UNIVERSIDADE CATÓLICA PORTUGUESA

The pricing of sustainable Project Finance Loans

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Abstract

This work presents a comparative analysis of loan spreads and pricing between sustainable and conventional project finance loans. We analyse a cross-section of 1,195 project finance loan tranches closed from 2017 to 2024 and show that while sustainable and conventional loans are priced differently by common pricing factors, their spreads show no significant difference. Furthermore, banks consider contractual characteristics, macroeconomic factors, syndicate structure, and borrower characteristics when determining prices for sustainable loan tranches.

Key words: ESG; Project finance loans; credit spreads; loan pricing; pricing factors.

9.999 words

Resumo

Este trabalho apresenta uma análise comparativa do spread e do preço de empréstimos sustentáveis e empréstimos convencionais na ótica de Financiamento de Projetos. Analisamos uma secção transversal composta por 1.195 tranches de empréstimos de Financiamento de Projetos, fechados entre 2017 e 2024 e mostramos que, apesar os fatores de preço afetarem de forma diferente o preço de empréstimos sustentáveis e empréstimos convencionais, os spreads destes dois tipos de empréstimo não apresentam diferenças significativas. Além disso, os bancos têm em conta as caraterísticas contratuais, os fatores macroeconómicos, a estrutura do sindicato e as caraterísticas do mutuário na determinação dos preços das tranches de empréstimos sustentáveis.

Palavras-chave: ESG; empréstimos de Financiamento de Projetos; spreads de crédito; preço de empréstimos; fatores de preço.

9.999 palavras

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Introduction

Infrastructure investments must stop following the "business-as-usual" approaches as they cannot deliver sustainable infrastructure on the necessary scale. Investing in sustainable infrastructure is amongst the most effective strategies for achieving the Sustainable Development Goals (SDGs), as it is directly linked to all 17 goals and influences 92% of the 169 individual targets (United Nations Environment Programme, 2022). Furthermore, sustainable infrastructures are critical to meeting the Paris Agreement's climate targets, which require a 43% reduction in Greenhouse gases (GHG) emissions by 2030 and carbon neutrality by 2050. However, current investment levels fall significantly short of what is needed, particularly in low and middle-income countries (Global Infrastructure Hub, 2024). The OECD estimates that annual investments of around USD 6.4 trillion will be needed over the next decade to meet these objectives (OCDE, 2025). In this regard, Project Finance (PF)[1] emerges as an effective and innovative financial mechanism to bridge this gap and reduce overreliance on public financing, which can lead to unsustainable debt burdens. It also creates an enabling environment that mitigates risks for private sector participation, ultimately ensuring long-term sustainable economic growth and resilience.

In 2024, the lending volume in Global Project Finance reached its highest level in 10 years. Up 15% on 2023, it totalled US$417.4 billion in volume and 1004 transactions in number. The Power sector remained dominant, up 30% year-on-year, primarily driven by the Renewables sub-sector, which accounted for 75% of the Power sector with US$89.9 billion in 2024. In this regard, sustainable syndicated lending – green, sustainability-linked and social syndicated loans [2] - increased by

[1] See, among others, Brealey et al. (1996); Dailami and Leipziger (1998); Esty (2002, 2004); Esty and Megginson (2003); Guedes and Pinto (2023); Kleimeier and Megginson (2000); Pinto (2017).

26% compared to 2023, totalling US$765.3 billion in 2024, the strongest year for sustainable syndicated lending since 2018. European borrowers accounted for 40% of all sustainable lending in 2024, and BNP Paribas was the top mandated arranger of sustainable syndicated loans. Despite the growing importance of sustainable lending in the PF debt market, there remains a lack of analysis on how this class of bank loan operates[3].

This work contributes to two major strands of literature. First, it contributes to the existing research on the determinants of PF loan spreads. The theoretical and empirical literature on pricing traditional PF loans is extensive and continues to grow as this market develops. PF transactions operate through a legally and financially independent Special Purpose Entity (SPE) with a highly leveraged structure, primarily funded by limited or non-recourse syndicated loans (Esty & Megginson, 2003). This structure isolates the project from its sponsors, with borrowing costs determined by creditworthiness and cash flow capacity (Esty, 2004; Guedes & Pinto, 2023; Pinto, 2017). As a result, the literature identifies key pricing factors influencing PF debt spreads, including the country's risk level or the country's political risk, external guarantees, and tranche credit ratings (Bouzguenda, 2014; Dailami & Leipziger, 1998; Guedes & Pinto, 2023; Kleimeier & Megginson, 2000; Pollio, 1998; Sorge & Gadanecz, 2004). Within this literature, several studies examine the impact of ESG characteristics of borrowers and ESG risks on syndicated loan spreads. Earlier studies have concentrated on the impact of corporate social responsibility on loan spreads (Goss & Roberts, 2011), the connection between companies' social capital levels and the costs of bank financing (Hasan et al., 2017), the relationship between a company's carbon risk exposure due to emissions and the spreads on syndicated loans (Ehlers et al., 2022; Ho & Wong, 2023), and if risks from physical climate change are factored into the corporate loan market (Correa et al., 2022; Delis et al., 2018), and more recently, a study

[3] Sustainable Finance Review, full year 2023; Global Project Finance Review, full year 2024. Source: Refinitiv (https://www.lseg.com/en/data-analytics/products/deals-intelligence).

comparing the impact of common pricing factors on sustainable versus conventional syndicated loans, but excluding PF loans (Alves et al., 2023). Regarding PF loan spreads, a study was found comparing the spread of PF loans issued by Equator Principles (EP) banks and non-EP banks (Amiram et al., 2021). However, research on the determinants of sustainable loan spreads for PF transactions is non-existent. Thus, this work contributes to the existing literature on PF loan pricing by exploring a previously unexamined question: How do common pricing factors influence sustainable vis-à-vis conventional PF loan spreads? Additionally, it extends research on the determinants of sustainable loan spreads by analysing a specific sample of sustainable loans.

Second, this thesis adds to the emerging literature examining whether sustainable debt instruments have lower spreads than traditional alternatives. Most studies in this area focus on the bond market, mainly on green bonds, with mixed findings regarding the existence of greenium. Several studies find lower spreads on sustainable bonds compared to conventional ones (Baker et al., 2022; Caramichael & Rapp, 2024; Poggensee, 2023), while others show no differences in the spreads of sustainable versus conventional bonds (Flammer, 2021; Larcker & Watts, 2020; Tang & Zhang, 2020). There is limited evidence regarding the pricing of sustainable loans; however, emerging studies on the syndicated loan market, which includes PF loans, offer initial insights. As in the bond market, the evidence is mixed in the loan market: while Alves et al. (2023) find no differences between the spread of all three categories of sustainable loans and comparable conventional ones, Kim et al. (2021) show different conclusions for each sustainable loan category, at issuance: while there are no differences in the spread of sustainability-linked loans (SLLs) compared to non-ESG loans, for green loans the spread is lower. Additionally, recent research on financial motivation has argued that by issuing sustainable debt, creditors reduce their exposure to ESG risks and secure future business opportunities (Houston & Shan, 2022), lenders

seek borrowers with low ESG risk in order to minimise monitoring costs (Ioannou & Serafeim, 2019), that lender with lower ESG scores tend to offer favourable financial terms to borrowers with high ESG ratings to improve their own ESG reputation (Shin, 2020), and lenders use SLLs to improve monitoring and qualification of borrowers' ESG activities, thereby minimising asymmetric information costs (Aleszczyk et al., 2022). Regarding PF, banks' increasing adoption of universal frameworks for managing ESG risk, such as the Equator Principles, promotes the alignment of interests of different stakeholders and financial benefits (Eisenbach et al., 2014). For the above reasons, we expect sustainable loans to have lower spreads than comparable conventional loans. To the best of our knowledge, no previous studies have compared the spread of sustainable and conventional PF loans. We extend the research on the greenium of sustainable loans by being the first study that focus exclusively on the PF market. We employ an Ordinary Least Squares (OLS) regression and a matching methodology to conduct this analysis. As this is a particular and emerging market, we have only conducted this analysis for sustainable loans in general. As a suggestion, future studies should analyse each sub-category of sustainable PF loans (green, social, and sustainability-linked loans).

Using a sample of PF loans (81 sustainable loans and 1114 traditional loans, worth $ 300.252 billion and $ 66.081 billion, respectively) closed in the 2017-2024 period, we find that sustainable and conventional PF loans are differently priced. Results from an OLS estimation method show that key pricing factors for conventional loan pricing, such as deal size, number of banks, country risk, country ESG rating, market-based, and creditor rights also play a significant role in determining spreads on sustainable loans. However, common pricing factors that do not influence sustainable loan spreads, such as time to maturity, subordinated loans, fee information, term loan and yield curve slope, affect conventional loan pricing.

Regarding the spread of sustainable versus comparable conventional PF loans, our results align with those of Alves et al. (2023). Therefore, we do not confirm the hypotheses that banks issue sustainable loans to mitigate monitoring and asymmetric information costs or provide favourable financial terms to borrowers with high ESG performance in anticipation of potential lower risks (Aleszczyk et al., 2022; Houston & Shan, 2022; Ioannou & Serafeim, 2019). Although we use virtually all sustainable loans with available information on spread, maturity, tranche size, and country risk closed since the first sustainable PF loan issuance in 2017, our sample of sustainable loans is about 6.78% of the total PF loan amount. We construct a loan-level matched sample of conventional loans to address these effects. In this sample, each sustainable loan is paired with a conventional loan that is otherwise similar, based on comparable tranche size, maturity, and credit rating characteristics. Our results remain robust under this methodology.

This thesis is structured as follows. Section 1 reviews the literature and outlines the research hypotheses. Section 2 discusses the data and the variables employed in the analyses. Section 3 examines the factors influencing sustainable versus conventional PF loan spreads. It also assesses whether the spread of sustainable loans is significantly different (lower) than traditional PF loans. Section 4 includes robustness checks to evaluate the reliability of our findings. Finally, Section 5 presents the key conclusions and acknowledges the limitations of this study.

1. Literature review and hypotheses

1.1. Financial economics of sustainable PF loans

The pressure to foster the transition to a more conscious and sustainable economy is growing. In this context, PF has become one of the most widely used funding models to bridge the existing financing gap (Kleimeier & Versteeg, 2010; Pinto, 2017). According to Dealogic, in October 2017, the Canadian Solar Infrastructure Fund Inc. issued the first sustainable PF loan, with a tranche size of $139 million and a 10-year maturity. The largest issuance to date occurred in June 2022, when the National Housing & Urban Regeneration Center issued a tranche of $14 billion with a 20.5-year maturity. However, what are the primary characteristics of sustainable PF loans that distinguish them from traditional ones?

Due to the lack of a theoretical definition of this financing instrument, we need to use two strands of the literature to answer the question: project financing and sustainable financing literature.

PF fills the financing gap for large projects that require significant upfront investment and have long payback periods (Pinto, 2017). According to Esty and Megginson (2003), a PF company is a legally and financially independent Special Purpose Entity (SPE) with a highly leveraged structure, predominantly financed by limited or non-recourse syndicated loans. Through this arrangement, which isolates the project from its sponsors, the project's borrowing costs are based on the project's creditworthiness and its overall cash flow capacity to fully service the debt, with the project itself serving as collateral for the lender (Esty, 2004; Guedes & Pinto, 2023; Pinto, 2017). Thus, PF transactions rely on a specific capital structure comprising the sponsor(s) and a syndicate of banks (Mertens et al., 2023). This type of structured loan involves a financing hierarchy with a few arranging banks at the top and many providing banks at the bottom. In the loan syndication process, arranging banks sell large loans in tranches to providing

banks based on the desired risk-return profile (Dennis & Mullineaux, 1999). In the specific case of PF loans, prior to the loan syndication process, a set of contracts is established to ensure that the project's future cash flows fully secure the repayment of the project. To achieve this and minimise default risk during the financing period, the project's risks are allocated through tranche loans to the parties best placed to manage them (Bouzguenda, 2014; Esty & Megginson, 2003; Pinto, 2017). Theoretical literature suggests that tranche loans can optimise financing costs by reducing information asymmetries, reducing monitoring costs and improving interest alignment, thereby minimising agency problems (Kleimeier & Megginson, 2000).

The literature comparing sustainable and non-sustainable debt asserts that the primary distinction between these two financial instruments is the use of proceeds (Larcker & Watts, 2020). Thus, sustainable loans for PFs presuppose the existence of sustainable infrastructures[4] as the underlying asset of the project since the sustainable debt market requires loans to be aligned with environmental, social and governance (ESG) criteria (Pohl et al., 2023). Loans are categorised as sustainable if they comply with one of the following loan principles: Green Loan Principles (GLP), Social Loan Principles (SLP), and Sustainability Linked Loan Principles (SLLP)[5]. The distinction between the three categories relates to the use of the proceeds: Green Loans designated for environmental initiatives, Socia Loans for projects with positive social impact, and Sustainability-linked Loans are used for general business purposes, with the interest rate linked to the

[4] UN define Sustainable Infrastructure as " […] that are planned, designed, constructed, operated and decommissioned in a manner that ensures economic and financial, social, environmental (including climate resilience), and institutional sustainability over the entire infrastructure life cycle." See https://www.unep.org/explore-topics/green-economy/what-we-do/sustainable-infrastructure-investment for detailed information.

[5] See https://www.lma.eu.com/sustainable-lending/resources for detailed information.

borrower's performance on sustainability metrics, as assessed by Key Performance Indicators (KPIs) and Sustainability Performance Targets (SPTs), negotiated between lenders and borrowers at the time the loan is granted (Alves et al., 2023; Pohl et al., 2023). Ensuring compliance with the principles imposes additional costs on borrowers, particularly first-time borrowers, as an external reviewer or developing in-house expertise is required to ensure the alignment (Caramichael & Rapp, 2024). Additionally, this instrument contributes significantly to the literature on performance-based pricing, as the spread of sustainable loans is directly linked to the borrower's ESG performance indicators (Alves et al., 2023). Based on the literature, their characteristics help align the interests of lenders and borrowers, reduce information asymmetries, and promote mitigating ESG risks and reducing agency costs and moral hazard (Freeman et al., 2010; Gao & Schmittmann, 2022; Yu, 2005).

Concerning the pricing of Sustainable loans, Alves et al. (2023) provides evidence that common factors affect sustainable and conventional loan spreads differently. The authors highlight the pricing factors that significantly impact sustainable loan spreads: credit rating, loan subordination, the borrower's history with syndicated loans, the number of participating banks, the lead bank's reputation, and market volatility. Additionally, they noted the common factors that affect conventional loan spreads but do not influence sustainable loan spreads, including maturity, borrower's rating, transaction size, number of tranches, country risk, lead bank's domestic status, market-based financial system affiliation, and the anti-director rights index. Moreover, the existing literature on pricing sustainable debt suggests that there are other factors affecting the spread, such as: the ESG profile of the borrower (Hauptmann, 2017; Pohl et al., 2023), the CSR strengths and CSR concerns of the borrower (Bae et al., 2018), the environmental risk (Ehlers et al., 2022), the ESG profile of the lender (Houston & Shan, 2022; Shin, 2020), since lenders consider ESG-related information in their pricing if they have good ESG profiles (Pohl et al., 2023), issuers' ESG ratings (Flammer,

2021; Larcker & Watts, 2020), and ESG lender characteristics (Hauptmann, 2017; Houston & Shan, 2022; Pohl et al., 2023).

Consequently, we anticipate that sustainable and conventional PF loans will be priced differently based on common pricing factors. This leads us to the following hypothesis:

H1: Sustainable and conventional PF loans are priced differently by common pricing factors.

1.2. Sustainable vs Conventional PF loans spread

The extant literature on the pricing of sustainable debt has yielded mixed evidence regarding a greenium or lower yields compared to conventional debt (Poggensee, 2023). Theoretically, the literature suggests that sustainable debt can reduce financing costs by promoting the alignment of interests between different stakeholders since sustainability-focused investors often agree to pay a premium for these instruments (Freeman, 2010). In addition, these securities help to mitigate problems of information asymmetry, especially in contexts with a higher level of private information, by encouraging greater transparency in transactions (Gao & Schmittmann, 2022; Yu, 2005). On the other hand, the reality of moving to a sustainable market is more complicated than it seems, due to the lack of clear, consistent and accurate regulations, the difficulty of accessing sustainable financial data, and the subjectivity and imprecision of ESG criteria ((Buch, 2022); Busch et al., 2016).

With the historical dominance of green bonds in the sustainable debt market, there is an extensive literature in this regard. Some studies suggest that green bonds offer issuers advantageous financing terms, reflecting investors' willingness to pay higher prices for sustainable assets. Caramichael and Rapp's (2024) study of corporate green bonds observed a greenium. However, the authors ar-

gue that this advantage depends essentially on specific characteristics of the issuer, such as its market share, the currency of the transaction and whether it is rated or not, and not on the marginal environmental impact of the project itself. The authors add that the mispricing in this market can be explained by the demand for sustainable investments being currently higher than the sustainable bonds available in the bond market. Poggensee (2023) on the pricing of Sustainability-Linked Bonds (SLBs) suggests that SLBs are traded at a premium, as investors pay higher prices and accept lower returns in both the primary and secondary markets, even though the lower cost of debt benefit is declining. The authors find that the issuer's ESG rating is a primary driver of premium pricing. However, studies such as Flammer (2021), Larcker and Watts (2020) and Tang and Zhang (2020) found no differences in the pricing of sustainable and conventional bonds. Bachelet et al.'s (2019) study shows that green bonds trade at higher spreads than conventional bonds.

The lack of consensus on the existence or non-existence of greenium is also present in the loan market. However, the number of existing studies on sustainable loan pricing is considerably lower than that of the bond market. Alves et al. (2023) found no difference between the spread of sustainable and comparable conventional loans. This result was maintained across the three categories of sustainable loans: sustainability-linked loans, green loans and social loans. Kim et al. (2021) suggest that when controlling for loan and borrower characteristics, the spread of SLLs is not issued with greenium, consistent with the findings of Du et al. (2022). The authors note that the spread of green loans is lower than that of conventional loans. Pohl et al. (2023) only analyse the pricing of SLLs and show that borrowers save an average of 9.5 bp by using SLLs instead of conventional loans. However, none of the authors include PF sustainable loans in their sample.

As this market has grown, so has awareness of ESG risks' impact on banks' credit and reputational risks. Houston and Shan (2022) argue that by issuing sus-

tainable debt, creditors reduce their exposure to ESG risks and secure future business opportunities. In this context, to maintain their reputation, banks tend to finance borrowers whose ESG ratings are similar to theirs, thereby promoting the continuous improvement of borrowers' ESG ratings over time. Ioannou and Serafeim (2019) argue that lenders seek borrowers with low ESG risk to minimise monitoring costs and reputational risks. Kim et al. (2021) extend this idea, showing that lenders with greater public scrutiny issue SLLs to demonstrate their commitment to sustainability. On the other hand, banks with a more limited ESG focus are determined to increase the number of sustainable borrowers in their portfolios to reduce potential reputational risks. Shin (2020) shows that banks with lower ESG scores tend to offer more favourable financial terms to borrowers with high ESG ratings to improve their ESG reputation. Du et al. (2022) show that the number of depositors increases significantly after issuing SLLs. Thus, lenders committed to ESG metrics have greater liquidity than non-sustainable lenders without offering favourable terms or taking on more risk. Aleszczyk et al. (2022) argue that lenders use SLLs to improve the monitoring and qualification of borrowers' ESG activities, thereby minimising asymmetric information costs.

The relevance of this topic has led to the creation of universal frameworks and certification mechanisms aimed at measuring ESG concerns and incorporating them into risk management models, thereby minimising information asymmetries. As banks are responsible for most PF financing, they play a fundamental role in addressing information asymmetries among the stakeholders involved in sustainable projects (Mertens et al., 2023).

In this regard, a few banks created the Equator Principles in 2003, a voluntary "code of conduct" that serves as a common baseline and risk management framework to guide financial institutions in identifying and managing environmental and social risks in the projects they finance. This initiative, created firstly to serve PF, establishes 10 standard principles applicable to all member institutions, serv-

ing as a foundation for developing internal methodologies within each organisation. Equator Principles Financial Institutions (EPFIs) ensure that the projects they finance adhere to social and environmental standards, minimising negative impacts on ecosystems and communities whenever possible. Beyond aligning the interests of diverse stakeholders, the Equator Principles promote knowledge sharing and the continuous improvement of sustainable practices, driving responsible and conscious development (Eisenbach et al., 2014). Amiram et al. (2021) examined how companies mitigate ESG concerns through loan contracts. Their findings suggest that firms borrowing from banks after these banks adopt the EP or switching from non-EP to EP-adopting banks tend to enhance their ESG performance. Moreover, loans under the EP framework help companies lower both their cost of equity and debt by signalling a concrete commitment to ESG principles.

Banks are adapting their business strategies to actively include projects aligned with their ESG standards in their portfolios, while safeguarding their reputations (Shin, 2020; Mertens et al., 2023). Therefore, we propose the following hypothesis:

H2: Sustainable PF loans have lower spreads than conventional PF loans.

2. Data and variable definition

2.1. Sample selection

The sample comprises individual loans obtained from Loan Analytics. The observation unit is a single tranche, meaning that a deal with one tranche corresponds to one observation, while a deal with multiple tranches corresponds to multiple observations. The sample period begins in 2017, as the first sustainable PF loan was issued that year, and extends to 2024, the last year for which all necessary information is available, to maximise the number of sustainable issues covered. Loan Analytics does not have a deal type code for 'project finance'. Therefore, we classified loans as PF if their primary use of proceeds was 'project finance', and only these loans were included in the sample. Loan Analytics assigns three market segment flags for all sustainable loans in the database: SLLP for those that comply with the Sustainability-Linked Loan Principles, GLP for compliance with the Green Loan Principles, and SLP for adherence to the Social Loan Principles. The remaining PF loans were classified as conventional loans. This platform was also used to extract data on the micro characteristics of PF loans, such as spread, maturity, deal size, tranche amount, currency risk, borrower rating, tranche rating, number of lenders, subordination, number of tranches, loan type (term loan versus line of credit), deal nationality, industry. Macroeconomic data, including market volatility, interest rates, and the yield curve slope, were obtained from Datastream. Country risk was sourced from Moody's country rating. The pricing date of the deals was used to match macro and microeconomic variables.

As this thesis aims to analyse how sustainable PF loans' spreads and pricing processes compare with comparable conventional loans, all observations with missing information about spread, maturity, tranche size and country risk in the *full sample* were excluded. These screens yield a *high-information sample* of 1,195

PF loans worth $ 366.333 billion, of which 81 tranches worth $ 66.081 billion are classified as sustainable loans (14 sustainability-linked loans and 67 green loans) and 1,114 tranches worth $ 300.252 billion as conventional loans. Due to the small size of this market and the restriction imposed, this sample does not include social PF loans.

Table 1: Distribution of the sample by year, region and industry, and top borrowers and switchers

Panel A: Distribution of Project Finance loans by year

Year	Conventional loans			ESG loans			Green loans			Sustainability-linked loans		
	Number of tranches	Total value [$ Million]	Percent of total value	Number of tranches	Total value [$ Million]	Percent of total value	Number of tranches	Total value [$ Million]	Percent of total value	Number of tranches	Total value [$ Million]	Percent of total value
2017	271	64 196,60	21,38%	1	139,31	0,21%	1	139,31	0,26%	0	0,00	0,00%
2018	179	57 358,20	19,10%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
2019	125	27 079,20	9,02%	3	1 502,51	2,27%	3	1 502,51	2,79%	0	0,00	0,00%
2020	92	10 470,60	3,49%	4	538,15	0,81%	4	538,15	1,00%	0	0,00	0,00%
2021	112	30 779,00	10,25%	13	3 583,98	5,42%	13	3 583,98	6,66%	0	0,00	0,00%
2022	122	40 438,10	13,47%	16	23 051,20	34,88%	12	21 987,80	40,88%	4	1063,42	8,65%
2023	162	61 138,30	20,36%	19	19 562,70	29,60%	13	17 333,30	32,22%	6	2229,40	18,14%
2024	51	8 792,13	2,93%	25	17 702,90	26,79%	21	8 707,47	16,19%	4	8995,38	73,20%
Total	**1 114**	**300 252,13**	**100,00%**	**81**	**66 080,75**	**100,00%**	**67**	**53 792,52**	**100,00%**	**14**	**12288,20**	**100,00%**

Panel B: Distribution of Project Finance loans by industrial category of borrower

Industrial category of borrowers	Conventional Loans			ESG Loans			Green Loans			Sustainability-Linked Loans		
	Number of tranches	Total value [$ Million]	Percent of total value	Number of tranches	Total value [$ Million]	Percent of total value	Number of tranches	Total value [$ Million]	Percent of total value	Number of tranches	Total value [$ Million]	Percent of total value
Commercial and Industrial												
Agriculture, Forestry and Fishing	2	170,00	0,06%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
Communications	19	8 590,24	2,86%	3	3 931,70	5,95%	3	3 931,70	7,31%	0	0,00	0,00%
Construction/Heavy Engineering	116	21 888,20	7,29%	3	79,53	0,12%	3	79,53	0,15%	0	0,00	0,00%
Manufacturing												
Aerospace	1	110,15	0,04%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
Chemicals, Plastic and Rubber	25	28 743,80	9,57%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
Computers and Electronics	32	18 800,60	6,26%	3	1 750,00	2,65%	1	1 250,00	2,32%	2	500,00	4,07%
Consumer Products	1	3,1675	0,00%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
Food and Beverages	4	165,15	0,06%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
Machinery and Equipment	1	517,231	0,17%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
Steel, Aluminum and other Metals	10	2 677,01	0,89%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
Mining and Natural Resources	22	2 524,51	0,84%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
Oil and Gas	41	38 987,40	12,98%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
Real Estate	78	15 547,00	5,18%	11	12 033,50	18,21%	6	3 062,10	5,69%	5	8 971,42	73,01%
Services												
Dining & Lodging	1	685,000	0,23%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
Healthcare	5	2 465,90	0,82%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
Holding Companies	1	102,922	0,03%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
Leisure & Recreation	15	7 592,90	2,53%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
Professional Services	15	1 604,37	0,53%	3	652,90	0,99%	3	652,90	1,21%	0	0,00	0,00%
Finance and Insurance	25	4 585,94	1,53%	15	1 692,19	2,56%	11	1 262,73	2,35%	4	429,46	3,49%
Public Administration/Government	12	1 532,19	0,51%	1	13 863,80	20,98%	1	13 863,80	25,77%	0	0,00	0,00%
Transportation	148	56 501,70	18,82%	4	2 012,89	3,05%	4	2 012,89	3,74%	0	0,00	0,00%
Utilities	529	85 665,90	28,53%	29	25 286,60	38,27%	27	23 486,60	43,66%	2	1 799,94	14,65%
Multiple	11	790,78	0,26%	9	4 777,67	7,23%	8	4 190,30	7,79%	1	587,38	4,78%
Total	**1 114**	**300 252**	**100%**	**81**	**66 081**	**100%**	**67**	**53 793**	**100%**	**14**	**12 288**	**100%**

(Continued)

(Continued)

Panel C: Geographic distribution of Project Finance loans

Geographic location of borrower	Conventional Loans			ESG Loans			Green Loans			Sustainability-linked Loans		
	Number of tranches	Total value [$ Million]	Percent of total value	Number of tranches	Total value [$ Million]	Percent of total value	Number of tranches	Total value [$ Million]	Percent of total value	Number of tranches	Total value [$ Million]	Percent of total value
Europe	**131**	**35 361,71**	**11,78%**	**3**	**482,04**	**0,73%**	**3**	**482,04**	**0,90%**	**0**	**0,00**	**0,00%**
European Union	105	27 674,48	9,22%	3	482,04	0,73%	3	482,04	0,90%	0	0,00	0,00%
United Kingdom	24	7 397,08	2,46%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
Eastern Europe	2	290,16	0,10%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
Americas	**400**	**94 451,09**	**31,46%**	**52**	**47 414,03**	**71,75%**	**47**	**37 206,09**	**69,17%**	**5**	**10 207,94**	**83,07%**
United States	275	83 732,80	27,89%	44	42 876,20	64,88%	41	34 468,20	64,08%	3	8 408,00	68,42%
Canada	9	868,26	0,29%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
Latin America and Caribbean	116	9 850,02	3,28%	8	4 537,83	6,87%	6	2 737,89	5,09%	2	1 799,94	14,65%
Asia	**454**	**142 210,66**	**47,36%**	**26**	**18 184,77**	**27,52%**	**17**	**16 104,4**	**29,94%**	**9**	**2 080,26**	**16,93%**
Central Asia	2	900,04	0,30%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
East Asia	199	84 181,84	28,04%	20	16 659,24	25,21%	12	15 166,28	28,19%	8	1 492,88	12,15%
Japan	14	1 025,22	0,34%	10	677,64	1,03%	6	248,18	0,46%	4	429,46	3,49%
Taiwan (China)	25	4 323,44	1,44%	10	15 981,60	24,18%	6	14 918,10	27,73%	4	1 063,42	8,65%
West Asia	6	442,03	0,15%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
South Asia	179	33 665,28	11,21%	4	863,15	1,31%	4	863,15	1,60%	0	0,00	0,00%
Southeast Asia	68	23 021,47	7,67%	2	662,38	1,00%	1	75,00	0,14%	1	587,38	4,78%
Australia	**72**	**11 722,00**	**3,90%**	**0**	**0,00**	**0,00%**	**0**	**0,00**	**0,00%**	**0**	**0,00**	**0,00%**
Africa	**57**	**16 506,63**	**5,50%**	**0**	**0,00**	**0,00%**	**0**	**0,00**	**0,00%**	**0**	**0,00**	**0,00%**
Sub-Saharan Africa	38	4 692,59	1,56%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
Middle East and North Africa	19	11 814,03	3,93%	0	0,00	0,00%	0	0,00	0,00%	0	0,00	0,00%
Total	**1 114**	**300 252,08**	**100,00%**	**81**	**66 081**	**100%**	**67**	**53 793**	**100%**	**14**	**12 288**	**100%**

Panel D: Top 10 borrowers

Conventional loans			Sustainable loans		
Firm	**By value of deals**	**By number of deals**	**Firm**	**By value of deals**	**By number of deals**
Zhejiang Petrochemical Co Ltd	4,70%	0,281%	National Housing & Urban Regeneration Cente	3,78%	0,14%
Foundry JV Holdco LLC	3,89%	0,140%	SunZia Finco Holdings LLC	2,40%	0,14%
Rio Grande LNG LLC	2,95%	0,140%	CyrusOne LP	2,16%	0,14%
HPCL Rajasthan Refinery Ltd	2,73%	0,281%	CHPE LLC	1,54%	0,14%
DFMG Holding GmbH	2,00%	0,140%	QTS Fayetteville I DC1-2 LLC	0,84%	0,14%
Port Arthur LNG LLC	1,92%	0,140%	Power DevCo Warehouse Borrower LLC	0,68%	0,14%
PRPC Refinery & Cracker Sdn Bhd	1,91%	0,140%	Bellefield 1 Finco LLC	0,66%	0,14%
Venture Global Calcasieu Pass LLC	1,58%	0,140%	Metro de Panama SA	0,55%	0,14%
Beijing International Resorts Co Ltd	1,14%	0,140%	Aguas Horizonte SpA	0,49%	0,14%
	1,11%	0,140%	Bellefield 2 Seller LLC	0,46%	0,14%

Panel E: Top 10 Switchers

Conventional loans		Sustainable loans	
Firm	**By value of deals**	**Firm**	**By value of deals**
Canadian Solar Infrastructure Fund Inc	0,241%	SunZia Finco Holdings LLC	2,40%
Enex Infrastructure Investment Corp	0,100%	Power DevCo Warehouse Borrower LLC	0,68%
Sunrock Assets Holding BV	0,041%	Sunrock Assets Holding BV	0,17%
SB Energy Six Pvt Ltd	0,006%	Canadian Solar Infrastructure Fund Inc	0,13%
Power DevCo Warehouse Borrower LLC	0,005%	Enex Infrastructure Investment Corp	0,04%
		SB Energy Six Pvt Ltd	0,03%

Panel A describes the distribution of sustainable and conventional PF loans by year, Panel B presents the industrial distribution of loans, whereas Panel C details the loan allocation to borrowers in a particular country. Panel D and Panel E rank the top 10 borrowers and switchers, respectively, by value and number of deals. Data are for PF loans with spread, maturity and tranche/transaction amount available, closed during the 2017-2024 period. Sustainability-linked loans are those that comply with the Sustainability-Linked Loan Principles, and green loans comply with the Green Loan Principles.

Panel A of Table 1 illustrates the distribution of loans per year, while Panel B and Panel C depict the industrial distribution and the allocation of loans to borrowers in a specific country. Panel A indicates that while conventional loans exhibited an inconsistent trend in the amounts closed throughout the sample period, sustainable loans experienced a significant increase since 2021, particularly regarding green loans. Panel B reveals that sustainable and conventional loans are concentrated in a few industries. Sustainable loan issuance is concentrated in three key industries: utilities (38.27%), public administration/government (20.98%) and real estate (18.21%), which represent 77.46% of all sustainable loan issuance by volume. Although conventional loan issuance is less concentrated, it also highlights three key industries: utilities (28.53%), transportation (18.82%) and oil and gas (12.98%), which represent 60.33% of all conventional loan issuance by volume. Panel C presents similar geographical distributions for both loan types, as they are highly concentrated in the US and East Asia. These two geographies account for 78.82% and 99.27% of all conventional and sustainable issuances, by volume, in our sample, respectively. The European Union is also relevant for conventional loans, accounting for 9.22% of all conventional loans in our sample by volume.

Panel D provides information on identifying the major players and their relative significance in PF markets, based on both value and the number of deals across the entire sample. Panel E illustrates the relevance of switching firms that close both sustainable and conventional loans during the sample period, again considering the whole sample by value. The top ten sustainable and conventional borrowers contributed different weights based on the value of the deals. While the top ten borrowers of conventional loans accounted for 23.93% of all tranches in our sample, the top ten issuers of sustainable loans represent 13.57%. Notably, none of the firms in the top ten for sustainable loans are included in the ranking for conventional loans. Panel E finds that both sustainable and conventional loan switchers contribute a small portion to the overall sample, representing only

3.46% and 0.39% of all issuances by volume, respectively. Interestingly, only two switchers (SunZia Finco Holdings LLC; Power DevCo Warehouse Borrower LLC) are in the top 10 sustainable loan borrowers.

2.2. Dependent and independent variables

Table 2 presents comprehensive definitions and sources for all the variables utilised, along with the anticipated effects of the explanatory variables on the loan spreads.

Table 2: Definition of variables, sources, and the expected impact on spread

Variable name	Variable definition	Source	Expected impact on spread
Dependent variable:			
Spread	Spread of the loan tranche (in bps) including margin and fees - thanche all-in pricing	Loan Analytics	
Independent variables:			
Core variables			
Sustainable	Dummy equal to 1 if the loan is ESG-linked, and 0 otherwise.	Loan Analytics	-
Maturity	Maturity of loan, in years.	Loan Analytics	+
Rated	Dummy equal to 1 if the loan tranche has a credit rating from Fitch, Moody's and/or S&P, and 0 otherwise.	Loan Analytics	-
Tranche rating	The Fitch, S&P and/or Moody's tranche rating at closing; the rating is converted as follows: AAA=Aaa=1, AA+=Aa1=2, and so on until D=24. If a tranche has more than one credit rating, the average is computed.	Loan Analytics	+
Contractual characteristics			
Transaction size	Loan deal size measured in $ million.	LoanAnalytics	-
Number of tranches	Number of loans per deal.	LoanAnalytics	-
Currency risk	Dummy equal to 1 for loans that are denominated in a currency different from the currency in the borrower's home country.	LoanAnalytics	+
Experienced	Dummy equal to 1 for borrowers who have closed a syndicated loan (sustainable or conventional) previously.	Authors'	-
Switcher	Dummy equal to 1 for borrowers that have closed simultaneously a sustainable and a convenional loan in the sampling period.	Authors'	-
Subordinated	Dummy equal to 1 for tranches that are subordinated - classified by Dealscan as 'Junior Subordinated', 'Mezzanine', 'Senior Subordinated', 'Subordinated'-, and 0 otherwise	LoanAnalytics	+
Fee information	Dummy equal to 1 for tranches with information on fees (e.g., upfront fee, commitment fee, facility fee, cancellation fee), and 0 otherwise.	LoanAnalytics	+
Term loan	Dummy equal to 1 if the loan is a term loan and 0 if the loan is a credit line.	LoanAnalytics	+
Syndicate structure			
Former lender	Dummy equal to 1 if the borrowing firm already has an established relationship with a lead bank during our sampling period, and 0 otherwise.	Alves et al. (2024)	-
Number of banks	The number of lenders participating in the deal.	Loan Analytics	-
Domestic lead bank	Dummy equal to 1 if the bank's syndicate lead bank's (or at least one of the lead banks) nationality is the same as the deal country, and 0 otherwise.	Authors'	?
Equator Principles Financial Institution (EPFI)	Dummy equal to 1 if the one of the banks from the syndicate is a EPFI, and 0 otherwise.	Equator Principles Limited 2025	-
Bank reputation	Global syndicated loans mandated arrangers' rank according to Refinitiv League Tables for 2024. Ranks range from 1 (best) to 25 (worst).	Refinitiv Deals Intelligence	-

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Macroeconomic factors			
Country risk	Moody's country credit rating at close. The rating is converted as follows: AAA=1, AA+=2, and so on until D=24.	Moody's Global Rating	+
Country ESG rating	Vigeo's country ESG rating at closing. Ratings range from 0 to 100, with 100 being the highest score for Corporate Social Responsibility (CSR)	CSR Hub	-
EPI	Environmental Performance Index (EPI) ranks countries on climate change performance, environmental health, and ecosystem vitality.	YaleCELP & CIESIN	-
High Carbon	Dummy equal to 1 for borrowers that belong to a high carbon industry, and 0 otherwise.	Ehlers et al. (2022)	+
Capital Intensive	Dummy equal to 1 for borrowers that belong to a capital intensive industry, and 0 otherwise.	Alves et al. (2021)	-
Market-based	Dummy equal to 1 if the loan is extended to a borrower located in a country with a market-based financial system, and 0 otherwise.	DemirgücKunt and Maksimovic (2002)	+
Creditor rights	Measured using La Porta et al. (1998) indices, revised by Djankov et al. (2007). We use four creditor rights variables (no automatic stay on assets; secured creditors first paid; restrictions for going into reorganization; management does not stay in reorganization) and added up the scores to create an index as in Esty and Megginson (2003).	LLSV (1998); Djankov et al. (2007)	-
Enforcement	Measured using La Porta et al. (1998) indices. We use five enforcement variables (efficiency of judicial system; rule of law; corruption; risk of expropriation; risk of contract repudiation) and added up the scores to create an index.	LLSV (1998)	-
Anti director rights	Measured using La Porta et al. (1998) indices, revised by Spamann (2010). Formed by adding one when (i) the country allows shareholders to mail their proxy votes; (ii) shareholders are not required to deposit their shares prior to the general shareholders' meeting; (iii) cumulative voting or proportional representation of minorities on the board of directors is allowed; (iv) an oppressed minorities mechanism is in place; (v) the minimum percentage of share capital that entitles a shareholder to call for an extraordinary shareholders' meeting is less than or equal to 10% of the sample median; or (vi) shareholders have preemptive rights that can only be waived by a shareholder meeting. The range for the index is from zero to six.	LLSV (1998); Spamann (2010)	+
Volatility	The net income before preferred dividends minus preferred dividend requirement, divided by total assets.	Datastream	+
5yTB-3mTB	The yield curve slope. Obtained as the difference between the U.S. five-year Treasury Bond rate and the U.S. 3-month Treasury Bill rate.	Datastream	-

The following characters mean: – = negative impact on spread | + = positive impact on spread | ? = sign cannot be clearly determined based on extant literature.

2.2.1. Spread

Spread corresponds to the interest rate the borrower pays to the lender on the amount borrowed, measured as a premium over a benchmark (e.g., Libor or Euribor). Tranche all-in pricing[6] was used to measure spread.

2.2.2. Independent Variables

We start by discussing the core independent variables. To test hypothesis H2, we utilise an indicator variable that equals one for sustainable loans—those adhering to SLLP, GLP, or SLP. We anticipate that sustainable loans will exhibit lower spreads than similar traditional PF loans.

2.2.2.1. Contractual characteristics

Recent empirical research shows that various contractual factors communicate details about loan and bond pricing (e.g., Alves et al., 2023; Alves et al., 2022; Dennis and Mullineaux, 1999; Esty & Megginson, 2003; Kleimeier & Megginson, 2000; Sorge & Gadanecz, 2004). These include credit rating, deal size, currency risk, loan type, and fees.

The literature on the term structure of spreads is mixed. Guedes and Pinto (2023) demonstrate that the spread of PF bonds highly increases with maturity. Kleimeier and Megginson (2000) argue that long-term PF loans have smaller spreads, ceteris paribus. Sorge and Gadanecz (2004) show that PF loans have a 'hump-shaped' or non-linear term structure. Project risks are predominantly concentrated in the early stages of the deal and are gradually mitigated over time (Sorge, 2004). Consequently, the spread begins at a higher level and gradually diminishes. Moreover, since PF deals face short-term liquidity constraints, lenders provide longer maturities to reduce the likelihood of project default. Thus,

[6] Based on Loan Analytics, "measures how much a borrower has had to pay out to the bank for the loan at the tranche level […] it also considers the fee as well as the margin."

we control for loan *maturity* and the *logarithm of maturity* (log maturity) as a surrogate for any non-linear relationships between spread and maturity. Regarding credit ratings, Guedes and Pinto (2023) show that credit ratings remain the most important determinant of PF bond spreads despite the non-linear relationship. Loan Analytics provides information on tranche ratings. Due to the absence of information for several tranches, we introduce a dummy variable that equals one if the loan has a credit rating from Fitch, Moody's, and/or S&P, and zero otherwise. For those tranches with at least one credit rating assigned by Fitch, Moody's, and/or S&P, we converted credit ratings as follows: AAA=Aaa=1, AA+=Aa1=2, and continuing similarly until D=24. We calculated the average when a tranche has two or three credit ratings. Rating scales are inverse, so we expect spreads to rise as the rating decreases. For deal size, Sorge and Gadanecz (2004) show that larger PF loans are cheaper, which aligns with Guedes and Pinto's (2023) findings. Therefore, we anticipate that transaction size will significantly negatively impact spread. PF loans allow different levels of risk and reward to be allocated through tranches to parties best suited to manage them, simultaneously reducing asymmetry information. Furthermore, it is structured so that each position gains from the credit protection of all the positions subordinated to it (Dennis & Mullineaux, 1999; Esty & Megginson, 2003). As in Cumming et al. (2020), we measure the tranching of a syndicated loan deal by considering the number of tranches and anticipate a negative impact on the spread. As in Kleimeier and Megginson (2000), we estimate currency risk using a dummy variable that equals one if there is a mismatch between the currency of loan repayment and the currency of the borrower's home country and expect that tranches exposed to currency risk will have higher spreads than those that are not. Contrarily, as in Alves et al. (2023), we expect companies that have already closed a syndicated loan deal before – experienced –, whether sustainable or conventional, as well as those that close both types of financing – switchers –, to face a

lower spread because there are significant fixed costs associated with establishing a first syndicated deal, namely if it is a sustainable loan deal. As in Guedes and Pinto (2023), we expect that subordinated loans, measured by a *subordinated dummy* that equals one if the loan is subordinated, have higher spreads than senior loans. We also control for the following dummy variables: *term loan* and *fee information* (Alves et al., 2023; Alves et al., 2022; Lim et al., 2014). We expect them to influence the spread significantly and positively.

2.2.2.2. Syndicate structure

Bharath et al. (2011) demonstrate that borrowing more than once from the same lender enhances loan terms, as it diminishes information asymmetry, particularly in cases involving low-transparency borrowers and/or moral hazards in banking syndicates. Therefore, we expect the former lender variable to have a negative impact on the spread. Kleimeier and Megginson (2000) show that PF loans require larger syndicates than any other type of syndicated loan, as they allow uncertainty and risk to be spread across a larger number of banks, promoting positive risk mitigation effects (Sorge & Gadanecz, 2004). The size of a syndicate is indicated by the number of banks involved in a deal. Given that syndication enhances risk sharing, we anticipate a decrease in spreads. Esty (2002) finds that the presence of foreign banks in the banking syndicate increases spreads. On the one hand, foreign banks indicate a lack of lending capacity in the host country and on the other hand, these banks demand higher spreads as they enter a market with an information disadvantage. We analyse this effect by introducing a dummy control for domestic lead banks versus foreign ones. We also consider bank reputation in the syndicated loan market, measured by the annual Thomson Reuters mandated arrangers' rankings, to identify additional differences among bank syndicates (Alves et al., 2023). We adopt a similar approach to bank reputation in sustainable syndicated loans by controlling for Bank ESG's reputation. We expect a negative relationship between the reputation of lead banks and

spreads, as a highly reputable lead bank may reduce information asymmetries. We assumed that subsidiaries have the same ranking as the parent bank. Additionally, we control for bank loan contracts under the EP framework. According to Amiram et al. (2021), firms can reduce capital costs by borrowing from EPFI. To the best of our knowledge, no previous study has analysed this as a pricing determinant of PF loan spreads. We use an *EP-adopter* dummy, which equals one if one of the banks in the syndicate is an EPFI and zero otherwise, and expect a negative impact on the spread.

2.2.2.3. Macroeconomic factors

Kleimeier and Megginson (2000) demonstrate that PF loan borrowers, on average, operate in riskier countries, with country risk being the primary driver of the spread. Dailami and Leipziger (1998) highlight that country risk influences pricing for foreign PF deals, as debt servicing relies on both project viability and host country policies on capital mobility and currency convertibility. We account for these factors using Moody's country rating and Vigeo's ESG rating at closing. We also control for environmental performance index ranks – EPI ranking and employ the following dummy variables to control for structural differences across industries: high carbon and capital intensive (Alves et al., 2023; Alves et al., 2022; Ehlers et al., 2022).

Banks closely supervise borrowers and can enforce contracts independently by utilising contractual covenants, giving them a comparative edge in reducing asymmetric information problems. We anticipate that whether the financial system is market-based or bank-based will affect loan pricing differently. According to Bae and Goyal (2009), Lin et al. (2011), and Qian and Strahan (2007), stronger creditor rights reduce loan spreads. Bankruptcy laws dictate the management of the insolvency process and establish the rights and priorities regarding a bankrupt firm's assets. Consequently, we expect that stronger creditor rights, as indicated by Djankov et al.'s (2007) creditor rights index, will decrease loan spreads.

We rely on the anti-director rights index (La Porta et al., 1998; Spamann, 2010) as a proxy for shareholder protection and anticipate that more robust laws regarding shareholder rights will increase loan spreads. Finally, we account for additional macroeconomic factors such as the term structure of interest rates, 5YrTB-3mTB, which is calculated as the difference between the 5-year and 3-month U.S. T-bill rates at the deal closing date, along with market volatility, assessed by the Chicago Board Options Exchange Volatility Index.

2.3. Financial characteristics of sustainable versus conventional PF loans

Table 3 describes the sample by loan typology and compares the values of each variable in the sustainable loan subsample with those in the conventional loan subsample, using the Wilcoxon rank-sum and Fisher's exact tests. Nearly every pairwise comparison reveals significant statistical differences among the common pricing variables associated with the two subsamples.

Table 4: Univariate statistics - pricing features associated with loans compared

Variable of interest	Conventional Loans	ESG loans	Sustainable loans: Green loans	Sustainable loans: Sustainability loans	Variable of interest	Conventional Loans	ESG loans	Sustainable loans: Green loans	Sustainable loans: Sustainability loans
Univariate analysis - continuous variables									
Credit spread (bps)					**Tranche size ($ Million)**				
Number	1 114	81	67	14	Number	1 114	81	67	14
Mean	323,72	175,72 ***	166,02 **	222,14	Mean	269,53	815,81 ***	802,87 ***	877,73
Median	210,00	175,00	175,00	250,00	Median	68,75	255,77	269,68	148,37
Tranche Rating [1-24 weak]					**Country risk [1-24 weak]**				
Number	41	3	2	1	Number	1 114	81	67	14
Mean	11	11	9	14	Mean	5,53	3,20 ***	3,00 ***	4,143
Median	11	10	9	14	Median	5,00	1,00	1,00	4,00
Vigeo ESG Rating					**Maturity (years)**				
Number	1 003	70	60	10	Number	1 114	81	67	14
Mean	72,30	74,29 ***	74,14 ***	75,24	Mean	9,67	6,53 ***	6,07 ***	8,70
Median	74,43	74,43	74,43	74,43	Median	7,00	5,00	5,00	6,83
Number of tranches					**Transaction size ($ Million)**				
Number	1 114	81	67	14	Number	1 114	81	67	14
Mean	2,51	3,04 ***	3,04 ***	3,00	Mean	595,28	1 463,60 ***	1 484,84 ***	1 361,91 ***
Median	2,00	3,00	3,00	4,00	Median	184,84	799,33	799,33	825,40
Number of banks					**Bank Reputation [1-25 weak]**				
Number	1 114	81	67	14	Number	1 114	81	67	14
Mean	5,27	9,79 ***	9,76 ***	9,93 ***	Mean	17,12	10,70 ***	10,42 ***	12,07
Median	3,00	9,00	9,00	9,00	Median	26,00	7,00	5,00	7,00
Creditor rights [0-4 strong]					**Enforcement**				
Number	1 002	74	62	12	Number	1 002	74	62	12
Mean	2,11	1,55 ***	1,48 ***	1,92	Mean	38,81	45,22 ***	45,31 ***	44,74 *
Median	1,00	1,00	1,00	2,00	Median	39,35	47,61	47,61	46,86
Anti director rights [0-6 strong]					**EPI**				
Number	1 002	74	62	12	Number	1 112	80	66	14
Mean	2,11	4,46 ***	4,56 ***	3,92	Mean	49,09	55,13 ***	55,06 ***	55,46
Median	1,00	5,00	5,00	4,00	Median	53,00	57,20	57,20	55,10
Univariate analysis - dummy variables									
Subordinated					**Rated**				
Nr. of tranches	1 114	81	67	14	Nr. of tranches	1 114	81	67	14
Nr. of tranches with d=1	4	0	0	0	Nr. of tranches with d=1	40	3	2	1
% of total	0,4%	0,0%	0,0%	0,0%	% of total	3,6%	3,7%	3,0%	7,1%
Currency risk					**Borrower Rated**				
Nr. of tranches	1 114	81	67	14	Nr. of tranches	1 114	81	67	14
Nr. of tranches with d=1	168	14	11	3	Nr. of tranches with d=1	39	1	0	1
% of total	15,1%	17,3%	16,4%	21,4%	% of total	3,5%	1,2%	0,0%	7,1%
Term loan					**Former lender**				
Nr. of tranches	1 114	81	67	14	Nr. of tranches	1 114	81	67	14
Nr. of tranches with d=1	684	43	33 **	10	Nr. of tranches with d=1	59	5	5	0
% of total	61,4%	53,1%	49,3%	71,4%	% of total	5,3%	6,2%	7,5%	0,0%
Experienced					**Switcher**				
Nr. of tranches	1 114	81	67	14	Nr. of tranches	1 114	81	67	14
Nr. of tranches with d=1	732 ***	64 ***	52 *	12	Nr. of tranches with d=1	0 ***	14 ***	14 ***	0
% of total	65,71%	79,01%	77,61%	85,71%	% of total	0,00%	17,28%	20,90%	0,00%
Domestic lead bank					**Fee information**				
Nr. of tranches	1 114	81	67	14	Nr. of tranches	1 114	81	67	14
Nr. of tranches with d=1	915 ***	56 ***	44 **	12	Nr. of tranches with d=1	1 091	81	67	14
% of total	82,14%	69,14%	65,67%	85,71%	% of total	97,9%	100,0%	100%	100%
Market based					**EP adopters**				
Nr. of tranches	1 002	74	62	12	Nr. of tranches	1 109	81	67	14
Nr. of tranches with d=1	610	48	44	4 *	Nr. of tranches with d=1	575 ***	77 ***	63 ***	14 ***
% of total	60,9%	64,9%	71,0%	33,3%	% of total	51,85%	95,06%	94,03%	100,00%

This table reports summary statistics for a sample of PF loans with spread, maturity, and tranche/transaction amount available, closed during the 2017-2024 period. Sustainable loans include sustainability-linked loans and green loans. Information on the characteristics of loan issuances and borrowing firms was obtained from Loan Analytics. We test for similar distributions for sustainable *versus* conventional loans using Wilcoxon's rank-sum test for continuous variables and Fisher's exact test for discrete ones. ***, **, and * indicate significant difference at the 1%, 5% and 10% levels, respectively. For a definition of variables, see Table 2.

Table 3 illustrates that the average spread of conventional loans (323.72 bps) is statistically higher than that of sustainable loans (175.72 bps). This holds true for maturities, as conventional loans mature, on average, in 9.67 years, and sustainable loans mature, on average, in 6.53 years. This is consistent with the literature suggesting that longer maturities imply higher spreads. The average credit rating is the same for conventional and sustainable loans (11 | BB+), but this variable is insignificant. Regarding transaction size, the average exhibited by conventional loan deals ($595.28 Million) is lower than that of sustainable loan deals ($1.463,6 Million). This holds true for tranche size, with an average tranche size of $259.53 Million for conventional and $815.81 Million for sustainable. These findings align with the higher transaction costs associated with structuring a sustainable deal compared to conventional ones, as borrowers must either hire an external review provider or develop internal expertise to evaluate and ensure the alignment with sustainable loan principles (Caramichael & Rapp, 2024). Sustainable loans, on average, have a higher number of tranches per deal (3 tranches) and a significantly larger number of participating banks (9.79 banks) than conventional loan deals, which average 2.5 tranches and 5.27 banks. These findings align with the idea that underwriting banks aim to raise the tranching level and the number of institutions involved in sustainable loan issuances of a specific size, thereby distributing risks among more banks. Results also indicate that sustainable loans are issued by more reputable banks than conventional loans. The average country-risk levels for conventional loans (5.53) are significantly higher than for sustainable loans (3.20), indicating that, in our sample, conventional loans are located in riskier countries. Sustainable loans are closed in countries with significantly better ESG scores than conventional ones. Finally, sustainable loans are issued in countries with significantly weaker credit rights and higher anti-directors rights index than conventional loans.

Table 3 results of dummy variables suggest that sustainable and conventional loans are different financial instruments. Sustainable loans are more likely to be closed by experienced borrowers (79.01% versus 65.71%) and switchers (17.3% versus 0.00%). A domestic lead bank (82.14%) arranges a higher fraction of conventional loans than sustainable loans (69.14%). Additionally, most sustainable loans (95.06%) in our sample are originated by EPFIs, compared to only 51.85% of conventional loans. Finally, loan subordination, currency risk, tranche rated, term loans, fee information, issuance by former lenders, or market-based characteristics do not significantly influence these two loan categories.

As the results show that common pricing characteristics vary significantly in value between sustainable and conventional loan tranches, we would expect the impact on pricing to be specific to each loan.

3. Methodology

3.1. Determinants of sustainable and conventional loan spreads

We started this analysis by investigating whether the spread and maturity of individual sustainable and conventional PF loans are influenced simultaneously when discussions about the financial package commence (Bharath et al., 2011). If so, an instrumental variable approach was followed. To analyse this scenario, the Durbin-Wu-Hausman chi-squared test was estimated, and the null hypothesis that maturity is exogenous to spread was accepted, as the chi-squared test statistic was 1.78 (p-value= 0.1826). Thus, an instrumental variable approach is employed in the robustness checks section, utilising the Two-Stage Least Squares (2SLS) regression technique with the following instruments for maturity: tranche size and whether the loan is tranched. We use the model described in equation (1). The dependent variable is the *spread* in basis points. In this section, we employ an OLS regression. Due to time-varying risk premia and as this analysis is conducted by tranches, we estimate standard errors clustered by year and deal, and estimate a regression of the following form:

$$\begin{aligned} Spread_{i,t} = {} & \alpha_0 + \beta_1 Sustainable_{i,t} + \beta_2 Maturity_{i,t} + \beta_3 \operatorname{Log} maturity \\ & + \beta_4 Tranche\ rating * Rated_{i,t} + \gamma\ Contractual\ controls_{i,t} \\ & + \delta\ Syndicate\ structure_{i,t} + \varphi\ Macroeconomic\ Controls_t + \varepsilon_{i,t} \end{aligned} \quad (1)$$

Where the subscripts refer to loan *i* at time *t*.

To determine whether the sustainable and conventional loan spreads are affected differently by common pricing characteristics, a Chow test is employed to assess for a structural break. The primary objective is to determine whether the pricing factors included in equation (1) are significant for both tranches, and if so, whether they have the same coefficient values. As the Chow test statistic is

6.70 (p-value = 0.0000), we reject the null hypothesis of no differences between the two types of loans. Thus, as the results obtained in section 2.3 are supported by the Chow test, we confirm that sustainable and conventional PF tranches are different financial instruments and are influenced differently by common pricing factors. Consequently, we corroborate H1 and proceed with analysing the determinants of spreads for each loan instrument separately.

To study the pricing of sustainable loans, we use equation (1) and estimate separate models for sustainable and conventional loans. Table 5 presents pricing regression results for a sample of 81 sustainable (Model [6]) and 1114 conventional loans (Model [8]).

Table 6: The pricing of PF loans - category breakdown

Dependent variable: Credit spread (bps)	[6] Conventional loans	[7] Conventional loans	[7a] Conventional loans	[8] Sustainable loans	[9] Sustainable loans	[9a] Sustainable loans
Maturity	12.25	13.91	17.63446 *	2.14	5.28	-1.62
	(0.140)	(0.212)	(0.062)	(0.753)	(0.637)	(0.901)
Log Maturity	-97.35	-117.38	-134.6622	27.33	-5.98	18.51
	(0.223)	(0.224)	(0.122)	(0.514)	(0.916)	(0.782)
Tranche rating *Rated	6.66	6.66	7.869054	3.67	6.20	10.08 **
	(0.251)	(0.293)	(0.190)	(0.388)	(0.138)	(0.054)
Contractual controls						
Log transaction size	-25.55 **	-31.60 **	-28.25695 **	6.59	-41.78 **	-60.74 ***
	(0.027)	(0.044)	(0.052)	(0.752)	(0.016)	(0.010)
Number of tranches	-19.71	-22.57	-14.80095	-27.04	-18.43 *	-21.01 *
	(0.158)	(0.151)	(0.251)	(0.115)	(0.078)	(0.061)
Currency risk	-38.53	-36.68	-73.94446	-2.05	-28.62	3238.60 ***
	(0.376)	(0.423)	(0.110)	(0.970)	(0.871)	(0.002)
Experienced	12.93	54.73	34.06228	37.81	-0.97	7.05
	(0.830)	(0.500)	(0.632)	(0.376)	(0.972)	(0.830)
Switcher				-50.50	20.89	51.38 *
				(0.182)	(0.391)	(0.057)
Subordinated	413.19 *	590.52 ***	454.04 **			
	(0.070)	(0.010)	(0.049)			
Fee information	-192.96 **	-235.25 ***	-236.28 ***			
	(0.020)	(0.003)	(0.001)			
Term loan	64.87 **	71.60 *	81.51 *	15.27	7.90	13.61
	(0.053)	(0.075)	(0.034)	(0.406)	(0.331)	(0.384)
Syndicate structure						
Former lender	-8.33	15.78	8.48	-80.63	-345.21 ***	-392.99 ***
	(0.888)	(0.818)	(0.890)	(0.227)	(0.000)	(0.000)
Number of banks	1.87	5.31 *	5.75 **	-3.96	3.57 *	4.75 *
	(0.484)	(0.080)	(0.044)	(0.129)	(0.075)	(0.078)
Domestic lead bank	14.40	-12.81	-4.90	-19.19	64.88 **	81.73 **
	(0.621)	(0.669)	(0.871)	(0.642)	(0.038)	(0.017)
Bank reputation	2.25 **	2.25	2.48	-2.14	2.72 **	2.91 **
	(0.051)	(0.155)	(0.120)	(0.290)	(0.051)	(0.053)
EP adopters		-36.63	-24.97		-67.18 ***	-81.83 ***
		(0.229)	(0.358)		(0.000)	(0.007)
Macroeconomic controls						
Country risk	7.73 **	-4.24	-9.74 *	10.67 *	56.91	-31.23
	(0.046)	(0.400)	(0.079)	(0.089)	(0.116)	(0.330)
Country ESG rating		-34.73 ***			33.21 **	
		(0.000)			(0.047)	
EPI			-18.23 ***			-62.96 ***
			(0.000)			(0.003)
Market-based		-8.05	90.63 **		203.56	2326.91 ***
		(0.897)	(0.021)		(0.418)	(0.000)
Creditor rights		20.74	28.39 *		29.46	-3253.50 ***
		(0.233)	(0.088)		(0.729)	(0.001)
Antidirector rights		7.14	4.68		84.47	1161.08 ***
		(0.583)	(0.689)		(0.131)	(0.000)
Volatility	3.18	-0.30	-0.48	6.28	-8.54 ***	-9.58 ***
	(0.318)	(0.930)	(0.879)	(0.151)	(0.004)	(0.005)
5yTB_3mTB	0.48	0.67 **	0.64 **	-0.51	-0.15	-0.07
	(0.103)	(0.037)	(0.046)	(0.133)	(0.417)	(0.738)
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1114	886	995	81	64	74
of which sustainable	0	0	0	81	64	74
of which conventional	1114	886	995	0	0	0
Adjusted R^2	11,06%	15,21%	15,17%	66,02%	77,93%	75,98%
Chow test	6.70			6.70		
p-value	0.0000			0.0000		

This table presents the results of OLS regressions on spreads (all-in pricing in bps) for PF loans with spread, maturity, and tranche amount available, closed during the 2017-2024 period. Sustainable loans include green and sustainability-linked loans. Information on the characteristics of loan issuances and borrowing firms was obtained from Loan Analytics. Models [6] and [8] reflect the full sample of conventional and sustainable loans, respectively, including only the pricing factors that do not reduce the number of observations. Models [7] and [7a] focus on the full sample of conventional but include additional key pricing factors that reduce the number of observations. Models[8] and [8a] focus on the full sample of sustainable loans but include additional key pricing factors that reduce the number of observations. Standard errors are clustered at the deal-year level. ***, ** and * indicate that the reported coefficients are significantly different from zero at the 1%, 5% and 10% levels, respectively. For a definition of the variables, see Table 2.

Contrary to our expectations, Models [6] and [8] demonstrate that maturity has an insignificant relationship with the spread for both conventional and sustainable loans, aligning with Alves et al.'s (2023) findings. Models [6] and [8] demonstrate that rated tranches and tranche credit ratings do not impact the spread of both loan types, contradicting Guedes and Pinto's (2023) findings of a positive and significant effect of credit ratings on PF loan spreads.

Transaction size significantly and negatively impacts the spread of conventional loans, suggesting that increasing the transaction size of a conventional deal by $100 million reduces the required spread by 25.55 bps in the Model [6]. These results may be explained by the fact that larger deal sizes benefit from economies of scale and reduced transaction costs (Sorge & Gadanecz, 2004). Contrarily, the transaction size does not impact the pricing of sustainable loans in the Model [8]. Contrary to Kleimeier and Megginson's (2000) findings that tranche loans can optimise financing costs by reducing information asymmetries, *the number of tranches* has an insignificant impact on spread for sustainable and conventional loans. As expected, *subordinated* tranches have higher spreads. Tranches with *fee information* have lower spreads for both types of loans. Regarding *term loans*, the impact on conventional loan spreads is significant and positive, while their influence on sustainable loan spreads is insignificant. Additionally, *currency risk, experienced, and switcher* variables do not significantly influence the spread of both loan categories.

Analysing the syndicate structure, we observe that relationship banking has an insignificant effect on both sustainable and conventional loan spreads. The

literature suggests that larger bank syndicates allow uncertainty and risk to be spread across a greater *number of banks*, thereby reducing loan spreads (Kleimeier & Megginson, 2000; Sorge & Gadanecz, 2004). However, the number of banks does not affect the spread for both loan categories in Models [6] and [8]. The involvement of a domestic *versus* a foreign bank in arranging the deal does not influence loan pricing for either loan category. Contrarily, bank reputation is an insignificant pricing factor for sustainable loan spreads. For conventional loan spreads, we verify a significant and positive impact. This aligns with the fact that more reputable banks offer better guarantees that transactions will succeed and also have more capacity to hold these loans on their balance sheets, enabling them to demand larger spreads for the loans they extend to borrowers.

Regarding macroeconomic factors, we find that borrowers in riskier countries pay higher spreads for both types of loans. The yield curve slope and market volatility do not affect the spread for either loan.

We re-estimate the previous models in Models [7] for conventional loans and [9] for sustainable loans, incorporating key pricing factors that were omitted from equation (1) to preserve the number of observations. Additionally, to test the robustness of these models, we re-estimate them, in [7a] for conventional loans and [9a] for sustainable loans, by replacing the country ESG rating with the EPI index. Therefore, Table 5 also presents the results for these two samples: 64 sustainable loans and 886 conventional loans, and 74 sustainable loans and 995 conventional loans, respectively.

In Models [7] and [9], deal size significantly and negatively impacts the spread for both loan categories. The number of banks also gains importance in these models, but contrary to what we expected, a larger number of banks in the syndicate increases the spread of both PF loans. Whether a domestic or foreign bank arranges the deal positively and significantly impacts sustainable loan spreads. Relationship banking significantly reduces the spread for sustainable loans in the Model [9]. As expected, loans issued by EPFI have significantly lower spreads for

sustainable loans. For conditional loans, the effect on the spread is insignificant. These models also capture the effect of additional macroeconomic variables. Country ESG rating, proxied by Vigeo's country ESG rating at closing, has a significant and negative impact on the spread of conventional loans. Contrary to what we expect, it impacts positively the spread of sustainable loans. Variables that capture legal and institutional characteristics do not influence the pricing of either loan category. Consequently, our findings challenge the emphasis placed on the importance of institutional and legal factors in determining sustainable loan spreads. Market volatility significantly and negatively affects sustainable loan spreads.

In Models [7a] and [9a], the following variables gain significance for sustainable loans: tranches credit rating has a positive impact on the spread; a higher number of tranches reduces spreads; the presence of different currencies has a positive impact on spread. All the results are consistent with the literature. For conventional loans, maturity positively and significantly impacts spread, which aligns with Guedes and Pinto's (2023) findings. As expected, the EPI index negatively and significantly impacts both sustainable and conventional loan spreads. Conventional and sustainable loans extended to borrowers in market-based financial systems have higher spreads, holding other factors constant, than those extended to borrowers in bank-oriented countries. The influence of the creditor rights index on spread is positive for conventional loans and negative for sustainable ones. The anti-director rights index, which is a proxy for equity investor protection, has an insignificant impact on spread for conventional and a positive and significant influence on sustainable loan spreads.

Overall, our results align with H1, indicating that common pricing factors affect sustainable and conventional loan tranches differently.

3.2. Pricing of sustainable vis-à-vis conventional loans

In the previous section, we find that sustainable and conventional loans are different financial instruments and are affected differently by common pricing factors. Therefore, to analyse the differences between the spreads of these two loan types, we start by comparing the spreads among the securities. As we have a small number of each subcategory of sustainable loans, we only analyse the spread of sustainable loans in general.

Models [1] and [1a] of Table 4 show that, for the samples discussed in section 2.3., sustainable loan spreads have no significant differences from those of conventional loans. Considering that important pricing factors were not included in equation (1), as they reduce the number of observations, we re-estimate the previous model in Models [2] and [2a] by incorporating these pricing factors, and the results remain the same. In Model [2b], we re-estimate Model [2a] by replacing the country ESG rating variable with the EPI index, and the coefficient on the *sustainable* variable remains insignificant. Similar results are obtained in Models [3] and [4] when re-estimating Model [1], including loans extended to borrowers in capital-intensive industries (Model [3]) or high-carbon industries (Model [4]) only. As only 3.68% of the loans in our sample have a credit rating, we do not re-estimate the previous models focusing solely on rated loans. Since sustainable loans account for approximately 6.78% of our total sample, we re-estimated Model [1] for a matched sample, as suggested by Roberts and Whited (2013). We proceed as follows. As we have a small number of sustainable PF loans, we match each sustainable loan to the most comparable conventional loan from the same year by using a handmade matched approach. Before starting the analysis, as we seek the most comparable conventional loan in terms of rating, tranche size, and maturity, we standardise the values of these variables for each sustainable and conventional loan in our sample. Then, we compute the Euclidean Distance be-

tween each conventional and sustainable loan, and finish by selecting conventional loans with the minimum distance. If the same conventional tranche has a minimum distance to more than one sustainable tranche, we assign it to the sustainable tranche with the lowest distance. For the remaining sustainable tranches, we select the conventional tranche with the following smallest distance, and so on. Upon completing this procedure, we obtained a sample of 81 sustainable loans and a quasi-identical loan-level matched sample of 81 conventional loans. As only six firms in our sample have issued sustainable and conventional loans, we could not include this parameter in the comparison.

Table 8: The pricing of PF loans

Dependent variable:	[1]	[1a]	[2]	[2a]	[2b]	[3]	[4]	[5]
Credit spread (bps)	All Loans	All Loans	All Loans	All Loans	All Loans	Capital Intensive	High Carbon Industires	All loans | Matched sample
Independent variables:								
Core variables								
Sustainable	4.58	8.66	3.38	33.28	17.77	40.51	14.14	-9.53
	(0.862)	(0.804)	(0.912)	(0.453)	(0.662)	(0.760)	(0.767)	(0.780)
Maturity	16.58 **	12.88	13.92	13.33	17.03 *	27.54	15.03 *	16.58 ***
	(0.039)	(0.108)	(0.199)	(0.219)	(0.065)	(0.158)	(0.087)	(0.000)
Log Maturity	-110.89	-97.94	-109.92	-110.85	-128.40	-347.73 *	-116.14	-39.23
	(0.159)	(0.205)	(0.244)	(0.233)	(0.128)	(0.099)	(0.182)	(0.262)
Tranche rating *Rated	5.39	5.30	6.49	7.12	7.57	27.73 ***	2.74	-5.52
	(0.326)	(0.339)	(0.205)	(0.224)	(0.175)	(0.013)	(0.694)	(0.577)
Contractual controls								
Log transaction size	-31.71 ***	-23.47 **	-30.60 **	-31.18 **	-28.03 **	-62.82 **	-24.26 *	-26.14
	(0.001)	(0.028)	(0.027)	(0.037)	(0.039)	(0.031)	(0.057)	(0.193)
Number of tranches	-28.91 **	-19.64	-27.80 *	-20.33	-13.29	-46.36	-21.52	-17.74
	(0.036)	(0.141)	(0.080)	(0.161)	(0.268)	(0.439)	(0.135)	(0.127)
Currency risk	-38.33	-38.68	-55.71	-51.60	-79.22 *	-94.67	-44.61	-1.32
	(0.374)	(0.355)	(0.215)	(0.254)	(0.077)	(0.385)	(0.366)	(0.975)
Experienced	40.54	20.92	54.43	54.64	37.81	202.99	35.69	66.85 *
	(0.519)	(0.720)	(0.485)	(0.475)	(0.580)	(0.306)	(0.605)	(0.096)
Switcher	-45.30	-69.97	-50.32	-63.35	-32.95	332.59	-49.22	19.46
	(0.401)	(0.332)	(0.309)	(0.366)	(0.644)	(0.363)	(0.592)	(0.682)
Subordinated	389.47 *	407.93 *	545.00 **	595.69 ***	449.17 **	309.41 *	601.96 ***	
	(0.099)	(0.071)	(0.018)	(0.009)	(0.049)	(0.074)	(0.005)	
Fee information	-168.99 **	-198.60 **	-216.70 ***	-224.77 ***	-228.47 ***	-411.88 ***	-64.80	-202.54
	(0.054)	(0.017)	(0.002)	(0.002)	(0.001)	(0.005)	(0.360)	(0.332)
Term loan	91.05 ***	63.81 **	74.08 **	67.98 *	77.76 **	304.59 **	80.82 **	21.97
	(0.013)	(0.042)	(0.044)	(0.064)	(0.027)	(0.029)	(0.045)	(0.239)
Syndicate structure								
Former lender	-36.26	-19.67	24.56	12.75	12.57	94.23	-17.79	-187.24 ***
	(0.518)	(0.724)	(0.675)	(0.844)	(0.828)	(0.395)	(0.777)	(0.008)
Number of banks	3.10	1.61	4.97 *	4.33	4.44 *	-1.82	-0.02	2.17
	(0.194)	(0.494)	(0.084)	(0.117)	(0.097)	(0.774)	(0.996)	(0.554)
Domestic lead bank	39.49	6.52	-6.27	-4.70	-0.34	26.39	12.69	-17.15
	(0.165)	(0.805)	(0.798)	(0.865)	(0.990)	(0.772)	(0.670)	(0.583)
Bank reputation	2.70 ***	2.16 **	1.73	2.18	2.07	1.45	0.65	0.24
	(0.007)	(0.051)	(0.173)	(0.156)	(0.180)	(0.635)	(0.596)	(0.916)
EP adopters			-73.40 ***	-35.35	-24.96			
			(0.011)	(0.229)	(0.341)			
Macroeconomic controls								
Country risk	10.62 ***	8.36 **	-3.56	-3.55	-7.47	4.65	10.39 **	6.09
	(0.014)	(0.024)	(0.397)	(0.459)	(0.152)	(0.613)	(0.016)	(0.248)
Country ESG rating			-16.21 ***	-31.65 ***				
			(0.000)	(0.000)				
EPI					-16.12 ***			
			(0.495)		(0.000)			
Market-based			-29.89	-8.29	75.57 *			
			(0.495)	(0.883)	(0.058)			
Creditor rights			28.51 ***	17.34	28.57 *			
			(0.009)	(0.299)	(0.085)			
Antidirector rights			0.18	6.58	6.44			
			(0.987)	(0.598)	(0.587)			
Volatility	-5.81 ***	2.79	-2.60	0.24	0.44	3.84	2.99	-2.89
	(0.001)	(0.347)	(0.193)	(0.938)	(0.882)	(0.652)	(0.362)	(0.525)
5yTB_3mTB	0.13	0.45 *	0.04	0.57	0.56 **	0.82	0.47	-0.25
	(0.244)	(0.092)	(0.815)	(0.388)	(0.048)	(0.232)	(0.153)	(0.302)
Region fixed effects	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Number of observations	1 195	1 195	950	950	950	410	990	162
of whichsustainable	81	81	64	64	64	21	48	81
of which conventional	1 114	1 114	886	886	886	389	942	81
Adjusted R^2	8,41%	11,22%	12,87%	15,47%	15,48%	13,32%	11,58%	31,10%

This table presents the results of OLS regressions on spreads (all-in pricing in bps) for PF loans with spread, maturity, and tranche amount available, closed during the 2017-2024 period. Sustainable loans include green and sustainability-linked loans. Information on the characteristics of loan issuances and borrowing firms was obtained from Loan Analytics. Models [1] and [1a] reflect the full sample, including only the pricing factors that do not reduce the number of observations. Models [2], [2a] and [2b] focus on the full sample, including additional key pricing factors that reduce the number of observations. Models [3] and [4] focus on a subsample of firms in capital intensive and high carbon industries, respectively. Model [5] is estimated for a subsample of sustainable loans and a matched sample (control group) of conventional loans. To create a matched sample of conventional loans, we follow a handmade matching approach (loan-level), by matching the most identical conventional loan closed in the same year to each sustainable loan with the following characteristics: loan rating, size, and maturity. Standard errors are clustered at the deal-year level. ***, ** and * indicate that the reported coefficients are significantly different from zero at the 1%, 5% and 10% levels, respectively. For a definition of the variables, see Table 2.

Model [5] results are consistent with earlier findings, indicating that there is no significant difference in the spread of sustainable and matched conventional loans. These results align with the findings of Alves et al. (2023). Conversely, they contradict the arguments presented in the theoretical literature on sustainable finance (Pástor et al., 2021; Pedersen et al., 2021; Schmittmann & Gao, 2022)and stakeholder theory (Freeman et al., 2010).

Hence, our findings do not support H2: banks do not seem to be offering sustainable PF loans to mitigate monitoring and asymmetric information costs or provide favourable financial terms to borrowers with high ESG performance in anticipation of potential lower risks (Aleszczyk et al., 2022; Houston & Shan, 2022; Ioannou & Serafeim, 2019)

Two major factors can explain our results. First, uncertainty and asymmetric information complicate pricing. Information on loan contracts, particularly for tranches with detailed information on the spread, is still very limited. In the PF loan market, information asymmetry arises because project implementation teams have more information than lenders regarding the project itself. They selectively disclose details that do not increase their cost of funds, making it difficult for lenders to determine the real impact of projects (Dua, 2022). Secondly, challenges arise in effectively integrating relevant information into pricing due

to inconsistent methodologies, non-standardized metrics, and a lack of comparable disclosures (Eren et al., 2022). With the recent emergence of sustainability-linked, green, and social loan financing, market participants might be trying to determine the most effective contractual provisions and the optimal method for calculating the expected loss of a specific sustainable loan. As the volume of information available in the market grows and lenders become increasingly sophisticated, borrowers' improved sustainability performance could result in a greenium within the PF loan market.

4. Robustness checks

To ensure that our results do not suffer from endogeneity, we employ 2SLS regression techniques and use the tranche size and whether the loan is tranched as instruments for maturity. We did so for two reasons. First, the tranche size and if the loan is tranched are correlated with maturity. Larger tranches may suggest shorter maturities, as they represent a larger portion of lenders' loan portfolios. Berger et al. (2005) prove that the choice of debt maturity is directly linked to the level of asymmetric information, demonstrating that firms with a higher level of asymmetric information typically have shorter maturities. Literature regarding the loan market suggests that structuring debt into tranches allowed risk to be allocated to the parties best placed to manage them, mitigating asymmetric information and market incompleteness problems (Cumming et al., 2020; Esty & Megginson, 2023). Therefore, tranched loans may positively affect maturity as they reduce the deadweight costs of asymmetric information. Secondly, as far as we know, the tranche size and whether the loan is divided into tranches do not relate to unobserved factors affecting the spread. We have accounted for all other variables that may influence how tranche size and the number of tranches per deal affect spreads. In particular, if the loan is tranched, it affects loan spreads through credit rating and the number of tranches variables - in syndicated deals, loans are structured by creating different tranches with different risk-return profiles and, therefore, different spreads. The same goes for the tranche size, which influences the spread via transaction size - larger tranches lead to a larger deal size - and the number of banks - the larger the number of banks involved in the banking syndicate, the larger the number of tranches the deal will have so that all the bank lenders share the total volume of the operation. Furthermore, credit rating, number of tranches, transaction size, and number of banks are included as controls in our estimation equation. Section 3.1., we demonstrate that maturity is exogenous to spread. To assess the relevance of our instruments, we perform

Anderson's LR test, which examines the null hypothesis that the correlations between the instruments and the endogenous variable are fundamentally zero. We reject the null hypothesis for the models in Table 6, indicating a stronger correlation between the instruments and maturity. Since our OLS regressions estimate standard errors clustered by year and deal, we apply the same approach in the 2SLS regression to ensure comparability. However, after conducting 2SLS estimation with cluster-robust standard errors, Stata does not compute Hansen's J-statistic for overidentification restrictions. As a result, we can only confirm that our instruments are relevant. The details of these tests and their results are presented at the bottom of Table 6. Finally, the 2SLS regression results reinforce the conclusions drawn from the OLS regression, indicating significant differences between the spread of sustainable and conventional PF loans. Overall, our results remain qualitatively the same.

Table 10: Robustness Check -The pricing of PF loans

Dependent variable: Credit spread (bps)	[13] All Loans	[14] All Loans
Core variables		
Sustainable	81.70	17.93
	(0.268)	(0.764)
Maturity	75.32 ***	-3.56
	(0.138)	(0.943)
Log Maturity	-476.10	-20.10
	(0.124)	(0.939)
Tranche rating *rated	9.44	6.00
	(0.174)	(0.339)
Contractual controls		
Log transaction size	-51.36 ***	-25.64 **
	(0.051)	(0.215)
Number of tranches	-43.06	-16.26
	(0.074)	(0.221)
Currency risk	-62.70	-53.96
	(0.246)	(0.258)
Experienced	115.99	39.42
	(0.241)	(0.514)
Switcher	-10.62	-71.15
	(0.874)	(0.258)
Subordinated	436.25	578.05 ***
	(0.043)	(0.010)
Fee information	-205.05	-226.53 *
	(0.035)	(0.001)
Term loan	55.52 *	71.76
	(0.104)	(0.090)

Syndicate structure		
Former lender	-130.14	42.95
	(0.225)	(0.708)
Number of banks	3.21	3.66
	(0.401)	(0.260)
Domestic lead bank	-23.83	-3.08
	(0.581)	(0.914)
Bank reputation	-1.07	2.76
	(0.7923)	(0.285)
EP adopters		-46.14
		(0.273)
Macroeconomic controls		
Country risk	11.24 **	-1.63
	(0.036)	(0.798)
Country ESG rating		-31.47 **
		(0.000)
Market-based		9.43
		(0.878)
Creditor rights		14.31
		(0.432)
Antidirector rights		8.06
		(0.576)
Volatility	-0.29	1.24
	(0.948)	(0.790)
5vTB 3mTB	0.65 *	0.49 **
	(0.060)	(0.116)
Region fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Number of observations	1 195	950
of which sustainable	81	64
of which conventional	1 114	886
Adjusted R2	.	14,65%
Anderson's LR statistic	20.12	12.20
p-value	(0.0000)	(0.0000)
Hansen's J-statistic	.	.
p-value	.	.
Durbin-Wu-Hausman chi-squared	1.78	0.11
p-value	(0.1826)	(0.7385)

This table presents the results of 2SLS regressions on spreads (all-in pricing in bps) for PF loans with spread, maturity and tranche amount available, closed during the 2017-2024 period. Sustainable loans include green and sustainability-linked loans. Information on the characteristics of loan issuances and borrowing firms was obtained from Loan Analytics. Model [13] reflects the full sample, including only the pricing factors that do not reduce the number of observations. Model [14] reflects the full sample, including key pricing factors that reduce the number of observations. We conduct Anderson's LR test to evaluate the null hypothesis that our instruments – if the loan is tranched and the tranche size – and endogenous variables are not correlated. Stata does not compute Hansen's J-statistic for overidentification restriction after conducting 2SLS estimation with cluster-robust standard errors. For each independent variable, the first row reports the estimated coefficient, and the second row reports the p-value. Standard errors are clustered at the deal-year level. ***, ** and * indicate that the reported coefficients are significantly different from zero at the 1%, 5% and 10% levels, respectively. For a definition of the variables, see Table 2.

Conclusion

This work aims to analyse the pricing of sustainable loans for PF purposes, which has grown exponentially over the past years. To do so, we compare the spreads and pricing of sustainable loans with conventional loans using a cross-section of PF loans closed during the 2017-2024 period. Since this is a highly specific and emerging market, we extend the observation period to its maximum range, starting from the year the first sustainable PF loan was issued and ending in the last year for which all necessary information is available. This approach ensures the most comprehensive analysis possible. We also investigate whether matched sustainable and traditional loans exhibit significant spread differences.

Our findings reveal that common pricing characteristics influence sustainable and conventional loans differently. Sustainable loan spreads are primarily affected by (i) credit rating, deal size, number of tranches currency risk and switcher firms, at a contractual level; (ii) the relationship banking, the number of participating banks, if the arrangement is made by a domestic versus a foreign bank, the lead bank's reputation and if at least one of the backs in the syndicate is an EPFI, at the syndicate structure level; and (iii) country risk, country ESG rating, market-based, creditor rights, anti-director rights, and market volatility, at the macroeconomic level. In contrast, some contractual characteristics that influence conventional loan spreads - such as maturity, subordinated loans, fee information, term loan and yield curve slope - do not impact sustainable loan spreads. These findings are valuable for banks to more effectively adjust pricing models for a recent and increasingly significant product category.

Our results demonstrate that the spreads of sustainable PF loans do not differ significantly from those of comparable conventional PF loans. These findings hold across all models and robustness checks. This is a relevant issue for governments and policymakers, as the higher transaction costs associated with sustainable loans—without corresponding reductions in spreads—could discourage

companies from adopting such financing options, which are vital during the transition to a sustainable economy.

The main limitation of this study is the quality of the data available and the small size of this market. Inadequate historical data, inconsistent methodologies - such as the significant ESG rating divergence documented by Berg et al. (2022) - and a lack of standardised metrics and comparable disclosures (Eren et al., 2022) increase uncertainty and asymmetric information, complicating loan pricing. Sustainable PF loans are a relatively new financial instrument, and the number of loans with data on critical pricing factors such as spreads, maturities, and tranche classifications are limited. This problem may lead to biased conclusions and prevent a detailed analysis of each sub-category of loans. Future research could complement this study by including the same analysis for PF bonds.

As PF deals are typically funded through multiple tranches, the spread of each tranche does not represent the full economic cost of the loan. For further research, we also suggest testing this issue by aggregating tranches at the deal level and computing the weighted average spread (WAS) as the weighted average of the loan spread and its corresponding weight in the deal size.

Investing in efficient institutions and well-designed police forces is essential to prevent infrastructure investment from going down an unsustainable path (United Nations Environment Programme, 2022). Initial efforts to integrate ESG considerations into infrastructure investment began with the 2015 Paris Agreement. While the Green Loan Principles, Social Loan Principles, and Sustainability Loan Principles have been established to provide best practice guidelines for the green, social, and sustainability loan markets, risks of “greenwashing”, “social washing”, and “sustainability washing” remain. Recent regulatory developments, such as the EU's Taxonomy Regulation (Regulation (EU) 2020/852), the EP framework, and the Securities and Exchange Commission’s (SEC) efforts to

standardise ESG product labelling and disclosures, may help mitigate asymmetric information costs and improve security design. These issues are also suggested areas for future research.

Declaration

I hereby declare on my honour that I have prepared my written work/thesis, "The Pricing of Sustainable Project Finance Loans", with complete honesty and free from any fraudulent practices, namely copying or plagiarism.

I also declare that I am aware that committing fraud during written assessments constitutes a serious violation of the rules of ethics and academic conduct in force at the Universidade Católica Portuguesa, resulting in disciplinary action, as outlined in the Code of Ethics and Conduct of this University – paragraph b, nr. 3 of article 8 and nr. 3 of article 12.

Full name: Inês Martins Almeida

Student number: 355123017

Date: 19/03/2025

Signature: Inês Almeida

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of my written work/thesis, "The Pricing of Sustainable Project Finance Loans", Grammarly, DeepL Write, ChatGPT and Mendeley were used for the following tasks: syntax correction and writing improvement, correction of errors in Stata codes and assistance with writing the acknowledgements, and automatic bibliography and authors' citations, with the prompts used listed at the end of the document in the Prompts List section. After using these tools/services, I reviewed and edited the content as necessary, and I take full responsibility for the content of the work presented.

I also declare that I am aware of and respect the Artificial Intelligence Rules of Conduct of Católica Porto Business School.

Full name: Inês Martins Almeida

Student number: 355123017

Date: 19/03/2025

Signature: Inês Almeida

Prompt List

1. Could you provide some background information about Project finance and sustainable project finance instruments?
2. In my thesis, I aim to compare the influence of the pricing factor on the spread of sustainable and conventional PF loans. To achieve this, I aim to determine whether pricing factors affect sustainable and conventional loans differently, with the spread being the dependent variable. Additionally, I want to analyse whether there is a greenium in this market - if the spread of sustainable PF loans is lower than the spread of conventional PF.
    2.1. Having that information in mind, which are the most suitable regression models to analyse the main drivers of sustainable and conventional loan spreads? And to analyse the existence of greenium?
3. Is an OLS regression the best option for conducting my analysis, since maturity is exogenous to the spread in my sample? Could you please list some alternatives and illustrate the pros and cons?
4. To test my hypothesis, which variables are the most important to include in an OLS regression?
5. Could you please analyse the following Stata code and explain how I can adapt it to my own model and sample?
6. Can you correct the following errors in Stata Code?

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