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Are sustainability-linked loans designed to effectively incentivize corporate sustainability? A framework for review

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Abstract

This paper analyzes sustainability-linked loans (SLLs), a new category of debt instrument that incorporates environmental, social, and governance (ESG) considerations. Using a large sample of loans issued between 2017 and 2022, we assess the design of SLLs by evaluating their key performance indicators (KPIs) using a comprehensive quality score. Our findings suggest that SLLs only partially rely on KPIs that generate credible sustainability incentives. We document that SLL borrowers do not significantly improve their ESG performance post issuance and show that stock markets are rather indifferent to the issuance of SLLs by EU borrowers, while SLL issuance announcements by US borrowers are met with significantly negative abnormal returns by investors. These findings call into question the beneficial sustainability and signaling effects that borrowers may hope to achieve by issuing ESG-linked debt.

KEYWORDS
ESG-linked loans, sustainability KPIs, sustainability-linked loans

1 | INTRODUCTION

A recent development in the realm of corporate finance is the emergence of debt instruments that incorporate environmental, social, and governance (ESG) considerations. These instruments serve two primary purposes: procuring capital and fostering corporate sustainability practices. One category of such instruments, sustainability-linked loans (SLLs),[1] is particularly distinct from other emerging instruments such as green bonds, social bonds, and green loans. Unlike these instruments, whose proceeds have to be allocated toward environmentally or socially responsible projects, SLLs are general corporate purpose loans. The issuance of SLLs is therefore not characterized by their use of proceeds, but by the borrower's performance against predefined ESG targets.

Achievement of these targets is measured by key performance indicators (KPIs), which typically impact loan pricing in the form of an interest rate discount or premium. The Loan Market Association (LMA), which published the Sustainability-Linked Loan Principles (SLLP) as a set of voluntary guidelines for market practitioners, defines SLLs as "any types of loan instruments and/or contingent facilities for which the economic characteristics can vary depending on whether the borrower achieves ambitious, material and quantifiable pre-determined sustainability performance objectives" (Loan Market Association, 2023b, p. 2). The primary objective of SLLs is therefore to support the borrower's efforts to improve its sustainability profile over the life of the loan (Loan Market Association, 2023b).

While SLLs have gained increasing popularity, accounting for approximately 10% of the global corporate syndicated loan market in 2021 (Kim et al., 2023), there is still limited understanding of the specific characteristics of the sustainability KPIs that are included in these contracts. This aspect is particularly relevant when considering that SLLs can be tied to multiple KPIs covering a wide range of ESG issues. At a time when there is growing concern about greenwashing practices (Carrizosa & Ghosh, 2022; Kim et al., 2023), it is critical to gain more clarity on whether—and if so, which—KPIs are credible and meaningful for achieving sustainability goals.

This is where our paper seek to contribute. By providing a detailed analysis of KPI characteristics, we aim to further the discussion on the effectiveness of SLLs in promoting ESG activities beyond "business as usual" (Loan Market Association, 2023a, p. 3). Specifically, we evaluate the design of KPIs in ESG-linked loan contracts along six key dimensions derived from the SLLP. We then use this evaluation as a basis for investigating whether the issuance of SLLs positively incentivizes borrowers to improve their sustainability performance ex post. In addition, we examine whether SLLs are perceived by the stock market as credible signals of corporate commitment to ESG considerations.

Our study is based on a sample of SLLs extracted from the Refinitiv DealScan database. We focus on borrowers headquartered in the European Union and the United States for both historical and regulatory reasons. From a historical perspective, the emergence of SLLs, which were virtually nonexistent prior to 2017, saw a rapid increase in total issuance volume, rising from over $2 billion in 2017 to more than $310 billion by the end of 2021.[2] This growth trend was particularly pronounced in Western Europe in the early years and later spread to other regions of the world, most notably the United States (Kim et al., 2023). While current regulations do not specifically require companies to report comprehensive information about their credit agreements, the existing regulatory frameworks in both the EU and the United States still create important incentives for disclosure. In the EU, for example, large companies are required to disclose environmental and social policies in their nonfinancial statements. Large US corporations proceed similarly. Such disclosures allow us to obtain detailed information about the issuance of SLLs and the KPIs set forth in those contracts.

In the first part of this paper, we examine whether the design of KPIs creates credible incentives for companies to improve their sustainability practices. We address this question by developing a qualitative scoring methodology along six key dimensions: (1) strategic relevance, (2) materiality, (3) measurability, (4) benchmarking, (5) pricing mechanism, and (6) external review. These dimensions serve as a framework that outlines distinct criteria that, according to the

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[1] SLLs are also sometimes called "ESG-linked loans." We use the terms interchangeably throughout this paper.

[2] Kim et al. (2023) capture a similar trend by documenting a rapid increase in ESG lending activity from 2017 to 2021, with most of the SLL borrowers concentrated in the United States and Western European countries.

LMA, SLLs should meet in order to be considered credible (Loan Market Association, 2023b). Our analysis delivers a multidimensional KPI score per loan that can be used to assess and compare the quality of the incentives defined in the SLLs. As each dimension captures unique information that contributes to a comprehensive understanding of the KPIs' credibility, our approach is consistent with the recommendations of Edmans (2023), who calls for granular assessments in ESG-related studies.

The results of our KPI analysis suggest that SLLs only partially rely on KPIs that create credible sustainability incentives. In particular, our results show significant variation across the dimensions assessed in our framework. On the positive side, we find that most SLLs include KPIs that are strategically relevant and part of the borrowers' existing sustainability strategies: Only 22% of SLLs feature KPIs that do not match the borrowers' stated sustainability objectives or priorities. This suggests that firms employ SLLs as a holistic approach to further integrate existing ESG considerations into corporate operations. In addition, we observe that the vast majority of SLLs are tied to measurable and objectively quantifiable KPIs that allow lenders to easily track performance against the selected KPIs.

However, on the negative side, our materiality assessment against the Sustainability Accounting Standards Board (SASB) standards shows that 42% of the SLLs in our sample are linked to KPIs that are not financially material. This indicates a misalignment between the sustainability goals that the SLLs seek to achieve and the sustainability considerations that are most likely to impact the company's financial performance. In addition, only 15% of the SLLs in our sample are clearly benchmarked, suggesting a lack of reference points for setting the KPIs. As a result, key stakeholders, including investors, may not be able to objectively assess and compare the level of ambition of the KPIs. Our analysis furthermore reveals mixed results with respect to the pricing mechanism and external review of the KPIs. While 40% of the SLLs in our sample explicitly include a malus system that requires borrowers to pay higher interest rates if they fail to meet their sustainability targets, we find that 17% include only a bonus and no financial penalty. In addition, only half of the SLLs in our sample are linked to KPIs that are subject to external and independent verification at least annually.

Overall, the SLLs in our sample achieve an average KPI score of 3.47 on a scale of 0 to 6, suggesting that these debt instruments are only partially designed to incentivize sustainability efforts by their borrowers. Surprisingly, we observe that the number of KPIs that are included in a loan is negatively associated with this score. While companies may fear that focusing on only a small number of ESG objectives could signal a weaker commitment to sustainability, increasing the number of KPIs actually seems to make such instruments less effective in improving sustainability incentives.

In the second part of our paper, we empirically test whether the issuance of SLLs is associated with a positive ex post change in borrowers' ESG performance. To do so, we employ a difference-in-differences design based on a matched sample. To identify the relationship between SLL issuance and ex post ESG performance, we use a two-way fixed effects (TWFE) estimator that compares SLL issuers to a control group of conventional borrowers before and after the treated firms issued their first SLL. Our analysis relies on several ESG performance metrics obtained from Morgan Stanley Capital International (MSCI), including the overall industry-adjusted total ESG scores and environmental, social, and climate change pillar scores. We primarily examine these performance metrics to account for the fact that most KPIs in ESG-linked loan contracts relate to environmental and social issues (58% and 25% of all KPIs in our sample, respectively), while governance-related KPIs make up only 1.35% of our sample. In addition, about 17% of the KPIs in our sample are linked to ESG ratings or similar certifications.

Our results show that the issuance of SLLs is not associated with a significant change in the ex post ESG performance of the borrowers. In other words, we observe neither an improvement nor a deterioration in ESG performance. This holds also when looking at the overall ESG score and the scores of each pillar separately. We repeat our analysis by measuring the weighted group time average treatment effect on the treated (ATT), as proposed by Callaway and Sant'Anna (2021). This procedure allows us to address concerns about the reliability of the TWFE estimator in ordinary least squares (OLS) (Baker et al., 2022; de Chaisemartin & D'Haultfœuille, 2020). Once again, the ATT coefficients are statistically insignificant, confirming our earlier findings and suggesting that SLLs are not associated with a subsequent change in ESG performance. Overall, these results indicate that the issuance of SLLs

primarily maintains the current level of ESG performance rather than leading to significant improvements in subsequent years.

In the final part of our paper, we conduct an event study to determine whether equity investors perceive SLLs as credible signals of corporate commitment to sustainability and, therefore, whether the issuance of such loans is associated with positive stock market reactions. Previous research shows that investors react particularly strongly to the release of environmental and community news (Krüger, 2015). In addition, Flammer (2021) finds that stock market investors respond positively to the issuance of green bonds when such instruments are subject to third-party verification and when the use of proceeds is financially material to the company's operations. Thus, we use variation in KPI quality, as measured by our KPI score, to examine stock market reactions to SLL issuance announcements in relation to specific KPI characteristics, such as materiality and external verification. This approach allows us to gain further insights into the perceived credibility of SLLs.

We find that stock markets are rather indifferent to the issuance of SLLs by EU borrowers. In contrast, investors react cautiously to SLL issuance announcements by US borrowers, especially when such loans include environmental KPIs. More precisely, we document a significant negative market reaction with an average cumulative abnormal return of −0.49% in the event window symmetrically surrounding the announcement date of issuance. In a further analysis, we also find a negative association between a higher number of KPIs and the market response to loan issuance announcement. There are several possible interpretations for these results. For example, the results may reflect growing skepticism, particularly in the United States, about the value of integrating ESG factors into investment decisions (see, e.g., Edmans, 2023). In addition, as the selected KPIs in SLLs often fail to address financially material issues, assessing the potential financial benefits of SLLs may be challenging. Finally, investors may also be wary of possible greenwashing practices, which have become increasingly common in recent years (Kim et al., 2023).

Our study builds on and complements the work of other scholars, including Kim et al. (2023), Carrizosa and Ghosh (2022), Du et al. (2023), Caskey and Chang (2022), Loumioti and Serafeim (2022), and Dursun-de Neef et al. (2023). Collectively, our findings make important contributions to the rapidly growing literature on SLLs. In particular, our paper adds to recent studies that explore the selection and design of sustainability KPIs in ESG-linked loan contracts. Loumioti and Serafeim (2022) investigate KPI materiality and report that most SLLs fail to focus on material ESG features and do not address borrowers' relevant ESG risks. Carrizosa and Ghosh (2022) examine the presence of an external KPI auditor and find that the likelihood of KPIs being monitored and audited is positively associated with the ESG expertise of the lead arranger and the number of KPIs. Kim et al. (2023) and Du et al. (2023) report that SLL borrowers face limited financial penalties for failing to meet their sustainability targets. Although these prior studies have individually explored different aspects of KPI characteristics, our paper stands out as the first attempt to systematically analyze a set of six dimensions (i.e., strategic relevance, materiality, measurability, benchmarking, pricing mechanism, and external review) together in a single framework. This framework is based on the SLLP, a set of recommendations for market practitioners developed by the LMA, outlining fundamental characteristics that SLLs should meet in order to provide credible sustainability performance incentives. We show that the six dimensions deliver complementary information and collectively contribute to a comprehensive understanding of the incentive structures (and their current limitations) built into ESG-linked loan contracts.

Our study also sheds new light on the mixed results observed in the existing literature regarding the ability of SLLs to influence corporate sustainability performance. Dursun-de Neef et al. (2023) find that firms improve their overall ESG performance after issuing SLLs by increasing their environmental and governance scores. Kim et al. (2023) find that borrowers' ESG performance metrics deteriorate after the issuance of low-transparency SLLs. Du et al. (2023) use the ESG scores of different rating agencies (Asset4, RepRisk, and S&P) and document that SLL issuance does not result in a significant change in overall ESG performance. We complement this study by providing additional evidence on the lack of a clear relationship between SLL issuance and ex post ESG performance based on MSCI ratings. We show that SLL issuance does not lead to a significant change, that is, neither deterioration nor improvement, in borrowers' ESG profiles, as measured by their industry-adjusted, environmental, social, and climate scores from MSCI. In addition, our KPI analysis, which highlights the limitations of current SLLs, extends this

literature by providing new rationales for the lack of meaningful sustainability improvements in the years following SLL issuance.

Finally, our findings also contribute to the literature on sustainable finance instruments and their signaling function (Flammer, 2021). Examining SLLs, Kim et al. (2023) find that stock prices react positively to public announcements of high-transparency SLLs, while Carrizosa and Ghosh (2022) report negative and mostly statistically insignificant reactions to loan announcements. Our study adds to this literature by highlighting marked differences between EU and US borrowers, revealing distinct patterns in stock market reactions across regions. Here as well, the results of our KPI analysis, such as the number of KPIs and the lack of financial materiality, provide additional explanations for the negative market reactions in the United States or the absence of market response observed in the EU, respectively. Relatedly, our paper contributes to the growing body of research that questions the value implications of green financial instruments (Aswani & Rajgopal, 2022; Kölbel & Lambillon, 2022). Specifically, our results add to the study by Aswani and Rajgopal (2022), who find negative or partially insignificant reactions for issuers of green bonds and sustainability-linked bonds. Similar to our analysis of ex post ESG performance, their study shows that green bond issuers do not significantly change their greenhouse gas emissions in the years following bond issuance. Overall, our paper provides somewhat sobering evidence on the stock market reactions to the issuance of SLLs and their immediate impact on corporate sustainability.

The remainder of this paper is organized as follows. Section 2 discusses the potential motivations for issuing SLLs. Section 3 describes the data collection procedure and provides descriptive statistics for our sample of SLLs. Section 4 explains our KPI scoring methodology and presents the results of our KPI analysis. Section 5 describes the empirical results. Finally, Section 6 concludes.

2 | BACKGROUND

At first glance, it may seem surprising that companies would choose to issue SLLs over conventional loans. Not only can SLLs result in higher interest rates if certain sustainability targets are not met, but they also come with additional administrative and compliance constraints. By including ESG considerations in their loan agreements, companies explicitly commit to targets for which they can be held accountable and for which they are financially liable (Kim et al., 2023). Nevertheless, SLLs are becoming increasingly popular (Du et al., 2023). So what are the motivations for firms to issue them?

One potential motivation for firms to issue SLLs may be the need to strengthen their sustainability strategy. SLLs allow firms to take a holistic approach to sustainability objectives by embedding existing ESG considerations into an important aspect of their business: their financing. Furthermore, SLLs may serve as an additional mechanism to ensure that strategic sustainability considerations are actually implemented within the company. In doing so, SLLs enable companies to receive advice and regularly engage with their lenders on sustainability issues. From the lenders' perspective, the issuance of SLLs may also be motivated by the need to mitigate financial and reputational risks associated with any poor sustainability practices by their borrowers (Kim et al., 2023). As borrowers are encouraged to seek external, independent advice on the selection of KPIs prior to signing (Loan Market Association, 2023b), the process of issuing an SLL may also reinforce and lend further credibility to the company's overall sustainability strategy.

By requiring lenders to sign off on KPIs, SLLs may demonstrate lenders' confidence in their borrowers' strategic ESG commitments (Kim et al., 2023). Therefore, another possible motivation for issuing SLLs may be an attempt to signal commitment to sustainability issues to a broader group of stakeholders in response to growing investor demand and public scrutiny (Flammer, 2021; Ilhan et al., 2023; Krueger et al., 2020). Because investors often do not have sufficient information to assess a company's commitment to ESG goals, this information asymmetry creates a need for companies to differentiate themselves from their peers by signaling their strategy in a credible way (Flammer, 2021). SLLs may therefore serve as signaling tools, for example, by being mentioned in media press releases or by encouraging

borrowers to regularly disclose their progress toward specific ESG goals in their annual reports. In this way, SLLs allow to increase the visibility of borrowers' ESG commitments.

In addition, SLLs represent a particularly attractive financing instrument for companies that were previously excluded from sustainable lending due to the nature of their core activities and wish to enter this space (Kim et al., 2023). In particular, the absence of requirements on the use of proceeds ensures that SLLs are not limited to firms with specific environmental and climate-friendly projects. Thus, unlike green loans or green bonds, SLLs can be used in a wider range of industries and for a broad variety of purposes. By design, these loans offer a high degree of flexibility, allowing borrowers and lenders to tailor the KPIs to the specific situation of the company (Dursun-de Neef et al., 2023).

Finally, financial discounts may also motivate the issuance of SLLs. In the case of conventional loans, borrowers typically pay a spread in addition to a benchmark (e.g., Euro Interbank Offered Rate, Euribor) based on various measures of a borrower's credit risk, such as credit rating. In the case of SLLs, this spread is adjusted by a predefined amount to reflect a borrower's progress, assessed on a annual basis, against one or more sustainability KPIs (Loumioti & Serafeim, 2022). For example, a loan may be priced at 175 basis points (bps) over Euribor, with this spread reduced by 5 bps if the borrower meets its sustainability target in a given year. The pricing mechanism of SLLs can include not only financial rewards but also penalties for not meeting the targets. Appendix C includes a detailed example of such pricing mechanism. While Kim et al. (2023) show that the initial spreads at which SLLs are issued are no different from those of conventional loans, borrowers may still have an incentive to issue SLLs because of the financial rewards that can be earned by meeting their sustainability targets over the life of the loan.

Despite these motivations, SLLs also carry risks for both borrowers and lenders. In particular, the emerging literature on SLLs already suggests that such loans can be misused for greenwashing purposes and frequently serve to showcase an empty emphasis on ESG to stakeholders (Kim et al., 2023). Moreover, despite the appeal of potential margin discounts, initial evidence on the pricing of SLLs indicates that the size of these discounts to borrowers is limited (Du et al., 2023). These observations make an analysis of the sustainability KPIs at the core of SLLs even more crucial.

3 | LOAN DATA AND SAMPLE

3.1 | SLL data

We obtain our data from the Refinitiv DealScan database by extracting loans originated between 2017 and 2022 that are labeled as "sustainability-linked loans." Refinitiv Dealscan assigns this specific label based on loan characteristics gathered from loan agreements, corporate press releases, business press articles, and discussions with borrowers and lenders. We also exclude from our database all SLLs that do not have an announcement date and a closing date. The loan announcement date is critical for our analysis of market reactions, and the financial close date ensures that the transaction was successfully completed. In total, we identify 595 ESG-linked loans issued to listed borrowers in the EU and the United States over the sample period from 2017 to 2022.

Table 1 shows the time series of SLL issuance for our sample. SLL issuance totals $755 billion over the sample period, growing from $2 billion in 2017 to approximately $248 billion in 2022. In terms of issuance volume, the United States surpasses the EU in 2021 and shows a comparable, slight downward trend in 2022.

Table 2 shows the country distribution of the SLLs in our sample. The largest issuer of SLLs are the United States (25.55%), followed by France (15.29%) and Spain (14.29%), which is similar to what has been documented in previous literature on ESG lending (Dursun-de Neef et al., 2023; Kim et al., 2023).

Table 3 provides an overview of SLLs by sector, as defined by the Thomson Reuters Business Classification (TRBC). We find that most SLLs were issued by firms operating in the industrials (17.82%) and utilities (15.46%) sectors, while firms in the healthcare (4.03%) and financials (2.69%) sectors issued the lowest number of loans and the lowest total volume.

TABLE 1 Issuance of sustainability-linked loans (SLLs) over time.

| Year | European Union | | United States | | Total | |
	Number of SLLs	Volume (in Mio. $)	Number of SLLs	Volume (in Mio. $)	Number of SLLs	Volume (in Mio. $)
2017	4	2,176.24	0	0	4	2,176.24
2018	19	23,318.04	2	3,050.00	21	26,368.04
2019	60	61,249.63	4	7,025.36	64	68,274.99
2020	71	84,737.86	5	11,730.80	76	96,468.66
2021	135	141,462.22	76	172,776.84	211	314,239.06
2022	154	123,862.07	65	123,765.92	219	247,627.99
Total	443	436,806.06	152	318,348.92	595	755,154.98

Note: This table reports the total issuance amount and number of SLLs issued to borrowers headquartered in the European Union and the United States. The sample consists of 595 loans issued between 2017 and 2022.

TABLE 2 Sustainability-linked loans (SLLs) by country.

Country	Number of SLLs	Percentage of SLLs	SLL volume (in Mio. $)
United States	152	25.55%	318,348.92
France	91	15.29%	137,569.37
Spain	85	14.29%	57,111.15
Italy	68	11.43%	73,281.31
Germany	42	7.06%	66,835.80
Finland	40	6.72%	14,325.55
Netherlands	29	4.87%	22,836.00
Sweden	21	3.53%	18,051.81
Belgium	18	3.03%	7,600.47
Denmark	13	2.18%	14,513.09
Ireland	12	2.02%	11,028.35
Austria	6	1.01%	2,750.90
Greece	5	0.84%	628.19
Portugal	5	0.84%	4,004.31
Luxembourg	4	0.67%	6,937.70
Poland	3	0.50%	1,189.39
Estonia	1	0.17%	142.66
Total	595	100.00%	757,154.98

Note: This table reports the total issuance amount and number of SLLs categorized by borrowers' country of incorporation. The percentage of SLLs for each country is calculated as the ratio of the number of SLLs per country to the total number of SLLs in our sample. The sample consists of 595 loans issued between 2017 and 2022.

Overall, we observe a broad diversification of SLL issuance across sectors. Compared to green loans, SLLs are not concentrated in the energy and utilities sectors (Dursun-de Neef et al., 2023), but are also widespread in the industrials (17.82%), real estate (14.29%), consumer cyclicals (14.12%), and basic materials (12.61%) sectors. In addition, we note regional differences within our sample. For example, the majority (58.82%) of SLLs issued by firms in the real estate sector are loans to US borrowers. US firms also account for a large share of SLLs in the financials (37.50%) and

TABLE 3 Sustainability-linked loans (SLLs) by sector.

Sector	Number of SLLs	Percentage of SLLs	SLL Volume (in Mio. $)
Industrials	106	17.82%	124,093.55
Utilities	92	15.46%	127,140.83
Real Estate	85	14.29%	103,166.27
Consumer Cyclicals	84	14.12%	89,574.33
Basic Materials	75	12.61%	69,331.60
Technology	46	7.73%	94,092.35
Consumer Non-Cyclicals	36	6.05%	35,219.64
Energy	31	5.21%	45,337.04
Healthcare	24	4.03%	33,065.02
Financials	16	2.69%	29,715.46
Total	595	100.00%	757,154.98

Note: This table reports the number of SLLs and total issuance amount by sector of the borrowers. Sectors are defined using Thomson Reuters Business Classification (TRBC). Percentage of SLLs is the ratio of the number of SLLs in each sector to the total number of SLLs in our sample. The sample consists of 595 loans issued between 2017 and 2022.

TABLE 4 Sustainability-linked loans (SLLs) by use of proceeds.

Use of proceeds	Number of SLLs	Percentage of SLLs
General corporate purpose	512	86.05%
Refinancing	22	3.70%
Working capital	21	3.53%
Acquisition finance	13	2.18%
Capital expenditures	13	2.18%
Real estate/Property acquisition	5	0.84%
Ship financing	5	0.84%
Leveraged buyout	1	0.17%
Management buyout	1	0.17%
Project finance	1	0.17%
Aircraft financing	1	0.17%
Total	595	100.00%

Note: This table reports the breakdown of SLLs by the use of proceeds. The percentage of SLLs for each category is calculated as the ratio of the number of SLLs by use of proceeds to the total number of SLLs in our sample. Use of proceeds are extracted from the Refinitiv database. The sample consists of 595 loans issued between 2017 and 2022.

technology (33%) sectors. In contrast, EU borrowers account for the largest share of loans to the utilities (80.43%) and industrials (79.30%) sectors. These regional differences in SLL lending may be due to varying regulatory frameworks and market conditions between the EU and the United States.

As shown in Table 4, approximately 86% of SLLs in our sample are general corporate purpose loans, which is consistent with the notion that these loans can be used for a wide range of corporate purposes, without a prespecified use of proceeds. Because SLLs can be tailored to different corporate needs and strategies, they represent a flexible and particularly attractive tool for companies looking to enter the sustainable finance market.

TABLE 5 Number of key performance indicators (KPIs) per sustainability-linked loan (SLL).

Number of KPIs	Number of SLLs	Percentage of SLLs
1	131	35.99%
2	121	33.24%
3	84	23.08%
4	26	7.14%
5	2	0.55%
Total	364	100.00%

Note: This table reports the distribution of SLLs by the number of KPIs per loan. The percentage of SLLs is calculated as the ratio of the number of SLLs in each category of KPIs per loan to the total number of SLLs in the sample. The sample consists of 364 SLLs with KPI information issued between 2017 and 2022.

3.2 | KPI data

Since Refinitiv DealScan does not include detailed data on KPI characteristics, we manually collect such data from company websites, annual reports, stand-alone ESG reports, integrated reports, general registration documents, company presentations, and press releases from both borrowers and lenders. Since there is no standardized reporting system for SLLs, most of these data are selectively disclosed by borrowers and lenders. For US companies, we also look for credit-related information in the 8-K and 10-K filings in the SEC's Electronic Data Gathering, Analysis, and Retrieval (EDGAR) system. In rarer cases, we obtain data from financial news reports. We then classify each loan in our sample according to the level of information available on its underlying KPIs. Loans with information on their main sustainability objectives and KPIs are classified as "with KPI information." In total, our sample of SLLs contains 364 loans with KPI information, representing slightly more than 61% of the original SLL sample.

Table 5 shows that the total number of KPIs per SLL ranges from 1 to 5, although most loans in our sample contain between 1 and 3 KPIs. Specifically, almost 36% of SLLs are tied to only 1 KPI, while around 56% of SLLs in our sample include 2 or 3 KPIs. Only less than 9% of the SLLs in the sample have 4 or more KPIs. From a regional perspective, we identify KPI information for 281 out of 443 SLLs (63.43%) issued to EU borrowers. For the US sample, we are able to collect KPI information for 83 out of 152 SLLs (54.61%). These observations suggest that EU borrowers are more likely to disclose information about the characteristics of their loans than their US counterparts. We also observe sector-specific disclosure characteristics. For example, we find that SLLs issued by firms in the utilities sector account for the largest share (16%) of loans with KPI information, while SLLs issued by firms in the real estate sector represent a large share (18%) of SLLs without KPI information. One possible explanation for this difference is the level of regulatory oversight in the utilities sector, where firms are subject to strict environmental regulation and therefore more likely to disclose sustainability-related information as part of their annual reports and in loan agreements.

Our analysis shows considerable heterogeneity in the thematic focus of the underlying KPIs among the SLLs in our sample, suggesting that borrowers customize and tailor KPIs to meet their specific sustainability objectives. In addition, it is important to note that SLLs may be linked to multiple KPIs, and each KPI may cover different ESG dimensions. To ensure a granular analysis of the KPIs, we have grouped them into a total of 18 different categories based on four thematic pillars: environmental, social, governance, and ESG.[3]

Table 6 provides an overview of the distribution of KPIs within the clusters. With respect to the overarching pillars, we find that more than half of the KPIs in our loan sample (58.43%) belong to the environmental pillar. In contrast, the social pillar accounts for about 24% of all KPIs identified in the SLLs in our sample, and the governance pillar accounts for less than 2% of the KPIs in our sample. Finally, we find that ESG ratings and ESG certifications are also commonly

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[3] An overview of the pillars, including a summary description of the KPIs included in each category, is provided in Table A.1 in Appendix A.

TABLE 6 Distribution of key performance indicators (KPIs) within sustainability pillars.

Category	Number of KPIs	Percentage of KPIs
Environmental	**433**	**58.43%**
Greenhouse gas emissions	247	33.33%
Renewable energy	55	7.42%
Energy consumption and efficiency	35	4.72%
Circular economy	24	3.24%
Waste reduction and elimination	21	2.83%
Water consumption	19	2.56%
Use of sustainable resources	18	2.43%
Environmentally sustainable investments	9	1.21%
Biodiversity	5	0.67%
Social	**176**	**23.75%**
Employee diversity and gender equality	63	8.50%
Employee health and safety	45	6.07%
Sustainable products and customer benefits	26	3.51%
Social responsibility and community engagement	18	2.43%
Diverse and sustainable supply chain	13	1.75%
Employee training	11	1.48%
Governance	**10**	**1.35%**
Business ethics	10	1.35%
Environmental, social, and governance (ESG)	**122**	**16.46%**
ESG rating	70	9.45%
Other ESG assessment or certification	52	7.02%
Total	741	100.00%

Note: This table shows the distribution of KPIs (in absolute and percentage terms) within the environmental, social, governance pillars. In addition, the table presents the distribution of KPIs linked to ESG ratings or similar certifications. The sample consists of 741 KPIs in 364 SLLs issued between 2017 and 2022.

used in SLLs, accounting for about 17% of the KPIs in our sample. Overall, this distribution of KPIs suggests that borrowers place more emphasis on environmental aspects than on social or governance aspects when determining their KPIs. One possible explanation for this observation could be that investors (including lenders), regulators, and society place a high value on environmental responsibility; see, for example, Ilhan et al. (2023) and Krueger et al. (2020). As a result, companies may have stronger external incentives to set environmental KPIs.

Within these pillars, about one-third of all KPIs fall into the category of greenhouse gas emissions, suggesting that a significant proportion of KPIs are aimed at reducing such emissions, which is consistent with the analyses of Carrizosa and Ghosh (2022) and Loumioti and Serafeim (2022). In addition, a significant proportion of the KPIs fall into the category of ESG ratings. We find that SLLs are linked to up to three ESG ratings from three different rating agencies, although most SLLs have only one ESG rating as a main KPI. However, if we look at the trend in the use of ESG ratings as KPIs, we find a steady decline over the period of our sample. This trend may be due to the lack of transparent methodology underlying ESG ratings (Berg et al., 2022). In addition, the LMA recommends that borrowers explain why a particular ESG rating best reflects the ESG challenges of their core business when using it as a KPI (Loan Market Association, 2023a). Overall, such developments are likely to encourage the use of individual and company-specific KPIs in the future.

TABLE 7 Distribution of key performance indicators (KPIs) within sectors.

Sector	Environment	Social	Governance	Environmental, social, and governance (ESG)
Basic Materials	12.93%	10.23%	0.00%	16.39%
Consumer Cyclicals	14.55%	15.91%	0.00%	11.48%
Consumer Noncyclicals	8.78%	6.25%	0.00%	7.38%
Energy	4.16%	3.41%	20.00%	3.28%
Financials	1.39%	4.55%	40.00%	1.64%
Healthcare	2.31%	6.25%	0.00%	2.46%
Industrials	16.86%	21.02%	0.00%	18.85%
Real Estate	10.16%	3.41%	0.00%	23.77%
Technology	9.70%	17.05%	0.00%	5.74%
Utilities	19.17%	11.93%	40.00%	9.02%
Total	100.00%	100.00%	100.00%	100.00%

Note: This table shows the distribution of environmental, social, governance, and ESG KPIs (absolute and percentage terms) within each sector in our sample. ESG KPIs are tied to ESG ratings or similar certifications. The sample consists of 741 KPIs in 364 SLLs issued between 2017 and 2022.

Table 7 provides an overview of the distribution of KPIs across sectors. The utilities sector has the highest proportion of environmental KPIs (19.17%), followed closely by the industrials and consumer cyclicals sectors, which account for 16.86% and 14.55% of all environmental KPIs, respectively. Overall, the distribution of environmental KPIs suggests that they are widely used across various sectors. Social KPIs are prevalent in SLLs issued to firms in the industrials (21.02%) and technology (17.05%) sectors, while the majority of KPIs covering ratings or similar certifications can be found in the real estate (23.77%) and industrials (18.85%) sectors. In contrast, KPIs covering corporate governance factors are concentrated in only three main sectors, namely, financials (40%), utilities (40%), and energy (20%).

4 | THE DESIGN OF SLLs

4.1 | Scoring methodology

In recent years, academics and practitioners have raised concerns about greenwashing practices observed in SLL transactions.[4] Greenwashing is particularly likely when KPIs are not material and central to the borrower's business activities, when they are not sufficiently ambitious or meaningful, and when the borrower's performance is inaccurately or inadequately measured, benchmarked, and monitored (Loan Market Association, 2023a). Given their critical role in incentivizing corporate sustainability efforts, we begin our analysis by shedding light on the characteristics and quality of the KPIs in our sample. To this end, we evaluate each SLL individually and measure KPI quality by developing a scoring system based on the SLLP (Loan Market Association, 2023b). The SLLP provide a framework for the key characteristics that SLLs and their associated KPIs should meet in order to credibly and effectively incentivize ESG performance. In line with the SLLP, we develop six scoring dimensions to assess the quality of KPIs. They are summarized in Table 8.

[4] For example, the oilfield services company Schlumberger signed an SLL in 2021 before it had even established official sustainability KPIs (International Financing Review, 2021).

TABLE 8 Key performance indicator (KPI) score dimensions.

Score dimensions	
1	Strategic relevance
2	Materiality
3	Measurability
4	Benchmarking
5	Pricing mechanism
6	External review

Note: This table shows the six main dimensions on which our score for measuring the quality of SLL KPIs is based. Strategic relevance refers to the relevance of the KPIs to the borrower's strategy and sustainability objectives. Materiality assesses whether the KPIs address financially material issues based on the SASB Materiality Map. Measurability assesses whether the KPIs are measurable or quantifiable on a transparent methodological basis. Benchmarking examines whether the KPIs are benchmarked against relevant standards or targets. Pricing mechanism refers to the existence of a bonus and malus system related to interest rate adjustments. External review refers to an external independent verification of performance against the KPIs.

To calculate a score for each SLL based on the dimensions described, each dimension is assigned a value of 0, 0.5, or 1 depending on the degree of fulfillment. Thus, the maximum score per SLL is 6 points if all dimensions score fully. The KPIs are considered at the loan level. An overview of examples of KPIs that have been assigned a value of 1 in a particular dimension can be found in Appendix B.

The first dimension assesses whether the KPIs are relevant to the borrower's strategy (Loan Market Association, 2023b). To satisfy the first dimension, a KPI must either be an integral part of a clearly defined sustainability strategy, or represent an important sustainability objective set by the company prior to the loan issuance. KPIs are assigned a value of 0 if they are not in line with the borrower's official sustainability goals. In addition, KPIs are assigned a value of 0 if there is no public information on the borrower's sustainability goals. Consequently, companies without a sustainability strategy cannot receive a full score in this dimension. This is consistent with the following principle: "A SLL could be made theoretically to any borrower, but will be best suited to those that already have a sustainability strategy in place" (Loan Market Association, 2023a, p. 4). However, it is important to note that this does not disadvantage companies with low ESG ratings. These companies may already have a sustainability strategy or be actively developing one to improve their ESG performance. This dimension therefore assesses the strategic relevance of KPIs included in SLLs, regardless of the company's ESG performance. In contrast, KPIs are assigned a value of 0.5 if they are only partially aligned with the borrower's sustainability strategy. Finally, KPIs are assigned a value of 1 if they are fully aligned with the borrower's publicly disclosed key sustainability objectives.

The second dimension of the score examines whether the KPIs are material and address financially relevant sustainability challenges in the industry in which the company operates. For example, a company may choose to reduce its scope 1 emissions as part of its SLL, even though these emissions are not a material part of its total emissions because it operates in an industry that primarily generates scope 3 emissions. In accordance with the LMA guidance (Loan Market Association, 2023a), we consider whether KPIs cover material issues by applying the materiality standards developed by the SASB. In total, the SASB standards provide industry-specific standards for 77 different industries, enabling a comprehensive assessment of sustainability issues (e.g., diversity and inclusion or water management) for both green and brown industries. For each industry, SASB ranks sustainability issues by level of interest, such as the number of mentions in media reports and 10-Ks (Grewal et al., 2016). In addition, SASB assesses whether the management (or potential mismanagement) of these issues may affect a company's valuation or its operational or financial performance (Sustainability Accounting Standards Board, 2017). From an investor's perspective, these standards represent the relative priority of sustainability issues for each industry, allowing different KPIs to be compared and contrasted across industries. The SASB standards are increasingly used in academic research to assess the

materiality of sustainability issues ((see, e.g., Grewal et al., 2016; Khan et al., 2016). KPIs are assigned a value of 0 if they do not address material sustainability issues as defined by SASB. If the KPIs only partially address material topics, they receive a score of 0.5. KPIs that are tied to ESG ratings represent a special case. If KPIs in the form of ESG ratings appear individually within an SLL, rather than in combination with other individual and company-specific KPIs, they can only receive a score of 0, as it is not possible to assess the consistency of an ESG rating with this dimension.

The third dimension examines whether the KPIs are measurable or quantifiable. To satisfy this dimension, the KPIs must be specific (e.g., expressed with a clear numerical value) and target sustainability aspects that can be objectively quantified (Loan Market Association, 2023a). In particular, the SLLP recommends specifying the applicable scope of KPIs as well as their calculation method (Loan Market Association, 2023a). An example of a KPI that would not receive a full score on this dimension is a social impact KPI defined as "the number of people positively impacted by the company" and measured "in good faith."

While the third dimension assesses the ability to objectively quantify and measure a borrower's performance, the fourth dimension involves verifying that a KPI is benchmarked against an external reference, which is an important feature to facilitate an assessment of the overall level of ambition. The SLLP recommend a range of benchmarking approaches, including the use of industry initiatives and standards, science-based scenarios, and country targets (Loan Market Association, 2023b). Therefore, KPIs that are explicitly linked to a benchmark, such as the Science Based Targets initiative, receive a value of 1. In addition, it is important to note that all KPIs in our sample that meet this fourth dimension also fulfill the third dimension and are therefore measurable. However, measurability alone is no guarantee that a KPI is benchmarked.

The pricing mechanism in terms of interest rate adjustments is assessed in the fifth dimension. A key feature of SLLs is that the margin can be reduced if the borrower meets its sustainability targets as measured by pre-defined KPIs. SLLs can also be designed to require the borrower to pay higher interest rates if it fails to meet its sustainability targets. To address this fifth dimension, SLL margin adjustments should explicitly include not only a bonus (i.e., margin reduction) but also a malus (i.e., margin premium). With a malus system, borrowers demonstrate an even stronger commitment to their sustainability objectives by facing the possibility of paying higher interest rates. In general, penalties have been shown to be more effective incentives than rewards (Andreoni et al., 2003). Since KPIs linked only to a bonus system create weaker incentives, they are given a score of 0.5, while a neutral bracket in which no margin adjustment applies does not create a credible incentive and is given a score of 0. In addition, KPIs receive a score of 0 if no bonus or malus system is clearly mentioned. As the SLLP point out, transparency is "of particular value in this market" (Loan Market Association, 2023b, p. 4), and borrowers are therefore encouraged to publicly report information on such loan characteristics.

Although we consider the design of the pricing mechanism, we do not assess the actual level of interest rate adjustments in bps as this information is often confidential and data for most SLLs in our sample are lacking.[5] We assume that the larger the adjustment in bps, the greater the incentive for borrowers to meet their sustainability targets. A few cases in our sample suggest that such adjustments are often limited to 5 bps. In rare cases, they can reach up to 10 bps. This is consistent with Du et al. (2023), who conclude that the size of margin discounts is not economically large enough to make loan spreads of SLLs significantly lower than those of non-SLLs. Overall, the potential benefit to borrowers so far appears to be economically small (Du et al., 2023).

The final dimension assesses whether the KPIs are subject to independent third-party verification. According to the SLLP, borrowers should have an independent and external review of their performance against each sustainability objective at least once a year. To be credible, this review should be conducted by a qualified external verifier, such as an auditor, by way of limited or reasonable assurance, or a rating agency (Loan Market Association, 2023b). For example, if the KPIs are linked to ESG ratings, they receive a score of 1 as external rating agencies monitor and review these ratings at least annually. However, if there is only a one-time certification of progress, or if only one of several

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[5] This is particularly the case for EU SLLs. In contrast, 8-K forms tend to include information on the actual amount of interest rate adjustments.

Financial Management FMA

TABLE 9 Correlations between key performance indicator (KPI) score dimensions.

| Score dimension | Score dimension | | | | | |
	Strategic relevance	Materiality	Measurability	Benchmarking	Pricing mechanism	External review
Strategic relevance	1.000					
Materiality	0.530	1.000				
Measurability	0.040	−0.002	1.000			
Benchmarking	−0.187	−0.177	0.088	1.000		
Pricing mechanism	−0.063	0.032	−0.007	0.021	1.000	
External review	−0.359	−0.104	0.072	0.231	0.143	1.000

Note: This table presents the pairwise correlation coefficients between the dimensions of our KPI score. The sample consists of 364 sustainability-linked loans (SLLs) issued between 2017 and 2022.

underlying KPIs is subject to an explicit external review, such as a reasonable assurance review, the dimension is only partially met.

Table 9 shows the pairwise correlations between all six dimensions of our KPI score. The highest correlation is between strategic relevance and materiality (0.53), indicating a moderate relationship. However, all other correlations are weak, underscoring the importance of including all six dimensions in our KPI analysis. In particular, we find that strategic relevance has a modest positive correlation with measurability (0.040), while it is negatively correlated with benchmarking, pricing mechanism, and external review. Although one might expect measurability to be positively correlated with both benchmarking and external audit, the corresponding pairwise correlations between measurability and external audit (0.072) and between measurability and benchmarking (0.088) are rather weak. In addition, we find that the pricing mechanism is only weakly correlated with the other five dimensions. Overall, the correlation matrix suggests that each of these dimensions captures unique and different information and together contribute to a comprehensive understanding of the KPIs.

4.2 | Score results and distribution

Figure 1 shows the distribution of KPI scores for each score dimension. Overall, the results show significant differences between the various dimensions. Panel A presents the results for the assessment of the strategic relevance of the KPIs. We find that 218 out of 364 SLLs (60% of our sample with KPI information) are structured around KPIs that are explicitly part of an existing strategy. The majority of borrowers refer to the objectives associated with the KPIs in their reference documents such as annual or sustainability reports. On the other hand, 22% of the SLLs in the sample have KPIs that do not align with the borrowers' stated sustainability goals or priorities. In addition, a few companies do not explicitly reference a sustainability strategy in their reporting. In general, the results suggest that borrowers are using SLLs as a means to further embed existing sustainability goals in their organizations.

Panel B shows the results of the materiality assessment using the SASB standards. We find that 153 SLLs, or 42% of our sample, are tied to sustainability goals that are not financially material, while 30% of SLLs fully meet this criterion and 28% are only partially tied to material KPIs. This finding is consistent with Loumioti and Serafeim (2022), who report that only about half of the SLLs in their sample include material KPIs. Given that the goal of the SASB Materiality Map is to highlight the sustainability issues that are most likely to impact the company's financial performance, this suggests that a large portion of the KPIs in ESG-linked loan agreements do not target improvements in the sustainability areas that are most important to investors.
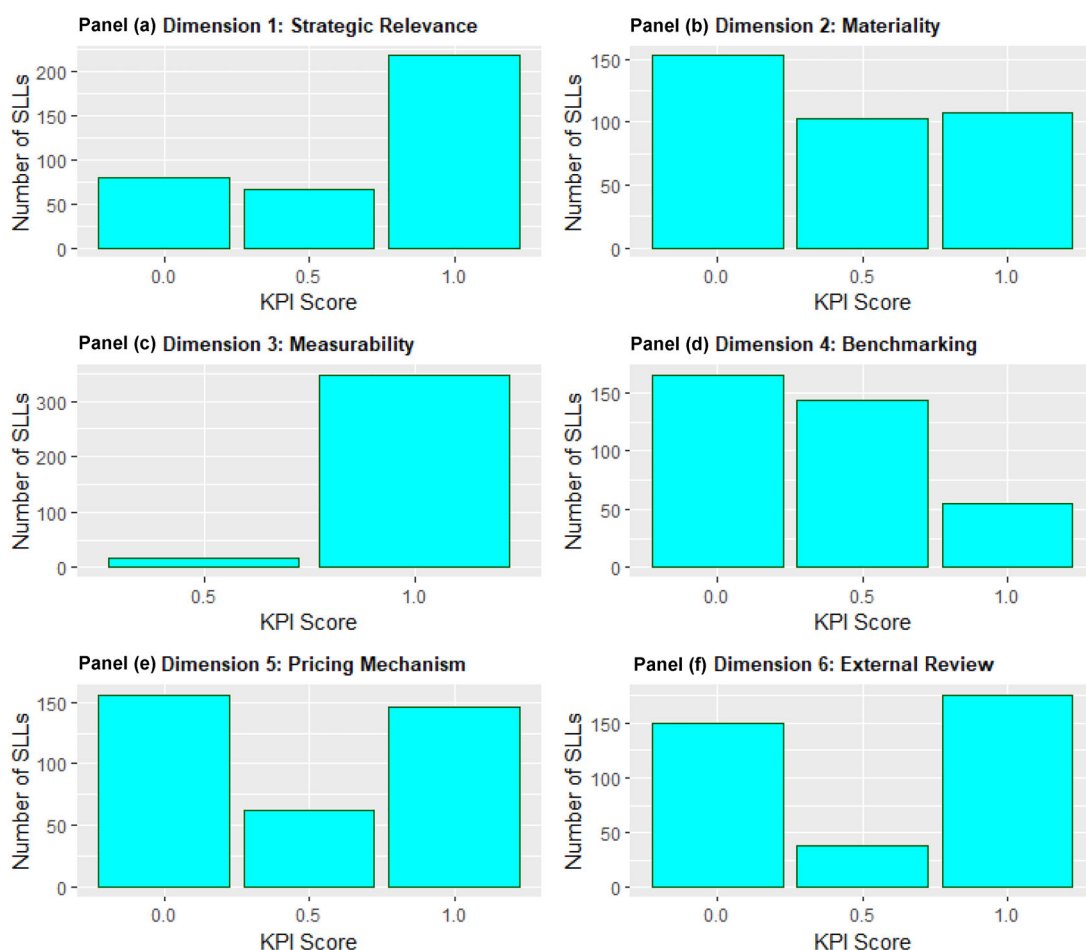
FIGURE 1 Assessment of key performance indicator (KPI) score per dimension. This figure shows the frequency of loans with specific KPI scores on each scoring dimension. Dimension 1 (strategic relevance) refers to the relevance of the KPIs to the borrower's strategy and sustainability objectives. Dimension 2 (materiality) assesses whether the KPIs address financially material issues based on the Sustainability Accounting Standards Board (SASB) Materiality Map. Dimension 3 (measurability) assesses whether the KPIs are measurable or quantifiable on a transparent methodological basis. Dimension 4 (benchmarking) examines whether the KPIs are benchmarked against relevant standards or targets. Dimension 5 (pricing mechanism) refers to the existence of a bonus and malus system related to interest rate adjustments. Dimension 6 (external review) refers to an external independent verification of performance against the KPIs. The sample includes a total of 364 sustainability-linked loans (SLLs) with KPI information. Each loan is given a score of either 0, 0.5, or 1 in each of the six dimensions. [Color figure can be viewed at wileyonlinelibrary.com]

Turning to the third dimension of our score, our results in Panel C show that 95% of SLLs are tied to measurable and quantifiable metrics. Perhaps not surprisingly, this suggests that most of the SLLs in our sample are based on goals that include a specific and objectively quantifiable metric that allows lenders to track performance against the predefined goals. On the other hand, only 17 SLLs (5%) in our sample are tied to KPIs whose measurability is subject to interpretation, such as the number of people positively impacted by the business and measured "in good faith." Since lenders must approve the selected KPIs, setting targets that are not measurable would not only make it difficult to evaluate performance, but could also damage the lenders' reputation. Measurable KPIs are therefore critical to ensuring the integrity of SLLs and mitigating reputational risks for lenders.

In contrast, the results in Panel D show that only 55 SLLs, or 15% of the sample, contain a clear reference to a benchmark, while 144 loans (40%) are partially benchmarked and 165 (45%) contain no form of benchmark. The lack of benchmarks for the selected KPIs makes it difficult to compare and contrast their level of ambition. Even ESG ratings, which can be considered a form of benchmark as they are based on a standardized scale, tend to differ from each other, limiting their comparability (Berg et al., 2022). However, this may also be due to a lack of appropriate benchmarks, especially since many of the industry standards, science-based targets, or other proxies proposed by the LMA (Loan Market Association, 2023a) primarily address the environmental dimension and do not necessarily serve as appropriate benchmarks for social and governance KPIs.

Panel E shows the results for the fifth dimension, which relates to the pricing mechanism. We find that about 40% of SLLs include a malus mechanism that requires borrowers to pay higher interest rates if they do not meet their sustainability targets. In comparison, 17% of SLLs include only a bonus mechanism, suggesting that borrowers can benefit from a lower interest rate if they meet their targets, but do not have to pay a financial penalty if they do not. This finding is consistent with Carrizosa and Ghosh (2022), who report for their sample that most ESG-linked loan contracts include interest rate reductions in response to positive sustainability performance, but only half of the contracts include interest rate increases when performance is negative. In our case, 156 out of 364 SLLs, or 43% of the sample, indicate that the loan margin is linked to sustainability KPIs, but do not provide further details. While the exact amount of the adjustment in bps can be considered confidential, it is noteworthy that SLLs tend to exhibit limited disclosure of bonus and/or malus provisions.

Finally, we find mixed results with respect to the annual external review of the selected KPIs, as shown in Panel F. We report that almost half (48%) of the SLLs in our sample are tied to KPIs that are subject to explicit external review at least once a year, which is consistent with previous literature on SLLs (Carrizosa & Ghosh, 2022). In these cases, the independent third party is explicitly mentioned in the documentation and/or the KPIs are part of annual reporting subject to limited or reasonable assurance. In addition, KPIs linked to ESG ratings are, by their nature, also subject to annual review. However, we also note that 150 SLLs (41%) do not satisfy this fifth dimension. In particular, many borrowers do not specifically mention a mandated third party and/or do not report on their performance against the KPIs in the years following issuance by including performance review information in the form of limited or reasonable assurance audits. This suggests that the disclosures of SLL borrowers are often insufficient to meaningfully review and assess performance against targets.

In a next step, we examine the distribution of the KPI score across our sample. Figure 2 shows the overall KPI score distribution. This distribution follows a Gaussian-like bell curve, which validates our methodology as we expect data points near the mean to have a higher frequency than those farther from the mean. The average KPI score in our sample is 3.47 and the median is 3.50, and while there is no loan that achieved the lowest possible score of 0, only 11 loans achieve a maximum score of 6 points. The majority of loans in our sample have a score of 3.5 or less, suggesting that these loans are only partially designed to incentivize sustainability efforts by their borrowers.

Panel A in Figure 3 shows the evolution of the average KPI score over time. The score improves over time, starting with an average of 2.88 in 2017 and increasing to 3.71 in 2022, suggesting that SLLs are becoming more stringent in terms of their ESG incentives. However, it is also important to note that the number of SLLs has increased over time, so the higher overall average at the end of our sample period could also be due to a larger sample size. We also find in Panel B that a higher number of KPIs per SLL does not necessarily lead to a higher KPI score. While focusing on a limited number of sustainability targets may prevent SLL borrowers from meeting the needs and interests of all their stakeholders, simply multiplying KPIs also seems to make such instruments less effective in strengthening sustainability incentives. This "multitasking problem" (Bebchuk & Tallarita, 2022), which has also been documented in the earlier literature on ESG-based compensation, further corroborates the challenges companies face in identifying and defining value-relevant and measurable metrics.
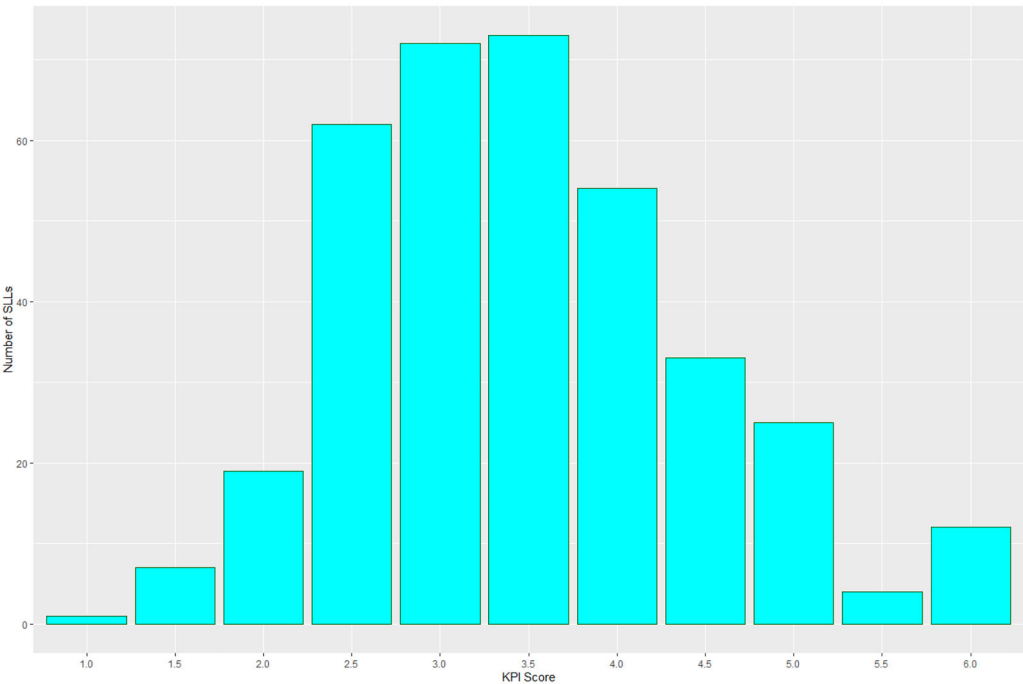
FIGURE 2 Number of sustainability-linked loans (SLLs) by key performance indicator (KPI) score. This figure shows the distribution of the total KPI score. The total KPI score for each loan is the sum of the individual scores for the six dimensions. The sample consists of 364 SLLs issued between 2017 and 2022. [Color figure can be viewed at wileyonlinelibrary.com]

5 | EMPIRICAL RESULTS

5.1 | Firm-level data and matching procedure

Our prior KPI analysis provides insights into the design of SLLs and casts doubt on their effectiveness in incentivizing corporate sustainability efforts. In this section, we explore this question further by empirically examining how firms' ESG performance, measured by their different ESG scores, evolves following the issuance of SLLs. Following the methodology in Kim et al. (2023), we contrast changes in the ESG ratings of SLL borrowers and a set of control firms that also borrowed over the same period but not through SLLs.

As there could be structural differences between SLL borrowers and other firms, we apply the 1:1 nearest-neighbor matching method following Rubin (1973) to find comparable firms to SLL borrowers as control firms and run the regressions on this matched sample. To examine the development of firms' ESG performance following the issuance of SLLs, we match the SLL borrowers in our sample with conventional borrowers based on one-year lagged values for profitability, leverage, size, book-to-market ratio, ESG score, as well as industry and region. To ensure a comprehensive data set for conventional borrowers, we retrieve data from Refinitiv DealScan's database. SLL borrowers and conventional borrowers are matched in the years of loan origination. For example, firms that concluded an SLL in 2019 are matched with firms that obtained a conventional loan in 2019. In the context of this study, we define a conventional borrower as a firm that acquired a loan in a specific year but did not issue any SLL throughout the sample period. We perform the matching without replacement so that each control firm is unique, and drop unmatched firms from our sample to avoid any bias from inadequate comparison.

As shown in Table 10, treated and control firms display differences before matching. We observe that SLLs are

TABLE 10 Differences between treatment and control firms.

	Prematching				Postmatching			
Panel A: Sample sizes								
N firms	274	1683			187	225		
Panel B: Control variables								
	Mean SLL borrowers	Mean conv. borrowers	Difference	t-stat	Mean SLL borrowers	Mean conv. borrowers	Difference	t-stat
Leverage	0.334	0.535	−0.201	−0.999	0.326	0.314	0.012	0.848
Book to market	0.760	0.594	0.166	1.840	0.601	0.585	0.016	0.457
Size	22.871	22.107	0.764***	7.960	23.300	23.400	−0.100	−0.757
Profitability	3.825	5.745	−1.920***	−5.470	3.930	4.000	−0.070	−0.172
ESG Score	6.500	4.901	1.599***	11.300	6.670	6.110	0.560***	2.840

Note: This table reports the differences in firm characteristics between sustainability-linked loan (SLL) borrowers (treated) and conventional borrowers (control) before and after matching. We match SLL borrowers with conventional borrowers based on lagged (1 year) values for profitability, leverage, size, book-to-market ratio, environmental, social, and governance (ESG) rating, as well as industry and region. Control firms are matched to borrower firms using 1:1 nearest-neighbor matching method following Rubin (1973). We match each borrower on the year prior to the issuance of SLL without replacement and drop nonmatched firms from our sample.
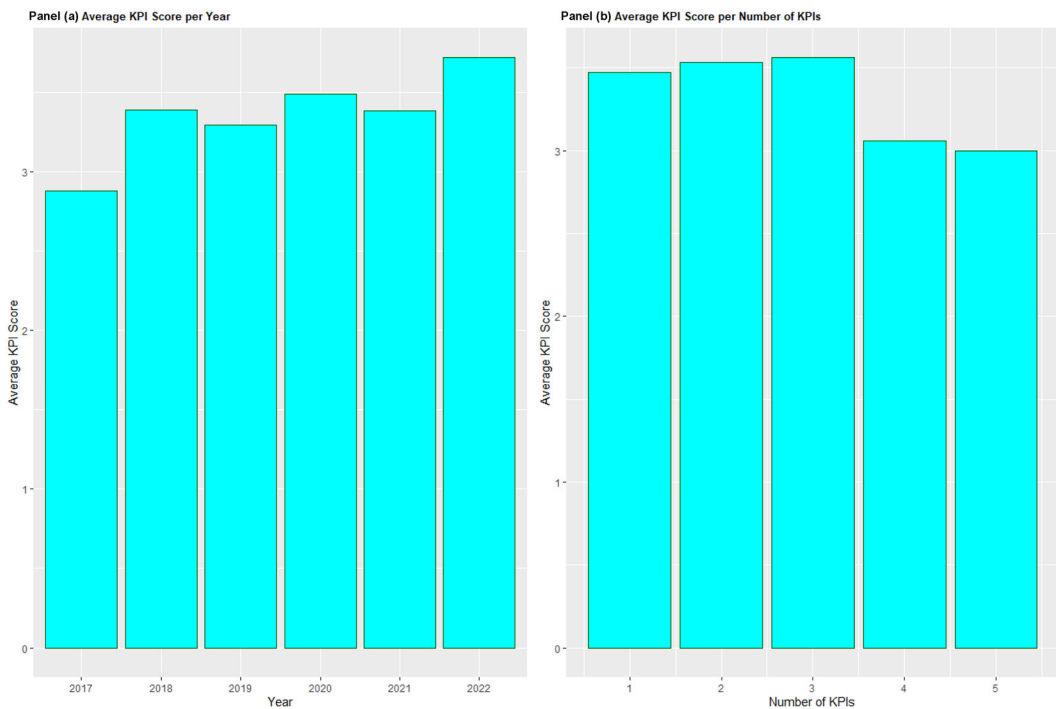
FIGURE 3   Average key performance indicator (KPI) score per year and number of KPIs. Panel A shows the average total KPI score per year. Panel B presents the average total KPI score per number of KPIs included in an sustainability-linked loan (SLL). The sample consists of 364 SLLs issued between 2017 and 2022. [Color figure can be viewed at wileyonlinelibrary.com]

generally issued by firms that exhibit above-average ESG performance and have significantly higher ex ante ESG scores than borrowers of conventional loans. In addition, SLL borrowers are typically characterized by larger company sizes, higher book-to-market ratios, and lower levels of leverage and profitability. Our matching procedure results in 187 unique SLL borrowers and 225 unique matched peers and significantly reduces the observed differences between treated and control firms.[6]

Table 11 presents the key ESG and financial data for the matched sample of treated and control firms. Panel A reports the descriptive statistics of the overall ESG score, its three main pillars, and the climate score. We obtain the ESG scores from the MSCI database to capture borrowers' ESG performance before and after loan origination. To be included in the sample, we require at least one year of MSCI ESG score in each of the pre- and post-issuance periods.

In our analyses, we use different types of ESG data, including industry-adjusted scores, environmental and social pillar scores, and climate change scores. These scores capture sustainability aspects that also play a key role in the selection of KPIs in ESG-linked loan agreements. In particular, the industry-adjusted scores allow us to consider the importance of ESG performance indicators for different industries and borrowers. Environmental and social pillar scores are calculated based on the weighted average of key aspects such as carbon emissions, biodiversity and land use, raw material sourcing, health, and safety of employees within each pillar. The climate change score falls under the environmental category and assesses a company's exposure to climate change and its efforts to manage that exposure.

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[6] The mean values correspond to the time of matching. Although they represent a large fraction of SLL borrowers, firms that issued an SLL in 2022 were not matched, as their ex post ESG performance, for example, in year 2023, cannot yet be assessed.

TABLE 11 Summary statistics (matched sample).

	Sustainability-linked loan (SLL) borrowers (treated)					Conventional borrowers (control)				
	N	Mean	Std. dev.	Min.	Max.	N	Mean	Std. dev.	Min.	Max.
Panel A: Environmental, social, and governance (ESG) data										
ESG score	1217	6.476	2.137	0.000	10.000	1427	6.093	2.057	0.000	10.000
E score	1246	6.021	2.061	0.000	10.000	1459	5.917	2.102	0.100	10.000
S score	1246	4.959	1.800	0.000	10.000	1459	4.847	1.730	0.000	10.000
G score	1246	5.951	1.377	0.300	9.400	1459	5.637	1.298	0.800	9.500
Climate score	1063	7.512	2.658	0.000	10.000	1244	7.485	2.357	0.000	10.000
EU Sample										
ESG score	870	6.894	1.966	0.000	10.000	795	6.541	1.931	0.000	10.000
E score	892	6.101	2.127	0.000	10.000	818	5.869	2.146	0.700	10.000
S score	892	5.125	1.680	0.000	10.000	818	5.114	1.705	0.000	10.000
G score	892	6.135	1.411	0.300	9.400	818	5.935	1.335	0.800	9.500
Climate score	762	7.504	2.792	0.000	10.000	698	7.538	2.255	0.000	10.000
US Sample										
ESG score	347	5.429	2.191	0.300	10.000	632	5.530	2.057	0.000	10.000
E score	354	5.820	1.873	1.600	10.000	641	5.978	2.045	0.100	10.000
S score	354	4.542	2.015	0.000	10.000	641	4.505	1.703	0.000	9.800
G score	354	5.488	1.170	1.200	8.000	641	5.256	1.142	1.900	8.400
Climate score	301	7.534	2.286	0.000	10.000	546	7.417	2.481	0.000	10.000
Panel B: Financial data										
Size	1296	23.243	1.453	18.971	27.570	1547	23.389	1.659	18.606	27.696
Leverage	1294	0.302	0.143	0.000	0.706	1545	0.305	0.167	0.000	0.805
Profitability	1216	0.051	0.051	−0.160	0.374	1416	0.047	0.056	−0.358	0.458
Book to market	1280	0.630	0.518	0.006	6.330	1526	0.622	0.561	0.004	8.265

Note: This table reports the summary statistics for ESG and financial data employed in our sample of SLL borrowers (treated) and conventional borrowers (control). Panel A reports the ESG data for treated and control firms. The ESG data is provided for the whole sample as well as for the EU and US samples separately. The *ESG score*, the *climate score* as well as the *environmental-, social- and governance-score* are taken from MSCI. Panel B reports the firm-level financial data for the treated and control firms. *Firm size* is defined as the natural logarithm of the firm's total assets, *leverage* is measured as the firm's total liabilities divided by total assets, *profitability* is the firm's net income prior to financing costs divided by total assets and *book-to-market ratio* is a company's book value per share divided by its stock price. Our total sample contains a total of 2,884 firm-year observations. The firm-level controls are winsorized at 1% and 99%.

MSCI rates firms' ESG performance on a scale of 0 to 10, with 10 representing the highest performance. Such ratings are updated at least annually. Ongoing or structural controversies lead to score deductions. For the purpose of our analyses, MSCI ratings offer several advantages over other data providers. First, MSCI is the largest provider of ESG ratings globally, resulting in broader coverage of companies relative to other providers, as reported in previous studies (Eccles & Stroehle, 2018; Pástor et al., 2022). In addition, MSCI ESG ratings are of significant importance in the context of US ESG fund holdings, as shown in recent research (Berg et al., 2022). Given their influential role in the market, investors are therefore more likely to react to fluctuations in these specific ratings. Finally, while ESG ratings from other providers such as Asset4 appear to have been subject to

backward revisions (Berg et al., 2020), there is currently no evidence that this is also the case for MSCI ESG ratings.

As shown in Table 11, the average SLL borrower in our matched sample has an overall ESG score of 6.48. We also present summary statistics for the ESG data of the EU and US subsamples. The average SLL borrower in the EU has a higher overall ESG score of 6.89, indicating particularly strong environmental and corporate governance performance. In contrast, the average SLL borrower in the United States scores a comparatively lower overall ESG score of 5.43, indicating weaker performance on ESG aspects compared to their European counterparts.

As other factors may influence the development of ESG performance subsequent to the issuance of ESG-linked loans, we control for several measures of financial performance by including firm-specific variables obtained from Refinitiv. Specifically, we account for *firm size*, defined as the natural logarithm of the firm's total assets, and *leverage*, measured as the firm's total liabilities divided by total assets. We also account for *profitability*, calculated by dividing the firm's net income prior to financing costs by total assets. Finally, we incorporate the *book-to-market ratio*, calculated by dividing a company's book value per share by its stock price. To eliminate outliers, we winsorize firm-level control variables at the 1st and 99th percentiles. As shown in Table 11, the average SLL borrower in our sample has a size of $23.24 billion in total assets (log-transformed values are shown), a mean profitability (ROA) of around 5%, a mean leverage ratio of 0.30, and a book-to-market ratio of 0.63. Our total sample contains a total of 2884 firm-year observations.

5.2 | SLL issuance and ex post ESG performance

To determine the relationship between SLL issuance and ex post ESG performance, we use a TWFE model to estimate our difference-in-differences design. Using this approach, we examine treated firms that issued SLLs and compare them to a control group of firms that took conventional loans both before and after the treated firms issued an SLL for the first time. Specifically, we estimate the following model:

$$\text{ESG Score}_{i,t} = \beta_1 \text{Post Loan Issuance}_t + \beta_2 \text{SLL Borrower}_i + \beta_3 \text{SLL Borrower}_i \times \text{Post Loan Issuance}_t$$
$$+ \chi_t + \iota_{in} + \rho_c + \epsilon_{it}, \quad (1)$$

where *ESG Score*$_{i,t}$ is the ESG score of borrower i in time period t. SLL Borrower$_i$ is an indicator variable that equals 1 if borrower i received an SLL at least once in the sample period, and 0 otherwise. Post Loan Issuance$_t$ is an indicator variable equal to 1 for years after the year of first loan issuance, and 0 otherwise. The model accounts for year (χ_t), industry (ι_{in}) and country (ρ_c) fixed effects. To ensure that our results are not sensitive to different permutations of fixed effects, we also include firm, industry-by-year, and country-by-year fixed effects in several specifications. ϵ_{it} is the error term. All standard errors are clustered at the firm level. We also estimate our model at the firm-year level in further specifications.

Table 12 presents the results for the matched sample of treated and control firms for Equation (1). Specifications (1)–(3) rely on the whole sample, specifications (4)–(6) are based on all SLLs with at least one environmental KPI, specifications (7)–(9) consist of all issued SLLs with at least one social KPI, specifications (10)–(12) rely on all SLLs with at least one CO_2-related KPI, and specifications (13)–(15) comprise all SLLs with a high KPI score of at least 3.5.

Specifications (1) to (3) show positive coefficients, but statistical significance is only observed in specification (1) at the 10% level. For specifications (4) to (6) focusing on SLLs with environmental KPI, and specifications (7) to (9) considering SLLs with social KPIs, there is no clear evidence of a significant impact on the environmental and social scores of the SLL borrowers, respectively. Likewise, specifications (10) to (12) examining SLLs with CO_2-related KPIs do not indicate a positive effect on the climate scores of the borrowers. Finally, specifications (13) to (15) analyze SLLs

TABLE 12 Environmental, social, and governance (ESG) performance following the issuance of sustainability-linked loans (SLLs; matched sample).

Dependent variable	ESG score	ESG score	ESG score	E-score	E-score	E-score	S-score	S-score	S-score	Climate Score	Climate Score	Climate Score	ESG Score	ESG Score	ESG Score
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
SLL Borrower × Post Loan Issuance	0.289*	0.166	0.078	−0.055	0.021	0.004	−0.062	−0.032	0.062	0.329	−0.204	−0.050	0.178	−0.039	−0.063
	(0.132)	(0.121)	(0.119)	(0.208)	(0.128)	(0.114)	(0.304)	(0.242)	(0.224)	(0.328)	(0.300)	(0.232)	(0.098)	(0.166)	(0.151)
Post Loan Issuance	0.164	−0.200**	−0.188**	0.382	0.065	0.025	−0.016	−0.199	−0.192	0.056	0.006	−0.092	0.247	−0.120	−0.140
	(0.131)	(0.099)	(0.090)	(0.211)	(0.123)	(0.094)	(0.296)	(0.179)	(0.157)	(0.352)	(0.239)	(0.189)	(0.179)	(0.135)	(0.122)
Firm FE	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Year FE	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
Industry FE	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No	No
Country FE	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No	No
Industry × Year FE	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No
Country × Year FE	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes	No
Observations	2637	2637	2637	1504	1504	1504	752	752	752	987	987	987	1,172	1,172	1,172
Adjusted R-squared	0.217	0.829	0.823	0.128	0.874	0.882	0.237	0.750	0.757	0.278	0.780	0.769	0.196	0.805	0.802

Note: This table presents firm ESG performance after the issuance of SLLs using quasi difference-in-differences panel regressions on the matched sample. We match borrowers to their control firms in the year prior to the issuance. SLL Borrower is a firm-invariant indicator variable equal to one if the borrower obtains a sustainability-linked loan during the full sample period and zero otherwise, Post Loan Issuance an indicator variable equal to one for the years after the loan issuance and zero otherwise and SLL Borrower × Post Loan Issuance denotes their interaction. The dependent variable is either the overall ESG score, the environmental score, the social score or the climate score of the borrower in a given year. The final sample consists of 2637 firm-year observations. We also run the regression on different subsamples. Specifications (1)–(3) are based on the full sample of SLLs, specifications (4)–(6) on all SLLs with at least one environmental KPI, specifications (7)–(9) on all SLLs with at least one social KPI, specifications (10)–(12) on all SLLs with at least one CO_2-related KPI, and specifications (13)–(15) on all SLLs with a high KPI score as described in section 4. The model accounts for firm, year, country, industry, industry-by-year and country-by-year fixed effects. Robust standard errors in parentheses are clustered at the firm-year level in columns (1), (4), (7), (10), and (13) and at the firm level otherwise. ***, **, * denote statistical significance at the 1%, 5% and 10% level, respectively.

TABLE 13 Weighted average treatment effects of sustainability-linked loan issuance on environmental, social, and governance (ESG) performance (matched sample).

Dependent variable	ATT (1)	SE (2)	Lower CI (3)	Upper CI (4)
Whole Sample				
ESG Score	−0.156	0.111	−0.373	0.061
E KPI Sample				
E Score	−0.082	0.092	−0.263	0.099
Climate Score	0.020	0.111	−0.197	0.238
S KPI Sample				
S Score	−0.055	0.179	−0.406	0.296
CO2 KPI Sample				
Climate Score	−0.036	0.121	−0.274	0.203
High KPI Sample				
ESG Score	−0.183	0.142	−0.462	0.095

Note: The table presents the weighted group-time average treatment effect on the treated following Callaway and Sant'Anna (2021). Standard errors (SE), lower and upper 95% confidence intervals (CI) are adjusted for multiple testing and calculated using bootstrapped standard errors. ***, **, * denote statistical significance at the 1%, 5% and 10% level, respectively.

with a high KPI score, zeroing-in on the "high-transparency" group in Kim et al. (2023). Again, the results do not indicate any significant positive effect on the borrowers' overall ESG scores, confirming the results of Kim et al. (2023).

Overall, the coefficients for SLL borrower$_i$ × Post Loan Issuance$_t$ indicate that there is no consistent and strong evidence to support the idea that the issuance of SLLs leads to higher ESG performance for the borrowing firms. The coefficients are generally small and often statistically insignificant, suggesting that the relationship between SLLs and ESG performance is weak or inconclusive.

These findings are in line with with those of Du et al. (2023), who also report that SLL borrowers do not improve their ESG performance in the years after SLL origination. In addition, they confirm the findings of Kim et al. (2023), who document that the issuance of SLLs with verifiable information on KPIs is not associated with significant improvements or declines in borrowers' ESG scores. In contrast, Kim et al. (2023) also find a post-loan deterioration in ESG performance for borrowers with low-transparency SLLs. It is important to note, however, that differences in matching procedures and the choice of borrowers' sustainability scores can significantly affect the results of the analyses, as documented by Du et al. (2023) and previous studies on ESG ratings (Berg et al., 2022). Due to considerations highlighted in Section 5.1, including backward revisions in Asset4 ESG scores (Berg et al., 2020), we choose to rely on MSCI in our analyses.

A recent literature shows that estimating Equation (1) as a conventional event study, that is, by OLS with TWFE and some lags, produces estimates that are not reliable (see e.g., de Chaisemartin & D'Haultfœuille (2020), Baker et al. (2022)). This is because the TWFE estimator compares firms that received an SLL later in the sample period with firms treated earlier, creating a "bad comparison" problem (Baker et al., 2022). One way to address concerns about the reliability of the TWFE estimator is to measure the weighted group-time ATT, as proposed by Callaway and Sant'Anna (2021). By suppressing the 2 × 2 differences-in-differences comparisons between newly treated and previously treated firms, this procedure is robust to heterogeneity in the treatment effect resulting from differences in the timing of SLL issuance.

Table 13 presents the group-time ATTs along with 95% confidence bands. In column (1), we report the ATT for all samples. First, we use the entire sample of borrowers and test whether issuing an SLL is associated with an increase in the ESG score. We then repeat the analysis with different subsamples of borrowers and analyze

whether the sustainability dimensions captured by the KPIs are linked to a change in the corresponding sustainability scores. In other words, we analyze the relationship between SLLs with environmental, social, or climate change KPIs and environmental, social, or climate change scores, respectively. The ATT coefficients are all statistically nonsignificant, confirming our results above and suggesting that SLLs are not associated with a change in corporate sustainability performance and that the KPIs included in an SLL are not related to an increase in the respective ESG pillar score. Finally, we also examine the subsample of SLL borrowers with a high KPI score. Our results may be heterogeneous due to SLLs that score poorly in all six KPI dimensions. However, even when using a subset of all borrowers whose SLLs have a score of at least 3.5 and their respective control firms, we still find no statistical significance.

Taken together, these results support the hypothesis that SLL issuance is not associated with a significant change, that is, neither deterioration nor improvement, in borrowers' ESG profiles ex post. While existing studies have produced mixed results regarding the impact of SLLs on ESG improvements (Du et al., 2023; Dursun-de Neef et al., 2023; Kim et al., 2023), our methodology for assessing the quality of KPIs in SLLs contributes to a deeper understanding of the underlying factors that can explain the observed nonexistent relationship between SLL issuance and sustainability performance. In addition to the lack of credible incentives provided by the KPIs, another possible explanation for our results could be that firms receiving SLLs already have above-average ESG performance before the loan is even issued, as shown in the data from Section 5.1. Thus, SLLs appear to simply sustain the current level of ESG performance rather than significantly improving it in the years following the issuance.

5.3 | Stock market reactions to SLL issuance announcements

One of the reasons often cited in the literature for issuing sustainable debt is the signaling effect (see e.g., Flammer (2021); Kim et al. (2023)), which states that borrowers seek to signal their ESG commitment by obtaining sustainable debt instruments from established lenders. In this section, we explore this question by analyzing stock market reactions to SLL announcements. Such announcements may be perceived positively by investors, leading to positive market reactions. However, there are also several reasons to believe that stock markets may respond negatively or be indifferent to the issuance of SLLs.

First, assuming that stock prices reflect all the information available at a given point in time, SLLs may not provide investors with new information that is not already included in companies' annual reports or sustainability strategies. Second, the selected KPIs often fail to address issues that are financially material, as shown by our KPI analysis. Therefore, it is likely that the issuance of SLLs does not provide any new information about a company's financial performance, which is the primary driver of stock prices. In addition, the financial incentives tied to SLLs may not have an immediate and strong effect on firms' financial performance, making it difficult for investors to assess the potential financial benefits of SLLs. Moreover, in an equilibrium, the more sustainable stocks of greener firms tend to exhibit lower ex ante CAPM alphas (Pástor et al., 2022). Finally, SLLs are also typically costly due to the additional reporting and monitoring requirements in the short run,[7] while the longer term nature of their sustainability goals may not align with the short-term focus of the equity market (Pedersen et al., 2021).

In our analyses, we make use of the fact that the Refinitiv DealScan database contains the announcement date of the SLLs, that is, the day on which a company announced the closing of a loan. The announcement date is the relevant date for our event study because it captures the day when the information is released to the market. However, for most SLLs in our sample, we find that the announcement date and the financial close date are similar, suggesting that the market is generally informed about an SLL issuance as soon as the loan agreement is successfully closed. In our analyses, we use unique events and consider each announcement of one or more SLLs on a single day as one event.

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[7] Kim et al. (2023) show that SLL borrowers do not enjoy pricing benefits at issuance from obtaining SLLs.

TABLE 14 Borrower stock returns around sustainability-linked loan (SLL) issuance announcements.

Event Window	All SLLs			E KPI			S KPI		
	CAR	t-stat	N	CAR	t-stat	N	CAR	t-stat	N
Panel A: EU Sample									
[−1,1]	−0.11	−0.55	436	−0.24	−0.81	214	−0.38	−1.24	112
[−1,5]	−0.26	−0.91	436	−0.25	−0.63	214	−0.43	−0.87	112
[1,3]	−0.19	−0.78	436	−0.13	−0.16	214	−0.31	−0.68	112
[1,10]	−0.77**	−2.22	436	−0.88	−1.78	214	−0.51	−0.78	112
Panel B: US Sample									
[−1,1]	−0.49*	−1.81	148	−0.74*	−1.75	67	−0.92	−1.61	27
[−1,5]	−0.51	−1.14	148	−0.71	−0.89	67	−0.54	−0.75	27
[1,3]	−0.44	−1.64	148	−0.93	−1.55	67	−0.82	−0.97	27
[1,10]	−0.92	−1.33	148	−1.54*	−1.89	67	−1.31	−0.86	27

Note: This table reports average cumulative abnormal stock returns (CARs) of SLL borrowers for different time windows around public announcements of SLL issuance. The overall sample consists of 584 SLL issuance events. CARs are computed from a market model using the Stoxx Europe 600 in Panel A and and the S&P 500 in Panel B as the market benchmark for the 120 trading day period ending 30 trading days prior to the loan announcement date. We report average CARs around different event windows for the whole sample and subsamples of SLLs with either environmental and/or social KPIs. CARs are reported in %. ***, **, * denote statistical significance at the 1%, 5% and 10% level, respectively.

To conduct the event study, we employ the standard market model methodology using an estimation window of 120 trading days that ends 30 days prior to the event. The abnormal returns are computed using STOXX Europe 600 and S&P 500 as our relevant benchmarks for SLL borrowers in the EU and the United States, respectively. In addition, we consider the following four event windows: [−1,1] and [−1,5], [1,3] and [1,10], which account both for the possibility that some information may have been known to the public prior to the announcement and for a staggered response.

In Table 14, we report the average cumulative abnormal stock returns (CARs) expressed as a percentage for each event window. In Panel A, we report the average CARs for the subsample of EU SLL borrowers, comprising 436 issuance events. As shown, the results indicate that the CARs are insignificant, with the exception of the larger event window [0,10], where the CARs are negative and significant at the 5% level. While this suggests that the stock market reacts negatively to the issuance of SLLs, the results could also be due to unrelated trends around the event date. In a next step, we report the average CARs for the subsample of loan issuances with at least one environmental KPI and the subsample of loan issuances with at least one social KPI. In both subsamples, the CARs are insignificant for all event windows.

Panel B of Table 14 presents the average CARs for the US subsample, comprising a total of 148 issuance events. In this case, we document a significant negative market reaction with cumulated abnormal returns of −0.49% in the event window [−1,1], symmetrically surrounding the announcement date of issuance. This result also holds when considering only the subsample of US firms issuing SLLs with a least one environmental KPI. These firms exhibit CARs of −0.74% in the event window [−1,1] and −1.54% in the event window [1,10].

In Table 15, we present the average CARs for subsamples of issuance events associated with high KPI (at least 3.5) or low KPI score (below 3.5). The CARs are insignificant in all intervals, except for US firms issuing SLLs with a high KPI score which exhibit negative CARs of −2.40% in the event window [1,10].

Overall, our results suggest that stock markets are rather indifferent to the issuance of SLLs by EU firms. In contrast, announcements of SLL issuance in the United States are met with caution by investors, especially when the loans include environmental KPIs. There are several possible interpretations for these observations. First, investors

TABLE 15 Borrower stock returns around high- and low-quality key performance indicator (KPI) loan announcements.

Event window	High KPI score			Low KPI score				
	CAR	t-stat	N	CAR	t-stat	N	Difference	t-stat
Panel A: EU sample								
[−1,1]	−0.23	−0.54	91	−0.21	−0.74	126	−0.02	−0.03
[−1,5]	−0.30	−0.52	91	−0.13	−0.40	126	−0.17	−0.24
[1,3]	−0.02	−0.03	91	−0.34	−1.04	126	0.32	0.67
[1,10]	−0.81	−1.14	91	−0.75	−1.35	126	−0.06	−0.07
Panel B: US sample								
[−1,1]	−0.78	−1.56	35	0.13	0.29	33	−0.91	−1.19
[−1,5]	−0.99	−0.98	35	1.60	1.34	33	−2.59**	−2.07
[1,3]	−0.65	−0.98	35	0.36	0.07	33	−1.01	−1.39
[1,10]	−2.40*	−1.75	35	−0.11	−0.39	33	−2.29	−1.28

Note: This table reports average cumulative abnormal stock returns (CARs) of sustainability-linked loan (SLL) borrowers for different time windows around public announcements of SLL issuance. The sample consists of 285 SLL issuance events. CARs are computed from a market model using the Stoxx Europe 600 in Panel A and and the S&P 500 in Panel B as the market benchmark for the 120 trading day period ending 30 trading days prior to the loan announcement date. We report average CARs around different event windows for subsamples of SLLs with high and low KPI scores. We report the difference of means between the two subsamples as well as the associated p-value. CARs are reported in %. ***, **, * denote statistical significance at the 1%, 5%, and 10% level, respectively.

may remain skeptical about the value of integrating ESG factors into investment decisions, which could contribute to the observed lack of positive response (see, e.g., Edmans, 2023). This is particularly the case in the United States, where growing ESG sentiment, especially in Republican states, has led to restrictions on state funds from investing in ESG products. Second, investors may be also wary of possible greenwashing practices, which have become more prevalent in recent years (Kim et al., 2023). Third, SLLs have higher costs than conventional loans due to additional reporting and monitoring requirements, which may also discourage investors from responding positively to their issuance.

In a next step, we investigate whether specific loan characteristics may explain the observed stock market reactions described above. While our KPI analysis helps explain the nonexistent relationship between SLL issuance and borrowers' ex post sustainability performance, it may also shed light on the different stock market reactions to SLL announcements. Thus, we estimate the following basic equation using OLS:

$$CAR_i = \beta_0 + \beta_1 \text{Number of KPIs}_i + \beta_2 \text{KPI Score}_i + \gamma' x_i + \varepsilon_i, \tag{2}$$

where CAR_i is CAR(−1,1) for firm i measured using the market model abnormal returns, Number of KPIs$_i$ is the number of KPIs per loan, KPI Score$_i$ corresponds to the KPI score for each loan. We either consider the total KPI score or each of the score dimensions separately. x_i is a vector of additional control variables, which are described in Section 5.1. ε_i is the error term.

Table 16 reports results from estimating Equation (2) for the sample of SLLs with KPI information. The coefficient for Number of KPIs$_i$ is significant and negative in columns (1) and (2). This result is consistent with the previous findings indicating that investors are vigilant against the issuance of SLLs, especially when such loans involve a high number of KPIs. In column (3), we find further evidence of a negative association between a higher number of KPIs and market responses to loan issuance. More precisely, the relationship becomes negative once an SLL has four KPIs. This is consistent with our findings in 1 where the average KPI score in the sample drops significantly after four KPIs. This is

TABLE 16 Cumulative abnormal stock return (CAR) determinants of sustainability-linked loan (SLL) announcements.

Dependent variable	CAR (−1,1) (1)	CAR (−1,1) (2)	CAR (−1,1) (3)	CAR (−1,1) (4)
Number of KPIs	−0.007***	−0.007***		
	(0.002)	(0.003)		
Total KPI Score	−0.001	0.001		
	(0.002)	(0.003)		
2 KPIs			−0.011	
			(0.008)	
3 KPIs			−0.009	
			(0.008)	
4 KPIs			−0.033***	
			(0.013)	
5 KPIs			−0.006	
			(0.029)	
KPI Score - Strategic Relevance				−0.044
				(0.008)
KPI Score - Materiality				0.010
				(0.010)
KPI Score - Measurability				0.041**
				(0.021)
KPI Score - Benchmarking				−0.002
				0.010
KPI Score - Pricing Mechanism				0.004
				(0.007)
KPI Score - External Review				0.001
				(0.010)
Controls	No	Yes	Yes	Yes
Observations	347	167	167	167
Adjusted R-squared	0.019	0.005	0.005	0.006

Note: This table reports the OLS estimations for different samples of SLLs issued from January 1, 2017, to December 31, 2022. The sample consists of 579 SLL issuance events. CAR(−1,1) is the cumulative abnormal return with an event window of one day before the event to one day after. We estimate the market model using value-weighted market returns for the 120 trading day period ending 30 trading days prior to the loan announcement date. CARs are reported in %. Robust standard errors are in parentheses. ***, **, * denote statistical significance at the 1%, 5%, and 10% level, respectively.

also in line with Carrizosa and Ghosh (2022), who document a negative relationship between the number of KPIs and CAR (−1,1).

In contrast, we do not find clear evidence that stock markets respond to SLL design characteristics. In column (1), *Total KPI Score* has a negative coefficient, while it has a positive coefficient in column (2). In both cases, the coefficients are not statistically significant. Similarly, there is no clear association between the dimensions of the KPI score and CARs, as shown in column (4), with the exception of *Measurability*, which appears to be positively linked to CAR (−1,1).

Overall, our results are consistent with Carrizosa and Ghosh (2022), who document negative and mostly insignificant market reactions to SLL issuances. They also corroborate the findings of Kim et al. (2023), who report negative market reactions for low-transparency loans.

6 | CONCLUSION

In this paper, we contribute to the emerging literature on ESG lending by conducting a comprehensive analysis of the characteristics of SLLs, with a particular focus on their underlying KPIs. The selection and design of KPIs are critical aspects of ESG-linked loan contracts. Therefore, a detailed analysis of the KPIs is essential to draw conclusions about the ability of SLLs to incentivize corporate sustainability efforts.

As a first step, we propose a new framework that examines KPIs in SLL agreements along six dimensions: strategic relevance, materiality, measurability, benchmarking, pricing, and external review. By examining KPIs along each dimension, our framework provides a detailed understanding of the strengths and weaknesses of SLLs. In particular, our results show that KPIs often have strategic relevance and are based on measurable and quantifiable metrics. However, KPIs frequently lack materiality and are not always subject to external, independent review. In addition, we find that KPIs are only occasionally developed against a specific benchmark and that failure to meet KPIs does not consistently result in financial penalties in the form of interest rate increases. Overall, SLL borrowers appear to enter into such agreements to showcase their existing sustainability practices rather than to incentivize further ESG improvements through stringent KPIs.

In a second step, we empirically analyze whether the issuance of SLLs is associated with a change in borrowers' ex post ESG performance using a difference-in-differences design. Our results confirm the results of our KPI analysis and suggest that the issuance of an SLL does not have a significant impact on the firms' ex post ESG performance. We also examine stock market reactions to public announcements of SLLs by conducting an event study. Our results suggest that the issuance of SLLs by EU firms has no significant impact on their stock prices, while US firms experience a significant negative market reaction, especially when their loans include environmental KPIs.

Our study has several practical implications for market participants. First, lenders and borrowers should be careful when designing KPIs for SLLs, as lax KPIs can damage their reputation and raise greenwashing concerns. This applies not only to the sustainability targets associated with the KPIs, but also to their implementation and independent verification over the life of the loan. Although SLLs have the potential to promote sustainability, our findings suggest that they are not effective in significantly improving ESG performance in the short term. Instead, SLLs may be more effective in sustaining the already high level of ESG performance of borrower firms, rather than significantly improving it. Borrowers and lenders should therefore have reasonable expectations about the potential impact of SLLs as an incentive for sustainable practices.

Overall, our study contributes to the growing literature on ESG lending. Due to the novelty of SLLs, current studies typically suffer from small sample sizes. As more data become available, future research could examine the long-term sustainability impacts of SLL issuance on borrowers. Additionally, while transitioning away from use-of-proceeds–based debt instruments can help democratize sustainable finance, hurdles remain for companies with lower ESG profiles and for small and medium-sized enterprises. In particular, firms that lack specific sustainability resources or expertise may stay out of the SLL market, despite potentially having a greater need for new forms of sustainability incentives. Therefore, a more inclusive approach to sustainable finance instruments may be needed—one that does not compromise on design rigor and allows all market actors to contribute to addressing critical societal challenges.

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APPENDIX A: KPI CLASSIFICATION

APPENDIX B: EXAMPLES OF KPIs

Below are examples of KPIs that received a value of 1 for each score dimension. The name of the borrower is indicated in parentheses.

Dimension #1: Strategic relevance

- **KPI**: "The margin of the new credit facility is in fact linked to two strategic targets in the field of energy transitioning and the circular economy which A2A has defined in its 2021-2030 Business Plan and which are included in the recently published Sustainable Finance Framework. The first goal is related to the growth of installed capacity from renewable sources while the second is represented by the increase of recovered materials from treated waste" (A2A SpA).
- **KPI**: "The indicators are linked to Corbion's key sustainability initiatives from its Creating Sustainable Growth strategy: Responsible sourcing, Responsible operations and Sustainable ingredient solutions" (Corbion NV).

Dimension #2: Materiality

- **KPI**: "The pricing mechanism of the RCF is linked to Stora Enso's science-based climate targets. Stora Enso commits to reducing absolute scope 1 and 2 greenhouse gas (GHG) emissions from its own operations, as well as scope 3 GHG emissions from its value chain, by 50% by 2030 from the 2019 base-year" (Stora Enso Oyj). The company belongs to the Basic Materials sector. Comparing this KPI with the SASB standards for this company (see pulp and paper products), we find that reduction of gross global scope 1 emissions is a material issue.
- **KPI**: "Pricing for the facility is based upon the company's performance against annual intensity reduction targets for its sulfur dioxide (SO2) and nitrogen oxide (NOX) emissions" (Cabot Corp). Comparing this KPI with the SASB standards for this company (see chemicals), we find that the reduction of emissions from air pollutants, including sulfur oxides and nitrogen oxides, is a material issue.

Dimension #3: Measurability

- **KPI**: "Endesa has committed to increasing the percentage of renewable sources in its total installed power generation capacity in the Iberian Peninsula from 45% at the start of the year to 50% by end December 2021" (Endesa SA).
- **KPI**: "The Sustainability-Linked financing is linked to the achievement of Enel's sustainability target to reduce direct greenhouse gas emissions (Scope 1), measured in grams of CO2eq per kWh, to equal or less than 148 gCO2eq/kWh by 31 December 2023, thereby contributing to the United Nations Sustainable Development Goal (SDG) 13 (Climate Action)" (Enel SpA).

TABLE A.1   Key performance indicator (KPI) classification.

Category	Example
Environmental	
Biodiversity	Conserve, promote, and protect biodiversity and ecosystems.
Energy consumption and energy efficiency	Reduce energy consumption, improve energy efficiency.
Renewable energy	Increase the share of renewable energy produced or installed, increase the share of renewable energy used or sold, increase the share of electric vehicles in the total vehicle fleet.
Circular economy	Increase recycling rates, increase recovered materials from production waste, reduce waste of resources using recycled and/or reusable raw materials, reuse and repair equipment.
Sustainable resources and responsible sourcing	Increase the use of sustainable raw materials in production, sourcing and use of products from responsible sources, sustainable and transparent supply chains.
Environmentally sustainable investments	Increase the share of sustainable investments to total investments that contribute to environmental sustainability.
Reduction and elimination of waste	Reduce & avoid waste, reduce waste & avoid landfilling of waste, improve waste separation & collection.
Greenhouse gas emissions	Reduce scope 1, 2, and/or 3 greenhouse gas emissions, achieve carbon neutrality in own operations, and use emission-free machinery and vehicle fleets.
Water consumption	Make water use more sustainable, improve water conservation, reduce water consumption in operations and production.
Social	
Employee health and safety	Reduce the incidence of occupational accidents, injuries and diseases, implement health and safety measures, promote employee well-being and satisfaction at work, ensure human and labor rights.
Employee diversity and gender equality	Increase the number of women in leadership positions, promote gender equality in all areas of the company, encourage diversity in leadership positions.
Sustainable products and customer benefits	Provide sustainable, safe and reliable products and solutions to customers, expand the range of sustainable products, increase sales of sustainable products and revenue from products that improve sustainability and safety for customers.
Employee training	Increase the number of employee training hours, encourage participation in sustainability-related training, increase employee skill development.
Diverse and sustainable supply chain	Establish a diverse and sustainable supply chain by selecting suppliers that adhere to ethical and sustainable practices and reflect the diversity of the communities they serve.
Social responsibility and community engagement	Improve the relationship and dialogue between companies and the communities in which they operate, provide (financial) support to nonprofit organizations, foundations, and local initiatives, support disadvantaged groups, reduce social inequalities, implement social responsibility and community engagement programs.

(Continues)

TABLE A.1 (Continued)

Category	Example
Governance	
Business ethics	Ensure compliance with the company's business ethics, code of conduct and code of ethics of the company, engage with stakeholders, prevent business ethics violations, including corruption, bribery, fraud or insider trading, provide training to board members, improve ESG-related processes and due diligence.
Environmental, social, and governance (ESG)	
ESG rating	Improve ESG rating performance.
Other ESG assessment and certification	Improve ESG rating or achieve equivalent ESG assessments or ESG certifications.

Note: The table provides an overview of the issues addressed by the KPIs in our sample. The issues are grouped into four main categories: environmental, social, governance and ESG. The right side of the table provides examples of the objectives covered by each KPI issue.

Dimension #4: Benchmarking

- **KPI**: "The credit margin under the facility will be adjusted based on Maersk's progress to meet its target of reducing CO2 emissions per cargo moved by 60% by 2030, which is significantly more ambitious than the IMO target of 40% by 2030 (all 2008 baseline)" (AP Moller-Maersk A/S).
- **KPI**: "The first target is Ørsted's science-based target of reducing the carbon emissions from its energy generation and operations (scopes 1-2) to 10 g CO2e/kWh by 2025, which is the main lever for achieving carbon neutrality in 2025, and which is aligned with a 1.5°C climate scenario. The second target is Ørsted's taxonomy-aligned green investments linked to its announced approx. DKK 350 billion investment programme for 2020-2027, which constitute a significant step in achieving Ørsted's strategic ambition of reaching approx. 50 GW of installed renewable capacity by 2030" (Orsted A/S).

Dimension #5: Pricing mechanism

- **KPI**: "Under this loan, the margin amount that we are required to pay can be either increased or decreased, by up to 10 bps per year, to the extent that we are able to meet certain sustainability metrics for any fiscal year beginning with the fiscal year ended December 31, 2021" (Diana Shipping Inc).
- **KPI**: "Supplier SBT Percentage Applicable Spread Adjustment Amount means, with respect to any period between Sustainability Pricing Adjustment Dates, (a) positive 0.04%, if the Supplier SBT Percentage for such period as set forth in the KPI Metric Report is less than the Supplier SBT Percentage Target for such period, and (b) negative 0.04%, if the Supplier SBT Percentage for such period as set forth in the KPI Metric Report is greater than or equal to the Supplier SBT Percentage Target for such period" (Moody's Corp).

Dimension #6: External review

- **KPI**: "Kinnevik will seek independent and external verification of our actual KPI performance relative to the SPT(s), on an annual basis and in relation to the Target Observation Date(s). The verification will be conducted by a reviewer with relevant expertise with limited assurance by the reviewer. The verification will be made public on our website by the dates outlined in the transaction specific documentation" (Kinnevik AB).

- **KPI**: "Such determination and reporting in the ESG Annual Report shall be verified by an independent third party in accordance with the Greenhouse Gas Protocol Corporate Reporting and Accounting Standard (the "ESG Third Party Verification") and such final, verified reporting will be attached to and reported on the ESG Compliance Certificate as the Sustainability Metric for such Reference Year" (Ingredion Inc).

APPENDIX C: EXAMPLE OF PRICING MECHANISM

To illustrate how SLLs align financial incentives with sustainability goals, we present the following example of an SLL issued to Avangrid in 2018 by a syndicate of lenders.

The baseline applicable margin of the loan is determined based on Avangrid's credit rating. As described in the loan agreement, this applicable margin may also vary depending on the borrower's performance against a sustainability target:

"**Applicable Margin**" shall mean for each type of loan, the rate per annum set forth under the relevant column heading below which corresponds with the most current rating of such Borrower's senior unsecured long-term debt issued by Moody's and S&P, respectively. Such Applicable Margin may be increased or decreased pursuant to the Applicable Sustainability Adjustment.

Ratings	Applicable Margin for Eurodollar Loans	Applicable Margin for ABR Loans
>A1/A+	0.800%	0.000%
A2/A	0.900%	0.000%
A3/A-	1.000%	0.000%
Baa1/BBB+	1.075%	0.075%
Baa2/BBB	1.275%	0.275%
Baa3/BBB-	1.475%	0.475%
<Baa3/BBB-	1.650%	0.650%

The margin adjustment resulting from the firm's sustainability performance is defined as follows in the loan agreement:

"**Applicable Sustainability Adjustment**" means, for any fiscal year (beginning with fiscal year 2018): (a) if the annual sustainability amount is greater than or equal to 110% of the baseline sustainability amount, a 0.05% increase in the specified applicable margins; and (b) if the annual sustainability amount is less than or equal to 90% of the baseline sustainability amount, a 0.05% decrease in the specified applicable margins.

The above definition of Applicable Sustainability Adjustment specifies that such adjustment depends on a sustainability amount and a baseline sustainability amount, defined as follows:

"**Baseline Sustainability Amount**" means 58.4 g CO_2/kWh, as contained in the opinion of Vigeo Eiris delivered to the borrowers and furnished to the lenders.

"**Sustainability Amount**" means the greenhouse gas emissions intensity resulting from the borrowers' and their subsidiaries' operations, calculated in the manner set forth by Global Reporting Initiative 305-4 (previous G4-EN18) based on direct emissions from production facilities divided by the net production, including steam, and expressed as a ratio of grams of carbon dioxide to kilowatt hour (g CO_2/kWh).

In summary, this loan agreement incorporates a dynamic pricing mechanism that rewards or penalizes Avangrid's sustainability performance relative to the baseline sustainability amount of 58.4 g CO_2/kWh. The spread charged by the lenders may be adjusted up or down by 5 bps.