ON SUSTAINABLE AND GREEN DEBT INSTRUMENTS

A. What is Sustainable and Green Debt?

Sustainable debt includes bonds and loans that are labeled for their environmental or social benefits. The sustainability aspect is incorporated in two forms (table 1). For activity-based instruments, raised funds are earmarked for a specific project or activity with sustainable characteristics. There are no restrictions on issuers' overall activities and degree of sustainability or greenness. Green bonds, social bonds, sustainability bonds, and green loans are activity-based instruments. In contrast, issuer-based instruments include an overall sustainability performance target for the issuer, while the specific proceeds can be used for any purpose. For issuer-based instruments, the interest rate typically varies depending on achievement of sustainability performance targets. Sustainability-linked bonds and loans are issuer-based instruments.

Table 1. Sustainable Debt Types

Debt Type	Debt style	Purpose	Cumulative issuance up to 2020 (\$bn)
Green bond	Activity-based	Environmental projects	1,139
Social bond	Activity-based	Social projects	192
Sustainability bond	Activity-based	Environmental & social projects	143
Sustainability-linked bond	Issuer-based	Institutional ESG targets	16
Green loan	Activity-based	Environmental projects	501
Sustainability-linked loan	Issuer-based	Institutional ESG targets	311

Source: Adapted from BloombergNEF; IMF staff.

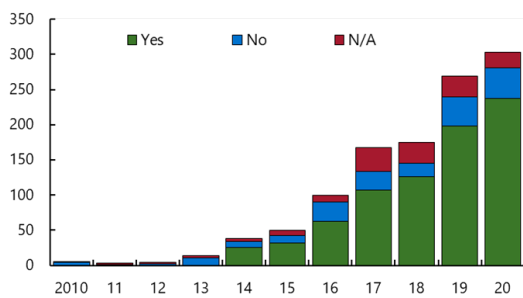
Data as of December 31, 2020

Sustainable debt relies on self-labeling by the issuer. A growing number of principles, guidelines, and standards provide guidance to issuers. For activity-based instruments, principles tend to lay out permissible use of proceeds, project evaluation and selection, disclosure, and reporting. The project aspect is not present for issuer-based instruments where guidelines are focused on structuring features, disclosure, and reporting.

Private, voluntary governance regimes have dominated in the provision of guidance and standards in the sustainable debt market (Park 2018). For example, the International Capital Market Association (ICMA), a leading industry association for financial market participants, provides principle frameworks for green bonds, social bonds, sustainability bonds, and sustainability-linked bonds. Other industry associations have issued guidance on green loans and sustainability-linked loans (jointly by the Asia Pacific Loan Market Association, the Loan Market Association, and the Loan Syndications and Trading Association). These principles tend to be high-level and process oriented. For green bonds the Climate Bonds Initiative (CBI) provides standards combined with a certification process.

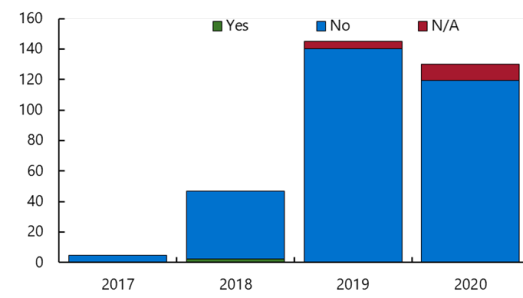
Private external reviewers are a source of assurance of the sustainability credentials of debt which otherwise relies primarily on the sustainability claims of the issuer. Various forms of reviews exist covering pre and post issuance aspects against fees.⁶ Baker et al. (2018) find lower yields on certified green bonds that are likely to outweigh the costs of certification for large issuers. Similarly, Flammer (2021) finds that green bonds certified by an external reviewer attract more interest from investors, and firms that certify their green bonds reduce CO2 emissions more than green bond issuers that do not certify their bonds. Figures 1 and 2 show that external reviews are common for green bonds but not for the more recent innovation of sustainability-linked debt. For green loans, there are typically no external reviews. Finally, index providers play a role in determining sustainability credentials through index admission criteria.

Figure 1. External Review of Green Bonds
(Billions of US Dollars)



Source: BloombergNEF

Figure 2. External Review of Sustainability-linked Bonds and Loans
(Billions of US Dollars)



Source: BloombergNEF

While private governance arrangements still dominate in sustainable debt markets, regulators are increasingly setting standards. For example, in the green bond space, China, India, and Japan have issued standards and work is underway in the EU. Beyond providing standards for sustainable debt, regulators affect markets in other ways including through providing taxonomies of what constitutes a green activity or through support schemes.⁷

⁶ See <https://www.climatebonds.net/market/second-opinion> for external reviews available for green bonds.

⁷ For example, the Monetary Authority of Singapore provides grants to support various sustainable debt products, external reviews and ratings. Similarly, in Japan the Ministry of the Environment provides subsidies for external reviews and consulting related to green bond issuance.

The voluntary nature of most standards and the self-labeling approach raise risks of unsubstantiated claims of greenness, so called greenwashing (Tuhkanen & Vulturius 2020). Risks of greenwashing are not only present ex ante, but also ex post including due to failures in reporting, monitoring, and impact assessment. The proliferation of frameworks and standards creates complexity that could hinder market development and make it harder for investors to assess the sustainability and greenness merits of labeled debt (Schumacher 2020).

The credit risk of sustainable and green debt instruments is equivalent to conventional debt by the same issuer. Accordingly, sustainable and green debt instruments are conventional debt plus a promise by the issuer to use the proceeds from the debt for an earmarked purpose (activity-based) or a sustainability performance target that affects the interest rate (issuer-based). A plan by Danish authorities to issue a conventional bond and a separate green certificate which can be traded separately illustrates this point. The Danish proposal aims to preserve the liquidity of the conventional sovereign bond yield curve while demonstrating a green commitment that is equivalent to a green bond.⁸ Germany is taking another approach to preserve the liquidity of its sovereign yield curve while establishing a green sovereign curve. Under the twin bond concept Germany is issuing a conventional bond alongside a green bond with the same coupon and maturity. Investors in German green bonds will be allowed to swap their holdings with the conventional bond twin whenever they want. According to the German Federal government, the twin bond mechanism will increase the marketability of green bonds and facilitate access to liquidity.⁹ Turning to issuer-based instruments, these could be decomposed into a conventional bond plus a certificate with a penalty or bonus depending on achievement of sustainability performance targets.

The following sections discuss the rationales of green debt issuers and investors as well as the environmental impact channels for green debt. The focus in the next sections will be on green debt, but similar reasoning applies to sustainable debt with other objectives.

B. Why do Corporates Issue Green Debt?

The issuance of green debt imposes additional costs on the issuer relative to conventional debt. The costs of green debt include certification fees and additional reporting and disclosure costs. Green debt also imposes restrictions on the issuer – for activity-based instruments the issuer commits to using raised funds for specified projects and for issuer-based instruments the issuer agrees to entity-wide sustainability targets. Given this, what motivates issuers of green debt?

⁸ For details on the Danish plan to decompose green bonds into a conventional bond and a green certificate see: <https://www.nationalbanken.dk/en/governmentdebt/IR/Pages/Model-for-sovereign-green-bonds.aspx>

⁹ For details see: <https://www.deutsche-finanzagentur.de/en/institutional-investors/federal-securities/green-federal-securities/>

A potential reason could be that green debt sells at a premium (lower yield for the issuer) because investors value green credentials. The pricing of green bonds is one of the most widely researched questions in green debt, but results have been inconclusive likely due to differences in samples and imperfect matching strategies to control for differences other than the green designation. Studies that find a premium for green bonds over conventional bonds include Baker et al. (2018) for green municipal bonds, Zerbib (2019) for municipal, sovereign, and green bonds, and Kapraun and Scheins (2019) for sovereigns, supranationals and very large corporates. In contrast, Karpf and Mandel (2017) find that green bonds trade at a discount to other bonds. Studies that do not find a premium for green bonds are Larcker and Watts (2019) for US municipal bonds, IMF (2019) for corporate, supranational, and sovereign bonds, and Flammer (2021) for corporate bonds. In line with this, Maltais and Nykvist (2020) find in a survey of green bond issuers that cost of capital considerations are secondary for green bond issuance decisions. For issuer-based instruments which include interest rate discounts/penalties if the issuer achieves/misses predetermined sustainability targets, there is no research on pricing. While it may seem intuitive that interest rate discounts could be a rationale for issuing such debt, the discounts may not be significant after considering the higher issuance costs and costs related to achieving the sustainability targets. In addition, the pre-discount/penalty interest rate is likely to reflect the expected likelihood of the issuer achieving the sustainability target.

A second rationale for issuers of green debt could be to provide a credible signal of their commitment to the environment. Flammer (2021) argues that the empirical evidence is consistent with the signaling argument: the stock market reacts positively to the issuance of green bonds, especially to certified issuances and first time issuers; long-term and green investors increase their holdings of the issuer's stock; and issuers improve their environmental performance post issuance. Similarly, Tang and Zhang (2020) find a positive stock price reaction to green bond issuance, an increase in the institutional ownership share, and improved stock liquidity. Maltais and Nykvist (2020) in their survey of green bond issuers also find that issuers see green bonds as a way to communicate their green credentials. In the survey, issuers note that the ability to issue a green bond is perceived as a stamp of quality for the firm.

A third rationale for issuing green debt could be to send a false signal of sustainability credentials. Flammer (2021) argues that this greenwashing rationale is unlikely since she finds that green bond issuers improve their environmental performance post green bond issuance.

Maltais and Nykvist (2020) find other rationales in their interviews with issuers, including demand from investors, broadening the investor base, the view that green credentials will be increasingly important for access to capital in the future, and that issuing a green bond helps with mainstreaming sustainability work within the firm and is a catalyzer to raise green ambitions. They also note that the initial idea to issue a green bond is typically coming from the underwriting banks.

C. Why do Investors Buy Green Debt?

The discussion in the previous section showed that there does not seem to be a consistent premium of green bonds over conventional bonds. As such, it is unlikely that financial return considerations provide much of an incentive for green debt investors. Maltais and Nykvist (2020) find in interviews with investors that indeed financial considerations are secondary, with some indicating that there could be a risk reduction given that green bond issuers are expected to perform well on sustainability. However, Ehlers and Packer (2017) point out that green bonds could be more exposed to environmentally related credit risks than conventional debt on average given the higher concentration of issuers in industries at risk from climate transition and physical risks. While direct return considerations may be secondary, for intermediaries including asset managers it might be attractive to offer and market green and sustainable financial products in order to justify higher fees (Winegarden 2019).¹⁰

Signaling of green credentials may play a role for investors as well. Indeed, Maltais and Nykvist (2020) find that investors (asset managers) value green debt as a signal of their commitment to green issues to end-investors and internally to staff. Another factor is activist pressure on asset managers to align their portfolios with green targets, especially related to climate change.¹¹ Other potential reasons for investors to purchase green debt include the opportunity to engage with issuers on sustainability (Maltais and Nykvist 2020) and end-investor demand.

Overall, there is a lack of studies of investors' motives for engagement in green debt. That said, the above evidence shows consistency between issuers and investors in that financial motives appear to be secondary, while signaling, learning about sustainability through engagement, and organizational internalization of sustainability appear to be the main driving forces of interest in green debt.

D. Environmental Impact Channels

Section I presented the limited literature on the environmental impact of green bonds. Flammer (2021) finds that green bond issuers improve their environmental performance more than other firms following the issuance of a green bond. Results in Ehlers et al. (2020) and Tuhkanen and Vulturius (2020) are less conclusive. In the paragraphs below, we elaborate on potential channels through which green debt could affect the environmental performance of issuing firms.

¹⁰ Exchange-traded funds that explicitly focus on socially responsible investments have 43% higher fees than popular standard ETFs, according to the Wall Street Journal. See <https://www.wsj.com/articles/tidal-wave-of-esg-funds-brings-profit-to-wall-street-11615887004> retrieved on July 4, 2021.

¹¹ See for example: <https://www.politico.com/news/2020/06/19/pension-funds-face-pressure-from-all-sides-over-going-green-329181>

A direct channel would be through the funding of environmentally valuable projects that would not be financed without green debt. The term additionality is often used for this. However, given the lack of evidence for a financially meaningful premium on green debt (see section II b), it is unlikely that projects become financially viable because they are funded with green debt. The issuer survey by Maltais and Nykvist (2020) supports this notion. In addition, Flammer (2021) points out that green bonds are often small relative to issuer size so that it is unlikely that green bond funded projects explain large improvements in the environmental performance of issuers. For sustainability-linked instruments the adjustment of the interest rate depending on the achievement of environmental targets could provide a more direct financial incentive. For example, a recent sustainability-linked bond issued by ENI, the Italian utility, includes a 25 bps interest rate step up if carbon footprint and renewable capacity targets are not reached.¹²

Indirect channels are likely to be more important for the environmental impact of green debt. Engagement with green debt helps with mainstreaming green and climate considerations in the financial and corporate sectors. Firms learn through the issuing process which requires meeting green debt requirements and building internal capacity. More broadly, guidelines and standards help advance thinking on what constitutes a green asset or project and how firms can become more climate friendly.

The use of green debt by firms to credibly signal their green credentials as suggested by Flammer (2021) could create a positive spillback effect through lowering the overall cost of capital of green firms, in line with findings of a positive stock market reaction to green bond issuances (Tang and Zhang (2020), Flammer (2021)). The green debt signal may also have broader beneficial effects for issuing firms through a positive impact on employee, customer, and other stakeholder relationships. The realization of these positive effects through the green debt signal could encourage further investments by firms to become greener. However, it should be noted that any association between green debt issuance and issuing firms being greener than other firms or becoming greener post issuance could simply be partially or fully due to already green firms choosing to issue green debt even if there are no benefits associated with doing so.

III. SUSTAINABLE AND GREEN DEBT MARKET DEVELOPMENTS

Sustainable debt issuance has been growing rapidly in recent years reaching \$730bn in 2020 (figure 3). However, relative to total global debt at \$281tn (Institute of International Finance) sustainable debt remains a small fraction. Activity-based instruments that are linked to specific projects accounted for more than 80 percent of sustainable debt issued in 2020. Issuer-based instruments (sustainability-linked loans and bonds) have grown rapidly in popularity reaching a share of about 20 percent of sustainable debt in 2020 from close to zero in 2016. Europe

¹² <https://www.eni.com/en-IT/media/press-release/2021/06/eni-launches-first-sustainability-linked-bond-issue.html>

accounted for more than half of the sustainable debt issuance in 2020, followed by the Western Hemisphere at 20 percent and Asia at 15 percent (figure 4).

Green bonds are the largest sustainable debt category with about \$300bn raised in 2020. European issuers accounted for 55% of issuance, followed by issuers in the Western Hemisphere and Asia (figure 5). The EUR is the most popular issuance currency followed by the USD, with the two combined accounting for 80 percent of issuance. Corporates account for slightly more than half of all green bonds issued, with financials and utilities as the main corporate issuers of green bonds (figure 6). National governments account for about 22 percent of green bonds, asset-backed securities (ABS; mostly mortgage-based securities from Fannie Mae) account for 10 percent, supranational issuers for 9 percent, and US municipal debt for 5 percent.

The green loan volume in 2020 was about \$80bn down from \$93bn in 2019 (figure 7).¹³ This likely reflects the impact of the COVID pandemic on bank lending. Green loans are almost exclusively used by corporates, mainly energy and utilities companies (figure 8).

Turning to issuer-based instruments, about \$120bn of sustainability-linked loans were made in 2020, from \$140bn in 2019 (figure 9). The decline has probably similar reasons as the decline in green loans. Sustainability-linked loans are an innovation with the first loans made in 2017. Formal guidelines for sustainability-linked loans were published by the International Capital Markets Association (ICMA) in June 2020. Sustainability-linked loan borrowers are corporates, mostly from Europe, with utilities and industrials as the largest industries. Tanzania became the first sovereign borrower with a sustainability linkage in 2020. Sustainability-linked bonds are the newest variety of sustainable debt. Enel, the Italian utility, issued the first bond linking interest payments to its corporate sustainability performance in 2019. Other issuers have followed bringing total issuance in 2020 to \$10.6bn. ICMA released sustainability-linked bond principles in June 2020.

¹³ Bloomberg includes labeled and unlabeled loans in the green loan category. The only requirement is that a loan is earmarked for an eligible environmental project.

Figure 3. Sustainable Debt Issuance by Instrument
(Billions of US Dollars)

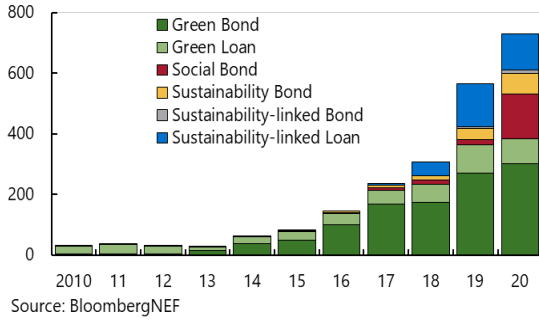


Figure 4. Sustainable Debt Issuance by Location of Issuer
(Billions of US Dollars)

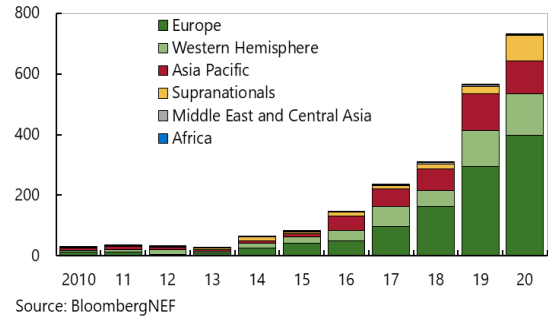


Figure 5. Green Bond Issuance by Location of Issuer
(Billions of US Dollars)

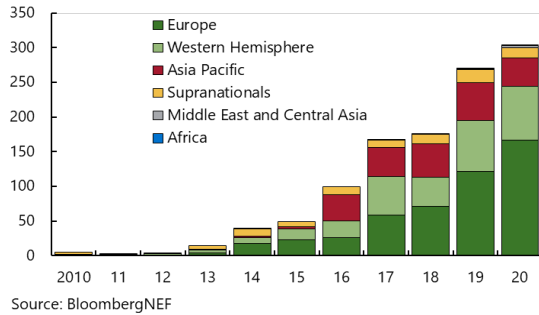


Figure 6. Green Bond Issuance by Industry
(Billions of US Dollars; cumulative since 2007)

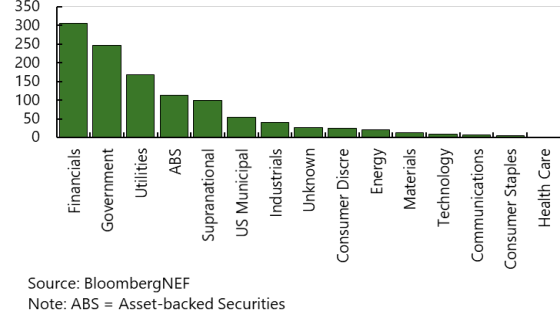


Figure 7. Green Loans by Location of Borrower
(Billions of US Dollars)

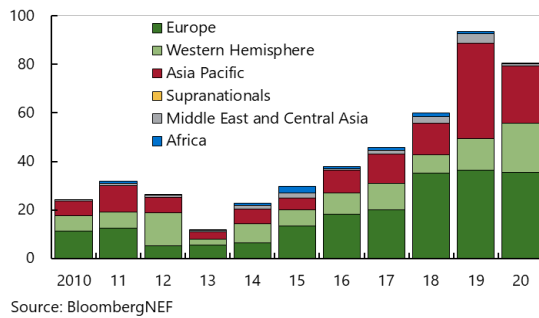


Figure 8. Green Loans by Industry
(Billions of US Dollars; cumulative since 2007)

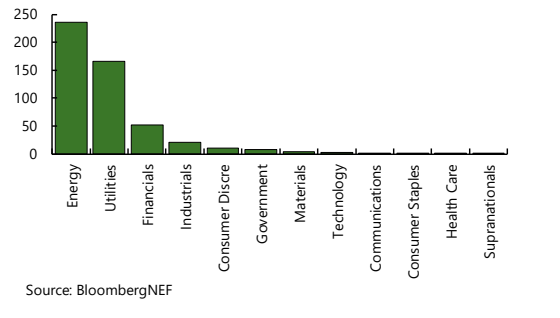


Figure 9. Sustainability-linked Bonds and Loans
(Billions of US Dollars)

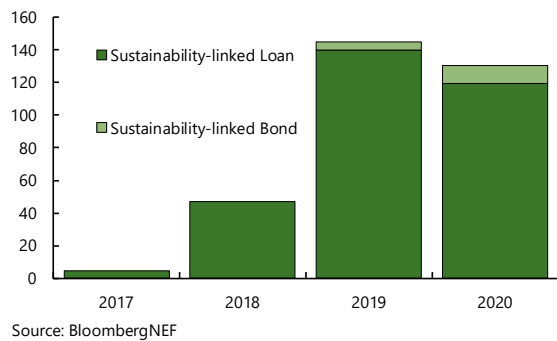
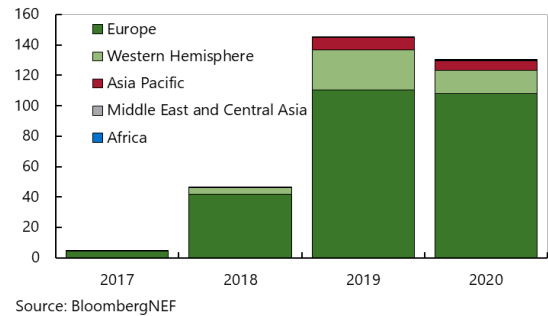


Figure 10. Sustainability-linked Debt by Region
(Billions of US Dollars)



IV. GREENNESS OF ISSUERS

This section presents greenness indicators for borrowers issuing/borrowing green bonds and loans, and sustainability-linked loans. We measure greenness by CO₂ emissions scaled by revenue and assets. There are different scopes for the reporting of CO₂ emissions. Scope 1 covers direct emissions from owned or controlled sources, scope 2 covers indirect emissions from the generation of purchased electricity, steam, heating and cooling consumed by the reporting company, and scope 3 includes all other indirect emissions that occur in a company's value chain. We present below data for scope 1 and 2 emissions which more companies report than the more difficult to measure scope 3 emissions. See appendices 1, 3, and 5 for separate scope 1 and 3 emission data. In general, our results are robust to the inclusion of scope 3 emissions.¹⁴

Our data set includes all firms in the S&P Global 1200 index. Among the S&P Global 1200 firms 76% report at least scope 1 and 2 emission data. We obtain CO₂ emissions from Bloomberg and Thomson Reuters, revenues/assets from Bloomberg, green debt data from BNEF, and environmental scores from Refinitiv via Thomson Reuters. Table 2 provides summary statistics for our dataset. We have 148 unique firm level observations for green bond issuers, 49 observations for green loan borrowers, and 70 observations for sustainability-linked loan borrowers.¹⁵ Green bond issuers are larger than the average firm in the S&P Global 1200 index by revenues and in particular by assets. Over half of green bond issuers are financials or utilities, a much higher share than in the index. Green loan borrowers tend to also be larger than the average firm in the index, but they are less asset-heavy than green bond issuers. Green loan borrowers are dominated by utilities (45%), followed by financials (20%). Sustainability-linked loan borrowers are similar in size on average to the average index firm measured by revenues and smaller measured by assets. The industry structure of sustainability-linked loan borrowers includes few financials with most borrowers in the utilities (21%), industrials (20%), and materials (17%) segments.

In the following sections, we present emission intensities in 2019 for green debt issuers and for firms that do not issue green debt. In addition, we show the evolution of emission intensities for green debt issuers around the time of first issuance.¹⁶

¹⁴ We acknowledge that for financial firms a better measure of greenness than scope 1-3 emissions would be the greenness of their loan book or asset holdings more broadly.

¹⁵ There are only six sustainability-linked bond issuers in the S&P Global 1200 until the end of 2020.

¹⁶ In the evolution charts we include additional green debt issuer observations of firms not in the S&P 1200 Global index. We control for a general trend of declining emission intensities across all firms by subtracting the trend. In unreported results, we confirm that our aggregate results also hold within the industries where we have the most observations. For industries with a few observations, results partly deviate substantially likely due to idiosyncratic factors at the firm level. As more data becomes available, future studies shedding light on cross-industry differences would be useful.

Table 2. S&P Global 1200 Index Green Debt Data (2019)

Debt Type	Number of Firms	Revenues (USD mn)		Assets (USD mn)		Share of Firms (%) in					Number of Firms that Report Emissions
		Average	Median	Average	Median	Utilities	Financials	Industrials	Energy	Others	
All	1216	25,404	11,175	109,497	22,175	5.5	15.6	15.1	4.8	59.1	930
Green Bonds	148	38,374	20,601	450,192	90,427	14.9	37.8	10.1	1.4	35.8	136
Green Loans	49	40,174	22,567	222,141	58,079	44.9	20.4	8.2	6.1	20.4	44
Sustainability-linked Loans	70	26,022	13,636	51,353	25,719	21.4	2.9	20.0	2.9	52.9	64

Sources: Bloomberg; Reuters; IMF staff.

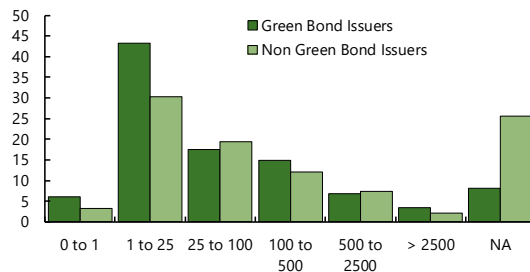
A. Green Bonds

Green bond issuers have lower CO₂ emissions relative to revenue and assets than firms that do not issue green bonds (figures 11 and 12). Green bond issuers are also more likely to report CO₂ emissions.¹⁷ These results are robust to the scope of emissions (see appendix 1). Industry effects are likely to have a large impact on firms' emission intensities. In appendix 2 we show results for industries in which we have at least 10 observations: financials, utilities, industrials, and consumer discretionary. Across these industries green bond issuers tend to have lower emissions than non-issuers, and green bond issuers are more likely to report emissions, both in line with the results in the full dataset.

Figure 13 shows that green bond issuers also tend to have higher environmental rating scores than non-issuers. Green bond issuers that engage external reviewers to provide assurance of their green bond issuances tend to have lower CO₂ emission intensities than green bond issuers that do not seek external assurances (figure 14).

Figure 11. Green Bond Issuers vs Non-issuers: Share of Firms by CO₂/Revenue Buckets

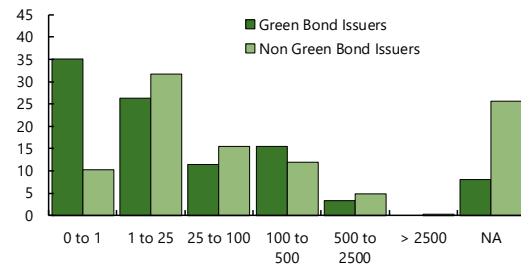
%, Financial Year 2019, Scope 1+2 emissions



Sources: BloombergNEF, Reuters, IMF staff calculations

Figure 12. Green Bond Issuers vs Non-issuers: Share of Firms by CO₂/Assets Buckets

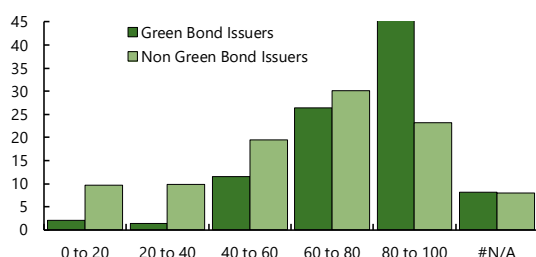
%, Financial Year 2019, Scope 1+2 emissions



Sources: BloombergNEF, Reuters, IMF staff calculations

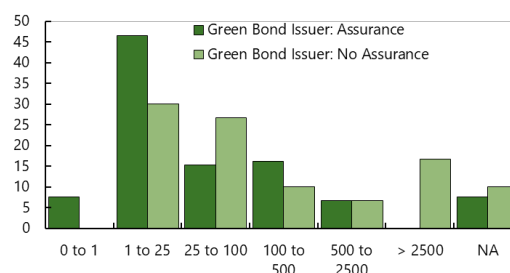
¹⁷ It appears plausible that firms that do not report CO₂ emissions tend to be 'dirtier'. In that case, there would be a bias against our finding that green bond issuers have lower emission intensities than other firms.

Figure 13. Green Bond Issuers vs Non-issuers: Share of Firms by Environmental Rating Buckets
%, Financial Year 2019



Sources: BloombergNEF, Reuters, IMF staff calculations

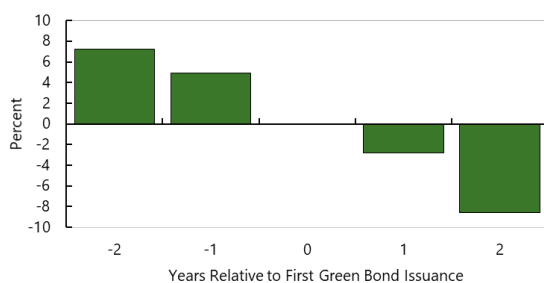
Figure 14. Green Bond Issuers with External Assurance vs Green Bond Issuers without: Share of Firms by CO₂/Revenue Buckets
%, Financial Year 2019, Scope 1+2 emissions



Sources: BloombergNEF, Reuters, IMF staff calculations

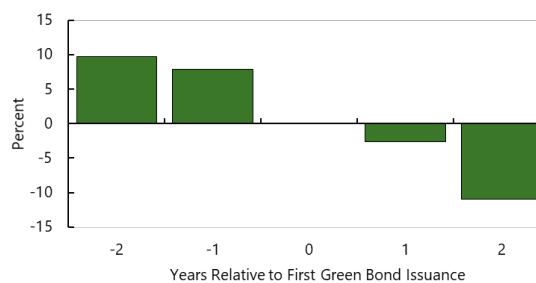
Next we show the evolution of emission intensities for green bond issuers around the year in which they issued their first green bond (figures 15 and 16). Emission intensities are shown relative to the year of issuance. Green bond issuers reduce their emission intensities notably in the second year after first issuing a green bond. There is also a significant reduction in emission intensity in the year of issuance relative to the previous year. This could be due to a particular focus on green credentials in the issuance year. Greater effort to reduce emissions in the issuance year could make it harder in the subsequent year to reduce emission intensity further, which could explain the limited improvements in the first year after issuance. Overall, our results are consistent with green bond issuers having a greater focus on reducing emissions than non-issuers and with continued improvement in environmental performance post issuance.

Figure 15. Change in CO₂/Revenue around Green Bond Issuance
(CO₂ Scope 1+2 emissions; adjusted for overall firm level emission intensity trend)



Sources: BloombergNEF, Reuters, IMF staff calculations

Figure 16. Change in CO₂/Assets around Green Bond Issuance
(CO₂ Scope 1+2 emissions; adjusted for overall firm level emission intensity trend)



Sources: BloombergNEF, Reuters, IMF staff calculations

B. Green Loans

Green loans are bank loans earmarked for eligible environmental projects. Unlike green bond issuers, green loan borrowers in our sample tend to have higher CO₂ emissions relative to revenue and assets than firms that do not borrow with green loans (figures 17 and 18). However, this appears to be driven by industry composition effects. Industries with high emission intensity, especially utilities which account for close to half of the green loan

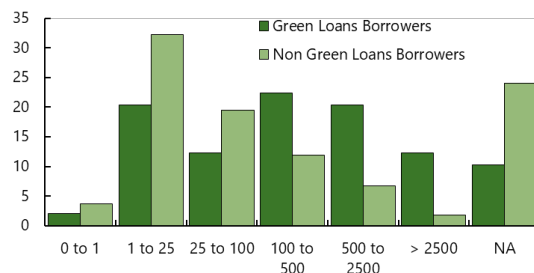
borrower sample, are overrepresented among green loan borrowers compared to the general population of firms (table 2). Appendix 4 presents emission intensities by industry for green loan issuers. Within industries there is no clear difference in emission intensities between green loan borrowers and other firms. Appendix 3 shows that the results hold for different emission scopes.

Figures 19 and 20 show the evolution of emission intensities for green loan borrowers in the years around the loan. For the time span from two years before the origination of the green loan to two years after, there is improvement relative to other firms, but this is primarily due to a drop in emission intensities in the second year following the loan. Compared with the emission intensity evolution for green bond issuers, green loan issuers show a smaller reduction in emission intensity over the entire 5-year period.

Several reasons may explain why we do not find that green loan borrowers have lower emission intensities than other firms and show less improvement in emission intensities, in contrast to our findings for green bond issuers.¹⁸ First, the definition of what constitutes a green loan is less clear than it is for green bonds. BNEF classifies loans earmarked for environmental projects as green loans irrespective of whether the borrower self-labels the loan as green. In addition, green loan standards are relatively new and high level. External assurances are rare for green loans, while most green bonds are externally assured which provides a greater degree of certainty that green bonds follow relevant standards. Second, it is possible that green conditions in green loans may be less ambitious and monitoring less stringent, although research is needed on the stringency of green conditions across green debt products.¹⁹

Figure 17. Green Loan Issuers vs Non-issuers: Share of Firms by CO₂/Revenue Buckets

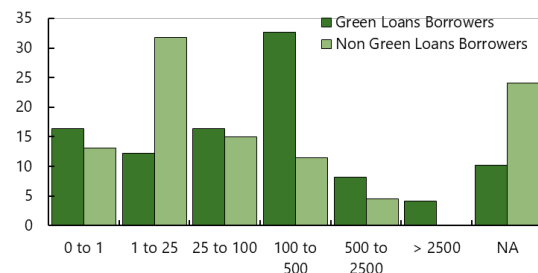
%, Financial Year 2019, Scope 1+2 emissions



Sources: BloombergNEF, Reuters, IMF staff calculations

Figure 18. Green Loan Issuers vs Non-issuers: Share of Firms by CO₂/Assets Buckets

%, Financial Year 2019, Scope 1+2 emissions



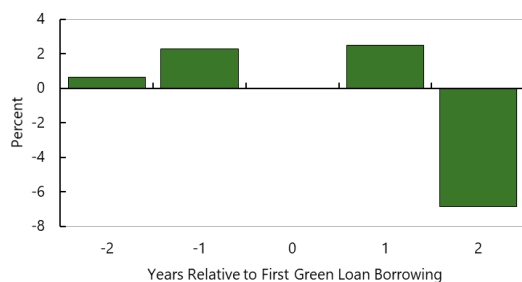
Sources: BloombergNEF, Reuters, IMF staff calculations

¹⁸ In addition, the share of firms that do not report CO₂ emission data is higher among firms that do not borrow with green loans, similar to what we have observed for green bonds. If firms that do not report emissions tend to have higher emission intensities, this could create a bias against green loan borrowers.

¹⁹ De Haas and Popov (2021) suggest that stock market financing is encouraging more energy efficient investment and green innovation than bank-based and debt finance more broadly. We are not aware of studies that compare the environmental impact of bank-based versus market-based debt financing.

Figure 19. Change in CO₂/Revenue around Green Loan Borrowing

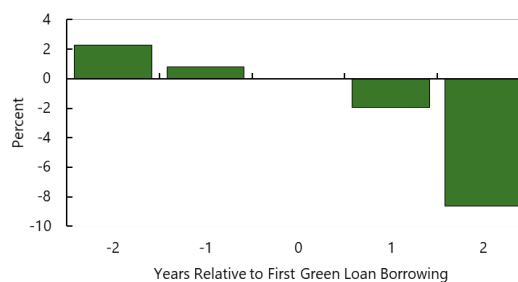
(CO₂ Scope 1+2 emissions; adjusted for overall firm level emission intensity trend)



Sources: BloombergNEF, Reuters, IMF staff calculations

Figure 20. Change in CO₂/Assets around Green Loan Borrowing

(CO₂ Scope 1+2 emissions; adjusted for overall firm level emission intensity trend)



Sources: BloombergNEF, Reuters, IMF staff calculations

C. Sustainability-linked Loans²⁰

Sustainability-linked loans are issuer-based products that link the interest rate to issuer-wide sustainability targets while the loan proceeds can be used for general purposes (see section III). Sustainability-linked loans are a recent innovation in sustainable finance with the first loan made in 2017.

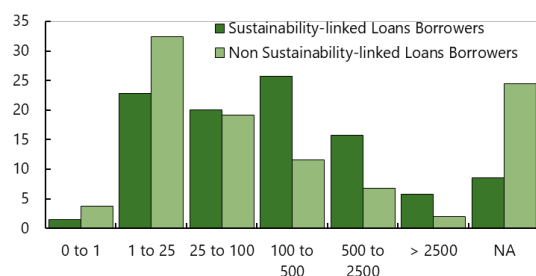
Sustainability-linked borrowers tend to have somewhat higher CO₂ emission intensities than other firms in aggregate (figures 21 and 22, appendix 5 for other emission scopes), although this appears to be due to industry composition effects. Appendix 6 shows emission intensities of sustainability-linked issuers and other firms by industry. For utilities which account for 21% of the sample, the sustainability-linked borrowers have somewhat lower emission intensities than other firms. Figures 23 and 24 present emission intensities in the year before and after a sustainability-linked loan.²¹ For CO₂/revenue and CO₂/assets, there is a big improvement in the year of the loan and some improvement in the following year. The improvement is larger than it is for green loans and of similar magnitude as for green bonds. This could tentatively suggest that sustainability-linked loans incentivize emissions reductions somewhat better than green loans, or alternatively, that greener firms tend to be more interested in sustainability-linked loans. However, given the small sample sizes due to the novelty of green debt products, more analysis on the merits of activity-based vs issuer-based instruments will be needed as additional data becomes available.

²⁰ There are insufficient observations to analyze sustainability-linked bonds which only exist since 2019.

²¹ We can only show the evolution of emission intensities for sustainability-linked loan borrowers over three years given that the first loan was made in 2017.

Figure 21. Sustainability-linked Loans Borrowers vs Non-borrowers: Share of Firms by CO2/Revenue Buckets

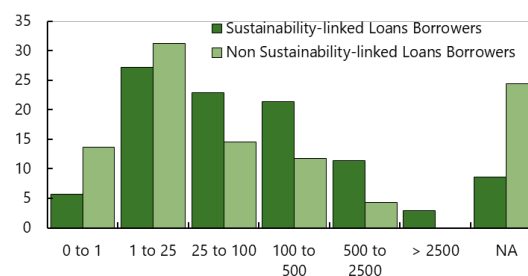
%, Financial Year 2019, Scope 1+2 emissions



Sources: BloombergNEF, Reuters, IMF staff calculations

Figure 22. Sustainability-linked Loans Borrowers vs Non-borrowers: Share of Firms by CO2/Assets Buckets

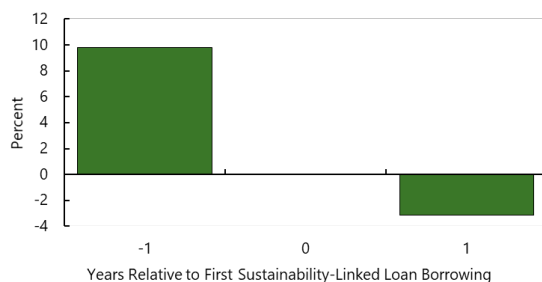
%, Financial Year 2019, Scope 1+2 emissions



Sources: BloombergNEF, Reuters, IMF staff calculations

Figure 23. Change in CO2/Revenue around Sustainability-linked Loan Borrowing

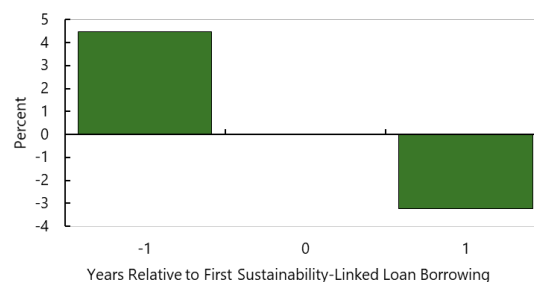
(CO2 Scope 1+2 emissions; adjusted for overall firm level emission intensity trend)



Sources: BloombergNEF, Reuters, IMF staff calculations

Figure 24. Change in CO2/Assets around Sustainability-linked Loan Borrowing

(CO2 Scope 1+2 emissions; adjusted for overall firm level emission intensity trend)



Sources: BloombergNEF, Reuters, IMF staff calculations

V. CONCLUSION

Green debt markets are rapidly evolving. Issuance of green and other sustainable debt variants is growing, security design is developing, and private and public governance arrangements including standards and guidelines are being refined. Green bonds remain the largest sustainable debt category, but new innovations including issuer-based instruments that link interest rates to firm-level sustainability targets have emerged. Many policymakers and investors view green debt as an important component in the policy mix to achieve the transition to a low carbon economy and ensure the pricing of climate risks. Meanwhile, more research on some aspect of green debt including environmental impact and its channels, the motivations of market participants, and the design of green debt to incentivize environmental objectives is needed. Existing research is focused on green bonds, while the analysis of bank-based green products (green loans and sustainability-linked loans) and issuer-based instruments (sustainability-linked bonds and loans) has been hampered by data constraints.

We contribute to the developing literature by documenting the CO2 emission intensity of green debt issuers relative to other firms and over time. We find evidence that green bond issuers have lower emission intensities than other firms, while green loan and sustainability-linked loan borrowers are in line with other firms after controlling for industry composition.

Green bond, green loan, and sustainability-linked loan borrowers lower their emission intensity over time at a faster rate than other firms. A likely interpretation of our results is that green debt issuers pursue green debt to signal their green credentials as argued by Flammer (2021) for green bonds. Additional reasons for issuers including engagement with investors, organizational learning, and mainstreaming of green considerations potentially play a role as well. Direct financial benefits through lower debt cost are unlikely to be a major factor given the lack of conclusive evidence of a substantive pricing difference between green and conventional debt in the literature.

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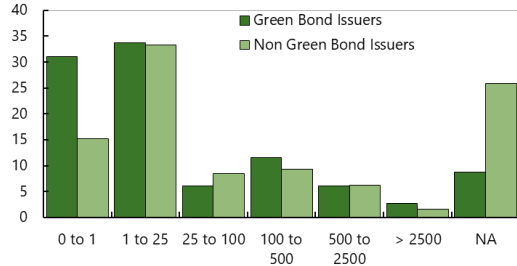
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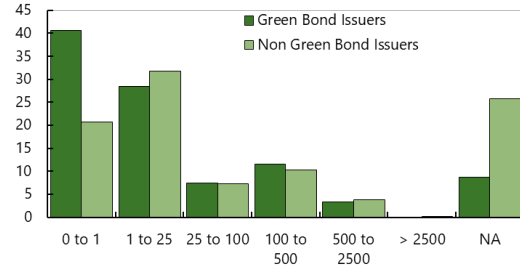
APPENDIX 1: GREEN BOND ISSUERS VS NON-ISSUERS BY SCOPE OF EMISSIONS

Figure 25. Green Bond Issuers vs Non-issuers: Share of Firms by CO2 (Scope 1)/Revenue Buckets
%, Financial Year 2019



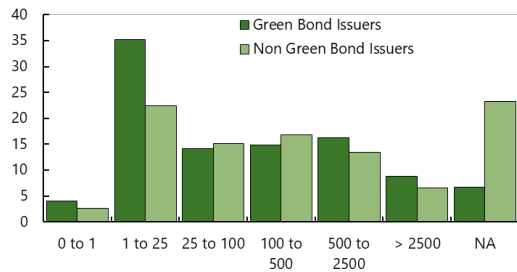
Sources: BloombergNEF, Reuters, IMF staff calculations

Figure 26. Green Bond Issuers vs Non-issuers: Share of Firms by CO2 (Scope 1)/Assets Buckets
%, Financial Year 2019



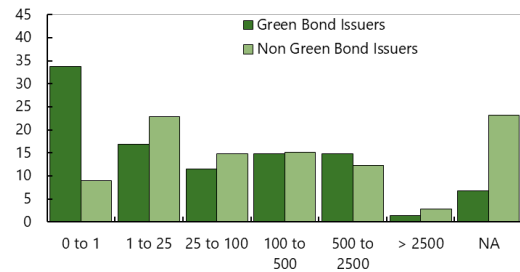
Sources: BloombergNEF, Reuters, IMF staff calculations

Figure 27. Green Bond Issuers vs Non-issuers: Share of Firms by CO2 (Scope 1+2+3)/Revenue Buckets
%, Financial Year 2019



Sources: BloombergNEF, Reuters, IMF staff calculations

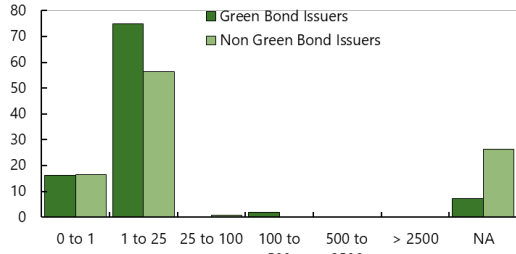
Figure 28. Green Bond Issuers vs Non-issuers: Share of Firms by CO2 (Scope 1+2+3)/Assets Buckets
%, Financial Year 2019



Sources: BloombergNEF, Reuters, IMF staff calculations

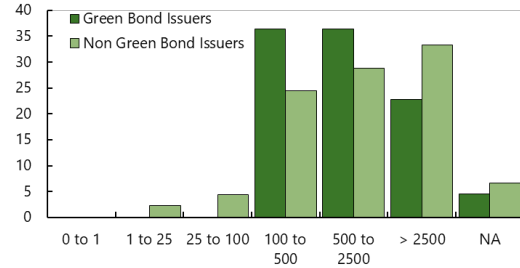
APPENDIX 2: GREEN BOND ISSUERS VS NON-ISSUERS BY INDUSTRY

Figure 29. Financials: Share of Firms by CO2 (Scope 1+2)/Revenue Buckets
%, Financial Year 2019



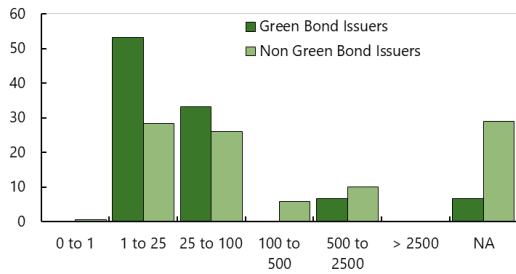
Sources: BloombergNEF, Reuters, IMF staff calculations

Figure 30. Utilities: Share of Firms by CO2 (Scope 1+2)/Revenue Buckets
%, Financial Year 2019



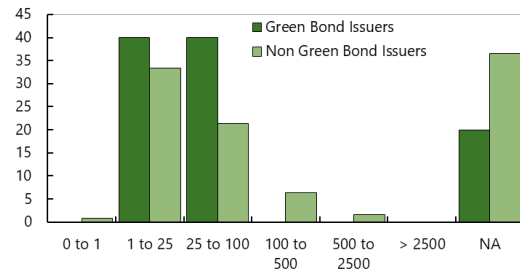
Sources: BloombergNEF, Reuters, IMF staff calculations

Figure 31. Industrials: Share of Firms by CO2 (Scope 1+2)/Revenue Buckets
%, Financial Year 2019



Sources: BloombergNEF, Reuters, IMF staff calculations

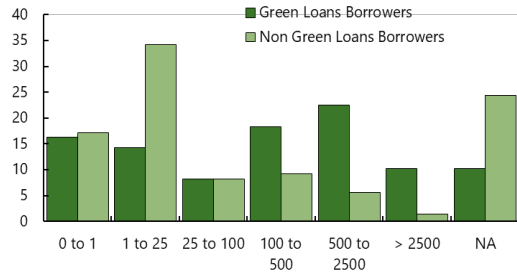
Figure 32. Consumer Discretionary: Share of Firms by CO2 (Scope 1+2)/Revenue Buckets
%, Financial Year 2019



Sources: BloombergNEF, Reuters, IMF staff calculations

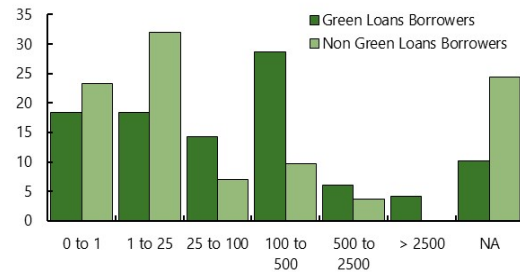
APPENDIX 3: GREEN LOAN BORROWERS VS NON-BORROWERS BY SCOPE OF EMISSIONS

Figure 33. Green Loan Borrowers vs Non-borrowers: Share of Firms by CO2 (Scope 1)/Revenue Buckets %, Financial Year 2019



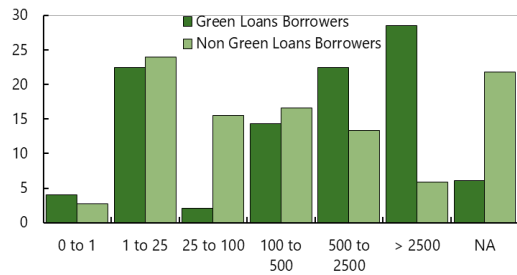
Sources: BloombergNEF, Reuters, IMF staff calculations

Figure 34. Green Loan Borrowers vs Non-borrowers: Share of Firms by CO2 (Scope 1)/Assets Buckets %, Financial Year 2019



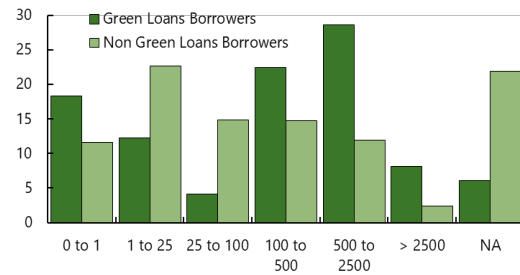
Sources: BloombergNEF, Reuters, IMF staff calculations

Figure 35. Green Loan Borrowers vs Non-borrowers: Share of Firms by CO2 (Scope 1+2+3)/Revenue Buckets %, Financial Year 2019



Sources: BloombergNEF, Reuters, IMF staff calculations

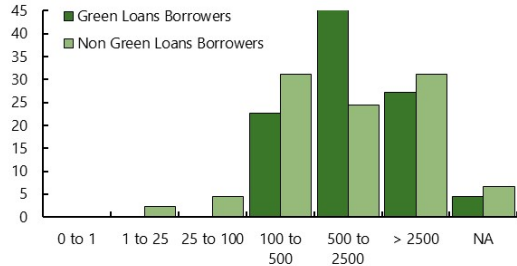
Figure 36. Green Loan Borrowers vs Non-borrowers: Share of Firms by CO2 (Scope 1+2+3)/Assets Buckets %, Financial Year 2019



Sources: BloombergNEF, Reuters, IMF staff calculations

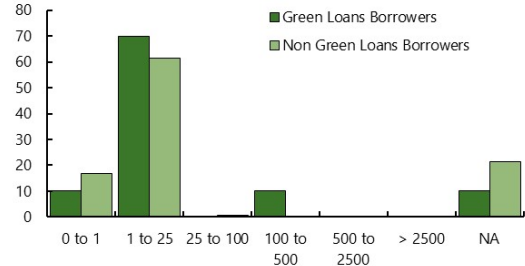
APPENDIX 4: GREEN LOAN BORROWERS VS NON-BORROWERS BY INDUSTRY

Figure 37. Utilities: Share of Firms by CO2 (Scope 1+2)/Revenue Buckets
%, Financial Year 2019



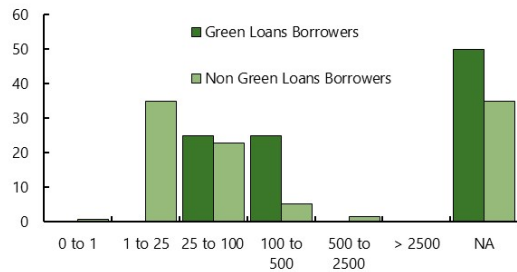
Sources: BloombergNEF, Reuters, IMF staff calculations

Figure 38. Financials: Share of Firms by CO2 (Scope 1+2)/Revenue Buckets
%, Financial Year 2019



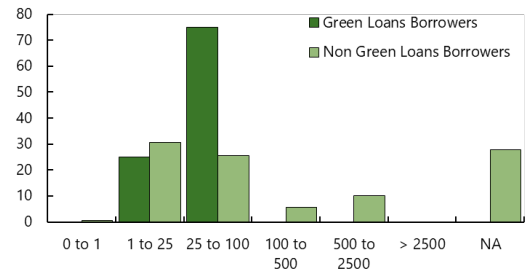
Sources: BloombergNEF, Reuters, IMF staff calculations

Figure 39. Consumer Discretionary: Share of Firms by CO2 (Scope 1+2)/Revenue Buckets
%, Financial Year 2019



Sources: BloombergNEF, Reuters, IMF staff calculations

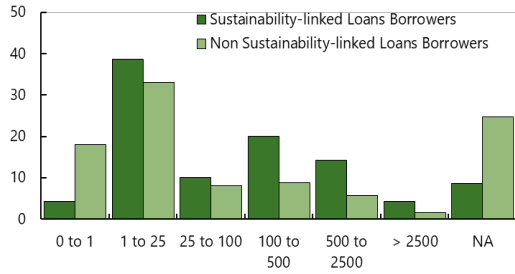
Figure 40. Industrials: Share of Firms by CO2 (Scope 1+2)/Revenue Buckets
%, Financial Year 2019



Sources: BloombergNEF, Reuters, IMF staff calculations

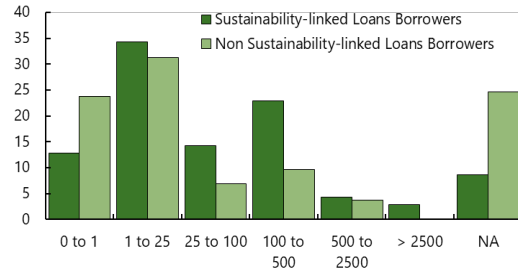
APPENDIX 5: SUSTAINABILITY-LINKED LOAN BORROWERS VS NON-BORROWERS BY SCOPE OF EMISSIONS

Figure 41. Sustainability-linked Loans Borrowers vs Non-borrowers: Share of Firms by CO2 (Scope 1)/Revenue Buckets
%, Financial Year 2019



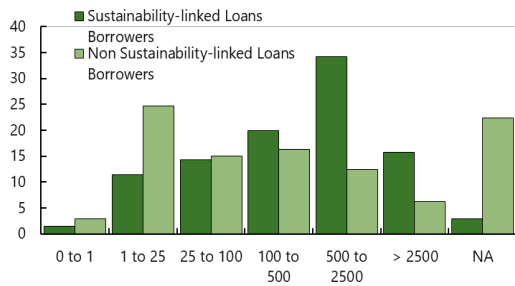
Sources: BloombergNEF, Reuters, IMF staff calculations

Figure 42. Sustainability-linked Loans Borrowers vs Non-borrowers: Share of Firms by CO2 (Scope 1)/Assets Buckets
%, Financial Year 2019



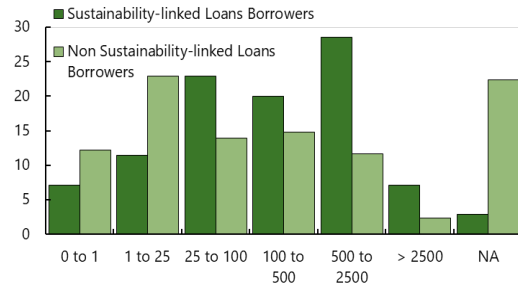
Sources: BloombergNEF, Reuters, IMF staff calculations

Figure 43. Sustainability-linked Loans Borrowers vs Non-borrowers: Share of Firms by CO2 (Scope 1+2+3)/Revenue Buckets
%, Financial Year 2019



Sources: BloombergNEF, Reuters, IMF staff calculations

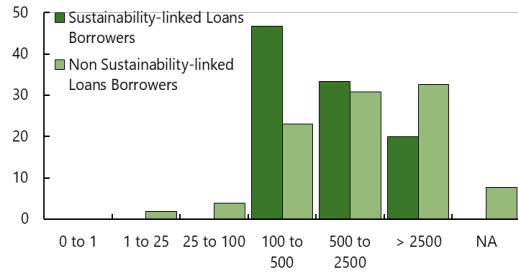
Figure 44. Sustainability-linked Loans Borrowers vs Non-borrowers: Share of Firms by CO2 (Scope 1+2+3)/Assets Buckets
%, Financial Year 2019



Sources: BloombergNEF, Reuters, IMF staff calculations

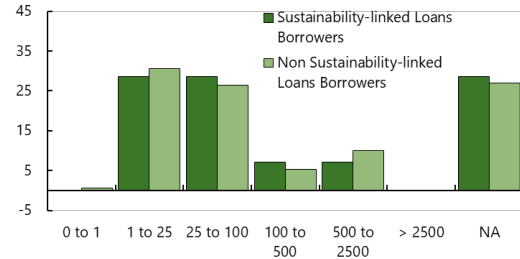
APPENDIX 6: SUSTAINABILITY-LINKED LOAN BORROWERS VS NON-BORROWERS BY INDUSTRY

Figure 45. Utilities: Share of Firms by CO2 (Scope 1+2)/Revenue Buckets
%, Financial Year 2019



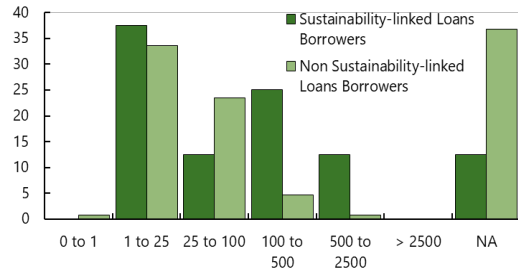
Sources: BloombergNEF, Reuters, IMF staff calculations

Figure 46. Industrials: Share of Firms by CO2 (Scope 1+2)/Revenue Buckets
%, Financial Year 2019



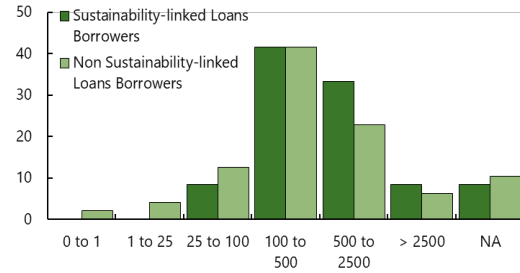
Sources: BloombergNEF, Reuters, IMF staff calculations

Figure 47. Consumer Discretionary: Share of Firms by CO2 (Scope 1+2)/Revenue Buckets
%, Financial Year 2019



Sources: BloombergNEF, Reuters, IMF staff calculations

Figure 48. Materials: Share of Firms by CO2 (Scope 1+2)/Revenue Buckets
%, Financial Year 2019



Sources: BloombergNEF, Reuters, IMF staff calculations