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A Potential Path for Alleviating Currency Risk in Emerging Market Green Bonds

By **Dr. Gautam Jain**

September 2023

REPORT

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Executive Summary

A large gap exists between the financing needed for the energy transition and what is being invested. Green bonds are flourishing as one of the main sources to close this financing gap, with over $2.5 trillion issued globally thus far. However, emerging market and developing economies (EMDEs) haven't fully capitalized on the growth of this asset class: the share of EMDE (excluding China) green bonds denominated in *local currencies* within the total green bond universe remains minuscule. While some EMDE issuers can sell a bond denominated in dollars and hedge by swapping the dollar exposure into the local currency of the underlying projects, the cost of doing so is usually prohibitive.

This report, part of the Financing the Energy Transition initiative at the Center on Global Energy Policy at Columbia University SIPA, adds to ongoing discussions of how to encourage a greater flow of green financing from international investors to emerging economies. Toward that end, it explores a blended finance structure wherein an intermediary takes on the local currency risk of an EMDE green bond, effectively converting it to a dollar bond that settles internationally, to potentially stimulate more issuances and expand the pool of international investors with access to these bonds.

Key takeaways from this report include the following:

- A mismatch exists between the currency in which EMDE issuers would prefer to sell green bonds and the currency of denomination demanded by many international investors. To potentially help address it, the intermediary discussed in this report absorbs the local currency risk between the two parties. By converting interest and principal payments to dollars, this structure would allow the EMDE sovereign or corporate to issue a hard currency bond indirectly, avoiding the exchange rate risk while paying its domestic market interest rate to all investors.
- If the currency risk is managed properly, such as by diversifying across a number of EMDE currencies and employing a euro hedge—as back-tested in this report—the intermediary could likely mitigate much of the risk.
- In addition to avoiding the exchange rate risk, though, clear monetary incentives may be needed to convince EMDE governments to undertake the complex tasks of creating green bond frameworks and sourcing applicable projects along with bearing the added expenses of issuing green bonds that, at the same time, limit their flexibility in using the bond proceeds

(as opposed to issuing conventional bonds). A guarantee on interest-rate payments by philanthropies and donors could be a relatively low-cost impetus making these bonds more affordable for emerging economies to issue.

- For low-income economies with environmental projects that may not add up to the minimum size needed to issue a bond, the structure could be extended into regional bonds, with the intermediary pooling projects across countries without requiring governments to directly coordinate with each other.
- The blended finance structure discussed in this report requires an intermediary with deep expertise in bond and currency markets. While multilateral development banks, development finance institutions, and the like may be natural fits, these institutions have historically been highly risk-averse and therefore would likely require a shift in thinking to assume the intermediary role.

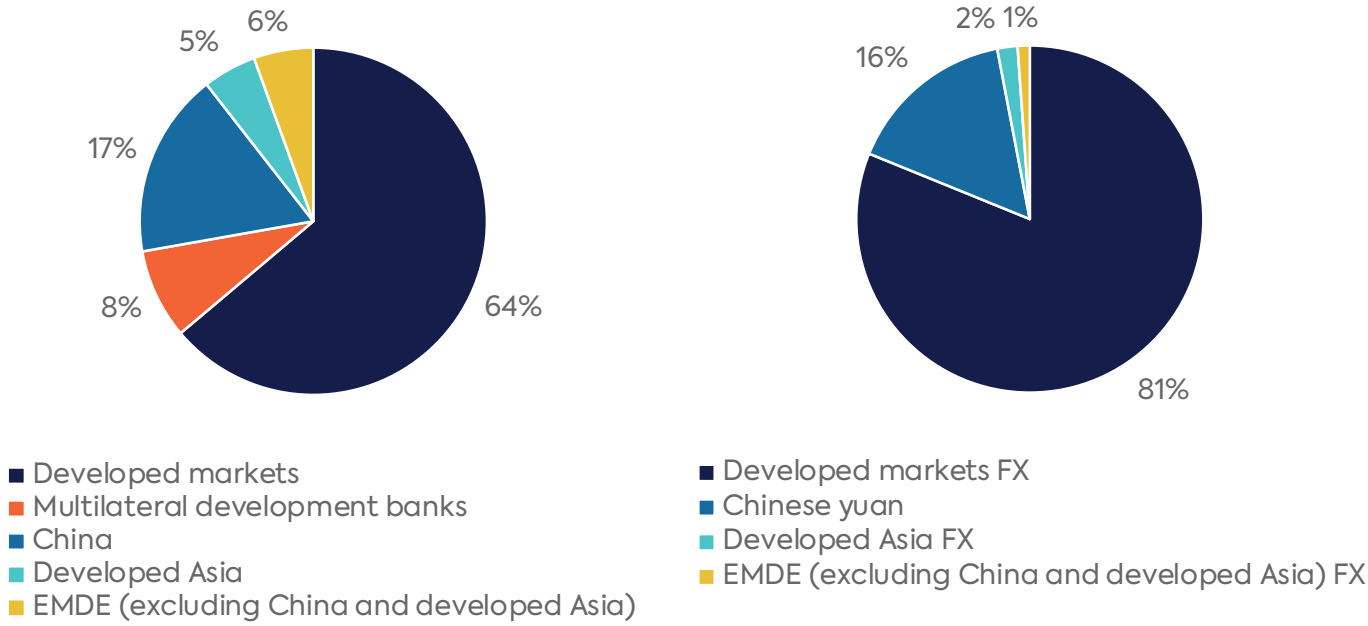
Introduction

Annual spending on clean energy systems is currently running at roughly a third of the $5 trillion in global investments needed by 2030 to meet net-zero targets (International Energy Agency May 2021 and May 2023). That ratio is even lower for emerging market and developing economies (EMDEs).[1] As of 2020, only 15 percent of the $1 trillion needed annually for EMDEs, excluding China, was being invested. These countries' clean energy investments have only dropped since the pandemic, as more government resources have been allocated toward energy affordability (International Energy Agency June 2021 and June 2023).

The bond market is already an important source of financing for sustainability projects. Cumulative issuance of green bonds—a type of thematic bond[2] whose proceeds are earmarked or ring-fenced for projects with clear environmental benefits (see, for example, Organization for Economic Cooperation and Development 2021 or Jain 2022)—has risen from around $100 billion in 2015 to over $2.5 trillion now, based on Bloomberg data. Nevertheless, in terms of stock, they still make up[3] less than 2 percent of the $126.9 trillion fixed-income market (SIFMA Research 2022). Similarly, in terms of flow, the average annual green bond issuance of close to $550 billion over the past two years is just around 2 percent of yearly global fixed-income issuances of $26.8 trillion by corporates and sovereigns (SIFMA Research 2022). These comparisons showing the relative size of green bonds in the broader market give a sense of their potential to expand further.

EMDEs may be missing out on this growth potential, though: their share of global green bonds is stagnating at a low level, even though the need for climate financing is acute in these countries. Excluding China, EMDEs make up less than 6 percent of the total amount of green bonds issued thus far when all currencies are included—a share that has stayed relatively stable over the past few years—and 1 percent of global green bonds when denominated in their local currencies (Figure 1).

Figure 1: Total global green bond issuance by market and currency



Note: Developed Asia includes Singapore, Hong Kong, Taiwan, and South Korea. Data as of June 30, 2023.
Source: Bloomberg, author's calculations.

There are many reasons for modest green bond sales by EMDEs. In the past couple of years, many low-income countries have lost the ability to borrow from financial markets as they have been left in fiscally precarious situations in the pandemic's aftermath; over 50 countries are currently facing severe debt distress (Chabert et al. 2022). Although many of the same countries are also among the most vulnerable to climate change (Chamon et al. 2022), they have no fiscal room to spend on basic services, let alone raise funds via capital markets for climate change mitigation or even adaptation.

The small share of EMDEs among global green bonds, however, predates the recent fiscal turmoil that these countries are facing. The many impediments to EMDE green bond issuances—from both the supply and demand side—have been identified and discussed in detail in previous articles (for example, Organization for Economic Cooperation and Development 2017 and 2021, and Jain 2022).

One prevalent obstacle is the institutional complexity of setting up a green bond framework and taxonomy, which typically involves creating an inter-ministry committee comprising finance, environment, energy or power, and transportation, among others. This can be a time-consuming

and complicated process because of the political angle. There is also a direct monetary cost for acquiring external pre-issuance and post-issuance reviews, necessary steps to successfully sell green bonds by assuaging investor fears of greenwashing.

The framework also entails delineating the projects for which the funds raised using the bond are earmarked. In theory, there should be a lot of new projects that could be financed using these bonds, since most EMDEs currently lack low-carbon infrastructures. However, the exercise of identifying and listing projects—in sizes large enough to justify a bond issuance as well as to meet the threshold of external reviewers' scrutiny—is not a trivial task for these countries. There is also a propensity for projects in many EMDEs to cater to climate *adaptation*. Such projects don't always have clear revenue streams, making it a challenge to prove they are "bankable" or "investable."

Finally, there are market accessibility and liquidity issues for foreign investors. Specifically, some very low-income countries lack credible financial infrastructures. Some larger EMDEs may have reasonably developed capital markets, but the combination of regulatory hurdles such as complications in accessing local bonds, the lack of liquidity in some of these markets, and the small weight or complete elimination of bonds from these countries in global green bond indexes may discourage atypical EMDE investors—such as those with international ESG mandates—from buying local currency bonds.[4] EMDE issuers are therefore reliant mostly on domestic demand for these bonds: domestic investors on average hold over 80 percent of all local currency bonds (International Monetary Fund 2023).[5] With few, if any, ESG or sustainable fixed-income mandates in these countries and low investment allocations from global ESG funds into EMDEs (International Monetary Fund October 2022), the cost-benefit analysis favors issuing conventional bonds over green or any other thematic bonds.

This report homes in on several of the issues identified above, most specifically the embedded exchange rate risk in bonds denominated in local currencies, and discusses potential ways to alleviate them. It also considers ways to help lower the issuance cost of green bonds for EMDEs. This discussion may not apply to countries currently facing debt distress, which may, for now, be reliant on grants, concessional loans, or possibly debt-for-climate swaps (Chamon et al. 2022). But for the large universe of middle- and low-middle-income countries that maintain market access (for example, Brazil, India, Mexico, South Africa, etc.), the approaches discussed here could help attract private capital from international investors.

Various Approaches to Assuaging Currency Risk

Currency risk has for some time been well understood to be a hindrance to investments in EMDEs (Monaco 2017), and a few solutions have been proposed and implemented. The Currency Exchange Fund (TCX) was set up in 2007 by a group of development finance institutions (DFIs) and donors to offer currency solutions for its investors (Organization for Economic Cooperation and Development 2016, TCX Investment Management Company 2023, Brouwer 2023). TCX acts as a market-maker in currencies and maturities that are typically not covered by commercial banks. While providing a vital function, the scope of TCX is relatively limited, with a total of $1.4 billion of sustainable finance flows into emerging and frontier countries hedged in 2021 (TCX Investment Management Company 2022). The small amount is partly because the fund provides services to some of the most vulnerable countries that lack access to capital markets and tend to be small economies, and, as such, require hedging for small amounts of investments. More importantly, the cost of hedging tends to be quite high (as shown later in the report), which means that, except in extreme situations, it becomes too expensive for some countries to pursue.

One proposal made at the June 2023 Summit for a New Global Financial Pact in Paris[6] as part of Barbados prime minister Mia Mottley's Bridgetown Initiative was to allocate $100 billion toward currency-exchange guarantees in multilateral development banks (MDBs) and the International Monetary Fund (IMF) (Rathi 2023, Jessop and Jones 2023, Reuters 2023). Avinash Persaud (2023) details the proposal by arguing that MDBs could use these funds to guarantee exchange rate risks in projects—prioritized by their climate impact—by providing hedging at cheaper-than-market levels (Wolf 2023). This is part of a broader effort to reform the international financial architecture and the role of MDBs, a topic that is expected to be high on the agenda at the United Nations Framework Convention on Climate Change Conference of the Parties (COP28) later this year as well (Di Paola and Ratcliffe 2023). Persaud proposed that an FX Guarantee Agency could be created with the support of MDBs and the IMF to provide hedging without "overpayment" for the "excess risk premium" when these costs rise, and to pool these hedges to lower the cost further. By doing so, he estimates that currency hedges would cost on average 3.5 percent less per annum.

In theory, Persaud's proposal for lowering the cost of hedging could tie in with at least one of the proposals made by Fink et al. (2023) to mitigate the currency risk passed on to borrowers in fragile and conflict-affected countries. A large share of development finance in these countries needs to be deployed in local currencies, but most of the DFI lending on which they rely to achieve their sustainable development goals (SDGs) takes place in foreign currency. The Fink proposals to address this problem include: DFIs could offer guarantees that take on part of the credit risk in local currency loans, or help set up foreign exchange platforms, either onshore or offshore, that could be utilized for providing local currency hedges.

Another novel approach to tackle local currency risk in an EMDE-based clean energy project was proposed by Benoit et al. (2022). As part of an exchange rate facility, the authors suggest ways to cover currency risk, including with the support of MDBs and philanthropies, and monetizing carbon credits generated by the projects being funded.

The structure discussed in this report takes a different tack, addressing the problem at the bond level that funds a pool of such projects. Specifically, this paper explores a bond structure to address exchange rate risk in EMDE local currency green bonds[7] by having MDBs or similar entities act as intermediaries between EMDE governments and international investors, taking on the currency risk in lieu of either the investors (if they were to buy the bond denominated in local currencies) or the issuer (if it were to issue a hard currency bond instead). The bond structure can be seen as a combination of some of the blended finance instruments and mechanisms that have emerged to close the financing gap in achieving SDGs (see Habbel et al. 2021, for example, for details on blended finance tools). With the intermediary bearing the exchange rate risk in the structure, the paper then examines ways to mitigate this risk, including with a euro hedge.

Since the structure still may not be enough in itself to catalyze increased green bond issuances from EMDEs, the paper then explores a way to further incentivize emerging economies to tap into the green bond market by potentially lowering the cost of issuance with the support of interest-rate guarantees from donors. If a lack of sufficient bankable projects still stands in the way, a regional bond structure is discussed as a natural extension of the one for a single issuer. The paper closes by considering which entities might be appropriate to take on the important role of the intermediary in the bond structure discussed in the paper.

Currency Mismatch between Demand and Supply

Emerging market local currency bonds became a separate investable asset class in the mid-2000s. The EMDE local currency bond market started to grow on the back of structural reforms and institutional developments in many emerging economies, including the introduction of flexible exchange rates and inflation-targeting monetary policy regimes accompanied by stronger economic and fiscal performance (International Monetary Fund 2006). As the EMDE local debt asset class matured over the years to make up almost a quarter of the global fixed-income market (Dehn 2020),[8] it attracted investors that fall into three broad categories: domestic investors, EMDE-dedicated international investors, and "crossover" international investors, which refers to global fixed-income investment managers who invest in EMDEs only opportunistically, as part of either unconstrained multi-sector bond funds (MSBFs) or hedge funds (Cortes and Sanfilippo 2020). Funds with dedicated EMDE mandates could be benchmarked to an EM-specific index (for example, JP Morgan's GBI-EM index; see Kim 2018) or a global fixed-income index that includes a select few EMDEs, typically in small weights (for example, FTSE World Government Bond Index; see FTSE 2023).

Following the launch of the first EMDE local currency bonds index in mid-2005, foreign holdings of these bonds continued to rise for over a decade, especially following the 2008–09 global financial crisis (Buzas et al. 2021, International Monetary Fund 2023). However, the share of non-resident investors in EMDE local debt may have peaked in 2019, before the pandemic (see, for example, the charts and data in International Monetary Fund 2023). The share of EMDE local currency bonds in the investments of MSBFs peaked in 2015 and has since hovered around 11–12.5 percent of their portfolio mix (Cortes and Sanfilippo 2021).[9]

With the traditional set of international investors potentially reaching their limit, at least in terms of their share of the total outstanding amounts of bonds, other avenues may be necessary to find new types of investors. ESG and sustainable funds may be one route. These have experienced spectacular growth in recent years: assets under management of funds incorporating ESG criteria reached $8.4 trillion in 2022 in the US (US SIF 2022) and are expected to continue expanding globally (Foster 2022). To appreciate the scale of recent growth, a subset of these funds comprising open-end funds and exchange-traded funds focused on sustainability, impact, or ESG factors have grown from around $1 trillion at the end of the fourth quarter of 2019 to $2.7 trillion at the end of the first quarter of 2023, almost a three-fold increase in just over three years (Morningstar 2022, 2023).

As reliance on foreign currency debt has declined since the early 2000s (Beirne et al. 2021), a little over 80 percent of all outstanding EMDE debt is now denominated in local currencies (Dehn 2020). However, the reverse holds for green and other thematic bonds. As Figure 1 showed, less than 20 percent of the (small amount of) green bonds issued by EMDEs were denominated in local currencies, with the vast majority denominated in a hard currency like the dollar or the euro.

For an international investor, investing in EMDE local currency bonds entails many risks,[10] including exchange rate and credit risk. Dedicated and crossover EMDE investors are well versed in these risks. However, some international managers of the relatively new class of ESG fixed-income funds may be less accustomed to these risks. While the attractive yields and diversification benefits of EMDE bonds may entice some investors to take on added risks, especially in the form of a green bond being bought as part of a sustainable fund, others may be less interested in doing so.

Several risks specifically accompany international investors' ownership of EMDE bonds denominated in a local currency versus a hard currency (in addition to the credit risk that both local and hard currency bonds entail). Currency depreciation is an obvious one, but for investors less familiar with EMDEs, the perceived risk of "convertibility"—changes in regulations, such as the introduction of capital controls, that limit the ability to freely convert a local currency into a foreign currency, which if instituted could result in the loss of part or the entirety of the investment—could be quite important. Additionally, there may be regulatory hurdles for international investors, such as the complexity of setting up local accounts and dealing with tax withholdings, along with potential changes in the domestic regulatory regime (Organization for Economic Cooperation and Development 2017). The higher volatility of EMDE local currency bond returns compared with hard currency bond returns likely does not help, either (see, for example, Hong Kong Monetary Authority 2020).

Finally, while liquidity in the EMDE local currency bond market has been improving over the years, reflecting the development of this market and the broadening of the investor base, transaction costs remain higher than in advanced economies, and many EMDEs continue to express limited secondary bond market liquidity as a challenge (International Monetary Fund and the World Bank 2020). The lack of depth and liquidity in the secondary market could be a problem for international institutional investors who would need confidence in their ability to transact in large sizes without impacting the price. Moreover, secondary market liquidity has been shown to be linked to issuance yields in primary markets—lower liquidity leads to higher yields, and vice versa, as the liquidity risk premium gets priced (for example, Goldstein et al. [2019] demonstrate this on corporate bonds). As a result, in a situation where liquidity, convertibility, and regulatory risks—real or perceived (Gbohoui et al. 2023)—are high, the minimum yield demanded by investors may dissuade the issuer from moving ahead with the bond offering.

Limited Inclusion of EMDE Local Bonds in Indexes

Another practical reason for ESG funds' low exposure to EMDE local currency bonds could be restrictions applied in the construction of fixed-income indexes that are typically used as benchmarks for funds. Around 80 percent of US mutual funds explicitly compensate portfolio managers based on their performance relative to a benchmark (Ma et al. 2019). As a result, the inclusion of a country's bonds in an index leads to a natural demand for them from asset managers benchmarked to it. Conversely, if a bond is not included in these indexes, it is likely to see weaker demand from international investors.

Several green bond indexes have emerged in recent years, keeping pace with growth in the asset class. Similar to other bond indexes, either currency or credit rating restrictions limit the inclusion of most EMDEs in these indexes, with some excluding local currency bonds altogether (Table 1).

Table 1: Selected green bond indexes and their restrictions

Index	EDME local FX bonds limited or restricted	Rating restriction	Currency restriction
FSTE Global Green Impact Bond Index	No	None	Multi-currency
FTSE WorldBIG Green Impact Bond Index	Yes	IG only	US dollar, euro, British pound
Solactive Green Bond Index	Yes	IG only	Multi-currency
Solactive Global Green and Social Bond IG TR Index	Yes	IG only	Multi-currency
Bloomberg Barclays MSCI Global Green Bond Index	Yes	IG only	Multi-currency
iBoxx® Global Green Bonds Select Index	Yes	None	US dollar, euro, British pound, Canadian dollar
S&P Green Bond Select Index	Yes	None	Group of Ten currencies
J.P. Morgan EM Green Bond Diversified Index	No	None	Multi-currency
J.P. Morgan EM Credit Green Bond Diversified Index	Yes	None	Hard currencies
J.P. Morgan ESG GSS IG EUR Bond TR Index	Yes	None	Euro

Note: IG = investment grade.
Source: Websites of listed index providers.

As a recent example, India's sovereign green bonds denominated in rupees that debuted this year received limited interest from foreign investors despite additional incentives, such as exempting foreign participation from investment caps (Dhutia 2023, Kumar 2023, Jain and Deb 2023). In contrast, Chile's sustainability bond denominated in pesos had 46 percent participation from foreign investors (Ministry of Finance of the Republic of Chile 2022). The main difference between the two countries is that India is excluded from practically all major fixed-income indexes, while Chile is included in some—not just for green bonds but even traditional EMDE local currency bond indexes (Wheatley and Lockett 2022).

Although there may be demand for hard currency EMDE green bonds from investors benchmarked to the indexes described in Table 1, emerging economies are generally reluctant to issue bonds in dollars (or another hard currency) with project revenues in their local currency. One reason for this is many emerging economies have suffered through balance sheet crises due to weakening currencies in the past, particularly in the 1980s and 1990s (Jeanne and Zettelmeyer 2002). A weakening currency increases the debt burden and leads to a vicious cycle with the domestic currency selling off and depreciating further (Eichengreen and Hausmann 1999). There is effectively a mismatch between the currencies of bonds demanded by ESG-focused international investors and the currencies of potential supply from EMDE issuers.

Issues with Hedging

One seemingly simple solution to the problem of the currency mismatch between demand and supply is for the EMDE issuer to sell a dollar bond and then hedge or swap the cash flows (coupons and principal payments) back into the local currency. Indeed, as discussed earlier, this is a function already being facilitated by TCX. However, hedging tends to be quite an expensive option.

There are two drivers of the hedging cost (see the text box for an illustration). First, when an EMDE sovereign issues a dollar bond, it includes a spread that reflects country risk over US interest rates.[11] In the hedge, this spread is borne as a cost by the sovereign. Second, while the interest rates paid for the local currency hedge should be correlated with interest rates in the domestic market, typically there is a difference or "basis" between these two.[12] There are several reasons for this basis to exist, but the most important driver is the demand versus supply of currency hedges. Since the demand for hedging typically exceeds supply in EMDEs, the basis between the cross-currency swap rate and the domestic interest rate swap of the same maturity is positive, adding to the cost of the hedge.

Hedging Cost Illustration: Colombia

The high cost of hedging can be illustrated by an example. Colombia is one of the few countries with a relatively liquid cross-currency swap market. A cross-currency swap is simply an agreement between two parties to exchange interest and principal payments in two different currencies (Mitchell 2020). Interest rates can be fixed, floating (variable), or a combination of the two. In the case of Colombia's cross-currency swaps, the interest rates on the Colombian peso leg are fixed while the interest rates on the US dollar leg are floating.

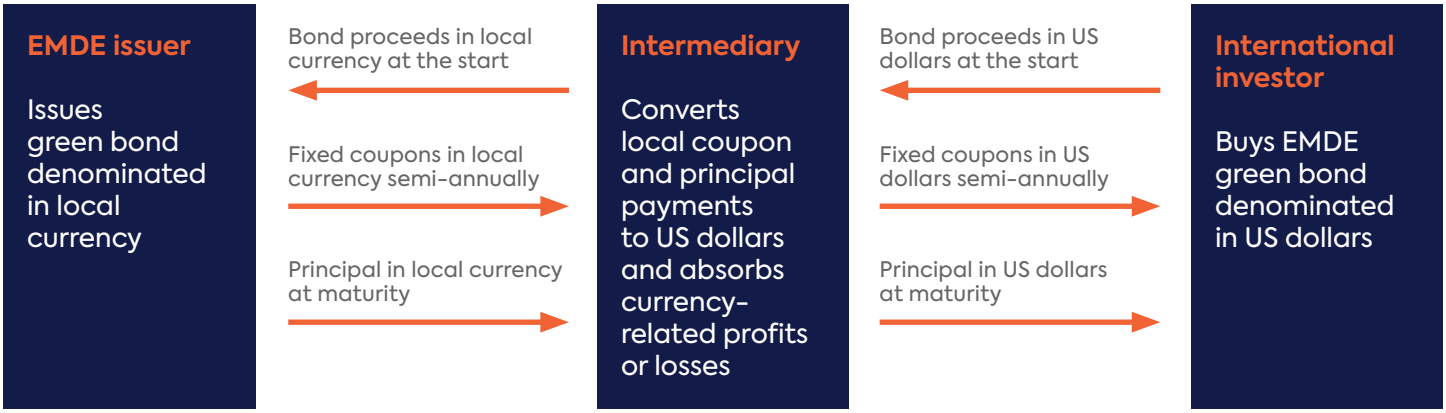
Let's say Colombia issued a five-year dollar bond on June 30, 2023. Colombia's March 2028 dollar bond was trading at a yield of 7.1 percent that day. Though it's not precisely a five-year bond, for the sake of simplicity, let's assume that was the interest rate at which the dollar bond was issued. Colombia then enters into a cross-currency swap to match the coupons and principal payment dates to effectively eliminate the exchange rate risk.[13] On that day, the cross-currency swap rate—which is the fixed leg—was 8.8 percent. The interest rate on the US dollar leg is floating and tied to the six-month LIBOR (London Interbank Offered Rate),[14] which on that day was 5.8 percent. However, this is a floating rate that resets every six months. Based on the US swap curve, which is inverted, the average six-month LIBOR rate over the five-year period works out to be 4.8 percent. In this example, the country pays 7.1 percent interest on the dollar bond, receives 4.8 percent on average on the dollar leg of the cross-currency swap, and pays 8.8 percent on the fixed leg of the cross-currency swap, resulting in a net annual interest payment of 11.1 percent on average over five years. The April 2028 peso bond was trading at a yield of 9.8 percent on the same day. Hedging the dollar cash flows thus resulted in the country paying 1.3 percentage points more than if it had simply issued a peso bond instead. Moreover, it is important to point out that this example uses mid-prices. Incorporating transaction costs—particularly for the cross-currency swap, which tends to be less liquid than interest-rate swaps or bonds—would result in an even higher cost for the sovereign to hedge its dollar exposure.

Despite the high cost of hedging, it may be the only option available to many EMDEs when financing at the project level. Moreover, as mentioned earlier, Persaud (2023) has proposed setting up an agency by multilateral development banks and the IMF to provide currency hedges during periods of stress when the risk premium increases to extreme levels, resulting in potential overpayment for the currency risk. While this may be one path for encouraging greater investment flows to EMDEs, a different approach to addressing currency risk, involving bonds that could fund a pool of projects, is presented next.

Aligning Currency Needs of Issuers and Investors Using an Intermediary

To address the currency mismatch between demand and supply, an intermediary could absorb the currency risk embedded in an EMDE local currency green bond. A potential structure for the intermediary's role between the issuer and investor is shown in Figure 2.

Figure 2: Potential green bond structure whereby an intermediary absorbs currency risk



Source: Author.

An EMDE sovereign (or corporate entity) issues a local currency green bond priced according to its domestic yield curve. An intermediary agrees to convert the cash flows from this bond to dollars[15] and pay a fixed coupon in dollars based on the issuing entity's dollar yield curve, with payment dates matching that of the local currency bond. At the bond's maturity, the international investor receives the principal in the same dollar amount as was originally invested. Effectively, international investors would be buying a dollar green bond from the EMDE issuer. The issuer in the structure, meanwhile, is able to issue a hard currency bond indirectly, thus avoiding the exchange rate risk that would have accompanied a direct hard currency bond issuance. This structure also allows the issuer to potentially attract more international investors than it would otherwise while paying its domestic market interest rate.

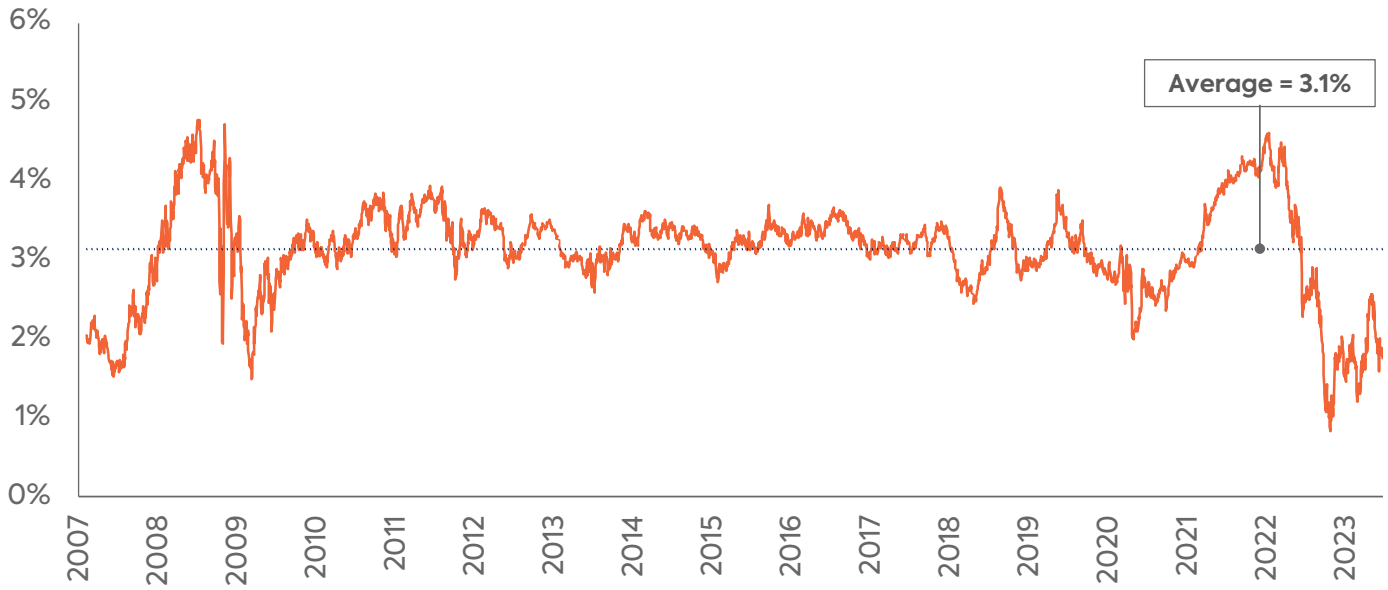
Because the intermediary converts each coupon and the principal received from the issuer to dollars, and is committed to making these payments that have been fixed in dollars, it will realize

a net gain or loss based on the exchange rate on the coupon and principal payment dates. The total gain or loss experienced by the intermediary is, therefore, a function of the local and dollar coupon rates as well as the nominal currency exchange rate on each of the payment dates, and can be expressed as a simple formula (see Appendix 1). It is important to note that the intermediary is absorbing only the currency risk in this structure; the credit risk is still borne by the international investor. If the issuer were to default, the international investor would bear the loss resulting from it.

While the intermediary in this structure would be exposed to the depreciation of the issuer's currency, it is important to note that the differential between the interest rate it receives from the issuer and the interest rate it pays to the investor is usually high and positive. Domestic interest rates in EMDEs tend to be higher than the interest rate they pay when borrowing in the external market,[16] because in addition to the credit risk—which is reflected in the dollar interest rate of a sovereign—the domestic interest rate curve typically would also include inflation and fiscal risks (along with other risks such as convertibility, liquidity, and regulatory, as discussed in a previous section), which have a bearing on the exchange rate.[17] In effect, investors require a larger yield compensation to account for the many risks, including the exchange rate risk, in EMDE local currency sovereign bonds (see, for example, Gadanecz et al. 2014), which allows the intermediary to capture the interest rate differential between the local currency and the dollar bonds.

As an example, the difference between local and dollar rates for a basket of 10 EMDE countries has averaged 3.1 percent over the past 15 years[18] (Figure 3). The intermediary would thus have some cushion against currency weakness, given that the interest rate paid by the issuer to the intermediary should be higher than the interest rate the intermediary must pay to the investor. In this example, on average, losses will be incurred by the intermediary if the EMDE basket depreciates by more than approximately 15 percent over five years based on the annual average estimate of 3.1 percent,[19] which indeed has been the case since 2015 (i.e., the five-year returns for the currency basket position that were initiated starting in 2010). As such, the cushion needs to be enhanced by deploying other strategies to alleviate the currency risk (as discussed later in the paper).

Figure 3: Difference between EMDE local currency and US dollar five-year interest rate, 2007–23



Note: Equally weighted EMDE basket of local currency and dollar rates encompassing Brazil, Colombia, Chile, Mexico, Peru, South Africa, Turkey, China, Indonesia, and Malaysia. Data as of June 20, 2023.

Source: Bloomberg, author's calculations.

Precedent for the Structure

The bond structure discussed above is not entirely without precedent. In November 2004, the Colombian government issued a global bond denominated in the domestic currency (Jeanneau and Tovar 2008). Although the interest and principal were paid in the Colombian peso, the bond settled internationally in US dollars based on the spot rate at the time of the payments. In this case, the purpose of these bonds was different. The primary objective was to create a mechanism for international investors seeking exposure to local currency bonds to access the otherwise quite restrictive local markets in many EMDEs at the time. A second objective was for issuers to extend the term structure of their yield curves. Many EMDE issuers at the time were unable to sell long-maturity bonds in the local market because domestic investors were wary of these countries' inflationary pasts.

The investor bore the currency risk in these bonds but received the payments in US dollars, and the bonds settled internationally, thus avoiding any risks associated with exchange controls. The issuance allowed the country to extend the maturity of its debt curve in addition to attracting a new set of international investors, who had until then been cut off from this market. Colombia's

global bond was soon followed by similar bonds issued in Brazil, Peru, Uruguay, the Philippines, and Russia (see, for example, the prospectus of Brazil Global 2028 bond; Securities and Exchange Commission 2008).

Pros and Cons of the Bond with Intermediary Approach

The green bond structure discussed in this paper may offer several potential advantages and disadvantages compared to other approaches, such as those at the project level that would typically be financed via loans:

Potential Advantages

- **Easing the pathway for EMDE climate finance:** It could create a pathway for international private capital from rapidly growing ESG and sustainable funds to be directed toward environmental projects in EMDEs through the intermediary. In addition to addressing the risk of currency depreciation for an international investor, the structure eliminates convertibility and local regulatory risks, since the bond would be settled internationally and fall under international law.
- **Scalability:** By supporting the issuance of the bond, which finances a pool of projects, the intermediary is able to attract a large amount of private capital relative to its risk exposure (as will be shown later), effectively leveraging its balance sheet.
- **Simplicity:** Financing at the project level is a complex, time-consuming, and costly exercise that requires a clear understanding of the expected cash flows. This structure transfers the burden of finding projects to fund to the EMDE issuer of the local currency bond.
- **Integrity of use of proceeds:** The task of ensuring that proceeds are used for the projects as intended shifts to the financial market, effectively, which needs to verify that green bond principles (International Capital Market Association 2022) are being honored.
- **Cost efficiency:** A bond is accessible to a wide range of investors because it trades in public markets, which generally makes it more cost-efficient than a loan (unless it's a concessional loan, such as from an MDB).
- **Long-term financing:** It's easier to issue long-dated bonds to match the duration of underlying projects, while loans are typically short-dated and need to be rolled over frequently (Organization for Economic Cooperation and Development 2021).

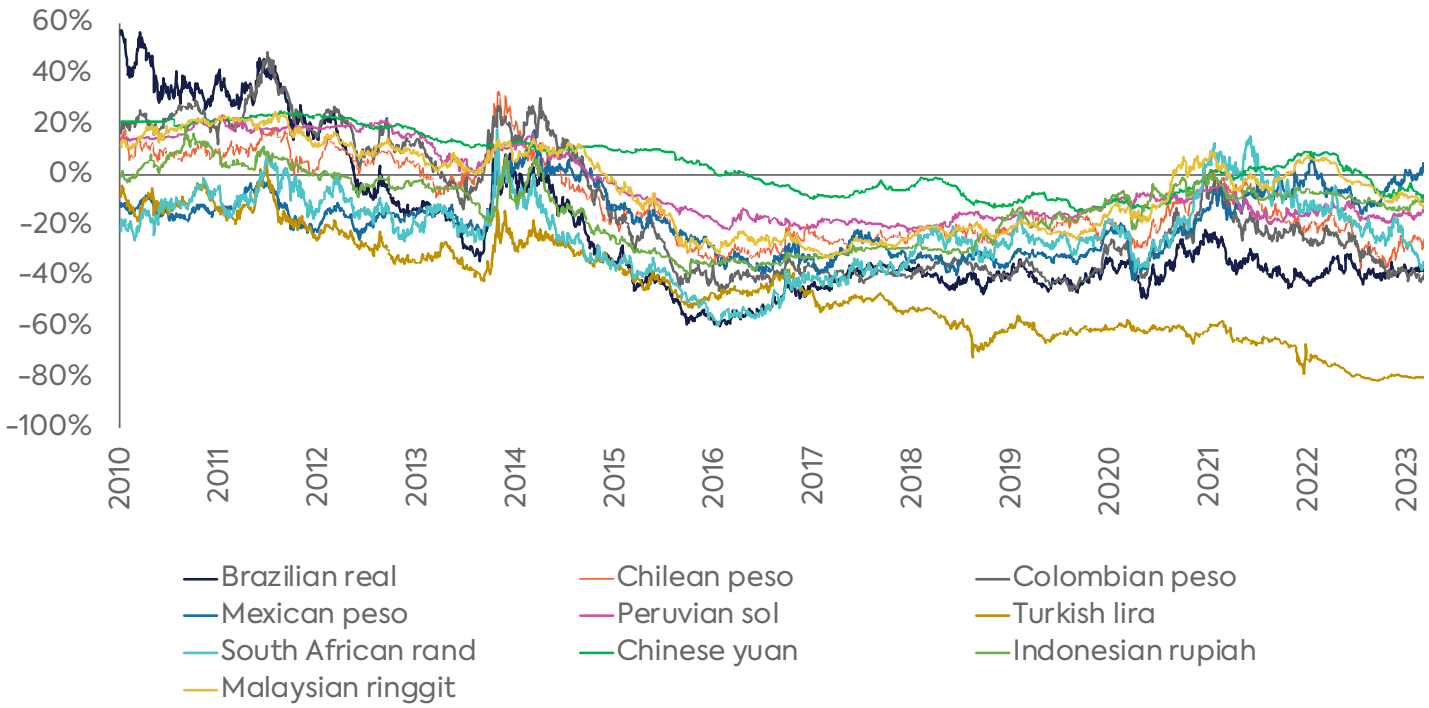
Potential Disadvantages

- **Needs market expertise:** The success of the structure is not guaranteed. The intermediary would need to be well-versed in the functioning of bond and currency markets and be able to coordinate with various parties involved in the structure, including EMDE governments, index providers, and financial services companies to settle cross-border transactions.
- **Not applicable to very low-income countries:** In very low-income countries, project-level financing may be the only viable option, as they may lack market access entirely and thus may be dependent on (concessional) loans and grants.
- **May not be easily compatible with other sources of funding:** Addressing currency risk at the project level could take advantage of other sources of funding, such as carbon credits (Benoit et al. 2022), that may not be straightforward to incorporate in a bond covering a pool of projects.
- **Bond returns may be lower than project-level returns:** Project-level returns tend to be higher than those from bonds—a key reason they attract private equity investors, who are willing to take greater risks that come with investing directly in projects.

Mitigating the Intermediary's Currency Risk

Based on the purchasing power parity principle,[20] EMDE currencies are expected to depreciate nominally against the US dollar due to the relatively higher inflation in these countries. As Figure 4 shows, EMDE currencies have depreciated over most five-year horizons since 2005, with only a few exceptions.

Figure 4: Percent changes in selected EMDE currencies over rolling five-year horizons, 2010–23



Note: Data as of June 20, 2023.
Source: Bloomberg, author's calculations.

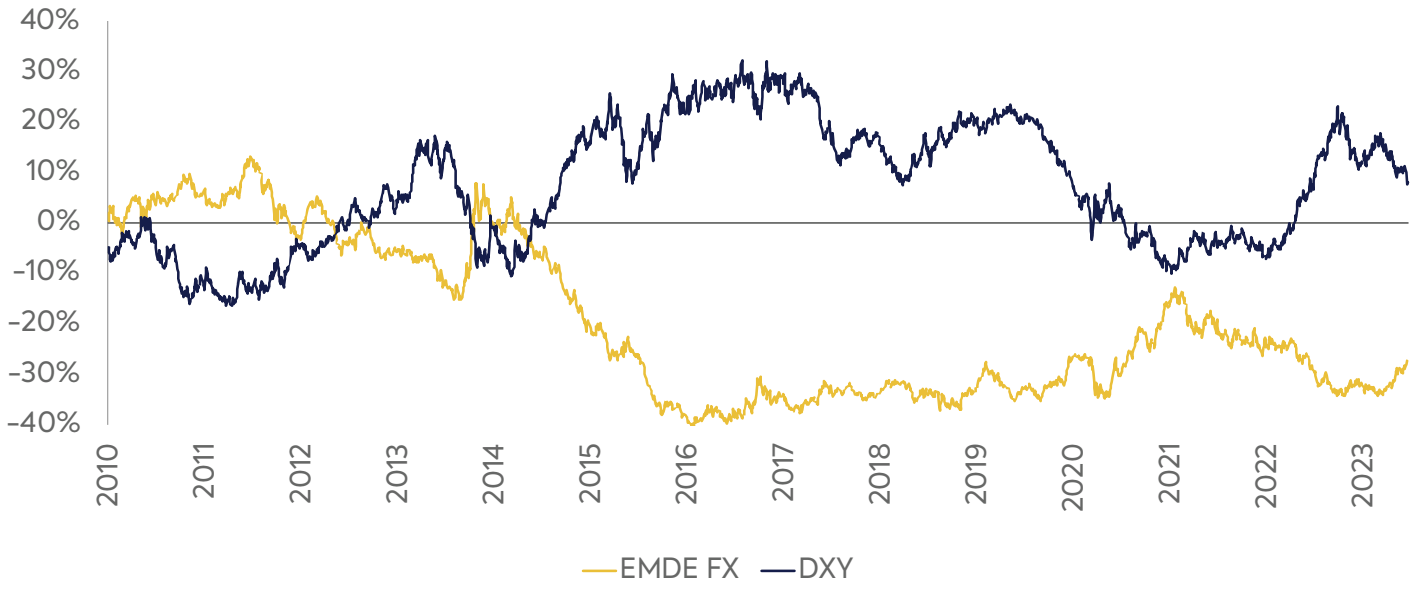
As noted, the exchange rate between two currencies is expected to adjust according to the inflation differential between the two countries.[21] For example, if the inflation rate in an EMDE is, on average, 3 percent higher than the inflation rate in the US, then the EMDE currency should depreciate by 3 percent per annum against the dollar. As such, at any given time, forward exchange

rates should be expected to reflect the forecasted inflation differential between the two countries. Exposure to an EMDE currency is therefore an issue only if it depreciates more than would have been anticipated based on the inflation differentials.

In this regard, the two primary risks that need to be monitored for EMDE currencies are:

- **Idiosyncratic developments:** Unexpected macroeconomic and political developments in a country can cause a currency to depreciate much more than implied by inflation forecasts.
- **Dollar strengthening:** According to the "dollar smile" theory, the US dollar tends to strengthen against other currencies during periods of strong growth as well as during periods of risk aversion, with the currency treated as a safe-haven asset—the two ends of the smile (Constable 2020). Indeed, EMDE currencies typically weaken during periods of dollar appreciation and vice versa, almost independently of countries' domestic developments (Figure 5).

Figure 5: Rolling five-year percent change for a basket of EMDE currencies and the dollar index



Note: EMDE FX refers to an equally weighted basket of currencies from Brazil, Colombia, Chile, Mexico, Peru, South Africa, Turkey, China, Indonesia, and Malaysia; DXY refers to the dollar index that measures the dollar against the euro, British pound, Japanese yen, Canadian dollar, Swiss franc, and Swedish krona. Data as of June 20, 2023.

Source: Bloomberg, author's calculations.

The most obvious and direct way to hedge against these risks is to short the EMDE currency against the local currency green bond. However, as discussed earlier, hedging EMDE currencies tends to be expensive, because interest rates are generally higher in these countries vis-à-vis the US, partly reflecting the inflation gap between them. Additionally, hedging may not be an option in some countries with limited depth and liquidity in their currencies.

In the absence of the perfect hedge, the following strategies can be deployed instead:

- **Diversification:** Holding a basket of EMDE currencies reduces the idiosyncratic risk of an individual country. The lower the correlations between the currencies, the greater the diversification benefit.[22]
- **Hedging with the euro:** At the two ends of the dollar smile, the dollar strengthens and the euro—as the major currency on the flip side in the dollar index—depreciates against it. Since EMDE currencies also typically depreciate at the two ends of the smile, a proxy hedge for an EMDE local currency bond could be selling the euro against it. While not a perfect hedge by any means, an additional advantage of selling the euro is that it typically entails negative cost, i.e., positive carry, since rates in the eurozone have historically been lower than in the US due to lower inflation in the former relative to the latter.

Testing and Analyzing the Intermediary's Currency Risk in the Bond Structure

For demonstration purposes, the above strategies for mitigating the currency risk were tested with historical data by implementing the following:

- To ensure diversification, an equally weighted basket of 10 emerging market countries (from Africa, Asia, Eastern Europe, and Latin America) was used based on the availability of historical data for local rates, dollar rates, and foreign exchange rates.[23]
- With regard to the euro hedge, a fixed hedge ratio was used based on the long-term relationship between the local currency portfolio and the euro.[24]

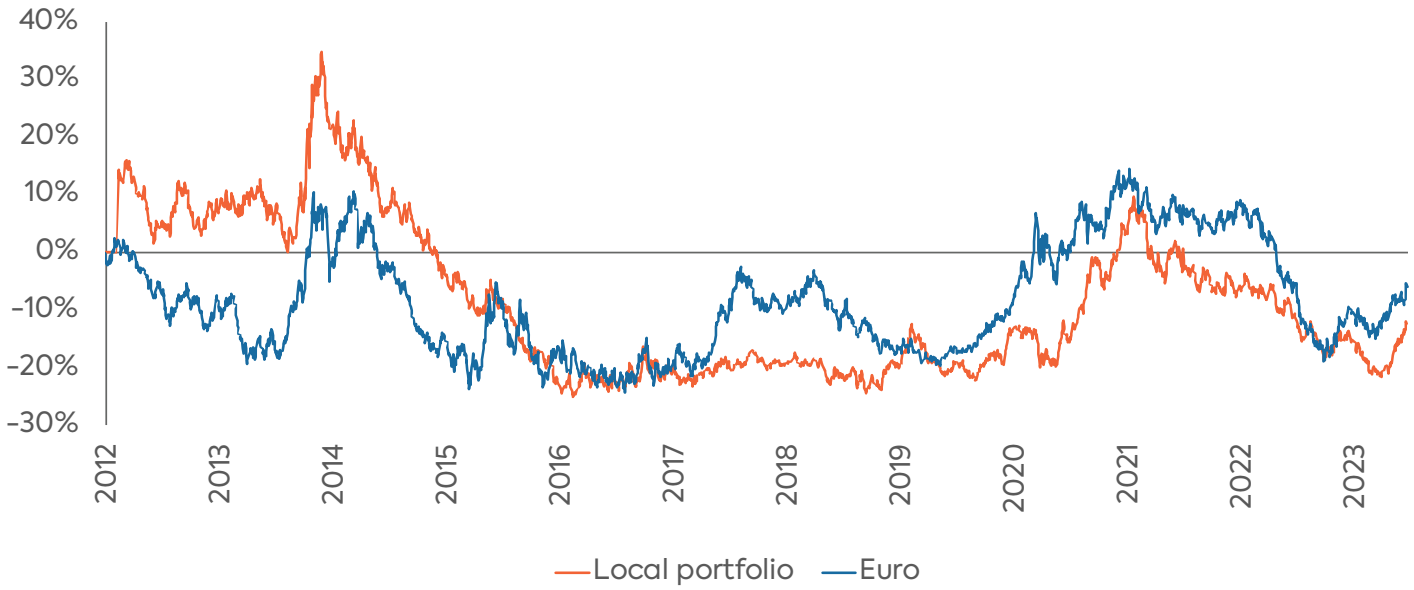
Further, it was assumed that five-year[25] bonds of the 10 countries in the basket were held to maturity and that their coupon payment dates matched with each other; no borrowing or reinvestment rate was applied; five-year interest-rate swap rates were used as proxies for local bond yields;[26] the dollar rate was proxied using the five-year credit default swap spread over the five-year US interest-rate swap rate; and no transaction costs were applied, although these would apply but tend to be very small for currency transactions in the spot market.[27] As noted earlier, the

data goes back approximately 15 years because of the limitation of EMDE local currency bond data, which date to the mid-2000s for most countries.

Under these assumptions, the "local portfolio" of the intermediary comprises the gains and losses incurred as it receives the 10 interest payments[28] and the final principal from each of the 10 local currency bonds. The intermediary converts them to dollars at the spot exchange rate on each payment date and makes the payments on the dollar bond. The return on the local portfolio over any five-year period as the local currency and dollar bonds mature is positive if it incurs a profit while conducting these transactions, and is negative otherwise.

As expected, the local portfolio correlates well with the euro (see Figure 6).

Figure 6: Historical five-year rolling performance of the sample local portfolio held by the intermediary versus the euro

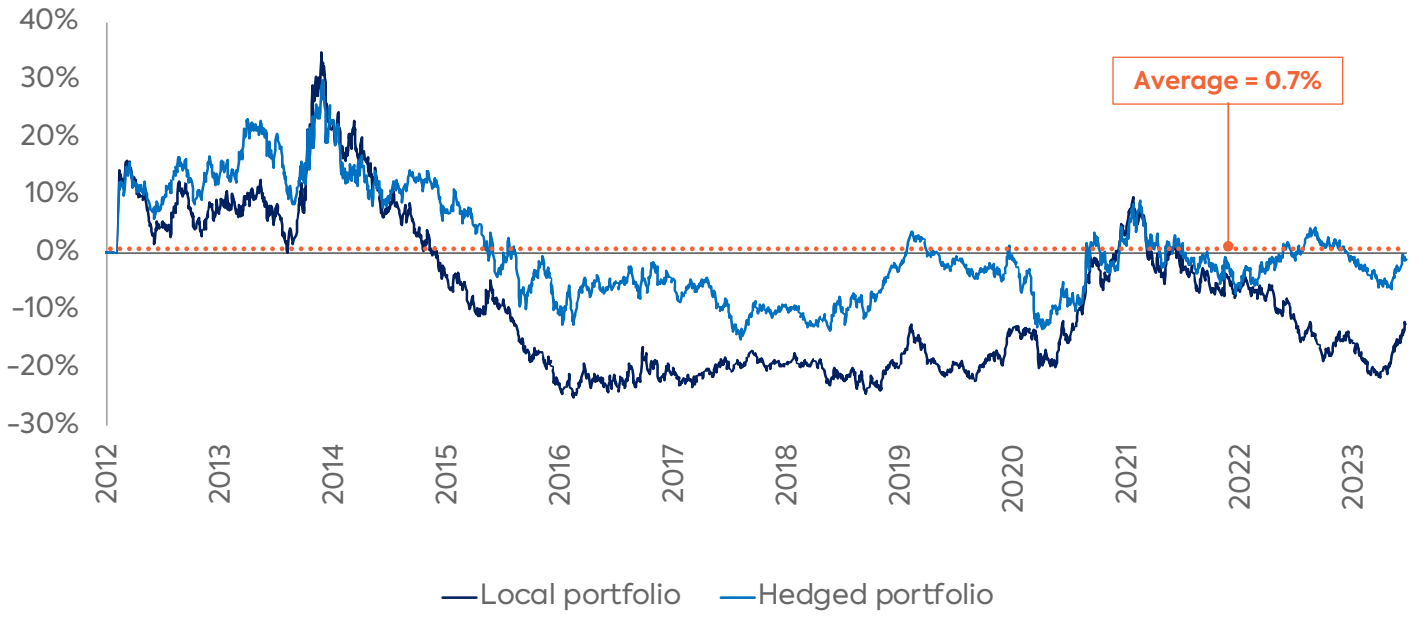


Note: "Local portfolio" refers to the profit or loss incurred by the intermediary in the structure. Data as of June 20, 2023.

Source: Bloomberg, author's calculations.

This makes a strong case for the euro to be used as a hedge. Figure 7 corroborates this, as can be seen from the returns of the hedged portfolio, which consists of the local portfolio with an overlay of a short euro position whose size is based on the hedge ratio mentioned above.

Figure 7: Historical five-year rolling performance of the sample local portfolio and its hedged version held by the intermediary



Note: "Local portfolio" refers to the profit or loss incurred by the intermediary in the structure. Data as of June 20, 2023.

Source: Bloomberg, author's calculations.

For demonstration purposes, the exercise shows that if we assume the intermediary created a new local portfolio every day starting in February 2007 and hedged it with the euro, the worst-case loss would have been 15 percent.[29] Assuming that the returns are normally distributed, the value at risk (VaR)—which is a measure of the risk of loss of capital—at the 95 percent confidence level is also 15 percent.[30] In other words, there is a 0.95 probability that the losses for the hedged local portfolio in this simple exercise will not exceed 15 percent on any given day. Moreover, the average return across every portfolio that matured every day from February 2012 to the present[31] was not negative in this exercise, but slightly positive (0.7 percent). The portfolio return was between -5 percent and 5 percent 42 percent of the time, greater than 5 percent 29 percent of the time, and less than -5 percent 29 percent of the time (see Appendix 2 for the return distribution).

The reduction of the worst-case loss from 40 percent for the basket of EMDE currencies in Figure 5 to 15 percent for the hedged local portfolio of the intermediary in Figure 7 is due to the combination of the interest rate differential between local and dollar bonds and the euro hedge.[32]

The purpose of the analysis in this section was to gauge a possible range of returns for the intermediary in the euro-hedged structure. Like any back-test, it should not be treated as a complete analysis. The caveat that past performance is not a predictor of future returns applies, especially given the short span of time captured because of the limited EMDE local currency bond data. Having said that, the back-test does cover a 15-year span in which global interest rates moved from one extreme to the other, as this period was marked by multiple economic cycles. Nevertheless, a more thorough analysis is warranted before implementing the structure.

Enhancing and Expanding the Green Bond Structure

The objective of the financial structure described in this report is to help address, in part, one major hurdle to EMDE green bond issuance: issuers would prefer to issue in their local currencies, which may not appeal to some international investors, especially given that these bonds are typically excluded from many green bond indexes. Addressing this issue could potentially encourage increased issuance, and because payments are made in dollars along with the international settlement of the bonds, the outcome could be to draw in more foreign private capital directed toward climate finance in these countries. However, EMDE countries face several additional impediments when issuing green bonds, as discussed in the introduction, so other factors may also need to be addressed before greater issuance can be expected.

Donors Could Help Lower Issuance Costs

Direct and indirect costs borne when green bonds are issued discourage many countries from going down this path (Jain 2022).[33] To assuage greenwashing fears of investors, issuers must follow green bond principles (International Capital Market Association 2022). This entails setting up a green bond framework, which, as mentioned earlier, typically requires the creation of an inter-ministry committee to appropriately define the use and management of proceeds, set up a process for project evaluation, approve and compile a list of projects underlying the bond, and report annually on the progress of these projects. Coordinating between ministries is particularly challenging in some developing countries, as governance can be an issue. In addition to these implicit costs, payments need to be made for second-party pre-issuance opinions and third-party post-issuance certifications.

While green bonds have been shown to trade with a premium (Jain 2022), the savings realized don't appear to be enticing many EMDE governments to go through the arduous task of inter-ministry coordination to identify projects and create a green bond framework, especially when domestic investors in these countries have limited, if any, ESG mandates. Providing clear and specific monetary incentives for issuers, though, could change the equation.

Philanthropies and other donors (perhaps the intermediary introduced earlier, or a third party working with the intermediary) could step in to offer these incentives. Their contributions could be directed toward reducing the interest rate EMDEs must pay for a green bond they issue.[34]

But lowering the cost may not even require early—or possibly any—cash outlays from donors. The Brady Plan debt restructurings of the 1980s and 1990s offer a blueprint. This was a period marked by debt crises as several countries, mostly in Latin America, defaulted on their bank loans. Named after US treasury secretary Nicholas Brady, the Brady Plan, announced in 1989, offered an approach to debt restructuring different from previous unsuccessful attempts in that it explicitly considered debt reduction as part of the deal that ultimately helped to resolve the crisis. An important feature of the Brady Plan's success was its guarantees of principal and interest-rate payments—provided with the financial support of the IMF and the World Bank—as part of the debt restructurings (Berthélemy and Lensink 1992).

Principal guarantees on thematic bonds have already been provided by multilateral development banks. In 2020, for example, Ecuador issued its first sovereign social bond with the support of an Inter-American Development Bank guarantee (Inter-American Development Bank 2020). While providing principal guarantees may make sense in some low-income countries or countries facing debt distress, they make less sense for countries that have no issues with market access because of the monetary constraints on the amount of principal guarantees an MDB can provide.

The author has found no example of interest-rate guarantees being applied to thematic bonds. In the case of Brady bonds, those stemming from the Brady Plan mentioned above, the interest-rate guarantee was either for a fixed amount of interest payments or comprised a rolling guarantee that applied to a specified number of upcoming coupons. For the bond structure examined in this report, a donor could guarantee all (or some of) the dollar-denominated interest payments (i.e., even if the EMDE green bond issuer defaulted, the fixed dollar coupons would still get paid in full based on the payment schedule). Since the coupons are either fully or partially guaranteed, this should get reflected in the form of a lower interest rate demanded by investors, thus realizing cost savings for the issuer.

The value of the guarantee would increase the higher the bond's yield, thus providing more savings to countries with lower credit quality that pay a higher interest rate and need the guarantee the most.[35] For countries not facing debt or market access problems, providing an interest-rate guarantee could be a much cheaper option for the sponsor than providing a principal guarantee, and if the guarantee lowers the interest-rate cost for the issuer sufficiently relative to a conventional bond, then it may provide enough of an incentive for some EMDE sovereigns (or corporates) to issue a green bond.

As an example, using the current average five-year dollar yield of 5.7 percent on the 10-country EMDE basket discussed in the previous section, the cost to the donor of guaranteeing interest rate payments would be around 4 percent, which effectively would lower the yield of the five-year EMDE local green bond by an estimated 95 basis points from the current average local yield of 7.5 percent

for the basket.[36] Combined with the observed greenium of 5 to 10 basis points (Jain 2022), the total saving could entice more EMDE governments to go through the effort of collating projects, creating a green bond framework or taxonomy if they don't have one, and issuing the bonds. Moreover, relative to the guarantee value, the donor manages to scale up its investment many times—by 25 times in the above example given the estimated upfront cost of 4 percent (the $4 set aside by the donor resulted in $100 of the bond being bought by private investors). To get a sense of scale, the 4 percent cost on a $1 billion bond issuance would be reflected as a $40 million liability on the donor's balance sheet.

A few aspects of this cost need to be clarified. First, it would change with time, both because the yields, and therefore the probability of default implied by the bond price, change with time, and because as coupons get paid the amount of the guarantee needed drops. Second, this is just the cost reflected on the balance sheet. As such, if there is no default, there is no cost borne by the donor. On the other hand, if the issuer defaults early in the life of the bond, the actual cost borne could be much higher than the ex-ante estimate because the rest of the coupons would need to be paid immediately, a higher amount than the probability-adjusted present value of future payments. Finally, the donor may lower their cost by providing rolling guarantees for the next few interest payments, rather than ensuring the entire coupon stream. The savings realized by the issuer would decrease accordingly, but may still suffice as an incentive to issue a green bond. Providing a precise threshold of savings that would stimulate such action would vary by country and is beyond the scope of this report.

It is important to point out that the green bond structure discussed in this report does not need to add to the debt of the country. Rather, the goal would be to redirect budget outlays that were already meant for infrastructure projects. Effectively, in exchange for the savings, the government would agree to direct part of the budget toward funding specific green infrastructure projects. Moreover, the government would be able to pass on some of the savings domestically to companies involved in the projects underlying the bond by lending to them at a favorable rate.

Regional Bonds

Some countries lack bankable projects of the order of magnitude necessary to issue a bond in a "benchmark" size—i.e., in a size large enough to be included in indexes. (For example, in the indexes in Table 1, the minimum size for a bond to be included ranges between $250 to $500 million.) This is particularly true in many low-income countries where spending on less capital-intensive climate adaptation projects is as or more important than spending on climate mitigation projects.

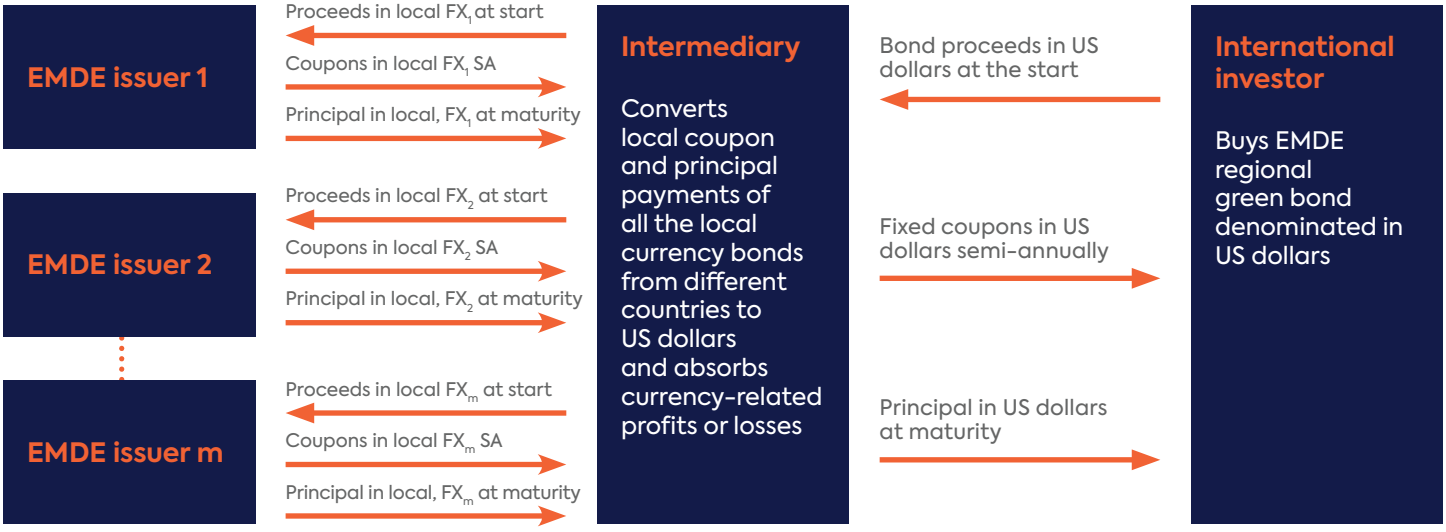
One way around this problem could be to issue a regional bond that pools projects across countries. There have been only a few issuances of regional bonds, and those were by highly rated

regional development banks. For example, Corporación Interamericana para el Financiamiento de Infraestructura issued a regional green bond in 2022 covering 18 Latin American and Caribbean countries (Organization for Economic Cooperation and Development 2023, Symbiotics Group 2022). While contributing to the financing need, such issuances by development banks or similar institutions don't necessarily support the development of EMDE domestic capital markets.

Additionally, in theory, countries in a specific region could themselves engineer a regional bond, but it's impractical to expect governments to be able to coordinate with each other and arrive at such a structure: even if there are no governance issues in a country or geopolitical differences between countries, agreeing to a common green bond framework and the technical aspects of the bond, such as coupon payments and the settlement mechanism, is likely to be very time-consuming at a minimum.

Instead, as shown in Figure 8, the bond structure discussed in this report could be adapted by the intermediary to create a regional bond without needing any direct involvement of countries whose bonds are included. Unlike the regional bonds issued by development banks, this green bond would reflect the weighted average credit risk of the underlying issuing sovereigns, and would create a diversified currency portfolio for the intermediary. To be clear, the diversification benefit within a regional bond is less than that of a portfolio covering EMDEs from different regions, since regional economies tend to be more correlated than economies across regions.[37]

Figure 8: Sample regional green bond structure with intermediary absorbing currency risk



Note: SA=semi-annually.

Source: Author.

Intermediary Choices, Hurdles, and Workarounds

For the blended finance structure discussed in this paper to succeed, the intermediary would need to have a high level of expertise in the workings of bond and currency markets and be able to engage with different parties. Specifically, it would need to:

- Coordinate between different EMDE governments to ascertain they have credible green bond frameworks and taxonomies
- Manage technical details, such as ensuring that the coupon dates match across countries that are part of the structure to minimize the currency risk in its portfolio
- Ascertain that the taxonomies, green bond frameworks, and standards align across countries in the case of regional bonds, in addition to the above, since only one bond would be issued representing all of them (Organization for Economic Cooperation and Development 2023)
- Partner with index providers to ensure bonds that meet their criteria are included in the applicable indexes. As discussed earlier, getting included in an index opens the pool of potential investors. If one bond issued based on the blended finance structure is met with high demand, it could pave the way for more to be created along the same lines.
- Collaborate with financial market infrastructure companies such as Euroclear to ensure that the green bond in the structure settles easily and conveniently in international markets
- Work with financial institutions to execute the currency trades in the spot market and the euro hedge in the forward market at a low cost in a timely manner

Candidates that could likely fill the demanding role of the intermediary are multilateral development banks, and possibly development finance institutions, local or regional development banks, and investment management companies focused on sustainability.

MDBs have been called upon in recent months to change their approach to lending and better leverage their balance sheets to support climate financing in EMDEs (Palmer and Schroeder 2022, Yellen 2022, Di Paola and Ratcliffe 2023). Last year, a G20 panel reviewing MDBs recommended they change their risk tolerance and expand the use of financial innovation to increase the impact of their limited capital, estimating that MDBs can raise their investment capacity by $1 trillion without impacting their AAA credit rating (G20 Expert Panel 2022, FT Editorial Board 2023). With proper

reforms, MDBs could potentially channel a large pool of private capital and become the foundation of a new Marshall Plan to address the climate crisis, just as Bretton Woods created the World Bank to rebuild Europe following the Second World War (Marsh 2023).

For MDBs, DFIs, and other international financial institutions to develop innovative financial instruments to crowd in private capital for climate financing in EMDEs and to provide risk absorption capacity (International Monetary Fund October 2022) would require a shift in thinking. These institutions have historically been highly risk-averse—especially when it comes to currency risk, since they have conventionally provided financing to EMDEs in foreign currencies (Bresser-Pereira and Bechelaine 2019)—and it remains to be seen if they would be willing to change their approach.

The bond structure discussed in this paper could align with such calls for change, including the proposal as part of the Bridgetown Initiative presented at the June 2023 Paris Summit for a New Global Financial Pact that suggested $100 billion a year in currency risk guarantees, managed by an agency under the purview of MDBs and the IMF, to drive private capital investments to support the energy transition in EMDEs (Reuters 2023, Persaud 2023).

Besides currency risk guarantees, another possibility is the creation of a green investment bank (GIB), capitalized by MDBs and other international financial institutions, that would act as the intermediary (Organization for Economic Cooperation and Development May 2016). Typically, GIBs have been created in a variety of national and local contexts, but since their objective is the same as that of green bonds—i.e., channeling private investments into low-carbon projects—an international green investment bank might be an appropriate intermediary since the primary strategies they deploy are aggregation and securitization (Wapner and Youngs 2019).

A slightly different path to setting up the bond structure could entail a group of MDBs and DFIs establishing an entity similar to TCX to act as the intermediary (World Bank 2022, Organization for Economic Cooperation and Development 2016) or possibly expanding the role of TCX itself by adding expertise in bond markets to its currency specialization.

Conclusion

The need to direct more capital toward EMDEs for climate mitigation and adaptation projects, given the gap between financing levels and global ambitions for decarbonization, has received a lot of attention at recent COPs and other summits. In this context, policymakers globally are working to find ways to address currency risk and other impediments to greater capital flows—including reforming the global financial infrastructure, particularly when it comes to multilateral development banks.

The structure discussed in this report might encourage greater flows to EMDEs by facilitating their issuance of local currency green bonds. An intermediary absorbs the local currency risk and, by converting interest and principal payments to dollars, potentially expands the pool of international investors with access to these bonds. Doing so removes from the EMDE issuer the burden of selling a hard currency bond, which entails either high hedging costs or generating a currency mismatch between its assets and liabilities.

Additionally, this study showed that, if managed properly—such as by diversifying and employing a euro hedge—the EMDE currency risk can be substantially mitigated by the intermediary.

Further incentives from various parties could also potentially bolster EMDE green bond issuances by providing ways issuers can lower their cost, such as guarantees of interest payments. Moreover, the design of the structure makes it adaptable for a regional bond, which may help address the issue of limited bankable projects available in low-income countries.

The scale and challenge of sourcing trillions of dollars in clean energy and low-carbon infrastructure investments for EMDEs could require new thinking in financial instrument design and a willingness of international institutions to take on expanded roles. This report describes one specific option among many to come, in an attempt to further the conversation on how the world can make faster progress down the path toward realizing its goals to address climate change.

Appendix 1

As the intermediary converts each coupon and the principal received from the issuer in the local currency to dollars to pay to the investor, it will realize a net gain or loss ("PnL," or profit and loss) based on the exchange rate on the coupon payment dates and principal payment date. The total PnL realized by the intermediary at the maturity of the bond, having converted the local currency coupons ("i_{LC}") and principal ("P_{LC}") to dollars ("$i_\$$" and "$P_\$$," respectively) on each of the t_1 to t_n payment dates, can be expressed as:

$$PnL = \sum_{j=1}^{n} \left[\left(\frac{i_{LC} * P_{LC}}{FX_j} \right) - i_\$ * P_\$ \right] (1 + r_{US,(n-j)/2})^{\frac{n-j}{2}} + \left(\frac{P_{LC}}{FX_n} - P_\$ \right)$$

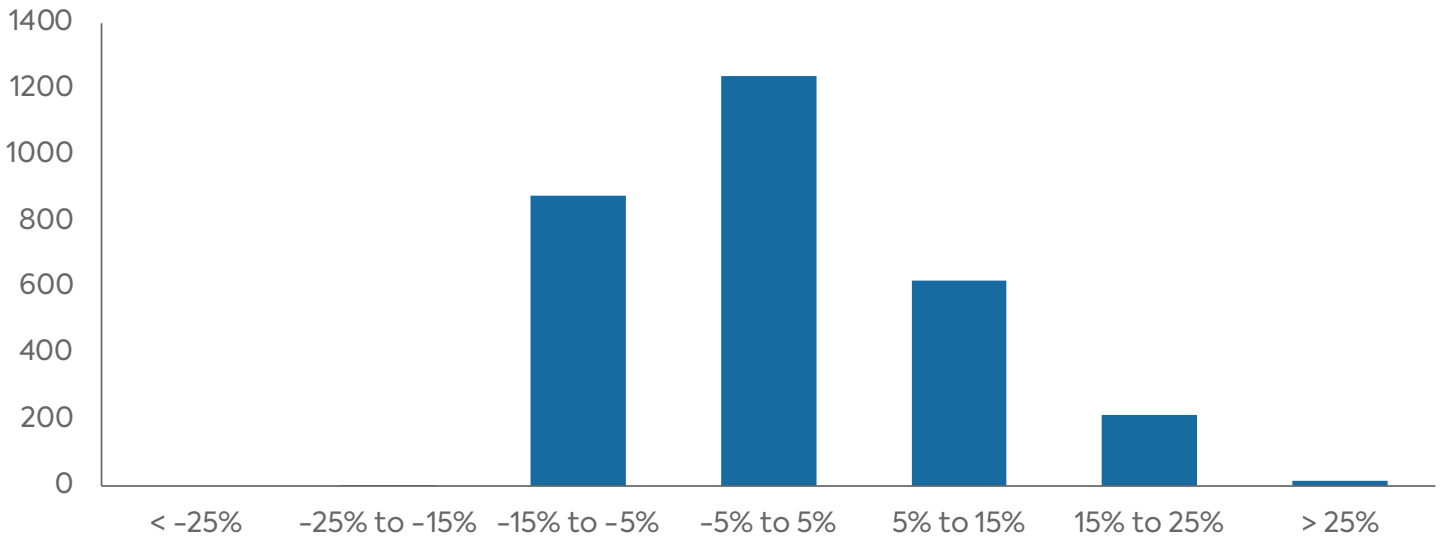
where $r_{US,l}$ is the l-year US interest rate.

In the case of the regional bond covering m countries, the above formula can be expanded as follows:

$$PnL = \sum_{j=1}^{n} \left[\sum_{k=1}^{m} \left(\frac{i_{LC,k} * P_{LC,k}}{FX_{j,k}} \right) - i_\$ * P_\$ \right] (1 + r_{US,(n-j)/2})^{\frac{n-j}{2}} + \left(\sum_{k=1}^{m} \frac{P_{LC,k}}{FX_{n,k}} - P_\$ \right)$$

Appendix 2

Figure A-1: Distribution of the hedged local portfolio returns



Note: "Local portfolio" refers to the profit or loss incurred by the intermediary in the structure. Data as of June 20, 2023.

Source: Bloomberg, author's calculations

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Notes

1. There is no official definition of an emerging market (see Duttagupta and Pazarbasioglu 2021). The *IMF World Economic Outlook* (International Monetary Fund April 2022) defines 39 countries as advanced based on several factors, including GDP per capita, the share of global trade, and integration into the global financial system. The rest of the countries are labeled emerging market and developing economies (EMDEs).

2. Thematic or labeled bonds are the broader asset class within which green bonds fall. Very simply, thematic bonds are fixed-income instruments issued with the objective of financing specific themes, such as environmental, social, or even sustainable development goals (Jain 2022).

3. The amount of outstanding green bonds is less than the total issued, as some of the bonds have already matured.

4. One way to gauge the general reluctance of global fixed-income investors to take EMDE currency risk is by looking at their share of multi-sector bond funds (MSBFs), one of the most important sources of international investments in EMDE bonds. MSBFs reached a size of around $1 trillion in 2021, roughly 10 percent of the entire global bond investment funds, and the share of EMDE bonds in these funds have been in the 12–18 percent range, or $100–$160 billion, in recent years (Cortes and Sanfilippo 2021). This is a small fraction of the EMDE local fixed-income market, which was around $24 trillion, or 20 percent of the global fixed-income universe (Dehn 2020).

5. The average share across 14 countries—Brazil, Mexico, Colombia, Peru, Poland, Turkey, Romania, Czechia, China, Indonesia, Malaysia, Thailand, India, and South Africa—of the local government debt holdings for non-resident investors was 18 percent as of May 2023 (International Monetary Fund 2023).

6. https://nouveaupactefinancier.org/en.php

7. While the structure is discussed in the context of a green bond, it applies to any thematic bond.

8. Although the size of the EMDE local market was estimated to be around $25 trillion in 2020, the investable portion based on index representation was just slightly over 10 percent of this amount (Dehn 2020).

9. The total hard and local currency exposure has peaked in the 16–18 percent range, with local currency debt making up around two-thirds of EMDE investments by MSBFs (Cortes and

Sanfilippo 2021).

10. Investments in EMDEs present a host of risks, including political, geopolitical, liquidity, macroeconomic, etc. The exchange rate and credit risks are typically at the top of mind for investors.

11. In Colombia's example in the box, the difference between the five-year dollar rate of 7.1 percent and the average six-month LIBOR rate over five years of 4.8 percent is 230 basis points, which is close to the five-year credit default swaps (CDS) level of 235 basis points for the sovereign on June 30, 2023, and represents the country risk.

12. In Colombia's example in the box, the basis between the five-year cross-currency swap and the local interest-rate swap was 125 basis points on June 30, 2023.

13. In this simple example, there is still some residual exchange rate risk due to the difference in interest payments on the dollar bond and the interest rate received on the dollar leg of the cross-currency swap. To eliminate the exchange rate risk entirely, the structure would need to be more complex.

14. SOFR or Secured Overnight Financing Rate has replaced LIBOR or London Interbank Offered Rate from July 1, 2023.

15. In principle, it could be any hard currency. For simplicity, the US dollar is used here as the default hard currency.

16. Although it is true that domestic interest rates are higher than a country's external interest rate under most circumstances, situations may arise when this is not the case, for example when a sovereign is about to default on its external debt but not on its domestic debt. Having said that, it is difficult to find actual historical episodes when this transpired. It is easier to find episodes when the reverse took place—e.g., in 1998, when Russia defaulted on Soviet-era debt but not on the external debt of the Russian Federation. Nevertheless, it is important to be cognizant of the risk because it is possible that, for political reasons, a sovereign gives a more favorable treatment to domestic debt than external debt.

17. There can be other drivers of the domestic versus external interest rate differential, such as liquidity differences between the two markets or the presence of capital controls, but the prominent drivers tend to be inflation and fiscal developments.

18. This note used data going back 15 years because, as explained earlier in the paper, investors started viewing emerging market local currency bonds as a separate investable asset class

only in the mid-2000s. For example, the JP Morgan GBI-EM index, which among emerging markets local bond indexes has the most assets benchmarked to it, was launched in June 2005 (Kim 2018).

19. To compute the interest-rate differential, five-year local interest rate swaps were used instead of five-year local bonds. Since local bonds usually trade with a spread over the interest-rate swap curve, the interest-rate differential in favor of the intermediary would be even larger when considering bonds.

20. Purchasing power parity states that the exchange rate between two countries is in equilibrium if a basket of goods costs the same in both countries when converted at that exchange rate. Assuming that the real effective exchange rate remains unchanged, an inflationary impulse in one country should therefore lead to a change in the exchange rate such that in the new equilibrium, the purchasing power parity is maintained (see, for example, Lipschitz and Schadler 2019, 70–72).

21. This is based on purchasing power parity (PPP). However, exchange rates have been shown to historically deviate significantly from the PPP estimates. Other fundamental currency models have been proposed as a result. See, for example, MacDonald and Clark (1998).

22. The variance, which is a statistical measure of risk, of a two-asset portfolio with weights w_1 and w_2, respectively, is $w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + p_{1,2} w_1 w_2 \sigma_1 \sigma_2$, where σ_1 is the standard deviation of the first asset, σ_2 is the standard deviation of the second asset, and $p_{1,2}$ is the correlation between them. When $p_{1,2} < 1$, the portfolio's risk will be less than a linear combination of the risks of the two assets, which is the essence of diversification—the unsystematic or idiosyncratic risk of a particular asset can be diversified away in a portfolio. See Reilly and Brown (1997) for more details on Markovitz's modern portfolio theory.

23. The countries included were Brazil, Colombia, Chile, Mexico, Peru, South Africa, Turkey, China, Indonesia, Malaysia, Thailand, and South Korea. The data series starts in 2007, which, as mentioned earlier, is approximately when EMDE local markets started becoming liquid enough to be considered a separate asset class.

24. The hedge ratio for the local portfolio is higher than that of a basket of EMDE currencies alone since it includes the net coupon payments that add on average approximately 15 percent to the principal amount. Moreover, a constant hedge ratio was used here to keep the exercise simple. More sophisticated techniques with dynamic hedging could be deployed to achieve better outcomes.

25. Most of the bonds issued are either of five-year or 10-year maturities. As a result, the paper

looked at five-year returns. Moreover, it may be difficult to get a clear picture if shorter horizons are used, given the volatility of currencies. Nevertheless, before adapting the structure, it may be important to assess its expected performances over short periods as well, although given that the intermediary converts local currencies to dollars on a spot basis, forward rates would need to be employed, which may introduce uncertainty in the analysis. Similarly, the analysis should also be extended to 10-year bonds to assess the performance of the structure in those situations as well.

26. Since local bonds typically trade with a spread over the local interest-rate swaps, this penalizes the return in this simple exercise. In other words, using bonds instead of interest-rate swaps should produce a better outcome. But this was done to simplify the exercise, since it's easier to obtain a time series of five-year interest-rate swaps in comparison with a time series of the yield of a bond with a fixed maturity of five years, which would need interpolation between bonds.

27. The only forward market currency transactions involved related to the euro, which unlike EMDE currencies is highly liquid with a turnover of $2.3 trillion per day (Bank of International Settlements 2022).

28. Most bonds pay coupons on a semi-annual basis.

29. To put it in perspective, if the intermediary helps 10 countries issue bonds of $1 billion each, then it will be directing $10 billion of private capital toward EMDEs with a potential loss of $1.5 billion in a very extreme case.

30. As Appendix 2 shows, the return distribution is not exactly normal, making the calculated VaR a rough estimate.

31. To 2018 rather than to the present, to be precise; because the bonds created since then have not matured, the information is incomplete for them to be included.

32. Note that the 40 percent worst-case loss for the basket of EMDE currencies itself has benefited from diversification. Figure 4 shows that the Turkish lira depreciated by almost 80 percent over the most recent five-year period, implying that exposure to a single currency can result in much greater losses due to idiosyncratic developments.

33. Sustainability-linked bonds don't have the same requirements for external reviews as use-of-proceeds thematic bonds such as green, social, and sustainability bonds. However, they could still entail additional costs by having to pay higher interest rates if the underlying key performance indicator is not met.

34. There are many other steps donors can take to promote the issuance of EMDE thematic bonds, as detailed in recent notes by the Organization for Economic Cooperation and Development (2022, 2023) and a High-Level Expert Group set up by the European Commission (2023).

35. To estimate the cost of the guarantee, the implied probability of default, p, of a five-year local currency bond (since the guarantee will be triggered if the local currency bond issuer defaults) is computed first, assuming for simplification that this probability remains constant in every period and using a constant recovery value of 50 percent, in line with historical recovery rates following sovereign defaults (Duggar and Cantor 2012). This probability can then be used to estimate the value of the guarantee by using a binary tree, with one leg representing a payment of the remaining stream of coupons (due to the occurrence of default) with probability p and the other leg representing no payment with the probability (1 – p) and so on. The coupons in the binary tree should be the ones from the dollar bond, because they are assured by the guarantee. The present value of the total payments is then determined from this binary tree, which is how much the guarantee is worth.

36. Estimating these values required a couple of steps. First, the value of the guarantee is estimated as explained in the preceding endnote. Since the guarantee can be considered a free option received by an investor, effectively it can be added to the price of the dollar bond. Since the same price premium can be transferred to the local currency bond at the start when the exchange rate is known and fixed, to convert this value of the guarantee from price to yield, add the guarantee to the price of the local currency bond, compute the yield, and then subtract it from the yield of a bond with no guarantee.

37. For example, countries in Asia, with few exceptions, are importers of commodities, particularly metals. Several countries in Latin America, such as Chile and Peru, are exporters of copper and other critical minerals. Including countries from both regions would therefore result in a portfolio that may be less sensitive to sharp moves in metal prices. Similarly, including countries from the northern and southern hemispheres results in more stable portfolios because seasonality patterns in economic data tend to cancel out.