

Digitalization in Green Bond Markets

Introduction to Digital Bond Markets

The bond market, a cornerstone of global financial markets, is undergoing a digital transformation. Blockchain technology and distributed-ledger technology (DLT) provide tamper-proof and secure ledgers, enabling more efficient and transparent transactions in the issuance and trading of bonds. This transition from traditional to digital bond markets is particularly significant for green bonds, which fund environmentally sustainable projects.

Digitalization offers several key benefits for green bond markets. Blockchain's immutable ledger minimizes the risk of fraud and unauthorized data alterations, significantly enhancing security. By automating manual processes and eliminating intermediaries, blockchain reduces underwriting fees, administrative overhead, and other transaction costs. Blockchain facilitates fractional ownership of bonds, allowing smaller investors to participate in the market, thereby increasing liquidity and inclusivity.

While the potential benefits of digital bonds are substantial, there are challenges, including regulatory uncertainty, interoperability among blockchain platforms, and technical complexities in integrating blockchain with existing systems. Addressing these challenges is crucial for the widespread adoption of digital bonds.

Theoretical Background: Resource-Based and Dynamic Capability Theories

This special section is based on two key theoretical frameworks to explain the role of blockchain in green bond markets: resource-based theory (RBT) and dynamic capability theory (DCT).

RBT posits that firms gain a competitive advantage by leveraging their unique resources. Blockchain technology—with its secure, transparent, and

decentralized structure—provides firms with a valuable resource in the green bond market. The transparency and trust facilitated by blockchain can differentiate firms and attract investors who prioritize security and environmental impact.

DCT complements RBT by focusing on a firm's ability to adapt to rapidly changing environments. In green bond markets, where regulations and investor expectations are continuously evolving, blockchain allows firms to adjust processes dynamically. By integrating blockchain, firms can respond more effectively to regulatory shifts, meet the increasing demand for transparency, and maintain their competitive edge.

These two theories suggest that firms that adopt blockchain technology in the issuance of green bonds not only improve their operational efficiency but also enhance their ability to navigate evolving market demands and regulations.

Literature Review: Benefits of Blockchain in Green Bond Markets

The paper this special section is based on synthesizes numerous empirical studies that highlight the benefits of integrating blockchain and DLT into green bond markets. These benefits include cost reduction, enhanced transparency and security, and increased market liquidity.

Cost Reduction

Blockchain significantly reduces the costs associated with bond issuance and trading. Studies by Leung, Wang, and Wong (2023) and Javaid (2022) show that tokenization of bonds through blockchain lowers underwriting fees, borrowing costs, and administrative overhead by automating many processes and eliminating intermediaries.

Leung, Wang, and Wong (2023) find that blockchain reduces the costs of bond issuance by automating complex processes that traditionally require significant manual intervention. Javaid (2022) highlights how digital securities, facilitated by blockchain, offer faster and more cost-effective issuance, making green bonds more attractive to both issuers and investors.

The reduction in transaction costs and the acceleration of bond issuance processes make digital bonds a more efficient and cost-effective option for financing green projects.

Transparency and Security

One of the most significant advantages of blockchain is its ability to provide transparency and security in green bond transactions. According to Christodoulou, Lafond, and Wilson (2023), transparency is crucial in green bond markets to ensure that funds are allocated to genuine environmental projects. Blockchain's decentralized ledger system allows real-time tracking of bond proceeds, reducing the risk of "greenwashing" (i.e., the misuse of funds meant for environmental purposes).

Moreover, blockchain enhances security by making unauthorized data alterations virtually impossible. This reduces the risk of fraud, further boosting investor confidence in the integrity of green bond markets. Investors can trust that their funds are being used appropriately, knowing that blockchain ensures full transparency and accountability.

Liquidity and Market Accessibility

Blockchain's ability to enhance liquidity and market accessibility is another significant advantage. By enabling fractional ownership of bonds, blockchain allows smaller investors to enter markets that were previously dominated by large institutional players. Trivedi (2021) explains that this fractionalization increases liquidity by lowering the entry barriers for investors and enabling bonds to be traded more frequently.

Furthermore, blockchain's real-time settlement capabilities reduce delays and counterparty risks, enhancing the overall efficiency of bond markets. Parker and Scott (2021) also highlight how 24/7 trading capabilities provided by blockchain platforms enhance

liquidity, making the bond market more attractive to a broader range of investors.

Case Studies: Practical Applications of Blockchain in Green Bond Markets

The paper this special section is based on presents two case studies from Japan and Hong Kong, China to illustrate the practical applications of blockchain technology in the issuance of green bonds.

Japan Exchange Group's Digitally Tracked Green Bonds

Japan Exchange Group (JPX) has introduced a groundbreaking initiative by issuing digitally tracked green bonds. These bonds, designed to finance environmentally sustainable projects, use blockchain technology to track and report the environmental impact of the financed projects in real-time. Key features of this initiative are discussed below.

Blockchain allows investors to monitor the environmental outcomes of their investments in real-time, ensuring transparency in the use of proceeds. In collaboration with Hitachi, JPX developed the Green Tracking Hub, which provides investors with data on the environmental performance of the projects funded by the bonds.

JPX's initiative demonstrates how blockchain can improve the accountability and transparency of green financing, increasing investor confidence in the integrity of green bond projects.

Hong Kong, China's Digital Green Bonds

In 2023, the Government of the Hong Kong Special Administrative Region of the People's Republic of China issued the world's first tokenized green bond as part of its Government Green Bond Programme. This issuance, valued at HKD800 million, was conducted using blockchain technology and smart contracts, resulting in several key benefits.

These automated smart contracts facilitated bond issuance, settlement, and redemption, significantly reducing transaction times. The settlement period for these bonds was reduced to T+1 days from the T+2 or

T+3 days typical of traditional bond markets. The bonds were tokenized and issued using the Hong Kong Monetary Authority's digital currency, referred to as e-HKD, demonstrating Hong Kong, China's commitment to integrating digital solutions into its financial infrastructure.

The successful issuance of these tokenized green bonds also highlights Hong Kong, China's leadership in both green finance and fintech innovation, setting a new standard for global bond markets.

Empirical Analysis: Liquidity and Efficiency Gains in Digital Bond Markets

This chapter provides empirical evidence demonstrating the growing adoption of digital bonds globally, particularly between 2020 and 2024. Over this period, more than USD3 billion in digital bonds was issued, reflecting the increasing role of blockchain technology in global financial markets. The table below summarizes the total issuance amounts of digital bonds over the 5-year review period.

Table 4 shows a clear upward trend in the issuance of digital bonds during the review period, with the exception of a minor dip in 2022. This growth indicates a significant shift toward the adoption of digital solutions in bond markets, driven by the advantages of blockchain technology in terms of efficiency, transparency, and security.

Table 4: Global Digital Bond Issuances by Year

Year	Issuance Amount (USD billion)
2020	0.50
2021	1.11
2022	0.82
2023	1.01
2024	1.20
Total	4.64

USD = United States dollar.
Source: Bloomberg.

Key Findings: Liquidity and Efficiency Gains in Digital Bonds

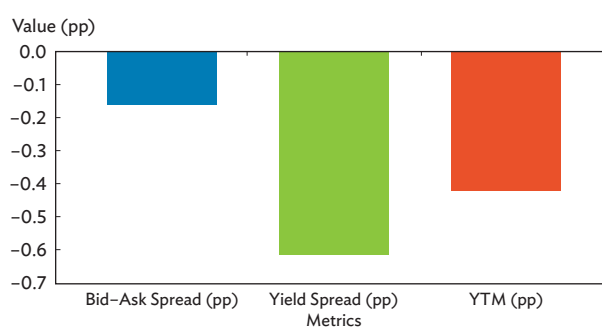
Figure 22 provides empirical results that compare the liquidity and efficiency of digital bonds to conventional bonds. The metrics analyzed include bid-ask spread, yield spread, and yield to maturity (YTM).

The bid-ask spread is defined as the difference between the bid price and the ask price. The bid-ask spread for digital bonds is 0.16 percentage points lower than that of conventional bonds, indicating significantly higher liquidity for digital bonds. The t-statistic for this estimate is -6.04, indicating statistical significance at the 1% level.

The yield spread is defined as the difference between the yield on a bond and the risk-free rate. The yield spread for digital bonds is 0.62 percentage points lower than that for conventional bonds. This pronounced decline suggests that digital bonds are perceived as less risky, or more desirable, resulting in reduced yields. The t-statistic for this estimate is -9.75, which is also significant at the 1% level.

The YTM is defined as the expected return on an investment, given current market conditions and the investment's specific characteristics. The YTM for digital bonds is 0.42 percentage points lower than that for conventional bonds. This further supports the notion that digital bonds offer efficiency gains. The t-statistic for this estimate is -2.69, which is significant at the 5% level.

Figure 22: Liquidity and Efficiency of Digital Versus Conventional Bonds



pp = percentage points, YTM = yield to maturity.

Note: This figure describes the estimated reductions in liquidity (bid-ask spread), yield spreads (May 2024), and YTM (issuance date) when comparing 24 pairs of digital bonds and 208 matched bonds.

Source: Author's calculations.

Digital bonds exhibit superior liquidity and efficiency compared to conventional bonds. The lower bid–ask spreads, yield spreads, and YTM collectively indicate that digital bonds provide significant advantages in terms of trading efficiency and cost-effectiveness.

Summary and Implications

This study reveals meaningful insights into the potential of blockchain technology to optimize green bond market operations. Blockchain and DLT offer significant benefits in terms of efficiency, transparency, security, and accessibility in bond markets. These technologies can play a crucial role in preventing greenwashing by ensuring the accurate and transparent tracking of green bond proceeds. However, several challenges must be addressed to fully realize their potential. These include technical complexities, regulatory uncertainties, interoperability issues, and privacy concerns. Continued research and collaboration among market participants, regulators, and technology providers in the ASEAN+3 region is essential to addressing these challenges and promoting the broader adoption of blockchain technology in bond markets.¹⁰

Policymakers and industry leaders have a critical role to play in shaping the future of green finance by developing supportive policies and infrastructure that foster the adoption of blockchain technology. By doing so, they can help scale up sustainable finance efforts and contribute to the global fight against climate change through more efficient and transparent financial instruments.

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¹⁰ ASEAN+3 is defined to include the member states of the Association of Southeast Asian Nations (ASEAN) plus the People's Republic of China; Hong Kong, China; Japan; and the Republic of Korea.