Research on the Green, Social, and Sustainable Bond in the Asia-Pacific Region

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Abstract

This paper examines the recent research on Green, Social, and Sustainability (GSS) bonds, with a focus on the pre-issuance, issuance, and post-issuance stages. While GSS bonds have become a key instrument in sustainable finance, challenges are found in terms of credibility, pricing, transparency, and long-term impact. Pre-issuance studies emphasize the importance of external reviews and certification, though the lack of standardized frameworks limits comparability. In the issuance process, a "greenium" effect is highlighted, resulting in lower yields for GSS bonds, although their size varies by issuer and region. Post-issuance, the impact on environmental performance and stock market reactions is mixed, underscoring the need for stronger monitoring and accountability. The review highlights the centrality of credibility throughout the lifecycle and notes that emerging markets, particularly those in the Asia-Pacific region, remain underexplored in the literature. It calls for further research into social and sustainability bonds, long-term impacts, and the role of regional dynamics, particularly in emerging markets. Overall, while GSS bonds are important for sustainable finance, their effectiveness depends on transparency, rigorous standards, and deeper regional insights.

Keywords: Green Bonds, Social Bonds, Sustainable Bonds, Asia-Pacific Region

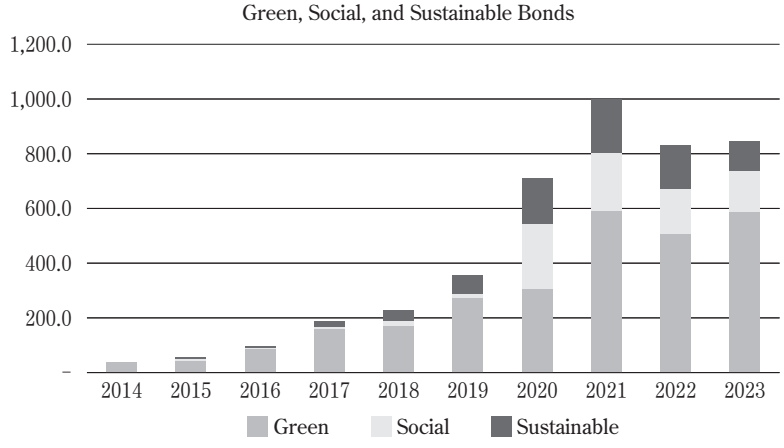
I Introduction

Sustainable finance has emerged as a means to align capital with environmental and social goals, guided by the UN's Sustainable Development Goals (SDGs). Among its instruments, green bonds have grown rapidly since their introduction, requiring adherence to the Green Bond Principles and ensuring proceeds are allocated transparently to projects such as renew-

able energy, clean transportation, and climate adaptation. Alongside them, social bonds, aligned with the Social Bond Principles, finance projects that address social challenges such as affordable housing, healthcare, and education, with their issuance notably increasing during the COVID-19 pandemic. Sustainability bonds combine the purposes of both, channeling funds into both environmental and social initiatives under dual frameworks, making them a flexible tool for achieving broader SDG objectives. While these instruments play a vital role in sustainable finance, especially as investor interest grows, further research is needed to assess their long-term impact on issuers' commitments and measurable outcomes.

According to the Climate Bonds Initiative (2024), the cumulative issuance from 2006 until the end of 2023 is USD 4.4 trillion. This proportion is primarily contributed by green bonds, at USD 2.8 trillion, followed by social bonds at USD 821 billion, and sustainable bonds at USD 768 billion. Below is the summary of the green, social, and sustainable bond market by issuer type.

Figure 1. Green, Social, and Sustainable Bonds over the years



As illustrated above, labeled bonds, including green bonds and sustainability bonds, exhibit distinct structural and functional characteristics. Recent trends indicate a steady increase in the issuance of labeled bonds beyond green bonds, reflecting a diversification in the ESG bond market. However, to date, empirical research has predominantly focused on green bonds, with limited attention given to the environmental performance implications of other labeled bonds, particularly social and sustainability bonds. Given the differences in the scope of eligible projects and the intended impact, it is plausible that each type of labeled bond exerts a unique influence on corporate environmental behavior. Addressing this re-

search gap is essential for advancing a more comprehensive understanding of the ESG bond market and for informing the development of effective sustainability-oriented financial instruments and policies.

In the Asia-Pacific region, the market for GSS bonds has expanded considerably in response to growing environmental and social challenges, as well as increased investor demand for ESG-aligned assets. Countries across the region have demonstrated varying levels of engagement with GSS bonds, reflecting differences in regulatory environments, economic development, and sustainability priorities. Economies such as Japan, China, South Korea, Singapore, and Australia have played leading roles in scaling up issuance, supported by government initiatives, central bank guidance, and efforts to align national taxonomies with international standards. At the same time, emerging markets within Southeast Asia and South Asia are increasingly tapping into the GSS bond market to finance infrastructure, energy transition, social inclusion, and climate adaptation projects.

Despite this upward trend, the development of GSS bonds in the Asia-Pacific also faces structural and operational challenges. These include inconsistencies in disclosure and reporting standards, limited availability of verifiable impact data, and varying degrees of market maturity across countries. While larger issuers in advanced economies often have the capacity to structure and monitor labeled bonds in line with international principles, smaller issuers and those in developing economies may lack access to technical expertise or affordable verification services. Moreover, the diversity of national regulatory frameworks and taxonomies may pose difficulties for cross-border investment and market harmonization. As such, enhancing transparency, building issuer capacity, and promoting regional cooperation are essential steps toward strengthening the credibility and scalability of the GSS bond market in the Asia-Pacific. A deeper understanding of how these bonds influence corporate and policy-level environmental and social outcomes in the region is crucial for shaping future sustainable finance strategies.

This paper aims to shed light on the empirical approaches of current research regarding the corporate GSS bonds in the Asia Pacific region through a systematic review. To assess the current research on corporate GSS bonds, this paper is divided into three main sections based on the timing of GSS bond issuance: pre-issuance, issuance, and post-issuance. Several factors related to the pre-issuance process, such as the types of companies that tend to issue GSS bonds, are considered in light of their financial and environmental performance backgrounds, as well as the motivation behind companies issuing GSS bonds. During the issuance

process, several papers have conducted studies examining the market reaction to companies' announcements of GSS bond issuance and the pricing of GSS bonds compared to conventional bonds. Moreover, we will explore the post-issuance effects of GSS bonds on the issuing company, including its financial performance, environmental performance, and green innovation, as well as any potential greenwashing that may be involved. Additionally, we will discuss a more current condition, specifically in the Asia-Pacific GSS bond market, and provide a discussion and conclusion for future research regarding this topic.

Ⅱ The Lifecycle of GSS Bonds

The lifecycle of a GSS bond involves three main phases: pre-issuance, issuance, and post-issuance. Each of these steps is taken to ensure integrity, transparency, and credibility in financing projects that offer environmental benefits.

In the pre-issuance phase, issuers establish a GSS Bond Framework aligned with standards such as the Green Bond Principles and Social Bond Principles, defining eligible projects, evaluation methods, and often obtaining an external review to enhance credibility. The issuance phase involves releasing the bond into the market through offering documents, integrating the framework and external assessments, while ensuring transparent financial management through dedicated accounts and clear policies for unallocated proceeds. The post-issuance phase emphasizes accountability through annual allocation and impact reporting, combining quantitative and qualitative measures to demonstrate environmental outcomes, often verified by independent external reviews, alongside ongoing transparency and communication with stakeholders. While some studies address overlapping aspects of these phases, their findings can broadly be categorized according to this lifecycle structure.

1 The Pre-Issuance of GSS Bonds

(1) Environmental and Financial Performance and Determinants of the Issuers

Franke and Katzer (2025) examine the relationship between firms' climate change exposure and their decision to issue corporate green bonds, highlighting how environmental pressures impact corporate financing behavior. Their findings suggest that firms with higher exposure to climate-related regulatory and opportunity shocks, not direct physical risks, are more likely to issue green bonds. Importantly, these firms exhibit tangible improvements in environmental outcomes, including lower emissions and greater green investments. This

highlights the dual role of green bond issuance as both a financing mechanism and a means to enhance long-term environmental performance. The authors highlight the importance of transparency in climate risk exposure to strengthen investor confidence in firms' sustainability commitments.

On the other hand, the financial dimension of Green and ESG bond issuance has been approached from multiple perspectives. Wang, Lee, and Park（2022）focus on the Korean ESG bond market, finding that issuance is more common among larger firms, those with higher foreign ownership, firms with ESG committees, and those regulated under carbon emission trading. However, unlike in developed markets, ESG bond issuance in Korea does not elicit significant stock market reactions, raising concerns about the effectiveness of ESG bonds as a signaling mechanism in emerging markets. The authors recommend stronger post-issuance reporting and verification standards to improve credibility.

Complementing this, Dutordoir, Li, and Neto（2022）analyze issuance decisions across the US, Western Europe, and China, providing evidence that firms with lower disclosure costs, reputational incentives, and an innovation focus are more likely to issue green bonds over conventional ones. They find only limited support for the idea that borrowing constraints drive issuance. Their cross-country and cross-industry findings, including increased issuance during the COVID-19 pandemic, suggest that green bond issuance is often strategic, aligning with reputational and market positioning goals rather than financial necessity.

Expanding the scope further, Jelili（2025）employs advanced machine learning to analyze global issuance patterns of green, social, sustainability, and sustainability-linked（GSSS）bonds. The study identifies firm size, governance quality, ESG performance, and macroeconomic conditions（GDP per capita, inflation）as key predictors of issuance, with larger firms and strong governance emerging as the most influential factors. Regional dynamics are also highlighted, with Europe's leadership underscoring the role of institutional frameworks in shaping sustainable finance markets.

Taken together, these studies demonstrate that the financial performance outcomes of green and ESG bonds are context dependent. While in developed markets, issuance is tied to reputation, innovation, and disclosure strategies（Dutordoir et al., 2022）, in emerging markets like Korea（Wang et al., 2022）, the market response remains muted, indicating institutional gaps. The use of machine learning（Jelili, 2025）further advances the literature by providing scalable predictive tools and reinforcing the importance of governance and macroeconomic stability in determining issuance trends.

(2) Mechanisms, Motivations, and Investor Preferences Shaping the GSS Bond Market

The rapid expansion of sustainable finance has generated a growing body of research that investigates the mechanisms, motivations, and investor preferences shaping the green bond market. As the market matures, three interrelated themes have emerged in the literature: the role of external reviews in assuring credibility, the expectations and behavior of investors, and the underlying motivations of issuers. Together, these perspectives provide a comprehensive understanding of both the supply and demand dynamics that influence the development and integrity of green and sustainable debt instruments.

A central concern in the literature is how credibility and transparency are safeguarded through external reviews. Dinh, Eugster, and Husmann (2025) examine this issue across the two main phases of the corporate green bond process: pre-issuance and post-issuance. Their findings indicate that "high environmental performers" are more inclined to secure second-party opinions from ESG specialists, who bring technical expertise and depth of assessment, while weaker performers in Asian markets are more likely to engage external reviewers to bolster credibility. Importantly, the type of reviewer, generalist rating agencies or auditing firms versus specialized ESG providers, carries distinct signaling implications. While generalists offer broad legitimacy and recognition, specialists contribute technical environmental validation.

From the investor perspective, Sangiorgi and Schopohl (2021) provide complementary insights through survey evidence from European asset managers. Their study reveals robust and diverse investor participation in the green bond market, with strong preferences for sovereign and corporate issuers. Notably, investors express unmet demand for green bonds from non-financial corporates, particularly in sectors such as industrials, automotive, and utilities, highlighting a structural supply gap. Investment decisions are shaped by a combination of financial and non-financial considerations, with competitive pricing and demonstrably strong green credentials, both at issuance and throughout the bond's lifecycle, emerging as decisive factors. Conversely, inadequate or opaque reporting on the use of proceeds is a significant deterrent, leading investors to avoid or divest from green bonds lacking transparency. Policy measures such as preferential capital treatment for low-carbon assets and minimum standards for green definitions receive strong support among investors, although opinions diverge on whether rigid or flexible definitions of "green" are most conducive to market scaling.

Issuers' motivations further complicate the dynamics of the sustainable bond market. Rose

(2025) traces the exponential growth of sustainable debt issuance, from $29 billion in 2013 to $1 trillion in 2023, while probing the drivers behind issuer participation. An analysis of hand-collected issuer disclosures shows that material legal, regulatory, and physical risks are rarely identified as reasons for engaging in sustainable finance. Instead, issuers primarily cite shareholder pressures and the desire to enhance corporate branding around sustainability, environmental stewardship, and social engagement. This finding suggests that reputational considerations and investor expectations may outweigh direct risk management concerns in motivating issuers to enter the market.

Finally, external reviews serve as assurance mechanisms, but their effectiveness varies depending on the type of reviewer, the environmental performance of issuers, and the disclosure context (Dinh, Eugster, & Husmann, 2025). Investor preferences reveal both a willingness to participate broadly and a sensitivity to transparency, pricing, and credible green performance signals (Sangiorgi & Schopohl, 2021). Issuers, meanwhile, appear motivated less by regulatory risk management than by reputational benefits and shareholder expectations (Rose, 2025). Together, these insights highlight that the credibility and expansion of sustainable finance will require not only robust external assurance and transparent reporting but also alignment between issuer motivations and investor demand.

2 The Issuance of GSS Bonds

(1) Announcement of GSS Bond Issuance

The growing prominence of GSS bonds has attracted considerable scholarly attention, particularly regarding how financial markets respond to the issuance of these bonds. Existing studies investigate whether such announcements generate measurable stock market reactions and what these responses reveal about investor perceptions, firm performance, and the signaling value of sustainable debt instruments.

Tang and Zhang (2020) present one of the earliest comprehensive international analyses of the announcement effects of green bond issuances across 28 countries from 2007 to 2017. They document a positive stock market response following issuance announcements, suggesting that equity investors reward firms engaging in sustainable finance. Importantly, this effect does not appear to be driven by lower debt costs, as no significant premium was identified. Instead, green bond issuance is associated with improved institutional ownership, particularly domestic institutions, and greater stock liquidity, thereby benefiting existing shareholders beyond immediate market valuation gains.

Table 1. Summary of Literature Review on Pre-Issuance of GSS Bonds

Study	Author	Focus	Main Findings
a. Issuing Company Environmental Performance			
	Franke, Katzer (2025)	Green Bond	Firms with a higher climate change exposure are more likely to issue green bonds.
b. Issuing Company Financial Performance			
	Wang, Lee, Park (2022)	GSS Bond	A bigger size and a more foreign-owned company tend to issue green bonds more.
	Dutordoir, Li, Neto (2022)	Green Bond	Firms with lower costs of disclosure, higher reputational gains from being seen as green, and a stronger focus on innovation are more likely to issue green bonds instead of conventional bonds.
	Jelili (2025)	GSS Bond	Size, governance quality, ESG performance, and macroeconomic factors such as GDP per capita and inflation are positively related to the GSSS bond-issuing company.
c. Issuing Company Motivation			
	Rose (2025)	GSS Bond	Issuers motivated by shareholder pressures and a desire to enhance the ESG nature of their corporate brand.
d. Investor Motivation: Investing in Green Bond			
	Sangiorgi, Schopohl (2021)	Green Bond	The majority of investors are actively invested in the green bond market via a variety of investment channels.
e. Pre-issuance External Review			
	Dinh, Eugster, Husmann (2025)	Green Bond	High environmental performers are more likely to obtain a second-party opinion or certification from ESG specialists rather than rating agencies or other providers.

Complementing these findings, Glavas (2018) analyzes 780 corporate bond issuance announcements in 22 countries between 2013 and 2018, applying event study, regression, and difference-in-differences approaches. This study confirms that firms experience a positive abnormal stock return around green bond issuance announcements. Notably, the reaction strengthened after the 2015 Paris Agreement, indicating that the agreement shifted investor sentiment toward valuing green bond issuances as a credible signal of long-term sustainability commitment. This highlights the role of policy frameworks in amplifying the signaling effect of green finance.

However, the positive relationship between green bond announcements and stock performance has not been universally confirmed. Bhagat and Yoon (2023), using an international sample of 1,560 corporate green bond announcements between 2013 and 2022, find

no significant stock market reaction. Their analysis, which accounts for event window length and other robustness checks, suggests that green bond announcements may not systematically generate excess returns for shareholders. Moreover, they report that firms announcing green bonds exhibit significantly negative abnormal operating performance during the same year, implying that some managers may use green bond issuances to divert attention from underlying business underperformance. This contrasts sharply with the positive interpretations offered by earlier studies.

Flammer（2021）provides a broader perspective by examining not only immediate announcement returns but also the long-term impacts of corporate green bonds. Her findings suggest that green bonds have positive short-term announcement effects and promote long-term improvements in firm value, environmental performance, and innovation in green technologies. Additionally, issuance is shown to attract environmentally conscious investors, particularly those with long-term and green-oriented investment strategies. This reinforces the notion that green bonds serve as a credible commitment device, enhancing both financial and non-financial performance over time.

Extending the discussion beyond green bonds to sustainability bonds, Mathew and Sivaprasad（2023）investigate the performance of corporate sustainability bond issuances worldwide from 2014 to 2020. Their results reveal that sustainability bond announcements elicit stronger positive stock market reactions compared to traditional bonds, with repeat issuers benefiting even more than first-time issuers. Furthermore, firms with higher ESG scores experience more pronounced positive market responses, underscoring the role of environmental and social credibility in enhancing the signaling power of sustainability bonds. These findings suggest that sustainability bonds may amplify investor trust in firms' commitments to ecological and societal goals, thereby yielding favorable market outcomes.

While several studies（Tang & Zhang, 2020; Glavas, 2018; Flammer, 2021; Mathew & Sivaprasad, 2023）highlight positive announcement effects, improved investor composition, and long-term value creation, others（Bhagat & Yoon, 2023）caution that these effects are neither universal nor guaranteed. The mixed evidence suggests that contextual dependencies, including regulatory frameworks, firm ESG credibility, and investor expectations, play a role. Overall, GSS bond issuance announcements appear to function as a signaling mechanism; however, the extent of their impact remains contingent on both firm-specific and institutional factors.

(2) The Pricing of GSS Bonds

The pricing of GSS bonds has emerged as a central theme in the sustainable finance literature, with scholars debating whether a “greenium”, a yield discount relative to conventional bonds, exists and under what conditions it materializes. The discussion centers on factors such as issuer credibility, market demand, certification, regulatory environment, and the broader dynamics of sustainable investing.

Kaprauny, Latinoz, Scheins, and Schlag（2019）argue that the existence of a green premium depends critically on the perceived credibility of both the issuer and the bond. Their analysis of more than 1,500 green bonds shows that such a premium is observable primarily in government and supranational issuances, euro-denominated bonds, and large corporate issues. Importantly, they demonstrate that corporate bonds benefit from credibility signals, such as third-party certification or listing on exchanges with strict requirements, which enhance investors’ willingness to accept lower yields. This highlights the significance of institutional credibility and effective governance structures in determining green bond pricing.

Expanding on this, Zhang, Li, and Liu（2021）provide evidence from China that green bond issuance reduces the corporate cost of capital, not only through lower debt costs but also by lowering the cost of equity. Using propensity score matching to compare green and conventional corporate bonds, they identify three main channels: reduced information asymmetry, improved security liquidity, and diminished perceived risk of issuers. Their findings suggest that beyond immediate borrowing cost advantages, green bonds contribute to firm value by improving overall financing conditions.

At the global level, Caramichael and Rapp（2024）document an average yield discount of approximately eight basis points for green bonds compared to conventional counterparts. They note that this greenium has become more pronounced since 2019, coinciding with regulatory developments in the EU and the expansion of sustainable asset management. Their results highlight that demand-side factors, particularly oversubscription levels and bond index inclusion, are key drivers of the observed premium. Interestingly, while governance mechanisms of green bonds influence the greenium, the credibility of underlying projects does not significantly alter pricing. The benefits appear concentrated among large, investment-grade issuers in developed economies, particularly within the banking sector, suggesting that green bond pricing advantages are not evenly distributed.

Zhou, Li, and Luo（2022）focus on Chinese corporate green bonds and report a pricing premium of 21 basis points relative to conventional bonds. Their study reveals that the pre-

mium is more significant for issuers with lower ownership concentration and for bonds with third-party certification, reinforcing the credibility argument raised by Kaprauny et al. (2019). By contrast, green bonds subsidized by local governments exhibit no significant premium, implying that policy interventions may offset or distort natural pricing dynamics. The authors argue that reducing issuance costs and offering fiscal incentives would better facilitate the growth of the green bond market.

The relationship between ESG performance and green bond pricing introduces further complexity. Jin and Turvey (2024) find a generally negative relationship between ESG scores and corporate bond yield spreads, supporting the notion that higher ESG quality reduces financing costs. However, in the case of green bonds, a counterintuitive positive relationship is observed between ESG scores and yield spreads, particularly in the banking and electric utilities sectors. Regional differences are also apparent: ESG scores reduce spreads in Eurobonds but increase them in US corporate bonds. These results suggest a diminishing greenium and raise concerns about greenwashing, as stronger ESG credentials do not consistently translate into pricing advantages in green bond markets.

Finally, Pinto (2024) presents a comprehensive, large-scale comparative analysis of 30,368 bonds from 8,267 non-financial firms spanning the period from 2012 to 2022. The study finds no significant differences in credit spreads between sustainable and conventional bonds, a result that holds across green, social, and sustainability bonds, as well as across pre- and post-COVID periods. Pinto further notes that investors place less emphasis on credit ratings when pricing sustainable bonds compared to conventional ones, indicating that sustainable debt instruments may follow different valuation logics. However, the absence of consistent borrowing cost advantages challenges the assumption that GSS bonds universally reduce financing costs for issuers.

The current literature paints a nuanced picture of GSS bond pricing. While some studies document clear evidence of a greenium, its existence appears to be contingent upon issuer credibility, third-party verification, market demand, and regional context. In some cases, particularly in large, developed markets, pricing advantages are evident. However, in others, such as broad corporate issuance or global cross-sections, the greenium is minimal or absent. Moreover, the potential erosion of the greenium, as indicated by recent findings, raises important questions about the long-term sustainability of investor incentives and the possibility of greenwashing. The empirical evidence thus suggests that while GSS bonds can lower financing costs under specific conditions, their broader pricing dynamics remain heterogene-

Table 2. Summary of Literature Review on the Issuance of GSS Bonds

Study	Author	Focus	Main Findings
a. GSS Bond Issuance Announcement			
	Tang, Zhang（2020）	Green Bond	Positive market reaction.
	Glavas（2018）	Green Bond	Positive market reaction.
	Bhagat, Yoon（2023）	Green Bond	No significant market reaction.
	Flammer（2021）	Green Bond	Positive market reaction.
	Mathew, Sivaprasad（2023）	GSS Bond	Positive market reaction.
b. The Pricing of GSS Bond			
	Kaprauny, Latinoz, Scheins, Schlag（2019）	Green Bond	Only certain types of bonds trade at a Green premium.
	Zhang, Li, Liu（2021）	Green Bond	Reduces the cost of debt and the cost of equity.
	Caramichael, Rapp（2024）.	Green Bond	Has a lower yield spread than green bonds.
	Zhou, Li, Luo（2022）	Green Bond	There is a green premium.
	Jin, Turvey（2024）	Green Bond	There is a green premium related to the ESG score.
	João, Pinto（2024）	GSS Bond	Issuing firms do not use sustainable bonds as a strategy to lower borrowing costs.

ous and evolving.

3 The Post-issuance of GSS Bonds

(1) Environmental Impact of Green Bond Issuance

Empirical evidence largely supports a positive correlation between green bond issuance and improvements in environmental performance, although the strength and causality of these effects remain nuanced. Fatica and Panzica（2021）demonstrate that non-financial firms issuing green bonds exhibit a statistically significant reduction in carbon intensity, particularly in Scope 1 emissions. These improvements are more pronounced when proceeds are allocated to new projects rather than refinancing existing ones, and when the bonds receive external review. This suggests that the credibility and intended use of proceeds play critical roles in ensuring environmental impact.

Complementing these findings, Chen et al.（2025）employ a Controlled Interrupted Time Series design and advanced machine learning models to assess firm-level environmental performance post-issuance. Their study confirms improvements in environmental outcomes for green bond issuers compared to conventional bond issuers. Notably, the effectiveness of green bonds is strongly influenced by firm-level characteristics, more so than bond-specific features. This highlights the importance of internal corporate strategies in leveraging green

financing to achieve sustainable outcomes.

However, Mao（2023）cautions against over-attributing environmental performance improvements solely to green bond issuance. Using a Difference-in-Differences（DiD）framework, Mao finds that while GHG intensity tends to decline following green bond issuance, these effects may not be causally driven by the bond itself. Instead, firms that already have green initiatives underway, regardless of their financing, appear to use green bonds as a signaling mechanism. Nevertheless, repeat issuers show more credible and sustained improvements, indicating the value of long-term commitment to green finance frameworks.

The limitations of green bond efficacy are further explored by Leung, Wan, and Wong（2023）, who expose the presence of greenwashing within the market. Some firms demonstrate no observable environmental improvement post-issuance, raising concerns about the authenticity of their green credentials. While the market exhibits some capacity to penalize these issuers, reflected in constrained access to future green financing, the study highlights the need for stronger regulatory oversight, such as robust taxonomies and disclosure mandates, to mitigate opportunistic behavior.

⑵ ESG Performance Beyond Environmental Outcomes

While environmental metrics dominate the discussion on GSS bonds, recent research has begun to examine the broader ESG implications of such issuances. Chen, Tan, and Liu（2023）analyze the effect of green bond issuance on corporate ESG performance using a quasi-natural experimental design and DiD methodology. Their findings suggest that green bond issuance significantly enhances overall ESG performance, not just environmental indicators. This improvement is attributed to mechanisms such as reduced financing constraints, enhanced earnings quality, and increased green innovation.

Importantly, the study reveals heterogeneity in outcomes based on factors such as enterprise ownership, industry sector, and regional environmental regulation. For instance, state-owned enterprises and firms operating in heavily regulated regions experience greater ESG gains post-issuance. These results highlight the significant role of institutional context in shaping the effectiveness of green finance tools.

Shimauchi et al.（2025）expand the lens further by comparing green bonds with sustainability bonds and sustainability-linked bonds（SLBs）. Using DiD and event study methodologies, their analysis finds that sustainability and SLBs, by design, allow broader use of proceeds and incorporate performance-based triggers, yielding greater environmental improve-

ments than green bonds. This suggests that instruments explicitly tying financing to sustainability outcomes may provide stronger incentives for corporate behavioral change.

⑶ Green Bond Issuance and Green Innovation

The intersection of green finance and innovation has garnered increasing attention in recent years, particularly in the context of corporate green bond issuance. Green bonds, a financial instrument designed to fund environmentally sustainable projects, have emerged as a critical mechanism for fostering green innovation. Dong, Zhang, and Zheng（2024）delve into the impact of green bond issuance on corporate green innovation and its underlying mechanisms. Their study finds a positive relationship between green bond issuance and the promotion of green innovation, noting that the effect is particularly strong in regions with less stringent climate regulation. The study further highlights that industries with better environmental performance and firms with concentrated ownership structures tend to exhibit a stronger response to the issuance of green bonds. This suggests that the presence of green bonds not only drives innovation but also facilitates the reallocation of investment capital toward research and development（R&D）, effectively overcoming the financial constraints that often impede the pursuit of environmentally innovative technologies.

Importantly, the study underscores that the upsurge in green innovation resulting from green bond issuance is not limited to technological advancements but also includes improved financial outcomes. Firms that engage in green innovation experience enhanced financial performance, alongside significant environmental benefits, such as better environmental investment and stronger environmental, social, and governance（ESG）performance. The findings of Dong et al.（2024）highlight that the role of green finance, particularly green bonds, is pivotal in advancing sustainable corporate innovation and addressing climate governance issues, contrasting the tendency of some firms to engage in “greenwashing.”

Li et al.（2025）offer additional insights into the role of green bonds in stimulating green technological innovation. By examining data from A-share listed companies in China over a twelve-year period, the authors reveal that the green bond policy has a significant impact on increasing corporate green patent applications, especially for green invention patents. The study further identifies heterogeneity in the policy’s impact, with a stronger effect on high-pollution industries and non-state-owned enterprises. Li et al.（2025）argue that green bonds work as a signaling mechanism, demonstrating a firm’s environmental commitment and alleviating financing constraints, which in turn accelerates green technological innovation. Fur-

thermore, the study points out that green bond issuance promotes greater environmental information disclosure, thus enhancing transparency and fostering a deeper commitment to sustainability.

These studies collectively emphasize the critical role of green bonds in advancing corporate green innovation. They show that green bond issuance not only supports innovation at the firm level but also contributes to broader environmental goals, helping to mitigate climate change by facilitating the development and adoption of green technologies.

⑷ External Reviews of Green Bonds Post-Issuance

External reviews play a significant role in the corporate green bond process, particularly in enhancing transparency and credibility. The post-issuance phase of the green bond lifecycle, in which issuers provide reports on the use of proceeds and environmental impact, is a key stage where external reviews come into play. Dinh, Eugster, and Husmann（2023）investigate the role of external reviews in this phase, emphasizing the increased likelihood of obtaining external reviews for companies that are high environmental performers in common-law countries and Europe, while companies with poorer environmental records are more likely to seek reviews in Asian countries.

The study introduces a self-developed disclosure index validated by automated text analysis, which assesses the quality of green bond reports with and without external reviews. The authors find that reports accompanied by external reviews exhibit higher overall disclosure quality. However, the improvement in disclosure quality is less pronounced for items that require subjective judgment, making them more difficult to verify. This suggests that while external reviews enhance the transparency of green bond reports, their effectiveness may vary depending on the type of information disclosed.

The findings of Dinh et al.（2023）underscore the variability in the monitoring role of external reviews across different phases of the green bond process. The post-issuance phase appears to be a critical juncture where external reviews can help mitigate concerns about greenwashing and ensure that the proceeds are used for their intended environmental purposes. However, the authors also note that regional differences and the types of providers conducting the reviews play a significant role in shaping the effectiveness of these reviews.

In conclusion, external reviews in the green bond process play a critical role in enhancing transparency, improving disclosure quality, and ensuring that green bonds fulfill their environmental promises. These reviews help mitigate the risk of greenwashing, thereby contrib-

uting to the credibility and success of the green bond market. Moreover, their impact on green bond pricing highlights the economic incentives for issuers to obtain high-quality external reviews, which ultimately fosters greater confidence and participation in the market.

⑸ Impact on Credit Risk and Default Risk Perception

The issuance of green bonds has garnered attention not only for its environmental benefits but also for its potential financial advantages. One critical area of investigation is the impact of green bond issuance on firms' credit risk and default risk perceptions. Ahn, Attaou, and Fouquau（2025）explore this aspect by focusing on credit default swap（CDS）spreads, a key indicator of a firm's credit risk. Their study highlights that green bond issuance is associated with a significant reduction in CDS spreads, signaling a decrease in perceived default risk. This effect is especially pronounced for firms' first green bond issuance, which marks their initial commitment to sustainability. Subsequent issuances show diminishing effects on CDS spreads until the third issuance, which again leads to a notable risk reduction. These findings suggest that green bonds not only represent a firm's commitment to sustainability but also serve as a forward-looking indicator of creditworthiness, enhancing the firm's reputation in the market and lowering its cost of credit. This research adds to the growing body of literature suggesting that the market reacts positively to green bond issuance, reducing a firm's perceived default risk. It underscores the importance of a firm's continued commitment to sustainability, noting that the benefits to credit risk perceptions accumulate with repeated green bond issuance, thereby fostering long-term financial stability.

⑹ Economic and Financial Performance Post-Issuance

Beyond credit risk, the financial performance of firms post-green bond issuance has been the subject of various studies, with mixed results regarding the economic benefits. Coelho et al.（2024）analyze data from European firms that issued green bonds between 2013 and 2021, revealing that such issuances positively influence firms' profitability, size, and overall financial value. They find that the issuance of green bonds has a pronounced effect in industries where environmental concerns are financially material, suggesting that green bonds are not just about raising capital for environmentally sustainable projects, but also contribute to the firms' economic growth.

Moreover, the study by Flammer（2021）reinforces these findings by documenting the positive financial outcomes of green bond issuance. Green bonds were found to yield positive

Table 3. Summary of Literature Review on the Post-Issuance of GSS Bonds

Study	Author	Focus	Main Findings
a. Environmental Performance after the issuance (Greenwashing)			
	Fatica, Panzica (2021)	Green Bond	Reduction in carbon emissions.
	Leung, Wan, Wong (2023)	Green Bond	Some corporations are found to have no reduction in greenhouse gas emission intensities.
	Mao (2023)	Green Bond	The improvements are not causally attributed to green bond issuance and are likely due to green initiatives that would have been funded regardless.
	Shimauchi, Fukui, Yamamoto, Taura, Kameda (2025)	Sustainability Bond	Enhanced environmental performance for sustainability bond issuance compared to issuing only a green bond.
b. ESG Performance after the issuance			
	Chen, Tan, Liu (2023)	Green Bond	Significantly amplifies ESG performance.
	Chen, Erlwein-Sayer, Mamon, Spagnolo, Spagnoloc (2025)	Green Bond	The issuance of green bonds positively affects companies' environmental performance.
c. Financial Performance after the issuance			
	Coelho, Madaleno, Pacheco, Pinto (2024)	Green Bond	Issuance positively benefits the firms' financial performance.
	Flammer (2021)	Green Bond	Issuance positively benefits the firms' financial performance.
d. Green Innovation after the Issuance of GSS Bond			
	Dong, Zhang, Zheng (2024)	Green Bond	Promotes the firm's green innovation.
	Li, Cao, Wang, Zhang, Liu (2025)	Green Bond	Promotes the firm's green innovation.
e. Post-Issuance External Review			
	Dinh, Eugster, Husmann (2023)	Green Bond	External reviews exhibit higher disclosure quality in general, but not for items on which preparers' judgment is more subjective, which makes the items harder to verify.
	Allman, Lock (2024)	Green Bond	There is no significant effect of external review on green bond issuance.
f. Green Bond Issuance and Credit Default Risk			
	Ahn, Attaou, Fouquau (2025)	Green Bond	Green bond issuances lead to a significant reduction in CDS spreads.

announcement returns, enhance long-term value, and improve operational performance. Notably, the issuance also fostered an increase in green innovations and attracted long-term, environmentally conscious investors. These outcomes point to the broader financial benefits that extend beyond the immediate use of proceeds for environmental initiatives. Firms issuing green bonds seem to experience a shift toward greater value creation over time, as the

investments made through green bonds help improve both their environmental footprint and overall market performance.

Both studies suggest that the economic benefits derived from green bond issuance are not solely driven by cheaper capital access. Instead, the funds raised are effectively channeled into initiatives that enhance long-term financial and operational performance. Additionally, the growing recognition of firms' commitment to sustainability appears to attract investors who value environmental, social, and governance（ESG）principles, which may further contribute to sustained financial performance.

Ⅲ GSS Bond in the Asia Pacific Region

Several countries in the Asia-Pacific have taken significant steps to promote the issuance and credibility of green, social, and sustainable bonds, supported by evolving regulatory frameworks and growing investor interest. China, for example, is one of the largest issuers of green bonds globally. In 2022 alone, Chinese issuers accounted for approximately 15% of global green bond issuance, with strong backing from the government and state-owned banks. China's transition to align its domestic green bond taxonomy with international standards, culminating in the 2021 Common Ground Taxonomy jointly developed with the EU, represents a major step toward increasing transparency and cross-border compatibility.

Japan has also emerged as a leader in the sustainable finance space, underpinned by robust public-private collaboration. The Japanese government has issued sovereign green bonds and established the Green Bond Guidelines and Social Bond Guidelines, which provide voluntary standards tailored to domestic issuers while remaining aligned with International Capital Market Association principles. In addition, Japan launched a GX（Green Transformation）Bond Framework in 2023 to finance its ambitious carbon neutrality goals, with the first issuance of ¥1.6 trillion in fiscal 2023 aimed at decarbonizing industry and promoting clean energy.

In Southeast Asia, Indonesia and the Philippines have pioneered sovereign GSS bond issuances to support climate and social priorities. Indonesia issued the world's first sovereign green sukuk in 2018 and has since become a repeat issuer, using proceeds to finance renewable energy, sustainable transport, and disaster resilience. The Philippines issued its first sustainability bond in 2020, and in 2022, it launched its Sustainable Finance Roadmap to guide the development of ESG-related financial instruments and address climate and social vulner-

abilities. Meanwhile, Singapore has positioned itself as a regional hub for sustainable finance, introducing the Green and Sustainability-Linked Loan Grant Scheme and offering subsidies for external review costs. In 2022, the Monetary Authority of Singapore（MAS）unveiled the Singapore Green Bond Framework and committed to issuing up to S$35 billion in green sovereign bonds by 2030. The first sovereign green bond, worth S$2.4 billion, was issued in 2022 to support public infrastructure and climate adaptation projects.

Australia and New Zealand have also contributed to regional momentum. Australia's market is primarily driven by sub-sovereign entities and corporate issuers in the energy and banking sectors. In 2023, the Australian government announced its intention to issue sovereign green bonds and launched a Sustainable Finance Strategy, which includes developing a taxonomy and mandatory climate-related disclosures. New Zealand issued its inaugural NZ $3 billion sovereign green bond in 2023, supporting projects in clean transport, renewable energy, and biodiversity conservation.

While these examples demonstrate the region's progress, further harmonization, capacity building, and impact measurement remain critical. Multilateral organizations such as the Asian Development Bank（ADB）continue to support the development of local currency GSS bond markets, particularly in frontier economies, through technical assistance and blended finance. Continued collaboration between governments, financial institutions, and regulators will be essential to scaling up GSS bond issuance and ensuring that financing translates into measurable environmental and social outcomes across the Asia-Pacific.

Ⅳ Conclusion

This literature review synthesized findings on the lifecycle of GSS bonds, spanning the stages of pre-issuance, issuance, and post-issuance. Across the lifecycle, research demonstrates that GSS bonds have evolved into a central pillar of sustainable finance. However, challenges remain in terms of credibility, pricing, transparency, and long-term impact.

At the pre-issuance stage, studies highlight the critical role of external reviews, certification mechanisms, and disclosure practices. While these mechanisms enhance investor confidence and mitigate concerns about greenwashing, the literature also emphasizes heterogeneity in standards, which limits comparability and global harmonization. During the issuance stage, empirical evidence consistently shows a "greenium" effect, characterized by modest but significantly lower yields for certified green and sustainable bonds compared to their con-

ventional counterparts. However, this premium is not universal and varies by issuer credibility, region, and institutional frameworks. Market dynamics, investor demand, and regulatory contexts heavily influence issuance outcomes. At the post-issuance stage, studies investigate the real effects of GSS bonds on firms and projects. Evidence suggests mixed results: some firms experience improved environmental performance and positive stock market reactions, while others exhibit limited or symbolic impact. The diversity of findings underscores the importance of monitoring frameworks and accountability mechanisms to ensure that proceeds translate into measurable sustainability outcomes.

The reviewed literature illustrates both the potential and fragility of the GSS bond market. While issuance volumes have expanded rapidly, the ecosystem still faces unresolved questions of standardization and impact measurement. A key insight across the lifecycle is the role of credibility. At pre-issuance, credibility hinges on rigorous external reviews. At issuance, it relies on pricing transparency and disclosure. At post-issuance, it is based on accountability in proceeds allocation. The fragmentation of standards across jurisdictions, ranging from International Capital Market Association principles to the EU Taxonomy, creates uncertainty for issuers and investors, limiting the market's scalability. Furthermore, while investor appetite is strong, skepticism about "greenwashing" undermines confidence. These issues are particularly pronounced in emerging markets, where institutional frameworks are weaker, transaction costs are higher, and the penetration of green bonds remains limited.

One striking gap is the Asia-Pacific region, which has witnessed some of the fastest growth in GSS bond issuance globally, particularly in markets such as China, Japan, Singapore, and Australia. Despite this momentum, academic research has largely overlooked Asia-Pacific dynamics. The lack of region-specific studies leaves critical questions unanswered: how regulatory environments, cultural factors, and market structures shape issuance, pricing, and post-issuance impact. Given the scale of climate and social challenges in the Asia-Pacific region, this omission represents a major blind spot in the literature.

This review is subject to several limitations. First, while the categorization by lifecycle provides clarity, some studies overlap across stages, making strict separation difficult. Second, the literature on social and sustainability bonds remains underdeveloped, leading to a green bond-centric synthesis. Third, heterogeneity in methodologies, ranging from event studies to quasi-experiments, limits the comparability of results. Fourth, most studies rely on datasets biased toward Europe and North America, leaving the Asia-Pacific region underexplored, despite its rapid growth in GSS issuance. Ultimately, the generalizability of the find-

ings to emerging economies is constrained by institutional and market differences.

Overall, the literature indicates that GSS bonds have evolved into a vital instrument for channeling capital toward sustainability, but their effectiveness depends on credibility, transparency, and accountability throughout their lifecycle. The omission of the Asia-Pacific and other emerging markets from current academic work presents a significant opportunity. Understanding these rapidly growing regions will be crucial for assessing whether GSS bonds can fulfill their promise as a genuinely global driver of sustainable development.

Ⅴ Future Research

Several gaps remain open for future inquiry. Firstly, research on social and sustainability bonds is scarce compared to green bonds. Future studies should explore whether issuance dynamics, pricing, and impact differ systematically across categories. Secondly, the Asia-Pacific region's rapid development in GSS bond markets demands a dedicated study. Future research should examine issuance practices, investor behaviors, and regulatory frameworks unique to the Asia-Pacific region and compare them with those in established Western markets. Thirdly, beyond the Asia-Pacific region, expansion to Africa and Latin America is necessary to assess scalability in diverse institutional contexts. Moreover, more empirical work is needed to link GSS bond proceeds with measurable environmental and social outcomes, beyond symbolic commitments. Studies relating to the long-term effects, especially in the post-issuance literature, often focus on short-term stock market reactions. Longitudinal studies could clarify whether GSS financing generates sustained performance improvements. Lastly, as taxonomies and disclosure requirements become increasingly stringent globally, future research should examine how regulation influences market pricing, issuance quality, and investor demand.

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