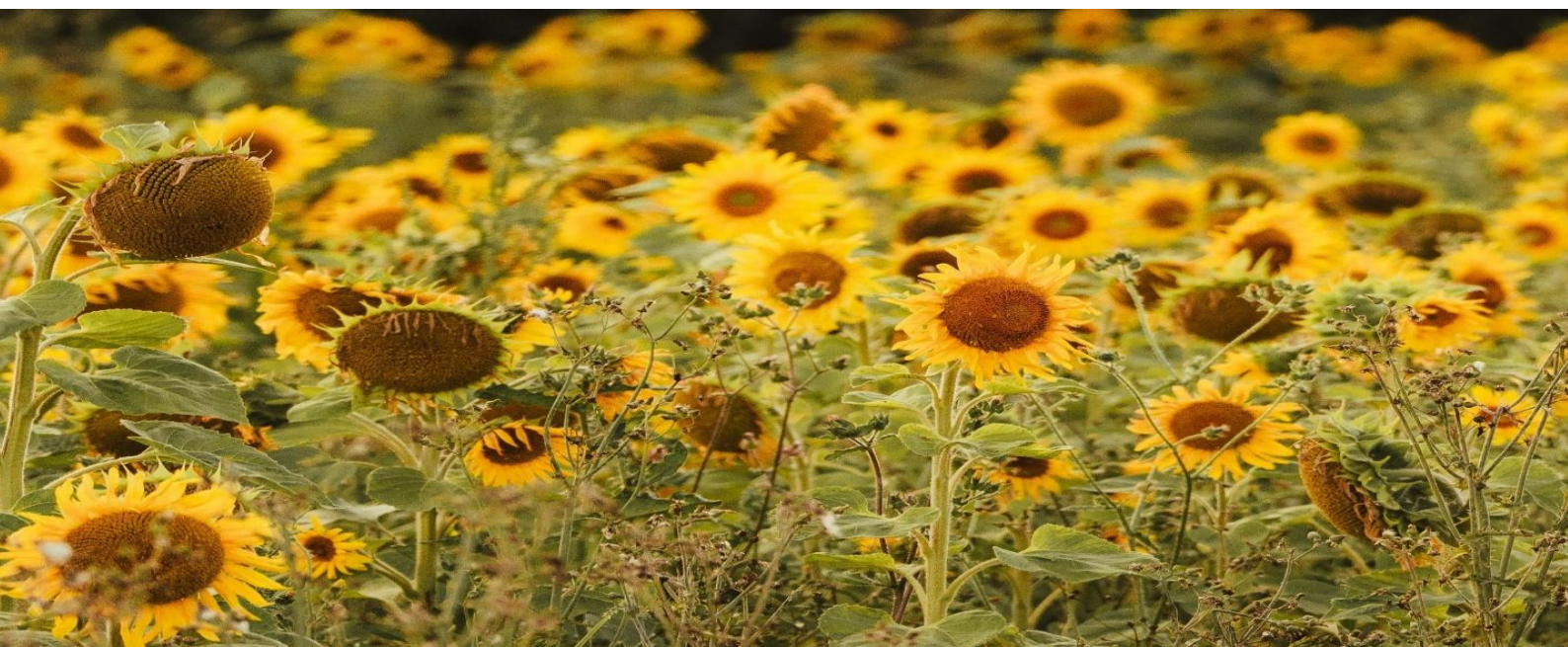




Accelerating the adoption of digital and tokenised sovereign bonds in emerging and developing economies to fund climate action and sustainable development

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Abbreviations and acronyms

AML	Anti-money laundering
ATM	Automated teller machine
BIS	Bank of International Settlements
BOT	Bank of Thailand
BTr	Philippines Bureau of the Treasury
CBDC	Central bank digital currency
CBK	Central bank of Kenya
CMU	Hong Kong Central Moneymarkets Unit
CCP	Central counter party
CSD	Central securities depository
DLT	Distributed ledger technology
DvP	Delivery versus payment
EMDE	Emerging market and developing economy
EUR	Euro
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
HQLA	High quality liquid asset
HKD	Hong Kong Dollar
HKMA	Hong Kong Monetary Authority
HKSARG	Hong Kong Special Autonomous Region Government
IDR	Indonesian Rupiah
KES	Kenyan Shilling
KPI	Key performance indicator
KYC	Know your customer
LIC	Low-income country
MAS	Monetary Authority of Singapore
ORI	Obligasi Negara Ritel (Indonesian retail government bonds)
PHP	Philippine Peso
RTGS	Real time gross settlement
SDG	Sustainable Development Goal
SGD	Singaporean Dollar
THB	Thai Baht
USD	United States Dollar
UNDP	United Nations Development Programme
UNCTAD	United Nations Trade and Development

Executive summary

Emerging market and developing economies (EMDEs) face a triple challenge of sustainable investment gaps, capital flight and aid cuts. In this bleak environment, EMDEs must redouble efforts to mobilise domestic savings for local investment, rather than channelling trillions of USD into overseas financial centres. Potential enablers to persuade EMDE residents and institutions to bring this capital back are new digital finance platforms for sovereign fund raising, partnerships with private sector fintechs, and tokenised sovereign bonds.

New technologies such as mobile money and mobile apps make it much easier for EMDEs to raise government financing directly from domestic households. Previously, the United States' Treasury Direct was a rare example of a platform through which retail investors have direct, non-brokered access to primary government bond issuance. Replicating such a system in smaller countries used to be prohibitively expensive. This is no longer the case. For instance, in 2025, the Philippines launched the GBonds service on the private sector GCash mobile app. GBonds enable the investment in government bonds for as little as PHP 500 (USD 8.5, EUR 7.3) and increased the number of retail investors in sovereign debt from 10,000 to 300,000 in four months. Other countries such as Hong Kong, Indonesia, Kenya, Thailand, and Singapore have launched similar schemes that allow retail investors to invest in government bonds.

Tokenised bonds may be the aspirational goal of digital bonds. Digital platforms for official sector fund raising span all the way from a mobile app that enables the purchase of small denomination savings bond, to modern back-end processing infrastructure, to innovative tokenised bonds issued on programmable platforms. All these functions and features have the potential to scale domestic financing capacity, address new investor groups and lower the barriers to onboarding the unbanked into the financial system. Tokenised bonds specifically promise the elimination of a variety of legacies from the paper-based past of sovereign bonds, such as wet signatures, and settlement and counterparty risks.

Tokenised green or sustainable bonds may be able to natively include records on sustainable projects and be updated to track their performance against KPIs or sustainability metrics. This convergence can then deliver unprecedented levels of sustainability transparency and openness, which currently varies across issuers and bonds.

We find that a series of up-front investments, for example in digital infrastructure and new legal and regulatory frameworks, are required to unlock the potential of sovereign digital finance. The benefits have the potential to outweigh these costs and can be unlocked in a modular fashion. We estimate that in 2024, Kenya's offering of sovereign bonds to domestic retail investors incrementally substituted for 6% of other types of sovereign financing.

These developments represent a move by countries to lessen their reliance on fickle international capital. Enhancing domestic capital mobilisation and the supply of local currency finance is a critical precondition for gradually reducing the cost of capital to foster investment. Digital approaches to expand financing capacity should be considered by EMDEs globally.

1. Introduction

The urgency to raise finance for climate action and sustainable development for EMDE countries cannot be overstated. These nations, most of which have contributed relatively little to global emissions, bear the brunt of climate disasters – extreme weather, rising sea levels, and food insecurity. Two commonly cited potential sources of climate finance are overseas development aid and international capital markets. We seek to raise the profile of a third option and argue that capital in the hands of EMDE residents and institutions can become a key source of financing. Volz, Lo and Mishra (2024) find that over two decades, developing economies excluding China acquired net foreign assets and reserves of USD 15.5 trillion. We argue this capital could be used to partially address the annual Sustainable Development Goals (SDG) investment gap in developing countries of USD 4 trillion per year (UNCTAD, 2023). The latter gap is being compounded by aid cuts. Raga et al. (2025) estimates that, for Low Income Countries (LICs), recently announced cuts are equivalent to almost 2% of GDP. Capital flight, investment gaps and aid cuts; from this unpromising backdrop, might these challenges force countries to redouble efforts to seek alternative sources of capital?

We argue investing in digital finance infrastructure is a promising avenue for strengthening domestic financial resource mobilisation. Importantly, this goes beyond capital raising. These investments may help democratise access to local government debt, enabling citizens to capture yields at lower risk than bank deposits, and reduce the cost of borrowing for governments. Other key spillovers include the development of local capital markets and increased resilience i.e., reduced government dependency on foreign currency borrowing.

Nevertheless, because we can see capital flowing out of EMDEs does not mean we can easily direct it into domestic sustainable development. Policy makers must go beyond safeguarding macroeconomic and financial stability. Needed is the development of attractive financial products, robust technology platforms and strong legal frameworks, implemented step by step to accelerate the emergence of this capacity. Fortunately, these goals are not a distant dream – progress is being made across multiple countries. Indonesia, Kenya, the Philippines and Thailand are successfully increasing the quantity of their government debt issued to domestic households. Thailand, the Philippines and Hong Kong are making progress in piloting tokenised bonds.

It is important to understand the risks and what digital finance cannot solve. It cannot eliminate sovereign debt sustainability risk and may introduce new channels for volatility if it allows market participants to trade securities in real time. Therefore, sound debt management and fiscal rules remain central to ensuring digital issuances do not result in taking on unsustainable debts. Digital finance will increase the risk surface of the sovereign, boosting the need to invest in cybersecurity and careful consideration of potential avenues for financial crime and financial scams. Another challenge is the existing level of financial

development. This may imply that digital finance is more appropriate for middle income EMDEs with comparatively developed institutions. For LICs digital sovereign bonds can thereby be seen as a graduation tool, rather than a leapfrog technology, in the sense that when a country has passed a certain threshold of institutional readiness digital infrastructure can be a pathway to design modern capital markets.

The activities discussed in this report form part of the digitisation of finance, characterised by the rise of new digital systems, apps and platforms (Kowalewski & Pisany, 2023). They are lowering minimum required investment levels, and onboarding groups that were previously underbanked. In this way it is scaling distribution channels which were previously underweight or non-existent. Increasing attention is going towards the specific tool of tokenisation, defined as the digital creation of assets, or representations of assets, on a programmable platform or ledger (Agur et al., 2025). This allows part, or the whole, of the bond's life cycle (from issuance through trading to reporting) to be carried out digitally and thus potentially in a more transparent, efficient, and tamper-proof manner. It removes multiple points of failure, such as settlement and counterparty risk, from the process. Also tokenised bonds may be able to engage with financial innovations such as smart contracts and decentralised exchanges. In other words, tokenisation may replace banks, custodians and wet signatures with software applications that can later be upgraded again.

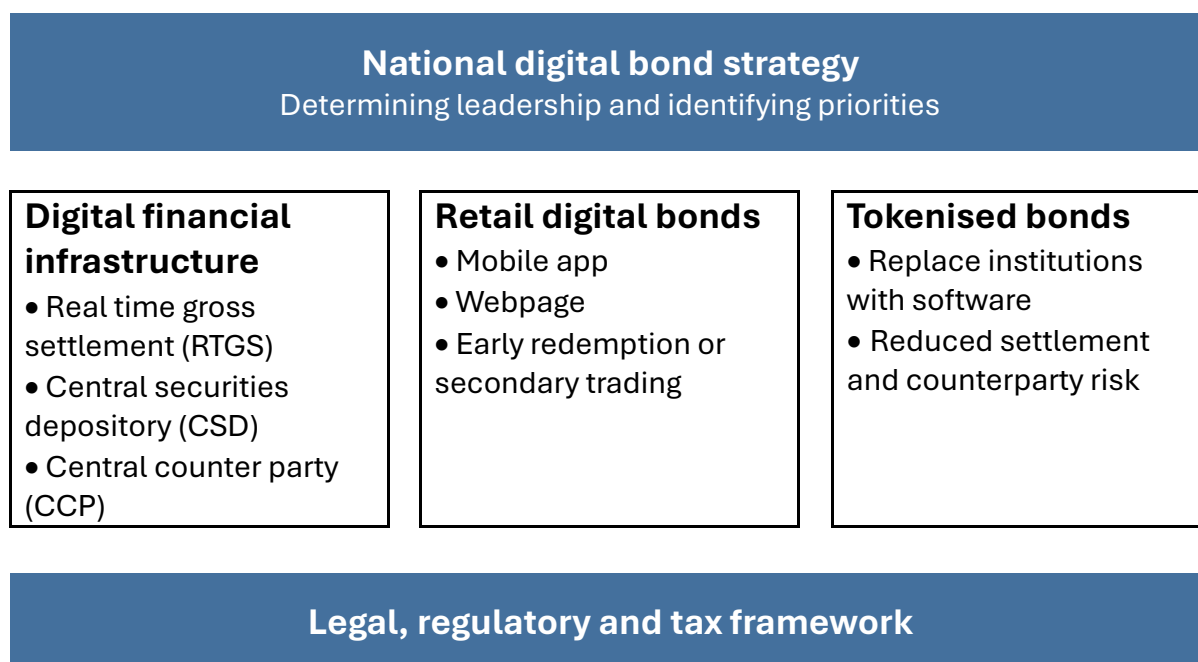


Figure 1: Stylised model of digital sovereign bond adoption strategy and building blocks. It highlights the goals of a coherent national strategy, a solid legal and regulatory base, and the three pillars of digital financial market infrastructure, retail digital bonds and tokenised bonds.

Source: Compiled by authors.

We provide a stylised representation of a digital sovereign bond adoption strategy and its building blocks in Figure 1. At its start, the Ministry of Finance, Treasury, Debt Management Office or Central Bank should develop a national strategy for digital bonds, comparable to the Philippines Government Securities Digitisation Roadmap (cf. Section 3.1). This national strategy will first analyse the local context and ensure an appropriate legal and regulatory basis. After this a country can then invest in building its digital financial infrastructure, develop a digital platform to issue sovereign bonds to local retail investors, and issue tokenised bonds to institutional and retail investors. If desired, this can build towards the issuance of tokenised green or sustainable bonds. Indonesia provides an insightful example of the benefits of an incremental approach that analyses each task coherently (cf. Section 3.2).

The overarching plan would be to create a digital financial infrastructure to mobilise domestic finance, at yields commensurate to existing government borrowing, from the widest range of potential investors possible. Ultimately this may broaden the domestic investor base and gradually achieve a reduction in the cost of capital. The key spillovers are the development of a domestic local currency capital market open to many parties, increased resilience, and the financing of a broad range of sustainable development. Local currency domestic bond issuance specifically keeps interest payments circulating within the domestic economy. We argue these financial instruments, and the financial markets around them, could also attract capital held by residents overseas (Volz et al., 2024). Importantly, enhancing domestic capital mobilisation and enhancing the supply of local currency finance to the economy is a critical precondition for gradually reducing the cost of capital and overcoming one of the most important hindrances to fostering domestic investment.

The rest of this report lays out how digital platforms can help scale domestic financing capacity, for example by lowering distribution costs and widening participation. We provide a series of case studies of efforts by countries digitising government securities. We use these case studies to adumbrate the different levels of digitisation that countries can target to best meet their requirements and objectives. The report makes the case that countries, in particular those with stronger institutions, should offer digital sovereign bonds to their own citizens. Tokenised bonds then follow as an innovation that opens the door to wider benefits across new investors, new financial product features, deeper capital markets, higher levels of transparency and programmable finance. To further diffuse this knowledge and drive the adoption of best practice, we provide an illustrative road map for other developing economies to take advantage of the same trends and raise capital for sustainable development. We discuss regulatory requirements, list out key performance indicators (KPIs), and provide an illustrative road map of policy recommendations.

Section 2 will provide an overview of the emerging opportunity space for strategically employing digital finance to mobilise domestic financial resources. Section 3 will then provide six country case studies, highlighting digital innovations in bond markets from the Philippine, Indonesia, Kenya, Thailand, Hong Kong, and Singapore. Section 4 reviews different levels of

bond digitisation, followed by a discussion of the challenges and benefits of digitising sovereign bonds in Section 5 and a policy discussion in Section 6. Section 7 concludes.

2. The emerging opportunity space

Discussions of digital innovation can easily become bogged down in a discussion of technology. The first point is that the actual technology is less important than the functions and features it enables. If two technologies can achieve the same goal, then a country should generate their requirements, and choose the technology that best meets their requirements. The Digital Finance Strategy for the EU (2020) refers to this as technology neutrality.

Distributed ledger technology (DLT) is the most mature way of implementing tokenised bonds and yet is a good example of this. In many ways, some private permissioned DLTs share more similarities with traditional cloud-based IT deployments than the blockchains underpinning the most popular crypto assets. In other words, it is now common for two systems, both described as DLTs, to deliver two incongruent packages of functionality in two technically different ways. Clearly a comparison of these systems and their costs, against project requirements, becomes the only logical way to decide which path to take.

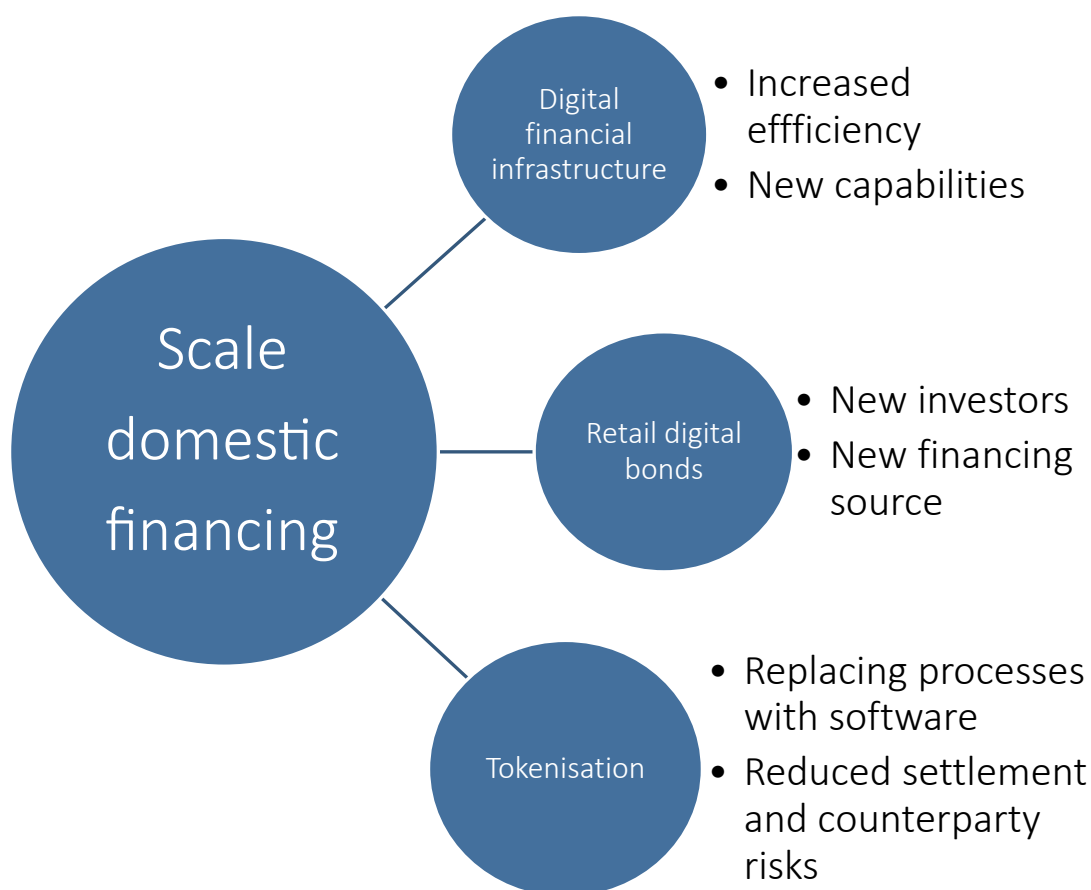


Figure 2: Digitisation of finance with respect to sovereign bonds can scale domestic financing capacity. This incremental financing can be used for sustainable development.

Source: Compiled by authors.

The central idea with digital platforms is their ability to scale domestic financing capacity. We feature this point and the benefits of our three digital pillars in Figure 2. Two potential elements of retail digital bonds are the creation of a mobile app or website that lets users buy domestic sovereign debt. As we discuss in Section 3.3, in 2017 Kenya launched M-Akiba as a way to purchase government bonds with mobile money (M-Pesa). Following some early success on registrations, the initial project later disappointed expectations largely due to poor timing and market fit (FSD Africa, 2018). All else equal, if a consumer can choose between a bank deposit and a government bond with similar interest rates, it is logical to assume the consumer will continue to hold the product they purchased previously. In 2023 Kenya tried again, launching a new digital platform, DhowCSD, with a retail and institutional mobile app / web page as a portal to a series of backend infrastructure upgrades. A new Central Securities Depository (CSD) seamlessly handled registry, custody and settlement, and it connected digitally to the Nairobi Stock Exchange enabling secondary market trading. The importance of the latter is the investor's ability to exit their bond and retrieve their funds early. The importance of the CSD is as a modern, cost efficient, higher throughput system for issuing and managing the related financial instruments. For brevity, we group together the sprawling space of CSDs, Central Counter Parties (CCP) and digital bond markets (primary and secondary) into the category of digital financial market infrastructure. We discuss this topic further in Section 4. Conversely a webpage, mobile app, and online secondary trading (or early redemption) constitute a set of features of a competitive retail bond distribution channel. They onboard investor groups into sovereign debt that are less correlated to overseas fiscal policies and development aid cycles.

The third leg in Figure 2 is tokenisation. The Philippines and Hong Kong have piloted bonds with records kept on a DLT and both later issued bonds that were at partially tokenised. One way to understand tokenised assets is to observe that non-tokenised financial assets evolved from paper based financial instruments. They therefore come with paper related concepts like wet signatures, registry, custody and clearing, each with their associated costs and risks. Ownership is recorded separately by buyers, sellers and a trusted third party, all of whom can make mistakes. We characterise non-tokenised securities markets as institutionally orientated, with many intermediaries required to execute multiple critical roles. In contrast, tokenised assets are digitally native. Instead of investors keeping a record of how many bonds they own, their wallet looks up this information on a single source of truth that may be built on a DLT. This has the potential to revolutionise registry, custody, clearing, settlement, collateralisation and exchange. Digital bonds that are not tokenised retain more of these legacies, potentially only switching the records of ownership to a DLT. Conversely, in the future tokenised government bonds may leverage the growing crypto asset system, be traded on third party exchanges and interact natively with crypto assets and programmable central bank digital currencies (CBDCs). We characterise tokenised financial systems as software orientated. It may enable a reduction in the origination and issuance costs of sovereign debt.

The last paragraph raises the prospect of leapfrog financial digitisation, where tokenised bonds interacting with CBDCs can replace traditional financial market infrastructure with software. This would imply substituting all the roles of CSDs, CCPs, stock and bond markets by a DLT which any service provider can connect to and develop a front-end user interface for. However, this is not straightforward. Several of the experts interviewed for this report counselled against rapid change. Their position is multifaceted. One element is that the legal and regulatory framework required is so complex and interdependent it is best evolved incrementally, with some steps piloted in a regulatory sandbox. A second element is the need to bring along existing investors. In Hong Kong, the technical part of this was the tokenised system's connection to the Hong Kong Central Moneymarkets Unit – which then also provides a link to other CSDs globally, e.g. Euroclear and Clearstream. But there is more, including ensuring regulatory equivalence of the tokenised bonds to legacy bonds and outreach to existing holders of legacy bonds. Even sophisticated investors will need the benefits and risks of new financial instruments clearly articulated. We discuss tokenisation further in Box 1.

Box 1: Tokenisation – heavily marketed, rarely explained

Tokenisation is regularly discussed as a revolutionary element of digital finance, listing benefits such as faster settlement and fractional shares, but often without any clear sense of its mechanics (Whiffin, 2024).

CBDCs, a specific type of token issued by central banks as legal tender, can be used to illustrate some effects of tokenisation. A traditional bank payment involves at least three banks: the sending bank, the receiving bank and the central bank. Irrespective of the digital tools used, a key technology for such a payment is the bank balance sheet. When a user makes a bank payment, each of the three banks changes the entries of their balance sheet such that ultimately the user's account at the sending bank is debited, and the receiver's bank account is credited. This is a legacy of the original non-digital nature of the payment process, which we characterise as institutionally centric.

Conversely, a CBDC could operate as a token on a distributed ledger instead. Such a system would then simply change the owner, or owning account, associated with the token. All three bank balance sheets, all three records, and all three sets of counterparty risks are removed from the process. Moving on, hypothetically, in a world where every asset on the bank's balance sheet was tokenised on a public DLT – the bank would no longer require an internal accountant to construct and check these financial statements (in addition to an external accountant who audits these), rather software could be used to collate the values of such a balance sheet in real time. Additionally, nearly all existing financial instruments are subject to a custody fee by the intermediary maintaining the definitive record. Tokenisation could eliminate such fees.

It should be clear that tokenised bonds would have the potential to share the same benefits as a CBDC, eliminating custody costs and counterparty risks. Tokenised assets, whether a currency or a bond, could be programmable, earning automated interest or have its interest rate changed based on its performance against KPIs. It would be possible to implement smart contracts, better understood as shared computer code, to execute functions previously carried out labour intensively such as payment of interest or insurance features.

To be clear on the difference versus CBDCs, tokenised sovereign bonds would not be legal tender and would be a debt instrument modelled on conventional sovereign bonds.

Ultimately, tokenised bonds would be dependent on the non-digital laws that define them and the regulations they are subject to. Agur, et al. (2025) highlight how tokenisation and digital ledgers might eliminate frictions from existing systems. We take this further: hypothetically, everything related to an investment, beyond the user's phone, could ultimately be replaced with modular, upgradeable software, much of which might be written and operated by third parties. This replaces an institutionally centric system with a software-based system.

A tantalising prospect for tokenised bonds is the ability to natively associate data with it. With a traditional bond, this must be recorded in a database or a file outside of the bond. But with a tokenised bond it is relatively straightforward to include information, such as the prospectus or the list of projects it is to fund (Chen & Volz, 2022). They could even incorporate real time sensor data, such as Hitachi (2023), and link this to the terms of the bond e.g., interest rate. Tokenisation raises the possibility of an unprecedented level of transparency and immutable record keeping.

A further point on tokenisation is on the collateralisation benefit for financial institutions. Currently, collateral is typically limited to a single exchange or clearing house, and therefore often of a single asset class, e.g., the cash you hold against your bond futures. Tokenised assets raise the possibility of significantly more flexible collateralisation, across assets and real time, boosting the efficiency of companies and the resilience of financial markets. There is a caveat to this opportunity – although technically complex collateralisation is possible with tokenisation, tokenised bonds are not yet legally valid collateral anywhere. Regulations need to catch up.

Aldasoro et al. (2025) use a matched sample of tokenised and conventional bonds (corporate, public and supranational) and find that the former have average bid-ask spreads of 19 basis points compared to 30 basis points for the latter, i.e., tokenised bonds may enjoy better liquidity. Their work distinguishes between two types of tokenised bonds, those that are conventional financial instruments but with a digital representation, and native issuance. Either type, once on an appropriate platform, “can unlock capabilities from interlinking various types of tokenised assets...it could streamline monetary policy implementation, e.g., by making use of tokenised repurchase agreements” (Aldasoro et al., 2025, p. 5).

In addition to the potential of digitising financial market infrastructure and financial instruments, there is the emerging opportunity of partnering with innovative local fintechs. Having initially evaluated developing its own platform, comparable to the US Treasury Direct, to provide domestic retail investors access to sovereign bonds, the Philippines was unable to justify the up-front development costs. However, they have now partnered with a popular local fintech platform, GCash. This led to the launch of the GBonds section on the platform where retail investors can buy small denomination Philippine sovereign bonds. In less than four months this has raised PHP 500 million (USD 8.5m, EUR 7.3m). The number of retail investors in government debt has increased from 10,000 to 300,000. This is a textbook example of how economies can leverage private sector services to issue retail sovereign bonds in a way that may not have been possible a few years ago. Such firms can help address the cost challenge by allowing digital sovereign bonds to use the tools and apps fintechs have developed for their own products. Furthermore, they can help address the capacity challenge by providing private sector technical expertise, with all our case studies highlighting the importance of working within an ecosystem of financial institutions, fintechs, financial service providers and the official sector.

Bringing these threads together, digital finance has lowered the barriers to entry for EMDEs to raise money from more diverse sources. Many aspects of the scaling of domestic financing capacity that arises from this is subject to positive feedback loops, for example increased trading activity by retail investors in sovereign debt may be able to incentivise a market maker (a financial service provider that offers to buy and sell a financial instrument at the same time for a spread) that can also service institutional investors, with both groups then enhancing the liquidity provided by the other side. These benefits are even more important in a world where both overseas development aid is declining, and global trade is under pressure.

3. Country case studies

In this section we explore official sector digital sovereign financing activities for six countries. This list is not comprehensive but is chosen to illustrate several key developments. Of our sample, the only economy to have issued a tokenised sovereign green bond is Hong Kong. The Philippines have issued a tokenised conventional sovereign bond, and Thailand has announced plans to do so. Singapore is an issuer of conventional, green and sustainable bonds to its local citizens utilising digital approaches. Indonesia and Kenya are noteworthy as path leading issuers of sovereign bonds to domestic retail investors. Given the EMDE focus of this report, Hong Kong and Singapore are positioned as potential service providers, while Philippines, Indonesia, Thailand and Kenya are potential examples to be learned from.

Table 1: Financial market infrastructure elements, tools and instruments relevant to digital bonds. Case study acronyms: PH Philippines, ID Indonesia, KE Kenya, TH Thailand, HK Hong Kong, and SG Singapore

	System or instrument	Related case study	Description	Notes
Retail distribution	Website for retail bond investors	PH, ID, KE, TH, HK, SG	Provide primary bond issue access to households	Raising capital from households. Higher risk of financial and cyber crime
	Mobile app for retail bond investors	PH, ID, KE, TH, HK, SG	Provide primary bond issue access to households	Raising capital from households. Higher risk of financial and cyber crime
Programmable	DLT for bond record keeping	TH, HK, SG	Use of distributed ledger to record ownership instead of custodian	Implementation dictates features and functions addressed
	Tokenised bonds	PH, HK	Potential to replace CSD, CCP, debt markets, and bond underwriters with software.	Elimination of settlement and counterparty risks. Higher risk of financial crime and cybercrime
Financial market infrastructure	Central Securities Depository (CSD)	KE	Maintains ownership records and settles changes in ownership	Final source of truth service that charges a fee for custody
	Central Counter Party (CCP)		Intermediates between buyers and sellers. In 2021 the Nigerian stock exchange launched a CCP (NGX Group, 2021)	Prevents trade failures with margin rules and reserves
	Primary bond market for institutional investors		Primary issuance of debt instruments. Malawi is a low-income country with domestic bond markets	Local debt market needs scale to deliver potential financing benefits
	Secondary bond market for institutional investors		Secondary trading of debt instruments. Malawi is a low-income country with domestic bond markets	In many countries secondary trading is possible but rare i.e., illiquidity challenge

Source: Compiled by authors.

Table 1 features some of the financial market infrastructure elements, tools and instruments relevant to digital bonds. The retail distribution category names the front-end that users experience, however clearly it is the software development behind these that enables new

forms of retail access to sovereign bonds. Tokenised bonds sit within the programmable category as tokenisation is defined as the digital creation of assets, or representations of assets, on a programmable platform or ledger (Agur et al., 2025). Platforms are typically thought of as online infrastructure that facilitates interactions between groups. However, they can also be used to generate value by transforming existing relationships (Jovanovic et al., 2022). A programmable DLT platform can be used to instantiate a tokenised bond but can also be used simply for authenticated data storage, i.e., resistant to tampering and data corruption. As visible in the number of case study examples related to financial market infrastructure, this report is not focused on these elements that are well surveyed by World Bank (2023). However, without instantiating and digitising these systems and institutions, countries may face difficulties in implementing retail digital and tokenised sovereign bonds.

3.1 Philippines: Tokenised government bonds and GBond

A central element of the Philippine Development Plan (2023) is the digitisation of the state. Part of this is the Government Securities Digitalisation Roadmap. Phase 1 focused on front end order taking platforms and phase 2 the development of a bank agnostic DLT. Phase 3 targets tokenised sovereign bonds. Phases 1 and 2 are complete, while phase 3 is ongoing. Outside of these efforts, the Philippines is incrementally digitising its financial market infrastructure.

The phase 3 pilot involved the issuance of PHP 15 billion (USD 254m, EUR 220m) of one-year tokenised government bonds in November 2023 (BTr, 2023). PDAX, the largest crypto asset exchange in the Philippines, was the technology provider and minted the tokenised bond. The offering was solely to institutional investors and the digital wallet holding the tokens can be managed through the PDAX mobile app. The offering utilised a dual registry system with bonds existing within the traditional CSD system and tokenised on the Polygon blockchain (an Ethereum layer 2 network) in a registry controlled by the Bureau of the Treasury. This was not the first time the Philippines have issued bonds on a DLT, with a pilot in 2020 targeting retail investors via an app bonds.pdax (Inquirer.net, 2020). The difference between the two offerings highlights how using a distributed ledger for records is not the same as executing them as tokens on a distributed ledger. A key benefit of tokenisation is the lower associated cost. These lower costs have enabled the reduction of minimum investment thresholds in fractional bonds to almost USD 10, which compares to the prior minimum of USD 10,000. This ties in with the Philippines authorities' central motivation for these efforts: democratising investment opportunities and driving financial inclusion. Furthermore, the Philippines is currently paying 4-5 basis points to banks and financial service providers to underwrite and issue government debt. A long-term opportunity is to disintermediate these organisations and issue debt directly.

The Bureau of the Treasury identified three challenges that they wish to resolve next. The first is to classify tokenised bonds within the financial regulator's High Quality Liquid Asset (HQLA) classification and therefore eligible as collateral. This is an example of how even with issuance

comparable to a preexisting financial instrument, regulatory changes are still required to make them an equivalent asset. This also extends to the tax treatment of the tokenised bonds. The next challenge is that the bonds were not tradeable. This may be technically complex as the dual registry system needs a dual update system that does not allow for conflicts. The final challenge is the current dependency on the PhilPaSS Real Time Gross Settlement (RTGS) for the cash leg of the trade. Fully achieving the benefits of tokenised bonds may require tokenised cash. The Bureau of the Treasury is collaborating with the central bank, which is in the process of developing a private DLT for a CBDC with tokenised government bonds as their initial use case. This shows how public digital financial instruments are meaningfully interlinked and should ideally be considered as part of a broader government strategy.

In addition to being a leading emerging market economy issuing tokenised bonds, the Philippines has also followed a strategy with wide relevance for retail bond issuance. As discussed in Section 2, having initially evaluated a model like the US Treasury Direct, the Philippines was unable to justify the up-front development costs. However, they have now partnered with a popular local fintech platform, GCash. This led to the launch of the Gbonds section on the platform where retail investors can buy small denomination Philippine sovereign bonds. In less than four months this raised PHP 500m (USD 9m, EUR 7m). The number of retail investors in government debt has increased from 10,000 to 300,000.

3.2 Indonesia: From Digital Retail bonds to Green Sukuk bonds to SDG bonds

The Indonesian adoption path will resonate with many countries due to its pragmatic and incremental approach. Multiple government departments have coordinated a strategy focused on expanding the investor base across types of investors, types of bonds, and the location of issuance. The budget office in the Indonesian Kemenkeu (Finance Ministry) determines spending on projects; the treasury office plans much of the operational details including issuing the bonds; and then the money raised is passed to the central bank, which also regulates many investors such as domestic financial institutions. We discuss digital retail bonds before thematic bonds, but it is useful to bear in mind how these issuances are intertwined.

Indonesia began offering digital sovereign bonds to retail investors in 2016. The goal was to share access to individuals, expand the investor base, and drive participation in remote and rural areas. Extensive investor education was carried out and new business processes established. Government retail bonds, or Obligasi Negara Ritel (ORI) can be purchased through retail banks electronically via a mobile app. Many challenges and questions were addressed step by step. Both the offering memorandum and the payment process were made increasingly straightforward and clear. The minimum investment is set at IDR 1 million (USD 60, EUR 51). Individual issuances are made considering market conditions, for example 2-year

retail bonds yield circa 5%, compared to immediate bank deposit yields at less than 1%. Indonesia is willing to pay a premium on these bonds to support retail sovereign bond markets. Generally, retail bonds yields target a 1% yield premium over the equivalent term bank deposit. As the price is fixed, demand will fluctuate based on the premium on the offering. At times this led to offerings being fully subscribed in under ten seconds. In response to this, the time of offering was moved to 1am in the morning. Later, higher allocations and larger offering sizes solved this challenge. Before and during Ramadan, the proportion of Sukuks issued increases, for example to support the celebration of Eid Mubarak (the end of Ramadan). In terms of tradability, some retail bonds are classified as tradeable, and investors can sell these back to the banks.

An important facet of retail bond issuance is investor education and the prevention of fraud. Considerable effort is directed into educating the public to understand the process and the associated risks. Bond information is provided on official websites. The Finance Ministry works closely with bank partners as the onboarding channel and utilise their security mechanisms. QR codes can be used to make payments, and when there is no match in the underlying codes, the trade is not cleared. Retail sovereign bond issuance reached 100 trillion IDR (USD 5.6bn, EUR 5bn) in 2020 and is forecast to be 170 trillion IDR in 2026.

On the thematic side, with help from the UNDP, the Finance Ministry spent 2-3 years developing its green bond framework. This led in 2018 to the issuance of the world's first Sharia compliant sovereign green sukuk bond of USD 1.25 billion. A key driver for this choice were the characteristics and requirements of the underlying projects to be financed. As sukuk funding is comparatively circumscribed, Indonesia moved to offer a SDG bond in 2021. Indonesia operates a budget tagging approach to classify spending that meets the related green or SDG bond framework. This project analysis process includes a comparison against green and SDG principles; distinguishing the level of impact e.g., dark green and light green; and external validation of any categorisation. In 2023, Indonesia launched the world's first publicly available sovereign blue bond, financing projects such as coastal protection, fisheries management and mangrove rehabilitation. This enabled a diversification of projects. All the thematic bonds mentioned were launched on global capital markets, with the first SDG bond issued in Europe and the first blue bond issued in Japan. Consideration is made of both market willingness to invest in a bond and the interest rate required. When offering these bonds domestically, a key driver were regulatory changes by the central bank (Antara News, 2023). This incentivised domestic banks, who are now the largest holders of thematic bonds, to invest in the new products. After these regulatory changes, a greenium (lower cost) did become visible.

The innovation across bond digitisation and thematic bonds by Indonesia benefits from a relatively large market. Nevertheless, there are many lessons for other countries. Each bond distribution channel is addressed patiently. This is particularly important as some intermediaries charge fees of 30 basis points. Moving slowly enables thorough negotiation

around fees, both on levels and on the use of a portion of the fees for marketing. It provides time to resolve superficially minor but technically relevant details such as at what point in a process does an investment become classified as government financing. Indonesia shows how it may make sense to pursue a digital retail bond and thematic and sustainable bond strategy at the same time. It also highlights the critical importance of all the relevant government bodies working closely together to achieve the desired result.

3.3 Kenya: From M-Akiba bonds to DhowCSD

By enabling payments with a mobile phone, the M-Pesa system launched in 2007 established Kenya as a leader in fintech and private digital non-bank money. A decade later, Kenya again led the way with a sovereign bond issue via mobile money. The government hoped that issuing bonds via mobile money would provide them with access to low-cost capital, while also giving low-income Kenyans an additional means for saving. M-Akiba (M-Savings in Swahili) required a two-step process: first, the individual needed to register their mobile money account, and then they would purchase the bond. The minimum purchase amount was KES 3,000 (USD 23, EUR 20). Prior to M-Akiba, the minimum investment amount for a conventional bond was significantly higher (KES 50,000, USD 385, EUR 335), and there were only ten thousand retail investors holding 2% of outstanding Kenyan sovereign debt. The bond earned 10% interest annually, with disbursements made every six months directly into the individual's mobile money account. In a similar project called Treasury Mobile Direct, the Central Bank of Kenya enabled users to buy treasury bills and bonds on their phone.

Although there was considerable excitement when the M-Akiba bond was piloted, purchase rates proved to be lower than expected. During the pilot in March 2017, 102,000 people registered their mobile money accounts, and the government raised their initial target ahead of schedule. When the full launch took place three months later, a total of 303,000 people registered, yet the government raised a quarter of its KSh 1 billion target (less than USD 2m raised from a USD 8m target). Only 4% of people who registered went on to purchase the bond. A post issuance survey by FSD Africa (2018) of 500 people who bought the bond and 500 people who had registered but not bought identified several reasons why the M-Akiba bonds did not meet the expectations. Timing was a major issue: during the two-year period between the soft launch and full release, regulatory changes forced banks to raise savings interest rates from 0% to 7%, reducing the bond's yield advantage. This coincided with national elections, which overshadowed promotional efforts and diverted public attention. Beyond timing, product understanding among potential investors was poor. Many registrants who did not complete their purchase lacked awareness of key details such as interest rates, maturity periods, and deadlines. Even among those who invested, knowledge remained limited – fewer than 2% knew they could access their funds through the Nairobi Securities Exchange. The investment process itself was not user-friendly. While registration was simple, subsequent steps were unclear and lacked direct guidance, leaving some users under the impression that registration alone completed the transaction. Ambiguous or misleading web

pages compounded this confusion. Communication gaps further hindered uptake. Interviews revealed that 60% of registrants received no follow-up messages, and among those who registered but did not invest, 70% were unaware of deadlines. Agents, though effective at driving registrations through outreach in offices, markets, and community groups, did little to encourage actual bond purchases. Customers also struggled to get agent assistance after registering. The only available help channel was a landline phone number, which many found difficult to access. This became especially problematic when scam messages circulated, as users had no reliable way to verify information or receive timely corrections. Finally, the minimum investment requirement of KES 3,000 faced resistance. Some customers argued that this amount could generate better returns through gambling, commercial trading, or enable loans via informal savings groups (*chamas*). These registrants clearly did not view themselves as low-risk, low-return savers, implying marketing might have been mistargeted. Excluding timing, we summarise these challenges as poor market fit, limited user-centric design and inadequately thought-out incentives. Incentives for agents must target the right call to action, the onboarding process must be clear and complete, and the value offered must resonate with the target audience.

In July 2023, the Central Bank of Kenya launched a new digital platform DhowCSD. The launch capped off (1) an updated core CSD infrastructure covering registry, custody and settlement, (2) an electronic interlink between the CSD and the Nairobi Stock Exchange Automated Trading System platform, with (3) a front end, comparable to the original M-Akiba, that allows both retail and institutional investors to use a mobile app or web page to participate in primary government debt offerings and to trade on secondary markets. Commercial banks can access the CSD via the website or using SWIFT messages.

In terms of product market fit, Kenyan 91-day Treasury bill interest rates exceeded commercial bank retail deposit rates between 2021-2024 (CBK, 2024, p. 45). Longer dated government bonds enjoyed even higher yield premiums over bank deposit rates, which vary widely across Kenya's 38 commercial banks. These premiums have now moderated. The gap is likely to have been caused by higher global interest rates, nevertheless it incentivised adoption and potential scale.

As of June 2024, the number of accounts on the platform exceeded 83,000, 79% of which belong to households and individuals. A bank account is required for account creation. A year after the launch of DhowCSD, the share of government debt held by the other investors category, which includes individuals, rose from 7% to 13% (CBK, 2024), implying 6.4% of incremental financing.¹ An attractive facet of DhowCSD is that the implementation of retail access for Kenyan residents also extends to foreigners e.g., diaspora. DhowCSD received the news website Central Banking's Payments and Market Infrastructure Initiative Award 2024.

¹ Kenya did not borrow 6.4% more in practice. However, a stylised assumption in finance is that existing bond holders are willing to lend next year the value of their bonds plus interest. As Kenya found a new source for these funds, this figure assumes they could have also borrowed from the investors that were replaced.

Recently, the bank Standard Chartered announced that it was allowing Kenyan customers to borrow against their DhowCSD holdings (Star, 2025).

3.4 Thailand: The Bank of Thailand's DLT bond platform

Many countries state a vision for their financial system, but few pursue that vision as firmly as the Bank of Thailand. Multiple master plans with ambitious goals, including on digital sovereign bonds, have moved step by step from increasing financial access, to promoting competition to developing financial infrastructure. At a high level, these plans describe in advance what both success and failure look like.

On digital fund-raising, in 2020, the Bank of Thailand launched a new government bond infrastructure based on DLT. The Thai DLT bond platform aimed to increase the efficiency of registering, selling and distributing savings bonds. The launch involved the Bank of Thailand, the Public Debt Management Office, the Thailand Securities Depository, the Thai Bond Market Association and four domestic banks acting as selling agents. Key benefits included a dramatic reduction in the operational complexity of distributing savings bonds, monitoring and management of bond issues in real time, and the reduction in the time it takes for individual investors to receive their bonds from 15 days previously to two days.

The first offering saw THB 50 billion (USD 1.5b, EUR 1.3b) issued to investors, in denominations as small as THB 1 (BOT, 2020). Through such small-ticket savings bonds – referred to as 1-baht savings bonds – the government sought to encourage low-income earners to save money in risk-free assets (Chantanusornsiri, 2020). Over the next year, the issuance of ten series of government savings bonds, worth THB 160 billion, were supported by the DLT bond platform, though with a modestly higher minimum investment (BOT, Annual report 2021, 2021, p. 128). In 2021, the project was awarded the IDC Future Enterprise Award: Best in Future of Digital Innovation. Since mid-2022 the government bond sales process became standardised on the DLT system (BOT, Annual report 2022, 2022, p. 127). In addition to CBDC pilots such as mBridge with the BIS Innovation Hub, these efforts have made Thailand a leader in the application of distributed ledgers by the public sector, and shown how it can enable both accelerated processes, as well as new functionality such as small denomination issuances. In 2025, Thailand announced plans for the issuance of tokenised bonds and is working with a selection of private crypto asset and financial market companies to deliver this.

3.5 Hong Kong: Tokenised green bonds

In February 2023, Hong Kong issued the world's first tokenised government green bond and raised HKD 800 million (USD 102m, EUR 89m). Like other issuers in our sample, this groundbreaking issuance appears to have priced at a premium 4.05% (HKSARG, 2023) to the conventional benchmark at 3.78%,² reflecting how upfront investments may be required to

² <https://www.investing.com/rates-bonds/hong-kong-1-year-bond-yield-historical-data>

innovate financial instruments. A year later, a second issuance raised circa USD 750 million across HKD, Renminbi, US dollars and Euro. The Central Moneymarkets Unit (CMU) utilised the Goldman Sachs DLT platform for the 2023 offering, while the 2024 issue was via HSBC's DLT platform. The CMU's role crucially provided legal finality at settlement under Hong Kong law. Both bonds were settled on the distributed ledger, and utilised atomic Delivery versus Payment (DvP), which makes the payment of funds and the delivery of the bond inseparable – an action that is historically recorded as separate transactions and vulnerable to one side failing. A capability added to the second tokenised bond offering was the link to the traditional bond issuance infrastructure managed by the CMU. The CMU, as well as its linkage with Euroclear and Clearstream, have broadened investor participation, allowing investors to gain familiarity with these innovative financial instruments via existing workflows and technology interfaces. The use of established infrastructure for distribution can be a powerful way to address technical and operational hurdles.

Transparency is one potential benefit of DLT based systems. Linked disclosure of near real-time sustainability data, which investors could access on a mobile app, was successfully concept-tested in the preceding Project Genesis collaboration with the BIS. However, this feature was not included in Hong Kong's subsequent tokenised government green bond issuances. Sustainability data quality and granularity is a nuanced challenge to increasing transparency, in particular the types of projects and the data available. Although use of sensors to generate real time underlying performance can be compelling, for example quantifying the green energy generated, for other projects comparable data may not exist. Nevertheless, Hong Kong's efforts have pioneered an innovative level of openness. The Green Bond Report (HKSARG, 2024), which was made available on the DLT platform for the 2024 issue, lists all projects funded to date and outlines the expected impacts and highlights of a selection of them. For example, the I-Park1 municipal solid waste project is scheduled to enter service this year and is expected to treat 3,000 tonnes of waste a day, recover materials from 200 tonnes of waste, produce electricity, and reduce 440,000 tonnes of greenhouse gas emissions a year.

Hong Kong is committed to establishing itself as a trusted premier global hub for digital assets where innovation flourishes in a risk-managed manner (Financial Services and the Treasury Bureau HKSARG, 2025). This requires driving adoption. Its strategy for tokenised bond market development has been to test the technology and build capacity incrementally across multiple dimensions: governance, legal, regulatory, investor protections, legacy investor adoption, bond liquidity, digital wallets, and to draw in new issuers from the private sector and abroad. To support the last goal, the Hong Kong Monetary Authority (HKMA) offers a Digital Bond Grant Scheme that reimburses a selection of issuance costs for bonds that use Hong Kong capital markets service providers and have either a digital team in Hong Kong or use a DLT platform operated by the CMU. This programme has supported multiple private issuers of digital bonds in Asia, and there are hopes that other sovereign issuers might choose to issue in Hong Kong.

In November 2025, Hong Kong made a third offering of tokenised green bonds of circa USD 1.3 billion across HKD, Renminbi, US dollars and Euro. An innovation with this issuance was the ability to settle the HKD and Renminbi tranches with tokenised central bank money. Nevertheless, issuance of tokenised bonds in Hong Kong still requires several non-digital processes, for example wet ink signatures. To facilitate an increasingly digital process and capture the available benefits, the HKSAR Government and the HKMA are continuing to work together to identify potential enhancements to the current legal regime.

3.6 Singapore: Savings Bonds for green infrastructure

Singapore's Savings Bonds, which are issued and backed by the Singapore Government, have been available to residents since 2015 via digital channels. In 2022, this platform was used to issue an "inaugural tranche" of SGD 1.7 billion (USD 1.3b, EUR 1.1b) of green infrastructure bonds. The Singaporean government intends to issue SGD 35 billion (USD 26.7b, EUR 23b) in green bonds by 2030. Early tranches of this debt have been earmarked to finance investments into Singapore's electrified rail network. Two specific rail lines benefiting from past fund raising via this mechanism are expected to remove the equivalent of 22,000 cars from Singapore's road network (Singapore MOF, 2023).

Via small denominations and retail distribution through digital channels, Singapore Savings Bonds have expanded access to government backed financial instruments that had previously been largely limited to institutional and high net worth investors. These bond offerings incorporate many consumer-friendly innovations. Bonds can be purchased through bank partners via mobile banking, internet banking and ATMs. Although the bonds are long term e.g., 10 years, they can be redeemed on a monthly schedule without penalty. Interest rates are fixed at the time of the offering and can be slightly above or slightly below the equivalent yield on government debt. They are offered on a quantity ceiling format, with a fixed limit on how many bonds are available in each issuance, and, in contrast to conventional Singapore Government bonds, has no auction component (MAS, 2025).

Issuing ring fenced infrastructure and green bonds on the platform has been well received. Singapore savings bonds are particularly useful when an individual has exceeded the SGD 75,000 limits of the Singapore Deposit Insurance Scheme. Individuals are currently limited to SGD 200,000 of savings bonds. Singapore has pioneered the use of multiple attractive bond features to drive retail uptake and improved market fit.

4. Financial market infrastructure: degrees of digitisation

In section 3, this report discussed six public issuers expanding online retail bond distribution, or digitising sovereign bonds, all the way to full tokenisation. However, many actions discussed are difficult to implement if certain electronic building blocks are not in place. One

example is if a country cannot support low friction digital payments – then any digital bond must be purchased using a higher friction alternative. Countries can still issue digitised bonds, but digital innovation in such contexts would incorporate non-digital inefficiencies. Conversely, later waves of innovation can leapfrog prior waves. Mobile money has enabled low friction digital payments without a centrally led build out of digital infrastructure. Nevertheless, countries must plan their digitisation holistically. In this section we explore the financial digitisation steps that typically occur prior to the digitisation of bonds.

Moving on to wholesale payments, Real-Time Gross Settlement (RTGS) systems, such as Fedwire in the USA, or Pan-African Payment and Settlement System launched in 2023 by the African Union, are a common way to facilitate immediate settlement of large-value payments within a country or region. Banks and fintechs can connect to such digital settlement systems and offer retail digital payments and mobile money to individuals. Country level payment systems are diverse. They may be owned and run by the central banks, or by commercial banks or as a hybrid. The World Bank's (2023) global payment systems survey observes how most of the countries responding have a RTGS, but that less than a quarter have it operating 24 hours a day, 7 days a week. This hints at the wide variation in digital functionality on this single core system. The World Bank survey provides a useful list of many of the options countries have for their wholesale and retail payments systems, and the connecting systems such as for the clearing and settlement of foreign exchange and securities.

A list of system elements relevant to digital bonds are shown in Table 1. Broadly, the CSD, CCP, and bond market are financial market infrastructure that do not have to be digital. Yet building equivalent systems and digitising them is an efficiency goal of countries interested in financial development and enhancing local capital markets. A discussion of these elements of digital infrastructure for the trading, clearing and settlement of bonds is provided in Box 2. The digitisation of these systems and the dematerialisation of the financial instrument allow economies to refer to their sovereign bonds as digital bonds to varying degrees.

Once the back end is dematerialised and institutional access digitised, the next step in bond digitisation is the issuance of sovereign bonds via a website or mobile app. We note that in many markets purchases of sovereign debt may still be via phone or fax, or if digital investment is available, such systems are only accessible by financial institutions e.g., even companies are obliged to use a broker. Digitisation here, with its lower associated variable costs, is a central enabler of smaller bond sizes (or fractional ownership) and the reduction in minimum investment sizes. This report does not focus on institutional online access but retail access, as the latter is highly constrained prior to the existence of a dedicated retail distribution channel.

The hypothetical final stage of bond digitisation is tokenisation. In an idealised form, this would be the replacement of all legacy systems and institutions with software. In many ways this is part of the unique selling point of crypto assets such as Bitcoin and Ethereum. They are

payment assets that include their own embedded payments infrastructure; and are modular enough to be enhanced by decentralised programmable financial market capabilities (Box 1).

Although there is a wide variety in digitisation paths through these stages, we recommend that countries pay attention to a specific lesson from Kenya's path to DhowCSD. It is difficult to fully capture the benefits of digitisation if a retail mobile app is offering bonds that are not digitised at the back end. Slow response times will increase user friction and extra processing steps increase the risk of errors. Furthermore, the case studies in Section 3 suggest a leapfrog move from minimal infrastructure to tokenised bonds is difficult. The recommendation is the development of financial market infrastructure (e.g., CSDs and CCPs) that is technology neutral and defined in a way that supports a future move to tokenisation.

A critical complexity to digitisation is the importance of interrelated product features and functions. A key example is the ability for retail investors in sovereign bonds to sell or redeem their bonds early to access their cash. Only when this is possible can investments in government bonds challenge accessible bank deposits for retail investors. Kenya achieves this by connecting their CSD to the local stock exchange. Singapore enables this by allowing bond holders to redeem on a monthly schedule without penalty. At the same time, expanding distribution, for example via retail investors, and secondary trading, can help with the challenge of illiquidity, a classic problem for many local currency bond markets. They directly increase liquidity and provide a flow of activity that may incentivise a broker-dealer to act as a market maker i.e., offer to buy and sell these government securities at the same time for a spread. Expanding distribution of sovereign debt, similar to issuing bonds in an orderly fashion to create bond benchmarks, is an important way to support nascent capital markets. This is because of the positive feedback loops between market transparency, the number of participants, their activity, and liquidity.

Box 2: Digital infrastructure – trading, clearing and settlement of bonds

The settlement system for securities is often the Central Securities Depository (CSD). CSDs or equivalent systems are an important backbone to digital bonds. They typically act as a custodian, maintain ownership records and settle the trade by updating the definitive record of ownership. The World Bank (2023) reports that 78 out of the 86 economies (91%) responding have at least one CSD in operation. 87% of respondents reported that at least nine tenths of negotiable securities are immobilised or dematerialised in their CSDs, which can be interpreted as a proxy for digitisation. 3 respondents in Latin America and 3 respondents in Sub Saharan Africa have not yet achieved this immobilisation or dematerialisation benchmark. It is likely that economies that did not respond to the survey are less likely to have such financial market infrastructure.

An adjacent system that plays an important role in bond market infrastructure is a Central Counter Party (CCP). It stands between buyers and sellers guaranteeing the performance of trades in a way that mitigates counterparty credit risk, usually managing their own risk by requiring participants to post initial and variation margin as collateral; and holding its own reserves. Clearing the trade provides certainty that it does not fail but does not formally change ownership of a bond. 37 economies reported at least one CCP in operation (World Bank, 2023). Having a CCP privately owned is sometimes assumed to take financial risk out of the public sector, in contrast to the often publicly owned nature of CSDs and RTGS.

The next component is one of the most well-known: a bond market (which is often part of a stock market or exchange). A domestic primary bond market implies that a sovereign can issue bonds domestically. It requires the appropriate systems for registry, payment and settlement. If participants are able sell and buy already issued bonds, this constitutes a secondary domestic bond market. At the end of 2024, Malawi had outstanding treasury securities of MWK 6.1 trillion (USD 3.5b, EUR 3.3b) in face value, almost a third of GDP. During 2024 their secondary debt market did not register any trades (Registrar of Financial Institutions, 2024).

Malawi reveals how low-income countries can sometimes scale sovereign debt issuance, with issues at eight tenors up to ten years. The lack of secondary debt market trades is a major challenge for many economies. Secondary market trading by local retail bond holders offers the opportunity both to directly increase liquidity and to incentivise a broker dealer to make such a market i.e., offer to buy and sell at the same time.

Fully digitising CSDs, CCPs, and debt markets can make financial systems more efficient, lower transaction costs, increase volumes and drive financial market development. Against this must be weighed the large upfront costs of such investments, for example in software development, physical systems and networking. An evaluation of existing institutional quality and technical competency, followed by long term capacity building, may be necessary to deliver on digitisation investments.

5. Challenges and opportunities

EMDEs face a critical challenge in mobilising sufficient financing to meet their SDGs. In this report we explore the use of digital local currency sovereign bonds to solve this. Given the implicit limits on financing, it is no surprise that the biggest challenge for digital bonds has been the cost required to build the core systems, the digital distribution channels and then the links between the systems that eliminate all the seams. It is clear there are substantial outlays in delivering a unified digital experience for new and existing investors. Many countries often face significant fiscal constraints. However, we believe the development of digital bonds and EMDE financing capacity are policy goals with positive feedback loops, e.g., it is one sustainable development project that can finance future sustainable development projects, and therefore a strong case for support domestically and internationally can be put forward. Critiques regarding the transparent use of proceeds can be addressed by green, social, sustainable and SDG use of proceeds bonds.

The second biggest challenge is the legal and regulatory evolution required to establish and safeguard the same set of systems and distribution channels. Any country interested in digital bonds must review their existing laws and decide where they achieve what is required. Then it must map and plan the changes and updates required. As part of EU (2020)'s Digital Finance Strategy, the European Commission identified that some existing rules effectively forbid the adoption of DLT for certain financial market infrastructure. This illustrates the importance of the local context. This also extends beyond rulemaking to the political economy of making the necessary changes. Finally, it must cover customer protection and education.

The third challenge is lack of existing financial infrastructure and the required capacity building to address this. Some EMDE sovereigns currently do not have the technical skills to build the modern financial market infrastructure they lack. This extends to the expertise needed in supervisory authorities to avoid fraud and safeguard financial stability. Financial market development can be compared to a journey between two towns where there are a mix of longer paved roads and the occasional dirt track. Although short cut innovations (the less travelled dirt track) do exist, our interviews provide much support for incremental and holistic adoption paths (the paved roads) to manage risk. However, we believe that this challenge could be an opportunity. Implementing a series of development programmes building out digital infrastructure, with international technical support, can assist in the generation of domestic pipelines of software engineering and programme implementation talent. Technical capacity challenges can also be addressed by partnerships with the private sector as shown by the Philippines (Section 3.1). At times it may be possible for last mover advantages to be captured, with some steps compressed by using the latest processes and innovations. The advance of digital technology continuously paves new paths.

On wider risks, such as cybersecurity, digital bonds may expand the risk surface of the debt management office. The adjacent crypto asset space is rife with criminal activity such as

ransomware and cyber theft which needs to be carefully addressed to prevent the spread of financial crime. Another technical challenge is the dependence on existing payments infrastructure and RTGS. In other words, full tokenisation will always be incomplete until a CBDC can be used for the cash leg of a tokenised bond transaction. However, we consider this challenge somewhat distant as there are many other elements that need to be digitised prior to fully tokenised bonds.

In Sections 3.1 to 3.4 we showed how the Philippines, Indonesia, Kenya and Thailand are responding to these challenges. They are investing selectively in projects with clear benefits, incrementally updating laws and regulations while respecting the local context. Importantly they are adapting to disappointments. The central benefit of the projects discussed in this report are (1) the scaling of finance in EMDEs, (2) the deepening of local currency financial markets and the broadening of the local investor base plus associated private sector spillovers, and (3) the sustainable development that can be funded by the first two.

To be clear, the key milestones of local capital market development will revolve around economic development, fiscal capacity, financial sustainability and the associated sovereign credit rating. Nevertheless, digitisation of finance can support the transition along market development stages if it lowers the borrowing thresholds at which each stage is practicable to a given economy. Part of this is because many of the upfront investments, development costs and issuance fees are fixed or quasi fixed, and these costs represent a threshold of financial feasibility for a type of debt issuance. Borrowing cannot be justified below a given ratio of debt versus fixed cost. The next part is illustrated by the Philippines in Section 3.1, which provide a clear example of how digital finance can lower the cost denominator. Importantly, digitisation transforms the dynamics of raising of finance from local retail investors. The latter are many relatively small ticket potential lenders, which in the past made them expensive to address and therefore typically not targeted by the issuer. Hypothetically, all EMDEs may be able to use retail digital sovereign bonds to increase their borrowing capacity, borrow at longer terms or borrow more in local currency. Nonetheless, economies without the appropriate institutions should focus on capacity building and peer learning first.

In addition to these relatively narrow channels of scaling domestic financing capacity there is a cycle of innovation illustrated in Figure 3. Digital platforms can help to attract new investors and thus broaden the (domestic) investor base, that then funds an expanding circle of projects, which can then justify the issuance of new types of bonds. An underpinning thread here is the ability of innovation in one area to drive adjacent innovation, as banks and other financial institutions could be inspired to compete on interest rates and products. The alternative marketing of financial instruments overseas may leave countries dependent on financial and policy conditions far removed from their influence. Conversely the clever use of digital platforms is the marketing of bonds to locals operating within an economy where policymakers can drive change. Even if distributed to foreign diaspora, it would be hoped that such investors would be less pro-cyclical than other foreign investors (Ketkar & Ratha, 2010).

We caveat the innovation cycle here by recognising a major constraint to this related to domestic demand, specifically a lack of a pipeline of appropriate projects for thematic bonds, and institutional quality. Capacity building is necessary across multiple dimensions.

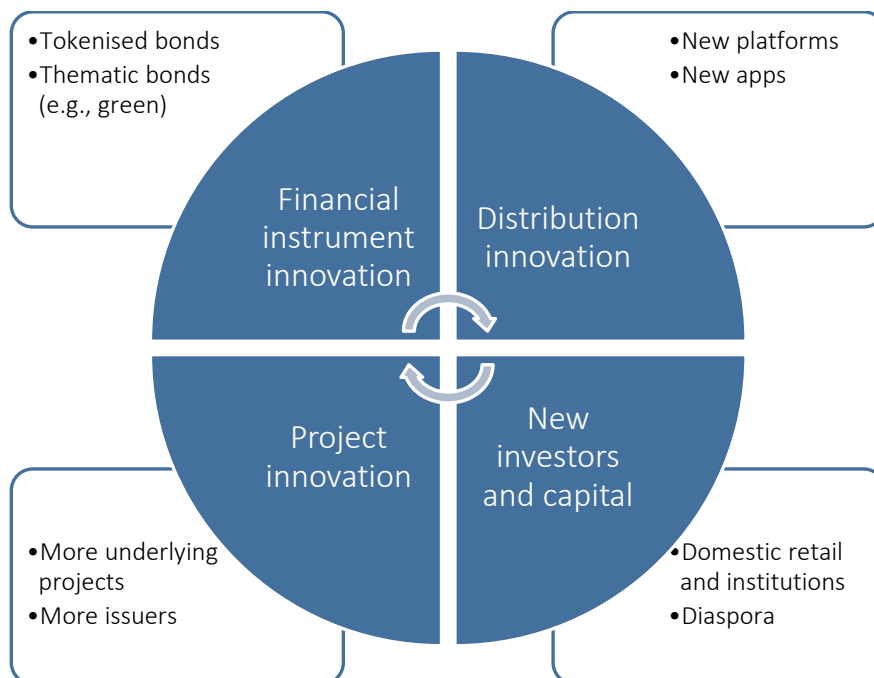


Figure 3: A cycle of innovation in digital sovereign finance

Source: Compiled by authors.

There are multiple other benefits to scaling retail domestic sovereign financing. A critical one is as a source of local currency financing that avoids foreign currency risk. Financing long term projects generating local currency revenues with short-term foreign currency credit creates a currency and maturity mismatch (Goldstein & Turner, 2004). This may offer a lower initial yield but can become much more expensive if the domestic currency devalues – a common feature of sovereign debt crises. As evidence emerges that natural disasters can cause currency depreciation in needy countries (Lo & Volz, 2025), if climate change causes a rise in the frequency and severity of disasters, foreign currency borrowing may act as a negative mediator channel from climate change to debt difficulties.

Furthermore, expanding domestic retail participation in domestic debt encourages the development of local currency capital markets. Sovereign issuance on a new digital platform may be able to lead to other issuers, official sector and commercial, to utilise the same platform. This could become a positive feedback loop driving financial development. For many countries, the only issuer capable of creating a benchmark local currency yield curve or new bond categories will be the sovereign.

The impacts on banking sector competition are more nuanced. Higher competition for deposits will lead to higher deposit rates, but only if this competition relates to a fixed amount of savings. Most EMDEs, however, have significant informal savings which are currently not absorbed by the banking system. This is partly due to a lack of trust in banks, but often because banks pay negative real interest rates on their deposits. Offering easy opportunities to households to invest their informal savings in safe assets that deliver reasonable returns can hence help to raise the formal savings rate and reduce the cost of capital across the economy (Volz et al., 2024).

Offering attractive and easily accessible savings products in capital markets would expose banks to greater competition and force them to offer more attractive returns on deposits. The goal of digital platforms is less to take share of deposits but rather to offer an alternative to residents moving capital overseas due to a lack of safe, investable domestic assets and support formal saving. These would benefit the banking sector and the country at large. An increase in the formal savings rate will contribute to a reduction in the cost of capital, which will in turn facilitate and enhance domestic investment. Both less foreign currency liabilities and deeper domestic local currency capital markets would increase financial resilience. Finally, there is the potential for digital platforms to contribute to financial inclusion. There are 80 million people in sub-Saharan Africa with a mobile phone, basic ID and a SIM card registered in their name who do not have a financial or mobile money account (Klapper et al., 2025). Offering more value to such individuals is advantageous in boosting financial inclusion and encouraging them to join the digital economy. Nevertheless, when a country develops digital bonds and offers it to retail investors it is critically important to fully understand the risks of such policies. No sovereign would assume its default, but this risk exists and it is necessary to communicate and mitigate this where possible. Such an analysis should extend to how retail investors can exit their bond holdings early, should the sovereign backstop this liquidity to control for price risk; the operational risks of platform failure and the cybersecurity risk of hacking and denial of service attacks.

Although this report is focused on official sector digital bonds, it is important to highlight two complementary connections with official sector thematic bonds, e.g., green, blue, social, sustainability and sustainability-linked bonds. Clearly once an app or platform exists to issue government digital bonds to retail investors, it becomes easy to also offer sovereign thematic bonds via the same platform.

As a rule, all thematic bonds are required to meet specific standards of management, transparency and reporting. The names of different types of thematic bonds connect the bond to its intended use of proceeds, for example green bonds generally require the proceeds to be used in a way that benefits the environment, or, in the case of sustainability-linked bonds, to intended outcomes. Digital infrastructure which combines DLT, AI-driven analytics, and satellite-based remote sensing constitute a critical enabler of green bond markets in emerging economies, precisely where verification infrastructure is weakest and

investor confidence is hardest to build. Together, these technologies are enabling a shift from periodic, manual use-of-proceeds reporting to continuous, automated monitoring of the underlying green assets. Automated monitoring can over time reduce the perceived risks of investing into these markets. Remote sensing provides the raw observational data; AI processes it at scale to detect changes, flag anomalies, and generate standardised performance metrics; and DLT creates an immutable, auditable record of both the proceeds flows and the environmental outcomes they are meant to finance.

Thematic financing options have established widespread traction in financial markets globally. OECD (2025, p. 173) finds that in 2024 companies issued USD 381 billion in green bonds, while the official sector issued USD 257 billion. These figures are global and dominated by developed countries plus China. It is clear that green bonds resonate with investors, and have the potential to create incentives for companies to change their behaviour to access dedicated funds providing this financing (Oehmke & Opp, 2024). Non-green sustainable bonds were a further USD 141 billion corporate, and USD 216 billion official sector. These figures illustrate how thematic bonds are an attractive way to generate high volumes of financing. Corporate issuance of thematic bonds is equivalent to 65-150% of sovereign issuance. The potential extent of spillovers from sovereign issuance into private issuance is an avenue for future research. It should be mentioned, however, that the empirical literature is mixed on whether behaviour change occurs in practice.

6. Developing a roadmap for digital sovereign bonds

The backdrop of this report is that ministries of finance, debt management offices, central banks and regulators have so many priorities they rarely have time to explore publicly their digital finance challenges and achievements. Next to fiscal policy, monetary policy and bank supervision, a mobile app to offer sovereign bonds to citizens, or let alone exploring tokenisation, can easily be left in the shade. This is unfortunate as using digital finance to fund sustainable development has the potential to address multiple convergent needs and challenges.

An increase in the number and intensity of climate-related disasters makes clear the need to decarbonise energy and transport systems to mitigate climate change and invest in resilience and adaptation. To this, awareness is increasing that accelerated investment in climate mitigation and adaptation have the potential to drive economic development. Intelligent sustainable development can create jobs and physical capital, with spillovers across workforce skills and institutional capacity. What is less often considered next to this is the micro and macro financial development of giving retail and domestic institutions compelling local currency financial instruments. Sovereign digital bonds could contribute to reduced capital flight and increased savings, shifting the accountability of governments, for the use of funds, from foreign creditors to the citizens of the country. Of course, this needs to be paired with supportive macroeconomic policy, robust regulation, and adequate consumer protection.

But policymakers need to be strategic. In the following, we provide an illustrative roadmap that EMDE policy makers can use as a starting point for internal discussions. The roadmap comprises five stages.

Stage 1: Development of a national strategy

The ministry of finance, treasury or central bank should establish lead responsibility and identify initial stakeholders. The group formed can then develop a national plan on digital and/or tokenised sovereign bonds that incorporates the local context.

Key questions:

- Which government bodies will participate and who will lead?
- Which private sector and partner entities should be involved?
- What are the key objectives?
- Which of these objectives will take priority?
- Which authorities will supervise and set rules for the envisaged platforms, trading venues and market participants?
- What incentives are required to align partners with national goals?
- What is the demand for digital sovereign bonds from retail and institutional investors?
- How can demand be stimulated via investor education and increased digital financial literacy of citizens?
- How does a national strategy for digital sovereign bonds fit into the countries' broader vision of financial and economic development?

Vision of success: A strategic plan identifies the desired benefits of the national strategy, understands existing resources and plans out a future path to issuing sovereign bonds to local retail investors or tokenised bonds to retail and institutional investors.

Stage 2: Developing the necessary legal and regulatory frameworks

It is necessary for each country to examine existing legal and regulatory frameworks, and where needed adjust those to bring them in line with its digital bond strategy. New legislation may be necessary however the political feasibility of this varies. When the Philippines began developing a digital finance policy, it found no issues with digital bonds (sovereign bonds issued via an app to retail investors) within its existing legislation. Conversely tokenisation has been more problematic, with alternative views between stakeholders in favour of exemptive regulatory relief and other stakeholders more focused on the potential risks. The development of legal and regulatory frameworks does not complete in a single step but will evolve as progress is made, up to and beyond issuance.

Key questions:

- How do existing laws and regulations compare with the new digital bond strategy?
- What tasks can be carried out within existing rules and regulations?

- What legal and regulatory changes need to be made?
- Who bears liability for operational failures?
- Who bears liability for cyber security failures?
- Who bears liability for smart contract errors?
- Are Know Your Customer (KYC) / Anti Money Laundering (AML) requirements fully delineated?
- Are investor protections legally defined? Do investor protections need to be updated?
- Are disclosure rules appropriate or do they need to be updated?
- Are market conduct and anti-manipulation rules adequate or do they need to be updated?
- Is there clarity on the rules on insolvency or debt work outs?

Vision of success: The proposed digital bond issuances have a secure position within the country's legal and regulatory system. Issuer reporting and investor protections are clearly delineated. Risks are understood and steps taken to mitigate them. The chosen framework supports local financial market development and targets spillovers across the private sector.

Stage 3: Developing core technology infrastructure

Countries need the capabilities of technology, and discussion of specific flavours should be left to specialists. We explored some of the key capabilities in Section 4 and Box 2. The Kenyan example in Section 3.3 highlights how upgrading one key system, its Central Securities Depository, was an important component to digitising the process it used to issue, custody and settle its sovereign bonds. The connection to the Nairobi Stock Exchange enabled trading, an important feature for retail investors requiring access to cash. For countries with less sophisticated framework conditions than Kenya, other pre-requisites might be to upgrade its existing payments system, e.g., Real Time Gross Settlement between domestic financial institutions.

Key questions:

- What is the status of the country's existing financial market infrastructure? Can the payments system support digital bonds?
- Can existing systems issue, manage and process the proposed new instruments?
- How will Know Your Customer (KYC) / Anti Money Laundering (AML) requirements be implemented?
- What data will need to be collected?
- What systems will hold data and provide reporting capabilities?
- What size and scope of technology investments need to be made?
- Does the technical capacity to implement already exist or will it need to be developed over longer time periods?
- How technically and operationally resilient are the proposed systems?
- What investments in cybersecurity are required?

- How much time can and should be allocated to these projects?
- What are the costs and benefits of launching financial instruments, such as retail sovereign bonds and tokenised bonds, prior to the completion of the full suite of upgrades?

Vision of success: The digital payment system works efficiently. The registry, custody and settlement of bonds is fully digitised. Reporting related to sovereign bonds are made in a timely and accurate fashion. Technical and operational risks are understood and steps taken to mitigate them.

Stage 4: Issuance of retail digital sovereign bonds

With appropriate legal and regulatory frameworks and the core technology infrastructure in place, the next stage is the issuance of a retail digital bond. Issuers should be aware that retail investors are often yield focused, and therefore it may be necessary to offer attractive yields and features that can persuade investors to switch. This cost should be weighed against the increase in market accessibility (democratisation and disintermediation effects), the deepening in capital markets, efficiency gains, the financial flexibility issuing retail sovereign bonds offers, and the possibility to extend maturities further out than institutional markets are willing to accept.

Key questions

- Which local financial institutions and fintech are suitable partners for the issuance?
- What controls and rectification measures are in place to manage the issuance?
- How will local retail investors access the sovereign bond offerings?
- Have Know Your Customer (KYC) / Anti Money Laundering (AML) requirements been correctly implemented?
- Will the unbanked be able to access offerings, e.g., by using monetary thresholds for KYC?
- What yields are offered by competing products?
- What yields and terms do the bonds require to establish scale?
- What is the tax treatment of these bonds?
- What are the impacts to banking sector stability and regulation?
- How do we minimise fraud and scams? Are extra protections required?
- Do investors have a means to withdraw their money prior to bond maturity?

Vision of success: Local citizens can easily sign up and invest funds into retail sovereign bonds. A reasonable and politically defensible balance is set between KYC / AML security and access for the unbanked. The offering is competitive against the most common savings product in the market and gradually gain scale as competing products mature and are then invested in retail sovereign bonds. The banking sector provides more value to consumers without any loss of macro financial stability. Financial crime risks are understood, and steps have been

taken to mitigate them. The country benefits from an increase in domestic local currency financing.

Stage 5: Issuance of tokenised sovereign bonds

For some countries, tokenised sovereign bonds will be the aspirational goal of digital sovereign finance. They are a fully digitised vision of government finance that reduces cost, eliminates risks and drives efficiency. Although it offers the potential for a leapfrog move by a less mature financial market, caution is warranted that attempting such a jump will be risky if the institutional prerequisites – especially the ability of financial authorities to regulate and supervise such new markets – are not met. There are many dependencies across legal and supervisory frameworks, technological infrastructure, and political economy. We note it is possible for a low-income country sovereign to ignore the steps we delineate here, via retail sovereign bonds, and go straight to issuing tokenised bonds. At the same time, we cannot emphasise enough the importance of the local context and the value of smaller projects that build on each other and gradually expand legal frameworks and domestic capacity.

Key questions:

- What are the national requirements and priorities for tokenised sovereign bonds, e.g., to widen access (Thailand), to drive financial innovation (Hong Kong) or to lower costs of government finance?
- What are the national requirements and priorities for tokenised sovereign bonds?
- Which technical solution best meets these requirements?
- What level of initial processing automation will be targeted?
- How much investment is required to connect the new technical solution to existing domestic payments and government finance systems?
- Will tokenised offerings be made available via traditional bond distribution, i.e., to existing investors?
- What is the key target audience for the tokenised bonds?
- How much data will be included in the tokenised bond or its programmable platform?
- What incentives will be offered to drive adoption?

Vision of success: The tokenised bonds generate incremental financing capacity and enjoy a reduction in cost that can be invested in the chosen national priority. Government issuance induces spillover benefits across (1) sustainable projects financed, (2) private sector issuance, and (3) local financial market development. Financial crime risks are understood, and steps have been taken to mitigate them.

Although this roadmap comprises five steps, the two key objectives that change a country's scale of domestic financing capacity are the issuance of retail digital sovereign bonds and the issuance of tokenised sovereign bonds. We list out quantifiable KPIs related to these two objectives in Table.

Table 2: List of KPIs associated with incremental bond issuance options

Objective	Key Performance Indicator
Retail digital sovereign bonds	• Sovereign retail bonds issued by value • Change in percentage of government finance raised from households • Increase in number of households invested in domestic sovereign bonds • Change in diaspora holdings of domestic sovereign bonds
Tokenised sovereign bonds	• Tokenised sovereign bonds issued by value • Reduction in cost of issuance as percentage of amount issued • Increase in number of investors in sovereign bonds • Share of sovereign finance from new investor groups

7. Conclusion

EMDEs face a triple challenge of sustainable investment gaps, aid cuts and capital flight. In this bleak environment, countries must redouble efforts to mobilise domestic financial resources and stop the outflow of significant parts of domestic savings to international financial centres. This is easier said than done but developing a strategic approach to strengthening the mobilisation of domestic financial resource and further developing the local financial system is a crucial prerequisite for reducing capital costs and boosting domestic investment. In this report we reviewed how several countries have started to change the scale of their domestic financing capacity by innovating the distribution and technology they use to issue sovereign bonds.

To be clear, local capital market development will also depend on enhancing broader economic development, fiscal capacity, financial sustainability, all of which has impacts on sovereign credit ratings. Nonetheless, the digitisation of finance can help to lower the barriers for governments to raise more finance from local retail investors and help put public finance on a more solid footing by reducing dependency on external debt denominated in foreign exchange. In most countries, sovereign bonds have high minimum investment levels and retail investors are obliged to use bond funds or purchase them from financial intermediaries. Technology has overturned this, opening new avenues for developing bond markets that are more inclusive and efficient.

As the Philippines, Indonesia, Kenya, Thailand, Hong Kong and Singapore have shown, sovereign bonds can be issued directly to citizens via their mobile phones or a website. In the fiscal year 2024, we estimate that Kenya incrementally substituted for 6% of other types of sovereign financing by doing this. This may force the banking sector to increase its competitiveness. Importantly, a broadening of the investor base can help the mobilisation of informal savings, which would prospectively contribute to a lowering of the cost of capital.

The next tools are tokenisation and DLT, whereby a digital asset is either created or registered on a programmable platform. This can reduce issuance and custody costs, eliminate counterparty risks and drive efficiency. Thailand and the Philippines used such cost savings to significantly reduce minimum investment sizes and increase financial access. Going forward, tokenisation could help to evolve bond markets from institutionally centric into a series of upgradeable software modules, helping to make capital markets more inclusive.

The additional sovereign financing raised by digital and tokenised bonds can be used to drive sustainable development. Digitising and developing local financial markets can create positive spillovers as private issuers follow suit and issue digital corporate bonds domestically. Together, these developments also represent a clear move by countries to lessen their dependence on fickle international private capital, fee charging financial service providers and under stress development finance institutions. We argue that these opportunities to expand their financing capacity should be considered by EMDEs with the appropriate institutional capacity.

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